

Research Article

An Axial-Vector Photon in a Mirror World

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Abstract: We discuss a theory in which the left- and right-handed axial-vector photons refer to long- and short-lived bosons of true neutrality, respectively. Such a difference in lifetimes expresses the unidenticality of masses, energies, and momenta of axial-vector photons of the different components, generalizing the classical Klein-Gordon equation to the case of C-odd types of particles with a nonzero spin. Together with a new Dirac equation for truly neutral particles with the half-integral spin, the latter admits the existence of the second type of the local axial-vector gauge transformation responsible for origination in a Lagrangian of an interaction Newton component, which gives an axial-vector mass to all the interacting particles and fields. The quantum axial-vector mass, energy, and momentum operators constitute herewith a new Schrödinger equation, confirming that each of them can individually influence on the matter field. They define at the new level, namely, at the level of the mass-charge structure of gauge invariance another Euler-Lagrange equation such that it has an axial-vector nature.

Keywords: mass energy and momentum matrices, a set-matrix duality, C-odd particles with a nonzero spin, mass energy and momentum operators, gauge transformations of the second type, an interaction newton component, selected quantum theory equations

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1. Introduction

Between nature of elementary particles and matter fields there exists a range of fundamental symmetries, which require to raise the question about axial-vector (A) photons (γ^A) having with truly neutral fermions a nonzero interaction. Their presence [1] restores herewith the broken gauge invariance of the unified field theory Dirac Lagrangian of C-odd particles. If such fermions are the axial-vector leptons ($l^A = e^A, \mu^A, \tau^A, \dots$) with neutrinos ($\nu_l^A = \nu_e^A, \nu_\mu^A, \nu_\tau^A, \dots$) and antileptons (\bar{l}^A) with antineutrinos ($\bar{\nu}_l^A$), they are not the invariant concerning the charge conjugation (C) and that, consequently, the operator C leads each of them into its antiparticle

$$Cl^A = \bar{l}^A, \quad C\nu_l^A = \bar{\nu}_l^A.$$

At the same time, C itself together with an operator of space reflection P constitutes another operator CP such that

$$CPl^A \neq \bar{l}^A, \quad CPv_l^A \neq \bar{v}_l^A.$$

Insofar as an operator P is concerned, its action appears in each transition of

$$Pl_{L,R}^A \rightarrow l_{R,L}^A, \quad Pv_{lL,R}^A \rightarrow v_{lR,L}^A,$$

$$P\bar{l}_{R,L}^A \rightarrow \bar{l}_{L,R}^A, \quad P\bar{v}_{lR,L}^A \rightarrow \bar{v}_{lL,R}^A.$$

Simultaneously, as is easy to see, the left (L) [right (R)]-handed neutrino of true neutrality in the field of an axial-vector emission can be converted into a right (R) [left (L)]-handed one without change of his own flavor. These interconversions together with the unity of flavor and gauge symmetry laws [1, 2] express the unidenticality of masses, energies, and momenta of truly neutral neutrinos of the different components. However, such a possibility, as was noted in [3] for the first time, is realized only at the spontaneous mirror symmetry violation of axial-vector types of fermions. In other words, the left-handed neutrino of true neutrality and the right-handed axial-vector antineutrino are of long-lived leptons of C-oddity, and the right-handed truly neutral neutrino and the left-handed axial-vector antineutrino refer to short-lived C-odd fermions.

This difference in lifetimes establishes a new CP-even Dirac equation and thereby describes a situation when the mass, energy, and momentum come forward in nature of truly neutral types of particles as the flavor symmetrical matrices

$$m_s = \begin{pmatrix} 0 & m_A \\ m_A & 0 \end{pmatrix}, \quad E_s = \begin{pmatrix} 0 & E_A \\ E_A & 0 \end{pmatrix}, \quad \mathbf{p}_s = \begin{pmatrix} 0 & \mathbf{p}_A \\ \mathbf{p}_A & 0 \end{pmatrix}, \quad (1)$$

$$m_A = \begin{pmatrix} m_L & 0 \\ 0 & m_R \end{pmatrix}, \quad E_A = \begin{pmatrix} E_L & 0 \\ 0 & E_R \end{pmatrix}, \quad \mathbf{p}_A = \begin{pmatrix} \mathbf{p}_L & 0 \\ 0 & \mathbf{p}_R \end{pmatrix}, \quad (2)$$

where s and A must be accepted as the indices of distinction. This does not exclude [3, 4] of course from the the further the ideas of that s as a self-value of the helicity operator $\sigma \mathbf{p}_s = s|\mathbf{p}_s|$ with the Pauli spin matrices σ is equal to $s = \pm 1$, the upper (lower) sign of which corresponds to the right (R) [left (L)]-handed neutrino of an axial-vector nature.

