

James Clerk Maxwell and Inertia-Free Physics

Liudmila B. Boldyreva*

The State University of Management
*Corresponding author: boldyrev-m@yandex.ru

Received February 02, 2021; Revised March 05, 2021; Accepted March 14, 2021

Abstract It is shown that using the inertia-free process of transferring angular momentum, which was introduced by Maxwell in the model of luminiferous ether, it is possible to explain many physical phenomena, most of them have had no physical explanation as yet. Such phenomena are, in particular: spin supercurrent supporting the “stiffness” of spin part of the order parameter in superfluid $^3\text{He-B}$; quantum correlations between any quantum entities of both zero rest mass (photons) and non-zero rest mass; the vector magnetic potential; the generation of energy in a rotating nonlinear magnetic field; the energy of cavity structures. The inertia-free process may spread at the speed higher than the speed of light and this does not contradict Special Relativity as the latter postulates the speed limit only for an inertial process; besides, the inertia-free process is not characterized by kinetic energy and does not take part in gravitational interactions.

Keywords: Maxwell's luminiferous ether, inertia-free process, spin supercurrent, transfer of angular momentum, spin

Cite This Article: Liudmila B. Boldyreva, “James Clerk Maxwell and Inertia-Free Physics.” *International Journal of Physics*, vol. 9, no. 2 (2021): 83-89. doi: 10.12691/ijp-9-2-3.

1. Introduction

One of the physical seminars organized by Vitaly M. Ginzburg, Nobel Prize Winner in physics in 2010, was devoted to the memory of James Clerk Maxwell. The speaker telling about Maxwell's model of “luminiferous ether” said: “Maxwell was cleverer than his model”. Ginzburg interrupted him: “Maxwell was a genius and we may be unable to understand all his ideas yet”. The present work is a prolongation of Ginzburg's answer: the analysis of Maxwell's model shows that Maxwell may be considered to be one of the founders of inertia-free physics, that is, the physics considering the processes not accompanied by the emergence of kinetic mass and, consequently, not having a kinetic energy and not taking part in gravitational interactions.

In 1861-1873 James Clerk Maxwell published the works [1,2] in which he presented a model of luminiferous ether, essentially consisting of two phases. According to Maxwell's model, the properties of the first phase of luminiferous ether had to explain the results of Faraday's experiments with magnetic field: this phase had to possess vorticity, and “velocity of the circumference of each vortex must be proportional to the intensity of the magnetic force” [1], p.282]. Concerning this phase Maxwell wrote [1], p.348]: “I have seen in Crelle's Journal for 1859, a paper by Prof. Helmholtz on Fluid Motion, in which he has pointed out that the lines of fluid motion are arranged according to the same laws as the lines of magnetic force”.

And further he continued the Helmholtz idea: “This is an additional instance of a physical analogy, the investigation of which may illustrate both *electro-magnetism and hydrodynamics*.” Thus, Maxwell considered the possibility of ascribing to the first phase the properties “of ordinary matter” [1], p.345], described by Newton's equations.

In contrast with the first phase, Maxwell supposed that the substance of the second phase is “not a substance at all, or in what way it differs from matter” [1], p.282]. The task of the second phase of luminiferous ether, according to Maxwell, was to provide synchronization of the rolling of vortices of the first phase and “transmit the motion of rotation to them, till at last all the vortices in the medium are set in motion with such velocities of rotation” [1], p.347]. Concerning the properties of this process, Maxwell wrote: “the angular velocity must be the same throughout each vortex” and “are maintained for an indefinite time without any expenditure of energy” [1], p.346]. Thus, Maxwell supposed the existence of a dissipative-free process in the second phase accomplishing the transfer of angular momentum between vortices of the first phase. The absence of “any expenditure of energy”, that is the absence of energy exchange of the process with ambient bodies may be due to the absence of kinetic energy of the process and consequently the absence of kinetic mass. Thus, the dissipative-free process may be an inertia-free process.

The inertia-free process possesses the following properties.

