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On the Experimental Testing of a New Theory of Electron-Electric Field Interaction

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Abstract. The new theory of interaction of an electron with an electric field is briefly discussed. The theory predicts currently unknown phenomena in the presence of strong electric fields. Due to the lack of direct experimental evidence, the theory is still in the status of a scientific hypothesis. To test this theory, a laboratory experiment is proposed that could definitively confirm or refute it.

Keywords: scalar theory, circular motion, Coulomb force, centripetal force

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1. Introduction

In recent years, a new theory has been developed in Armenia that describes the interaction of an electron with an electromagnetic field [1, 2]. The foundational hypothesis upon which this theory is built postulates the invariance of the electron's 4-momentum in an electromagnetic field. Consequently, it follows that the electromagnetic scalar and vector potentials acting on a moving electron are Lorentz transformations of potentials that act on a stationary electron at the same point. The successive development of this hypothesis leads to a novel description of the electron's interaction with the electromagnetic field, significantly different from the traditional one. Such a description provides alternative solutions to some theoretical problems that have not yet been experimentally verified and have conflicting interpretations.

The new theory differs significantly from the traditional one at high potentials, where the electron's potential energy becomes comparable to its rest energy. However, at low potentials, the new theory naturally turns into the traditional one. Thus, this theory may be correct and have far-reaching implications. However, due to the lack of direct experimental evidence, it is still in the status of a scientific hypothesis, therefore, its experimental validation is currently important. It turns out that the unusual phenomena predicted by the new theory can be observed on a macroscopic scale in experiments with electrons at potentials on the order of megavolts [2]. Therefore, the realization of such experiments in laboratory conditions does not pose fundamental difficulties. In this communication, a laboratory experiment is discussed to test the new theory of electrical interaction.

2. Basic equations

The basics equations of new theory describing total energy E and generalized momentum **P** of an electron in the presence of a scalar potential Φ are as follows

$$E = mc^2\gamma + e\Phi\gamma \qquad \boldsymbol{P} = \frac{\boldsymbol{\beta}}{c}E \tag{1}$$

Here **β**=**v**/c, **v** and c are speeds of the electron and light, $\gamma=1/(1-\beta^2)^{1/2}$ is Lorentz factor, e and m are the charge and mass of the electron (further e > 0 stands for the elementary charge).

Note that equations (1) were initially proposed in an alternative scalar theory of gravity [3], which, however, was not subsequently developed due to the lack of a description of the curvature of space-time. But equations (1) can become suitable for the theory of electricity, where space-time curvature is not taken into account. To compare the results derived from these new equations with traditional ones, let's consider the specific problem of an electron rotating in a circle around a positively charged sphere.

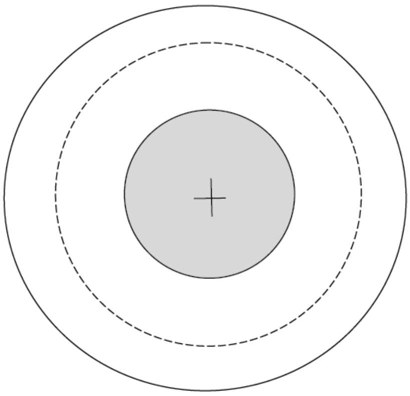

Fig. 1. Positively charged sphere with the radius 10 cm and potential 1 MV. Electron with kinetic energy 0.2 MeV rotates around the sphere along the circular orbit. The radius of circle (shown by the dashed line), computed by conventional formula (2) is 29 cm. The radius of circle (shown by the solid line), computed by the formula (4) of new theory is about 40 cm.

In the traditional theory, the orbital radius r can be determined by equating the centripetal force $mc^2\gamma\beta^2/r$ to the Coulomb force eq/r^2. The result is

$$r = \frac{eq}{mc^2}\frac{1}{\gamma\beta^2} \tag{2}$$

By this the energy and Lorentz factor are related by the equation

$$E = \frac{mc^2}{\gamma} \tag{3}$$

However, in new theory, the force acting on the electron at high potentials differs from the Coulomb force, but relation (3) for circular motion remains the same. Thus, from (1) and (3) it turns out the following formula for the radius

$$r = \frac{eq}{mc^2}\frac{1}{\beta^2} \tag{4}$$

3. Conclusions

This formula shows that the radius of the orbit cannot be smaller than the value eq/mc^2, which is called the critical radius. In contrast, formula (2) of the traditional theory allows circular motion with arbitrarily small radii. For a sphere with a radius of 10 cm charged to a potential of +1 MV, the total charge is approximately 11.1 μC, and the critical radius is 19.6 cm. The radius of the orbit of an electron with kinetic energy of 0.2 MeV, rotating in a circle around this sphere, is approximately 40 cm, according to formula (4) of the new theory, whereas the traditional formula (2) yields about

29 cm. Thus, the proposed experiment will allow for a definitive confirmation or refutation of the new theory.

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