We recognize in addition that the same particle has no simultaneously both vector C-even and axial-vector C-odd charges. Such an order, however, corresponds to the fact that the same C-even or C-odd particle cannot interact simultaneously with both a vector gauge boson and an axial-vector one. Thereby, it opens in principle the possibility for the classification of elementary objects with respect to C-operation, which reflects the availability [1, 2] of the two types of particles and fields of C-invariant and C-noninvariant nature.

The mass, energy, and momentum of the neutrino of a C-even charge are strictly vector (V) type [4]. In contrast to this, the neutrino of a C-odd electric charge [5] has the mass, energy, and momentum of an axial-vector (A) nature [3]. In other words, the matrices (1) and (2) refer to those elementary particles in which the vector C-even properties are absent.

Of course, these matrices from the point of view of nature itself give the right to write the unified field theory equation of truly neutral types of particles with the spin $1/2$ as a unification of the structural parts of their four-component wave function $\psi_s(t_s, \mathbf{x}_s)$ in a unified whole

$$i \frac{\partial}{\partial t_s} \psi_s = \hat{H}_s \psi_s. \quad (3)$$

So it is seen that

$$\hat{H}_s = \alpha \cdot \hat{\mathbf{p}}_s + \beta m_s, \quad (4)$$

and the sizes of m_s , E_s , and \mathbf{p}_s correspond in a mirror presentation [3] of matter fields, namely, in a matrix presentation of their axial-vector mass, energy, and momentum to the quantum operators

$$m_s = -i \frac{\partial}{\partial \tau_s}, \quad E_s = i \frac{\partial}{\partial t_s}, \quad \mathbf{p}_s = -i \frac{\partial}{\partial \mathbf{x}_s}. \quad (5)$$

The presence of an index s in (1), (4), and (5) implies the unidenticality of the space-time coordinates (t_s, \mathbf{x}_s) and the lifetimes τ_s for the left ($s = L = -1$)- and right ($s = R = +1$)-handed particles. They are of course the consequences of spontaneous mirror symmetry violation and describe [3] its dynamical origination. On this basis, nature itself has separated Minkowski space into the usual left (right)-handed and the mirror right (left)-handed spaces in which a neutrino of the same true flavor [1, 3] is characterized by the different masses, energies, and momenta. Then it is possible, for example, to use [3] any of earlier experiments [6, 7] about a quasielastic axial-vector mass as the first laboratory indication in favor of an axial-vector mirror Minkowski space-time.

We see in addition that the Dirac matrices $\gamma^\mu = (\beta, \beta\alpha)$ for the case $\partial_\mu^s = \partial/\partial x_s^\mu = (\partial/\partial t_s, -\nabla_s)$ when

$$\partial_\mu^s = \begin{pmatrix} 0 & \partial_\mu^A \\ \partial_\mu^A & 0 \end{pmatrix}, \quad \partial_\mu^A = \begin{pmatrix} \partial_\mu^L & 0 \\ 0 & \partial_\mu^R \end{pmatrix}, \quad (6)$$

can replace an equation (3) for

$$(i\gamma^\mu \partial_\mu^s - m_s)\psi_s = 0. \quad (7)$$

In these circumstances the free Dirac Lagrangian of a C-noninvariant [$Cl^A = \bar{l}^A(Cv_l^A = \bar{v}_l^A)$] fermion [$l^A(v_l^A)$] becomes naturally united and behaves as

$$L_{free}^D = \bar{\psi}_s \gamma^5 (i\gamma^\mu \partial_\mu^s - m_s)\psi_s. \quad (8)$$

The latter does not imply of course that the mass, energy, and momentum of the neutrino of true neutrality at the level as were united by the author [3] in a unified whole do not transform the left (right)-handed axial-vector neutrino into a right (left)-handed one without violate of Lorentz symmetry. Thereby, it does not exclude [1] the fact that regardless of whether or not an unbroken Lorentz invariance exists, the same neutrino may not be simultaneously both a left-handed fermion and a right-handed one. This is exactly the same as when each type of gauge boson constitutes a kind of physical current, which follows from the unified mirror principle.