- It may be spreading at a speed higher than the speed of light and this does not contradict Special Relativity, as the second SR postulate (the principle of constancy of the

speed of light) states: “in all *inertial systems* the speed of light has the same value when measured with length-measures and clocks of the same kind” [3]. That is, this postulate does not hold for an inertia-free process.

- Due to the absence of kinetic energy, the action of this process may result in the violation of the principle of energy conservation if we do not take into account the properties of Maxwell’s luminiferous ether.

- Due to the equivalence principle (the equality of gravitational and inertial masses), the absence of inertial mass means that gravitational field does not influence the spreading of this process.

In this work the validity of introducing by Maxwell of inertia-free process of transferring angular momentum is proved by that the action of this process explains many physical phenomena, most of them have had no physical explanation as yet. These phenomena are, in particular: spin supercurrent supporting the “stiffness” of spin part of the order parameter in superfluid $^3\text{He-B}$; quantum correlations between any quantum entities of both zero rest mass (photons) and non-zero rest mass; the vector magnetic potential; the generation of energy in rotating nonlinear magnetic field; the energy connected with cavity structures (bodies containing a cavity, pyramids, empty honeycombs, porous materials, etc.).

The work consists of the following sections.

2. The inertial properties of bodies in terms of contemporary physics.

3. The properties of the second phase of luminiferous ether in Maxwell’s model.

4. The phenomena explained by the action of inertia-free processes transferring angular momentum.

4.1. Spin supercurrent supporting the “stiffness” of spin part of the order parameter in superfluid $^3\text{He-B}$ [4,5,6].

4.2. The quantum correlations [7].

4.3 The vector magnetic potential [8,9].

4.4. The generation of energy in a rotating nonlinear magnetic field [10,11].

4.5. The energy of cavity structures [12,13,14].

2. The Inertial Properties of Bodies in Terms of Contemporary Physics

The mass of a body consists of two components: the rest mass and the so-called “relativistic” mass. The body mass is a total mass of quantum objects that constitute this body. According to the Lorentz transformation, mass M of the object moving at speed v equals:

$M = m_0 / \sqrt{1 - v^2 / c^2}$, where m_0 is quantum object’s rest mass, c is the speed of light. To an accuracy of $(v/c)^2$ the expression for M may be written as

$$M = m_0 + m_0 v^2 / (2c^2), \quad (1)$$

where m_0 is the rest mass of the quantum object, $m_0 v^2 / (2c^2)$ is the so-called “relativistic” mass. As any quantum object arises at photon’s decay, the mass m_0 is defined, according to [15], as:

$$m_0 = \hbar \omega_{ph} / (2c^2), \quad (2)$$

where ω_{ph} is the frequency of photon; for a circularly polarized photon ω_{ph} equals the photon’s spin precession frequency. (According to work [16], the orientation of photon’s spin is orthogonal to photon’s velocity. Consequently, the spin precession may take place for a circularly polarized photon.)

In 1949, Feynman [17] for denotation of force fields in his diagrams introduced virtual particles created by quantum objects. The properties of virtual particles depended on the interaction in which they were involved. For example, electric and magnetic interactions are accomplished by so-called virtual photons consisting of two oppositely charged virtual particles having spin.

According to investigation by Boldyreva [18], virtual photons created by quantum objects determine the wave properties of those objects: in particular, the frequency ω_v of precession of virtual photon’s spin equals the frequency of the wave function of quantum object that created this virtual photon, that is, for example, for the frequency ω_{Sh} of Schrodinger wave function we have:

$$\omega_v = \omega_{Sh}. \quad (3)$$

The frequency of the Schrodinger wave function is determined by the quantum object’s energy U_q (disregarding the energy connected with the rest mass) [15]: $\omega_{Sh} = U_q / \hbar$. Using this expression in equation (3) we have:

$$\omega_v = U_q / \hbar. \quad (4)$$

The virtual photon’s mass m_v , while using equation (4) and the classical relation between mass and energy ($m_v = U_q / c^2$), is determined to be:

