

Newton's First Law. Inertial force and its manifestations (rotation of an accelerating body, change in the weight of a rotating body)

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The purpose of this work is to prove that Newton's First Law (the law of inertia) is a consequence of the law of conservation of angular momentum (momentum of momentum) in a physical vacuum. The force of inertia arises in a body as a result of a change in the angular momentum of the body and the occurrence of processes that compensate for these changes. One of these processes is the occurrence of the force of inertia, which affects the speed of quantum objects that make up the body. Another compensating process is the rotation of the body. Both of these processes are observed in experiments.

The paper shows that a change in the angular momentum of a body can arise as a result of a change in the spin characteristics of virtual photons created by quantum objects that make up the body.

Introduction

In 1949, R. Feynman introduced virtual particles to denote force fields in his diagrams, the purpose of which was to implement the interaction of real particles [1]. The characteristics of virtual particles were determined by the interaction that was carried out with their help. For example, electric and

Magnetic interactions were carried out in Feynman diagrams by so-called virtual photons, which were formed in the region of the wavelength of a quantum object and had an electric dipole moment, $d\mathbf{v}$.

The properties of virtual photons are similar to those of photons that also carry electromagnetic interactions: in particular, they (like a circularly polarized photon) have a precessing spin. Consequently, a virtual photon, like a photon, can be classified as a spin vortex. And one of the basic relationships between the orientations of the spin S_v and the electric dipole moment $d\mathbf{v}$ is valid for it [2]:

$$\mathbf{S}_v \cdot d\mathbf{v} = 0 \quad (1)$$

Note: The properties of the virtual photon are not determined by the Heisenberg uncertainties, since the latter include uncertainties only in the amount of motion and energy and do not include uncertainty in the value of such a characteristic of a virtual photon as spin.

In 2020, Chinese scientists Li Hao et al. [3] experimentally confirmed the validity of Feynman's hypothesis. In a physical vacuum with internal angular momentum, they discovered the possibility of the formation of "quantized superfluid vortex lines under the action of axial flows." Considering that the electron, proton, positron and some other quantum objects arise from the decay of photons - spin vortices in a physical vacuum, moving quantum objects can play the role of such axial flows.

Thus, the motion of quantum objects (with velocity u) can be accompanied by the emergence of spin vortices (virtual photons) in the physical vacuum. One of the main properties of a spin vortex is the precessional motion (with frequency $\dot{\gamma}v$) of its spin S_v . Therefore, the following

the ratio is valid:

$$u \dot{\gamma}v : In \cdot \quad (2)$$

accordance with the properties of the horoscope [4], which is the spin vortex, the precession frequency $\dot{\gamma}v$ of the spin S_v and the moment Mv causing this precession,

are related by the ratio:

$$Mv vv \ddot{\gamma} \ddot{\gamma} S_v \cdot \quad (3)$$

The existence of an electric dipole moment dv of a virtual photon determines the mutual direction of the velocity u of an electrically charged quantum of the object and the precession frequency $\dot{\gamma}v$ of the spin of the virtual photon following it, since the electric field of the quantum object acts on the electric dipole moment of the virtual photon. Thus, taking into account equations (1)-

(3):

$$\ddot{\gamma}v \ddot{\gamma} \ddot{\gamma} u \cdot \quad (4)$$

Where $\ddot{\gamma} = \ddot{\gamma} 1$, for a charged object
 $\ddot{\gamma} = \ddot{\gamma} 1$, for a negatively charged object Fig. 1

shows a schematic representation of virtual photons created by positively and negatively charged quantum objects, taking into account their properties (1)-(5).

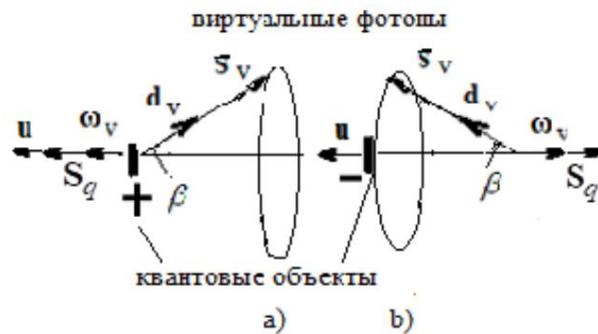


Fig. 1. Schematic representation of virtual photons created by positively (option (a)) and negatively charged quantum objects (option (b)); S_q is the spin of the quantum object; u is the velocity of the quantum object; $\dot{\gamma}v$ is the spin precession frequency S_v ; dv is the electric dipole moment; $\ddot{\gamma}$ - deflection angle.

The main difference between a photon and a virtual photon is the magnitude of the angle - (the angle deviations $\hat{\gamma}$ between the precessing spin S_v and the direction opposite to the precession frequency - j_{ν}). According to Weber's experiments [5], the angle the photon deflection is determined by the expression: $\hat{\gamma} = ph^{\frac{1}{2}}$. According to the conducted research [2] angle $\hat{\gamma}$ virtual photon is determined by the expression:

$$\sin \ddot{\gamma} = \dot{y} u c . /$$

From equation (6) it follows that when $u=c$, a virtual photon turns into a “real” photon, which is observed in the P.A. Cherenkov effect: the emission of a photon by a quantum object when it reaches the speed of light c .

Let us consider the inertial properties of quantum objects, based on the properties of virtual photons created by these objects.

1. Inertial properties of quantum objects

1.1 Non-rotating quantum object

According to the properties of the virtual photon (**Fig. 1**), the projection of its spin S_V onto

the direction of its velocity \mathbf{u} , $\hat{\mathbf{y}} \cdot \mathbf{v} / \hat{\mathbf{y}} \cdot \mathbf{u}$, taking into account equation (6) is determined expression:

$$\left| \frac{\ddot{y} s \cos v}{u} \right| \nu^{m_0} S S S \ddot{y} \quad \sqrt{1 \sin^2 \ddot{y}} \quad \nu \sqrt{1 - \frac{2u}{c^2}}. \quad (7)$$

According to expression (6), a change in velocity \mathbf{u} by the value $\hat{\mathbf{y}}\mathbf{u}$ means

change in the value of \hat{y} v \hat{y}_u S by the value: $\hat{y} \hat{y} \hat{y}$ S_v u :

$$\left| \frac{\mathbf{S}_V \mathbf{u}}{\mathbf{u}^T \mathbf{S}_V \mathbf{u}} \right|^{\frac{1}{2}} = \sqrt{1 - \frac{u^2}{c^2}} = \sqrt{1 - \frac{u^2}{c^2}}. \quad (8)$$

$\Delta \vec{\mathbf{L}}$ - this is the magnitude of the change in the angular momentum of a quantum object,

which created the virtual photon, along the direction of its motion. Due to the law of conservation of momentum, processes arise that compensate for this change. Such processes can be:

- 1) The emergence of a force that restores the value of the velocity. In essence, this force is the force of inertia, F_{in} , and it can be represented as:

$$\mathbf{F}_{in} \leftarrow \mathbf{s}_v \mathbf{y}_u | \quad (9)$$

\ddot{y} proportionality coefficient with the dimension 1/length, where in $\ddot{y} \in \ddot{y}_0$.

2) Rotation of a quantum object with angular momentum

J ; the value of

which, in accordance with the Einstein De Gas effect [6], must satisfy the condition

$$J_v \ddot{y} \ddot{y} \ddot{y} \ddot{y} \ddot{u} \quad , \quad (10)$$

where \hat{y}_v is determined by equation (8).

Let us consider these processes in detail.

The inertial force acting on a quantum object undergoing accelerated translational motion.

According to equations (7) and (9), the inertial force $\ddot{\mathbf{F}}_y$ in \mathbf{u} quantum object at the change in the magnitude of its speed is determined by the expression:

$$\mathbf{u} \in \mathcal{S}c \quad \sqrt{1 - \frac{u^2}{2c}} \frac{\ddot{y}}{\dot{y}^2 t} . \quad (11)$$

The \mathbf{F}_y in \mathbf{u} directed along the velocity \mathbf{u} as it decreases ($\ddot{y} \ddot{y} u t / 0$) and

force $\ddot{\mathbf{y}}$ is opposite to the velocity \mathbf{u} as it increases ($\ddot{\mathbf{y}} \propto \mathbf{u}/t_0$), which is consistent with determination of the force of inertia.

When the direction of velocity \mathbf{u} changes to un , the resulting inertial force F_{in}

is determined by the expression: $F_{in} = \frac{F}{u_n}$. Using in this definition

inertial forces equation (11), we obtain:

$$\text{Fu in} \quad \ddot{y} = Sc / \tau in \sqrt{\frac{2u}{2c}} \cdot \frac{\ddot{y}}{\ddot{y} - t} \quad \ddot{y} = Sc / \tau in \sqrt{\frac{2}{c^2}} \cdot \frac{\ddot{y} u_n}{\ddot{y} t} . \quad (12)$$

Force diagram \ddot{y} $F\ddot{y}$ in \mathbf{u} , \ddot{y} in $\ddot{\mathbf{y}}\mathbf{u}$ F and F_{in} is shown in Fig. 2.

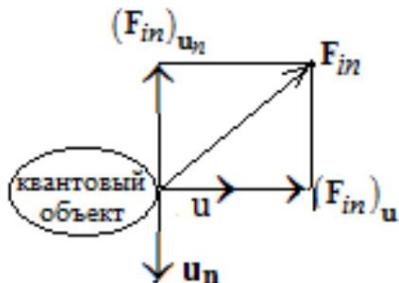


Fig. 2. Components \ddot{y} F_y in u and \ddot{y} in $yun F$

the resulting inertial force F_{in} acting on
the quantum object; **u and un**
initial and final velocities of a quantum object

**Rotation of an object performing accelerated translational motion
and not rotating in the initial state.**

Let us consider the motion of an electron, the speed of which changes from u_1 to u_2 ,

Projection of the precessing spin S_v of the virtual photon onto the direction of velocity according to equation (7) changes by the value:

$$\frac{\dot{S}_v \cdot \dot{S}_v}{\dot{S}_v} = \frac{\dot{S}_v \cdot \dot{S}_v}{\dot{S}_v} \cos \frac{u_2}{u_1} - 1 \cos \frac{u}{u_1} . \quad (13)$$

As follows from the above equation: at u_2

$$| | > | u_1 | \quad \text{at } u_2 < | u_1 |$$

$\dot{S}_v \neq 0$. Then, in accordance with conditions (3)-(5), (10) and (13), the angular momentum associated with the rotation of the body is determined by the expression:

$$J = \frac{1}{2} S_v | v | , \quad (14)$$

where $v = u_2 - u_1$.

This conclusion is consistent with the results of the experiments of V. N. Zatelepin and D. S. Baranov [7]. As an example, **Fig. 3**

shows the characteristics of a virtual photon created by an accelerated-moving electrically negatively charged quantum object.

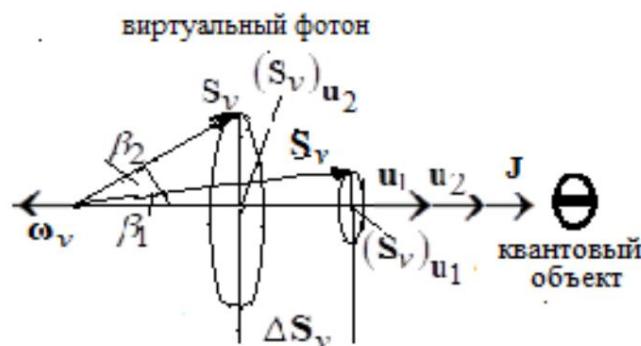


Fig. 3. Schematic representation of the characteristics of a virtual photon;

$\dot{S}_v \cdot \dot{S}_v$ and $\dot{S}_v \cdot \dot{S}_v$ projections of the photon spin S_v on the speed (respectively u_1 and u_2)

electrically negatively charged quantum object.

\dot{S}_v and \dot{S}_v - deflection angles;

ω_v - precession frequency; β_1 and β_2 - deflection angles;

rotating quantum object.

1.2. Rotating quantum object

Let us consider a rotating ferromagnet containing so-called "free" electrons with the following characteristics: \dot{S}_v is the electron velocity; ω_v - the spin precession frequency of a virtual photon created by a "free"

electron; according to expressions (4)-(5) $\omega \propto \omega_0$. Rotation of a ferromagnet with angular velocity ω (see Fig. 4) is accompanied by the following processes.

1) According to the experiments of SJ Barnett [8], the rotation of a ferromagnet leads to the polarization of the spins of the "free" electrons of the ferromagnet in the direction opposite to the angular velocity of rotation ω (which is consistent with formula (3)), that is:

$$\omega \propto \omega_0. \quad (15)$$

2) The conducted studies [2] show that the precessional motion of the spin of a virtual photon can be associated with the spin of a quantum object that creates a virtual photon:

$$S_q \propto \omega_0 \omega_v. \quad (16)$$

3) According to Eqs (4)-(5) and (14)-(15), the following equation is valid: $\omega \propto \omega_0$.

That is, the velocity u of "free" electrons (in a ferromagnet $\omega \propto \omega_0$) in rotating is directed along ω . Thus, as a result of the rotation of the ferromagnet, the initial precession frequency ω_0 of the virtual photon created by the "free" electron and its speed v change accordingly by the frequency ω_v and the velocity u . Thus, the projections of the spin of the virtual photon also change: the change in the projection of the spin on the velocity ω

is equal to $S_{\omega} = \frac{1}{2} \omega_0^2 c$; change of spin projection on

the velocity u is equal to $S_u = \frac{1}{2} \omega_0^2 u$. The emergence of inequalities

$S_{\omega} > S_u$ means the emergence of the corresponding force of inertia

$F_{in} = m \omega^2 r$, affecting the speed ω , and strength $F_{in} = m u \omega^2$, affecting the speed u .

Fig. 4 demonstrates the characteristics of the virtual photon created "free" electron before the rotation of the ferromagnet (ω_0 and ω) and during the rotation (ω_v and u).

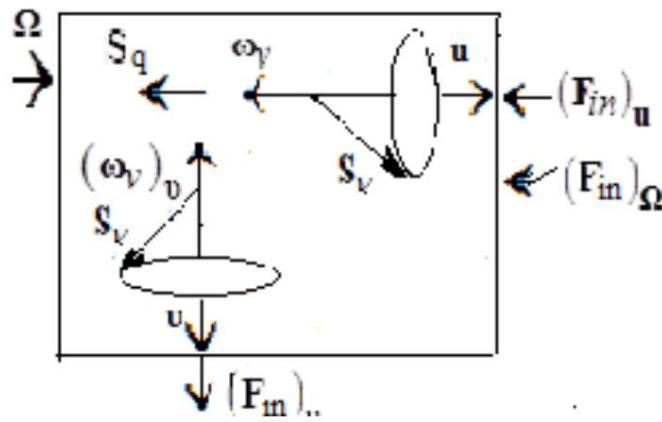


Fig. 4. Characteristics of a virtual photon created by a “free” electron constituting a ferromagnet. $\ddot{\gamma}$ is the angular velocity of rotation; $\ddot{\gamma} v \ddot{\gamma} \ddot{\gamma}$ and $\ddot{\gamma} v$

are the spin precession frequencies S_v , $\ddot{\mathbf{y}}$ and \mathbf{u} are the velocities of the electron

respectively, before and during rotation; S_q is the spin of the “free” electron; \hat{y}

\mathbf{F}_i in $\ddot{\mathbf{y}}$ and \mathbf{F}_i in \mathbf{u} inertial forces.; $\ddot{\mathbf{y}}$ $\ddot{\mathbf{y}}$ \mathbf{F}_i resultant force.

The resulting force acting on one “free” electron in a rotating ferromagnet is given by:

$$\ddot{y} F \ddot{f} \ddot{h} \ddot{y} n \ddot{y} \quad \ddot{y} \quad in \ddot{y} \quad \ddot{y} \quad \ddot{y} \quad . \quad (18)$$

Total force \vec{F}_t in \vec{y} , acting on all N "free" electrons

ferromagnet, according to equation (18) is determined by the expression:

$$\ddot{y} \text{FF} \ddot{m} \ddot{y} \ddot{y} \text{yu} \ddot{t} ii \quad \ddot{y} \quad \ddot{y} \quad in \ddot{y} \quad \ddot{y} \quad \ddot{y} \quad \ddot{y} \quad , \quad (19)$$

where N is the number of “free” electrons in a ferromagnet. The value is determined by the

$\ddot{\mathbf{y}}_{in \dot{i}\dot{y}}$ mutual orientation of the velocities ($\ddot{\mathbf{y}}$) of the “free”

electrons to the rotation of ferromagnets. If all orientations are equally probable, then:

$$\ddot{\mathbf{y}} \ddot{\mathbf{y}}^T \mathbf{F}_{in} \ddot{\mathbf{y}}_i = 0 \quad (20)$$

The \mathbf{F}_y in ui , acting on each “free” electron in a rotating

force \vec{y} in a ferromagnet, according to equations (11) and (17), is directed opposite to \vec{y} , hence:

$$\ddot{\mathbf{y}} = \mathbf{F} \dot{\mathbf{y}} + \mathbf{g}_u \quad . \quad (21)$$

Using equations (20) and (21) in Eq. (18) we obtain: $\ddot{y} \ddot{y} \ddot{y}$ in $\ddot{y} \ddot{y}$.

(22)

Let's consider some special cases.

1. The angular velocity of rotation $\ddot{\gamma}$ is oriented along the surface of the Earth (**Fig. 5**).

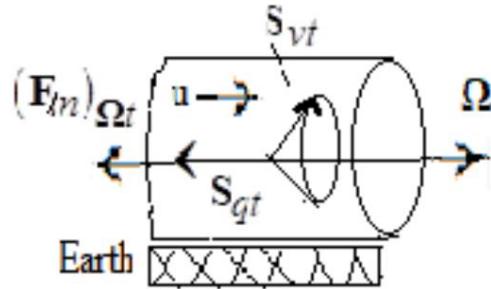


Fig. 5. S_{qt} is the total spin of “free” electrons; S_{vt} is the total spin of virtual photons created by these electrons; \mathbf{u} is the velocity of electrons;

$\ddot{\gamma} \text{ in } \ddot{\gamma} \text{ in } \mathbf{F}$ is the force of inertia; $\ddot{\gamma}$ is the angular velocity of rotation.

Under the action of force $\ddot{\gamma} \text{ in } \ddot{\gamma} \text{ in } \mathbf{F}$ there will be a movement of ferromagnets along surface of the Earth. This theoretical conclusion is confirmed by experimental data: the movement of a rotating cart (V.N. Tolchin [9]; the movement of rotating magnets G.I. Shipov [10].

2. The angular velocity $\ddot{\gamma}$ is oriented perpendicular to the Earth's surface (**Fig. 6**).

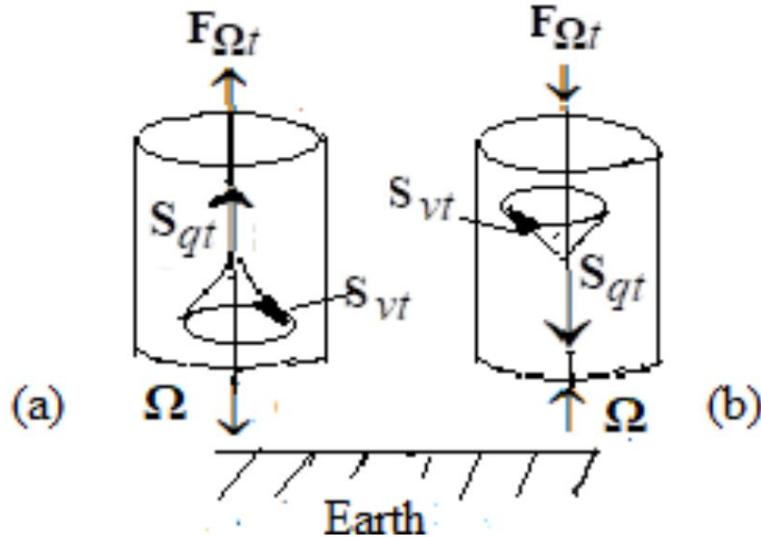


Fig. 6. Rotating ferromagnets with angular velocity $\ddot{\gamma}$ directed perpendicular to the

Earth. S_{qt} is the total spin of “free” electrons; S_{vt} is

the total spin of virtual photons created by these electrons; $\ddot{\gamma}$ - force of inertia.

$\ddot{\gamma} \text{ in } \ddot{\gamma} \text{ in } \mathbf{F}$

As follows from **Fig. 6**, the action of the inertial force $\ddot{\gamma}$

$\ddot{\gamma} \text{ in } \ddot{\gamma} \text{ in } \mathbf{F}$ affects weight

rotating ferromagnet. In variant (a), the inertial force is directed opposite to the gravitational force and, therefore, reduces the weight of the ferromagnet. In variant (b), the inertial force is directed along the gravitational force and, therefore, 206

increases the weight of the ferromagnet. Experimental data confirm the theoretical conclusions.

In 1990-1993, experiments with rotating magnets were performed by V. V. Godin and S. M. Roshchin [11]. When rotating clockwise, the weight of the installation decreased. When rotating counterclockwise, the weight of the installation increased. A similar experiment was conducted by Japanese researchers Hausaka and Sakae [12] with a gyroscope rotating around an axis vertical to the Earth. When rotating to the right, the weight of the gyroscope decreased.

Note: Possibility of using nonlinear magnetic fields instead of rotating the object. A change in the projection of the spin to any direction can occur not only as a result of rotation (the Barnett effect), but also by applying a magnetic field.

This direction of research was tested experimentally in Searle's experiments [13] and not only a change in the weight of the experimental setup was obtained, but also its levitation.

2. Additional properties of the force of inertia

In this section the following properties of inertial force will be considered:

1. The influence of the sign of the electric charge of a moving quantum on the force of inertia object.
2. Restoration of original data in experiments on the study of inertial forces in rotating quantum objects.
3. The possibility of deformation of the shape of a rotating body.

2.1. The influence of the sign of the electric charge of a moving quantum object on the force of inertia

The presence of the coefficient in equations (4) and (17)

\ddot{y} , sign dependent

electric charge of a moving quantum object, indicates a possible dependence of the inertial force acting on a quantum object on the sign of its electric charge. Electrons were involved in the examples considered above. Let us consider the option of using electrically positively charged objects (positrons, protons) in these examples

Rotation of an electrically positively charged quantum object performing accelerated translational motion.

(In Section 2.1, **Fig. 3**, the rotation of an electrically negatively charged quantum object performing accelerated translational motion is considered).

Fig . 7 shows a schematic representation of the characteristics of the motion of an electrically positively charged quantum object, based on equations (3)-(5) and (15)-(17).

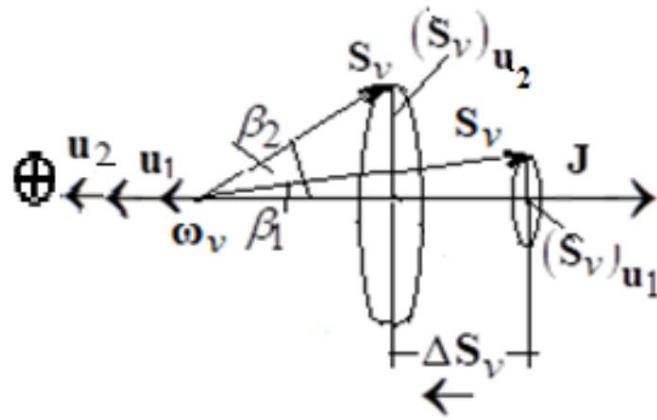


Fig. 7. Schematic representation of the characteristics of a virtual photon, created by a positively charged quantum object; $\vec{S}_v^y \vec{u}_1$ and $\vec{S}_v^y \vec{u}_2$ - projections of the photon spin onto the velocities of the quantum object u_1 and u_2 . $\vec{\omega}_v$ - precession frequency; \vec{J} - angular momentum of a rotating quantum object.

J is defined by the expression:

$$\mathbf{J} = \frac{1}{2m} \vec{S}_v^y \vec{u}_1 \vec{u}_2 \vec{S}_v^y \vec{v} \quad (23)$$

where $\vec{S}_v^y \vec{u}_1 \vec{u}_2$ and $\vec{S}_v^y \vec{v}$ $\cos \frac{\vec{u}_2}{\vec{u}_1} \cos \frac{\vec{u}_1}{\vec{v}}$.

equations (14) and (23) we can write the following:

$$\mathbf{J} = \frac{1}{2m} \vec{S}_v^y \vec{u}_1 \vec{u}_2 \vec{S}_v^y \vec{v}$$

where $\vec{S}_v^y \vec{u}_1$ and $\vec{S}_v^y \vec{v}$ are determined by the expressions considered above, and (5), that is, by the sign of the electric charge of the quantum object that makes up the rotating body.

Translational motion of a rotating body containing positively charged quantum objects.

(In Section 2.1, **Fig. 5**, the translational motion of a rotating body containing negatively charged quantum objects is considered).

Using equations (3-5) and (15)-(17) **Fig. 8** shows a schematic representation of the characteristics of a rotating body consisting of electrically positively charged quantum objects.

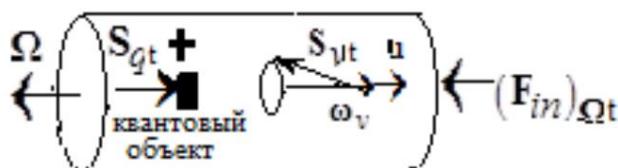


Fig. 8. Characteristics of a rotating body containing positive (+)

charged quantum objects. Sqt is the total spin of quantum objects; \dot{v} is spin precession frequency; Svt is the total spin of virtual photons created by these electrons; u is the speed of the virtual photon created quantum object; \ddot{y} is the angular velocity of rotation; \ddot{y} acting on a rotating body.

$F_{in} \dot{y}t$ -force of inertia,

As follows from **Fig. 8**, in the case of rotation of a positively charged quantum

object is true: $\ddot{y} = \sqrt{\frac{S}{u^2 + S^2}}$. Taking into account expression (22) for the inertial force, acting on a body consisting of electrons, in the general case we have: is determined by expression (5).

2.2. Restoring original data

From the definition of the projection of the spin of a virtual photon onto the direction of velocity u

$$\left| \ddot{y} \right| = \left| \frac{S \sin \theta}{u} \right| \quad \cos \theta \quad \text{it follows that the change } \ddot{y} \ddot{y} v \quad \left| \begin{array}{c} s \\ u \end{array} \right| \quad \text{Maybe}$$

occur either when the speed u of a quantum object changes within the limits (at $u=c$). or when the angle of deviation θ changes. Therefore, to ensure the work of the inertial force, that is, to ensure the inequality $\ddot{y} \ddot{y} / 0 \leq u c$,

$$\left| \begin{array}{c} s \\ v \\ u \end{array} \right| \quad \ddot{y} \ddot{y} t \quad 0 \text{ for a long time, introduction is necessary}$$

between working periods recovery periods. During the recovery period, the velocity u of the quantum object and the angle of deflection

\ddot{y} acquire initial values (see **Fig. 9**).



Fig. 9 Periods of testing bodies. Lines indicate, respectively, "working" and "recovery"

periods,

The theoretical conclusion is consistent with the experimental results. For example, in the experiments of V. N. Tolchin [9], in which the movement of the cart was carried out in jerks, moving weights were used, which moved faster in one direction than in the other. Recovery periods, in which the return to the initial value of the system characteristics was carried out, were also introduced in the experiments of V. N. Zatelepin and D. S. Baranov [7].

2.3. Changing the shape of a rotating body

If the rotating body has a complex shape, then in different areas of the body there may be a different number of "free" electrons, which, according to equation (19), can lead to different values of the inertial force in different areas of the body.

(respectively, the forces of inertia $\mathbf{F}_{in\ sum1}$ and $\mathbf{F}_{in\ sum2}$ in Fig. (10)). The difference in values $\mathbf{F}_{in\ sum1}$ and $\mathbf{F}_{in\ sum2}$ can lead to deformation of the body.

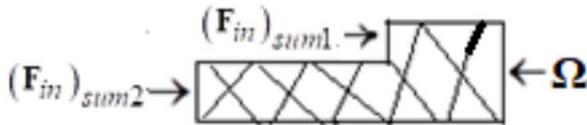


Fig. 10. Example of body deformation.

$\mathbf{F}_{in\ sum1}$ and $\mathbf{F}_{in\ sum2}$ forces

inertia; $\dot{\theta}$ - angular velocity
rotation of the body.

3. Discussion. The relationship between Newton's first and second laws

According to the Feynman hypothesis [1], the size of a virtual photon is equal to the wavelength Dq of the quantum object that created the virtual photon. The wavelength of a quantum

object with mass

and the speed u is determined by the expression: $D = \frac{h}{mc}$, where

h is Planck's constant. Let us determine the inertial force of a unit size body (specific

force of inertia) $\mathbf{F}_{in} = \frac{s}{u}$, taking into account equation (11) in q

$\dot{\theta} = k D / m q$, where

$k > 0$ is a dimensionless proportionality coefficient and, given that the spin of a virtual photon is h :

$$\mathbf{F}_{in} = \frac{s}{u} = k \left| \frac{u^2}{c^2} \frac{m}{\sqrt{1 - u^2/c^2}} \frac{\dot{\theta} u}{t} \right| \quad (24)$$

Expression $\frac{mq}{\sqrt{1 - 2^2 u^2/c^2}} \frac{\dot{\theta} u}{t}$ in equation (24) coincides with the expression for

Newton's second law ($F=ma$) in which the mass m is presented in relativistic form.

Conclusion

Newton's first law (the law of inertia) is a consequence of the law of conservation of angular momentum in a physical vacuum. A change in the angular momentum of a body occurs, in particular, when the characteristics of the spin of virtual photons created by quantum objects that make up the body change. The result of the action of the law of conservation of angular momentum is the emergence of processes that compensate for the change in this moment. These compensating processes can be, firstly, the rotation of the body, and secondly, the emergence of a force that affects the speed of this body - the force of inertia.

The force of inertia can arise in a progressively moving body when the speed of this motion changes and in a rotating body, since the rotation of the body affects the characteristics of the spins of virtual photons created by quantum objects of the rotating body. If this force is directed along the gravity vector, the weight of the rotating body increases. If this force is directed oppositely

the gravity vector, the weight of the rotating body decreases. If this force is directed perpendicular to the gravity vector, the body moves along the Earth's surface. All these phenomena are observed experimentally [14].

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The First Law of Newton. The force of inertia and its manifestations (the rotation of a body moving with acceleration, changing the weight of a rotating body)

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The aim of this work is to show that the first Newton's law (law of inertia) is a manifestation of the law of conservation of angular momentum in the physical vacuum. The force of inertia arises in a body as a result of a change in the angular momentum of the body. The change in the angular momentum can emerge when changing the characteristics of spins of virtual photons created by quantum objects constituting the body. Due to the law of conservation of angular momentum a change in the angular momentum results in the emergence of the processes compensating this change. One of these compensating processes is the emergence of force of inertia influencing the velocity of quantum objects constituting the body. Another compensating process is the emergence of rotation of these objects. Both these processes are observed in experiments.

The force of inertia may arise in rotating bodies as rotation of body influences the characteristics of spins of virtual photons created by quantum objects of rotating body. If the force is directed along the vector of gravitation, the weight of rotating body is increased. If the force is directed against the vector of gravitation, the weight of rotating body is decreased. If the force is directed perpendicular to the vector of gravitation, the body is moving along the Earth surface. All these phenomena are observed in experiments.

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From the properties of virtual photons to wave-particle duality

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The aim of this work is to show that the wave properties of quantum objects are determined by the wave properties of virtual photons created by these quantum objects. In particular, the frequency of the wave function of a quantum object is equal to the spin precession frequency of a virtual photon created by the quantum object. Quantum objects are called "entangled" if they have identically oriented and equal-in-magnitude spin precession frequencies of the virtual photons created by these quantum objects. Quantum correlations between quantum objects are realized by a superfluid spin current that transforms the angular momenta (precession angles and deflection angles) between the precessing spins of virtual photons created by interacting quantum objects. Quantum correlations can also arise between photons whose wave properties have much in common with the wave properties of virtual photons.

Introduction

The main experimental fact indicating the existence of corpuscular-wave duality is the emergence of "interference rings" when quantum objects pass through a crystal lattice, similar to those that arise when photons pass through the same crystal lattice (**Fig. 1**) [1].



Fig. 1. Interference rings that arise when quantum objects (including photons) pass through a crystal lattice.

One of the first experiments of this type was carried out by Clinton Joseph Davisson and Lester Halbert Germer

(English Lester Halbert Germer) in 1937 [2], in which electrons scattered by the surface of a crystal (metal-nickel) formed interference rings. A similar result was obtained using a flow of low-energy electrons. In these experiments, the probability of finding two electrons in the crystal lattice at the same time was insignificant (Fabrikant V.A., Biberman L.M., Sushkin N.G., 1949 [3]). Note. The existence of quantum correlations cannot be experimental proof of the existence of corpuscular-wave duality, since a single wave function introduced for interacting quantum objects is necessary only for

explanations for the superluminal speed of this process (in order to avoid contradiction with the second postulate of the theory of relativity).

The analogy between the “interference rings” obtained after photons pass through the crystal lattice and after quantum objects pass through it indicates the existence of an analogy in the wave properties of a photon and a quantum object.

In 1923, De Broglie [4] put forward a hypothesis according to which the wave properties of a quantum object with a non-zero rest mass (frequency, phase, wavelength) are similar to the analogous properties of a photon (as experiments have shown, these properties are not associated with electrical and/or magnetic interactions).

In 1949, Feynman developed a hypothesis [5] according to which electric and magnetic interactions are carried out by pairs of oppositely charged virtual particles emitted by quantum objects that are singularities in electric and/or magnetic fields. Since the purpose of a pair of these particles is in many ways similar to the purpose of photons that propagate electromagnetic oscillations, this pair was called a “virtual photon” and the properties of a virtual photon are similar to the properties of a photon.

From both hypotheses (De Broglie and Feynman) it follows that the wave properties of a quantum object are identical to the wave properties of the virtual photon created by this object.

This paper examines the characteristics of the wave properties of quantum objects (theory and experiments).

- Section 1. Wave properties of a virtual photon.
- Section 2. Properties of the physical process implementing the interaction of virtual photons: properties of superfluid spin current.
- Section 3. Quantum correlations of quantum objects.

1. Wave properties of a virtual photon

A virtual photon is characterized by only one wave process of non-magnetic and non-electric nature: the precession of its spin. Consequently, the characteristics of the spin precession of a virtual photon are equal to the corresponding characteristics of the wave function of the quantum object that created this virtual photon. In particular, the frequency $\dot{\gamma}v$ of the spin precession of a virtual photon

equals the frequency $\dot{\gamma}q$ of the wave function of the quantum object that created this virtual photon.

$$\dot{\gamma} \dot{\gamma} vq = \dot{\gamma} \quad . \quad (1)$$

According to Feynman's hypothesis, a virtual photon arises in a region which is $\dot{\gamma}$, size v equal to the wavelength of the wave function of the quantum object that creates virtual photon:

$$\dot{\gamma} vq = \dot{\gamma} \quad . \quad (2)$$

The precession $\ddot{\gamma}_v$ the spin of the virtual photon corresponds to the phase of the wave angle of the function of the quantum object that created the virtual photon.

The emergence of "interference rings" when virtual photons (as well as photons) pass through the crystal lattice can be caused by the following properties of these objects. 1) The existence of electrical, spin and magnetic components capable of

interact with the atoms of the crystal lattice.

- 2) Periodic oscillations of these components, caused by the precessional motion of the spin of these objects, can satisfy the following condition: the time interval $1T$ between the moments of interaction of the quantum objects under consideration with the atoms of the crystal lattice is a multiple of the period of this precession, or (which is the same) the distance between the nodes of the crystal lattice D_1 is a multiple of the wavelength of the virtual photon interacting with the lattice

$\ddot{\gamma}_v$ (in the case of a photon, a multiple of the photon wavelength):

$$D \cdot T u k 1 1 \quad \ddot{\gamma}_v, \quad (3)$$

where $k=1,2,3,\dots$; u is the velocity of the quantum object. Note that condition (3) is the "classical" condition for the formation of "interference rings" during the interaction of quantum objects with the crystal lattice [1].

