ФИЗИКО-МАТЕМАТИЧЕСКИЕ НАУКИ

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NEW LOOK AND APPROACH TO PHYSICAL AND QUANTUM PROPERTIES OF PHOTON

Grigoryev-Friedman S.N.
(Nizhny Novgorod research radiophysical institute
at Nizhny Novgorod state university by N.I. Lobachevsky,
Nizhny Novgorod)

Abstarct. New physical properties of photon, as quasi-neutral elementary particle, have been revealed at the atomic-molecular level of radiation interaction and photon absorption when electrons move from external, remote orbits of atoms matter to lower orbit rotation around the nucleus of atoms. Experienced way found fast-changing in time and space, its own orbital negative and positive charges photon. The use of the idea of Russian scientists on the presence of constantly changing in time and space of its own orbital charge photon in the creation of super-powerful and long-range combat laser is considered.

Keywords: photon, electron; positron; calibration boson; fermion; synchrophasotron; hadron collider; laser; spin; intrinsic orbital moment of photon; inertia orbital rotation of photon; intrinsic orbital charge of photon; modulated laser beam; electromagnetic wave; laser radiation; wavelength; signal frequency; quantum; coherence mass of photon; photon speed; period; photon momentum; photon energy; Hamilton operator; disturbance operator; Wendell Farry theorem; Niels Bohr`s principle of complementarity; Heisenberg uncertainty.

Introduction. The main problems of quantum mechanics and elementary particles in the domestic literature [1–13] are devoted to quite [14–17] extensive material. In this regard, it should be noted that all previous studies were based only on the classical, academic level of the development of modern quantum theory of radiation, absorption, reflection and distribution of photons, in representation of an outdated point view that the photon is only a flat, transboundary electromagnetic wave, in optical range, propagating in open space at speed of light. At same time, domestic and foreign scientists in this field of knowledge, accumulated extensive information on basis of laboratory-experimental research on nature and mechanism of behavior of known to science elementary particles in open space and interaction with physical substance, taking into account distribution of electromagnetic and gravitational fields, in particular, revealed newer physical properties of the photon, at atomic-molecular level of interaction of radiation and absorption of photons electrons move from the outer, remote orbit of atoms matter to lower rotation orbit around the nucleus of atoms.

In light of subsequent theoretical studies and their experimental evidence at the experimental test site, the Hadroon Collider of the Los-Alamos National Laboratory of the Energy Department USA in interval of time, accessible for detection, fixation and study the quantum nature of existence, rapidly changing in time and space, own orbital negative and positive charge of photon, like electron and its antiparticles are positron.

If in earlier stages of study the photon was studied in Wilson-Skobeltsyn's cell, Geiger-Mueller's counter, Glaser's bubble chamber, Cherenkov's counter, in the form of track trajectories and the fixation of all this on the photo emulsion film, when time of observation experiments themselves was determined in interval of $\tau = 1 \cdot (10^{-12} \ldots 10^{-15})$ s. Whereas, when two counter streams of photons interact, in the Hadron's Collider, the time of observation physical processes is even more reduced to interval of $\tau = 1 \cdot (10^{-18} \ldots 10^{-20})$ s. In this case, the presence of rapidly changing orbital charge in photons should be explained not only by influence of variable electromagnetic fields, in particular strong electric field, but also by increasing influence of general gravitational field during the interaction of physical matter with radiating, narrow-coherent beam of photons, its partial absorption and reflection, with the quantum transition of the electron from one level to another around the nucleus of the atom [4–9, 11–17].

If the particle accelerator in the Moscows of Serpukhov-city and the synchrophazotron at the experimental test site at the United Institute of Nuclear Research in the Moscows of Dubna-city was used, the principle of interaction flow elementary particles was used, like an electron, positron, proton, neutron, photon, etc. in accelerating electromagnetic field with the material of physical substance, the American Hadron Collider Los-Alamos National Laboratory used the principle of interaction between two counter-accelerating streams of elementary particles, for example, beams of photons with each other, also in accelerating electromagnetic field, but at same time power of physical interaction of oncoming accelerated streams of particles (photons) will be about 2.5 times greater than in the case of Serpukhov's or Dubna Russian particle accelerator designs, as the basis of rig and general technology in modern nuclear research on the peaceful use of released huge energy in the passage of controlled thermonuclear reactions of the fission uranium isotopes U_{92}^{235} and U_{92}^{238}, in the enrichment of plutonium isotopes Pu_{94}^{239} in modern nuclear reactors.

The theoretical basis on classical view of the nature photon particle. At the end of 2019 years, scientists from Los-Alamos National Laboratory — Thomas and Advard Lee Yung, conducted synhrophazotron and particle accelerator, such as the Hadron's Collider, at one of state-of-art test sites with synchrophazotron and accelerator of elementary particles, such as Hadronno collider, number of experiments and visual physical experiments in the field of detection and fixation of one's own, constantly changing in time and space, orbital charge in quasi-neutral elementary particle of the photon.

Photons accelerate, in internal structure of inverting crystal, to very large values of their kinetic energy, according to quantum theory and formula (1):

$$\overline{E_{\phi}} = m_{\phi}c^2\,, \tag{1}$$

where $m_{ф}$ — is the relativistic mass of the photon; $c = 3 \cdot 10^8$ м/сек — is the speed of light in free (air) space.

Often applied value — given constant M. Planck, described by the expression (2):

$$\hbar = \frac{h}{2\pi} = \text{const.} \tag{2}$$

On other hand, an electron moving from the upper, remote level of its orbit to lower electron emits a photon. At same time there is discrete radiation of energy by narrowly directed beam of photons, so-called portions of the quant, according to the formula M. Planck (3):

$$\overline{E}_{\phi} = h\nu = \hbar\omega, \tag{3}$$

where $h = 6{,}626070040(81) \cdot 10^{-34}$ Joule ·s (because $\hbar = 1{,}054571800(13) \cdot 10^{-34}$ Joule ·s) — is constant M. Planck; ω, MHz — is cyclical (angular) input frequency; T, s — is wave fluctuation period; ν, MHz — is frequency of input.