$$m_v = \hbar \omega_v / c^2. \quad (5)$$

If quantum object’s energy U_q equals the kinetic energy of the object ($U_q = m_0 v^2 / 2$), then from equations (4)-(5) follows the equality of quantum object’s relativistic mass (see equation (1)) and mass m_v of virtual photon created by the object, that is: $m_v = m_0 v^2 / (2c^2)$. Using the latter expression for m_v , equations (2) and (5) in equation (1), we obtain:

$$M = (\hbar \omega_{ph} / 2 + \hbar \omega_v) / c^2 \quad (6)$$

Thus, the quantum object’s mass M may be determined through precession frequencies of spin of photon, at decay of which this mass emerged, and spin of virtual photon created by this quantum object. As the photon and virtual photon have precessing spin, they may be classified as spin vortices. It is possible that this “gyroscopic” origin of mass may determine the inertial properties of quantum

object, and consequently the inertial properties of entire matter.

The properties of luminiferous ether in Maxwell's model are in accordance with this conclusion. The first phase of luminiferous ether is characterized by vorticity and the vortices have mass, the second phase of luminiferous ether is not characterized by vorticity and inertia-free process may emerge in it [1,2].

3. The Properties of the Second Phase of Luminiferous Ether in Maxwell's Model

According to Maxwell's model, the properties of the first phase of luminiferous ether have to explain the results of Faraday's experiments with magnetic field and the properties of light, and to this end this phase have to possess the vorticity, and "velocity of the circumference of each vortex must be proportional to the intensity of the magnetic force" [1], p.282]. Maxwell also considered the possibility of ascribing to the first phase the properties "of ordinary matter" [1], p.345], described by Newton's equations.

The properties of the second phase of luminiferous ether, by opinion of Maxwell, had to provide synchronization of the rolling of vortices of the first phase and "transmit the motion of rotation to them, till at last all the vortices in the medium are set in motion with such velocities of rotation" [1], p.347]. Maxwell considered that the substance of the second phase is "not a substance at all, or in what way it differs from matter" ([1], p.282) and has the following properties [1,2]:

1) The phase consists of the particles having very small size compared with the size of a vortex.

2) The particles "do not rub against each other" [1], p.346].

3) The particles "roll without sliding" [1], p.285].

4) The particles "are in **rolling** contact" [1], p.346] with the vortices, so that "the angular velocity must be the same throughout each vortex" [1], p.346] and "are maintained for an indefinite time without any expenditure of energy" [1], p.346].

Thus, the second phase of luminiferous ether is characterized by the absence of shear viscosity and by the possibility of emergence of dissipative-free process accomplishing a transfer of angular momentum between vortices that constitute the first phase. The absence of "any expenditure of energy", that is the absence of energy's exchange of the process with ambient bodies may be due to the absence of kinetic energy of the process and, consequently, the absence of kinetic mass. The absence of kinetic mass is in accordance with that this process emerges between vortices in a physical vacuum but does not create them (it is shown in Section 2 that the mass is created in spin vortices). Thus, the dissipative-free process may be an inertia-free process.

The inertia-free process may have the speed higher than the speed of light, and it does not contradict Special Relativity as the latter postulates the speed limit only for an inertial process [3]. Consequently, for speed y_{tam} of process of transferring angular momentum it may hold:

$$y_{tam} > c. \quad (7)$$

Besides, due to the absence of kinetic energy, the action of this process may result in the violation of principle of energy conservation if we do not take into account the properties of Maxwell's luminiferous ether.

Maxwell deduced an equation characterizing the process of transfer of angular momentum in the following way: "To determine the motion of a layer of particles separating two vortices let the circumferential velocity of a vortex, multiplied by the three direction-cosines of its axis respectively, be α , β , γ . Let l , m , n be the direction-cosines of the normal to any part of the surface of this vortex, the outside of the surface being regarded positive. Then the components of the velocity of the particles of the vortex at this part of its surface will be $n\beta - m\gamma$ (parallel to x), $l\gamma - n\alpha$ (parallel to y), $m\alpha - l\beta$ (parallel to z).