Fig . 2 shows a schematic representation of the characteristics of a virtual photon created by an electrically negatively charged quantum object. The spin S_v precesses with a frequency $\ddot{\gamma}_v$; α is the precession angle; $r.l$ is the reference line; β is the angle between S_v and $-\ddot{y}$ (deflection angle); u is the velocity of the quantum object creating the virtual photon. According to Feynman's hypothesis, a virtual photon consists of two oppositely charged virtual particles, i.e., a virtual $\ddot{y}\ddot{y}$ [5, 6] and one associated with

the photon has an electric dipole moment $d \ddot{y}\ddot{y}$

$v \quad S_v$

with it the electrical component $d E$

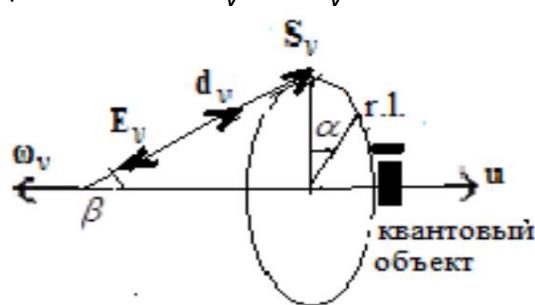


Fig. 2. Schematic representation of the characteristics of a virtual photon created by an electrically negatively charged quantum object. deviations; $\ddot{\gamma}_v$ is the spin precession \ddot{y} -corner frequency S_v ; α is the precession angle; $r.l$ is the reference line; d_v is the electric dipole moment; E_v is the electric component; u is the speed of a quantum object.

The wave properties of a virtual photon can be represented by equations describing the precession of the spin of a virtual photon with frequency ω_v and length λ . According to the waves $\psi_v = e^{i(\omega_v t - k_z z)}$ defined as $\frac{\partial^2 \psi}{\partial t^2} + \frac{1}{c^2} \frac{\partial^2 \psi}{\partial z^2} = 0$ Schrödinger equation

[7] $\frac{\partial^2 \psi}{\partial t^2} + \frac{1}{c^2} \frac{\partial^2 \psi}{\partial z^2} = -\frac{2m}{\hbar^2} E \psi$, where m_q the mass of the quantum object that created the virtual photon. Using the expression for ω_v in the formula for Dv , we get: $D = \frac{2\pi c}{\lambda}$

[7], or $\frac{\partial^2 \psi}{\partial t^2} + \frac{4\pi^2 m_q}{\hbar^2 c^2} E \psi = 0$, where Dq is the wavelength of the quantum object that created the virtual photon.

$$\psi = S \frac{\sin \omega_v t - \frac{1}{2} k_z z}{\sqrt{v v q}} e^{-i \frac{D}{2} z} = S \frac{\sin \omega_v t - i \frac{1}{2} k_z z}{\sqrt{v v q}} e^{-i \frac{D}{2} z},$$

$$z \text{ are Cartesian coordinates; } n=1 \text{ for } \psi \text{ u where } \psi = \psi_0 e^{i \omega_v t - i \frac{D}{2} z},$$

θ - deflection angle (deflection angle) (see Fig. 2).

Note: Since the term "quantum" means that the properties of an object are described by its wave function, which is determined by the properties of the virtual photon it creates, the phrase "a quantum object creating a virtual photon" carries redundant information.

2. Properties of superfluid spin current

The first works introducing the process of angular momentum transfer in the description of physical phenomena were the works of J. Maxwell, who proposed a model of luminiferous ether in 1861-1873 [8 - 9]. After 100 years, the study of the process of angular momentum transfer (taking into account the characteristics of a quantum object discovered in the 20th century - spin) was continued by M. Vuorio [10]. In his experiments, this process was called "remote spin polarization". In He-B, A. S. Borovik-

In subsequent years, this process was studied in superfluid by Romanov, Yu. M.

Bunkov, V. V. Dmitriev, and others [11-14]; in recent studies, the process of angular momentum transfer is called "superfluid spin current" (In 2008, Bunkov, Dmitriev, and Fomin were awarded the Fritz London Prize for their study of superfluid spin current in superfluid

³Non-B.)

Let us consider the main properties of the superfluid spin current arising between virtual photons with identically oriented (along the z axis) 2 -deflection angles; precession frequencies measured from the reference line θ_1 and θ_2 ; - precession angles ϕ_1 and ϕ_2 (rl); Sv - spin. A schematic representation of the characteristics of two virtual photons (including the superfluid J between them) is shown in Fig. 3.

spin current ψ

value of the superfluid spin current

J in the orientation direction (z-axis) 1) The

the precession frequencies ω_1 and ω_2 of the spins of virtual photons are determined as:

$$Jg z^{'''} = 12 \ddot{\gamma} \dot{\gamma} 22 1 \ddot{\gamma} \ddot{\gamma} \ddot{\gamma}, \quad (4)$$

where $1g$ and $2g$ are coefficients depending on $\ddot{\gamma}_1$ and $\ddot{\gamma}_2$.

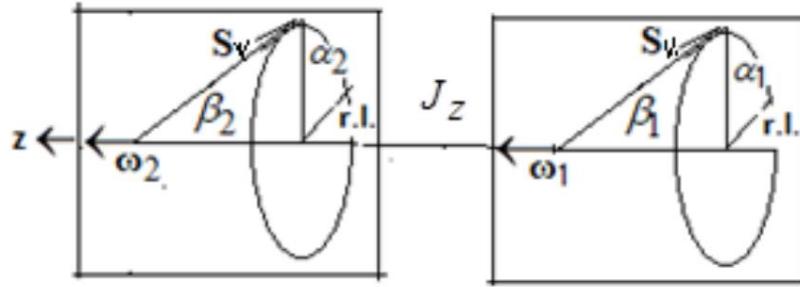


Fig. 3. Schematic representation of two virtual photons with the following characteristics: $\ddot{\gamma}_1$ and $\ddot{\gamma}_2$ - precession frequencies; deflection angles; $\ddot{\gamma}_1$ and $\ddot{\gamma}_2$ - precession angles measured from the reference line (rl); S_v - spin; J - superfluid spin current.

2) The action of the superfluid spin current is aimed at equalizing the values of the characteristics of the spins, that is, as a result of the action of this current we have:

$$\left| \begin{array}{c} \ddot{\gamma} \dot{\gamma} 12 12 \ddot{\gamma} \dot{\gamma} \ddot{\gamma} \\ \ddot{\gamma} \dot{\gamma} \end{array} \right|, \quad (5)$$

$$\left| \begin{array}{c} \ddot{\gamma} \dot{\gamma} 2 \ddot{\gamma} 12 \ddot{\gamma} \dot{\gamma} \ddot{\gamma} \\ \ddot{\gamma} \dot{\gamma} \end{array} \right|, \quad (6)$$

Where $\ddot{\gamma}_1$ and $\ddot{\gamma}_2$, and also $\ddot{\gamma}_1$ and $\ddot{\gamma}_2$ - values of the precession angles and deflection angles of the spins of interacting virtual photons after the action of the superfluid spin current.

3) As a result of the action of the superfluid spin current, not only the angles of precession and deviation of the spins of interacting virtual photons can change, but also the precession frequencies of these spins.

We assume that before the action of the superfluid spin current the precession angles $\ddot{\gamma}_1$ and $\ddot{\gamma}_2$ spins were related to the corresponding frequencies of their precession $\ddot{\gamma}_1$ and $\ddot{\gamma}_2$ (independent of time t) by the relations: $\ddot{\gamma}_1 = \ddot{\gamma}_1 t + \ddot{\gamma}_0$ and $\ddot{\gamma}_2 = \ddot{\gamma}_2 t + \ddot{\gamma}_0$, where $\ddot{\gamma}_0$ and $\ddot{\gamma}_1$ - values of the precession angles at $t=0$. If $\ddot{\gamma}_1 = \ddot{\gamma}_2$, then the next one equality holds:

$$\ddot{\gamma}_1 = \ddot{\gamma}_2 \quad \ddot{\gamma}_1 = \ddot{\gamma}_2 \quad \ddot{\gamma}_1 = \ddot{\gamma}_2 \quad \ddot{\gamma}_1 = \ddot{\gamma}_2, \quad (7)$$

From equations (5) and (7) it follows:

$$\left| \begin{array}{c} \ddot{\gamma} \dot{\gamma} \ddot{\gamma} \ddot{\gamma} \\ 12 12 \ddot{\gamma} \dot{\gamma} \ddot{\gamma} \ddot{\gamma} \end{array} \right|, \quad (8)$$

Where ω_1 and ω_2 – values of spin precession frequencies after the action of superfluid spin current.

4) At a certain difference a of the precession angles of the spins of the interacting spin structures, the effect of "slippage" of the phase (precession angle) can take place. The critical value of the superfluid spin current

J_c corresponds to the value ω_c

superfluid spin current

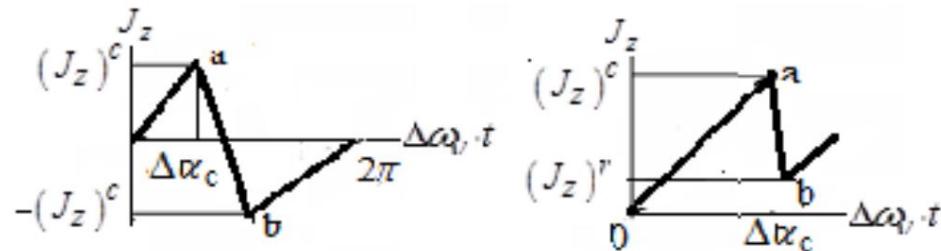
corresponding precession frequencies

precession angles: $\omega_1 - \omega_2 = \Delta\alpha_c t$.

Fig. 4 shows the dependence options.

J_z between two virtual photons with

ω_1 and ω_2 from the hypothetical difference between them



Variants of the dependence of the superfluid spin current

Fig. 4.

virtual photons from the hypothetical difference in their precession angles t

ω_V

(accordingly with the change of the sign of the sign

J_z and without change). ω_c

J_z^C

critical value of the superfluid spin current. ω_c value of the superfluid spin current. J_z^r - residual

Line ab corresponds to phase slip at a phase difference of $\omega_c t$

ω_c .

Equation (4), which defines the superfluid spin current, is valid only in the absence of "phase slip". The probability of "phase slip" is insignificant, provided that expression (7) is valid and the condition:

$$\omega_1 - \omega_2 < 0.1 \omega_c \quad (9)$$

Condition (9) can also be interpreted as a condition for the effective action of the superfluid spin current.

5) The dependence of the efficiency of the superfluid spin current on the distance between virtual photons has not been experimentally established. However, it is known that the efficiency of this current in superfluid $^3\text{He}-\text{B}$ is limited only by the volume of the liquid.

6) Superfluid spin current is neither an electrical nor a magnetic process, therefore it is not screened by electromagnetic screens.

7) Superfluid spin current was discovered in superfluid equalizing order parameter in $^3\text{He}-\text{B}$ as a process, $^3\text{He}-\text{B}$, that is, in the environment, the state

which is mathematically described by a single wave function. Therefore, according to the principles of quantum mechanics, the superfluid spin current is a non-dissipative process.

Due to the existence of a connection between mass and energy, the non-dissipative nature of the process means that it is not accompanied by the formation of mass, that is, it cannot be an inertial process, and, its speed, $\frac{ds}{dt} \leq c$, is greater than the speed of light: consequently,

$$\frac{ds}{dt} \leq c \quad . \quad (10)$$

Inequality (10) does not contradict either experimental data or the special theory of relativity, since the limitation of the speed of the process in STR applies only to inertial processes.

8) In the case of insignificant dissipation, the sum of the precession angles $\sum \hat{\theta}_1$ and the sum of the deflection angles $\sum \hat{\phi}_1$, determined for interacting virtual photons before the action of the superfluid spin current, do not change during the action of the superfluid spin current. That is, the following equalities are valid:

$$\sum \hat{\theta}_1 + \sum \hat{\phi}_1 = \text{const} \quad , \quad (11)$$

$$\sum \hat{\theta}'_1 + \sum \hat{\phi}'_1 = \text{const} \quad , \quad (12)$$

Where $\hat{\theta} = \hat{\theta}_1 + \hat{\theta}_2$ — sum of precession angles and sum of deflection angles

interacting virtual photons after the action of the superfluid spin current. Let us introduce the following notation:

$$\hat{\theta}_1 = \hat{\theta}_1' + \hat{\theta}_2' \quad , \quad \hat{\phi}_1 = \hat{\phi}_1' + \hat{\phi}_2' \quad , \quad \hat{\theta}'_1 = \hat{\theta}_1'' + \hat{\theta}_2'' \quad , \quad \hat{\phi}'_1 = \hat{\phi}_1'' + \hat{\phi}_2''$$

Using the introduced notations in equations (11)-(12), we obtain:

$$\hat{\theta} + \hat{\phi} = \text{const} \quad , \quad (13)$$

$$\hat{\theta}' + \hat{\phi}' = \text{const} \quad , \quad (14)$$

3. Properties of quantum correlations

Quantum correlations can be described using the following example. Quantum objects **a** and **b** (Fig. 5) are emitted by one source of quantum objects. The objects move in different directions: object **a** is directed, depending on the position (1 or 2) of switch P, either to detector A1 or to detector A2 (these detectors have different properties); object **b** is directed to detector B. According to the postulates of quantum mechanics, the detectable properties of object **b** depend on which detector previously detected object **a**. Note that the difference in the detection time of objects **a** and **b** can be very insignificant, which indicates the high speed of the process that carries out quantum correlations.

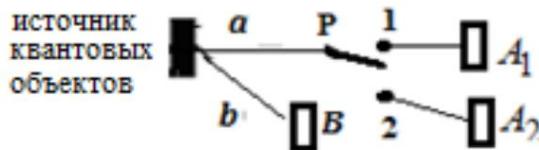


Fig. 5. Schematic diagram of an experiment illustrating quantum correlations between quantum objects **a** and **b**. **A₁**, **A₂**, and **B** are detectors; **P** is a switch with positions 1 and 2.

Let us consider the properties of quantum correlations and compare them with the properties superfluid spin currents [6, 15].

- 1) Correlations occur between quantum objects with both zero and non-zero rest mass.

Experiments demonstrating quantum correlations use both types of quantum objects: those with zero (photons) and those with non-zero rest mass. Common to both types is that they, having precessing spins, are characterized by precession and deflection angles and, therefore, can interact via a superfluid spin current. Note: Quantum correlations may not occur between a group of quantum objects producing virtual photons with a total spin equal to zero. For example, quantum correlations will be absent in superconductors between Cooper pairs, since the total spin of the virtual photons produced by the quantum objects of the pair is zero) [6].

- 2) Quantum correlations exist between quantum objects not only in the moment of simultaneous registration of objects.

It has been experimentally proven that correlations between quantum objects can arise when one of the quantum objects is still in a physical vacuum [16]. This means that quantum correlations do not arise between the source and the detector of interacting objects, but can be carried out by a physical process in a physical vacuum.

- 3) It has been experimentally shown that quantum correlations have maximum efficiency if they occur between so-called “entangled” quantum objects. “Entangled” quantum objects have the same frequency of the wave function and are generated, as a rule, by one source, for example, they are formed in atomic cascade transitions. However, in the experiments of D.N. Klyshko [17], quantum correlations (interference) were observed between photons emitted by different sources, but having the same frequency and not having crossed polarization.

The considered conditions for the emergence of effective quantum correlations are in agreement with the condition of effective action of the superfluid spin current between quantum objects: equality and a certain mutual direction of the frequencies of the wave functions of the interacting quantum objects (equation (9), property 4 of the superfluid spin current).

- 4) Quantum correlations can occur at distances between interacting structures exceeding 10 km [18, 19].

Independence of quantum correlations from the distance between interacting particles structures is consistent with the similar 5 property of superfluid spin current. 220

5) Quantum correlations are not screened by electromagnetic screens.

This property is consistent with property 6 of superfluid spin currents: they do not shielded by electromagnetic screens.

6) The speed of quantum correlations is greater than the speed of light; this follows from the possibility of quantum correlations of photons separated spatially and emitted by sources simultaneously.

There are experiments [20] demonstrating speeding quantum correlations of the speed of light in $4 \cdot 10^{-4}$ once.

This property is consistent with the 7 property of the superfluid spin current (condition (10)). 7) The relationships between the characteristics of the light field in quantum correlation experiments are similar to the relationships between the changes in the values of the corresponding characteristics of interacting virtual photons under the action of the superfluid spin current. Let us consider this property in detail using the example of two-photon interference [17]. **Fig. 6** shows a diagram of the experimental setup, where two beams of light are subjected to a phase delay. Fields 1 and fields $1b$ and $2b$

with frequency ω_1 and ω_{1b} with frequency ω_2 and ω_{2b}

with frequency ω_b are mixed by appropriate beam splitters.

Detectors and a coincidence circuit measure the correlation and intensities of the beams.

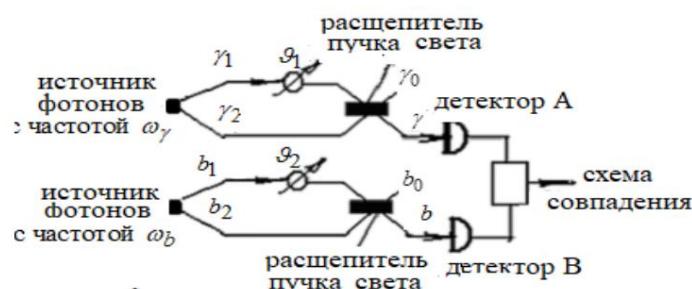


Fig. 6. Schematic diagram of a four-mode intensity interferometer. 1 , $2 2b$ – input light beams; γ – phase delays of light beams; b – beam frequency. Detectors A and B and coincidence circuits

Beam frequency ω_1 ; ω_2

measures the characteristics of the output beams.

Depending on the statistics of the incident light beams, two types of interference can occur: with phase $\gamma_1 + \gamma_2$ and with phase $\gamma_1 - \gamma_2$. The first interference of $\gamma_1 + \gamma_2$ is called Bragg interference [21], the second is called certain conditions, both types of interference are the result of the transformation by beam splitters of the relative phase fluctuations of the input beams into fluctuations in the intensities of the output beams.

Let us consider these conditions. Let the fields k and kb ($k=1, 2$) have constant unit amplitudes and phases that drift with time t as: $\exp(i\omega_k t)$. Condition of the first type k

$$\exp(i\omega_k t) = \exp(i\omega_{1b} t) = \exp(i\omega_{2b} t), \quad k = 1, 2$$

interference of intensities is determined by the equalities: 1 $\hat{x}\hat{y} = \hat{y}\hat{x}$ and 2 $\hat{x}\hat{x} + \hat{y}\hat{y} = 1$. The condition for these equalities is the following equality:

$$\hat{x}\hat{x} + \hat{y}\hat{y} = 1, \quad (15)$$

that is, the fluctuations of the phase of the light beam occur in such a way that the sum of the phases remains constant. These two conditions can be called the phase correlation and anticorrelation conditions, respectively. Condition (15) is satisfied, for example, when using a non-degenerate parametric oscillator, in which the phases (as well as the frequencies) of the signal and idler waves drift in different directions. Then and the phases for changes in the phase of the \hat{x} , \hat{y} , of the field b , \hat{y} , the following is true: that is,

$$\text{field } \hat{x}\hat{y} = \hat{y}\hat{x}. \quad (16)$$

The obtained relationship (16) between the changes in the phases of the light field is similar to the relationship between the changes in the values of, respectively, the precession angles (equation (13)) and the deflection angles (equation (14)) of the precessing spins of interacting virtual photons under the action of superfluid spin currents.

Thus, the above-discussed properties of quantum correlations between quantum objects can be explained using the properties of the superfluid spin current arising in the physical vacuum between virtual photons created by interacting quantum objects.

Conclusion

1. The wave properties of a quantum object are determined by the properties of the virtual photon created by this quantum object. The frequency and phase of the wave function of a quantum object are equal, respectively, to the frequency and phase of the spin precession of the virtual photon created by the quantum object in question. The wavelength of the wave function of a quantum object is determined by the size of the virtual photon created by it as an electric dipole.
2. The formation of “interference rings” by quantum objects passing through a crystal lattice, similar to those that arise when photons pass through the same crystal lattice, is the result of the creation by each quantum object of a virtual photon, the wave properties of which are in many ways identical to the wave properties of a photon.
3. Quantum objects are called “entangled” if the virtual photons they create are equal in size and oriented in the same way.
precession frequencies of their spins.
4. Quantum correlations between quantum objects are realized by superfluid spin currents that transform angular momenta (precession angles and deflection angles) between the precessing spins of virtual photons created by these quantum objects.

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From Property of Virtual Photon to Wave-Particle Duality

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The aim of this work is to show that wave properties of quantum objects are determined by the wave properties of virtual photons created by those objects: in particular, frequency of wavefunction of quantum object equals frequency of precession of spin of virtual photon created by the quantum object. The quantum objects named as “entanglement” are objects having equal and co-oriented frequencies of precession of spin of virtual photons created by these quantum objects.

The quantum correlations between quantum objects are accomplished by spin supercurrent transferring angular momentum (angles of precession and of deflection) between precessing spins of virtual photons created by the objects. The similar quantum correlations can arise as well between photons whose wave properties are like the wave properties of virtual photons.

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The mechanism of cavitation in solid, liquid, gaseous and etheric substances (electric shock)

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Based on the method of analogies and an interdisciplinary approach, it is proposed to extend the hypothesis developed by the author in geomechanics for the mechanism of sudden ejection of coal, rock and gas as a single mechanism for the following phenomena: cavitation (sonoluminescence) during a negative hydraulic shock (with a rupture of continuity); the formation of shock waves around an airplane when crossing the sound barrier, as well as the formation of Nikola Tesla shock waves in the ether.

The mechanism of coal, rock and gas ejection

As with cavitation in liquid, a void is artificially created, which is spontaneously filled with a substance. I cannot rewrite here everything that has already been published [1], but so that readers understand what is being discussed, I will do it briefly in broad strokes (Fig. 1). The superunity of the process ($COP > 100\%$) is visible to the naked eye - the generally accepted in official mining science model of "gas bag - membrane" (gas under pressure in coal is opened by mining operations) cannot provide the actually observed energy releases. I have not calculated and do not consider it advisable to do this because it is obvious. Although such calculations may exist, I have not come across them.



Fig. 1. Before and after a sudden release of coal and gas

During large emissions, there have been cases when a rock loading machine, which weighs as much as a tank, was thrown several meters. In this case, a trainload of coal is thrown out in a few seconds. When there is a place to throw it, for example, a straight long tunnel, then 14 thousand tons of coal (three trains or 200

wagons of 70 tons) and about 250 thousand m³ of methane. This is the largest emission in the world, which occurred in 1969 at the A.I. Gaevoy mine (Soviet Ukraine). The ejected coal filled half a kilometer of the crosscut (horizontal tunnel). A sudden emission of more than a million cubic meters of methane is known at the Sankhuba mine in China, which is equivalent to about a daily flow rate of a highly productive well in rich deposits of combustible gases.

A sudden outburst of coal, rock and gas (hydrodynamic phenomenon - HDP) occurs only at great depths. The term "great depths" for different sizes of seam mine workings differs in the absolute value of the depth of occurrence relative to the daylight surface. For coal seams about a meter thick, great depths begin at 300-600 m. For thicker coal seams, great depths are correspondingly greater. May miners forgive me, here and below I avoid highly specialized terminology, replacing it with words that are as understandable as possible for non-miners. Fig. 2 on the left shows a diagram illustrating the emergence of conditions for gas generation (cold nuclear fusion (CNF) from ether), and on the right is the actual outburst.

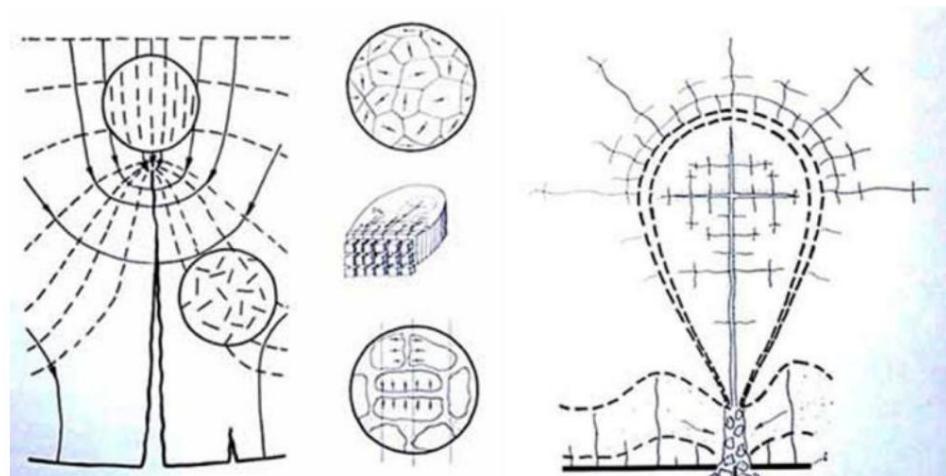


Fig. 2. Pear-shaped ejection cavity

At great depths, a crack grows from the mine workings into the massif under the action of rock pressure. When a critical depth is reached, the stress field in the vicinity of the crack tip abruptly deploys microdefects along the lines of force and leads to the appearance of diffusion superpermeability. A crack growing at the speed of sound generates methane or other gases at its tip by the self-assembly mechanism. The gas wedges the crack and continues its growth and dendrite-like branching (why dendrite-like will be clear below from the model consisting of rubber balls). The resulting positive feedback in the form of gas makes the crack formation process self-developing (explosive-like). As a result, the mine workings "collapse" - they are filled with highly crushed coal or rock. Before the appearance of the mine workings, the coal was in a volumetric-

stressed state under the action of the overlying rock mass. At the moment of formation of the mine workings, the surface of the outcrop gets the opportunity to deform. It is important to remember this when modeling. Compressive stresses from above generate tensile stresses on the surface of the outcrop (Fig. 3). To clarify the geometry of the crack system, we will conduct a thought experiment (Fig. 4). If anyone wants to check numerically, they can use my mathematical model [2]. But I cannot do this and do not consider it necessary, since "soft" modeling (a term of the French mathematician Rene Thomas) is sufficient.

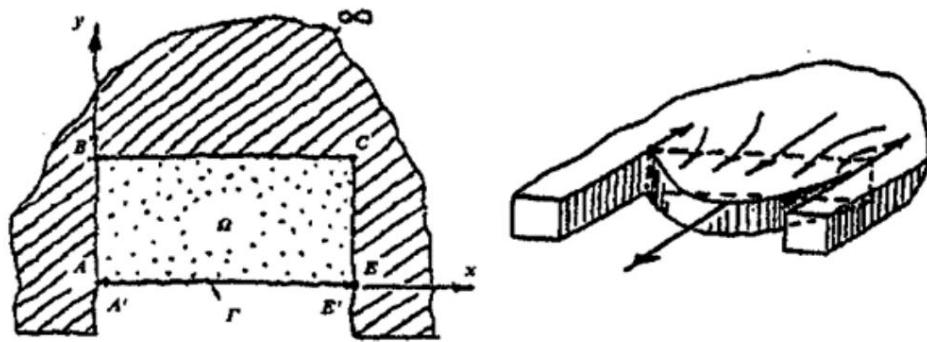


Fig. 3. Boundary and initial conditions for the rubber cube model

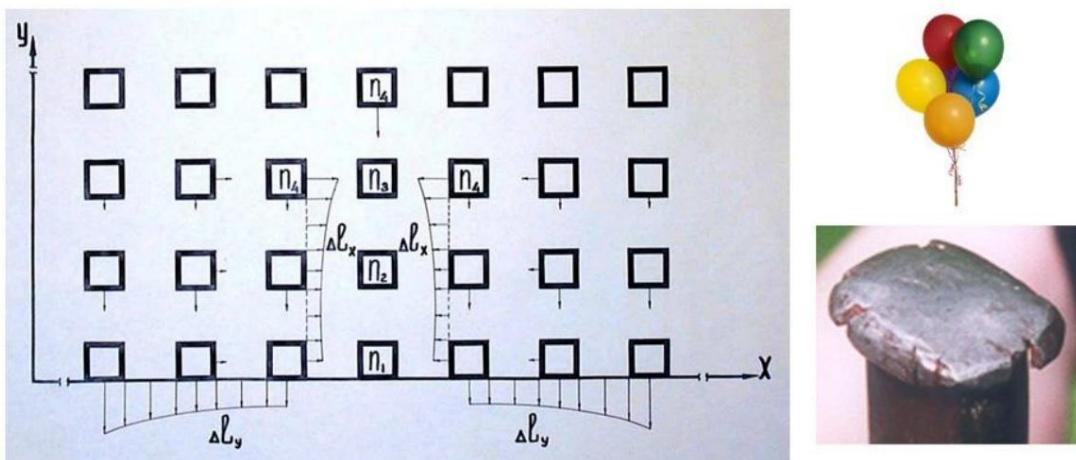


Fig. 4. Diagram of a model made of cubes (rubber balls in the shape of cubes)

The thought experiment consists of imagining a continuous two-dimensional environment consisting of rubber balls filled with air under pressure exceeding their ultimate strength. That is, if the ball is removed from the model, it will burst. To fix each ball in space, a glassless aquarium-type structure is used. The "aquariums" fit tightly against each other.

friend, are clamped at the top and bottom between something flat, for example, a table top and a sheet of plexiglass. The model is also limited along the perimeter, no matter what. The axes in the diagram are length Y and width X. The model is designed so that the border along the abscissa can instantly disappear. The mine workings are at the bottom, that is, in the negative part of the Y axis.

Let us take the maximum possible displacements as 1.0 or 100%. The diagram shows the displacement diagrams along the coordinate axes after the first weakest element (rubber cube) n1 has burst. The cubes are spaced apart in the diagram so that the diagrams can be drawn (we remember that the real modeling environment is continuous). Let us consider which cube should burst next. Cube n1 is missing, the displacements of the walls of its neighbors on the left and right are 0.5, because they have two exposed surfaces. And the cube in the depth of the model n2 has only one exposed surface and therefore its displacements are close to 1.0. It is clear that cube n2 will be the next to fail, and then n3. After n3 fails, the same conditions for failure both deep into the model and to the sides (n4 in the diagram) appear - the branching conditions of the "secant crack", they are also the branching conditions of each branch ("delamination cracks").

The dendrite-like geometry of the crack system that I have identified is a fractal (more about fractals below). Each branch is connected to each other and to the trunk, and at all scale levels down to the ether. I am not aware that this idea has been developed in geomechanics or described in the literature. I assume that the same situation exists in solid-state physics. This pattern (dendrite-likeness) allows us to explain the unexplained in mining. For example, how methane from a molecular pore gets into mine workings through gas-impermeable coal. The fact that coal seams have zero gas permeability everywhere below (deeper) the gas weathering zone has been experimentally proven in a mine [3]. And here is the explanation - gas and permeability appear simultaneously - CF from the ether at the tip of a growing crack.

The chisel head (see Fig. 4) is given as an experimental proof of the results of the thought experiment. Along the perimeter of the chisel head, at equal distances from each other, "secant cracks" grow, which branch into "delamination cracks". The latter separate a piece of metal, which, as is known, has the ability to get into the eye. This is an example of a direct and inverse problem. Not inverse, but "inverse" - a term from the EGDA (electrohydrodynamic analogies) method. The pattern of crack formation does not change qualitatively when the direction of the impact load changes from the mine working to the massif or, conversely, from the massif to the working. Another example: the pattern does not change if you hit the glass pointwise or shoot a bullet at it. Apparently, if you instantly remove part of the stressed glass, we will get the same cracks as when exposed to a bullet. Based on this, I assume that cavitation causes a rupture of continuity. And with sonoluminescence, the same gap, artificially (preliminarily) created in the form of a bubble, is compressed by ultrasound. Explosive-like filling of the void (mode with exacerbation according to S.P. Kurdyumov, a term from synergetics). Explosive-like

the collapse of the bubble always occurs locally (my hypothesis by analogy with crack formation), as with a sudden release of coal, rock and gas.

I found **evidence** of a dendrite-like crack system in the spontaneous division of the core into disks (Fig. 5). My model of rubber cubes was published in 1982 [4], and four years later it was partially confirmed by a group of scientists from the Siberian Branch of the Russian Academy of Sciences [5], who later formalized it as a discovery [6]. They experimentally discovered "stratification cracks" around mine workings, which they called zonal disintegration. I write "partially confirmed" because a tree does not have branches without a trunk. After such an authoritative approval of the discovery with the participation of an academician, my dendrite-like cracks are no longer a hypothesis! All experience in mining operations is fully consistent with the idea of a CN from the ether at the tip of a growing crack. The dendrite explains the pear-shaped form of the ejection cavity (see Fig. 2), but does not explain its spiral shape, which was formed (encountered) rarely, but they still existed (Fig. 6).

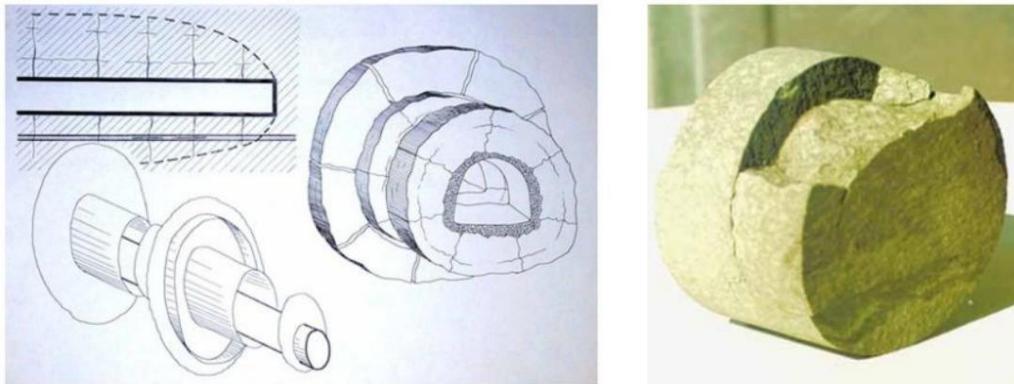


Fig. 5. Division of the core into discs and stratification cylinders

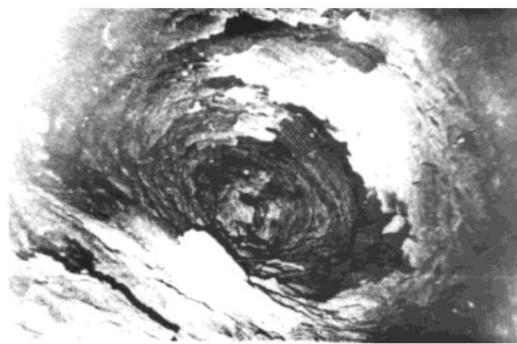


Fig. 6. Spiral shape of the cavity after the emission of coal and gas

To explain the spiral shape of the cavity, it was necessary to put forward another hypothesis [7], which was confirmed by D.S. Baranov and V.N. Zatelepin. After the seminar at RUDN on April 25, 2019, it dawned on me that 30 years ago I had corrected all three of Newton's laws. And, as I understand today, because I first defined the forces

inertia. Newton's laws came into being because of this "damned" thing. And as will be shown below, cavitation is also because of it. The essence of my second hypothesis is that inertial forces are something similar to electromagnetic self-induction forces! When I wrote the article in 1994, I imagined that everything consists of oscillatory circuits and that all of this is located and moves in an electromagnetic field.