Equating both energy values of emitting photon get (4):

$$\overline{E}_{\phi} = m_{\phi}c^2 = h\nu = \hbar\omega. \tag{4}$$

where, exact relativistic value of the mass photon, when it moves in open airspace or vacuum is determined from expression (4), according to the formula (5):

$$m_{\phi.} = \frac{h\nu}{c^2} = \frac{\hbar\omega}{c^2}. \tag{5}$$

From the course of classical electrodynamics it is known that the phase speed of the signal wave in conventional optically denser environment is determined through the speed of light, according to the expression (6):

$$\upsilon = \frac{1}{\sqrt{\varepsilon_0}\sqrt{\mu_0}} \cdot \frac{1}{\sqrt{\varepsilon_a}\sqrt{\mu_a}} = \left(\frac{1}{\sqrt{\varepsilon_0 \cdot \mu_0}}\right) \cdot \frac{1}{\sqrt{\varepsilon_a \cdot \mu_a}} = \frac{\left(\frac{1}{\sqrt{\varepsilon_0 \cdot \mu_0}}\right)}{\sqrt{\varepsilon_a \cdot \mu_a}} = \frac{c}{\sqrt{\varepsilon_a \cdot \mu_a}}, \tag{6}$$

where $\upsilon = f(\varepsilon_a, \mu_a)\Big|_{\begin{cases}\varepsilon_a \ge \varepsilon_0 \approx 1; \\ \mu_a \ge \mu_0 \approx 1\end{cases}} \le c$ — is phase speed of flat, monochromatic, electromagnetic wave in optically dense environment (gas, fluids, solid bodies); $\varepsilon_a \ge \varepsilon_0 \approx 1$ и $\mu_a \ge \mu_0 \approx 1$ — is relative dielectric and magnetic permeability of optically dense environment; $\varepsilon_0 \approx 1$ и $\mu_0 \approx 1$ — is relative dielectric and magnetic permeability of free airspace (vacuum) respectively.

From where we get the speed of flat, monochromatic, electromagnetic wave in optically dense environment, according to the expression (7):

$$c = \upsilon\sqrt{\varepsilon_a \cdot \mu_a}\,. \tag{7}$$

Finally, the exact relativistic mass value of the photon, when it is moves in optically dense environment is determined from expression (7), according to the formula (8):

$$m_{\phi.} = \frac{\hbar\omega}{\upsilon^2\,\varepsilon_a\,\mu_a}. \tag{8}$$

It should be noted that the mass of electron itself is quasi-static, not dependent on frequency of signal at the entrance, whereas the photon mass depends entirely on frequency of input signal, that is, the mass of photon will be for each frequency, its range, separate, different from each other. Consequently, the intensity, inverity, power and strength of laser radiation are highly dependent on range working frequencies of input signal.

It is necessary to remember that actual (real) mass of the photon, at rest is zero $m_{ф0} = 0$, that is, the photon has only so-called relativistic mass, different from zero. The same is true of rate photon, which is absent at rest, and exists only when the photon moves at the speed of light as transcurrent electromagnetic wave, in certain environment.

It should also be taken into account that photon's own spin is equal to: $S_{ph} = 1\hbar$. The spirality of the photon is equal to: $H_{ph} = \pm 1$. The number of spin states of the photon is equal to: $Q_{Sph} = 2$. The charging parity of the photon is negative — $Chi_{ph} = -1$.

Total photon charge is always zero for a full period of time T = 2π: $\sum_{\Phi} Q_{2\pi} = Q_{1^+} + Q_{2^+} + Q_{3^-} + Q_{4^-} = 1^+ + 0^+ + 1^- + 0^- = +1e + 0 - 1e - 0 = 0$. According to the fig. 1, for first quarter of his period $0 \le T_1 \le \frac{\pi}{2}$ in fact, the charge of quasi-neutral particle begins under exponential law enveloping function (describing the vector potential of the photon: $\vec{A}_n(\vec{r},t) = A_0(\vec{r}) \cdot e^{-i(\vec{k}\cdot\vec{r}-\omega\cdot t)} \cdot sin\left(\frac{\pi\cdot n}{\ell}\cdot\vec{r}\right)$, where the radius-vector is defined as $\vec{r} = r(x,y,z)$) increase $Q_{1^+} > 0^+ = +0e$. At the same time, the charge of the photon has its maximum positive value, equal to the charge of the position (antiparticles of the electron, with the back of the $S_{p^+} = \frac{1}{2}\hbar$: $Q_{1^+} = 1^+ = +1e$, at its point at $T_{1max} = \frac{\pi}{2}$. It should be noted that at this point, the photon's own orbital rotation point around its axis is: $L_1^+ = +1$. For the next, the second quarter of its period, at the same time as $\frac{\pi}{2} \leq T_2 \leq \pi$, value of the photon charge begins to decrease exponentially from its maximum value of $Q_{1^+} = 1^+ = +1e$ to zero, $Q_{2^+} = 0^+ = +0e$, that is, transboundary, monochromatic, electromagnetic wave passes through its first zero value, when the photon itself almost loses its speed, stops, has almost its zero mass of rest, while the photon, at this point in time, also lacks energy and momentum of movement. According to the fig. 1, at this point, the photon's own orbital rotation point relative to its axis is: $L_0^+ = L_0^- = 0$. Slung through the zero point, the charge of the photon begins to increase again on the module, also by exponential law from zero to $Q_{3^-} = 0^- = -0e$ to $Q_{3^-} = 1^- = -1e$ for the period: $\pi \leq T_2 \leq \frac{3\pi}{2}$. At the same time, the charge of the photon has its maximum negative value, equal to the charge of the electron (with the spine $S_{e^-} = \frac{1}{2}\hbar$): $Q_{3^-} = 1^- = -1e$, the subsequent third quarter the period of electromagnetic wave, at $T_{3min} = \frac{3\pi}{2}$.

It is worth noting that at this point the own orbital moment of rotation the photon around its axis is equal: $L_2^- = -1$. After that, for the next quarter of its period, at rate of $\frac{3\pi}{2} \leq T_4 \leq 2\pi$, the value of the photon charge on the module begins to decrease exponentially from its maximum negative value to $Q_{3^-} = 1^- = -1e$, to zero $Q_{4^-} = 0^- = -0e$, that is transboundary, monochromatic, electromagnetic wave passes through its second zero value, when the photon also again loses its speed, stops, has almost its zero mass of rest, while the photon also, at this point in time, there is no energy and momentum of movement.

Due to the law maintaining charging parity and its multiplier, in electromagnetic phenomena it is impossible to turn an even number of photons into odd and vice versa, based on the theorem of W. Farry, as the photon refers to the so-called calibration boson, where it is involved in electromagnetic and gravitational interaction with matter in nature. Moreover, part of its active time photon spends as virtual particle — vector meson or as virtual pair — Hadron-antiadron. All atoms is consist in nature of protons and neutrons, that is called Hadrons.

