ON THE ANOMALOUS STRUCTURES OF THE VECTOR LEPTONIC CURRENTS

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Each of existing types of the electric charges come forwards in the system as the source of a kind of the dipole moment. Therefore, to investigate these regularities we have established the compound structures of Dirac and Pauli form factors. They state that the electron possesses as well as the anomalous electric charge.
Owing to the vector nature of virtual photon, the elastic scattering of electrons by spinless nuclei depends on the Dirac $F_{1e}(q^2)$ and Pauli $F_{2e}(q^2)$ form factors of light leptons [1]. They are of course the functions of the square of four-dimensional momentum transfer. However, in spite of large number of works dedicated to the interaction between the electron and field of emission, thus far remains many uncertainties both in the structures and in the behavior of these currents. Usually it is accepted that $F_{2e}(0)$ is equal to the electron anomalous magnetic moment [2], and its full magnetic moment is defined by the combination [3] of form factors [4]

$$
\mu_{e}^{full} = \frac{F_{1e}(0)}{2m_{e}} + F_{2e}(0).
$$

(1)

It appears that here $F_{1e}(0)$ gives the electric charge leading to the appearance of the electron normal magnetic moment.

Such a procedure were based actually on the assumption [5] of that the functions $F_{1e}(q^2)$ and $F_{2e}(q^2)$ are not the Fourier transforms of the spatial distributions of the electric charge and magnetic moment of a particle. This is explained by some consequences of the classical model of an extensive electron [6].

According to the classical theory of electromagnetic mass [7], the availability of the eigenenergy $E_0$ of the electron electrostatic field implies the existence of the electric part of the electron rest mass:

$$
m_{e}^{em} = \frac{E_0}{c^2}.
$$

The opinion has been spoke out that all the mass of the electron is equal to its electromagnetic mass. Such an idea called simply a hypothesis of field mass and testifies in favor of the unsteadiness of charge distribution of the electron.

We start from the duality of matter that the mass and charge of a particle correspond to the most diverse form of the same regularity of the nature of this field [8, 9]. It states that each of all possible types of charges arises as a consequence of the availability of a kind of the inertial mass [10]. Thereby such a mechanism leads to the appearance of the intraelectron interratio between the forces of the electric and unelectric nature. Therefore, the charge distribution of the electron must be steady.

The purpose of the present work is to discuss some consequences and implications implied from the above-mentioned regularities of the nature of
matter. They give of course the justification of that in the same presentation as the form factors $F_{1e}(q^2)$ and $F_{2e}(q^2)$ was used are not in the states to explain the observed vector picture of the electron. For understanding the mechanism of the anomalous interaction of Pauli at the fundamental level, one must elucidate the compound structures of these functions.

From such a purpose, we not only must write the form factors $F_{ie}(q^2)$ in the form

$$F_{ie}(q^2) = f_{ie}(0) + A_{ie}(q^2) + ...$$

but also need conclude that each of existing types of the electric charges come forwards in the system as the source of a kind of the dipole moment. Herewith the independent components $f_{ie}(0)$ coincide with the normal size of the electric charge and magnetic moment of the electron:

$$f_{1e}(0) = e_{e}^{\text{norm}}, \quad f_{2e}(0) = \mu_{e}^{\text{norm}} = \frac{e_{e}^{\text{norm}}}{2m_{e}^{\text{norm}}}.$$  \hspace{1cm} (3)

where and further it is necessary to keep in mind that $e_{e}^{\text{norm}}$ for a particle (antiparticle) has the negative (positive) sign.

The second terms $A_{ie}(q^2)$ characterize the dependence of form factors on the square of three - dimensional momentum transfer $q^2$ and at the emission of a real photon ($q^2 = 0$) are reduced to the values

$$A_{1e}(0) = e_{e}^{\text{anom}}, \quad A_{2e}(0) = \mu_{e}^{\text{anom}} = \frac{e_{e}^{\text{anom}}}{2m_{e}^{\text{anom}}}.$$  \hspace{1cm} (4)

Here $m_{e}^{\text{norm}}$ and $m_{e}^{\text{anom}}$ are the Coulomb normal and anomalous masses. Insofar as the full electric mass is concerned, we will start from the fact that the Coulomb mass and charge of a particle correspond to two form of the same regularity of its electric nature. Therefore, we conclude [9] that

$$m_{\nu}^{E} = m_{\nu}^{\text{norm}} + m_{\nu}^{\text{anom}} + .....$$  \hspace{1cm} (5)

So, it is seen that any of form factors $F_{1e}(q^2)$ and $F_{2e}(q^2)$ includes in self both normal and anomalous interactions between the electron and field of emission. In other words, they must be Fourier transforms of the spatial density of charge and moment. Their value at zero four - dimensional momentum transfer ($q^2 = 0$) defines the full static size of the electric charge and magnetic moment of a particle:

$$F_{1e}(0) = e_{e}^{\text{full}} = e_{e}^{\text{norm}} + e_{e}^{\text{anom}} + ...,$$  \hspace{1cm} (6)
\[ F_{2e}(0) = \mu_e^{\text{full}} = \mu_e^{\text{norm}} + \mu_e^{\text{anom}} + \ldots \] (7)

By following the compound structures of form factors (3), we get

\[ f_{2e}(0) = \frac{f_{1e}(0)}{2m_e^{\text{norm}}}. \] (8)

Exactly the same one can found from (4) that

\[ A_{2e}(0) = \frac{A_{1e}(0)}{2m_e^{\text{anom}}}. \] (9)

According to the presented here point of view, the electron possesses as well as the anomalous electric charge which has an estimate of

\[ e_e^{\text{anom}} = \frac{\alpha}{2\pi} \left( \frac{m_e^{\text{anom}}}{m_e^{\text{norm}}} \right) e_e^{\text{norm}} \] (10)

in assuming that the size of \( A_{2e}(0) \) is equal to the electron Schwinger magnetic moment:

\[ A_{2e}(0) = \mu_e^{\text{anom}} = \frac{\alpha}{2\pi} \frac{e_e^{\text{norm}}}{2m_e^{\text{norm}}}. \] (11)

To brighter reveal our ideas one must apply to the process of elastic scattering of electrons and their neutrinos by spinless nuclei as to the source of unique information about structures of leptonic currents. It is already clear from (2) that in the case of one-photon exchange only the independent components of form factors are responsible for the interaction with matter. Therefore, a study of the behavior of light leptons \( (l = e, \nu_e) \) in the nucleus charge field leads us to the equation [9]

\[ 2m_l^{\text{norm}} \frac{f_{2l}(0)}{f_{1l}(0)} = \pm 1. \] (12)

Comparison of (12) with (8) say in favor of correspondence principle which states that each terms of the expansions (2) correspond to the definite approximations [9]. Under such circumstances the possibility of the inclusion of the anomalous phenomena \( A_{ie}(q^2) \) in the discussion is realized only in the second Born approximation. Nevertheless, without loss of generality, we must have in view of that any non-zero component of the interaction of Pauli implies the availability of a kind of the Dirac interaction. Of course, the above-noted regularities of vector picture of the electron and its neutrino open up new possibilities for developments of our sights at the nature of matter.
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