Physicist V.V. Shamaev (co-author of article [7]) and I had two different explanations for the formation mechanism of spiral ejection cavities. Therefore, in the framework of one article (one because the unique photos of the cavities were the property of V.V. Shamaev), in order to be different, his mechanism is conventionally called "acoustic" and mine "gravitational". After the seminar on April 25, 2019, I accidentally came across a brochure by the English physicist Oliver Joseph Lodge on the Internet, translated into Russian and published in 1904 [8], from which I learned that my understanding of inertial forces was known at the beginning of the last century. And I also knew that a hare loops, and a person in a blizzard, in the forest or in complete darkness walks in circles. All this became clear after a report at a seminar at RUDN with N.V. Samsonenko on April 25, 2019, "Change in the weight of bodies rotating with acceleration. Experiment" [11]. V.N. Zatelepin and D.S. Baranov corrected Isaac Newton [9-10]. They discovered that when a body rotates with acceleration, it moves. And in my case, it moves with acceleration and therefore rotates. I think that this is the same thing.

So, the laws of Isaac Newton in my interpretation:

1st law. "Inertial forces are the "electromagnetic forces" of self-induction in the ether"

[40];

2nd law. "A body moving with acceleration is subject to a rotating force according to the gimlet rule" [40];

3rd law. "Action equals reaction". Action is force multiplied by speed. This was my report on 30.04.2011 at the seminar in the Polytechnic Museum "Rhythmodynamics of Nature", led by Yu. N. Ivanov (there is a video [12]).

I see **evidence** of etheric CF everywhere, but within the framework of this article I can only dwell on some of them. This is the GDY at the micro level - the explosive Bridgman effect [13-15]. At the macro level, etheric CF is the endless oil on Earth [16-17] and methane rivers on Titan (a satellite of Saturn). At the mega level - up to solar prominences and the birth of planets by stars.

When mines reach great depths, growing cracks first generate water, and then gas. Miners in mines, deep and not so deep, wear boots. The "water permeability" of the mine wall is the main argument of specially trained people in defense of their hypothesis that coal seams are supposedly fissured-porous (visible to the naked eye), and therefore gas-permeable. In salt mines, when reaching great depths, the generation of water by growing cracks leads to the dissolution of protective pillars calculated according to formulas for dry salt at shallow depths (Fig. 7). At the Verkhnekamskoye deposit of potassium-magnesium salts in the Perm region, they apparently did not know about the HF from the ether.



Fig. 7. Failure in the workings of the salt mine in Berezniki (September 2012)

The next example: the little-known to the average person successes of the Americans in extracting coal methane in the 90s of the last century [18]. Let me remind you that coal seams are as gas-impermeable as glass. Then the Americans began to extract methane from sandstones, in the chemical formula of which SiO_2 there is no organic matter at all, much less hydrocarbons. Before that, Russia and other coal-mining countries did not extract methane, but fought against sudden emissions of coal, rock and methane. They fought against methane so that it would not explode. Then, about ten years ago (2010-13), the Americans began to extract oil from shale, and today they extract gas from shale. They successfully fool the whole world, talking about hydraulic fracturing (HF). And our President has spoken out on this topic a couple of times. I have tried many times to open the eyes of not only coal miners, but also oil and gas specialists, giving reports everywhere, including at the Gubkin Russian State University of Oil and Gas [18] (Fig. 24). It is all useless, since our professors are bought with American grants (science is controlled by money all over

the world, and we are no exception). The technology classified by the Americans was invented at my institute back in 1979 [19], reinvented at the Ordzhonikidze Moscow State Geological Prospecting Institute, and after the collapse of the USSR was transferred to the USA. Since 1993 and to this day, no one in the world except the Americans knows how to extract hydrocarbons from shale! Despite the fact that everyone has plenty of deposits. We have the Bazhenov Formation (see Fig. 24), in Ukraine. Where the war is going on now (Donetsk and Kharkov regions). It is possible that the Americans, provoking the war, planned to free up land for wells in this way so that Hunter Biden (Burisma company) would not

In short, the essence of the technology is as follows. Through wells drilled from the surface, using sandblasting, cavities of about ten meters in diameter are washed out in the shale (so that cracks begin to grow). The growing cracks generate oil or gas, depending on the distance from the daylight surface - first oil, then, as they go deeper, gas (just like with water in coal mines). The hydrocarbon reservoir formed around the cavity, with a radius of at least 100-150 m, allows for commercial production for a couple of years. Then they move on to the next well. My guess is supported by the dense grid of wells in American shale deposits (Fig. 8). Compare this with a traditional deposit somewhere in Siberia. From rig to rig

you need to fly by helicopter. This means that there are no hydrocarbons in the shale initially, and it is not even permeable to gas.

Hydraulic fracturing has been known to our coal miners for over half a century, having borrowed it from oil workers. Moscow Mining Institute (University, NUST MISIS) uses the method injection of a marker with subsequent sampling of coal determined the above-mentioned radius of 100-150 m. Such studies are not available to oil workers due to the high cost of drilling operations. Both believe in the fairy tale that it is possible to rupture a productive formation with water through a well from the surface. An underground nuclear explosion in Donbass (September 16, 1979 between coal seams developed by the Yunkom mine in the Donetsk region) with the purpose of combating coal and gas emissions created an impact zone (melting and cracking) of the same 100 m. This suggests that no impact using water pumps, even the most powerful, from a working (well) into a formation can cause cracking in a radius of 100-150 m.



Fig. 8. US successes in coalbed methane production and the shale revolution

In my opinion, cracks are formed due to rock pressure from the massif into the well. And those scientists who allegedly do hydraulic fracturing are sincerely mistaken and pass them off as a product of their activities. Let me remind you that an underground nuclear explosion of 300 kilotons in TNT equivalent had an influence radius of 107 m, i.e. less than with hydraulic fracturing.

The next example: the hydrogen degassing of the Earth, known to geologists, which is sometimes localized into hydrogen jets. And then, according to the hypothesis of A.F. Chernyaev, "stones fall into the sky" [22]. A gravibolide flies out of the earth - Tunguska, Sikhote-Alin, Sasovsky, etc. I am a follower of this hypothesis and believe that a cavity of ejection forms on the surface of the Earth, as recently on the Yamal Peninsula (Fig. 10).



Fig. 10. Gravibolide of A.F. Chernyaev. Chebarkul meteorite.

The ejected soil flies into space and returns from there in the form of the Chebarkul (Chelyabinsk) meteorite. Such meteorites are usually not found. Or rather, everything that is found during research turns out to be of terrestrial origin. The trajectory of their fall is always directed in the opposite direction from the rotation of the Earth, that is, to the west. And if we compare it with the maps of ozone holes on the date of the fall, we will find that all meteorites fall into ozone holes. The latter suggests that they fly out of tectonic faults - giant cracks in the earth's crust. The Earth is constantly growing in diameter and tectonic faults are deepening. At the moment of the next increment of the fault, an earthquake occurs and conditions for CN from the ether can occur at the tip of the crack according to the mechanism of coal and gas emission described above. If hydrogen ignites, then we get a volcano. Due to the format of the article, I am not able to cover this topic in more detail.

The next example from the same category is the "Bureya anomaly" on December 11, 2018 on the Bureya River, approximately 70 kilometers from the village of Chekunda. Several million tons of rocky soil fell (flew in through the air) into the river - almost half of the hill! Official versions, in my opinion, are nonsense compared to the hypothesis about Chernyaev A.F.'s gravibolide, as a failed (underdeveloped) ejection of rock into space (several million tons).

For those who have not understood the mechanism of localization of hydrogen jets from the earth and sudden ejection of soil (rock) and hydrogen into space, the magazines "Technology for Youth" [23] and "Young Technician" [24] will help. I will also note that ore formation (hydrogen ions from ether) during earthquakes was already known to M.V. Lomonosov (Word on the Birth of Metals from Earthquakes) [25].

Cavitation in water

In the 1989 film by the Kievnauchfilm studio, recommended by the USSR State Committee for Public Education for use as a teaching aid in higher education institutions, at the time mark of 13:33 the voice-over says "... the maximum impact pressure can be greater than that found by Zhukovsky's formula" [26]. Therefore, it was already known in 1989 that cavitation is an overunity process $COP > 100\%$. And N.E. Zhukovsky is the same icon as Isaac Newton, and it is high time to correct his formulas. As V.A. Atsyukovsky said, "there can be no authorities in science"!

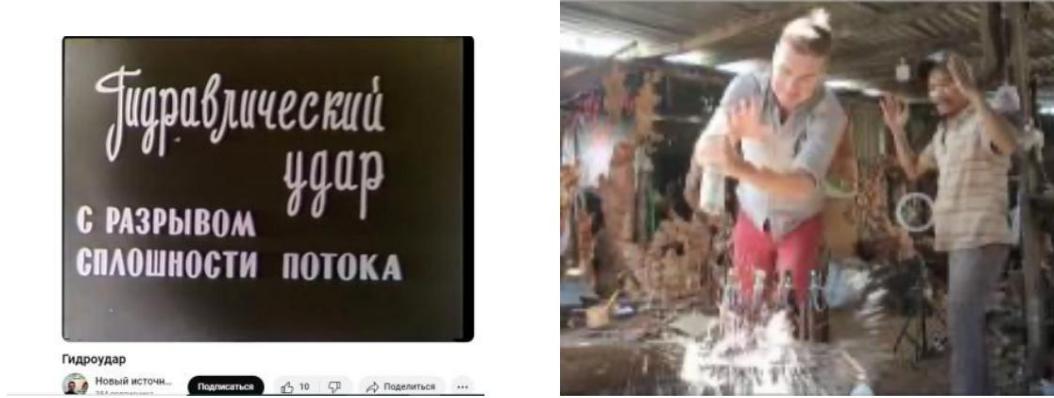


Fig. 11. What is cavitation in water – it is a discontinuity (“mining”)

When you hit the bottle with your hand, the water breaks away from the bottom. A void (vacuum and water vapor) is formed. It is important that a crack grows into the water from the resulting discontinuity, which, having reached a sufficient length, begins to generate Brown's gas, which wedges this crack and continues its growth and branching. Positive feedback (the crack generates gas, which generates new cracks, which release new portions of gas) translates the process into a self-sustaining, self-developing explosion (CFE from the ether in the aggravation mode according to S.P. Kurdyumov). An explosive release of water into a pore (into a discontinuity), tearing off the bottom of the bottle, in the physics of a propeller received

the name of cavitation.

From here on, if I say sonoluminescence, I mean cavitation; if I say in water, I mean in liquid (in acetone, in oil, water-oil emulsion, etc.). I consider the attempt of some researchers (R.I. Nigmatulina, M. Fomicheva-Zamilova, etc.) to separate sonoluminescence from the concept of cavitation-hydrohammer into an independent scientific direction to be unfounded and incorrect [27-

28]. I also think it is pointless for them to want to register neutrons to prove the presence of thermonuclear fusion. The presence of neutrons is a mandatory attribute for crack formation, cavitation, and LENR in general. I like the idea that thermonuclear fusion does not exist in nature at all, including on the Sun and other stars. Of course, it is possible to register neutrons, but it is impossible to identify the source of neutron radiation, because there are at least two sources, and maybe many. On February 7, 2024, M. Fomichev-Zamilov said at a webinar with A.V. Chistolinov that he can register neutrons. But he could not explain why they sometimes continue to be registered even after the experimental setup is turned off.

The source of neutron radiation is, first of all, the Earth [29-31]. My namesake I.P. Shestopalov registers neutrons during earthquakes and volcanism, that is, during GDY (CNS from the ether). And I am from the mechanism of these phenomena

I start from the beginning of the article, calling them cavitation in a solid aggregate state. I write that this is a single mechanism of cavitation in liquid, gas and ether. By neutrons I mean micro ball lightning and I will not be surprised by their appearance when a continuity is broken (it does not matter what). It is important that there are corresponding gradients 234

pressure function of the flow of mechanical energy, sufficient for the germination of the primary crack, its branching and the beginning of the ether HF at its tip (Fig. 12).

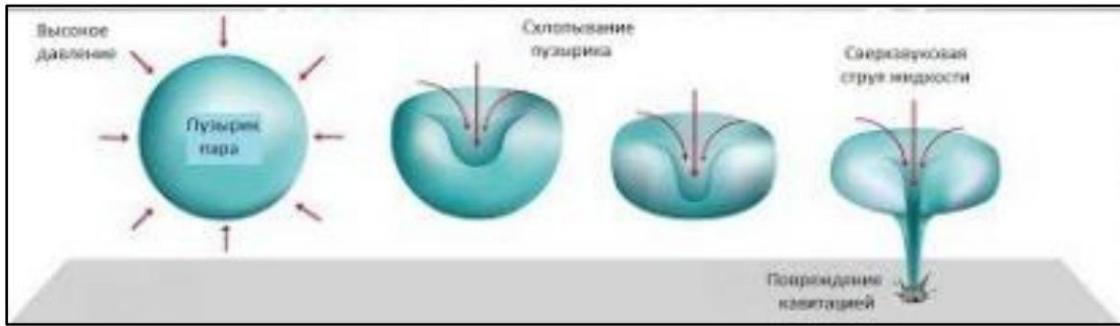


Fig. 12. Picture from the Internet - what is cavitation in water (supersonic jet of liquid)

As I have substantiated above (the solution of the direct and inverse problem), the pattern of crack formation does not change qualitatively from the direction of the instantaneous impact on the liquid-void boundary. Therefore, we can use glass pierced by a bullet as a model for sonoluminescence in acetone and cavitation in water (Fig. 13). Using this model, I want to show that the cracks that you see do not generate anything yet. The process of crack formation without localization in the synergetics of S.P. Kurdyumov is called quasi-stationary. And only when one of the cracks reaches the fundamental length, the localization of the crack formation process will occur. All cracks will stop growing, and this one, the first to reach the fundamental length, will continue to grow and branch with the generation of Brown's gas. This regime in the synergetics of S.P. Kurdyumov is called the regime with exacerbation.



Fig. 13. What is cavitation in water (my illustration of sonoluminescence)

I justify the proof of the correctness of my mechanism of cavitation in water by the extensive area of useful application of the water hammer effect in the national economy.

This effect has long been known to miners, who used it to combat coalbed methane by injecting water into coal seams in order to supposedly increase their permeability and gas recovery. It would be possible to simply inject water and not bother. V.B. Zberovsky processed from underground mine workings, injected water into the seam through a cavitator designed by the IGTM NAS of Ukraine [32-34]. V.I. Lipa processed coal seams through a well drilled from the surface into the coal seam through a cavitator designed by MGI [35-37]. The cavitator designed by the IGTM NASU was a tube with a variable flow section like the super-unit thermal installations "YUSMAR". The cavitator designed by MGI is the so-called "hydroram" among the people. Only instead of a stream - a reservoir with water, a pump and a pipe (water supply). It is officially considered that the hydraulic ram was invented by John Whitehurst (1713-1788), i.e. in the 18th century, super-unity fuel-free energy generators (FEG) based on cavitation (water hammer when the continuity of the water flow is broken) were already known. Despite this, V.V. Zberovsky and V.I. Lipa had revolutionary new developments in mining, which, as it turns out, are still far from being achieved by specially trained physicists today. There is a huge amount of information on the Internet about hydraulic rams and explanations of the operating principle with drawings and animations, descriptions of settings and successful implementation with addresses.

As is well known, there are no perpetual motion machines, but they can be bought. For example, the thermal installations "YUSMAR" by Yu. S. Potapov were produced by various companies for more than 50 years [38-39]. You can buy a super-unity water heater for space heating with $COP > 300\%$. But the equipment is noisy and is more suitable for huge spaces (workshops, warehouses, etc.) than for summer cottages. There are numerous developments by other authors, for example, hydropercussion thermal power engineering by Yu. I. Nefedov [42]. After V.V. Marukhin invented the hydraulic oscillating circuit (a hydraulic ram in a hydraulic ram), he made an electric power generator that does not consume any energy, even in minimal quantities (Fig. 15). On the PROatom website on August 11, 2009, an article was published under the title "To the President, who is looking for a new source of energy", which described all the ordeals of developers of free electricity [43]. It turned out that no one needs 220V 20 kW weighing 0.9 kg (Fig. 15)! A BTG operating on cavitation, of course, rattles a lot, but it has 20 kW of free electricity! But it can be used in the household (washing machine or dishwasher, TV), or in a BEK (unmanned boat) or a UAV (unmanned aerial vehicle) [44-51].



Fig. 15. What is cavitation in water (V.V. Marukhin's eternal battery)

Please do not confuse hydraulic rams with hydraulic pulsators, created, for example, by V.S. Medvedev [52]. These pumps also do not consume electricity, but their main difference is COP<1, although the flow rate of pumped water is much higher than that of hydraulic rams. Hydraulic pulsators have been known for over 100 years [53].

What does every firefighter know that an academic does not? That a fire hose (the tip from which a jet of water flies out) is an over-unity device (due to cavitation). In 2004, L.S. Kotousov somehow miraculously managed to publish research on a water jet accelerated by converging nozzles with different profiles in the peer-reviewed Journal of Technical Physics [54]. He discovered a power amplification coefficient of the jet of up to 4.0-4.5 units (COP>400%) in relation to the input power of the water flow, determined by its input excess pressure and volumetric flow rate. A discussion of the Kotousov effect can be found on the Internet [55]. This website of an unknown author also contains information on cavitation in general [56].

Cavitation in air

In the same article by L.S. Kotousov [54] it is written that the author also conducted research with air instead of water. For air, the power conversion coefficient (COP) can also reach more than 1.3 near critical flow parameters and in a supersonic flow. However, this coefficient is significantly lower than that of water. Other researchers, for example G.V. Treshchalov [57] and Yu.I. Volodko [58], write about the overunity effect in air. "Pneumatic impact" (cavitation in air) is observed when an aircraft passes the speed of sound. In the photo (Fig. 16), I see the mechanism of crack formation in air, which qualitatively repeats the "dendrite" I developed for a well or a round long mine working. The main proof of the plausibility of my vision of the geometry of shock waves is in my core (see Fig. 5). And in the case of airplanes, even the etheric nuclear fusion is visible in the form of a white fog that fills the cracks - most likely this is water vapor and water droplets.



Fig. 16. What is air cavitation (shock waves)

Cavitation on the air

Official science does not know what electric current is. It cannot be a flow of electrons, if only because the electron has mass. And therefore, with high-frequency alternating current, due to inertia forces, it will not flow anywhere, but will stand still. Electric shock is the same cavitation or sonoluminescence, the same mechanism for the emission of coal and gas, but only when there is a rupture in the continuity of the ether. Many scientists, from Nikola Tesla (1856-1943) to F.M. Kanarev (RKHTYAiSHM-19, 2012) and A.L. Shishkin (RKHTYAiSHM-25, 2018), who spoke at our conferences, have experimentally established that pulsed current allows you to get excess electricity. But the reason why of the two current pulse fronts, the front and the back, the main one in steepness (more effective) is the back one, was and remains unclear. The answer follows from the analogy with a water hammer when the continuity of the flow is broken: because after the "flap" the ether flow breaks and the void is filled with something thrown out of the ether.

I justify the proof of the correctness of my mechanism of cavitation in ether as in water by the extensive area of useful application of the electric shock effect in the national economy.

"Electric shock" (cavitation in the ether) and BTG based on it became widely known thanks to John Bedini (1949-2016). There may also be publications about the analogy between water hammer and "electric shock" (Tesla's shock wave), but I do not know about them. Until 2015 there was a website <https://johnbedini.net>, where you could easily buy Bedini's BTG for charging batteries. How does it work? A wheel with permanent magnets rotates from one battery, while charging two or more of the same batteries. Details in an interview with L.I. Primchuk (Vinnitsa, Ukraine), who repeated Bedini, blogger (engineer and scientist) Andrey Maklakov (Kyiv) [59] and in a scientific article by Indian scientists from Rajamangala University of Technology Rattanakosin [60]. And also from Bedini himself, the author of the three-volume BEDINI-SG_1 [61].

The self-taught inventor from Zimbabwe (Africa) Maxwell Chikumbutso has already been dubbed the "African Tesla" [62]. One of his outstanding creations is a 300 kW fuel-free electric generator, the testing of which can be seen in the film "Prosperity 2" (2020). The author of the film, Foster Gamble, flew to Africa especially for this. In 2015, Chikumbutso was invited to work in the United States under a contract (as Americans usually do - they patent it in their name and let you go home to die). There he had the most fruitful period of activity - a drone with unlimited flight time and a TV that does not require a connection to the mains appeared. But I do not think that all of the above is from the field of cavitation on the air. I reported on such BTGs at RKHTYAiSHM-26, calling them "microwave energy of A.Yu. Kushelev," [63-64]. His electric car, self-charging on the go, works on the Bedini effect (Fig. 17 on the left). The film "Prosperity" is constantly being removed from YouTube, but is currently available on Zen [65]. You need to watch about Chikumbutso from about the time mark 01:16:00 to 01:33:00. However, despite all his successes, none of his inventions have yet been mass-produced. Why?



Fig. 17. What is cavitation in the air (Chikumbutso and Rossi's car)

The same question is asked and answered by the authors of the film, which I recommend watching starting with the first episode [66].

And finally, the well-known Andrea Rossi, undeservedly forgotten by Klimov-Zatelepin's webinar. He also has an electric car that self-charges on the go (Fig. 17 on the right). On October 3, 2024, the E-Cat NGU generator was presented. An electric car equipped with this device, with a normal range of 75 km on one charge, traveled more than 6 hours over a distance of 201 km. During this time, the battery charge level increased from 62% to 83%. Exactly the same electric car (serial) stopped after 2 hours of driving, its battery was completely discharged. The Leonardo Corporation (Andrea Rossi's "Leonardo") [67] website published a technical report on this presentation in a "White Paper" titled "E-Cat Power: The Impossible Made Possible" [68], which states that the NGU Power Cell generates 10 W of DC current 24/7 for over a decade. Despite the sensational results, the major media ignored this presentation and the publication of the report, even Elon Reeve Musk.

Conclusion

During the explosive collapse of a "bubble" in a liquid (cavitation, sonoluminescence), the substance is born at the tip of the growing crack and is thrown into the cavity (into the bubble). I propose that the mechanism of GDP (gas-dynamic phenomena) developed by me during the development of coal deposits be considered more than proven and extended to cavitation in liquid and gaseous aggregate states of matter, as well as to the material ether of Descartes, Lomonosov, Mendeleyev, etc. I propose that electric current be considered an ether flow, as the great Nikola Tesla bequeathed to us. The EGDA (electrohydrodynamic analogies) method and the interdisciplinary approach without experimental confirmation and mathematical modeling do not prove anything, but they allow us to formulate directions for further research.

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The mechanism of Cavitation in Solid, Liquid, Gaseous and Ether (electric shock)

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Based on the method of analogies and an interdisciplinary approach, the hypothesis developed by the author in geomechanics for the mechanism of sudden emission of coal, rock and gas is proposed to be extended as a single mechanism for the following phenomena: cavitation (sonoluminescence) with negative water impact (with discontinuity); the mechanism of shock waves formation around the aircraft when crossing the sound barrier; as well as the mechanism of formation Nikola Tesla's shock waves on the ether.

Why are LENR phenomena observed in hydrides of nickel, palladium and titanium? Where do protons and deuterons come from in metal hydrides?

And what is the essence of low-energy nuclear interaction?

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"Caution! Reading may cause development of alternative points of view."

An attempt was made to draw the attention of researchers of low-energy nuclear reactions (LENR) to the fact that the prerequisite for the observed LENR phenomena in transition metal hydrides is the fact of metallic bonding in the hydrides of these metals. It was shown that hydrogen in hydrides of various chemical elements can have different types of chemical bonds: ionic, metallic and covalent. The mechanism of hydrogen absorption by chemical elements is described. It is noted that it is in hydrides with metallic bonding (NiH_2 , TiH_2 , PdH_2 , ZrH_2), in which LENR phenomena are observed, that conditions for nuclear reactions are formed due to the ability of the metal lattice to collect valence electrons. This is known to be the reason for the electrical conductivity of metals. Accordingly, just as in metals, in hydrides with metallic bonding, both the valence shell of lattice atoms and the valence electron shell of hydrogen are "dissolved". But if the atoms of the metal lattice, having lost valence electrons, retain their atomic structure due to the remaining electrons, then hydrogen has one electron shell, which is also the valence shell. "Dissolution" of this shell transforms the hydrogen atom into a proton, or deuterium into a deuteron. And inside the crystal lattice, proton (deuteron) gas appears as a reagent of the nuclear reaction of proton-proton (deuteron-deuteron) interaction. Attention is drawn to the results of studies by Chinese scientists on the dependence of the electrical conductivity of hydride on the degree of hydrogenation of zirconium, a transition metal. The formation of proton gas in hydride, and as a consequence, a sharp drop in the specific electrical resistance of hydride due to the appearance of new charge carriers, has a threshold value (Hydrogen concentration $\text{H}/\text{Me} \geq 1.6$). The result obtained for zirconium should be further studied for other transition metals. This fact can clarify the degree of reproducibility for many LENR experimenters.

Introduction

An analysis of the difficult path of cold fusion advancement has revealed a number of points that I would like to highlight in order to help LENR proponents gain a deeper understanding of the proposed approach to explaining the nature of low-energy

nuclear reactions, and to help opponents and undecided people break the stereotype of perception of the new physical phenomenon. Indeed, let us ask ourselves, why do the LENR phenomena observed in recent years occur in nickel, palladium or titanium lattices? Why did the Italian inventor Rossi choose nickel powder, Fleischmann and Pons conducted experiments with palladium electrodes, and Khrishanovich with titanium, Mironov with zirconium? Why does Mills use silver melt in his SunCells installation?

In addition, articles and statements by a number of scientists continue to be published, claiming that excess heat in experiments with nickel-hydrogen lattices is the result of chemical reactions rather than nuclear ones. That is, the authors of these articles do not see the conditions for nuclear reactions in nickel-hydrogen and palladium-deuterium lattices.

. **Let's try to figure it out.** Let's put aside for now the excess specific heat generation observed in LENR phenomena, which is many orders of magnitude higher than the possible heat generation in chemical reactions, and the discovery of new synthesized elements and isotopes in the reaction products. Let's approach the issue from a different angle. Since LENR proponents claim that nuclear reactions occur in their metal hydrides, let's see: are there reagents of nuclear reactions in metal hydrides, that is, nucleons and nuclei, in which hydrides, and what are the conditions for the appearance of protons (deuterons) in metal lattices? After all, nuclear reactions between atoms are hindered by the electron shell, which causes not nuclear, but chemical reactions. To begin with, let's focus on the following fundamental questions, which will facilitate the perception of the above:

Question one: if the world around us is a world of chemical interactions, and nuclear interactions under normal terrestrial conditions are forbidden by the Coulomb barrier, then where can protons or deuterons and nuclear reactions come from in the lattice of nickel or palladium hydrides under terrestrial conditions? **Question two:** why in the observed LENR phenomena, starting from Fleischmann and Pons, discovered 35 years ago, and up to the modern Rossi-Parkhomov, do we talk about reactions in the crystal lattices of metals, be it electrolysis or reactions in nickel-hydrogen (deuterium) systems? What role do metal crystal lattices play in these processes? **Although, we should immediately note that the phenomena in nickel-hydrogen or palladium-hydrogen systems are far from exhausting the diversity of cold nuclear fusion reactions in the world around us. NENR are global in nature,** they occur in the depths of the Earth, in the atmosphere, cosmic bodies and living things.

organisms.

In publications attempting to explain LENR phenomena, there is no certainty as to what happens to hydrogen and its isotopes in metal lattices when these metals are hydrogenated, that is, why we observe LENR phenomena.

namely in metal hydrides. Some authors talk about hydrogen and deuterium atoms, others about hydrogen or deuterium (obviously, about molecular), constructing complex schemes of interaction of their electron shells with nuclei and with atoms of the crystal lattice, others construct long nuclear macromolecules, someone talks about hydrogen ions, less often about protons or deuterons, as if about something self-evident. The most acceptable models explaining nuclear reactions in LENR phenomena are considered today to be those that, giving an explanation of what is

happening, adjust it to the prevailing Standard Model. Well, a proton cannot merge with another proton by non-force means, because this has been written about in a physics textbook since the 19th century, and this is sacred, and is not subject to doubt. Since, according to the Standard Model, non-kinetic fusion of protons is impossible, and the phenomena are observed, exchange processes in nuclear reactions through neutrons or intermediate mesons are invented. A neutron, as is known, can penetrate a nucleus, turn into a proton, and this is allowed. Then everything depends on the author's imagination. For this, for example, a multi-pass scheme is invented with heavy electrons, ultra-cold neutrons, which are captured by the nuclei of the lattice and there again turn into protons, for example, in the Widom-Larsen models, or hydrinos in the Mills models, ersons in the Bazhutov model, and so on.

In general, anything except proton-proton interaction. Because, within the framework of existing concepts of modern physics, this cannot be. A separate question for the authors of these models: where do free neutrons in nickel-hydrogen systems come from? Apparently, when creating such models of nuclear reactions involving neutrons, the authors do not think about this. Let me remind you that it is extremely difficult to detect free neutrons on Earth. Free neutrons are obtained in large quantities in a nuclear fission chain reaction in a nuclear reactor. In our case, there are none. There are also special

sources of free neutrons. But we don't have them either. A free neutron is beta-radioactive with a half-life of about 10 minutes, which corresponds to a characteristic lifetime of about 15 minutes. As for ultracold neutrons, they are obtained by isolating the slow component of the Maxwell spectrum of thermal neutrons, again, coming out of the moderator of a nuclear reactor. The question is: where can free neutrons appear in nickel-hydrogen and palladium-deuterium systems? After all, as is known, beta-radioactivity has not been detected in LENR phenomena.

What all the models have in common is that they all deny non-kinetic proton-proton interactions. They all try to explain LENR phenomena only on the basis of currently existing scientific concepts in nuclear physics. And there is nothing surprising about this. Since LENR phenomena

there is, that is, there is a need to somehow explain them. The easiest way to do this is from 247

existing ideas about the world order, everything else is heresy.... It turns out to be a vicious circle. LENR phenomena are observed. This is a new type of nuclear reactions. And they are trying to explain it with the help of knowledge and existing ideas about classical nuclear reactions. And, naturally, not a single explanation is perceived by the research community as adequate.

In fact, it is impossible to explain LENR phenomena using existing Ether-denying concepts derived from mainstream science. paradigms, it is impossible.

Actually, attempts to explain the nature of LENR at least somehow are normal, because this is the path that all new discoveries and patterns in science usually take. The diversity of attempts to explain new effects brings us closer to understanding the truth. The questions posed in the title of the report,

have long been well studied in electrochemistry, but for some reason have not attracted the attention of researchers. At least, no conclusions have been made that one of the types of chemical bonds in metal hydrides determines the possibility of nuclear reactions. We will turn to electrochemistry.

1. Classification of hydrides in domestic and foreign electrochemistry

Table 1. Classification of hydrides in domestic electrochemistry. [1]

Периоды	КЛАССИФИКАЦИЯ								ГИДРИДОВ									
	ІА	ІІА	ІІІВ	ІVІВ	ІVІІ	ІVІІІ	ІVІІІІ	ІІІІІІ	ЭЛЕМЕНТОВ									
І	Н								ІІА	ІІІ	ІІІІ	ІІІІІ	ІІІІІІ	ІІІІІІІ	ІІІІІІІІ	ІІІІІІІІІ	ІІІІІІІІІІ	ІІІІІІІІІІІ
ІІ	Li ³	Be ⁴							B ⁵	C ⁶	N ⁷	O ⁸	F ⁹	He ²				
ІІІ	Na ¹¹	Mg ¹²							Al ¹³	Si ¹⁴	P ¹⁵	S ¹⁶	Cl ¹⁷	Ar ¹⁸				
ІІІІ	K ¹⁹	Ca ²⁰	Sc ²¹	Ti ²²	V ²³	Cr ²⁴	Mn ²⁵	Fe ²⁶	Co ²⁷	Ni ²⁸	Cu ²⁹	Zn ³⁰	Ga ³¹	Ge ³²	As ³³	Se ³⁴	Br ³⁵	Kr ³⁶
ІІІІІ	Rb ³⁷	Sr ³⁸	Y ³⁹	Zr ⁴⁰	Nb ⁴¹	Mo ⁴²	Tc ⁴³	Ru ⁴⁴	Rh ⁴⁵	Pd ⁴⁶	Ag ⁴⁷	Cd ⁴⁸	In ⁴⁹	Sn ⁵⁰	Sb ⁵¹	Te ⁵²	I ⁵³	Xe ⁵⁴
ІІІІІІ	Cs ⁵⁵	Ba ⁵⁶	La ⁵⁷ *	Hf ⁷²	Ta ⁷³	W ⁷⁴	Re ⁷⁵	Os ⁷⁶	Ir ⁷⁷	Pt ⁷⁸	Au ⁷⁹	Hg ⁸⁰	Tl ⁸¹	Pb ⁸²	Bi ⁸³	Po ⁸⁴	At ⁸⁵	Rn ⁸⁶
ІІІІІІІ	Fr ⁸⁷	Ra ⁸⁸	Ac ⁸⁹ **	ГИДРИДЫ ПЕРЕХОДНЫХ МЕТАЛЛОВ										ГИДРИДЫ ПЕРЕХОДНЫХ МЕТАЛЛОВ				
Ионные гидриды			Ce ⁵⁸	Pr ⁵⁹	Nd ⁶⁰	Pm ⁶¹	Sm ⁶²	ПРОМЕЖУТОЧНЫЕ ГИДРИДЫ					КОВАЛЕНТНЫЕ ГИДРИДЫ					
Лантаноиды								Eu ⁶³	Gd ⁶⁴	Tb ⁶⁵	Dy ⁶⁶	Ho ⁶⁷	Er ⁶⁸	Tu ⁶⁹	Yb ⁷⁰	Lu ⁷¹		
Актиноиды			Th ⁹⁰	Pa ⁹¹	U ⁹²	Np ⁹³	Pu ⁹⁴	Am ⁹⁵	Cm ⁹⁶	Bk ⁹⁷	Cf ⁹⁸	Es ⁹⁹	Fm ¹⁰⁰	Md ¹⁰¹				

Let's consider how hydrides are classified in domestic electrochemistry depending on the type of chemical bond of hydrogen with the lattice of a chemical element. To understand what happens to hydrogen in metal hydrides, let's briefly consider the properties of these compounds, using **Table 1** for clarity.

If we refer to **Table 1**, we can see that the type of hydrogen bond in the hydride crystal lattice changes in the periodic table from left to right depending on which group (subgroup) of the periodic table it belongs to.

element. Hydrogen forms compounds with metals with different types of bonds. Hydrogen compounds with alkali and alkaline earth metals can be considered as chemical compounds of the ionic type, where hydrogen plays a role similar to chlorine in the compound NaCl. To characterize hydrogen compounds with transition metals, we can talk about metallic bonding, use the concept of interstitial solutions, where small hydrogen atoms of the crystalline void in the lattice. Hydrogen compounds with rare earth metals and elements of groups 4-8 of the Periodic Table have a covalent bond.

occupy	V	metal. —
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In the English-language literature on electrochemistry, the classification of hydrides is similar, but differs somewhat from the domestic one in that the classification of hydrides in it is carried out immediately according to the type of chemical bond hydrogen - chemical element. And a number of metals, those that are classified in the Russian table as transition metals, in the English-language one belong to the hydride gap, for example, platinum, iron and manganese or to intermediate hydrides. [2]

Table 2. Elemental types of hydrides Periodic table [2]

Covalent Hydride																	
Metallic Hydride																	
Intermediate Hydride																	
Ionic Hydride																	
Hydride Gap																	
Li	Be																
Na	Mg																
K	Ca																
Rb	Sr																
Cs	Ba																
Fr	Ra																
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb				
Ac	Th	Pa	U	Np	Pu	Am											
H																	He
B	C	N	O	F													Ne
Al	Si	P	S	Cl													Ar
Ga	Ge	As	Se	Br													Kr
In	Sn	Sb	Te	I													Xe
Tl	Pb	Bi	Po	At													Rn

Ionic or salt-like hydrides: Molten LiH conducts electricity and hydrogen gas is evolved at the anode, confirming the presence of the hydride ion H^- . The crystal structures show an ionic lattice rather than the molecular lattice of LiH. **Covalent hydrides** are formed by p-elements. **Metallic or interstitial hydrides** are formed by many d- and f-block elements when heated with hydrogen under pressure. Hydrides, as have variable composition, are generally non-stoichiometric and may exhibit hydride gaps where elements do not form hydrides. This roughly corresponds to the hydrophilic elements of the periodic table.