If this portion of the surface be in contact with another vortex whose velocities are α' , β' , γ' , then a layer of very small particles placed between them will have a velocity which will be the mean of the superficial velocities of the vortices which they separate, so that if u is the velocity of the particles in the direction of \mathbf{x} ,

$$u = \frac{1}{2}m(\gamma' - \gamma) - \frac{1}{2}n(\beta' - \beta), \quad (8)$$

since the normal to the second vortex is in the opposite direction to that of the first." [1], p.283-284].

It should be noted that as variables α , β and γ (α' , β' and γ' , as well) determine the circumferential velocity of the vortices, then at equal diameters of vortices the differences $(\alpha' - \alpha)$, $(\beta' - \beta)$ and $(\gamma' - \gamma)$ determine the difference in angular velocities of vortices between which the process of transfer of angular momentum emerges.

Let us consider the phenomena explained by the action of processes accomplishing the transfer of angular momentum.

4. The Phenomena Explained by the Action of Inertial-Free Processes Transferring Angular Momentum

4.1. The Spin Supercurrent Supporting the "Stiffness" of Spin Part of the Order Parameter in Superfluid $^3\text{He-B}$

In superfluid $^3\text{He-B}$ the angles of precession and deflection of precessing spins of ^3He 's atoms are the angles of orientation of the spin part of order parameter. As superfluid $^3\text{He-B}$ is a quantum system described by a single wave function, at emergence of differences in the values of the respective angles a process that tends to equalize these values has to emerge in the system. In accordance with the principles of quantum mechanics, this process must be dissipative-free and have infinite speed y_{SS} (otherwise the system ceases to be described by a single wave function), that is, the following must hold:

$$y_{ss} > c. \quad (9)$$

The first attempt to describe the phenomenon of long transport of spin polarization (spin supercurrent) was made by Vuorio [19]. In 2008, Russian scientists Bunkov, Dmitriev, and Fomin were awarded the Fritz London Memorial Prize for their studies of spin supercurrent in superfluid $^3\text{He-B}$ [4,5,6].

The value of spin supercurrent $(I_{ss})_z$ in the direction of the orientation (axis z) of the precession frequencies of the ^3He atoms' spins in superfluid $^3\text{He-B}$ is determined to be

$$(I_{ss})_z = -g_1 \partial \alpha_s / \partial z - g_2 \partial \beta_s / \partial z, \quad (10)$$

where α_s is the angle (phase) of precession of ^3He atom's spin, β_s is the angle of deflection of ^3He atom's spin, g_1 and g_2 are coefficients depending on β_s .

Let us consider the spin structures (consisting of objects having a precessing spin) with the following characteristics (see Figure 1): \mathbf{S} is spin, ω_1 and ω_2 are the spins' precession frequencies oriented along axis z , $(\alpha_s)_1$ and $(\alpha_s)_2$ are the angles (phases) of spins' precession determined relative to reference line r.l., $(\beta_s)_1$ and $(\beta_s)_2$ are the angles of deflection.

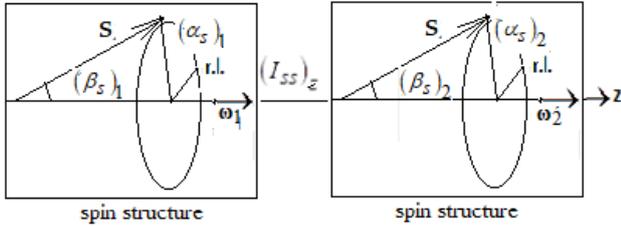


Figure 1. The schema of spin structures. $(I_{ss})_z$ is a spin supercurrent between spin structures. $(\alpha_s)_1$ and $(\alpha_s)_2$ are the angles of precession, $(\beta_s)_1$ and $(\beta_s)_2$ are the angles of deflection, ω_1 and ω_2 are the precession frequencies oriented along axis z ; \mathbf{S} is spin, r.l. is a reference line