To follow their mathematical logic at the new level, namely, at the level of hitherto internally undisclosed mirror structure of an axial-vector gauge invariance, we investigate here the questions implied from the invariance of the free Dirac Lagrangian (8) concerning the two forms of the local axial-vector gauge transformations including a unified theoretical description of the origination of mass of truly neutral types of particles and fields.

2. Mass structure of axial-vector types of photons

The importance of our notion about an electric charge of a C-noninvariant nature lies in the fact [5] that between leptonic current structural components there exist some paradoxical contradictions, which admit their classification with respect to C-operation. This emphasizes the circumstance that the classical anapole [8, 9] must be considered as the C-odd electric charge. It has a crucial value for axial-vector types of local gauge transformations.

One of them expresses, in the Coulomb (C) limit, the idea about that

$$\psi'_s = U_s^C \psi_s, \quad U_s^C = e^{i\beta_s(x_s)\gamma^5}, \quad (9)$$

and the Lagrangian (8) loses at the local phase $\beta_s(x_s)$ his gauge invariance.

For restoration of such a broken symmetry, it is desirable to introduce the photon Coulomb field $A_\mu^s(x_s)$ corresponding in a system to an axial-vector transformation

$$A_\mu^{s'} = A_\mu^s + \frac{i}{e_s} \gamma^5 \partial_\mu^s \beta_s \quad (10)$$

including the Coulomb mirror interaction constants e_s at the level of an electric charge of the C-noninvariant nature.

Insertion of

$$\partial_\mu^s = \partial_\mu^s - e_s A_\mu^s \quad (11)$$

in (8) leads us to the Lagrangian

$$L^D = L_{free}^D + L_{int}^D = \bar{\psi}_s \gamma^5 (i\gamma^\mu \partial_\mu^s - m_s) \psi_s - ie_s \bar{\psi}_s \gamma^5 \gamma^\mu \psi_s A_\mu^s. \quad (12)$$

Its invariance concerning the acting local gauge transformations (9) and (10) becomes possible owing to the interaction with an axial-vector photon Coulomb field of truly neutral types of fermions.

However, the fact that the very equation (7) does not exclude the symmetry with respect to its matrix structure indicates the role of the unified principle in all Lagrangians of its structural objects. Therefore, if it turns out that one such an object may be any of γ^5 , γ^μ , ∂_μ^s , m_s , e_s , $\bar{\psi}_s$, and ψ_s , the field A_μ^s equalized with the Coulomb field of an axial-vector photon (γ^A) must not in an interaction Lagrangian L_{int}^D be usual two component field, because it can appear only in conformity with the acting quantum operator ∂_μ^s as a consequence of 4×4 matrix, which is absent in a classical C-noninvariant Dirac Lagrangian.

So, we must recognize that the gauge state such as A_μ^s says about the existence in an axial-vector photon of a kind of inertial mass. In other words, each of C-odd left- or right-handed Coulomb field from

$$A_\mu^s = \begin{pmatrix} A_\mu \\ B_\mu \end{pmatrix}, \quad A_\mu = \begin{pmatrix} A_\mu^L \\ A_\mu^R \end{pmatrix}, \quad B_\mu = \begin{pmatrix} B_\mu^L \\ B_\mu^R \end{pmatrix} \quad (13)$$

corresponds in a Lagrangian (12) to a kind of fermion field [3] from

$$\psi_s = \begin{pmatrix} \Psi \\ \phi \end{pmatrix}, \quad \Psi = \begin{pmatrix} \Psi_L \\ \Psi_R \end{pmatrix}, \quad \phi = \begin{pmatrix} \phi_L \\ \phi_R \end{pmatrix}. \quad (14)$$

The coexistence, in the case of the Dirac Lagrangian (12), of both types of fields (13) and (14) expresses the idea of the mentioned experiments [6, 7] about neutrino scattering on a nucleus as an indication in favor of that the left (right)-handed axial-vector neutrinos due to the spontaneous mirror symmetry violation have no interaction with right (left)-handed photons of true neutrality. They possess with all the left (right)-handed C-odd gauge bosons the same interaction as the truly neutral electrons [1] of left (right) helicity.