The **intermediate hydrides** do not include: polymeric beryllium hydride, $(\text{BeH}_2)_n$. Other intermediate hydrides have properties between metallic and covalent.

Table 3. . [8]



2. The mechanism of hydrogen absorption by the metal lattice.

A thorough presentation of this mechanism in this paper seems to us to be an additional and necessary condition for a clear understanding of the processes occurring in nickel-hydrogen lattices, despite the fact that for many LENR researchers it seems simple and obvious. Almost all metals are capable of reacting with hydrogen. Metals are capable of dissolving hundreds and even thousands of volumes of hydrogen in one of

their volumes. Chemical interaction between hydrogen and metals leads to the formation of qualitatively new compounds - hydrides - with a new type of lattice, in which hydrogen has a chemical bond [4]. Note that the diffusion coefficients of hydrogen in solid metals differ little from the diffusion coefficients in liquids. This is due to the small atomic volume of hydrogen and the dissociation of the hydrogen molecule into individual atoms when entering the metal.

The hydrogenation process proceeds as follows. The process of physical adsorption of hydrogen occurs on the metal surface. As the temperature increases, physical adsorption decreases, and as the pressure increases, it increases, approaching the value corresponding to a monomolecular layer of gas. As the temperature increases, activated adsorption occurs on metals that can form chemical compounds with hydrogen. Activated adsorption occurs in hydrogen systems with copper, iron, and nickel. Activated adsorption is the result of the dissociation of hydrogen molecules into atoms that bind to metal atoms on its surface. The heat of activated adsorption is significantly higher than physical adsorption and is in kJ/mol: for copper 40-73 at +25° C, for nickel 52-120 at 0° C, for iron 43 in the range from - +96 to +78° C and for platinum 40-120 at 0° C. The amount of hydrogen absorbed during activated adsorption by metal powders can reach 10-1000

cm³ per 100 g. The heat of diffusion of hydrogen in various metals has approximately the same order of magnitude and ranges from 80 to 240 kJ/mol, with the exception of palladium, for which it is about 35–37 kJ/mol.

Due to activated absorption, **hydrogen diffuses through metals in an atomic** rather than molecular state. A number of authors believe that hydrogen diffuses in a number of metals in an ionized state in the form of a proton. We will clarify this a little further. Diffusion has measurable values at temperatures where activated adsorption phenomena are observed. (2) Therefore, it can be said that activated adsorption and the intense forces of chemical interaction between hydrogen atoms and surface metal atoms that arise in this case are a necessary preliminary stage of hydrogen diffusion in metals.

All metals have the ability to absorb hydrogen. The amount of hydrogen absorbed and the nature of the hydrogen bond with the metal vary significantly for different groups of metals. For metals such as iron, nickel, cobalt, silver, copper, aluminum, and platinum, the term hydrogen dissolution or **occlusion** in the metal is often used. (With **occlusion**, gases are absorbed not by the surface layer, but by the entire volume of the absorber. In this sense, **occlusion**

similar to **absorption** - the dissolution of gases in liquids.)

SO, dissolution or occlusion, as has already been said, is necessarily preceded by the process of activated adsorption and dissociation of hydrogen molecules into atoms. The dependence of hydrogen occlusion by various metals on temperature is complex. In some metals, hydrogen solubility increases with increasing temperature, while in others it decreases.

For a number of metals (manganese, molybdenum) extreme points are observed on the curve of hydrogen solubility from temperature. Therefore, it can be assumed that the sign the temperature coefficient of solubility in a particular metal depends on a certain temperature range. The process of hydrogen occlusion for the metals in question is completely reversible. [3]

3. The mechanism of formation of proton gas in metal hydrides.

As is known, the electron conductivity of metals is determined by the mechanism of socialization of valence electrons of the atoms of the crystal lattice, passing into the conductivity zone. Now let us consider what happens to the atoms of metal and hydrogen in the hydrides with metallic bonds that interest us (**NiH₂, TiH₂, PdH₂, ZrH₂**), in which LENR phenomena are observed. **Firstly**, the outer electron shell of the atoms of the metal lattice passes into the conductivity zone, due to which, in fact, the electron conductivity of metals is ensured. **Secondly**, in strong interatomic fields of the crystal lattice of transition metal hydrides, the electron shell of the hydrogen atom also "dissolves" and passes into the conductivity zone. But if the atoms of the crystal lattice of metals, having lost the valence electrons of the outer shell, structurally remain atoms due to the remaining internal electron shells, then the hydrogen atom, or its isotopes, has one electron shell, which is also the valence one. After the transition of the electron shell of the hydrogen atom to the conduction zone, it ceases to exist structurally as an atom. And turns into a proton. That is, in the process

hydrogenation we obtained reagents of nuclear reactions in the metal lattice of transition metals! Well, and if there are reagents of nuclear reactions, then nuclear reactions are also possible!

4. Experimental data on the formation of proton gas in hydrides transition metals.

The interaction of hydrogen with metal occurs according to the following scheme: adsorption on the surface – dissolution in the volume of the metal (occlusion) – chemical interaction (formation of hydrides). Adsorption and occlusion are purely physical processes: adsorption causes the dissociation of hydrogen molecules into atoms, during the occlusion process, hydrogen gives up an electron to the conduction zone of the metal and is present in its volume as a **proton gas**.

1) Experimental confirmation of the reality of this mechanism is that

When an electric current is passed through palladium hydride, hydrogen moves to cathode.

2) The study of NMR spectra of metal hydrides provides information on the diffusion of hydrogen in hydrides, as well as on the crystal and electronic structure of hydrides.

[6]. Orioni et al. [7], when studying the NMR spectra of vanadium hydride with the composition **V/H = 0.66**, revealed an extremely small value of the shift of resonance maxima for hydrogen atoms, which indicated a low density of unpaired s-electrons. This may serve as evidence that in metal hydrides

Hydrogen is present in the form of protons.

3) Another experimental confirmation of the description of the processes occurring in the crystal lattice of transition metals during their hydrogenation can be found in the work of the Chinese researcher Tang Qichen (Tomsk Polytechnic University) on the study of the electrical conductivity of zirconium hydride (a transition metal) during its hydrogenation. [5]

Since, according to the presented concept, during the hydrogenation of transition metals, due to hydrogen ions and its electrons, the number of charge carriers in the crystal lattice of the metal increases, then, consequently, during the hydrogenation of the metal, its specific electrical resistance should fall. Above, a reference was given to the work of Orioni from the book "The study of the NMR spectra of metal hydrides provides information on the diffusion of hydrogen in hydrides, as well as on the crystal and electronic structure of hydrides. [6] Orioni et al. [7]: ... when studying the NMR spectra of vanadium hydride of composition V/H = 0.66, they revealed an extremely small value of the shift of the resonance maxima for hydrogen atoms, which indicated a low density of unpaired s-electrons. This

can serve as evidence that in metal hydrides hydrogen is present in the form of protons. . "Let's write the degree of hydrogenation of vanadium otherwise H/V = 1.55. Let's remember this number for now.

5. Experimental data on the dependence of the specific electrical resistance of the hydride on the degree of hydrogen saturation.

Another experimental confirmation of the description of the processes occurring in the crystal lattice of transition metals during their hydrogenation can be the work of the Chinese researcher Tang Qichen (**Tomsk Polytechnic University**) on the study of the electrical conductivity of zirconium hydride (a transition metal) during its hydrogenation.[5] Since, according to the presented concept, during the hydrogenation of transition metals, due to hydrogen ions and its electrons, the number of charge carriers in the crystal lattice of the metal increases, then, consequently, during the hydrogenation of the metal, its specific electrical resistance should fall.

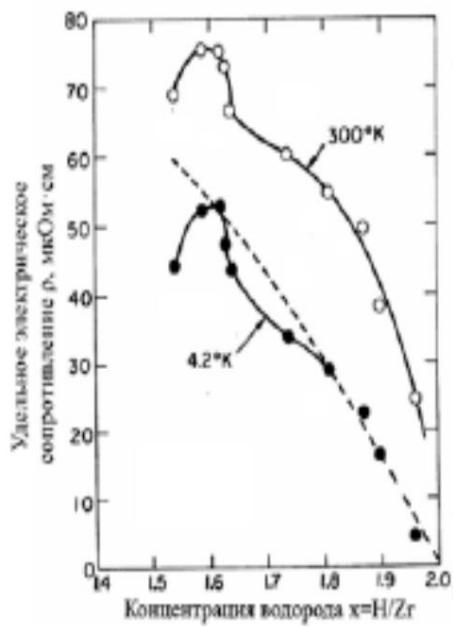


Fig. 1 shows graphs of the change in the specific resistance of zirconium hydride during hydrogenation, which show that during the hydrogenation of zirconium, the resistance of zirconium hydride drops sharply by almost half. Moreover, the dependence has a clearly nonlinear character, which manifests itself at a certain concentration of hydrogen in the transition metal.

Fig. 1. Specific electrical resistance of zirconium at 4.2 and 300 K

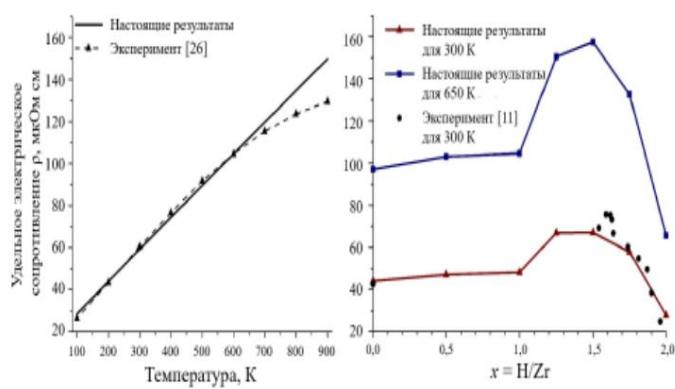


Fig. 2. Dependence of the specific electrical resistance of pure zirconium on temperature (left) and dependence of the specific electrical resistance of zirconium on the concentration of hydrogen in it (right).

from

As can be seen from these graphs, when transition metals, in this case zirconium, are hydrogenated, the hydrogen atom-proton

equilibrium inside the metal lattice is initially shifted toward the atoms, and the specific resistance of the hydride increases, which indicates a decrease in the charge carriers in the hydride, both positive and possibly negative. But as the amount of hydrogen in the lattice increases, it drops sharply. And the equilibrium shifts toward hydrogen ions, protons, as evidenced by the sharply falling specific electrical resistance of the hydride, starting from a certain value.

There appears

proton gas in a crystal lattice. Then the question is only about initiating the nuclear reaction CN.

It is worth paying attention to the results of these studies. It makes sense to think about the fact that the reproducibility of experiments on CN in many experimenters could be a consequence of a misunderstanding of the patterns and mechanism of hydrogenation of transition metal hydrides.

The dependence of the conductivity of hydrides on the degree of hydrogenation, i.e. the formation of proton gas inside the hydride only upon reaching a certain threshold (in these studies approximately H/Me = 1.6) has not been studied by anyone. For other transition metals, the threshold value will most likely have a different value. (See the Orioni NMR studies with vanadium above. V/H = 0.66 or H/V = 1.55)

Yes, it is not palladium, nickel or titanium, which most experimenters worked with, but in light of the above, zirconium belongs to the same group of transition metals that form a metallic bond in hydrides. And if we extrapolate the results of the Chinese studies to other transition metal hydrides, then this can explain many experiments. Naturally, experiments are needed to study the dependence of conductivity

of the transition metal hydrides used on the degree of hydrogenation, plotting graphs and identifying patterns. Experiments are also needed to study the electrical conductivity of hydrides on hydrogen pressure. At the initial stage, Andrea Rossi reported using pressures of up to 30 atmospheres in his first generators when hydrogenating. It is clear that Rossi is quite a fruit, but it would not hurt to check, since this does not diverge from common sense.

Thus, as a result of hydrogenation in the crystal lattices of transition metals, due to their physical properties, the appearance of proton gas is observed, and the possibility of the observed LENR phenomena arises.

low-energy nuclear reactions between protons or their isotopes. It is the structure and properties of the crystal lattices of metallic hydrides that largely determine the conditions for the occurrence of low-energy nuclear reactions. The generally accepted ideas about the metallic bond in transition metals require some clarification.

I believe that additional research is needed to measure the specific electrical conductivity during hydrogenation of other transition metal hydrides, especially nickel, titanium, and palladium. There is still much that is unclear in this area. In particular, what forces are used to construct metal crystal lattices? Why do the same atoms in some cases form cubic lattices, and in others, hexagonal ones?

And the most interesting thing is that it would be nice to understand who is right: if physicists say that valence electrons in metals become socialized, and it is easy 254

are torn away from atoms, and chemists claim that all chemical bonds in the crystal lattice are realized only due to valence electrons? Additional research will allow meaningful experimental work on CN.

5. What is the difference between LENR and classical nuclear reactions?

To begin with, let us try to briefly outline the essence of low-energy nuclear reactions and their difference from classical nuclear reactions. In classical nuclear physics, it is customary to consider proton-proton interaction as a thermonuclear reaction within the proton-proton cycle occurring in the depths of stars. The condition for such interaction to overcome the Coulomb barrier must be high kinetic energy of protons, determined by a temperature of tens of millions of degrees and enormous pressure in the reaction zone. Andrea Rossi's merit is that he demonstrated the reality of proton-proton interaction under terrestrial conditions.

According to the classical view, if you do not have millions of degrees, then there can be no proton-proton interaction, and the reaction can only be thermonuclear.... Thus, in modern physics, the only, forceful, option for overcoming the Coulomb barrier dominates. On Earth, it is realized in the explosion of a thermonuclear bomb and in accelerators of elementary particles. From here, an erroneous conclusion was made that this artificial mechanism of nuclear interaction is universal and the only possible one for all nuclear interactions in nature.

The consequence of this approach is the idea of a controlled thermonuclear reaction, which must take place in extreme (close to stellar) conditions. Dozens of tokamaks, stellarators and other devices built over 70 years, billions of dollars spent on their creation, unfortunately, have not brought humanity closer to cheap energy. Isn't it time to admit that the idea of a force-controlled kinetic overcoming of the Coulomb barrier for practical application in industrial power-generating installations is unattainable due to its extreme conditions? Due to the unwillingness of official science to publicly acknowledge this, the thermonuclear problem, which has no solution in the foreseeable future, has today become a feeding trough.

Or maybe there are examples of proton-proton interactions in nature that do not require a huge kinetic energy of the interacting protons? As it turns out, there are a great many such phenomena. Over the past three decades, a huge amount of experimental material has been accumulated that testifies to the LENR phenomena. Opponents of LENR argue that such reactions are impossible due to the Coulomb barrier. In fact, the mathematical model of spherical particles used in our ideas is inadequate to nature. A proton is not a ball; the charge field of a proton is anisotropic. LENR reactions are potentially orientational, unlike kinetic thermonuclear reactions. The diversity of crystal lattices is due to the structure of nuclei, and not electron shells. (cubic, hexagonal, face-centered, rhombic, etc.)

further) And for proton-proton interaction it is not necessary for them to collide at enormous speeds in order to overcome the Coulomb barrier. These phenomena

are called "low-energy (low-threshold) nuclear reactions."

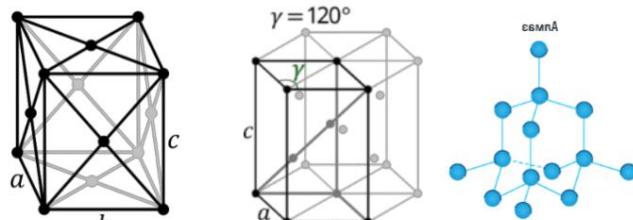


Fig. 3. Types of crystal lattices.

Conclusions

In **Table 1** considered by us in ionic hydrides to the left of transition metal hydrides, and to the right of them in intermediate and covalent hydrides, hydrogen in the metal lattice retains its atomic structure, and, accordingly, the electron shell, which determines chemical bonds with the atoms of the crystal lattice. In transition metal hydrides (metal hydrides), the hydrogen atom, as well as the lattice atoms, loses its valence electron shell and turns into a proton. The formation of proton gas has a threshold value during hydrogenation of the metal, and this must be taken into account when conducting experiments. Thus, in transition metal hydrides (metal hydrides), nature has created a unique environment containing reagents and prerequisites for cold nuclear fusion reactions. After which the mechanism of further transformations of nuclides begins to operate. Based on the mechanism of proton-proton interaction described in this article, it can be assumed that LENR phenomena can also be observed in the lattices of other transition metal hydrides. As confirmation, we can cite the expansion of the list of hydrides used from Pd hydrides by Fleischmann and Pons, Ni by Rossi, Ti by Khrishchanovich, Zr by Mironov, Ag (intermediate hydride) by Mills.

All of the listed metals have in common that they form metallic bonded hydrides with hydrogen and their hydrides are classified in the hydride table as transition metal hydrides that can be used in LENR.

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Why are LENR phenomena observed in nominal nickel, palladium and titanium hydrides? Proton and neutron emissions into metal hydrides? And what is the purpose of low-energy nuclear interaction?

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The article was made an attempt to draw the attention of researchers of low-energy nuclear reactions (LENR) to the fact that the background of the observed LENR phenomena in transition metal hydrides is the fact of the metallic bond in the hydrides of these metals. It is shown that hydrogen in hydrides of various chemical elements can have different types of chemical bonds: ionic, metallic and covalent. Described the mechanism of absorption by chemical elements of hydrogen. It is noted that it is in hydrides with a metal bond (NiH_2 , TiH_2 , PdH_2 , ZrH_2), in which phenomena of the Cold Fusion are observed, forming conditions for the occurrence of nuclear reactions due to the ability of a metal lattice to collectivize valence electrons. As is well known, this is the electrical conductivity of metals.

Accordingly, as in metals, in hydrides with a metal bond, the "dissolution" of the valence shell of the lattice atoms and the valence electron shell of hydrogen occurs.

But if the atoms of the metal lattice, having lost valence electrons, retain their atomic structure at the expense of the remaining electrons, then the electron shell has one electron, and the same one is also valence.

The "dissolution" of this shell transforms the hydrogen atom into a proton or deuterium into a deuteron.

And inside the crystal lattice, a proton (deuteron) gas appears as a reagent of the nuclear reaction of proton-proton (deuteron-deuteron) interaction. The report draws attention to the results of studies by Chinese scientists on the dependence of the electrical conductivity of hydride on the degree of hydrogenation of zirconium, a transition metal. The formation of proton gas in hydride, and as a consequence, a sharp drop in the specific electrical resistance of hydride due to the appearance of new charge carriers, has a threshold value (Hydrogen concentration $\text{H}/\text{Me} \geq 1.6$). The result obtained for zirconium must be further studied for other transition metals. This fact can clarify the degree of reproducibility for many LENR experimenters.

BALL LIGHTNING

BALL LIGHTNING

Thermochemical luminous formation (Ball lightning)

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The paper describes experiments on obtaining long-lived luminous formations (LGF) using a capillary discharge acting on metal samples of aluminum, iron, copper, and solder. The LGFs obtained were up to 2 cm in size and had a lifetime of up to 7 s. The balls exploded, went out, and disintegrated. When they hit a cuvette with water, the shell separated and a ball of cooled vapor material fell into the water. The model of ball lightning (BL) that occurs when ball lightning strikes the soil, metal, and dielectric objects is discussed. The sequence of events is assumed to be as follows. When linear lightning (or a high-current discharge) strikes the evaporated material, a high-temperature region of vapor of this material appears, the temperature of which is in the range of (2-3) 103 K. An oxide shell is formed on the surface of this region when interacting with atmospheric oxygen, i.e. a spherical object is formed. In this case, its radius reaches several centimeters, and the thickness of the shell is from 40 to 100 μm . Such a shell can withstand the internal pressure of the gas - the thickness of the shell. So for a sphere with a radius of 20 cm and a shell thickness the mechanical stress will reach 2 103

$\sigma = \frac{P}{R}$, where R is the radius of the sphere, P

Due to

this, an explosion will occur. When an electric charge from a lightning discharge is transferred to this object, the ball becomes charged and has all the properties inherent to the observed BL.

Introduction

Luminous objects have been known in nature for a long time [1-3], they appear in various conditions such as volcanic eruptions, linear lightning strikes into the soil, in water conditions during geotectonic events and intense atmospheric conditions. Usually these are balls up to 50 cm in size, with a lifetime of up to several tens of seconds. Other properties that distinguish them from natural objects include high energy and the ability to die with an explosion. While many properties of CO are understood on the basis of existing models [1-5], a number of properties require the creation of new models. In this work, based on our experiments [6-7], we chose a model in which CO is a charged sphere with a shell of atoms of the composition of the soil, metals, and/or water, with an internal volume filled with a gaseous or vaporous substance.

Such shells can be formed in electrical devices at high overvoltages in a high-voltage circuit in capillary and erosive discharges, as well as when lightning strikes the ground containing SiO₂ and Al₂O₃ and metal objects; they are realized in experiments with capillary discharges, when a high-temperature [6-7] plasma jet interacts with metal samples, forming luminous spheres with a shell and a gaseous core.

1. Capillary plasma torch

To conduct experiments on the creation of CO, a capillary plasma torch is used; we will dwell on its description, the same as in [1] [6-7].

The capillary plasma torch is the most well-known type of plasma torch for producing long-lived plasma and CO [1-3]. The basic diagram of this plasma torch is presented in [6]. It is a circuit that includes an initiating capacitor, a switch, a capacitor bank, and a discharge device, which includes flat electrodes separated by a dielectric with a capillary (Fig. 1).

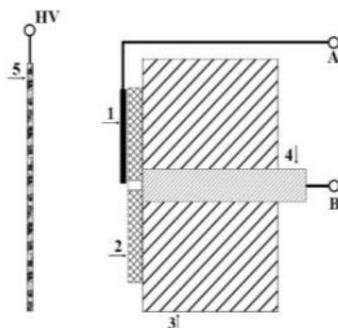


Fig. 1. Capillary plasma torch. 1,4 – electrodes, 2 – dielectric plate with capillary (discharge chamber), 3 – plasma torch base (dielectric), 5 – metal sample (target)

A wire of the material under study or a thin metal cylindrical plate under positive or negative potential or without voltage was placed on the jet path. The foil material was: steel, aluminum, tin, solder, copper. Table 1 shows typical parameters of a capillary plasma torch: capacity of the capacitor bank, energy deposited in the discharge, maximum current value, maximum voltage value, discharge action time.

Table 1.

Capacity, μF	Energy put into discharge, J	I_{\max}, A	U_{\max}, V	t, ms
13070	1176	72.3	172	15.4
16360	1472	72.3	192	25.3

With an increase in the energy input into the discharge, the current and voltage on the discharge increase, as does its duration. In this case, about 5-7% of the initially input energy is consumed in the discharge.

To obtain a discharge, a capillary made of PLA, i.e. polylactide with a diameter of 2 mm and a length of 4.5 mm, is often used. The discharge itself was carried out by directly applying voltage from charged containers to the plasmatron electrodes. The discharge current pulse has a triangular shape, its duration is $\sim 7\text{-}25$ ms.

Previously, temperature measurements and electron concentration distribution in a plasma jet created by an erosion plasma torch using a capillary made of organic glass were given in [5]. We will use these data for estimates. From the experiments it followed that the electron (ion) concentration changes along the discharge axis in the range of $10^{16}\text{-}10^{18} \text{ cm}^{-3}$

, and in the radial direction within $10^{15}\text{-}10^{17} \text{ cm}^{-3}$. In this case, the axial temperature distribution in

The plasma jet temperature was 5000-6000 K over a height of about 8-9 cm and the radial temperature distribution was 4000-6000 K over a radius of about 6 mm.

2. Obtaining CO with increased energy input into the jet.

The solder POS 61 (diameter 1.5) was used as the object of study. mm, the composition of which is: Sn - 59-61%, Pb - 39-41%), steel, tin, aluminum and copper. The metal plates were either under a potential of ± 13 kV or without voltage. The potential value did not allow charging the plates above 10-9 C (estimated on the basis of the charged disk model [8], since a breakdown of air occurred between the plate and the plasma torch.

Table 1 shows the parameters of the capillary plasma torch (see above). The results show that with an increase in the energy input into the discharge, the discharge current increases, as does its duration. The voltage did not change, the capacitors were charged to approximately the same voltage each time. The current depends on the discharge resistance and the discharge level of the capacitor bank. The main increase in power occurred due to the duration, since we increased the capacity to increase the power. The discharge time also increased proportionally. In this case, about 5-7% of the initially input energy is spent in the discharge.

Observation of ISH at high input energy

Fig. 8 shows a sequence of frames of CO emission from a lead plate. In all the photographs presented below, the highest available energy was used, put into the discharge, approximately 1.5 kJ. Some of the luminous objects exploded in the air.

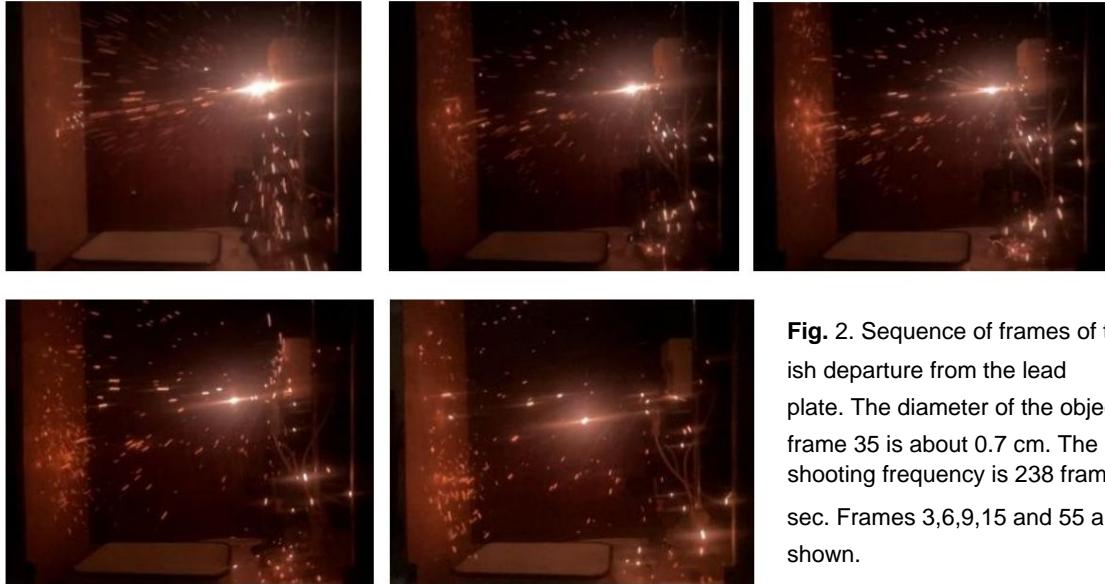


Fig. 2. Sequence of frames of the ISH departure from the lead plate. The diameter of the object in frame 35 is about 0.7 cm. The shooting frequency is 238 frames/sec. Frames 3,6,9,15 and 55 are shown.

The video film can be used to determine the lifetime from birth to destruction of the ISH, it is 2 s (the longest-lived CO in the photo has a lifetime of about 2 s). (The photos correspond to part of the life of the CO). Some of these CO exploded when falling on the surface of a table or paper, dividing into CO of smaller sizes. In 261

as a result of which they left traces on the paper, as shown in Fig. 3 below. These photographs are similar to those we presented in [6], i.e. the objects obtained also contained gas under the shell.



Fig. 3. Trace of CO explosion

In all the experiments conducted, the motion of the CO can be described as follows. Upon the next contact jumped to a with the surface, the CO certain height of about several centimeters, then fell again and jumped again. Such motion was observed for

their entire life, with the amplitude of each subsequent jump decreasing and the length increasing. In experiments with tin, aluminum, and solder, when a glowing ball fell into

a cuvette with water, a ball fell out of the object, and a translucent shell up to 100 μm thick was observed on the surface of the liquid. In experiments with a copper plate, no shells were observed.

In another series of experiments with tin (see Fig. 4), the dropped ball first decreased to 1 cm, and then began to grow. This continued for 4 frames, when it grew to 2 cm, and then began to slowly decrease, from 1 cm it decreased to 0.5 cm in 3 s.



Fig. 4. Videogram of the change in the diameter of the CO

It can be assumed that during this time oxygen from the air entered the ball through small holes in the surface and intensified the oxidation process inside the ball. Since oxidation processes are exothermic, additional heating of CO occurs.

The nature of explosions

Consideration of the situation with explosions and complex behavior of luminous spheres requires analysis. Let us consider the formation of a sphere when a jet impacts an Al sample. In the experiment, the transformation of CO with a visible sphere size of 1 cm into a cubic particle with a side of 2 mm was observed when the ball hit a dielectric film. Its volume was equal to $8.0 \cdot 10^{-9} \text{ m}^3$

. Let us take into account that the temperatures in the region of formation of spheres are lower than the temperature of the jet, i.e. lower than 5000 - 6000 K. In this case, the boiling temperature of Al is 2793 K, when no plasma processes occur inside the shell, since plasma processes in the air develop at a temperature above 5000 K [8]. Therefore, we write the equation of state for Al vapor in the region inside the shell, where m is

the mass of the sphere material (the substance of the atoms), $R = 8.3 \cdot 10^{-3}$

$$P_a V_{\text{term}} = \frac{\% m R T}{\ddot{y}}$$

J/(kmol) is the universal gas constant, T is the boiling point of the material inside the sphere, and is its atomic weight. \ddot{y} - Al=26, 98. From it we will determine the pressure inside the sphere. For the estimates we took the density of liquid Al $\ddot{y}=2.4 \cdot 10^3 \text{ kg/m}^3$, those. the mass of the particle was $m=1.9 \cdot 10^{-5} \text{ kg}$. Then the pressure inside the ball is $P=3 \cdot 10^7 \text{ Pa}$. Consequently, the spheres are in a state of stress.

If we take into account that for the mechanically stressed state of the surface of the spheres the relation [9-11] is fulfilled

$$\ddot{y} = \frac{PR}{2 \ddot{a}}, \text{ where } R \text{ is the radius of the sphere, } \ddot{y} \text{ - thickness}$$

shell, then the presence of a solid shell 100 microns thick can increase the stress on the surface of the sphere by 25 times. That is, the presence of the shell leads to a significant increase in the probability of destruction of the sphere during its cooling. This is the reason for the observed explosions of spheres - ball lightning. Below it is shown that the pressure in ball lightning can reach several thousand atmospheres, i.e. the explosion in this case will be extremely strong. The presence of a solid thin shell determines the sphericity of ball lightning and answers the main question about the reason for the sphericity of ball lightning.

The answer to the question of shell growth requires studying the process of oxidation of the jet surface by oxygen from the air. It is obvious that this oxidation is uneven, associated with turbulent diffusion of oxygen molecules. This issue has not been discussed in the literature and is beyond the scope of this article. Similar phenomena can occur during a short circuit in electrical devices. There, when energy is released, a

metal vapor in an oxide shell will be formed - which has the shape of a luminous ball. Such objects have often been observed during lightning discharges, when overvoltages occur in power lines.

Model CO.

According to the model, this object has a shell and a core, and can be charged. When a discharge strikes, which transfers a large amount of energy, part of which is spent on evaporating the substance with which it interacts, a vapor core and a shell of oxidized material are formed (lightning can transfer charges of the same sign). Then a charged object is formed, consisting of a shell and a core. For simplicity of analysis, we assume that the energy of the discharge (including lightning) is sufficient to transfer the core material into atoms of an ideal gas. The energy of such an object consists of thermal and electrostatic energies transferred from the discharge.

Energy of the object. Part of the energy CO, arising from the heating of the material during a lightning strike, is related to its parameters by an expression following from the Clapeyron-Mendeleev equation [13]

$$E_{term} = \frac{mR\bar{T}}{\bar{v}}, \quad (1)$$

where $R = 8.3 \cdot 10^3 \text{ J/(Kmol K)}$ – gas constant.

In the model we consider a unipolarly charged ball, for whose electrical energy [14] the following formula is known:

$$E_{el} = \frac{1}{8\pi\varepsilon_0} \frac{Q^2}{R^2}, \quad (2)$$

where Q is the charge of CO, R is the radius of the sphere without taking into account the shell thickness, $\varepsilon_0 = 8.85 \cdot 10^{-12} \text{ F/m}$ is the electric constant.

In this case, the internal energy of CO due to both excitation mechanisms is equal to

$$E_{term} = \frac{1}{8\pi\varepsilon_0} \frac{Q^2 m R T}{R^2}, \quad (3)$$

and the energy density at $R \gg \bar{v}$ equals 3

$$\frac{W_{el}}{V} = \frac{1}{(4\pi)^2 \bar{v}^2} \frac{Q^2 m R T}{R^2} = \frac{3}{4\pi R^2}, \quad (4)$$

where m is the mass of the material CO (substance of atoms), R is the universal gas constant, T is the temperature of the CO material, \bar{v} is the molecular weight of the dissociated molecules. In (4), is neglected compared to $R\bar{v}$. In this case, silicon is considered for estimates, the content of which in the earth's crust reaches 50%. In particular, in the model we assume that dissociation of SiO_2 occurs ($\text{Si} + \text{O}_2 = 28.09 + 32$), and the molecular weight

weight of the obtained particles $\bar{v}_p = 30$. The influence of temperature remains questionable

shell on the pressure inside the CO. The issue of a hot shell has not been studied in the literature known to the authors [10-12]. Let us consider the

formation of CO. In the experiments performed, a sphere appears with a clearly distinct core and shell [6-7] in both composition and appearance. This possibility was indicated by the results of experiments with the production of luminous spheres in experiments with the effect of plasma jets on solder, in which in

the shell contained oxide components that were absent in the core [6]. The existence of the shell is determined by nonequilibrium processes that occur when a discharge strikes a material, when nonequilibrium processes of shell formation lead to a change in its physical and chemical properties. The vapor consists of Si and O₂ particles, and the shell consists of a modified SiO₂ melt and its alloy with the components of the material, and in the case of lightning interaction with metals such as steel, tin, aluminum, solder, the vapor consists of atomic particles of the corresponding metal. For estimates, we will assume that the gas temperature inside the shell is close to 2000 K and is equal to the typical boiling point of SiO₂

Studies on flexible shells [10-12] show that, until the moment of loss of stability, compressive stresses occur in all normal sections of the shell.

voltage $q R$, the value of which is equal to:

$$\frac{q}{2} = \frac{P R}{2 h}, \text{ or } q = \frac{P R}{h}, \quad (5)$$

where q is the uniformly distributed transverse load from the side of the convexity, h is shell thickness, R is the radius of the sphere, where $P = 10^5 \text{ Pa}$ is the atmospheric pressure.

The expression for the Coulomb action of charges of the same sign on is known [14] surface of the sphere

$$F_{el} = \frac{1}{4\pi} \frac{Q^2}{R^2}, \quad (6)$$

where Q is the charge of the sphere. From this follows the expression for the Coulomb pressure of charges of the same sign acting on the shell

$$P_{el} = \frac{1}{4\pi} \frac{Q^2}{R^4} = \frac{Q^2}{4\pi R^4}, \quad (7)$$

We believe that it is the processes of atomization of matter, Coulomb repulsion and mechanical compression of the shell that lead to the establishment of pressure inside the sphere.