Based on equation (10), spin supercurrent $(I_{ss})_z$ between these spin structures may be written in the form:

$$(I_{ss})_z = -b_1((\alpha_s)_2 - (\alpha_s)_1) - b_2((\beta_s)_2 - (\beta_s)_1), \quad (11)$$

where b_1 and b_2 are coefficients that are respectively dependent on coefficients g_1 and g_2 introduced in equation (10); $b_1 > 0$, $b_2 > 0$. If assume that before the action of spin supercurrent the angles of precession $(\alpha_s)_1$ and $(\alpha_s)_2$ are associated with the respective precession frequencies ω_1 and ω_2 (ω_1 and ω_2 are assumed to be independent of time t) as follows: $(\alpha_s)_1 = \omega_1 t$ and $(\alpha_s)_2 = \omega_2 t$, then equation (11) may be transformed to be:

$$(I_{ss})_z = -b_1 t (\omega_2 - \omega_1) - b_2 ((\beta_s)_2 - (\beta_s)_1). \quad (12)$$

From equation (12) it follows that one of the conditions of equalizing the angles of precession by spin supercurrent I_{ss} is:

$$\Delta \omega = \omega_2 - \omega_1 \rightarrow 0. \quad (13)$$

The first summand in equation (12) is proportional to the difference in precession frequencies of spins of interacting spin structures and thus equation (12) is similar to equation (8), the summands of which are the differences in the angular velocities of interacting vortices. Besides, the spin supercurrent, as well as Maxwell's process of transferring angular momenta, is an inertia-free process and, consequently, its speed as well as the speed of Maxwell's process may be greater than the speed of light (compare equations (7) and (9)). Thus, it may be supposed that spin supercurrent is, essentially, a process of transfer of angular momentum introduced by Maxwell in the second phase of luminiferous ether.

4.2. The Quantum Correlations

Quantum correlations belong to the category of phenomena that are collectively called "quantum non-locality". The essence of the phenomenon can be described using the following example. Let two quantum objects (Figure 2) a and b emitted by the same source and having the same wave function at the initial moment of time move in different directions. Object a is directed, depending on the position (1 or 2) of switch P , towards either detector A_1 or detector A_2 (these detectors have different characteristics); object b is directed towards detector B . According to postulates of quantum mechanics, the properties of object b being detected will depend on that which detector detects a . It means that correlations of quantum objects a and b exist.

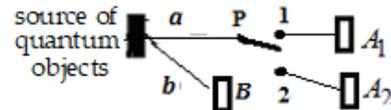


Figure 2. Schematic diagram of the experiment that illustrates quantum correlations between quantum objects. a and b are quantum objects; A_1 , A_2 , and B are detectors; P is a switch with positions 1 and 2

Let us consider the properties of quantum correlations.

1) *Correlations take place between quantum objects of zero or non-zero rest mass.*

The common property of quantum objects with zero and non-zero rest mass is the creation by them of spin vortices: respectively of photon by quantum objects with zero rest mass and of virtual photon by quantum objects with non-zero rest mass. This allows one to suppose that quantum correlations may be accomplished by a process equalizing the respective angles (phases) of precession and the angles of deflection of spins of the spin vortices created by quantum objects [18].

2) *As follows from experiments, the quantum correlation emerges between quantum objects described by a single wave function (for example, between either so-called "entangled" quantum objects or between photons not having crossed mutual orientation and having the same frequency [7]).* According to equality (3), it means that the quantum correlations emerge between quantum objects under the following conditions: first, the

precession frequencies of spins in the spin vortices created by interacting quantum objects have no crossed mutual orientation; secondly, the difference $\Delta\omega_v$ between the frequencies satisfies the condition:

$$\Delta\omega_v \rightarrow 0. \quad (14)$$

3) *The speed of quantum correlations is greater than the speed of light; this follows from the possibility of correlations of photons separated in space and simultaneously emitted.* The experiments exist [20] in which it is shown that the speed Δy_q of quantum correlations is greater by factor of 10^4 than the speed of light, that is

$$\Delta y_q > c. \quad (15)$$

4) *The effectivity of quantum correlations between quantum objects does not depend on the distance between them.* The unique experiments were conducted in 2017 by Ji-Gang Ren et al. They conducted the first quantum teleportation of independent single-photon from a ground observatory to a low Earth orbit satellite - through an up-link channel (sputnik channel) at a distance of up to 1400 km [21].