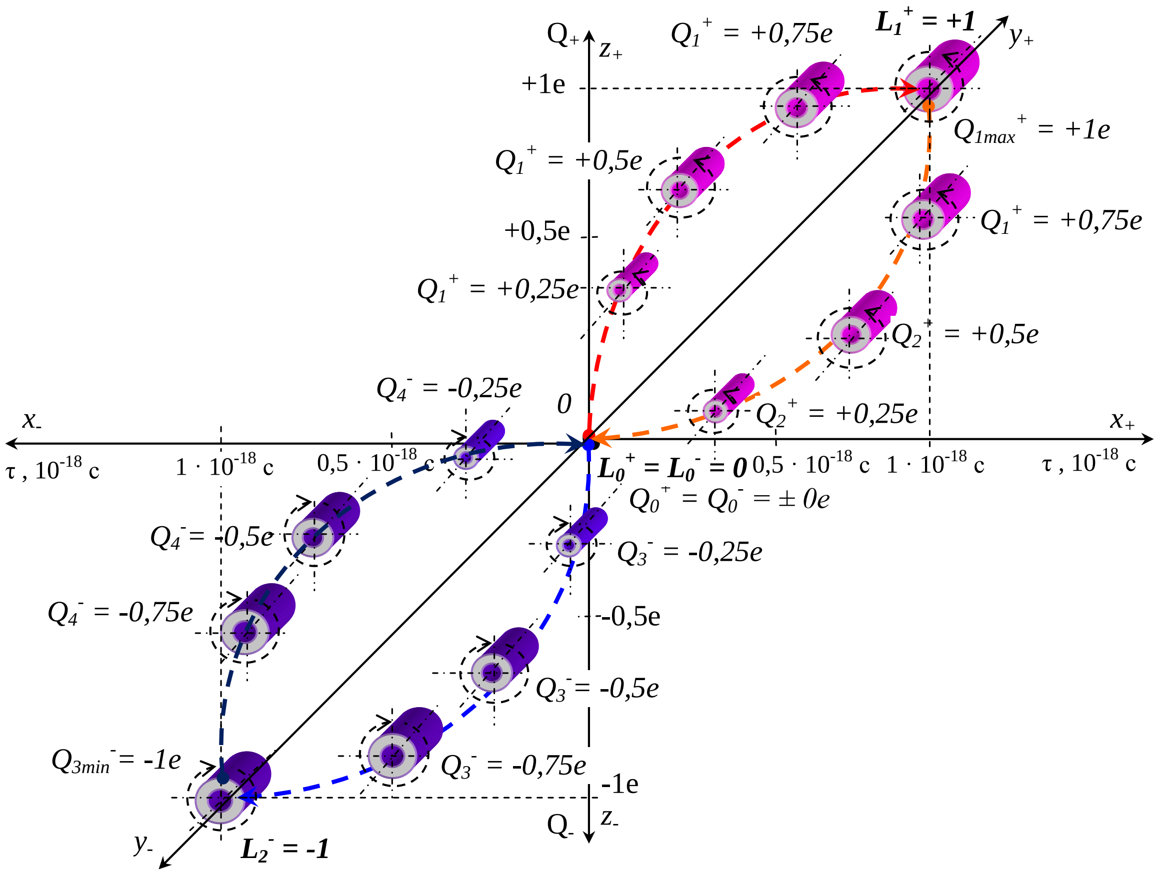

Fig. 1. Spinal-orbital model of the existence of photon and change in its own orbital charge during the observation period of τ = 2·10-18 s.

It should be emphasized that the phase transition in the change of the photon, for example, from the state of $Q_{1max}^+ = +1e$, equal to the charge of the positron, to $Q_{3min}^- = -1e$, equal to the elementary charge of the electron, in its principle is impossible, because of violation at least, accepted in quantum mechanics, the principle of additionalness N. Bohr [5-11]. There are possible transitions from the state of $Q_{1max}^+ = +1e$ to the state of $Q_0^+ = +0e$, and back — to the state of
$(Q_{1max}^+ = +1e) \leftrightarrow (Q_0^+ = +0e)$, as well as from the state of $Q_{3min}^- = -1e$, to the state of $Q_0^- = -0e$, and back — to the state of $(Q_{3min}^- = -1e) \leftrightarrow (Q_0^- = -0e)$. The fact that own orbital moments rotation of the photon around its axis are mutually opposite, due to the fact that in quantum mechanics for positive direction rotation of its own orbital moment rotation of the photon relative to its axis the direction is counterclockwise, and it is equal to:
$L_1^+ = J_1 \cdot \omega = +1$. If the direction rotation of the own orbital moment rotation of the photon relative to its axis will be clockwise, it will be considered negative and, therefore, its value in this case is equal to
$L_2^- = J_2 \cdot \omega = -1$. And $J_1 = -J_2$ represent the opposite directed inertia of the rotation of the photon itself relative to the orbital axis of rotation, at different transitions. For the entire minimum period $T_{min} = 2\pi$ is characterized by change in its charge from "+1" to "-1e", while passing through its characteristic zero point "± 0e" where the electrical charge in it is also zero.

The total time changing the photon's own charge is equal to an average of $\tau \approx 2 \cdot 10^{-18}$ s. The lifetime of positive or negative self-charge of photon is equal to
$\tau \approx 0{,}2 \cdot 10^{-18}$ s, when amount of positive charge is equal to $Q^+ = +0{,}8e \ldots +1e$ and negative charge is equal to
$Q^- = -0{,}8e \ldots -1e$.

Photon is kind of electromagnetic dipole, constantly changing in time and space, thus obeying the quantum principle of Heisenberg's uncertainty (9):

$$(\Delta x \cdot \Delta p) \geq \frac{\hbar}{2}, \qquad (9)$$

By measuring the magnitude of average quadratic deviation of the coordinates Δx and the medium-square deviation of the pulse Δp, and at same time, having known speed of light, the photon allows unlimited accuracy of measurement its coordinates in time and space, and therefore its changing orbital charge.

When reflecting from the mirror editor or when passing environments with density gradient, that is, in the phenomenon of aberration, an experimental way is found to change direction of the photon [5]. In all these cases, photons are not absorbed by substance, and are clearly not included with the carriers of the substance in the contact interaction, that is, in the format of elementary particles of the environment. However, there is change in direction and polarization of the photon [7]. This behavior of photon, like fermions-particles, is possible only under the influence of constant electric fields formed by electrons and protons of the environment. Analysis of many experiments indicates that effective factor in these interactions is not only the size of the field, but also the gradient, therefore, the photon is an excellent quantum detector the gradient of electric field [9].