It is already clear from the foregoing that the left- and right-handed axial-vector photons are of long- and short-lived bosons of true neutrality, respectively. Such a difference in lifetimes of photons of definite helicity can explain the spontaneous mirror symmetry absence, which comes forward also in the universe of C-noninvariant types of particles and fields as a spontaneity criterion of gauge invariance violation [10]. Thereby, it says about axial-vector photons of the different components possessing the unidentical masses, energies, and momenta. These properties have important consequences for generalization of the classical Klein [11]-Gordon [12] equation from the quantum electrodynamics of spinless particles [13] to the case of C-odd particles with an integral spin, because they give the possibility to directly define the structure of the latter for the four-component wave function $\varphi_s(t_s, \mathbf{x}_s)$ in a mirror world as following:

$$(\partial_\mu^s \partial_s^\mu + m_s^2) \varphi_s = 0 \quad (15)$$

in which appears one more connection such that

$$\varphi_s = \begin{pmatrix} \varphi \\ \chi \end{pmatrix}, \quad \varphi = \begin{pmatrix} \varphi_L \\ \varphi_R \end{pmatrix}, \quad \chi = \begin{pmatrix} \chi_L \\ \chi_R \end{pmatrix}. \quad (16)$$

The Lagrangian responsible for an equation (15) must have the form

$$L_{free}^B = \frac{1}{2} \varphi_s^* \gamma^5 (\partial_\mu^s \partial_s^\mu + m_s^2) \varphi_s. \quad (17)$$

In this definition, we have used the matrix γ^5 , because a set-matrix duality principle [14] is the unified for all the quantum theory equations. Insofar as its role allowing us to reveal the structural connections of the mirror equation (15) and to include in the discussion their aspects is concerned, it calls for special presentation.

At a choice of an axial-vector gauge transformation

$$\varphi'_s = U_s^C \varphi_s, \quad U_s^C = e^{i\beta_s(x_s)} \gamma^5 \quad (18)$$

having his own local phase $\beta_s(x_s)$, the invariance of the free boson Lagrangian (17) is violated without loss of possibility of further restoration. We can, therefore, introduce an axial-vector field A_μ^s in the presence of a kind of gauge transformation.

Unification of (11) and (17) convinces us here that at the local axial-vector transformations (10) and (18), the Lagrangian

$$\begin{aligned}
L^B &= L_{free}^B + L_{int}^B \\
&= \frac{1}{2} \varphi_s^* \gamma^5 (\partial_\mu^s \partial_s^\mu + m_s^2) \varphi_s \\
&\quad + \frac{1}{2} [e_s (\varphi_s^* \gamma^5 \partial_\mu^s \varphi_s A_s^\mu - \varphi_s^* \gamma^5 \partial_s^\mu \varphi_s A_\mu^s) - e_s^2 \varphi_s^* \gamma^5 \varphi_s A_\mu^s A_s^\mu]
\end{aligned} \tag{19}$$

steel remains gauge-invariant.

3. Axial-vector photon fields of coulomb and newton nature

The Lagrangian L_{int}^D as a part of the Dirac axial-vector interaction corresponds in (12) to the C-noninvariant electric charges

$$C e_s^{A'} = e_s^{\bar{A}'}, \quad C e_s^{V^A} = e_s^{\bar{V}^A}$$

of the interacting objects. But, as was noted in [15] for the first time, any interaction between the fermion and the field of emission includes not only a kind of Coulomb (charge) part but also a kind of Newton (mass) part. This in turn implies the coexistence, in the case of the Lagrangian (12), of both types of the Dirac interaction structural components. Such a connection is realized owing to a mass-charge duality [16], according to which, each of the electric E , weak W , strong S , and other innate types of charges testifies in favor of a kind of inertial mass. The masses and charges of a C-odd particle constitute herewith the united rest mass m_s^U and charge e_s^U coinciding with all its mass and charge:

$$m_s = m_s^U = m_s^E + m_s^W + m_s^S + \dots, \tag{20}$$

$$e_s = e_s^U = e_s^E + e_s^W + e_s^S + \dots \tag{21}$$

We encounter, thus, the fact that nature itself characterizes each free Lagrangian both from the point of view of charge and from the point of view of mass. Thereby, it admits the existence in any free Dirac or boson Lagrangian not only of a kind of Coulomb (C) component but also of a kind of Newton (N) component, the invariance of each of which concerning a kind of local gauge transformation leads to the appearance of the same interaction corresponding part.