5) *It follows from experiments that quantum correlations are of non-electric and non-magnetic nature and they are not screened by electromagnetic screens.*

6) *Correlations take place between quantum objects not only at the moment of simultaneous registration of the objects.* Experimentally it is established that correlations between two quantum objects may take place when one quantum object is detected and another quantum object is still in the physical vacuum [22]. It may mean that the quantum correlations between quantum objects are performed by a process in the physical vacuum.

Note that all considered properties of quantum correlations are analogous to the respective properties of spin supercurrent:

1) similar to quantum correlations the spin supercurrent may change the spin's characteristics of the spin vortices created by quantum objects;

2) the condition (14) of fulfilling quantum correlations coincides with condition (13) of effective action of spin supercurrent;

3) the equation (15) characterizing the speed of transferring quantum correlations is analogous to equation (9) for the speed of spin supercurrent;

4) the independence of the distance of quantum correlations between interacting quantum objects is a property of spin supercurrent as well (for example, the region of action of spin supercurrent in superfluid $^3\text{He-B}$ is limited only by the volume of superfluid);

5) as well as quantum correlations the spin supercurrent is of non-electric and non-magnetic nature.

The above considered analogies between the properties of quantum correlations and those of spin supercurrent allow us to suppose that a quantum correlation may be accomplished by spin supercurrent [18] or, which is the same, by a process of transfer of angular momentum introduced by Maxwell in the model of luminiferous ether.

4.3. The Field-free Magnetic Vector Potential

In classical electrodynamics, the induction \mathbf{B} of the magnetic field is determined by equation $\mathbf{B} = \text{curl}\mathbf{A}$,

where \mathbf{A} is the magnetic vector potential [23]. If the magnetic field is shielded, that is $\mathbf{B}=0$, it is possible that $\mathbf{A} \neq 0$, which is referred to as the field-free magnetic vector potential. The potential together with the quantum correlation are the phenomena classified as quantum non-locality. The magnetic vector potential has a physical meaning of its own. In 1949, Ehrenberg and Siday [8] predicted the ability of a magnetic vector potential to directly influence the characteristics of quantum objects, even though there is no electromagnetic field at the location of the objects. In 1959, the possibility of such an effect was considered by Aharonov and Bohm [9]. The possibility of action of potential on the wave function of quantum object follows from the Schrodinger equation as well. For example, one-dimension (axis x) Schrodinger's wave equation describes the action of potential $V(\mathbf{x})$ on the characteristics of wave function $\psi(\mathbf{x},t)$ (t is time) of quantum objects with mass m and energy U_q [15]:

$$\frac{\hbar^2}{2m} \nabla^2 \psi(\mathbf{x},t) = (U_q - V(\mathbf{x})) \psi(\mathbf{x},t). \quad (16)$$

Subsequently, a great number of experiments have been conducted which confirmed the theoretical predictions. In general, these experiments were as follows (see Figure 3): the beam of electrically charged quantum objects emitted by a source is split into two beams: C_1 and C_2 . Beam C_1 propagates through the region where $\mathbf{B}=0$ and $\mathbf{A}=0$. Beam C_2 passes through a magnetized toroidal solenoid. The solenoid is shielded in such a way that outside the substance of solenoid there is no magnetic field, $\mathbf{B}=0$, but the field-free vector potential is present: $\mathbf{A} \neq 0$. Both beams of the quantum objects arrive at the entrances of an interferometer.

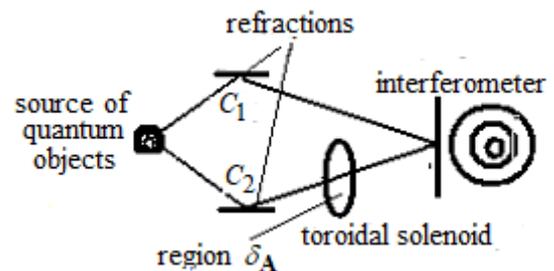


Figure 3. Schematic diagram of the experiment on the study of the effects of the magnetic vector potential on quantum objects. The source of the quantum objects emits beams C_1 and C_2 . Beam C_1 propagates through the region where $\mathbf{A}=0$. Beam C_2 passes through the region $\delta_{\mathbf{A}}$ where $\mathbf{B}=0$ and $\mathbf{A} \neq 0$. Interference rings are produced by the interferometer

The emergence of interference rings means that there is a change in the wave function's characteristics of the quantum objects of beam C_2 passing through the region $\delta_{\mathbf{A}}$ where $\mathbf{B}=0$ and $\mathbf{A} \neq 0$.