Unsteady theory of perturbations. Let H_0 — be so-called calm operator, representing time-dependent Hamiltonian quantum system in absence of external electric and magnetic fields. To do this, Schroedinger's equation allows for its exact solution. Then full Hamiltonian H of this system, in the presence of unsteady external field [8, 11, 12–17], has classic look (10):

$$H = H_0 + V(\vec{r},t), \qquad (10)$$

where $V(\vec{r},t)$ — is an operator of perturbation, describing the interaction of external electro-magnetic field with the quantum system. The theory of perturbations is used in following condition (11):

$$V(\vec{r},t) << H_0. \qquad (11)$$

Let the quantum system be in the field of falling, monochromatic electromagnetic wave, the characteristics of which periodically change over time with frequency ω. Then the $V(\vec{r},t)$ perturbation operator will also change periodically over time with the same frequency ω, hence it can be recorded as (12):

$$V(\vec{r},t) = 2\curlyvee(\vec{r})\cos\omega t = \curlyvee(\vec{r})e^{i\omega t} + \curlyvee(\vec{r})e^{-i\omega t}. \qquad (12)$$

Enter the designation $V^{\pm}(\vec{r},t) = \curlyvee(\vec{r})e^{\pm i\omega t}$, then the $V(\vec{r},t)$ perturbation operator takes following look (13):

$$V(\vec{r},t) = V^+(\vec{r},t) + V^-(\vec{r},t). \qquad (13)$$

In the first order, time-dependent perturbation theory, the probability is moving "w" of the quantum system's into unit of time from the state described by wave function Ψ_i to the state described by the wave function Ψ_f (Ψ_i and Ψ_f — is own functions the operator's H_0) under the influence of perturbation, the expression (14) is set:

$$w = \frac{2\pi}{\hbar}\left|\int \psi_f^* v(\mathbf{r})\psi_i d\mathbf{r}\right|^2 \rho_f(E_f) = \frac{2\pi}{\hbar}\left|\langle f \left| v(\mathbf{r}) \right| \rangle i\right|^2 \rho_f(E_f) \qquad (14)$$

And the transitions take place in states that have the energy of $E_f = E_i \pm \hbar\omega$ and density $\rho_f(E_f)$ (E_i and E_f — is own values operator's H_0, which correspond to their own functions Ψ_i and Ψ_f).

The indignation of $V^{+}(\vec{r},t)$ leads to the fact that the quantum system is loses energy ħω by means of is forced eletion: $E_f = E_i - \hbar\omega$. Under the influence of perturbation $V^{-}(\vec{r},t)$, the system is acquires the energy ħω and $E_f = E_i + \hbar\omega$. We will consider only the last case corresponding to the absorption of energy of electromagnetic field, is leaving in the operator of perturbation $V(\vec{r},t)$ only second formulation $V^{-}(\vec{r},t)$, which is depends on the time as $e^{-i\omega t}$.

A quantum system in field of flat electromagnetic wave. Consider the case when a flat monochromatic electromagnetic wave falls on the quantum system. Then the full Hamiltonian H particle system and electromagnetic field [4, 6, 11–17] has this view (15):

$$H = H_0 + H_{el} + V(\vec{r},t), \qquad (15)$$

where H_0— is the Hamiltonian system in absence of external electric and magnetic fields, H_{el} — is the Hamiltonian electromagnetic field and $V(\vec{r},t)$ — is the Hamiltonian interaction of the system with the electromagnetic field, which is the operator of the perturbation.

In the future, the system will be understood by the totality of $\vec{A}$ non-relitivist particles. Then we have an expression (16):

$$H_0 = \sum_{a=1}^{A} \frac{\mathbf{p}_a^2}{2m_a} + \sum_{a<b} W_{ab} \qquad (16)$$

where $\mathbf{p}_a$ и m_a — is pulse operator and system particle mass, W_{ab} — is energy interaction "a" and "b" particle. H_{el} — is energy of electromagnetic field. The classic expression for the energy of the electromagnetic field [11, 12] takes the form (17):

$$H_{el} = \frac{1}{8\pi}\int\left(\vec{\mathbf{E}}^2 + \vec{\mathbf{H}}^2\right)\partial x\partial y\partial z = \frac{1}{8\pi}\int\left(\vec{\mathbf{E}}^2 + \vec{\mathbf{H}}^2\right)\partial\vec{\mathbf{r}}\ , \qquad (17)$$

where $\vec{\boldsymbol{E}}$ и $\vec{\boldsymbol{H}}$ — is the tension electric and magnetic fields.

If the field is quantum and is a set of n photons of energy $\hbar\omega$, then the energy of such electromagnetic field is determined by expression (18):

$$H_{el} = n\hbar\omega. \qquad (18)$$

The expression for the operator $V(\vec{r},t)$ is a type of spine-free particle (19):

$$V(\mathbf{r},t) = -\frac{1}{c}\sum_{a=1}^{A}\frac{e_a}{m_a}\mathbf{A}\mathbf{p}_a \qquad (19)$$

where e_a — is electrical charges of particle system, $\vec{\mathbf{A}}$ — is the vector potential of the electro-magnetic wave at the point, where is located the "a" particle.

We specify this expression for the case when the system is absorbs falling on it the flat monochromatic electromagnetic wave. The vector potential $\vec{\mathbf{A}}$ of such wave [11, 12] can be recorded in the form (20):

$$\vec{\boldsymbol{A}}(\vec{\boldsymbol{r}},t) = 2A_0\varepsilon\cos\left(\vec{\boldsymbol{k}}\vec{\boldsymbol{r}} - \omega t\right) = A_0\varepsilon e^{i\left(\vec{\boldsymbol{k}}\vec{\boldsymbol{r}} - \omega t\right)} + A_0\varepsilon e^{-i\left(\vec{\boldsymbol{k}}\vec{\boldsymbol{r}} - \omega t\right)} \qquad (20)$$

where $\vec{\boldsymbol{k}}$ — is wave vector, the direction of which determines the direction of the wave (where $\vec{\boldsymbol{k}} = \frac{\boldsymbol{\omega}}{\boldsymbol{c}}\cdot\vec{\boldsymbol{n}}$, and $\vec{\boldsymbol{n}}$ — is single vector in the direction of $\vec{\boldsymbol{k}}$), and $\vec{\boldsymbol{\varepsilon}}$ — is single vector of radiation polarization.