This correspondence principle may serve, in the limits of $m_s = m_s^E$ and $e_s = e_s^E$, as an invariance criterion of any Lagrangian from (12) and (21) concerning the action of one more another type of the local axial-vector gauge transformation. One can define the structure of such a second type of an axial-vector transformation, which has the different local phase $\beta_s(\tau_s)$ for fermion ψ_s and boson φ_s fields by the following manner:

$$\psi_s' = U_s^N \psi_s, \quad U_s^N = e^{i\beta_s(\tau_s)\gamma^5}, \tag{22}$$

$$\varphi_s' = U_s^N \varphi_s, \quad U_s^N = e^{i\beta_s(\tau_s)\gamma^5}. \tag{23}$$

One more characteristic moment is that the Newton component with mass m_s in any Lagrangian from (8) and (17) is general concerning the corresponding axial-vector gauge transformation (9) or (18) and does not depend of whether it has a local or a global phase. Additionally, all conditions of gauge symmetry of a Coulomb part with operator ∂_μ^s hold in each Lagrangian from (8) and (17) regardless of whether the suggested second type of an axial-vector transformation is or not present in it.

Therefore, to conform with all quantum operators (5) and (6), we must choose a particle mass $m_s = -i\partial_\tau^s$ in which

$$\partial_\tau^s = \begin{pmatrix} 0 & \partial_\tau^A \\ \partial_\tau^A & 0 \end{pmatrix}, \quad \partial_\tau^A = \begin{pmatrix} \partial_\tau^L & 0 \\ 0 & \partial_\tau^R \end{pmatrix}. \quad (24)$$

From their point of view, the free Dirac Lagrangian (8) accepts the naturally united form

$$L_{free}^D = i\bar{\psi}_s \gamma^5 (\gamma^\mu \partial_\mu^s + \partial_\tau^s) \psi_s \quad (25)$$

responsible for an equation

$$(\gamma^\mu \partial_\mu^s + \partial_\tau^s) \psi_s = 0. \quad (26)$$

At first sight, the latter says that either ψ_s comes forward in it as a function $\psi_s(t_s, \mathbf{x}_s, \tau_s)$, namely, as a function of the fermion space-time coordinates (t_s, \mathbf{x}_s) and lifetimes τ_s or our reasoning about the quantum operator presentation of mass is not valid. Such an implication, however, does not correspond to reality. The point is that the spin properties of a truly neutral particle depend not only on its axial-vector mass, energy, and momentum but also on the nature of space [3], which characterizes it by space-time coordinates and lifetime until this is forbidden by symmetry laws. Therefore, without loss of generality, the axial-vector operators ∂_μ^s and ∂_τ^s can individually influence on the fermion field ψ_s as well as on each of the existing types of wave functions. By the same reason, we conclude that

$$\partial_\mu^s \psi_s = \partial_\mu^s \psi_s(x_s), \quad \partial_\tau^s \psi_s = \partial_\tau^s \psi_s(\tau_s), \quad (27)$$

$$\partial_\mu^s \beta_s = \partial_\mu^s \beta_s(x_s), \quad \partial_\tau^s \beta_s = \partial_\tau^s \beta_s(\tau_s). \quad (28)$$

With the use of the second type of an axial-vector transformation (22), the Newton part with operator ∂_τ^s must lead to the appearance in a Lagrangian (25) of one of its gauge-noninvariant components and that, consequently, the further restoration of such a broken symmetry requires one to introduce the Newton field $A_\tau^s(\tau_s)$ in conformity with an axial-vector transformation

$$A_\tau^{s'} = A_\tau^s + \frac{i}{m_s} \gamma^5 \partial_\tau^s \beta_s \quad (29)$$

including the Newton mirror interaction constants m_s at the level of an electric mass of the axial-vector nature.