As the characteristics of wave function are characteristics of spin's precession of virtual photons created by quantum objects, the existence of interference rings means that field-free magnetic vector potential influences the angles of precession and/or deflection angles of spins of virtual photons.

As the field-free magnetic vector potential emerges, in particular, at the motion of current-carrying quantum

objects, it may be supposed that the potential is a result of action of the process of transfer of angular momentum emerging between virtual photons created by current-carrying quantum objects and virtual photons created by quantum objects of beam C_2 [24].

The screening of magnetic field does not mean the screening of the process of transfer of angular momentum, as, according to Maxwell's model of luminiferous ether, the magnetic interactions and the process of transferring angular momentum are performed by the motion of different phases of the ether. The magnetic interactions are performed by the motion of the first phase of the ether consisting of vortices; the process of transferring angular momentum is performed by the motion of the second phase consisting of the particles having very small size compared with the size of the vortices. Therefore, the magnetic vector potential may act at screening of magnetic field (field-free magnetic vector potential).

4.4. The Generation of Energy in a Rotating Non-Linear Magnetic Field

Among the first experiments in which the generation of energy in a non-stationary magnetic fields was observed was a series of experiments conducted by Searl [10] in 1940–1950. In the experimental setup, there was a magnetic ring (stator), along which cylindrical rollers could move, and a pair of magnetic poles attached to roller heads so that a nonlinear rotating magnetic field could be created. In 1990–1993, experiments with rotating magnets were conducted by Godin and Roshchin [11].

In all experiments, at a critical value of the speed of rotation, the experimental setup began working without the consumption of energy and, in this case, the speed of rotation was able to increase. Besides, the emergence of recurring zones of elevated magnetic induction with a decrease in the temperature and not shielded by the reinforced concrete walls of a laboratory room is observed as well.

Let us show that these phenomena are in accordance with the properties of luminiferous ether in Maxwell's model. According to the model, "velocity of the circumference of each vortex must be proportional to the intensity of the magnetic force" [1], p.283]. Consequently, the following holds:

$$\mathbf{B} = \mathbf{k}_B \mathbf{v}, \quad (17)$$

where \mathbf{B} is the magnetic induction, \mathbf{k}_B is a factor of proportionality \mathbf{v} is the circumferential velocity of vortices, when using the denotation of Maxwell, see equation (8):

$$v = \sqrt{\alpha^2 + \beta^2 + \gamma^2}, \quad (18)$$

where α , β and γ (introduced by Maxwell) are the projections of velocity \mathbf{v} on three orthogonal axes (\mathbf{x} , \mathbf{y} , \mathbf{z}).

Due to equation (17) the inequality $\partial \mathbf{B} / \partial \mathbf{r} \neq 0$ (\mathbf{r} is a vector in a 3-dimension system \mathbf{x} , \mathbf{y} , \mathbf{z}) taking place in a rotating nonlinear magnetic field is accompanied by inequality:

$$\partial \mathbf{v} / \partial \mathbf{r} \neq 0. \quad (19)$$

From equations (18) and (19) it follows: $\partial \alpha / \partial x \neq 0$, $\partial \beta / \partial y \neq 0$, $\partial \gamma / \partial z \neq 0$. According to equation (8), these inequalities may be considered to be conditions of

emergence of the process of transferring angular momentum in the second phase of Maxwell's luminiferous ether. As this process is inertia-free and has no kinetic energy, the action of this process may result in the violation of principle of energy conservation (for example, generation of some type of energy), if we do not take into account the properties of Maxwell's luminiferous ether.