The vector potential $\vec{A}$ must satisfy the condition (21):

$$div\vec{\boldsymbol{A}} = 0. \qquad (21)$$

For flat, transverse, electromagnetic wave, polarized perpendicular to the direction of distribution, the condition (21) is tantamount to requirement (22):

$$\left(\vec{\boldsymbol{k}}\vec{\boldsymbol{\varepsilon}}\right) = 0, \qquad (22)$$

Substituting in the formula (19) for $V(\vec{r},t)$ is only the first member of expression (20) for the vector potential of a flat wave, which has a negative frequency and, is therefore responsible for the absorption of radiation, get (23):

$$V(\mathbf{r},t) = v(\mathbf{r})e^{-i\omega t} = -\mathbf{A}_0 e^{-i\omega t}\cdot\frac{1}{c}\sum_{a=1}^{A}\frac{e_a}{m_a}e^{i\mathbf{k}\mathbf{r}_a}\mathbf{p}_a \qquad (23)$$

And from the material equation (24):

$$\vec{\mathbf{A}}_0 = A_0\vec{\boldsymbol{\varepsilon}}. \qquad (24)$$

For the outrage operator $v(\vec{r})$ we end up with an expression (25):

$$v(\mathbf{r}) = -\frac{1}{c}\mathbf{A}_0\sum_{a=1}^{A}\frac{e_a}{m_a}e^{i\mathbf{k}\mathbf{r}_a}\mathbf{p}_a \quad (25)$$

A classic representation of radiation and photons. It was stated above that the electromagnetic field of photon radiation is represented in the classical form of flat transverse ($\mathbf{div}\vec{\mathbf{A}} = \mathbf{0}$) monochromatic electromagnetic wave (21). From the course of quantum mechanics it is known that an electromagnetic wave, consisting of photons, cannot have any intensity [4, 6, 11-15, 17]. To do this, the amplitude A_0 of vector potential is normalized so that, it corresponds to n photons in a unit of volume. In this case, the time-averaged energy density of the electromagnetic wave will be equal to the energy of n photons, according to the expression (26):

$$\frac{1}{8\pi}\langle\mathbf{E}^2 + \mathbf{H}^2\rangle = n\hbar\omega, \quad (26)$$

Using expressions (27)... (29):

$$\langle\vec{\mathbf{E}}^2\rangle = \langle\vec{\mathbf{H}}^2\rangle, \quad (27)$$

$$\vec{\mathbf{E}} = -\frac{1}{c}\frac{\partial\vec{A}}{\partial t}, \quad (28)$$

$$\langle\sin^2\omega t\rangle = \frac{1}{2}, \quad (29)$$

We get the value of the time-averaged energy density of the electromagnetic wave for n photons, according to the expression (30):

$$\frac{1}{8\pi}\langle\mathbf{E}^2 + \mathbf{H}^2\rangle = \frac{A_0^2\omega^2}{2\pi c^2}. \quad (30)$$

By equating two expressions (26) and 30), we gain equality (31):

Classification of photons and multipole waves. The states of the quantum systems under consideration (atom and nucleus) are characterized by certain values of the angular momentum J and parity P. Therefore, in any process in which such quantum systems pass from one state to another, the selection rules for moment and parity must be taken into account. If an atom or nucleus transfers from one state to another as a result of absorption of electromagnetic radiation, then the laws of conservation of angular momentum and parity require that the absorbed radiation also have certain values of J and P. Therefore, only such electromagnetic radiation can participate in atomic and nuclear processes, whose wave function — is an eigenfunction of the moment and parity operators [4, 6, 11–15, 17].

The vector potential $\vec{\boldsymbol{A}}(\vec{\boldsymbol{r}}, \mathrm{t})$of plane electromagnetic wave that does not have a definite moment and parity is expanded in series of states with certain values of angular momentum J and parity P in multipole waves or multipoles [4, 6, 11–15, 17]. Individual members of such an expansion will correspond to electromagnetic waves (photons) with certain values of the moment and parity, which can be absorbed by atoms and nuclei. Our task is to move from the photon field with a certain momentum value $\vec{\boldsymbol{p}} = \hbar\vec{\boldsymbol{k}}$ to the photon field with certain values of angular momentum J and parity P.

The total angular momentum of a photon J takes integer values, starting from unity: J = 1, 2, 3,...,N. Impossibility for a photon J = 0 follows from the fact that the electromagnetic wave is transverse and therefore cannot be described by a spherically symmetric wave function.

The usual definition of spin as the moment of momentum in the rest system is not applicable to the photon, since such system does not exist for the photon. Since photon is quantum of vector field, and any vector field is suitable for describing particle with spin 1, considering the properties of the vector field with respect to the rotations of the coordinate system, it is convenient to attribute the spin S = 1 to the photon. From this it follows that the total moment of the photon $\vec{\boldsymbol{J}}$ can be formally considered as the vector sum of spin $\vec{\boldsymbol{S}}$ and orbital $\vec{\boldsymbol{L}}$ moments — $\vec{\boldsymbol{J}} = \vec{\boldsymbol{L}} + \vec{\boldsymbol{S}}$, and the orbital moment L in this case is nothing more than the rank of the spherical functions Y_{Lm} that are part of the photon wave function [4– 12].

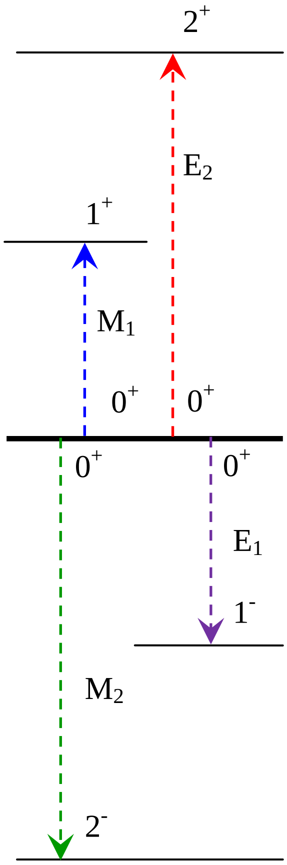

Fig. 2. The spinal-orbital model functioning of final state electrical and magnetic transitions in quantum photon system during the observation period of $\tau \approx$ 10-18 s, at zero back S = 0 and level counting, determined by positive parity of JPi = 0+.