Taking into account (11), (27), (28) and that

$$\partial_\tau^s = \partial_\tau^s - m_s A_\tau^s, \quad (30)$$

from (25), we are led to another new Lagrangian L^D , which is invariant concerning the local axial-vector gauge transformations (9), (10), (22), and (29), because it consists of the C-odd Dirac interaction following parts:

$$L^D = L_{free}^D + L_{int}^D = i\bar{\psi}_s \gamma^5 (\gamma^\mu \partial_\mu^s + \partial_\tau^s) \psi_s - ie_s j_C^\mu A_\mu^s - im_s j_N^\tau A_\tau^s. \quad (31)$$

Here j_C^μ and j_N^τ describe the Coulomb and Newton components of the same axial-vector photon leptonic current

$$j_C^\mu = \bar{\psi}_s \gamma^5 \gamma^\mu \psi_s, \quad (32)$$

$$j_N^\tau = \bar{\psi}_s \gamma^5 \psi_s. \quad (33)$$

One of the most highlighted features of these types of currents is their unity, which involves the commutativity conditions of matrices γ^5 , ∂_μ^s , and ∂_τ^s expressing the idea of the coexistence law of the continuity equations

$$\partial_\mu^s j_C^\mu = 0, \quad (34)$$

$$\partial_\tau^s j_N^\tau = 0. \quad (35)$$

Simultaneously, as is easy to see, the field A_μ^s and

$$A_\tau^s = \begin{pmatrix} A_\tau \\ B_\tau \end{pmatrix}, \quad A_\tau = \begin{pmatrix} A_\tau^L \\ A_\tau^R \end{pmatrix}, \quad B_\tau = \begin{pmatrix} B_\tau^L \\ B_\tau^R \end{pmatrix} \quad (36)$$

arise in a Lagrangian (31) as the Coulomb and Newton parts of the same axial-vector photon field.

The structure itself of the Lagrangian L_{int}^D in (31) testifies in addition that at the availability of an interaction Newton component with an axial-vector photon field, the neutrino of true neutrality must possess an axial-vector electric mass. Insofar as its C-noninvariant electric charge is concerned, it appears in the Coulomb part dependence of the same interaction.

The quantum mass operator in turn transforms (17) into a latent united Lagrangian of the unified field theory of C-odd bosons with a nonzero spin

$$L_{free}^B = \frac{1}{2} \phi_s^* \gamma^5 (\partial_\mu^s \partial_s^\mu - \partial_\tau^s \partial_s^\tau) \phi_s. \quad (37)$$

This connection suggests another new equation

$$(\partial_\mu^s \partial_s^\mu - \partial_\tau^s \partial_s^\tau) \varphi_s = 0 \quad (38)$$

and thereby confirms the fact that the operators ∂_μ^s and ∂_τ^s can individually influence not only on the fermion but also on the boson φ_s wave function

$$\partial_\mu^s \varphi_s = \partial_\mu^s \varphi_s(x_s), \quad \partial_\tau^s \varphi_s = \partial_\tau^s \varphi_s(\tau_s). \quad (39)$$

Uniting (37) with (11), (30) and having in mind (28) and (39), we find that the Lagrangian L^B invariant concerning the local axial-vector gauge transformations (9), (10), (23), and (29) must contain the following components of the C-noninvariant boson interaction:

$$\begin{aligned} L^B &= L_{free}^B + L_{int}^B \\ &= \frac{1}{2} \varphi_s^* \gamma^5 (\partial_\mu^s \partial_s^\mu - \partial_\tau^s \partial_s^\tau) \varphi_s \\ &\quad + \frac{1}{2} [e_s (J_\mu^C A_s^\mu - J_C^\mu A_\mu^s) - e_s^2 \varphi_s^* \gamma^5 \varphi_s A_\mu^s A_s^\mu] \\ &\quad - \frac{1}{2} [m_s (J_\tau^N A_s^\tau - J_N^\tau A_\tau^s) - m_s^2 \varphi_s^* \gamma^5 \varphi_s A_\tau^s A_s^\tau]. \end{aligned} \quad (40)$$