The emergence of recurring zones of elevated magnetic induction may be caused by the process of transferring angular momentum as well. According to supposition of Maxwell [1], p.282]: "the density of the substance of the vortex must be proportional to the capacity of the medium for magnetic induction", that is, the following equality holds:

$$B = f(\rho), \quad (20)$$

where ρ is the density of the first phase of luminiferous ether in Maxwell's model, f is a function.

It means that the process of transferring angular momentum influences the density of the first phase of luminiferous ether in Maxwell's model. Indeed, as the action of the process of transferring angular momentum causes the changes in projections (α , β and γ) of the circumferential velocity \mathbf{v} of a vortex, then, from equations (18) and (20) inequality $\partial \rho / \partial t \neq 0$ follows, that is, the density of the first phase of Maxwell's luminiferous ether changes.

It is known [25] that the jumps in the density may be observed in any medium if the speed of the process causing the contraction of the medium is greater than the speed of spreading the contraction in the medium. It is possible that it is the explanation of emergence of recurring zones of elevated magnetic induction in a nonlinear rotating magnetic field. Actually, according to condition (7), the speed of the process of transferring angular momentum is greater than the speed of light and may be greater than the speed of spreading the contraction in the first phase (the latter supposition is based on that the electromagnetic process emerging in the first phase has the speed equal to the speed of light).

4.5. The Energy of Cavity Structures

The discovery in physics of the process of transfer of angular momentum meant the possibility of explanation of the phenomena that have had no physical explanation as yet, in particular, of the phenomena connected with the form of ambient bodies.

The well-known researcher of pyramids J. Parr in the 80s of the past century [12,13] discovered the emergence of energetic region near cavity structures having the form of pyramid (Parr called this region a "bubble"). The "bubble" blocks all known energy fields and influence the weight of ambient bodies. In the experiments, Parr placed energy sources that emitted various fields (gamma rays and radio frequency sources) inside a pyramid and measured the extent the bubble shielded or blocked them. By rotating a pyramid in an alternating magnetic field, he could increase the bubble's shielding properties.

Around the same time V. Grebennikov [14] discovered that an ensemble of empty honeycombs was embanked by a system of invisible "shells", which could be detected by a man's hand as regions of high air density. These "shells" could not be shielded by brick screens.

From the determination of wave function $\psi(x,t) = \exp(i\mathbf{p}\mathbf{x}/\hbar - itU_q/\hbar)$ (the solution of wave equation (16) at $V(x)=0$) of quantum object with momentum \mathbf{p} it follows that the wave properties (phase, frequency, wavelength) of a quantum object are determined by its energy U_q . As one of the components of the energy is spin-orbital interaction depending on characteristics of orbit (in particular, on its configuration) of motion of quantum object, the wave properties of the object will depend on the type of orbit of its motion. As the wave properties of quantum objects are determined by characteristics (angles of precession and deflection) of spins' precession of virtual photons created by the objects, then the characteristics of this precession depend on the type of motion's orbit of the object as well. Taking into account equations (11)-(12), we may suppose that spin supercurrent emerging between quantum objects and, consequently, the energy connected with this current will depend on orbit's configurations of this quantum object and thus on the form of the body containing these objects [26].

5. Discussion

The ways of transfer and conversion of energy in macroscopic systems are studied by the science thermodynamics. The first law of thermodynamics states: the amount of heat passed to, for example, a gas is used for a change in the internal energy and execution of work by it. In all these phases, the major energy is kinetic energy. In this respect, the existence of inertia-free process not having kinetic energy results in the necessity to revise some aspects of thermodynamics, in particular, those concerning transformations of energy into temperature.

6. Conclusion

The analysis of the following physical phenomena: spin supercurrent supporting the "stiffness" of spin part of the order parameter in superfluid $^3\text{He-B}$, quantum correlations, the vector magnetic potential, the generation of energy in a rotating non-linear magnetic field, the energy of cavity structures, shows that these phenomena may be explained by action of inertia-free process of transferring angular momentum, that is of the process introduced in the Maxwell model of luminiferous ether. Thus Maxwell may be considered to be one of the founders of inertia-free physics.

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