Photons with specific value of J are called 2J-polar (dipole, if J = 1; quadrupole, if J = 2; octupole, if J = 3, etc.). For given J, the quantum number of the orbital momentum L can take three values: L = J + 1, J, J – 1 since the photon spin is S = 1.

The parity of the photon P_f is determined by the rule, according to the expression (35):

$$P_\phi = (-1)^{L+1}. \tag{35}$$

Therefore, photons with the same J can have different values of orbital moment, and therefore parity. Photons, for which the orbital moment coincides with the full L = J, have a parity $(-1)^{J+1}$ and are called magnetic M_J-photons. Photons, for which $L = J \pm 1$, have parity $(-1)^J$ and are called electric E_J-photons. Thus, these photons is electrical-type, unlike magnetic-type photons, do not have certain orbital moment. Their wave function is linear combination of states with $L = J \pm 1$ [4–17].

To describe electrical (E_J) and magnetic (M_J) radiation sican uses electrical and magnetic potentials $\mathbf{A}^{E}_{JM}$ and $\mathbf{A}^{M}_{JM}$, which can be seen as E_J and M_J's own radiation functions, having a full-moment projection equal to M. Decomposition is flat electromagnetic wave on multifields is decomposition by characteristic functions $\mathbf{A}^{E}_{JM}$ and $\mathbf{A}^{M}_{JM}$ [4–17].

The simplest kind of decomposition is when a flat electromagnetic wave is polarized in a circle and its wave vector $\vec{k}$ is directed along the 0z axis [4–9, 11–17]. In this private case, decomposition in multi-fields has a form (36):

$$\mathbf{A}(\mathbf{r},t) = A_0\mathbf{e}_p e^{i(\mathbf{kr}-\omega t)} = A_0 e^{i\omega t}\sum_{J=1}^{\infty} i^J \sqrt{2\pi(2J+1)}\,(i\mathbf{A}^{E}_{Jp} + p\mathbf{A}^{M}_{Jp}), \tag{36}$$

where $\vec{e}_p$ — is basic vectors of complex circular coordinate system, with left circular polarization responding to p = +1, and right p = –1. In accordance with this, the projection of full moment of the photon takes the values M = ± 1.

For most simple case, when initial state of quantum system has zero spin S = 0 and positive parity $J^P{}_i = 0^+$, possible end states $(J^P{}_f)$ systems, arising from the absorption of dipoly and quadrupoly photons of electric and magnetic type, shown in the fig. 2.

If the wave vector $\vec{k}$ has an arbitrary direction, then decomposition in multifields [4–9, 11–17] is more complex expression (37):

$$\mathbf{A}(\mathbf{r},t) = A_0\mathbf{e}_p e^{i(\mathbf{kr}-\omega t)} = A_0 e^{i\omega t}\sum_{J=1}^{\infty}\sum_{M=-J}^{J} i^J\sqrt{2\pi(2J+1)}D^J_{Mp}(\tilde{\varphi},\tilde{\theta},0)(i\mathbf{A}^E_{Jp}+p\mathbf{A}^M_{Jp}), \quad (37)$$

where in p = $\pm$1, D^J_{Mp} — is rotation matrix, which depends on angles $\hat{\theta}$ and $\hat{\varphi}$, which determine direction of the wave vector $\vec{k}$ in the polar coordinate system. In this case, full moment projection of the M photon is takes all possible values: M = $\pm$J, $\pm$(J–1),... .

Practical application of new quantum properties of photon. Recently, mass production of quantum generators and sources of laser radiation, as well as microprocessors on quantum beginnings, using the concept of the presence and modification of its own orbital charge at the photon mass production of powerful, high-performance and ultra-fast modern computers. Using the idea of Russian scientists about the presence of constantly changing in time and in the space of its own orbital charge photon formed a fundamental basis in the creation of a super-powerful (up to 1 MW) and long-range combat laser (up to 220 km), used in limited contingent of Russian military and space forces in Syria. The speed transmission of narrow-coherent beam photons modulated bit-information is 10^{10} times greater than when transmitting similar digital information using electrons as the main carriers of charge and vectors of information from the source (transmitter) to its users (receiver).

In this regard, it should be noted that the combat laser mounted on the destroyers "Ross" and "Donald Cook" of the USA Navy have capacity of up to 100 kW with an effective range hitting the target and the enemy at distance of up to 30 km. Moreover, if on American warships the laser installation works at full capacity, the ship or the combat vehicle stops and do not have the ability to go its own way, because there is not enough necessary design power, thus presenting of itself an excellent stationary target for torpedo-missile attacks of the enemy from underwater nuclear-powered ships or surface ships, from coastal and onshore mobile, anti-aircraft missile systems, type "S-400 Triumph", as well as from the air, using fighter-bombers. The Russian combat laser consists of one working, combat reactor, one backup reactor and one reactor for the necessary initial-accelerating swap. The first two (combat) reactors operate on fast neutrons, using their own orbital charge at narrowly directed, coherent beam of photons, flying at detected target or enemy, and third swap reactor functions on the slow (thermal) neutrons.

The Russian combat laser works completely autonomously, regardless of operation power plant of the warship. Which is great achievement of Russian military engineering thought. The Russian laser installation has three autonomous, independent cooling levels working body – quantum auto generator continuous and pulse type of photon beam generation from output of combat laser.

Conclusions:

1. Newer physical properties of photon, at the atomic-molecular level interaction of radiation and absorption of photons when electrons move from external, remote orbits atoms of matter to lower orbit of rotation around the nucleus of atoms have been revealed.
2. Experienced way discovered fast-changing in time and space, own orbital negative and positive photon charges.
3. Photon — is quasi-neutral elementary particle in nature, which has rapidly changing charge in time and space from "-1e" – negative charge, numerically equal to the charge of the elementary electron and up to the "+1e" – positive charge, numerically equal to the charge elementary positron as an electron antiparticle.
4. The existence of positive or negative self-charge of photon is equal to $\tau \approx 0{,}2\cdot10^{-18}$ s, when the amount of positive charge is equal to $Q^+ = +0{,}8e\ldots+1e$ and negative charge is equal to $Q^- = -0{,}8e\ldots-1e$.
5. The mass of the photon will be for each frequency, in the range in question, its own, separate, different from each other.
6. The intensity, inverity, power and strength of laser radiation are highly dependent on the range working frequencies of input signal.
7. In photon there is only so-called relativistic mass, different from zero, as its actual (real) mass, at rest is zero $m_{f0} = 0$.
8. The speed of the photon at rest is absent from $v_{f0} = 0$, as the photon moves at the speed of light as transord electromagnetic wave, in certain environment.
9. Transshift, monochromatic, electromagnetic wave, passing through its zero value, is characterized by the fact that at this point value charge of the photon begins to decrease exponentially from its maximum value $Q_{1^+} = 1^+ = +1e$, up to zero $Q_{2^+} = 0^+ = +0e$, when the photon itself almost loses its speed, it stops, has almost zero peace mass, and the photon, at this point in time, also lacks energy and momentum of movement.
10. For entire period T = 2π, the photon is energy-neutral and its full charge $Q^{2\pi}_{\Phi} = 0$.
11. The unsteady theory the perturbation of quantum system in is considered presence of unsteady external field. The indignation $V^+(\vec{r},t)$ leads to the fact, that quantum system is loses energy ħω by means forced eletion: $E_f = E_i - \hbar\omega$. Under the influence of perturbation $V^-(\vec{r},t)$, the system is acquires the energy ħω and $E_f = E_i + \hbar\omega$.
12. The electromagnetic field of photon radiation is represented in the classical form of flat transverse

($div\vec{A} = 0$) monochromatic electromagnetic wave. An electromagnetic wave is consisting of photons, cannot have any intensity.

13. The quantum transitions is occur in states that have the energy $E_f = E_i \pm \hbar\omega$ and density $\rho_f(E_f)$ (E_i and E_f — is own values the operator's H_0, that meet their own functions Ψ_i and Ψ_f).

14. The vector potential $\vec{A}(\vec{r}, t)$ of flat electromagnetic wave, which does not have certain moment and parity, decomposes into a row by state with certain values of the moment J and of the number P movement on multi-floor waves or multipoles. Individual members of this decomposition will respond to electromagnetic waves (photons) with certain moments and parity values that can be absorbed by atoms and nuclei of matter.

15. Using the idea of Russian scientists on the presence of constantly changing in time and in the space of its own orbital charge photon formed fundamental basis in the creation of super-powerful (up to 1 MW) and long-acting combat laser (up to 220 km) used in limited contingent of Russian military and space forces in Syria.

16. The speed at which narrow-coherent beam of photons is transmitted to modulated bit-information is 10^{10} times greater than when transmitting similar digital information using electrons as the main charge carriers and vectors of information from the source (transmitter) to its users (receiver).

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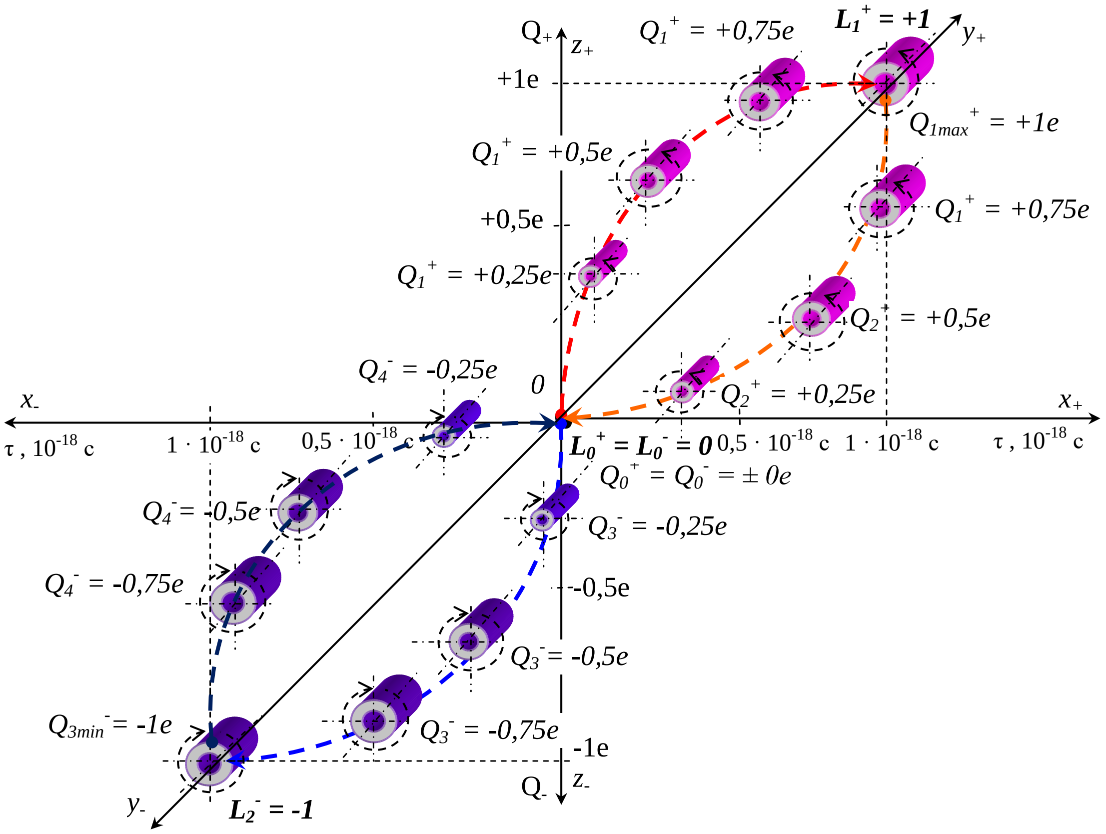

Fig. 1. Spinal-orbital model of the existence of photon and change in its own orbital charge during the observation period of τ = 2·10-18 s.