Coulomb and Newton electric currents, $J_C^\mu (J_\mu^C)$ and $J_N^\tau (J_\tau^N)$, interacting with axial-vector fields $A_\mu^s (A_s^\mu)$ and $A_\tau^s (A_s^\tau)$ respectively, constitute the two parts of the same axial-vector boson current

$$J_C^\mu = \varphi_s^* \gamma^5 \partial_s^\mu \varphi_s, \quad J_\mu^C = \varphi_s^* \gamma^5 \partial_\mu^s \varphi_s, \quad (41)$$

$$J_N^\tau = \varphi_s^* \gamma^5 \partial_s^\tau \varphi_s, \quad J_\tau^N = \varphi_s^* \gamma^5 \partial_\tau^s \varphi_s. \quad (42)$$

As well as in the systems of axial-vector leptonic currents, conservation of each boson current here must carry out itself as a consequence of the coexistence law of the continuity equations

$$\partial_\mu^s J_C^\mu = 0, \quad \partial_s^\mu J_\mu^C = 0, \quad (43)$$

$$\partial_\tau^s J_N^\tau = 0, \quad \partial_s^\tau J_\tau^N = 0. \quad (44)$$

In particular, about sizes of m_s and e_s should be mentioned, corresponding in a Lagrangian (40) to the fact that owing to the interaction with Newton A_τ^s and Coulomb A_μ^s fields of the same axial-vector photon, any of truly neutral bosons with a nonzero spin must possess simultaneously each of the axial-vector types of electric mass and charge. Such a boson

can, for example, be photon itself. It is not surprising therefore that $m_s^2 A_\tau^s A_s^\tau$ and $e_s^2 A_\mu^s A_s^\mu$ describe in (40) its Newton and Coulomb interactions with another photon of an axial-vector nature.

In both Lagrangians (31) and (40), as is now well known, the mass m_s and charge e_s , each of which is present jointly with a kind of axial-vector photon field, appear in the mass-charge structure dependence of gauge invariance, so that there exist the axial-vector tensors

$$F_{\mu\lambda}^C = \partial_\mu A_\lambda^C - \partial_\lambda A_\mu^C, \quad (45)$$

$$F_{\tau\sigma}^N = \partial_\tau A_\sigma^N - \partial_\sigma A_\tau^N. \quad (46)$$

With their availability, the structure of the unified field theory Lagrangian of C-odd neutrinos and particles with an integral spin has fully definite form

$$\begin{aligned} L = & i\bar{\psi}_s \gamma^5 (\gamma^\mu \partial_\mu^s + \partial_\tau^s) \psi_s \\ & + \frac{1}{2} \varphi_s^* \gamma^5 (\partial_\mu^s \partial_s^\mu - \partial_\tau^s \partial_s^\tau) \varphi_s \\ & - \frac{1}{4} F_{\mu\lambda}^C F_C^{\mu\lambda} + \frac{1}{4} F_{\tau\sigma}^N F_N^{\tau\sigma} - ie_s j_C^\mu A_\mu^s - im_s j_N^\tau A_\tau^s \\ & + \frac{1}{2} [e_s (J_\mu^C A_s^\mu - J_C^\mu A_\mu^s) - e_s^2 \varphi_s^* \gamma^5 \varphi_s A_\mu^s A_s^\mu] \\ & - \frac{1}{2} [m_s (J_\tau^N A_s^\tau - J_N^\tau A_\tau^s) - m_s^2 \varphi_s^* \gamma^5 \varphi_s A_\tau^s A_s^\tau]. \end{aligned} \quad (47)$$

Its components reflect just the fact that each of the axial-vector types of fermions or bosons possesses the C-noninvariant electric charge at the interaction with the Coulomb A_μ^s field of an axial-vector photon. This in turn implies the origination of an axial-vector electric mass of the investigated particles as a consequence of their interaction with the Newton A_τ^s field of the same type of photon.

We recognize that a characteristic part of the standard model [17–19] is the chiral presentation of the Weyl [20] in which a matrix γ_5 allows one to choose only the left components of the fermion field. In this situation, the presence of mass of any particle in an interaction Lagrangian violates its gauge invariance.