The pressure force of SiO₂ type particles inside the sphere is equal to

$$R_w = \frac{m}{3} \frac{RT}{R^3} = \frac{m}{3} \frac{RT}{R^3}, \quad (8)$$

and the voltage on the shell

$$q = PR_A / (2\pi R) = \frac{m}{4\pi} \frac{RT}{R^3} = \frac{m}{8\pi} \frac{RT}{(R)^2}, \quad (9)$$

From these expressions follows the equation for determining the balance of the acting forces 8.3 to the surface of the SM (where $R = 10 \text{ J/(Kmol K)}$ is the gas constant, T - the temperature of the gas particles inside

the SM). Table 2 presents the parameters of the charged ball depending on the magnitude of the charge and its radius for the size of the ball $R=0.1 \text{ m}$ and $R=0.2 \text{ m}$.

Table 2. Parameters of the charged ball

R, m	Q, C	10-6	10-5	10-4		10-3	10-2	10-1
0.1	P_{el} , Pa	28.6	286	103	2.86	105	2.86	107
0.1	W_{el} , J/m ³	21.5	2.15	103	2.15	105	2.15	107
0.2	P_{el} , Pa	1.79	1.79	102	1.79	1.79	1.79	1.79
0.2	W_{el} , J/m ³	1.34	1.34	102	1.34	104	1.34	106

It is evident from the table that the energy density of charged CO increases with the value of its charge, while the charge pressure on the shell increases. Already at $Q>10^{-4}$ C the charge pressure on the shell is comparable to atmospheric. In this case, an explosion is possible with an accidental breach of the shell. Table 2 shows the internal energy of CO depending on its weight at a vapor temperature of $T=2000$ K, with a shell thickness of $\ddot{y}=100$ μm and an average atomic weight of $\ddot{y}=30$ (as for dissociated SiO_2), with a CO size of $R=0.1$ m and $R=0.2$ m. We present the value of the voltage on the shell (9).

Table 3. Internal energy of CO depending on the weight of CO at $T=2000$ K, $\ddot{y}=30$. $\ddot{y}=100 \mu\text{m}$,

R m	M, kg	10-3	10-2	10-1	1	10
0.1	W_{term} J/m ³	1.32	105	1.32	106	
0.1	P_w Pa	1.32·105	1.32·106		1.32·107	1.32·108
0.1	\ddot{y} , Pa	6.6·107	6.6·108		6.6·109	6.6·1010
0.2	W_{term} J/m ³	1.65	104	1.65	105	
0.2	P_w , Pa	1.65·104	1.65·105		1.65·106	1.65·107
0.2	\ddot{y} , Pa	1.65·107	1.65·108		1.65·109	1.65·1010

*At $m=5.15·10^{-3}$ kg, the weight of CO is compared with the weight of the surrounding air.

From Table 3 it is evident that thermal energy increases with the growth of the weight of CO, and the mechanical stress on the surface of CO increases. With the mass of CO of the order of 10^{-5} kg, the stress on the shell exceeds the atmospheric pressure and CO can be destroyed by random fluctuations in CO parameters.

Since both the charge value and the mass value of the substance can influence the conditions of existence, the effect of these factors will be summed up. In this case, the total energy density can vary within wide limits and

reach values of 109 - 1010 J/m³, according to which is in agreement with some observations [5,15]. At Q>10⁻³ C, the charge pressure on the shell, and at m>10⁻⁵ kg, the pressure and tension are comparable to atmospheric, and the CO becomes unstable. High values of charges and masses, at which anomalous CO are observed, raise the question of the reality of such CO. CO with a mass of up to 10 kg fall into the energy density region of 108 -109 J/m³, which is not anomalous. High values of mass for CO of the order of 100 kg are difficult to imagine, although there are observations when a moving CO broke several trunks of thick trees [15]. CO with a charge of 10⁻² - 10⁻¹ C fall into the region of observations of energy density of 1010-

1011 J/m³. However, simple estimates show that the electrical voltage the fields on the surface of such CO are in the range of 108 -1010 V/m, which is difficult to explain, given the breakdown electric field strengths in air of the order of 3 106 V/m.

Electric field of highly charged CO

Estimates of the electric field strength near charged balls with the parameters of the observed high-energy CO raise the question of why the discharge to the ground is not realized. To answer this question, let us consider a charged ball in an electric field created by the ball's large proper charge. This electric field on the surface of the ball is large and is capable of ionizing the air.

From electrostatics [13] it is known that the electric field around a charged ball varies depending on the distance R from it, as

$$E \propto R^{-2}, \quad (10)$$

Where E_s , R - respectively - the electric field on the surface of the sphere and the distance

to the sphere, r is the radius of the sphere. The magnitude of the electric field E_s is related to the electric charge on the sphere Q and the radius of the sphere by the known relation $E_s = \frac{Q}{4\pi r^2}$ or

$$E_s = \frac{Q}{4\pi r^2} \quad (11)$$

In the process of charging an object with a discharge, a situation may occur when the initial electric field on the surface of the object is greater than the so-called breakdown field. As is known, in the breakdown field, the rate of ionization processes is compared with the rate of electron loss. In this case, the field on the sphere is related to the breakdown field E_{br} (in air $E_{br} \approx 2.8 \times 10^6$ V/m [16-17]) by the relation following from (10)

$$E_s = E_{br} r^{0.5}, \quad (12)$$

where r is the distance from the center of the sphere to the ionization boundary. A plasma layer is formed in the space around the charged sphere, which screens the electric field of the charged sphere.

At high values of electric field strength in air, as calculations have shown [16-17], plasma is formed, consisting mainly of NO+ ions and electrons; therefore, the electron concentration for estimates can be determined on the basis of a simplified equation

$$\frac{dn}{dt} = q n_i n_e - \frac{2}{e} \frac{dr}{dt}, \quad (13)$$

here t is time, q is the rate of formation of electron-ion pairs in the air due to

fast background particles, ionization n is the electron concentration, $\dot{\gamma}_i$ frequency E/N -

of air molecules by electrons in an electric field (its value depends on the parameter E/N , N is the concentration of gas particles) can be found in [16-18], is the coefficient of dissociative recombination cm / s of the gas temperature and electrons, respectively. electrons and molecular ions

$$\dot{\gamma}_i = 2 \cdot 10^7 T_{ge}^{0.5} T_{ie}^{-3}, \quad (14)$$

Note that we are considering the case of high values of the parameter E/N , when the role of negative ions can be neglected [17], therefore we do not present the term taking into account the attachment of electrons to oxygen molecules. Under conditions of quasi-neutral plasma, the electron concentrations

and, N_i is the concentration of positive ions. At . For example, as follows from [17], at $E=4$ MV/m positive ions are equal to $n N$

in this plasma layer EE br

($E/N=150 \text{ V/cm}^2$), typical time of increase of electron concentration to

$n_e: 10^2 \text{ cm}^{-3}$ is $t \approx 10^{-9} \text{ s}$ with and less.

Let us determine how the plasma affects the electric field in the layer $r rr$. According to

[13] The potential of a charged sphere in a plasma is determined by the expression

$$\frac{Q}{4\pi r^2 R} \exp(-R/r_D) \quad (14)$$

where $r_D = (r_0 + T_{ie} e / T_{ee})^{0.5}$ - Debye screening radius in case

two-component plasma, e is the electron charge, n is the plasma particle concentration

- temperatures of ions and electrons, respectively. At T_{ee} what is being done

at strong electric fields in the plasma, then

$$r_D = \text{absolute value of } T_{ee}^{0.5} \quad (15)$$

electric field, determined on the basis of expression (14) has the form

$$\frac{Q}{4\pi r_0^2 R^2} \exp(-R/r_D) \quad (16)$$

Calculations [17] show that for breakdown fields $N \approx 10^16 \text{ cm}^{-3}$, then the Debye radius

it turns out that $r_D \approx 1.2 \cdot 10^{-6} \text{ cm}$. Expression (16) is simplified and takes the form

$$\frac{Q}{4\pi r_0^2 R^2} \exp(-R/r_D) \quad (17)$$

Where

$$FR^2 \exp R/r/R_D^{13} \left(D \frac{\exp \left(\frac{en^2}{\gamma_0 T_i} \right)^{0.5}}{\exp R \left(\frac{en^2}{\gamma_0 T_i} \right)^{0.5}} \right)$$

Substituting specific values of parameters in the SI system into F , we obtain

$$FR^2 \exp R/r/R_D^{13} \left(2.3 \cdot 10^{13} \exp \left(\frac{en^2}{\gamma_0 T_i} \right)^{0.5} \right),$$

m and n is in m^{-3}

. This value tends to zero; therefore, we can assume that

plasma field E_p in the region $r \gg \gamma_0 T_i$ from the radius of the sphere for all $\gamma_0 T_i$ is

concentrations of plasma particles. Thus, plasma processes switch off the electric field. As noted above [16-17], plasma at strong fields $t 10^9$:

appears at c and less so that the electric field is switched off. Consequently, no breakdown phenomena occur in this spatial region. At $r \ll \gamma_0 T_i$ the electric field is again described by Coulomb's law

$$E = \frac{q}{4\pi \epsilon_0 r^2}. At r \ll \gamma_0 T_i, E is the thickness of the layer in which the generated$$

electrons and ions, of the order of the length of plasma oscillations - the thickness of the layer. In this layer in the stationary case from (13) it follows that

$$0 \leq \dot{n}_e = \frac{d\dot{n}_e}{dr},$$

or $n_e = \frac{1}{2} \sqrt{\frac{q}{4\pi \epsilon_0 r^2}}$

The specific value of the electron concentration under steady-state conditions at an electric field close to breakdown $E = 3.3 \text{ MV/m}$ turns out to be [17] of the order of $ne : 5 \cdot 10^{15} \text{ cm}^{-3}$ and the Debye radius is $rD : 1.8 \cdot 10^{-15} \text{ cm}^{-3}$. When $T_e : 3 \text{ eV}$, the layer can be seen as a halo over CO in air. ⁵ see, and this one

That is, the presence of a super-strong electric field in a highly charged CO is not a limitation for the existence of CO in the air, this conclusion is confirmed

the results of the implementation of corona discharges at fields on the surface of a high-voltage electrode that are 2 orders of magnitude greater than the breakdown field [19].

The combined effect of thermal and electrostatic properties of CO may improve the agreement between observations and calculations somewhat.

Lifetime of a charged ball relative to neutralization by air ions

The presence of a plasma layer affects the lifetime of the ball due to the movement of oppositely charged particles in the gas to the surface of the ball. Let us consider the decrease in the charge of a charged ball. For this, we also consider two

Oppositely charged ions move against r r \dot{r} \dot{y} \dot{R} \dot{N} \dot{b} \dot{r}

fields of the sphere to the boundary br . It can be assumed that it is the sphere of radius br r attracts ions. The equation describing the loss of ions from this region is

$$\frac{dQ}{dt} = -\frac{4\pi R^2 N wdr}{4\pi R^2 b^2} \cdot \frac{Q}{R^2} \quad (18)$$

$wdr = NbQ / r_0$

here wdr is the drift velocity of ions, b is their mobility. From (18) we can find

characteristic time of charge transfer across the boundary br $t_{dis} = r / (wdr)$.

Under normal conditions $N_i = 10^{10}$ cm⁻³ [5.13] and $b_i = 2.8 \times 10^{-4}$ m²/V² [13], then

we obtain the time of ion transfer beyond the boundary $t_{dis} = 1.9 \times 10^{-2}$ s. Crossing this border, ions enter the region where the electric field of the sphere does not act. There they diffuse to the surface of the sphere. The characteristic time of movement of ion diffusion D is the coefficient

on the surface of a sphere of order [13] $t_{dif} = (\pi D br)^{1/2}$, where

diffusion of neutral molecules for a mixture of N₂-O₂ $D = 0.2$ cm²/s [13,16]. For example, if

$r_s = 10$ cm $br = 10^3$ s. That is, the lifetime of a charged ball relative to its t_{dif}

neutralization by ions of the opposite sign increases significantly and

depending on the difference $t_{dif} = (br^2 / (8 \pi D))^{1/2}$, i.e. from the size of the ball and its charge.

CO radiation

The question of the cause of radiation in this model does not have a clear answer, since the BL has a complex structure. The cause of the generation of BL radiation in the optical and radio ranges may be plasma created under the influence of the electric field of the charge, high core temperature, or processes causing plasma pulsation near its shell [14]. BL radiation can be of two types. It can be equilibrium, when the BL shell filled with hot

steam. In this case, heat is transferred to the shell by steam particles located inside the shell. The radiation of CO can also be nonequilibrium, when under the influence of a large charge of CO, plasma appears near its surface as a result of ionization processes in a strong electric field. The lifetime of nonequilibrium radiation is determined by the lifetime of the plasma on its surface, that is, the time of decrease in the charge of CO. Parameters of nonequilibrium radiation

require a special analysis, requiring a thorough detailing of this model, which is beyond the scope of this article.

The parameters of equilibrium radiation can be estimated as follows. We will assume that the heating of the shell by steam is compensated by thermal radiation from the surface of the shell, then we can use the following approximation [13]:

relatively	heat capacity	real	gas	expression
$Nk_B R^2 \beta^3$	$\frac{dT}{dt}$	$\gamma \sigma_{SB} T^4$,

(19)

where k_B is the Boltzmann constant, and σ_{SB} – Stefan-Boltzmann constant. Solution this equation for determining the cooling time to temperature T_1 , if the initial temperature of the gas is much greater than the final temperature of the gas $T \gg T_1$: (20)

$$t_x = \frac{Nk_B R^3}{6\sigma_{SB} T_1^3} .$$

Substituting into (20) the following values of the average parameters of the CO from Table 1: $N = 8 \times 10^{27} \text{ m}^{-3}$, $R = 0.1 \text{ m}$, $T_1 = 500 \text{ K}$, we get $t_x \approx 260 \text{ s}$, and at $T_1 = 300 \text{ K}$ $t_x \approx 1200 \text{ s}$. These values are comparable with the observed lifetime of CO.

According to (20), the emission time of CO increases with the radius of the sphere, so the observed increase in the lifetime of CO with the increase of its radius is easily explained [5]. The color of CO in this model is determined by the material of which its shell consists.

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Thermal-chemical luminescent formation (Ball lightning).

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The work is devoted to luminous formations that appear in nature in various conditions such as volcanic eruptions, linear lightning strikes into the soil, in aquatic conditions during geotectonic events and other atmospheric conditions. The constructed theory explains the possibility of the formation of luminous objects in electrical devices at high overvoltages in a high-voltage circuit and during the interaction of linear lightning with a power line. Based on previous experiments, a model has been developed in the work, according to which the luminous formation is a charged sphere with a shell of atoms of soil, metals, and/or water, with an internal volume filled with a gaseous or vaporous substance. Such shells can be formed in electrical devices at high overvoltages in a high-voltage circuit, as well as when lightning discharges strike the ground containing SiO₂ and Al₂O₃ and metal objects of arbitrary composition. The internal energy is calculated during the formation of such a hot spherical object and during the transfer of charge from linear lightning. The possibility of the existence of this object with a high energy density up to 10¹⁰ - 10¹¹ J/m³ is considered.

Interpretation of experiments by D.S. Baranov, V.N. Zatelepin, A.L. Shishkin with spark discharges in a water-air medium in the paradigm of unipolar ether. Types of ball lightning.

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The properties of the unipolar ether are described, based on the sole assumption that the ether particles in the volume of the entire Universe have the same electric charge. In this paradigm, it is possible to explain the mechanisms of formation of all particles of matter, as well as other material formations ($\ddot{\gamma}$ -plasmoids), which arise in the unipolar ether. It is shown that the formation of $\ddot{\gamma}$ -plasmoids is the physical mechanism of many phenomena that have not yet been explained, including those indicated in the title. A physical mechanism of cold transmutation of nuclei is proposed.

1. Hypothesis and properties of unipolar ether.

The questions raised in the title at first glance relate to a narrow area of knowledge. However, an adequate answer to them requires a deep approach. For more than a hundred years, the entire community of physicists has been unable to answer many fundamental and specific questions. Or the answers that are satisfactory in one area of physics contradict the conclusions in another. This situation requires the development of a new paradigm.

The proposed paradigm [1,2] assumes **a single** independent condition: the unipolar ether (UE) is the ether of particles that have the same charge in the volume of the Universe. The properties of such ether automatically follow from this condition. I will name those that we will need in this work.

The only possible form of existence of the UE is a crystal lattice (plasma), in the nodes of which are located particles of the ether (like-charged particles of the ether are repelled, but cannot instantly fly apart, since the outer layers, which have not reached the speed of light, restrain the inner ones, pushing them inward due to the action of Coulomb's law). The same structure has flows of electrons, protons, ions and all metals with particles of the same sign in the nodes. Therefore, to understand the behavior of plasma in the ether, one can often use an analogy with the plasma of charges of matter.

Let's define the main parameters of plasma.

The physical meaning of the charge of the ether particle $q\ddot{\gamma}$ is determined by the fact that each of them is repelled from all the others. The density of the ether $\ddot{\gamma}\ddot{\gamma}=N/V$ is the number of ether particles in a unit volume. Given that all particles have the same charge, the density will be exactly equivalent to the magnitude of the space charge $Q\ddot{\gamma}=\ddot{\gamma}\ddot{\gamma}K=KN/V$, where K is a certain coefficient). The magnitude of the space charge

inside the volume of the Universe compared to the points where ether particles are absent, will unambiguously characterize the electric potential of the field at the points of the Universe. Considering that we can technically measure the difference in potentials only at close points in space, then for us the field potential will be the difference in potentials at the point of interest to us and the point conventionally taken by us as zero (usually "earth"). But in it the spatial charge is not equal to zero. Then the charge of any objects in space should be understood as the difference in the charge in the volume of the given object and the charge in the same volume in the EE of average density for the given section of the Universe. This difference can be of both signs. The field should be understood as the distribution of potential, spatial charge and EE density in space.

Let us note right away that any body possessing a certain number of electrically charged particles of matter (protons, electrons) in sections of the ether of different density will have a different potential relative to the average for our section of the Universe. Incidentally, this explains the circumstance that the field intensity during a lightning breakdown is several times less than during an artificial breakdown: the charge in the cloud simultaneously collects the charge in the ether.

2. Plasmoids in the unipolar ether.

Considering the UE as plasma, we will use an analogy. A number of experiments are known (cosmonauts S. Krikalev and P. Vinogradov at the space station in 2012 studied plasma in a state of weightlessness), which showed that volumetric voids can form in plasma.



Fig. 1 Volumetric void in plasma in zero gravity.

The plasma density far from the void and around it can technically be taken as zero. When moving towards the center, the density along the perimeter around the void increases, and in the center of the void it will have a minimum value, or be negative compared to the accepted "zero" density.

The analogy between the plasma density distribution and the curve is obvious. distribution of charge inside a proton, obtained by Stanford scientists.

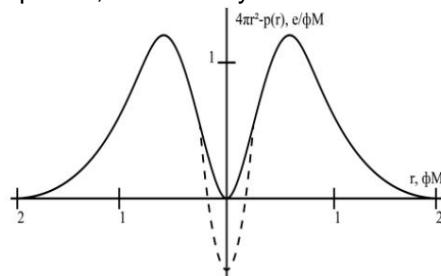


Fig. 2. Distribution of charge over the diametrical cross-section of a proton. The dotted line indicates that the charge value at the center of the proton is not necessarily zero.

The only figure through which the shooting of electrons will give such a distribution regardless of its orientation in space is a sphere with a fuzzy shell. Along **all** diameters of the proton-sphere (in a volumetric figure on the widened outer sphere of the sphere) we have two positive repulsive charges-humps with a dip between them (the depth of the dip can be different, which is shown by the dotted line): the proton is a hollow sphere with a fuzzy positive shell, which tends to push apart. Why is the proton stable? The answer, confirmed by experiment and calculation, is only one: the stability of the proton tending to crumble is due to the

repulsion inward, carried out by the external charge of the UE to the boundaries of the Universe. The electric constant $\bar{\epsilon}0$ is an integral characteristic of the repulsion inward (we do not have an analogue of Coulomb's law for moving charges).

The charge distribution in the proton, the specific binding energy of the nucleons and the vacuum electric constant $\bar{\epsilon}0$ cannot be changed by us, and there is no point in looking for analytical expressions to calculate the relationship of these characteristics. For integration, we divide the "humps" of Fig. 2 into columns (the charges of each column qn and qm are equal to its average height) and sum up the energy of their interaction $W=\bar{\epsilon}0nm$ (1), where n, m – column numbers on the right and left, $W_{nm}=Kqnqm/r_{n,m}$ ($r_{n,m}$ – distances between n and m columns). $K=1/(4\bar{\epsilon}\bar{\epsilon}0)$. The hump repulsion energy with recalculation of charge values (we normalize charges $q/2=\bar{q}qn=\bar{q}qm$, here q is the proton charge) and distances differs from the specific binding energy of nucleons measured by us in experiments by only 1.5-2 times. We compared the specific binding energy per nucleon measured in some experiments, the charge distribution in the proton in others, and the vacuum electric constant in others, and established a good correspondence between them in Coulomb's law.

For simplicity, the influence of the external ether, which was set by the value of the specific binding energy, can be replaced by the presence on each side of the proton of a line of ether from the boundaries of the proton to the boundaries of the Universe with a total charge Q , which has a gigantic mass due to the huge number of ether particles in it. We kind of assume that on one line there are four identical electric charges: two particles with half the charge of the proton $q/2$ and charges Q . In this model, it is easy to calculate the condition for the stability of the proton (and any plasmoid).

Let us write down the equation for the forces of interaction of these charges (meaning the force impact on the right half-charge of the proton from the other charges)

$$F = (kq/2)\ddot{y}Q/(Rr/2)^2 - (kq/2)\ddot{y}Q/(R+r/2)^2 - kq^2/4r^2 \quad (2).$$

The system is in equilibrium if the force F is zero. Given that R is much greater than r , the condition for stability (but not formation) is

$Q/q = 0.25\ddot{y}R^3/r^3$ (3), where r is the radius of a proton, or any plasmoid, R is the radius of an atom, or the conditional radius of the external ether.

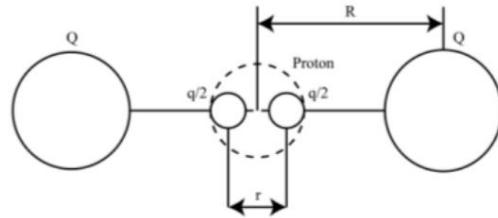


Fig. 3. Schematic representation of the interaction of proton charges with ether. \mathbf{Q} – half-charges of the ether, $\mathbf{q}/2$ – half-charges of the proton, \mathbf{r} – radius of the proton, and approximately equal to its distance between half-charges, \mathbf{R} – radius of the atom, or some conventional radius of the plasmoid.

Substitution into expression (1) showed that the proton can be a spherical plasmoid in the UE (by the way, taking into account that the proton density is 30-45 orders of magnitude higher — according to various estimates - higher than the density of the ether, then the formation of the proton cannot be explained by any vortices, and rotation is not visible in Fig. 1). As we have seen, voids are formed in any plasma (although we do not know the conditions of their formation). It can be stated that due to the enormous mass and charge of the UE of the Universe, any double-humped charged clot of ether can be made stable: you just need to select its dimensions and charge distribution (the charge of the Universe is constant, but q , R , r can be varied. The density of this clot may not be equal to the density of the proton, but be much smaller.

And then we can make a conceptual conclusion: **along with matter (nucleons and electrons), we encounter a certain "new" type of matter: not yet matter due to insufficient density, but certain relatively stable formations in the field of unipolar ether.** These formations obviously possess the energy of an electrically charged ball. All of them could be called ball lightning. Although we

must understand that protons and electrons are also ball lightning. They also include ball lightning itself, as well as possible giant formations on Earth and in space.

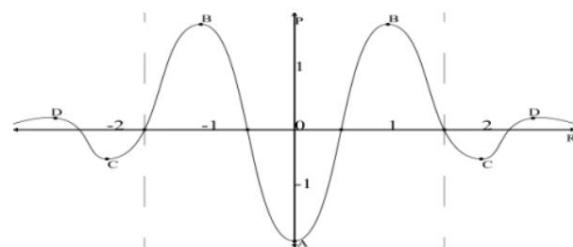


Fig. 4. Distribution of charge density in a \ddot{y} -plasmoid over any diameter (I called the two-humped plasmoid this because of the shape of the curve, reminiscent of the letter \ddot{y}).

Such a stable clot is formed in the form shown in Fig. 4 and has the form of spheres with different ether densities nested inside each other (similar to a nesting doll of spheres of different densities nested inside each other).

It is important to understand that the zero horizontal axis is not zero density, and not zero potential. This is the density, potential and spatial charge that provide a specific binding energy per nucleon of the order of 8-12 MeV. Even at point A there is not zero potential (there is no space without ether within the Universe), and at B the potential can be greater than on the "zero" line by tens of orders of magnitude, as in the proton.

In fact, a stable plasmoid can be not only double-humped, but also have any even number of humps, as long as they are centrally symmetrical (such is the neutron). Moreover, this symmetry can be violated in an asymmetric external field of the UE.

Condition (3) allows us to assume that a whole hierarchy of $\ddot{\gamma}$ -plasmoids is possible, in which all smaller plasmoids exist inside larger ones. The compression properties of the external ether are determined by the magnitude of the UE potential around the $\ddot{\gamma}$ -plasmoid, and therefore the charge and size of the plasmoid depend on the potential of the plasma immediately around it (they are different in regions A, B and C). That is, if a "small" plasmoid arises in a "large" plasmoid, then the charge, size and stability of the latter will depend on the density on the curve for the "large" plasmoid, since the "small" plasmoid is formed at a different level of "zero" density (just as the size of an air bubble depends on the depth of its immersion in water). And at some points of the density distribution inside smaller plasmoids, even smaller plasmoids can form at a different density level. The formation of $\ddot{\gamma}$ -plasmoids at different levels of UE density is the basis of the CTE in our experiments and in the actions of nature: a change in the density of the ether changes the value of the specific binding energy per nucleon. In experiments, a change in density is achieved by changing the pressure, temperature, and in electrical discharges.

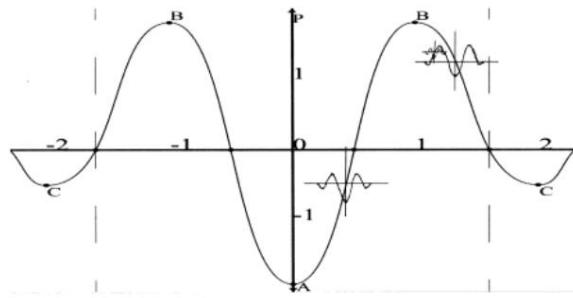


Fig. 5. Hierarchy of $\ddot{\gamma}$ -plasmoids. Horizontal lines of "zero" density of EE in places of formation of different $\ddot{\gamma}$ -plasmoids correspond to different values of EE density in these points. For understanding: protons located in regions A, B and C will have different sizes and charges.

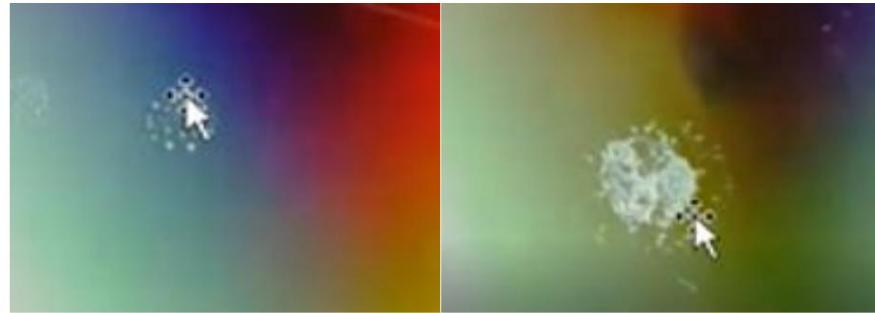
The sizes and charges of these $\ddot{\gamma}$ -plasmoids differ by orders of magnitude, as long as they satisfy condition (3): these are nucleons, atomic nuclei, micron-sized spheres,

millimeter, kilometer and galactic sizes. Their densities can be 10-20-30 orders of magnitude less than those of particles of matter. Such structures in the Universe can be the embryos of planets, stars and galaxies.

3. Experiments.

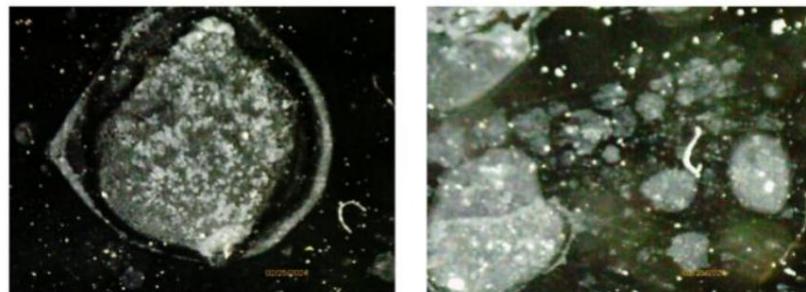
All the above-mentioned experiments do not contradict the properties of the UE and are physically justified by it.

- It is theoretically clear that plasmoids partially or completely leak through any structure of matter (like jelly through a fine sieve), since there are no continuous bonds between the particles of ether. And the ether itself flows freely between the particles of matter. In experiments, penetration of an "unknown substance" through the walls of light guides and glass walls of dischargers was observed. • The hierarchy of plasmoids is confirmed by the fact that "large" circles are subdivided into "small" (a round trace is left by a fallen ball). Each ball, possessing electrical energy, interacts with the surface of the screen, like ball lightning, destroying and leaving traces on it.



Forms of traces on CD-disks in experiments of V.N.Zatelepin.

Small balls inside the sphere are not distributed with the same density, which may indicate the movement of the ball along the surface of the SD, and that the ball with the same density has not yet formed.



The following photographs show the same thing: the arc on the left picture has the shape of a circle. The sizes of the dots differ from each other. Here the magnification is 200 times. It is possible that further magnification will give another hierarchy.

- The plasmoid has an electric charge, and it induces an opposite charge on any surface. This means that the plasmoid will change its trajectory of motion, being attracted to a surface with a larger induced charge.

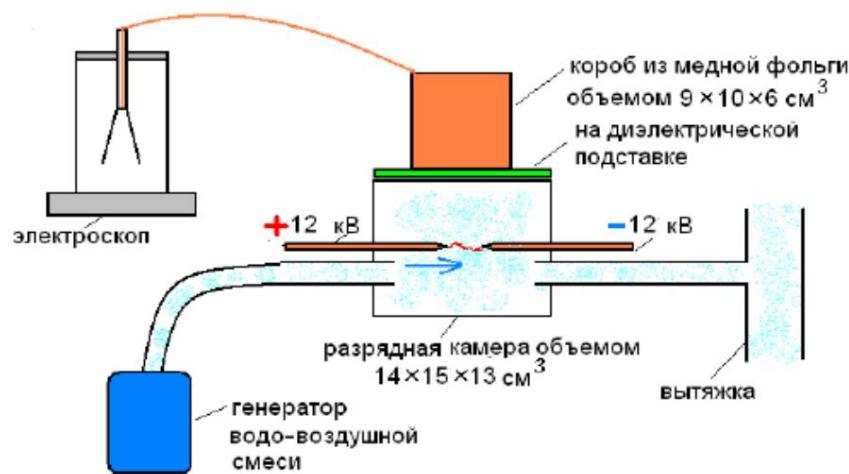
Two figures from V.N.Zatelepin's report. Spots of almost round shape are visible in the right photograph. The time of the plasmoid's fall can be determined not only by gravity, but also by its interaction with the induced charge. The leftward deviation of the flow can be caused by the induced charge on the left wall of the cuvette.



A plasmoid has no weight: its density can be orders of magnitude less than the density of matter, and its volume may not contain particles of matter. Everyone has seen on TV how an unknown "body" rushes about, instantly changing direction at a speed of up to 300 km/h. It is clear that this is possible if the "body" has no mass, has a charge, and moves under the influence of an electric field. A laser beam carries plasmoids. Its electromagnetic wave, like any wave, can move a charged "body". This is what the experimenters observed.

- A large plasmoid (centimeters, meters and more) is capable of creating a potential around itself that differs from the average for our part of the Universe (for example, in hump B in Fig. 4). An object that gets into this plasmoid, as stated earlier, will be charged with this potential. And this charge can flow into the surrounding ether for a long time, reducing the potential to "zero".

And here is the result of the experiment reported by V.N. Zatelepin.



The charge of the copper box was maintained for up to 30 minutes after the discharge was switched off.

Where did it come from and where could it go if not into the unipolar ether?

- Pressure and temperature in the UE depend not only on the movement of the molecules of the substance, but also on the vibrational movement of the ether particles in the crystal lattice. And, therefore, a change in the potential of the ether field near plasmoids should change these characteristics of bodies: the amplitude of oscillations of elements in the crystal lattice depends on the degree of its compression.

In the experiments of D.S. Baranov, V.N. Zatelepin, and A.L. Shishkin, a change in pressure was noted in a vessel near an electric discharge and when irradiated by a laser, the beam of which passed through a light guide near the discharge: the laser beam introduces additional vibrations into the crystal lattice of the ether.

- From what has been said above it follows that the nucleus of an atom will also have the form of a γ -plasmoid. And therefore the protons (independent γ -plasmoids) in it should be distributed along a similar curve, only larger in size: the main mass of protons is located closer to the radius of the nucleus (as if in the humps of B) with a "void" inside the nucleus.

In a plasmoid larger than the nucleus with a similar charge distribution (see Fig. 5), the atomic nucleus can fall into a region with a greater or lesser than "zero" ether density. Then the nucleus can disintegrate, or, on the contrary, attach nucleons, clusters, or even whole nuclei to itself [3]. This is the CTN. Then silicon and aluminum can be formed from the sum of the nuclei of nitrogen and oxygen isotopes. This is the path of evolution of nuclei from light to heavy.

A certain substance was formed during the experiments of their authors.



V.N. Zatelepin reported that Bob Griner discovered in the obtained substance initially absent aluminum. • The passage of an electromagnetic wave, including a laser beam, through a γ -plasmoid should lead to its reflection, scattering, partial, or complete absorption. Therefore, a laser beam that has passed near a discharge leaves a larger spot on the screen than a beam that is not in contact with the discharge.



4. Ball lightning in nature.

$\ddot{\gamma}$ -plasmoids in the unipolar ether are obviously SM, having the most diverse values and charges. They arise in the ether, and therefore can be in a vacuum (in space), air, water and solid matter.

In addition to the electric one, they can also affect radioactivity, since isotopes of chemical elements that got into the ether of unusual density in the "large" $\ddot{\gamma}$ -plasmoid can transform from stable to radioactive and vice versa. Or create an initially absent element. And one more important property of such ether: the structure of all biological tissues, right down to the size of atoms and molecules, depends on its density. That is, if

solid bodies were formed at one density and then got into another, then the distances between the nuclei of atoms that were formed earlier will now be non-optimal: they will tend to decrease or increase. If these are bones, muscles, vessels and nerve fibers, then the body will perceive such a change in density as a mechanical impact of great force.

Now examples connecting the properties of UE with natural phenomena.

- Every single version of the death of the Dyatlov group students does not stand up to any critics. But with SM everything falls into place, especially since people in that area have observed fireballs before and after.

In the ether of a different density, bones can be broken. This is noted in the protocols. By the way, it is clear why schools of fish, birds and bats die in the sky: there they meet such $\ddot{\gamma}$ -plasmoids.