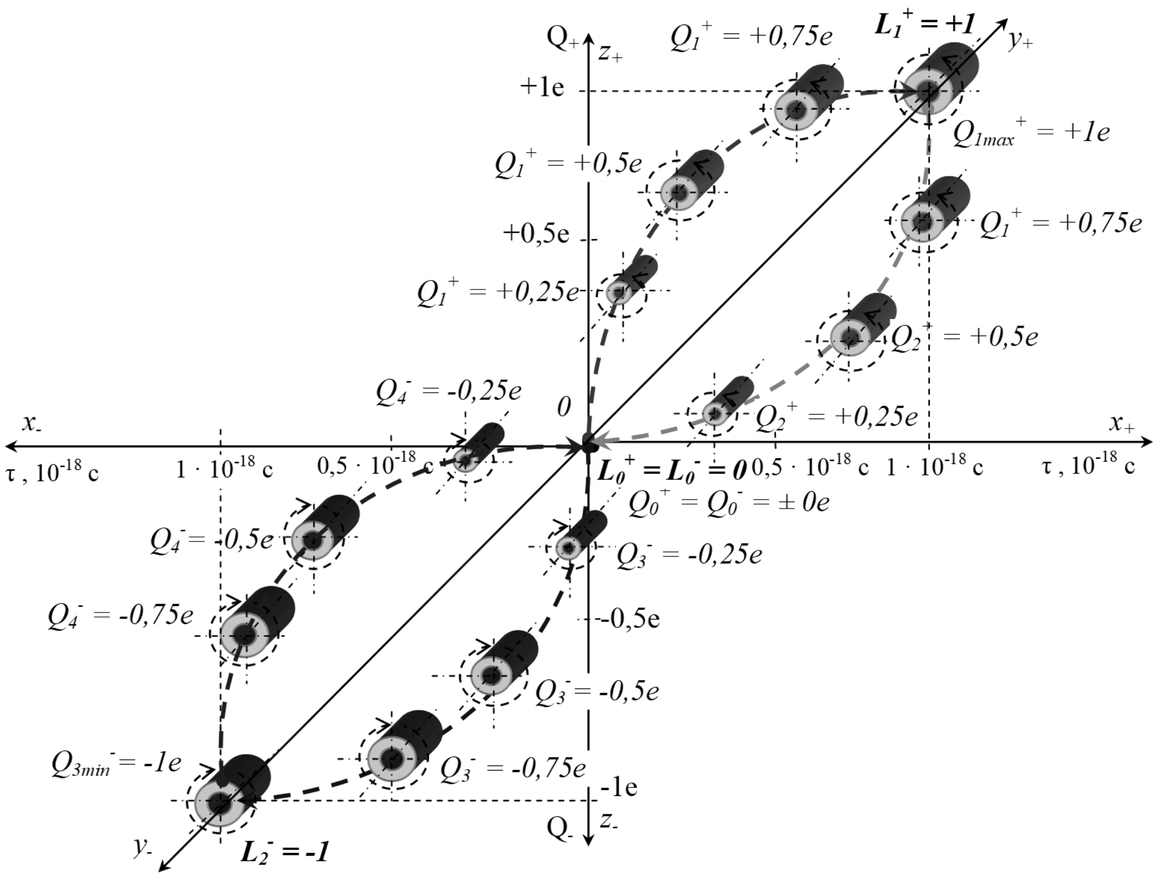

Fig. 1. Spinal-orbital model of the existence of photon and change in its own orbital charge during the observation period of τ = 2·10-18 s.

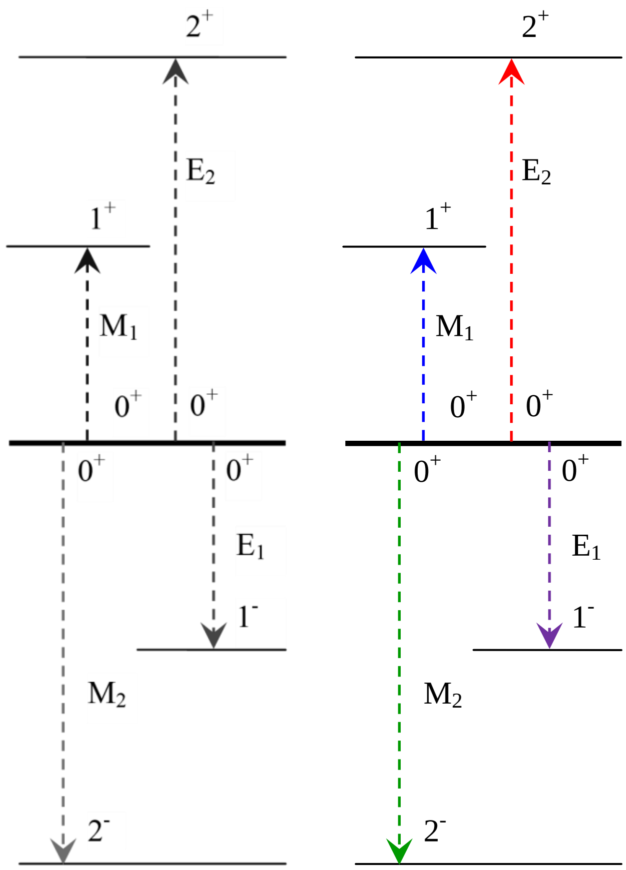

Fig. 2. The spinal-orbital model functioning of final state electrical and magnetic transitions in quantum photon system during the observation period of τ ≈ 10-18 s, at zero back S = 0 and level counting, determined by positive parity of JPi = 0+.

О НАЛИЧИИ ФОТОННОГО ИЗЛУЧЕНИЯ В ОБЪЕМЕ МЕТАЛЛОВ И ИХ СПЛАВОВ

Кошман Валентин Семенович
канд. техн. наук, доцент,
Пермский государственный аграрно-технологический университет,
г. Пермь, Россия

ON THE PRESENCE OF PHOTON RADIATION IN THE VOLUME OF METALS AND THEIR ALLOYS

Valentin Koshman,
Cand. tech. sciences, associate professor
Perm State Agrarian and Technological University, Perm, Russia

Аннотация. Автор обращает внимание на решение Р. Бермана: повышение точности измерения теплопроводности λ на основе закона Фурье в его записи для твердого тела как сплошной среды достижимо при учете нелинейности вида $\lambda = bT^3$, где в простейшем эксперименте $b = const$ в расширенном интервале температур ΔT. В данной связи высказано предположение и дано обоснование тому, что в объеме металла при создании градиента температуры транспорт теплоты, реализуемый электронами проводимости, сопровождается переносом теплоты фотонным излучением.

Abstract. The author draws attention to the Berman solution: improving of the accuracy of measuring thermal conductivity based on Fourier's law in its tractability for a solid as a continuous medium is achievable when taking into account the nonlinearity of λ=bT, where in the simplest experiment b=$const$ in the extended temperature range ΔT . Thereby it was suggested and proved that in the volume of the metal during the creation of the temperature gradient, the heat transport realized by conductivity electrons is accompanied by heat transfer by photon emission.

Ключевые слова: твердые тела, металлы, теплопроводность, закон Стефана – Больцмана, внутреннее фотонное излучение.

Keywords: solids, metals, thermal conductivity, Stefan – Boltzmann law, internal photon radiation.