At first sight, such a violation requires the existence of one more another type of the scalar boson [21] responsible for origination in a Lagrangian of mass of the interacting particles and fields. This, however, is not in line with nature, since the availability in it of the second type of the local transformation expressing the idea of the mass structure [22] of gauge invariance has not been known before the creation of the first-initial electroweak theory.

One more consequence implied from a set-matrix duality principle [14] is that we need to go away from the chiral definitions of the structure of matter fields taking into account that α , β , and γ_5 come forward in the Weyl presentation as the matrices having an internal undisclosed. Therefore, from the point of view of the mass, energy, and momentum matrices, the existence of a kind of set criterion [23] for selected quantum theory equations [24], namely, for the Dirac, Klein-Gordon, Euler-Lagrange, and Schrödinger equations, must be accepted as the absence of a place for internal undisclosed of internally disclosed sets [25].

4. Concluding remarks

Another of the most highlighted features of the quantum energy and momentum operators from (5) is such that they together with a relation

$$E_s = \frac{\mathbf{p}_s^2}{2m_s} \quad (48)$$

constitute in a mirror presentation [3] of axial-vector matter fields, namely, in a matrix presentation of their mass, energy, and momentum a new Schrödinger equation

$$i \frac{\partial \psi_s}{\partial t_s} - \frac{1}{2m_s} \frac{\partial \psi_s}{\partial \mathbf{x}_s} \frac{\partial \psi_s}{\partial \mathbf{x}_s} = 0 \quad (49)$$

having the C-noninvariant nature.

With the availability of a particle quantum mass operator $m_s = -i\partial_\tau^s$, it suggests one more highly important equation

$$\partial_t^s \psi_s \partial_\tau^s \psi_s - \frac{1}{2} \partial_{\mathbf{x}}^s \psi_s \partial_{\mathbf{x}}^s \psi_s = 0. \quad (50)$$

As well as in (26) and (38), the axial-vector operators ∂_t^s and $\partial_{\mathbf{x}}^s$ can individually influence here on the matter field

$$\partial_t^s \psi_s = \partial_t^s \psi_s(t_s), \quad \partial_{\mathbf{x}}^s \psi_s = \partial_{\mathbf{x}}^s \psi_s(\mathbf{x}_s). \quad (51)$$

Turning again to the equation (7), we remark that to it one can also lead by another way inserting the Lagrangian (8) in the Euler-Lagrange [24] equation, which in a mirror world has the fully regular form

$$\partial_\mu^s \left(\frac{\partial L_{free}^D}{\partial (\partial_\mu^s \bar{\psi}_s)} \right) = \frac{\partial L_{free}^D}{\partial \bar{\psi}_s}. \quad (52)$$

Furthermore, if it turns out that the latter is not in state to establish (26) on account of (25) and (27), this says about the existence in the same action of both Coulomb and Newton parts [15]. They constitute in a mirror presentation the Euler-Lagrange equation at the new level, namely, at the level of the mass-charge structure of an axial-vector gauge invariance:

$$\partial_\mu^s \left(\frac{\partial L_{free}^D}{\partial (\partial_\mu^s \bar{\psi}_s(x_s))} \right) + \partial_\tau^s \left(\frac{\partial L_{free}^D}{\partial (\partial_\tau^s \bar{\psi}_s(\tau_s))} \right) = \frac{\partial L_{free}^D}{\partial \bar{\psi}_s(x_s)} + \frac{\partial L_{free}^D}{\partial \bar{\psi}_s(\tau_s)}. \quad (53)$$

It states that

$$\partial_{\tau}^s \partial_{\mu}^s \psi_s(x_s) = 0, \quad \partial_{\tau}^s \psi_s(\tau_s) \partial_{\mu}^s \psi_s(x_s) \neq 0, \quad (54)$$

$$\partial_{\mu}^s \partial_{\tau}^s \psi_s(\tau_s) = 0, \quad \partial_{\mu}^s \psi_s(x_s) \partial_{\tau}^s \psi_s(\tau_s) \neq 0. \quad (55)$$

A fundamental role in nature of nonelectric components of the axial-vector mass and charge of truly neutral neutrinos and bosons with a nonzero spin and some above unnoted aspects of new equations of their unified field theory call for special presentation.

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Conflict of interest

The author declares no competing financial interest.

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