Between the points of the $\ddot{\gamma}$ -plasmoid (for example, point A and point B) there can be potential differences of up to tens of kilovolts of both signs of charge. Large electric currents arise, catastrophically destroying biological tissues. If such voltages are applied to the tongue, or to two points of the eyeball, they will simply evaporate (this is also noted in the protocols). There was also a radioactive effect: a strange tan on the faces of students was described and

traces of radioactive decay on clothing (essentially CTN). • The presentation of the Tunguska meteorite SM eliminates obvious inconsistencies. The object, the weight of which was estimated at 40 million tons, according to eyewitnesses, HANGED before the explosion, and after the explosion, witnesses saw a change in the color of the grass and foliage, from green to black, and then the opposite change. The object could have hung only in one case, if its weight was small due to the absence of particles of the substance, which, by the way, was never found.

After the explosion, the entire charge concentrated in the "meteorite" began to distribute itself in space, first increasing the density of the ether around the place

explosion, and then decreasing to normal. At the same time, the usual spectrum of light changed, and then everything returned to the usual density and color. • Plasmoids can reflect not only visible light (UFOs, "flying saucers"), but also radio waves, and then "radar angels" are observed, and in the water "unknown submarines."

- The presence on Earth of all the heavy elements of the periodic table, which supposedly could only have formed during a supernova explosion and then got to Earth in an unknown way (for some reason they did not settle on heavy planets and the Sun), suggests that they were formed here as a result of CTN. The formation of coal and petrified trees also suggests this. Such cold nuclear transmutations could have occurred in powerful electrical discharges-lightning and under the influence of the planet's movement in areas of space with different ether density during the addition of cumulative ether flows.
- Round holes in the ground in Yamal and Taimyr (as in the photo), as well as kimberlite pipes with a slight slope of the walls and a perfectly round funnel can only be formed by spherical objects erupting from the ground, but not by methane explosions.



- A mystery of nature are stones of spherical shape (deviation from it is about 0.5 cm on a diameter of 3 m). Neither "sculptors" nor nature, according to canonical ideas, could do this.



BL can absorb solid or liquid substances, such as lava or sand with shells. If the BL retains its spherical shape long enough for the lava or baked sand to solidify, a spherical stone.

.Conclusion

To summarize, it can be said that all the results of experiments and a large number of observations (not all of which I have listed) can be interpreted within the framework of the concept of unipolar ether. And the calculation of the balance of forces of charge repulsion inside the proton and the forces of compression from the ether shows that the probability of the correctness of this interpretation can be very high.

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Interpretation of experiments by DS Baranov, VN Zatelepin, AL Shishkin with spark discharges in a water-air environment in the paradigm of a unipolar ether. Types of fireballs.

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The properties of unipolar ether are described based on a single assumption that the ether particles throughout the Universe possess the same electric charge. This paradigm makes it possible to explain the mechanisms of formation for all particles of matter, as well as other material entities ($\ddot{\gamma}$ -plasmoids) that arise within the unipolar ether. It is shown that the formation of $\ddot{\gamma}$ -plasmoids serves as the physical mechanism behind many phenomena that have thus far lacked explanation, including those mentioned in the title. A physical mechanism for cold nuclear transmutation (Low Energy Nuclear Reactions) is proposed.

Cold non-nuclear fusion and ball lightning

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The mechanism of the origin of matter on ring-faced models of atoms and molecules is considered. Cold non-nuclear fusion is the self-assembly of elementary particles from ether, atoms from elementary particles, molecules from atoms. Since fusion (fusion of light nuclei) can only be thermonuclear, I called cold non-nuclear fusion cold nuclear fusion (CNF) from ether. Microball lightning occurs during cold nuclear transmutation (CNT), converts "fuel" into "ash" and burns out the filament in metal-hydrogen reactors LENR. The question of where the energy in ball lightning comes from is considered.

All my scientific life, which is more than 40 years, I have been working on the problem of combating coal methane, working as a research fellow at the Institute for Problems of Integrated Development of Subsoil of the Russian Academy of Sciences (IMD RAS named after N.V. Melnikov). Methane, as it turned out that initially there is no coal seam, and it appears as a result of mining operations. The last statement is my hypothesis! But the official mining science, in terms of gas-dynamic phenomena (GDP) during the development of coal seams at great depths, is also a hypothesis that is more than 100 years old. Sudden emissions of coal, rock and gas (part of GDP) still occur sometimes even today, even when the forecast is not

dangerous and the blowout prevention measures are fully implemented. GDP has decreased not due to the success of mining sciences, but because there are fewer mines. England, France and others have completely abandoned underground coal mining. In Russia, mining has moved from Donbass to Kuzbass, where the coal seams are thicker and they have the same problems as Donbass in combating emissions, as will be explained below, which will also arise later, when mining operations reach "great depths".

The main misconception of the officials is that they consider the coal seam to be a fractured porous medium containing methane in quantities actually observed during GDY. There are, however, several works whose authors admit the production of minor additional quantities of methane during the destruction of coal. The mine experiment has not yet been able to prove or disprove any of the hypotheses, and for the last 30 years it has not been available to a wide range of researchers due to the fact that the mines have become private property. Laboratory studies and mathematical modeling have also yielded practically nothing due to the impossibility of scaling GDY in physical modeling. Coal deep underground and raised to the surface is

are not the same thing. All the details are in the extensive specialized literature and my publications on mining and geomechanics (rock mechanics) [1].

From here on I call all, in my opinion, great scientists of our time by name and patronymic at the first mention, and at all subsequent ones I put only initials. At one of the previous RKKHTYalSHM I spoke about 2 possible paths of cold nuclear transformation [2-3]. Figuratively speaking, a house can be built from scratch, or it can be rebuilt. In the first case, this is an analogue of cold nuclear fusion from ether (CNFS), and in the second, an analogue of cold nuclear transmutation (CNTS). CNTS is a self-assembly of elementary particles, nuclei, atoms, molecules and sometimes supramolecules and clusters from ether, presumably due to magnetic forces. Electrical forces appear later, when elementary particles approach each other, and balance the first. I may be wrong about the name of the forces, because I am a mining engineer. In my opinion, CNTS is the pushing of a proton between neighboring nuclei, I assume exclusively under the action of a flow of mechanical energy arising, for example, due to thermal stresses as a result of heating the fuel powder in a metal-hydrogen reactor [4-5].



Fig. 1 Model of a substance made of multi-colored balls

The mechanism of CTN, which I called recombination, means a restructuring without breaking bonds, and therefore LENR (low-energy nuclear reactions) is like moving a fold in a carpet. Such a mechanism of transmutation explains a small set of the same chemical elements obtained in experiments, as well as the phenomenon of self-disappearance of some and self-appearance of new ones over time. CTN, in my opinion, is a non-nuclear transformation of the structure at the atomic-molecular level. For which, by and large, it is not important how the atoms and their nuclei are arranged. A model of matter from ordinary multi-colored balls is sufficient (see Fig. 1).

The second possible way of cold nuclear transformation is what I called in 2007 at ICCF-13 "CN from ether". To explain CN from ether, we need to know, at a minimum, what atoms and their nuclei consist of (Fig. 2). To do this, we need to accept the concept, the so-called method of stationary electrons (STEL) of M.Ya.Ivanov.

So far, only what is in the name of the method. Models of atoms and molecules by M.Ya. Ivanov will be discussed in detail at the end of this section. And I, running ahead, must warn you that we will not need them. I did not understand at all why they were created and how to practically make them or at least draw them. Their main merit is that the electron became stationary. But as you will learn below, for more than 100 years this concept of STELAS seems to many researchers to be the only possible and correct one. And it is important to keep in mind another property of the electron. The fact that it is lighter than the nucleus of an atom does not oblige it to be smaller than the nucleus. An electron can be of any size. For example, there is a hypothesis that ball lightning is a large electron.

There are rules of self-assembly in nature. Back in 1894, the German organic chemist Emil Fischer suggested that interactions occur if the shapes of molecules "fit" each other - just like a key fits a lock. Such rules were discovered and described for atomic nuclei by Yuri Vasilyevich Burtaev, for atoms by Boris Vasilyevich Bolotov, for protein molecules by Alexander Yuryevich Kushelev, who calls them the genetic code. I think that the list of names of the authors of the "rules" can be continued. Ring-faced models of atoms explain, confirm and clearly illustrate the empirical formula $N=2n^2$ for determining the number of electrons at energy levels n . I think that this alone transfers model representations to the rank of theory.

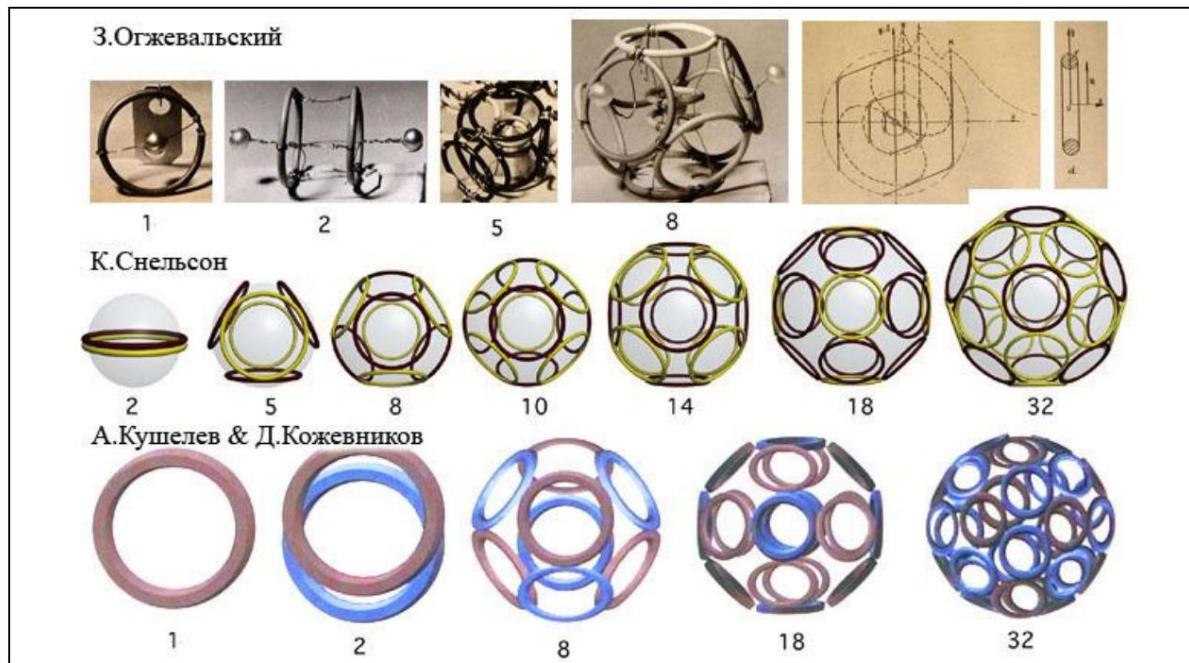


Fig. 2. Ring-shaped models of atoms of a Pole, an American and Russians

As is known, for example, from Boris Vasilyevich Bolotov and Vladimir Akimovich Atsyukovsky, and I suppose many people think so - atoms of all substances consist of hydrogen atoms. In my opinion, the ring-shaped model of the hydrogen atom is an analogue of a tornado, and the atoms of other substances are an analogue of Nikola Tesla's plasma lamp of 1894 (Fig. 3 on the right). I found confirmation of this idea in the film

Prosperity II and in computer graphics by Vladimir Vladimirovich Mylnikov (see Fig. 3 in the center). The author of the film Foster Gamble says in the 2nd episode that the atom is a "funnel in a sea of energy." And in the 1st episode he demonstrates Snelson's models, as it turned out from my correspondence with Kenneth, without his consent. Examples of self-assembly of two-dimensional (flat) structures of hydrogen atoms were first drawn on a computer by V.V. Mylnikov (Fig. 4-7 on the left). Visualization of 3-dimensional structures of rings using threads was done by A.Yu. Kushelev (Dmitrov, Moscow region) [6], and then Victoria Vasilievna Sokolik (Kharkov, Ukraine), they have a joint monograph on this topic [7-8] (1st and 2nd editions).

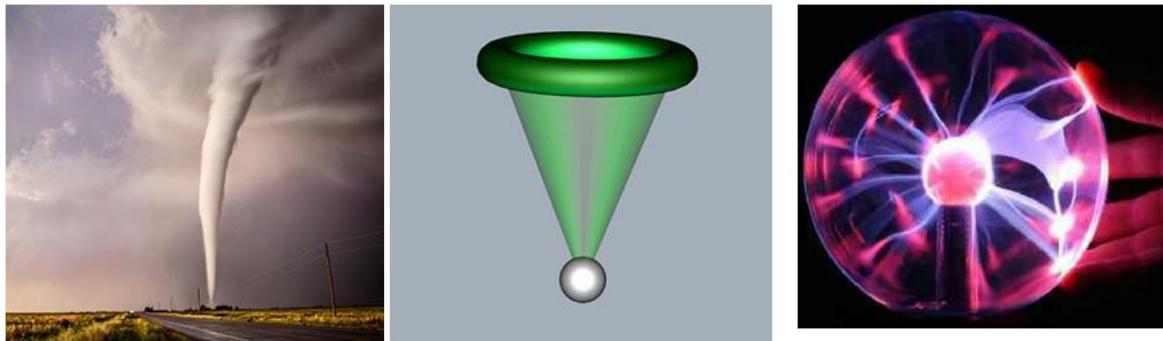


Fig. 3. Analogues of the ring-faced model of the hydrogen atom (my ideas)

At the second stage of self-assembly of atoms from the ether, a fundamental alpha particle appears (Fig. 4). And since there is no free atomic hydrogen in nature, it must be said that all atoms of all substances consist of alpha particles. I will not decipher what is drawn here and below, assuming that the readers are literate people and everything is clear to everyone - a torus or "donut" is an electron, a white ball is a proton, and a blue neutron. For the sake of history, I should note that both the late Kanarev Philipp Mikhailovich and the currently living Mylnikov V.V. [9-13] in correspondence and personal conversations with me categorically denied any connection between their models of atoms and molecules and ring-faced ones, without explaining the reasons and differences! Like read, study our correct models and do not ask how they differ from your incorrect ones.

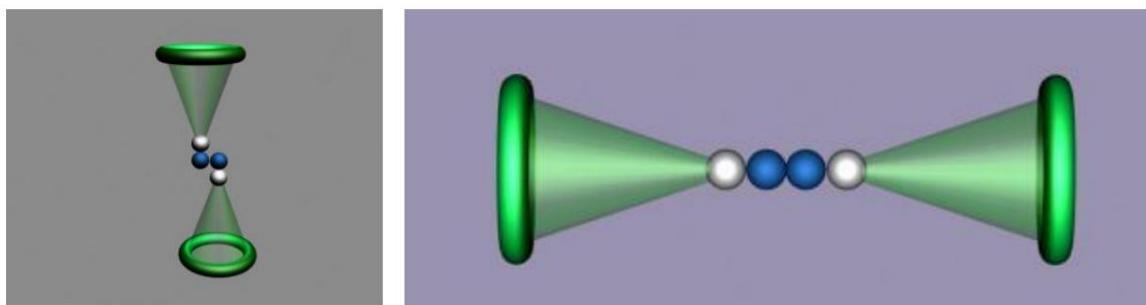


Fig. 4. Helium atom (alpha particle) Kanareva F.M.

From the theory of the microworld of F. M. Kanarev [12] it follows that all protons of nuclei are located on their surface, and also that the electron is a hollow torus rotating

relative to the central axis and the annular axis of the torus. Its magnetic field forms two magnetic poles, north and south, at the ends of its axis of rotation. The proton is a solid torus rotating about a central axis.

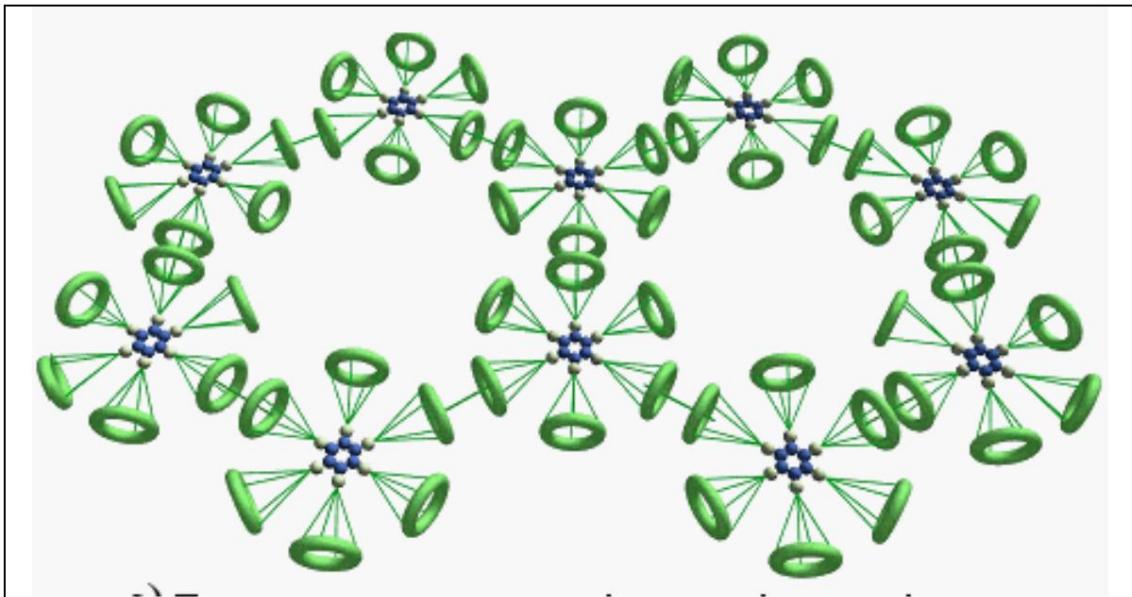


Fig. 5. Graphene from 10 carbon atoms according to Kanarev-Mylnikov

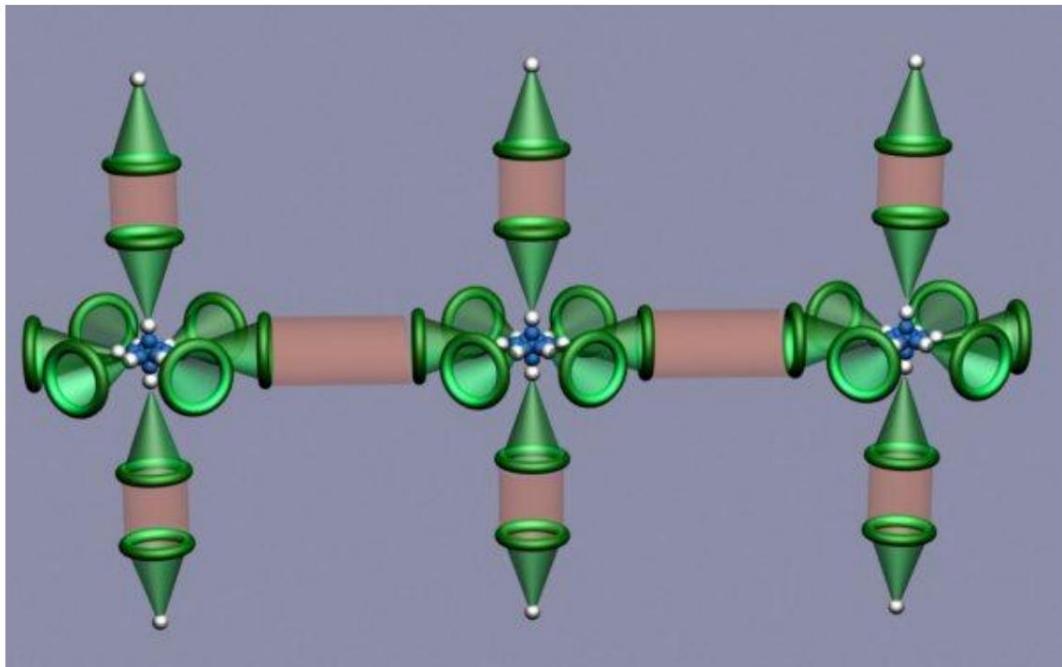


Fig. 6. Water from 3 H₂O molecules according to Kanarev-Mylnikov

It, like the electron, has two magnetic poles at the ends of the axis of rotation. The neutron has six magnetic poles. The electron and proton are connected in such a way that

When electrons of two atoms combine, they are brought together by opposite magnetic poles, and their approach is limited by like electric charges.

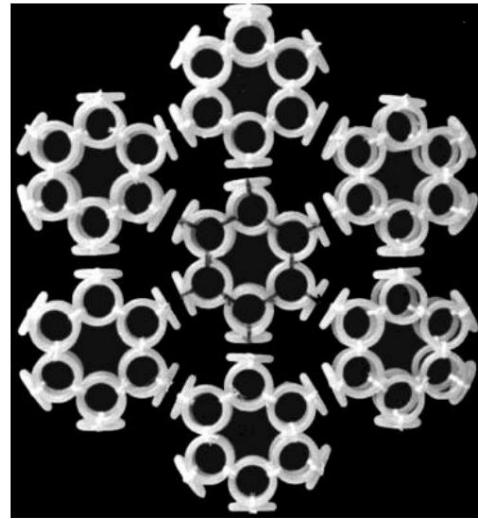
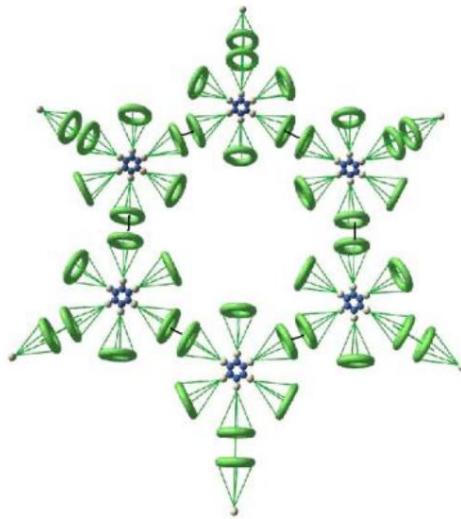


Fig. 7. Fractal in benzene: benzene atom C₆H₆ and a cluster of 7 benzene atoms

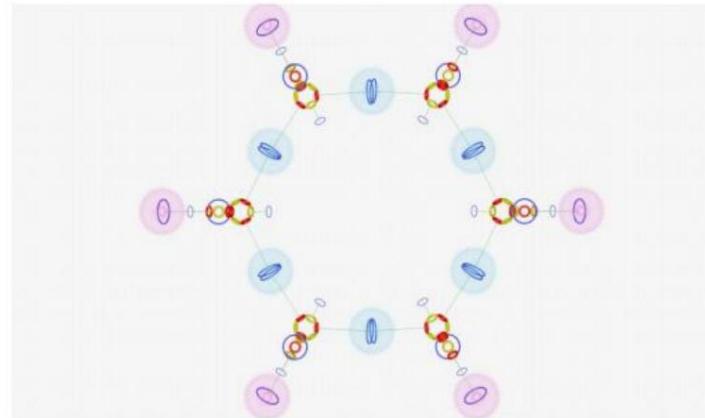


Fig. 8. In the graphene are carbon atoms bonded together in the hexagonal structure

Fig. 8. Fractal in graphene: hexagonal carbon atoms are linked together in a hexagonal structure (Pavel Osmera)

Carbon atoms are linked by bonds between valence electrons. Hydrogen atoms are similarly linked to benzene atoms.

The rediscovery of ring-faced models continues even now. For example, Pavel Osmera (Czech Republic) [14-16] (Fig. 8-10), Bob Grinye (Fig. 10 on the right) and probably others that I simply don't know about. Kushelev A.Yu. and maybe someone else also have models of leptons, but as you understand, I can't cover them all in one article.

immense (tell about everything). But in my opinion, the above is enough to close the former state corporation, now OJSC Rusnano, and create Rospiko in its place. It will not need any melkoscope. You take threads and baguette rings and knit (make models) on the table carbon atoms, which you combine into graphene and, to your surprise, discover benzene (Fig. 8). It turns out that in graphene, carbon atoms are linked to each other in a hexagonal structure. Isn't that amazing? So you can find gasoline and finally understand organic chemistry (what is the difference between benzene and gasoline). Benzene is a hydrocarbon molecule, and gasoline is a mixture of hydrocarbons. Gasoline contains hydrocarbons with benzene rings. Naturally, benzene is present in petrochemicals such as gasoline. Benzene is added to gasoline to increase its

octane number.

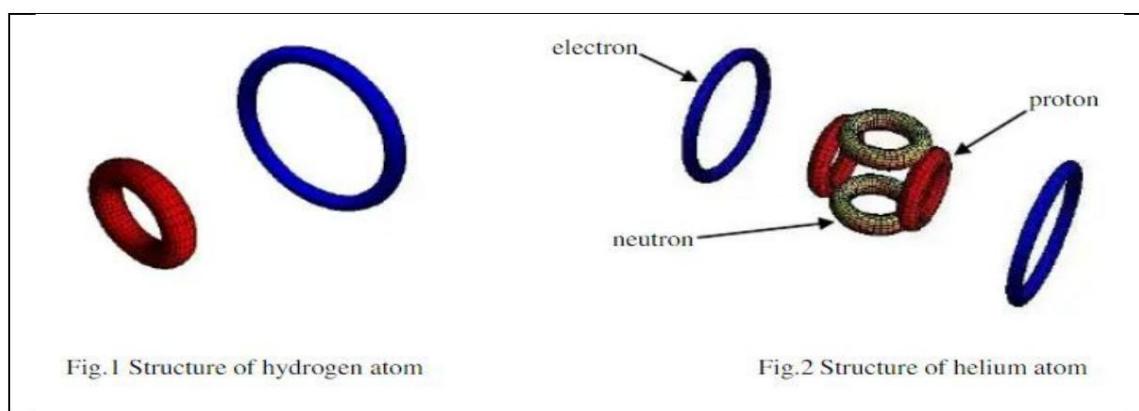


Fig. 9. Hydrogen and helium atom (alpha particle) by Pavel Osmera (Brno, Czech Republic)

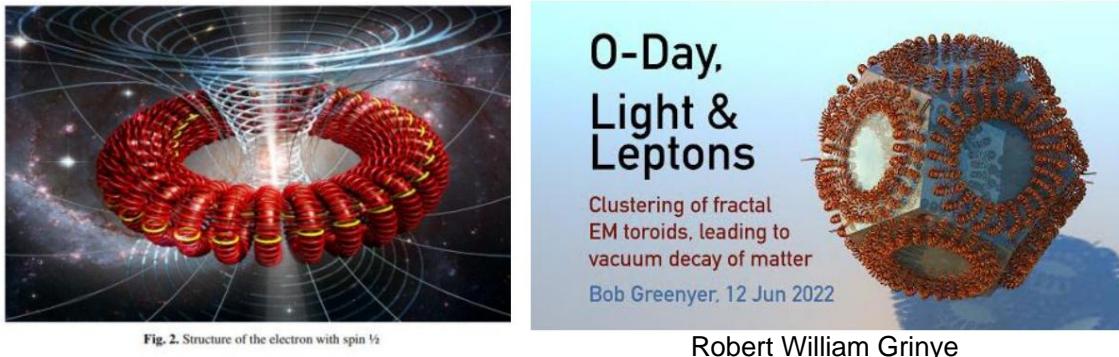
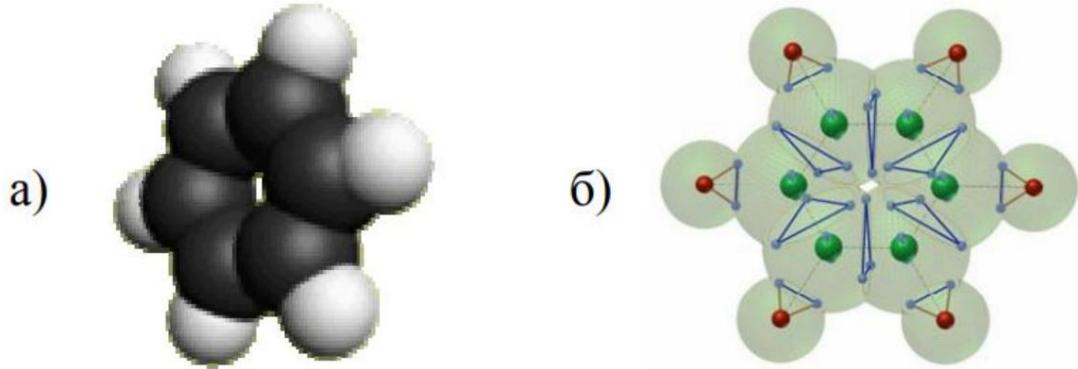


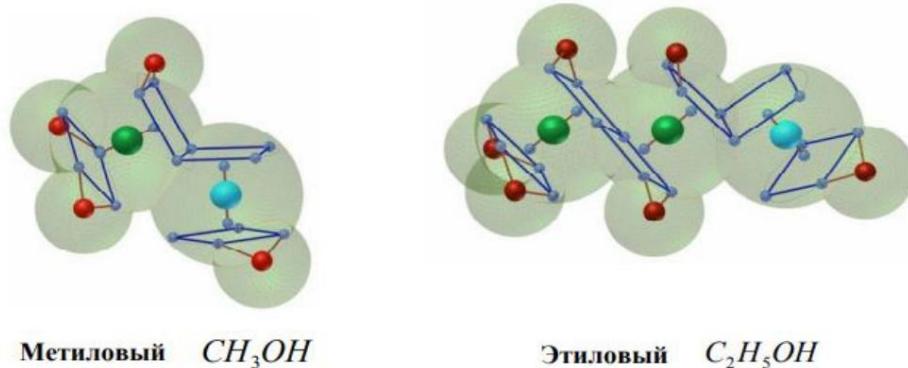
Fig. 10. Leptons (electron, muon, τ -lepton and their neutrino) P. Osmer and R. Grinier

Ivanov M. Ya. also published a number of articles on this topic [17-21]. He believes that models of polarized spaces, partially screening central concentrated electric charges, provide the opportunity for a visual physical interpretation of van der Waals spheres of atoms. These spheres are the outer boundaries of polarized spaces, with the Coulomb interaction of dark matter dipoles. On such spherical boundaries with a locally concentrated induced charge, concentrated charges of the opposite sign can be stably (stationary) located (Fig. 11-12).

**Fig. 11.** Benzene molecule according to the STEL method of M.Ya. Ivanov:

a – shape of the molecule (van der Waals spheres);

b – structure of a molecule with 6 carbon atoms (the centers of the atoms are shown as green balls) and 6 hydrogen atoms (the centers of the atoms are shown as red balls), all valence electrons are shown as blue dots.

**Fig. 12.** Green ball is the center of the carbon atom. Blue is oxygen.

Taking this opportunity, for the sake of history, I will briefly present the results of my own investigation and the chronology of the birth of ring-faced models. This picotechnology became known in our country thanks to the scandal with the monograph in the USSR Academy of Sciences, and abroad thanks to the famous American sculptor and photographer who invented it himself, wrote about it to famous physicists and somewhere dug up the first mention of it in 1915. However, for some reason this picotechnology (new model representations) is ignored by specially trained people (official science), perhaps the time has not come yet. Although since 1996 there has been an article in the peer-reviewed journal Russian Journal of Physical Chemistry [22-23], although published not abroad, but in Moscow in Russian and English. I did not understand who has access to the English version (I did not find it on the Internet). In addition, one of the developers of ring-faced models was a professional nuclear physicist

and worked at the Joint Institute for Nuclear Research in Dubna. This is Zbigniew Ogrzewalski, a Pole, his surname in Cyrillic is more correctly Ogrzewalski. He wrote a monograph, which was planned for publication under the auspices of MOIP but for some reason was never published, although it had two positive reviews. The original manuscript was kept by V.A. Atsyukovsky and during his lifetime it was rephotographed together with reviews and posted on the Internet by A.Yu. Kushelev [24].

I fully support the thesis that "science is done by amateurs", V.A. Atsyukovsky has such a book. And the first in physics, for which the time had not yet come, as always and in everything, were miners (I judge by myself, among other things). In this case, Mikhail Mikhailovich Protodyakonov Jr. (1911-1987), the prefix "Jr." because his father was also called Mikhail Mikhailovich. The son of a famous mining scientist, like me, he also worked at IPKON RAS, but only ten years earlier than me. At that time, my institute was still called the Sector of Physical and Technical Mining Problems at the Institute of Physics of the Earth of the USSR Academy of Sciences.

Protodyakonov M.M., according to Kushelev A.Yu., closely approached the rediscovery of the ring-faced world of Zbigniew Ogrzewalski (1956) and made a great contribution to the creation of picotechnology, founded by Kenneth Snelson (1960) and independently of them in 1988 by Kushelev A.Yu. and Kozhevnikov Dmitry Nikolaevich. Protodyakonov M.M. wrote two monographs, one himself [25], and the second about the same thing, but in co-authorship [26] with Gerlovin Ilya Lvovich (senior researcher of the Main Astronomical Observatory of the USSR Academy of Sciences, physicist, author of the FFT (fundamental field theory), the provisions of which contradicted the views of authoritative physicists in this field.

Immediately after the publication of the book, co-authored with I.L. Gerlovin, a devastating article by the future academician I.M. Khalatnikov appeared under the title "On one 'scientific theory'", and in the central newspaper "Soviet Russia" on 17.05.1976 [27] Protodyakonov M.M. was persecuted by the Physics Department of the USSR Academy of Sciences, as a result of which he was retired a year later, and the book became a rarity due to mass confiscation from stores and libraries.

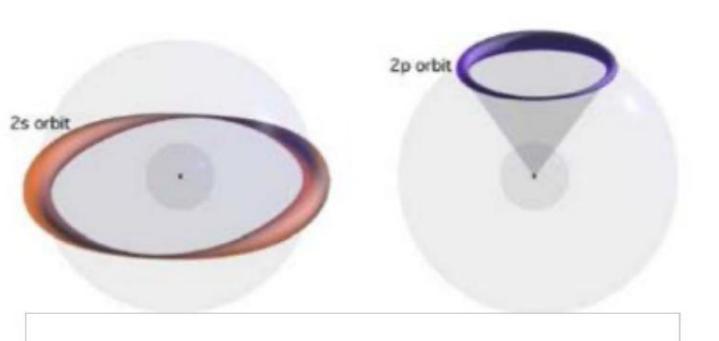


Fig. 13. Snelson K.D. models with a cone showing its directionality in relation to the core.

Since his first monograph [25] was not damaged, and the second [26] about the same thing caused a scandal, I conclude that the ring-faced models have nothing to do with it. Recently, an article about him appeared in Wikipedia, in which a photograph of Protodyakonov M.M.

miner's uniform (insignia on the lapel of the jacket) and a newspaper clipping with an article by I.M. Khalatnikov - it is my merit that I found it and posted it on the Internet.

The next scientist who rediscovered the ring-faced world of Z. Ogzhevsky was an American artist, sculptor and photographer at the same time - Kenneth Duane Snelson (1927-2016) [28-33]. Today there is already an article about him in the Russian-language Wikipedia, but in my time nothing was known. At first there was only the correspondence with him of Kushelev A.Yu. [31-32] and at the end of his life mine. And of course his website [33], which, unlike the website of Kanarev F.M., is alive to this day. By the way, Kenneth Snelson, like me, also depicted the hydrogen atom as a tornado (Fig. 13), although he did not write about it directly.

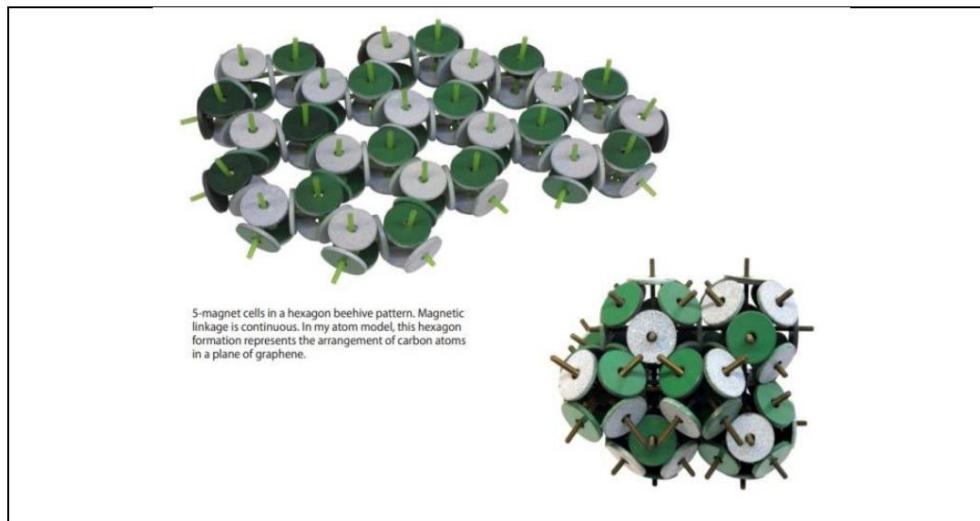


Fig. 14. Models of Shestopalov A.V. from tornadoes on the air at Kenneth Snelson

From the above review of ring-faced models of atoms and molecules, the conclusion suggests itself that these models must have a present and promising future, in addition to explaining Shestopalov's mechanism "CNS from the ether". For example, it is possible to make scientific discoveries like Pavel Osmar - to discover self-similar structures (fractals) or something else, if you are lucky. I needed the self-assembly mechanism to explain where gas comes from in coal and why its appearance is a super-unit process COP>100%. Although we do not supply any energy at all, during a sudden emission of coal and gas (spontaneous explosion of a part of a coal seam), energy is released that does colossal work on moving coal and equipment that was in the mine.

Of course, this does not happen every day and not everywhere. Everything depends on the availability of free space. Although we have import substitution, I cannot use our native efficiency because it is defined through work, and I do not like the definition of work (I have been disgusted by it since school). I cannot agree that if I hold something in my hands and do not go anywhere (do not move this something), but stand still, then I do not do work! Therefore, I use only COP (Coefficient of Performance),

which they define not through work, but through energy – as the ratio of the energy out (output) to the energy in (input).

For those who do not understand the mechanism of self-assembly based on the geometry of electrons shells, to help the magazine "Technology of Youth" [34].

Ball lightning, as defined by Petr Leonidovich Kapitsa (1894-1984), is a microwave discharge fed from the environment (Fig. 15 on the left). Plasma electrolysis and accidents at metal-hydrogen reactors LENR (Fig. 15 on the right) are the appearance (spontaneous generation) of electromagnetic (EM) radiation pulses, traditionally called "ultra high frequency" (UHF), but in fact pulses with a steep wave front. According to V.N. Zatelepin and D.S. Baranov, in a metal-hydrogen reactor, excess heat is obtained from the outlet due to high-frequency electrical energy pulses not accounted for by the meter, caused by a self-oscillating process [35]. And in my opinion, the oscilloscope records pulses of consumed electrical power not from the network, but from the ether.



Fig. 15. Volcanic eruption and burnout of the filament

Spontaneous generation of EM pulses in a reactor can be achieved by the experimenter through slow heating and maintained by electronic automation in a quasi-stationary mode for a long time. But if a positive feedback appears in the system, then an exacerbation mode will occur -

resonant ignition (formation) of micro ball lightning, which melts (burns through) the walls of the reactor vessel. In my opinion, metal-hydrogen cold non-nuclear fusion turned out to be ball lightning. I first heard about micro SM from Nikitin Anatoly Ilyich in relation to the explanation of the tracks from the "strange radiation" of Urutskoev Leonid Irbekovich. And I thought why they could not be the cause of accidents with metal-hydrogen reactors (the result of the response of "Maxwell's gears").

Miners are ahead of the rest of the world here too. My institute, IPKON RAS, has had a nanosecond EM impact setup for many years. Those who work on it call it MEMI (powerful electromagnetic pulses). I don't know how powerful they are, but they penetrate 10 mm of air 100 times per second [36]. Valery Vadimovich Krymsky (South Ural State University) is conducting similar work and calls it MNEMI (powerful nanosecond EM

impulses) [37]. I assume that frequency, wavelength and, especially, temperature have no physical meaning for an impulse. I assume that it is MEMI (MNEMI) that performs cold transmutation of nuclei of some chemical elements into others, due to the gradient (steepness of the front) of the flow of mechanical energy ("impact"). Barodynamics of Shestopalov A.V. is gradient etherodynamics. This is the synergetics of processes occurring under the action of gradients of the pressure function of the flow of mechanical energy, including from thermal stresses, electromagnetic (EM) and other shock waves. Microwave in barodynamics is the gradient of the pressure impulse (steepness of the wave front), and "ultra high frequency" is the original meaning of the term in physics (Fig. 16). Microwave in barodynamics, figuratively speaking, is a hammer or a sledgehammer.



Fig. 16. Barodynamics – gradient etherodynamics

In my opinion, ball lightning (BL) as a broadband self-sustaining microwave discharge is an uncontrolled analogue of the resonator of A.Yu. Kushelev. My further reasoning about plasmoids and ether follows from his works [38-40] or is their direct citation. All elements of the crystal-like Faraday-Maxwell ether ("Maxwell's gears") are in continuous rotational motion (Fig. 17), the energy density of which, according to Max Planck, is 10¹¹⁴ joules per cubic meter. "Maxwell's gears" are in engagement, i.e. it is impossible to stop one of them without stopping all the "gears" of the visible universe. The rotation of "Maxwell's gears" is maintained due to the internal energy of the second-order ether (picoworld, Kushelev's ether).

The correctness of the theoretical foundations of microwave energy by Kushelev A.Yu. was confirmed by NASA on the initiative of the British Roger John Shawyer [41], who reinvented Kushelev A.Yu.'s EmDrive [42-43]. If you don't count Etkin

Valery Abramovich (Israel), who posted an article [44] on his personal website and an interview with Georgy Gennadyevich Malinetsky on TV, who explained EmDrive by the Casimir effect [45], specially trained people (academicians and associate professors with candidates) kept mum! Even Nikolay Vladimirovich Samsonenko

ignored the sensation - a microwave oven suspended on a torsion scale was rotating (twisting the scale thread). Journalists dubbed it an "impossible engine" that was repelled by a microwave EM wave without throwing off the reactive mass.

About 10 years ago there was a lot of information about it on the Internet, the film about R. Shoer was even translated into Russian. There was a message that the Chinese successfully tested it in space. Today there is no positive information about it. I think they classified it or slandered it - like with the Yubileiny satellite (with the inertial engine of Valery Aleksandrovich Menshikov in space). EmDrive confirmed the hypothesis of A. Yu. Kushelev that the Christian cross can serve as a microwave engine capable of moving without a jet stream in the air and space. The mechanism for creating thrust is the same as that of a fish. Conduction current in a conductor or displacement current in a dielectric affects the ether in the same way as a fish affects water (pushed off from the environment). Why this movement exists remains to be found out in the future.

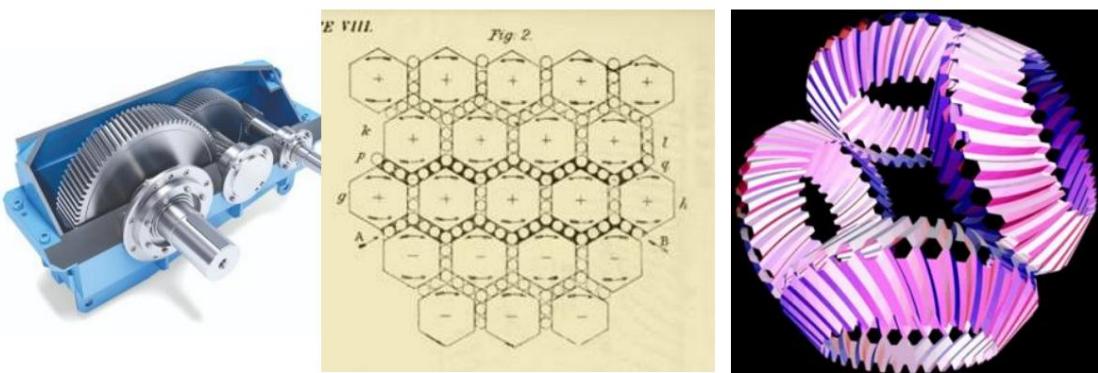


Fig. 17. Maxwell's gear reducer and gears (vortices in the ether)

To extract energy from the ether, electrical or thermal as in a microwave oven, resonators can be used - microwave energy Kushelev A.Yu. In this case, if the resonator is made of ruby balls, then the excess electromagnetic energy is illuminated, thereby protecting the resonator from destruction. One cubic meter of the structure of the nanoworld (ether) contains energy 96 orders of magnitude more than a cubic meter of nuclear fuel. There are other estimates, but in any case - this is a monstrous energy that can be taken from the structure of the nanoworld with the help of electromagnetic

resonator of a special shape and high quality of surface treatment. Theoretically, the quality factor should be more than 150,000. It has been experimentally confirmed [38-40] that the entire class of ritual objects (tridents of ancient gods, swastikas, various types of crowns, etc.) are in fact resonators unknown to official science. Their quality factor is limited only by the accuracy of the frame and the quality of the materials, and therefore is theoretically unlimited. These resonators can be made of both metal and non-conductor. The most effective are dielectric resonators (special classes of polyhedrons, in particular, diamond shape, etc.).

Ruby, basalt, quartzite (both natural and artificial), as well as ceramics, etc., are dielectrics. Ideally, a material with a certain refractive index and dielectric losses (thermal). With the help of such a material (whole or composed of elements), it is possible to organize (direct, focus) electromagnetic waves. Two key conditions must be met in the energy source: 1) good resonance; 2) superposition of electromagnetic fields. Resonance allows obtaining strong electromagnetic fields. In the 2011 experiment in Dubna, the electric field strength was obtained at which YAG (yttrium-aluminum garnet) or ruby glows, i.e. about 107 V/m. Thus, in the 2011 experiment and in

In subsequent experiments Saratov-2017, Moscow-2019, one condition was met - a strong EM field was obtained in a high-Q resonator. Now it remains to add the second condition - a superposition of fields. To do this, it is necessary to excite not a single ruby ball, but a group consisting of 3-5 identical ruby balls. In the space between the balls, a superposition of strong electromagnetic fields will be created (Fig. 18).

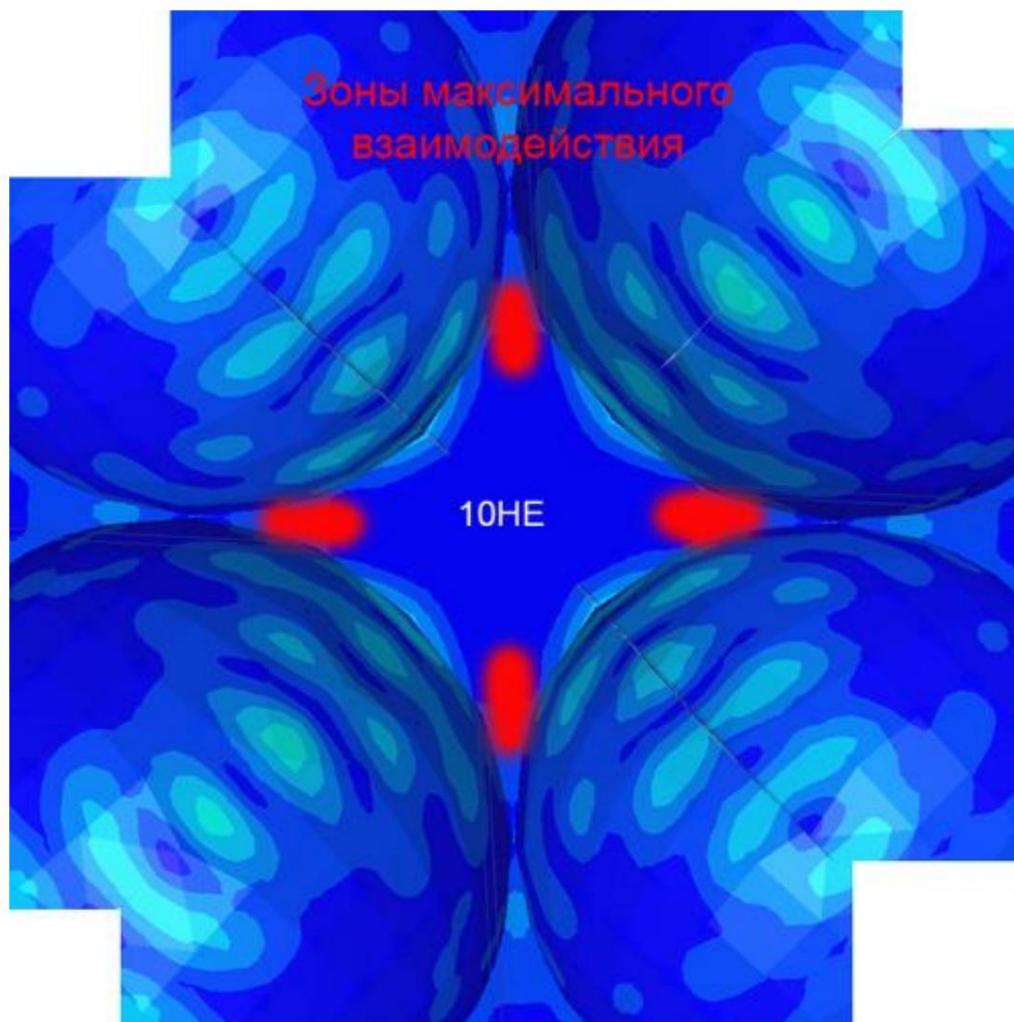


Fig. 18. Result of modeling in the HFSS program.

Let's get back to our metal-hydrogen reactors LENR. After heating the metal hydride to a critical temperature, spontaneous MNEMIs begin to be generated. The first in the world to discover self-generation of EMIs and draw a conclusion (LENR is an electromagnetic process) were V.N. Zatelepin and D.S. Baranov back in 2017 [46] (Fig. 19 on the left). In my opinion, they seem to have no idea that by interacting with the ether, they locally excite "chatter" in the "Maxwell gears" (see Fig. 17) and ignite ball lightning (BL) in the hydride. Self-generation of EMIs may have been observed by other researchers, but they did not draw the proper conclusions, for example, Boris Pavlovich Kuzmin (Fig. 18 on the right).



Fig. 19. Resonant response of Maxwell gears

The well-known "Energoniva" of Vachaev-Ivanov, its replica of 05.03.2015 by Shadrin Alexander Alexandrovich at a frequency of 30-60 GHz and experiments with its prototype by Godin Sergey Mikhailovich - I call the SM of Vachaev A.V. As is known, it has two possible modes: 1) "metallurgical" mode (production of metal powders); 2) "energy" with self-feeding (220-380V 50Hz without a converter). A. Rossi's E-Cat SK plasmoid will go out if you disconnect it from the socket.



Fig. 20. Microwave discharges (MD) Andrea Rossi

To make the plasmoid SM long-lived, it is probably necessary to feed it with "fuel" and remove "ash", but this is not certain. It is known that there was running water in the "Energoniva" installation. At the same time, the induction coil removed excess electricity, thereby protecting the reactor from melting.

Conclusion

The cause of cold nuclear transmutation (CNTS) is shock loads at a steep front of the volt-ampere characteristic, called microwave or powerful nanosecond electromagnetic pulses (MNEMI) of the flow of mechanical energy. Cold non-nuclear fusion is the self-assembly of elementary particles from ether, atoms from elementary particles, molecules from atoms. The so-called me

"HF from the ether". In metal-hydrogen reactors LENR (low-energy nuclear reactions) microscopic ball lightning (micro BL) is born, which emit ultra-high frequency electromagnetic (UHF EM) waves and cause the burnout of the reactor filament and "strange Urutskoev radiation".

Fuel-free electric power generators E-Cat SKL Rossi and Energoniva Vachaeva - This is a self-sustaining microwave discharge, fed from the ether. To explain the principle of their operation, one can and should use the theoretical foundations developed by Kushelev A.Yu. for resonators interacting with the ether, the so-called microwave energy.

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Cold non-nuclear fusion and ball lightning

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The mechanism of the origin of matter on ring-shaped models of atoms and molecules is considered. Cold non-nuclear fusion is the self-assembly of elementary particles from ether, atoms from elementary particles, molecules from atoms. Since synthesis (fusion of light nuclei) it can only be thermonuclear, then I called cold non-nuclear fusion cold nuclear fusion (CJF) from ether. Micro-ball lightning occurs during cold nuclear transmutation (CTH), converts "fuel" into "ash" and burns out the filament in LENR metal-hydrogen reactors. The question of where the energy in ball lightning comes from is considered.

Ball Lightning Characteristics Help Us Understand the Strange Particles: Micro Ball Lightning

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The study of ball lightning properties helps people to understand what I call "microplasmoids" such as the "strange radiation" that are studied by various Russian groups and those produced decades earlier by Bostick, Matsumoto and Shoulders. The various sizes of plasmoids that are in the 5th state of matter are similar to ball lightning and are similar no matter the size scale. So we can use ball lightning to understand how micro ball lightning act and how they are structured and vice versa. Knowing how ball lightning behaves helps us to understand whether models and hypotheses about the experimental micrometer-sized microplasmoids are correct and helps to develop a general theory about plasmoid state materials and also liquid, solid, gas and plasma.

The study of ball lightning (BL) properties helps people to understand what I call "microplasmoids" such as the "strange radiation" that are studied by various Russian groups and those produced decades earlier by Bostick, Matsumoto and Shoulders. The basic point of view of the plasmoid paradigm is that the various sizes of plasmoids that are in the 5th state of matter are similar to ball lightning and are similar no matter the size scale. So we can use BL to understand how micro ball lighting (MBL) act and how they are structured and vice versa. This is how the MBL/microplasmoid field started in the early 1990s by considering that their properties and characteristics are the same as BL. Understanding microplasmoids as MBL has been very fruitful. Knowing how BL behaves helps us to understand whether models and hypotheses about the experimental micrometer-sized microplasmoids are correct and helps to develop a general theory about plasmoid state materials and also liquid, solid, gas and plasma.

History of Micro Ball Lightning Research

After studying and learning about natural BL properties and characteristics, when Matsumoto wrote in early 1992 that he had discovered microscopic markings such as rings and lines on his nuclear emulsion films for particle detection, I realized that Matsumoto was producing MBL and encouraged him to start research on them. See Figure 1. It is his photograph of three rings and also a borehole, a tunnel, made by an MBL at the empty corner of the parallelogram. The MBL tunnel isn't visible in this photograph though it is visible in the original publication. From reading about BL in books and research articles, I knew BL is sometimes associated with transmuted residues as well as tunnels and various kinds of grooves and ditches they leave on surfaces and the ground. He didn't publish his BL articles in the ICCF conferences. I don't think he was ever invited to do so. Matsumoto experimented on MBL (microplasmoids) and attended BL symposiums.

In the early 1990s, I realized that the atoms themselves can enter a state in which they behave like BL. I called this state the "BL state" or alternatively the "plasmoid state" of matter.[1] I realized the anomalous reactions of the cold fusion field occurred when this state of matter was formed in experiments and that the microplasmoids could convert regular material to be in this state.

In 1992, I read Ken Shoulders' patents. At that time, he didn't have publications other than his book which few people had a copy of. In his writings, Shoulders called them "EVs" in the 1980s and early 1990s. By the middle 1990s, Matsumoto and Shoulders both experimentally showed that microplasmoids produced tracks and transmutation. Shoulders focused on explaining though his extensive experimental research that EV objects have black and white states into which they shift[2], and he also explained that there are other anomalous phenomena such as the "cold sloshing" phenomena in which the objects move materials without heat as if they make atoms of materials become superfluid.[3]

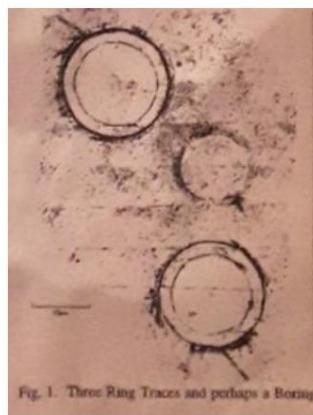
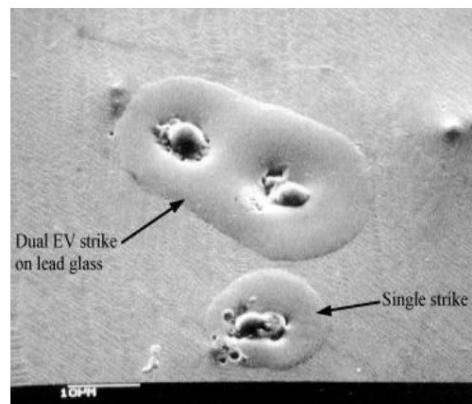


Fig. 1. Three Ring Traces and perhaps a Boring

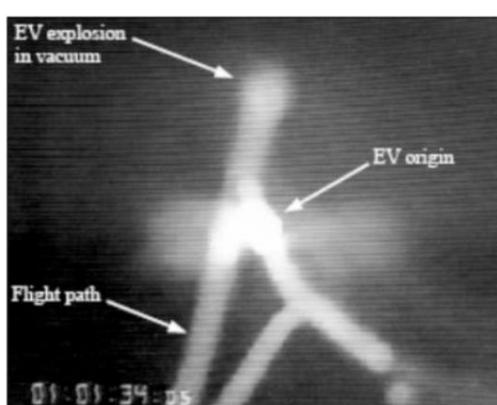


See Figure 2. It is a picture of MBL strike marks on glass. You can see that the individual MBLs left domes, and around the domes it looks as if the glass had melted.

According to Shoulders, atoms in such MBL strike marks would spread out to a thickness of only 1 atom. This suggested that the atoms had temporarily been in a superfluid state at ordinary temperatures, but emphasized that there was no evidence that the glass was heated

above room temperatures. This was a heatless "sloshing" of material as BL also does. In contact with BLs and MBLs, atoms loose their usual normal state properties and seem to have no inertia or friction. Friction is an electromagnetic phenomena. Inertia according to relativity theory is a property of mass-energy.

Shoulder's also emphasized the inertia-less motions of MBL. That is, when MBL makes turns, they turn without deceleration or curvature in flight. In the photograph in Figure 3, he pointed out that the streak of light on the photographic film that was



created by the very fast moving MBL did not show any brightening at the corners that would have happened if the MBL slowed down as it made the very sharp angled turns without curvature. This is highly anomalous but is characteristic also of BL motions

when they make sharp angled turns in the atmosphere. This is why people consider them to be from some other world since they never saw anything move in this way. Any model of microplasmoids must explain these anomalies as well as BL size and duration and gravity-like effects. As explained below, some large BL last more than an hour and have gravity-like effects on matter.

Micro Ball Lighting and Gigantic Atmospheric Ball Lightning Called UFOs

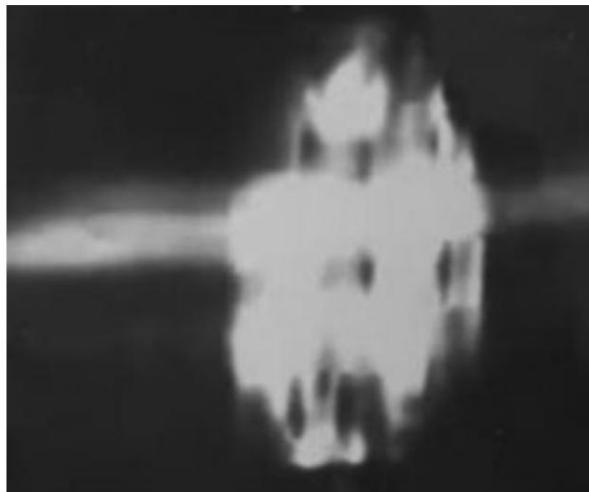
Microscopic-sized ball lightning (MBL) and giant ball lightning (BL) hundreds of meters or kilometers wide exist too.

Micro Ball Lightning

No matter the size, BL appears to behave the same. The MBL act just like bigger BL.

Until the 1990s, no one knew that BL existed in microscopic form. They were discovered when the Japanese researcher Matsumoto started to detect microscopic ring markings that were about 50 micrometers wide on particle detection film that he put outside of an electrolysis cell in 1992. Figure 1 with 3 rings is an example of the rings he discovered.

They are smaller than 80 micrometers or a little smaller than the width of human hair. Like snowflakes, each individual MBL and BL is different. I realized he was producing MBL because natural BL sometimes leave ring markings.



Since 1992, about two dozen groups of researchers have studied MBL. They produce them with electrical discharges and in other ways. They are easy to make with electrical discharges.

Figure 4 is a picture of a group of MBL in a geometrical cluster. It is 15 millimeters long. BL and MBL arrange themselves geometrically. Usually they are arranged as chains or rings, but more complex patterns are seen too. You can imagine that people seeing a big one like that in the sky might call it a UFO. Figure 4 was published by Bogdanovich et al. in 2019[4].

Usually, there is a haze or cloud around the 5th state components of an MBL or BL.

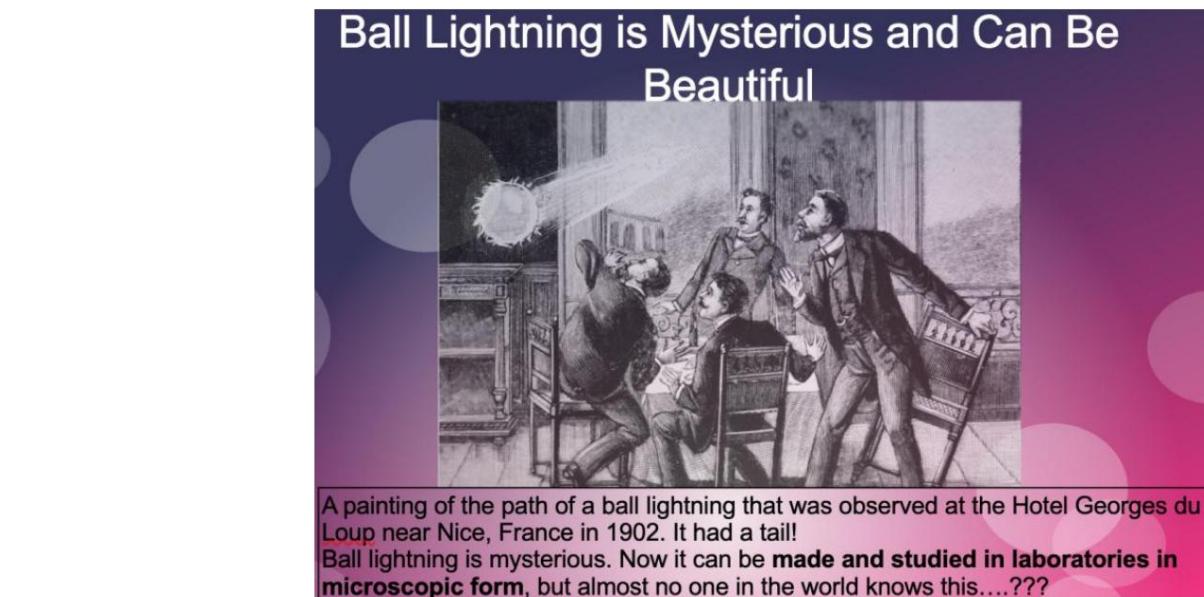
Such a cloud around the geometric configuration of MBL would make the object in Figure 4 appear more like a ball, perhaps an oblong ball. In the same way, a ring of individual MBL is visible as individual objects if it doesn't have a cloud around it. If it does, then it appears as a toroid or donut shape or a disc. Such a cloud would also include water vapor, leaves, and other materials if a BL is big enough or powerful enough to take materials with it. This happens with tornadoes.

Giant Ball Lightning

Usually, people say that BL are about the size of a volleyball or basketball as in Figure 5 that is a painting of a BL with a tail.

Giant BLs form in storm clouds or come out of the earth during volcanic eruptions and earthquakes. They can be bigger than 100 meters wide. Egon Bach wrote a wonderful book

with photographs and his description of state changing giant plasmoids changing repeatedly from black state to white state. His book is titled: "UFOs From the Volcanoes." [5] Giant BLs have been videoed around volcanoes since the time that video cameras and phones with video cameras have become widely used, and people have been calling them "orbs."



In Egon Bach's book[5], there is a chapter with very remarkable accounts from eyewitnesses about the emission of many huge ball lightnings about 130 meters wide and smaller from Redoubt Volcano in Alaska in Feb. 15, 1990. The book is extremely valuable for plasmoid researchers just for this section of the book. Bach had many far-reaching ideas.

Bach published this description given by John Burns who was a foreman on the Drift River Oil Terminal. Burns said:

"These comet-like things were mostly brilliantly white with a pale greenish ... tinge ... the objects really resembled the illustrations of comets. They left really broad tracks as they flew straight on their paths. There were also common lightnings ... I have seen lightnings in a big tornado back in Texas, but they were no match for all the volcanic lightning."

Equally large BL may be in storm clouds too. According to several meteorologists who published in the 1950s and 1960s, nimbus or cumulonimbus storm clouds may have big round blue blinking lights inside. For example, a meteorologist named Herbert L. Jones called them "tornado pulse generators." He wrote that the tornado pulse generators are generally at an elevation of six kilometers "somewhere in the middle of a massive thunderstorm structure" and appears as a "blinking, pale blue, circular area of light on the side of the thunderstorm cloud." [6]

As explained in several papers such as "Tornadoes and Ball Lightning" [7], a big BL that Jones saw became a huge, powerful and brilliantly shining blue tornado an hour later. Jones wrote that a storm cloud that he studied had such a big round blue light. This big blue BL turned into a huge, powerful and brilliantly shining blue tornado an hour later that wreaked destruction in Oklahoma and Kansas. The tornado started with a blue toroidal top, and later the whole funnel was brilliantly lit and blue.

Here is the sequence reports about the BL that turned into a tornado. This is all published material. First, a meteorologist in the Tornado Laboratory and the Department of Electrical Engineering of Oklahoma State University watched a big blue light that blinked on and off every two seconds in a nimbus or cumulonimbus thunder cloud that passed by in the evening at 9:25 PM near Stillwater, Oklahoma on May 25, 1955.[7] He and others in his Tornado Laboratory observed with meteorological equipment that there was significant electrical activity from the cloud that would indicate the generation of very much lightning, but he could see no visible lightning. He concluded that the electrical activity came from a big blue light in the cloud that blinked on and off every two seconds. It would shine for two seconds and then be totally dark for two seconds. While it was shining, it was emitted a great intensity of electromagnetic radiation. In the 2 second intervals when it was dark, their equipment didn't register the electromagnetic radiation. This is a common behavior of both atmospheric and microscopic BL because BL switch between black and white states. It is one of the strange behaviors of BL that people call UFOs.

Then in Blackwell, Oklahoma, at 9:27 PM, just two minutes later, a weather observer for the US Weather Service named F. Montgomery[8] who was stationed in Blackwell, Oklahoma in May of 1955 reported that the tornado in the same cloud structure passed by. He wrote that it had a deep blue section that was near the top near the cloud layer and that the top bright section of the tornado was "very much brighter" than an arc welder and too bright for him to look at, though the tornado was 9 blocks or 3600 feet away from him! I suspect that the bright section may have been toroid shaped since a common plasmoid form is toroidal and tornadoes are cylindrical as if they are composed of stacks of toroids. He reported that the air from the tornado felt hot and that the temperature as recorded by a thermometer at his instrument shelter rose from 74 degrees Fahrenheit to 80 degrees Fahrenheit when the storm struck. This is evidence of a spectacular rate of radiation.

Someone with the necessary mathematical skill and knowledge of thermodynamics might be able to calculate the energy release necessary to raise the temperature by 6 degrees in the open atmosphere from the energy from the tornado at that distance. And he reported:

"There were rapidly rotating clouds passing in front of the top of the funnel. These clouds were illuminated only by the luminous band of light. The light would grow dim when these clouds were in front, and then it would grow bright again as I could see between the clouds. As near as I can explain, I would say that the light was the same color as an electric arc welder but very much brighter. **The light was so intense that I had to look away** when there were no clouds in front. The light and the clouds seemed to be turning to the right like a beacon in a lighthouse[9].

A person named Lee Hunter saw this same tornado a little later, four miles north of Blackwell, Oklahoma. He reported:

"The funnel from the cloud to the ground was lit up. It was a steady, deep blue light -- very bright. It had an orange color fire in the center from the cloud to the ground. As it came along my field, it took a swath about 100 yards wide. As it swung from left to right, it looked like a giant neon tube in the air, or a flagman at a railroad crossing. As it swung along the ground level, the orange fire or electricity would gush out from the bottom of the funnel, and the updraft would take it up in the air causing a terrific light -- and it was gone!
As it swung to the other side, the orange fire would flare up and do the same[9]."

So the entire funnel became luminescent. This shows that the deep blue band of light that Montgomery saw was not intrinsically different than the rest of the funnel. The tornado was layered, I am guessing, and composed of stacked toroids because other observations support this idea. It is suggested that tornadoes too are plasmoid phenomena.

For example, a trained weather observer named R. Hall[10] was inside a tornado in Texas in 1948. In addition to reporting a large brilliant cloud which shimmered like a fluorescent light that partly filled the middle of the funnel and that did not touch the seemingly opaque sides, and no vacuum, he wrote: "It looked as if the **whole column were composed of rings or layers**, and when a higher ring moved on immediately toward the southeast, the ring below slipped over to get back under it. This ripping motion continued on down toward the lower tip."

It is quite rare that people have been inside tornadoes and survived. It is rarer still that people would be observant inside a tornado, and even rarer that an experienced weather observer would be so observant. It is quite rare still that a person's report of experiences inside a tornado would be published as widely as his was. So experiences like these should be pondered by those wishing to understand this phenomena.

Recently, better quality photographs of MBL strike marks that have been made available by various researchers show that some MBL may have inside them an internal structure of close-linked rope-like structures. It isn't clear as yet whether all MBL might have such structures inside them. This linkage structure is different than the one described by Shoulders for an MBL chain or an MBL ring, and it is different than the structure usually seen when atmospheric BL link into chains.

Shoulders described that the typical MBL chain or ring structure is one where the spacing of the MBL is about the same as the diameter of the MBLs in the chain or ring. In a typical chain or ring of BL and MBL, the individual components are about the same size.

Now it is clear that inside at least some MBL, there are closely-linked MBL ropes that have components that seem to almost touch each other or to actually touch as in the tornado stack that Hall saw. Greenyer recently obtained Matsumoto's original high quality photographs that show closely-linked chain structures in some MBL traces. These photographs are clearer and more detailed than those that Matsumoto made available in print while he was still publishing articles about the year 2005 and before.

Through repeated observations and tracking of nimbus or cumulonimbus clouds with big blue lights, Jones concluded that these clouds with lights might generate tornadoes, but they don't always do so. The electrical activity is higher if a tornado forms. He noticed that there was intense electrical activity recorded by meteorological equipment when the blue lights were visible when they are blinking and that there wasn't any electrical activity recorded when the blue lights were dark. This matches my ideas about the states of ball lightning and plasmoids in general. In the white state, they are energetic, and in the black state they are non-energetic and have little or no interaction with common matter so that they pass through

common matter with little or no damage as BL does through windows and other materials without making a tunnel or pit.

Based on Jones report that he saw these blue lights on other occasions and other evidence, this shows that tornadoes develop from plasmoids. The big BLs might be in a dark state in clouds so that they are not easy to see until they switch to the white state or start blinking, and of course if a tornado exists at night, it is easier to see the luminescence. Most tornados in the US occur during the daytime however.



Giant BL structures in clouds such as the ones seen by Jones are apparently not so uncommon. In a book about the Bermuda Triangle titled *The Devil's Triangle*, there is a drawing of a typical cumulonimbus cloud that was courtesy of the Aviation Training Division of the US Navy. The drawing was meant to be a diagram of typical cumulonimbus cloud structures. They drew a black spot in the base of the cloud, below the altitude of freezing, that was termed a "dark area" that is roughly similar in size and shape and position relative to the rest of the structure of the cloud as the blue spots in the clouds drawn by H. Jones and shown in his article. Perhaps they drew black state giant BL in clouds.

In Figure 6, there is a photograph of a big ring of shining giant BLs over Tijuana. It is easy to see that people would call that a UFO. It resembles the shape and structure of the ring of pits in the Figure 7 that was photographed by Shoulders. It is a ring of pits that was left on material by a ring of MBL. He called these circular string of MBLs "necklaces."

Both of these rings show what Shoulders and myself thought was the more typical spacing for MBL in the 1990s.

Astrophysical Fifth State Plasmoids

The plasmoid field started in the 1950s when Bostick experimented with electrical discharges and photographed the shapes of the plasmoids that were created. The plasmoids had the shape of galaxies. After that, much work about astrophysical modeling and theorizing of the Universe as plasmoid phenomena was accomplished for several decades by astrophysicists. The plasmoid concept was developed substantially by astrophysics and people modeling astrophysical plasmoids. In the 1970s, the focus of Shoulders and Bostick was in the fine structure of the microplasmoids. They both noticed that the energetic density of plasmoids was greater than would be possible if quantum mechanics were valid. People believed that so much charge could not exist in such tiny spaces. People believe that

electrons would naturally spread out and dissipate. Shoulders concluded that quantum mechanics isn't valid.

Shoulders continued his research to try to fine tune his equipment, and he was able to detect that the types of plasmoids that Bostick and others were studying are composed of smaller components he called "EVs." He intensively studied these EVs with a group of others in the 1980s. I call these EVs MBLs. Figure 7 is the mark of a ring of MBLs. He knew that the EVs violated the laws of quantum mechanics. The charge density was greater than quantum mechanics says is possible, but he is convinced Richard Feynman, one of the developers of QED theory, that the charge density actually exists.

About 20 years ago, a group called the Thunderbolts Project started to try to find evidence of planetary plasmoid activity. They've collected much evidence that huge plasmoids affect the planets and mark them with typical plasmoid markings. However, they do not research in the concept of BL or seem to appreciate the work being done in this microplasmoid field since they never mention the research. They showed that giant plasmoids exist in the solar system. There are hundreds of photographs of BL-like markings on planets and moons and asteroids. Figure 8 is an example. It is a picture of a dome and crater on the planet Mars that was taken by a spacecraft near Mars. It is shown next to Figure 9 that is a photograph of a similar crater and dome by Ken Shoulders. The inner dome is about 11 micrometers wide. Even though both craters look as if heating was involved in their formation and that there was melting of material, the material might have actually not melted. Perhaps the atoms changed state to move like a fluid with contact with the huge planetary BL and the MBL. Compare these houses with the houses in Figure 2.

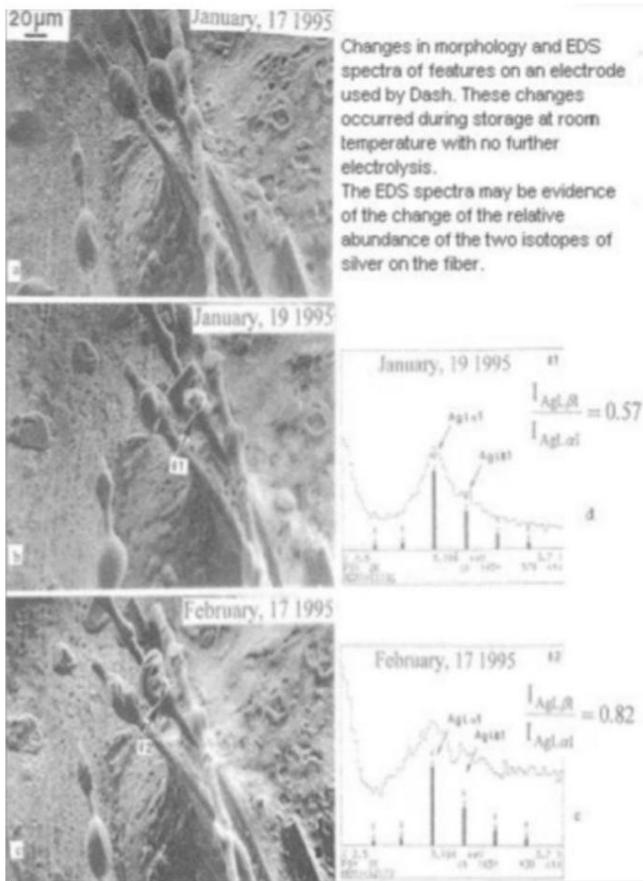
Domes are common in MBL markings.



What They Are: The 5th State of Matter!

These MBL, BL, and giant BL objects behave very differently than material in the common states of plasma, gas, water and solid. It is obvious that quantum mechanics principles can't apply to them since their behavior, including transmutation, frictionless and inertialess motion, and gravitational effect contradict quantum mechanics. In the early 1990s, I realized that BL and MBL are in the 5th state of matter. There is evidence that small patches of this state of matter exists for months and years in components of electrical

discharge and electrolysis experiments. Sometimes, such equipment continues to emit MBLs for months or years as Urutskoev reported. Researchers such as Savvatimova and Rodionov[11] find that microscopic patches of such equipment move very slowly, transform in shape, and transmute after the experiment is over. When material contains a patch of material that is in the fifth state, I call it a "microplasmoid patch." Such patches can't be called an MBL because BL move freely.



He showed EDS spectra with the pictures.

For example, 2006[11], Savvatimova and Rodionov wrote: "Sometimes these structures remind bacteria or a colony of bacteria, which may glow (fluoresce) in the dark. These objects move randomly, they appear on the surface or "plunge" back into the depth of the previously monolithic material. This activity of 'live' bacteria objects may continue for weeks after the energetic influence (after it has been finished)." Though they use the word "bacteria" in their article, they know it isn't biological bacteria. They are saying that the active, moving, and strange materials almost behave like living bacteria.

The first hard evidence I saw of this fifth state material existing for a long period of time, much longer than the hours of a BL-tornado structure, was an article published by John Dash in the middle of the 1990s. In his article, he showed the picture in Figure 10. These are fibers that grew during a period of 1 month. You can see that the maximum width of the fibers were 20 micrometers.

So when researchers stop their experiments and put the pieces away, the fifth state material may still transmute, transform, and emit MBL. They may be dangerous actually.

The fifth state materials might damage equipment as they move around and transmute chemically, elementally, and morphologically, and the MBL that the patches emit might damage equipment and life as well.

The Fifth State of Matter Has States of Existence

The 5th state of matter itself exists in states of plasmoid material: black, white and possibly gray states. Shoulders explained this in his writings and his book. This is what makes controlling and even detecting 5th state material difficult. The white state is energetic, luminescent and may explode and cause transmutations. If it contacts materials, it may leave

pits, tunnels, or grooves in the materials. The black state may be endothermic and absorb light. It can pass through materials without disturbing the materials they pass through.



They emit little or no radiation as when the giant BL in the cloud that Jones tracked was in the black state as it blinked black and white. Fifth state plasmoids can blink back and forth from white to black states. This is another reason

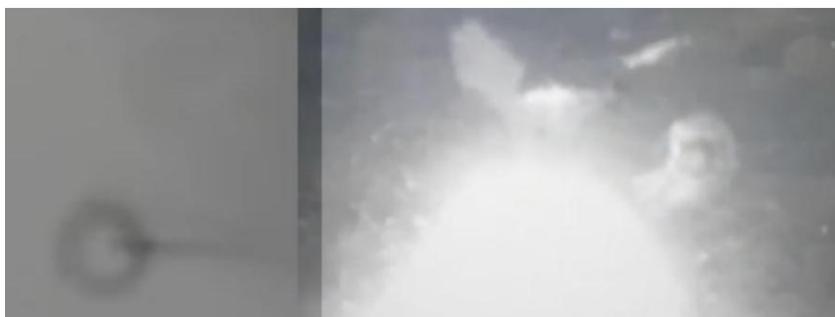
people think they are seeing UFOs. Egon Bach and Shoulders both showed photographic evidence of the state changing.

Egon Bach's photographs of this effect are in his book.

Shoulders picture of the flight path of an MBL that switched from white to dark to white as it moved is in his book. Shoulder's photograph is similar to Daviau's MBL tunnel and the picture of the two part tunnel that is discussed in the conclusion.

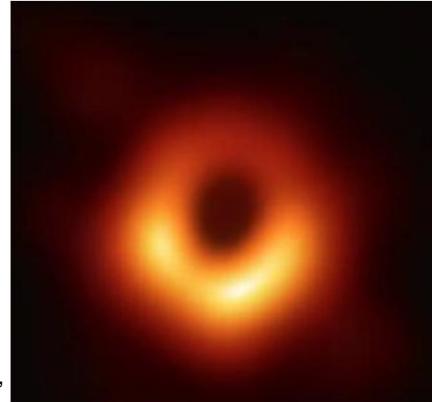
Bagdanovich took several pictures of black state MBLs[4]. See Figures 11, 12, and 13.

They are only seen as black rings against the bright background behind them.



For comparison, people are claiming that Figure 14 is as a photograph of a black hole. Might it actually be a picture of an astronomically large ring plasmoid? See how the shape of it is very similar to these black state toroidal MBL. It looks like a toroidal white state ball lighting.

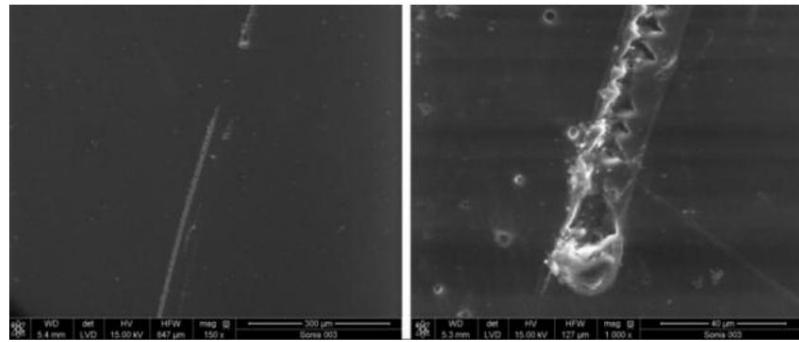
Both tornadoes and BL show gravitational effects. However, there isn't really space here to write about that or show the examples of where these gravitational effects were noticed. But here is one example: A person named Dr. Pettier saw fir trees being plucked up, and then "he felt a kind of pressure from above; he noticed an unusual smell of ozone; then he felt himself raised up, and this not by the wind, for it was calm, but as though by some invisible force." Also, "on many trees the foliage was scorched[12]." This particular tornado was also associated with ball lightning and round holes with sharp edges that were left in window 313



panes. Anyone experiencing such gravitation effects from large BL might deem this as UFO activity too.

Conclusion

The fifth state of matter exists from atomic sizes to astronomical sizes. On earth, large BL exist in clouds in the black state or the white state or shift between the two states, and sometimes, these large BL become tornadoes. People have seen huge brightly luminous tornadoes and ball lightning. They are often called UFOs.



Transmutation occurs when fifth state matter is formed. It causes atoms to act very anomalously, even loosing their friction, and when they move in flight, they don't exhibit inertial motion. They make very sharp angled turns or backtrack on themselves without deceleration. There is also evidence collected by researchers such as Nikitin and myself that they exhibit some sort of attractive force as was described above when R. Hall was inside a luminescent tornado in Texas. I think this is gravity.

Just as a BL or MBL may pass through glass or other materials, this state of matter, as it moves through atoms or contacts them, may cause atoms to change state, become like BL, and transmute. If the BL or MBL are in the black state, they may have no effect on regular state atoms as they pass through. The fifth state material, depending on its state, may interact with the regular state atoms or cause atoms to change state and interact and so transmutations and morphological transformations occur. If black state material is inside materials or beside atoms, if it changes state to a white state, then there may be sudden transmutation and changes of morphology. Crystals or strange objects such as spheres may form.

The fifth state of matter might be dangerous. BL kills or wounds people and animals and burns down buildings, and MBL may damage equipment and also cause cellular harm as the article by Priakhin and Urutskoev[13] described about the damage done to growing plants. Please take precautions by constantly monitoring MBL emission and using lead shielding. Perhaps stay away from the experiments during operation, and make sure that the components, especially the active components such as electrodes, are also put someplace

safe, perhaps in a lead container, since they also might continue to emit MBL. The MBL might be in a black state coming out of the experiment so that you wouldn't detect it.

However, it might continue to travel past your detectors, change state and cause damage away from the experiment. Also, MBL might fly and embed themselves in materials around your experiment or device and become long-lasting microplasmoid patch material.

For more information about fifth state matter safety considerations and also for a discussion and photographs about how an MBL in the white state made a micro tunnel in one of Daviau's samples and converted in motion to a black state and then changed to the white state leaving a two part tunnel with undisturbed material between them, see Reference 14. See Figure 15 by Daviau[15]

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Ball Lightning Characteristics Help Us Understand Strange Particles: Microball Lightning

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Studying the properties of ball lightning helps people understand what I call "microplasmoids" such as the "strange radiation" studied by various Russian groups and those called out decades earlier by Bostic, Matsumoto and Shoulders. The various sizes of plasmoids in the 5th state of matter are similar to ball lightning and are the same regardless of the size scale. So we can use BL to understand how microball lightning acts, how it is structured and vice versa. Knowing how ball lightning behaves helps us understand whether models and hypotheses about experimental microplasmoids of micrometer size are correct and helps develop a general theory about the plasmoid state of materials, liquid, solid, gas and plasma.

**Theoretical, experimental and applied studies of the
interaction of physical fields with matter**

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Reality as a symmetrical stratification into coordinate space and momentum space, dividing the electromagnetic wave into magnetic and electric components, and charges into electric and magnetic

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The paper substantiates the hypothesis that the six-dimensionality of the phase space in which the evolution of the entity occurs is not a mathematical abstraction, but an ontological reality. Dynamic space has its own geometry, where, as in the space of coordinates, the concepts of manifold, curvature, etc. are applicable. Then the electromagnetic wave, as the sum of two vectors, is a six-dimensional manifold, while its electrical part

connectivity

And

q-space generation, the magnetic part exists in p-like coordinate and momentum, have their own point spatial space. nature and evolve in parallel in conjugate spaces. Electric charges are singularities, magnetic monopoles appear in dynamic space as singularities with charge g, and appear in coordinate space as vectors or *strings*. This is the reason for the non-manifestation of the string. The electric potential is singular in the magnetic potential in the dynamic –

coordinate space

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Introduction

Based on the concepts of quantum mechanics, we can decompose the wave function of an arbitrary entity into a basis of possible states (an entity is understood as a single system: electron, proton, atom, molecule, etc.). The state of rest and the state of motion can be taken as such a basis. And, despite the fact that the state of rest is unique, while motion is a continuum of possibilities, these two states are orthogonal to each other, where is the volume. Such a picture arises if we consider reality from the coordinate space. If we move to the momentum space, then the picture will be symmetrical there - according to the Heisenberg uncertainty principle, a state with a certain momentum corresponds to a continuum of coordinates. Such a decomposition of the basis into rest and motion can be expressed somewhat differently. This is a decomposition of the basis into Euclidean and non-Euclidean, since motion leads to the appearance of a magnetic field, and becomes curvilinear. Therefore, *Euclideanity* and *rest* in our model are synonyms and are associated with the coordinate space. As will be seen below, the momentum provides

connectivity of the coordinate space, and the coordinate is the connectivity of the momentum space. At the same time, the state of rest

forms a dedicated coordinate system, which would seem to contradict the special theory of relativity. Here, for example, one can refer to the fundamental work [12], which shows that objectively one can only talk about the rest mass of a body and about the coordinate system where the body is at rest. The duality of the material and field approaches is well known, for example, Coulomb's law can be considered in two versions - as describing the interaction of charges or the interaction of charge

and field:

— · In other words, electric charge as an energy singularity

moves in a field with a changing energy density , which is modeled by the Hamiltonian. In addition, the external field changes the mass of the particle [14] that moves in it, which is well known from experiments to determine the features of the electron's motion in the self-consistent field of a crystal. Such a mass is called effective, although as a measure of inertia it is identical to the usual one. At the extremum points of the Fermi surface, the effective mass of an electron can be calculated using the formula: In other words, a free electron acquires an energy "coat" consisting of the surrounding space polarized by it. Can such a "coat" be considered the real mass of an electron? In

According to Mach's principle, the answer will be "yes", since mass is the measure of inertia of an entity.

Einstein [20] believed that mass particles differ from massless ones by a higher field density. In modern field theory, mass is identified with the oscillation frequency in a potential well formed by spontaneous symmetry breaking [16] to within a coefficient. A trinity arises: mass-energy-frequency. Therefore, the movement of a charge in a crystal can be considered the movement of an energy formation of one density inside another. Based on this, we can conclude that the reality of holes in a crystal is in no way "worse" than the reality of electrons, only in this case the interaction energy of the "hole" entity and the self-consistent field is less than the average background energy density of the crystal. Therefore, the discovery of other mobile energy structures in a crystal associated with the Fermi energy, similar to holes, may indicate, for example, the discovery of magnetic charges.

In the nineteenth century, Poincaré, Liouville, and Hamilton [1] introduced the idea that a six-dimensional phase space with three spatial generalized coordinates q and three coordinates p in momentum space is necessary and sufficient to describe any discrete system. These two conjugate spaces are independent and enter into the description of the system on equal terms, together forming a symplectic structure. Symplecticity

indicates the non-commutativity of the coordinate and momentum , well known from quantum mechanics. Here and denote the corresponding unit vectors in spaces with generalized p and q coordinates. That the coordinates and

impulses enter equally into the construction of reality, as evidenced by the factorization of the Hamiltonian having a symmetric form. In this case, the dynamics of the system is determined regarding replacement

Lagrangian or skew-symmetric form with respect to the same replacement Six-dimensionality also follows from the fundamental equation of dynamics – Newton's second law, which is a second-order equation with respect to the time derivative, since the solution of such an equation in accordance with the Cauchy rule requires initial conditions – coordinate and momentum. *The key assertion of our work is that the six-dimensionality of the phase space is not a mathematical abstraction, but an ontological reality.* For example, if Newton's equation were determined by the third derivative, then the space of accelerations would appear along with the spaces of coordinates and momentums.

In order to imagine such a six-dimensionality, we will turn to the already not new idea of discreteness of space, in other words, to a three-dimensional grid made with a certain step [2]. Then an arbitrary object, moving sequentially, activates the points located at the vertices of the said grid. In the work [17] we assumed that reality is sequentially assembled from two spaces (one is nested in the other): from the observed q-space, with q coordinates, and p-space, like Morse code: dash-dot-dash, forming a six-dimensional phase space, as schematically shown in Figure 1. The points of q-space alternate with the vectors of p-space. From the figure it is clear that p-space implements the connectivity of q-space.

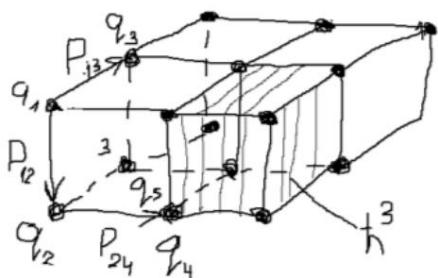


Fig.1

The elementary cell of the six-manifold is Planck's dimensional constant characterizes the minimal disordered cell, or six-dimensional cell of chaos, as shown in Figure 1. It is assumed that such cells form such defines . Constant

visible world.

Through such a model of six-dimensional reality, Zeno's paradoxes are resolved, among other things, since they arise as dimensional paradoxes. The term *dimensional* was introduced by Frankl in [19]. He considered two contradictory projections of a cone: a circle and a triangle. The reduction of the six-dimensional phase space to three-dimensional q-space, produced by Zeno, obviously leads to a loss of information. As a result of the reduction, there is no motion in Zeno's q-space.

Let us emphasize that the picture shown in Figure 1 demonstrates the projection of the phase space into the coordinate space, but if it is projected into the dynamic space, then q and p in the figure will change places and the coordinates will play the role of connectivity.

This work develops the ideas proposed in [18], where the mass of an arbitrary body was presented by us as a certain operator (tensor) that implements the connection between the coordinate space and the dynamic space. In the nonrelativistic case, this connection is implemented by the known expression for In both spaces, one can introduce the metric, distance, and such characteristics of the corresponding space as curvature, Christoffell symbols

- where the index means that the quantity belongs to the dynamic space,

,
and others.

Basic Provisions

The idea that the magnetic field is an inertial characteristic of an electromagnetic wave, i.e. exists in a dynamic space (momentum is a measure of the inertia of a body) first arose after B. Ya. Zeldovich [9] drew attention to the fact that impedance has the same dimension as the magnetic field. Also, the term with the magnetic field in Newton's second law (the Lorentz force) is linear in velocity and is responsible for the change in momentum, i.e. it plays the role of "viscosity". This confirms that the magnetic field is a dynamic characteristic of an electromagnetic wave. Dynamic, in the sense that the magnetic field evolves in a three-dimensional p-space of momenta, which is conjugate to the q-space. It is obvious that in this case the stationary picture of charges (when the projection of the system trajectory onto the p-space is zero, i.e. the entire six-dimensional manifold describing the system under consideration degenerates and is in the q-space) will not create a magnetic field, which is observed in the experiment. Thus, our hypothesis is that the electromagnetic is a manifestation of a wave as the sum of two vectors of the six-dimensionality of the phase space. In this case, its electric part is a product of the usual q-space, while the magnetic part exists in the p-space. The E -H parts are not transformed into each other according to the laws of orthodox electrodynamics, but evolve in parallel in different spaces, just as the momentum is not transformed into coordinates, but determines the change in coordinates by means of the mass operator.

And

It is known that electric charges are point-like and are spatial singularities, then, based on symmetry considerations and the above, magnetic monopoles should manifest themselves as features in dynamic, momentum space, and can look like vectors or *strings in coordinate space*. Such a representation may be the main reason for the string's own non-manifestation, since dynamic singularities are not observed directly [8]. The previous reasoning explains why a magnetic charge, like holes in a crystal, is not observed *in a free form*, although Ampere had already discussed this mysterious entity. Following him, Maxwell discovered that when replacing a magnetic field with an electric field E , an asymmetry of

the equations he had obtained arises. Dirac [8] attempted to reduce the equations to a symmetrical form, filling this gap and introducing the concept of a magnetic monopole. An important advantage of his theory was the explanation of the quantization of the electric charge e , associated with the intensity . In this case, the quantization of the electric charge occurs,

even if there is only one monopole. The fact that electric charge is quantized has been verified in numerous experiments, which indirectly confirms Dirac's hypothesis [3]. But attempts to detect magnetic monopoles have failed, and it has been accepted that they do not exist. Scientific journals have stopped accepting articles on such topics.

The essential difference between electric and magnetic charges in Dirac's theory is in their spatial distribution. If the electric charge is localized at a point where there is a singularity of the electric potential, the singularity of the magnetic potential, according to Dirac, is located on a certain curve extending from a monopole to infinity or to another monopole. Dirac called such a curve a string. Obviously, there is some overlap with the later string theory. He also noted that the variables describing such a string, which he called dynamic coordinates or *non-physical variables*, do not describe reality.

If, in accordance with the previous statement, the structure of the magnetic field describes the dynamic space, then the magnetic charge "lives" in its feature, and in the coordinate dynamic space can manifest itself in the form of a string. The index m means that this potential refers to

It is easy to see, using the TFKP approach, that if the feature the amplitude of the potential created by an electric charge has the form of a pole then the singularity of the magnetic monopole has the form of a cut of generating phase

Discussion

Einstein, constructing the general theory of relativity, following Clifford [4], introduced the concept of space curvature and equated it to the energy-momentum tensor, defining the dynamics of gravitating systems. But the electromagnetic field also introduces non-Euclidean properties into empty space, giving it curvature. Moreover, the vector potential of the electromagnetic field determines the connectivity of the electromagnetic manifold along which the particle under study propagates, and the Berry phase, defined below, determines the connectivity of the dynamic space, which continues to demonstrate the symmetry between q and p -spaces.

From differential geometry it is known that when some vector field evolves not in Euclidean space, but on a curvilinear manifold, the ordinary derivative changes to a covariant derivative [13]:

where the second term determines the connectivity of the manifold. More precisely, the correction to the trivial connectivity. The Christoffel coefficients contain information about the curvature and torsion of the manifold. And they also determine the dynamics of a system moving along such a manifold. It is known [11] that when a charge moves in an electromagnetic field, the momentum is replaced by an extended momentum of the same particle

in an electromagnetic field with potential. As you can easily see, the electromagnetic potential performs

the role of connectivity, which determines non-Euclideanism, and the electromagnetic field itself – the role of the manifold along which the particle moves. Since the momentum in quantum

mechanics associated with gradient —, the identity of movement is obvious

in an electromagnetic field:

— — — (2)

and motion along a curved manifold (1). With such motion, the particle acquires an additional phase shift due to the curvature of the manifold along which it moves, since the wave function from the Euclidean version must also be transformed:

— (3)

This additional phase excursion, as will be seen below, is associated with the effect of *the geometric phase* [10] and its special case – the dynamic phase (*Berry phase*). Returning to the Euclidean case, in the absence of electromagnetic potentials, the momentum p is a trivial connection of the coordinate space, which was depicted in Figure 1. The momentum plays the role of the generator of the Lie algebra of the commutative group of Euclidean translations and, at the same time, the group $U1$. The vector potential A determines the curvature of the electromagnetic manifold in which the particle moves, and, at the same time, the chosen field model. In accordance with the principle of relativity in the non-relativistic case, this model must be invariant with respect to Galilean transformations, which leads to gauge theory in quantum field theory, where the four-dimensional vector potential is known from

accurate to the gradient of an arbitrary function —.

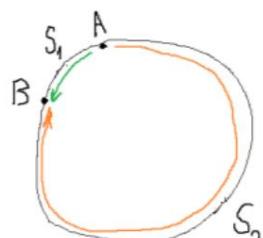
As can be seen from the expression, the evolution of a system with momentum p along an electromagnetic manifold determined by potentials leads to the appearance of an additional geometric phase. Such an additional phase appears when one oscillating system of a smaller scale moves along the surface of another oscillating system, such as, in our case, a free electron with momentum p and oscillation frequency of an electromagnetic manifold with vector potential A . A more familiar example is a Foucault pendulum moving along the surface of the Earth. "Oscillating" means that the system is described by the formula - some parameter belonging to —, moves along the system. More details on this in

, Where

next part.

The idea of the vector potential as a connection of the electromagnetic manifold gives only a local understanding. Within such a manifold, string-type singularities are possible, leading to a global phase excursion. It is known from the Lagrangian formalism that the action function S is the integral connecting . In order for this definition to be correct, it is necessary to require that the extremals emanating from the point no longer

along the extreme ,



intersected, but formed the so-called central field of extremals [1]. In other words, the picture shown in Figure 2, when there are two extremal paths, is impossible in traditional physics, based on Euclidean geometry. But if the movement occurs along a curvilinear manifold that forms an electromagnetic field, then such a possibility appears, the possibility of two or more extremals arises.

Fig.2

The requirement of uniqueness of the extremal means, among other things, the absence of interference, since if there were at least two identical paths according to the postulates of quantum mechanics, summing the amplitudes of all possible paths, we obtain the interference term:

(4)

where ψ is the amplitude of the normalized wave function. But such a picture is not equal to zero, means that the integral over a closed contour or inside the contour there is a phase singularity of the string type.

Geometric phase

The concept of the geometric phase (GP), which is about half a century old [10], has penetrated into many areas of physics: the Sagnac, Aharonov-Bohm, Jahn-Teller, Hall, some features of the spectra of molecules and nuclei, vortices in superfluid helium, chiral anomalies in gauge field theories.

Simon [15] immediately related this physical phenomenon to the concept of holonomy in differential geometry as a rotation by some angle of a tangent vector during its parallel translation along a closed curve on a curved surface. In this case, the set of planes tangent to it is an example of a fiber bundle. The geometric phase is a phase correction that the system acquires when it oscillates with some internal frequency and moves along a curved surface. Such a picture is shown in Figure 3.



Fig.3

Here a wheel with a small internal radius r moves along the surface of a manifold with a large radius of curvature R along a closed trajectory. In this case, the wheel acquires not only a phase but also an additive proportional to the solid angle formed by the closed surface, as shown in

Such an additive

Figure 3 [10].

A system resembling such a wheel is the aforementioned Foucault pendulum, the plane of polarization of which changes as the Earth moves. This change can be explained as follows. When moving in Euclidean space

the eigenfunctions of the Hamiltonian of a small system are orthogonal to each other and remain so during the evolution of the system. When moving along a curvilinear space, they interact with each other and exchange phase. For example, such a parameter can be the polarization of an atom or the spin of an electron. Usually, two orthogonal states are taken as the basis of spin: spin up and spin down. But when moving in an electromagnetic field, they will no longer be orthogonal to each other. Initially, Berry required the condition of adiabaticity or a significant difference in the scales of the evolving system and the curvilinear manifold along which the system moves, which can be expressed as where the radii are shown in Figure 3. Subsequently, it turned out that this requirement is unnecessary. Another example can be given of the Solar system oscillating inside the more global Milky Way system. Then we can try to explain the shift in the perihelion of Mercury as a phase addition due to an additional incursion of the geometric phase when the Solar system moves inside the manifold of the galaxy.

It is obvious that if a large system itself oscillates, moving along the surface of an even greater diversity, then the general geometric phase will be summed up from several additional phases:

(5),

where the index i denotes the scale index in the hierarchy of manifolds. Then it can be defined as the dynamic phase that the system acquires within itself.

It may be added that the method of slowly varying amplitudes, often used in physics for specific calculations, is a special case

geometric phase, since: is the slow part, and the second is the fast part.

We have considered the concept of geometric phase in coordinate space, but we can consider a similar construction in dynamic space. Only in this case the momentum operator will be replaced by the coordinate operator. Then expression (2) will take the following form:

— — — ,

where is the geometric phase in momentum space, replacing the vector potential and playing the role of connectivity in p -space. Such a phase will be the Berry phase in the momentum representation. In general, Berry [21] defined his phase through the motion of some system moving adiabatically over a larger system, depending on a number of arbitrary parameters . Then the Hamiltonian of the small system will also depend on the parameters of this general system.

what m that op that
 $\frac{1}{m} \int \frac{\partial \mathbf{k}}{\partial \mathbf{r}} \cdot d\mathbf{r}$ — oz $k t$ op to $g d t$ p o t T
 $\frac{1}{m} \int \frac{\partial \mathbf{k}}{\partial \mathbf{r}} \cdot d\mathbf{r}$ — .

For example, the Berry phase in a crystal arises when determining the average value of the coordinate operator in the momentum representation of the electron wave function in the crystal where can be represented as an expansion in eigenfunctions: – Bloch functions. Then,

Having calculated the average value of the coordinate operator , the traditional you can get that it representation must be replaced by an extended expression [5]:

(6)

Where . From this it is clear that the Berry phase is a characteristic of non-unitarity or openness of the oscillating system of a smaller scale relative to a larger manifold. It is also clear by analogy with (1) that the Berry phase in this case determines the connectivity in p-space.

One can imagine an electron moving in some self-consistent electromagnetic field of the crystal. Then the electron, in addition to the dynamic phase associated with its own oscillations and some period, will acquire an additional GF. It is assumed that the Hamiltonian has the property of electron cyclicity and the state vector. The total phase acquired by the state vector during the cycle is equal to the sum of the trivial dynamic phase and GF, . If the electron returns to its original position, then it additional phase incursion is multiple when the can be considered that it has rounded the string forming the torsion of the phase space.

Then the magnetic field is responsible for the feature of the dynamic p-space, its torsion. The string described by Dirac is a "vortex", the monopole is the end of the "vortex". Such a model is already actively discussed [6], which will be discussed in more detail in the next section.

Justification of the monopole hypothesis

The concept of the Berry phase is actively used in the theory of Weyl semimetals [5,6,7]. It is known from this theory that near some places of the Brillouin zone, the isoenergetic surface has a cone-shaped singularity that looks like a phase "vortex", as shown in Figure 2 [6, 7]. Near such a singularity, the Hamiltonian is linear in momentum (here C is the sign of the cone defining the surface). In the cone-shaped zone of the determinant of the matrix , the authors of [6] introduce a certain effective magnetic field, and the singularity (the top of the cone) is described as an always exist in pairs. In this case, effective Dirac monopole. According to the topological theorem [6], Weyl cones the cones that make up the pair have opposite chiralities. As studies show, the cones can separate in the coordinate space, due to which a photovoltaic current is possible in semimetals. Otherwise, when the singularities are connected, as shown in the upper part of Fig. 2, two counter currents compensate each other. We assume that the Weyl cones can move under the influence of a magnetic field, but at the same time they continue to be connected by a phase (Dirac) string, as shown in the lower part of Figure 4.

**Fig. 4**

The authors [6] introduce an expression for the magnetic fields:

$$\int \text{---} \quad (7),$$

Where

integral over a closed surface around a Weyl point. It is obvious that the first equation is a complete analogue of Coulomb's law

transferred to dynamic space, and as is easy to see, a magnetic charge.

Here C is the surface index, which denotes the surface torsion and plays the role of the charge g in p -space. The authors say that the singularity is only an analogue of a magnetic monopole [6], implying that its behavior is similar to that of a Dirac monopole, excluding the very possibility that this is the sought-after monopole itself. We believe that its pseudo-reality is expressed in its dynamic, rather than spatial nature.

If in coordinate space torsion is most likely impossible, as evidenced by the equations of Einstein's general theory of relativity, which take into account only its curvature, then in dynamic space there is nothing to contradict the possibility of torsion. At the same time, if we take the trajectory of a particle into which such a "vortex" falls, then an additional phase change occurs. From differential geometry it is known that torsion is determined by

the difference between the Christoffel symbols and their transposition:

$$(8),$$

Therefore, the torsion, and, accordingly, the magnetic monopole, in dynamic space can be determined using the Berry phase difference:

$$(9),$$

Based on the above, we can symmetrize Maxwell's equations when q is replaced by p

$$\text{---} \quad \text{---} \quad m \quad (10),$$

Where m — the potential of the magnetic field in p -space. Accordingly, from (7) we obtain an analogue of Gauss's law:

$$(11),$$

where is the density of magnetic charges in p -space.

Conclusions

Thus, it can be assumed that the electric field is the q -characteristic of the electromagnetic wave, and the magnetic field is its dynamic p -characteristic. They are not transformed into each other, as is commonly believed, they are simply built into each other, according to Fig. 1. The corresponding charges are features of the corresponding spaces.

We believe that the Dirac monopole is a spatially separated feature of the Fermi surface connected by a string, or phase "vortex," as shown in the lower part of Fig. 4. To prove this, we need an experiment that would allow us to detect the magnetic "string" - the feature connecting the two cones. To do this, we need to observe the motion of two electrons bending around the string from both sides and detect their interference. In addition, we need to learn how to move these features around the crystal, similar to how we manipulate electric charges, such as holes.

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Reality as a symmetrical stratification into coordinate space and momentum space, dividing the electromagnetic wave into magnetic and electric components, and charges into electric and magnetic

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The paper substantiates the hypothesis that the six-dimensional phase space in which the evolution of the essence takes place is not a mathematical abstraction, but an ontological reality. The dynamic space has its own geometry, where, as in the coordinate space, the concepts of diversity, curvature R, connectivity G_(l,nk), etc. are applicable. Then the electromagnetic wave, as the sum of two vectors E and H, is a six-dimensional manifold, while its electric part E is the generation of q-space, while the magnetic part H exists in p-space. E and H, like coordinate and momentum, have their own nature and evolve in parallel in conjugate spaces. Electric charges are point-like spatial singularities, magnetic monopoles are manifested by features in dynamic space with a charge g, and look like vectors or strings in coordinate space. This is the reason for the unmanifestness of the string. The electric potential is singular in the coordinate space $\ddot{y}_e \sim e/r$, the magnetic potential in the dynamic space is $\ddot{y}_m \sim g/p$