THE FUNDAMENTAL VACUUM PARTICLE.

by

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ABSTRACT

The interaction of the electron with the vacuum W^{μ} potential of ECE2 theory produces a new fundamental vacuum particle whose mass is calculated to be 2.1127×10^{-33} kg from the anomalous g factor of the electron. The latter is calculated to any precision from the vacuum particle mass, which is defined by the scalar part of the vacuum spin connection multiplied by the quantum of magnetic flux, h/e. The severe limitations of the Dirac theory of the electron are demonstrated with rigorous relativistic quantum mechanics and the de Broglie / Einstein equations. The rigorous theory shows that the Dirac theory does not produce spin orbit fine structure, and the rigorous theory reveals the existence of the new vacuum particle. This theory replaces quantum electrodynamics.

Keywords: ECE2 special relativity, the fundamental vacuum theory, limitations of the Dirac theory, replacement of quantum electrodynamics.

UFT 338

1. INTRODUCTION

In recent papers of this series {1- 12}, a new kind of special relativity has been developed in a space with finite torsion and curvature - ECE2 special relativity based on the Jacobi Cartan Evans (JCE) identity of UFT313, the second Bianchi identity corrected for torsion. Many new results have been inferred in the ECE2 series of papers (UFT313 - UFT320, UFT322 - UFT337 on www.aias.us). In this paper the theory is used to infer a new fundamental particle, the vacuum particle, whose mass is defined by the anomalous g factor of the electron, known to high experimental precision. Conversely the anomalous g factor of the electron is explained straightforwardly by the existence of the vacuum particle, whose mass is defined by the scalar part of the W^{μ} vacuum potential of ECE2 multiplied by the quantum of magnetic flux, $\hbar / e$. Here $\hbar$ is the reduced Planck constant and e the magnitude of the elementary charge. It is shown that the Dirac theory of the electron has severe limitations, and when replaced by rigorous relativistic quantum mechanics without approximation leads to the discovery of the vacuum particle. However, rigorous relativistic quantum mechanics also shows that the Dirac theory does not produce spin orbit fine structure. The latter appears from a contrived approximation first used by Dirac and repeated dogmatically for ninety years. The new method of this paper makes quantum electrodynamics (QED) obsolete, not before time, and QED is replaced by the far simpler and much more rigorous theory of this paper. The new theory is based on fundamentals and does not use any adjustables or hidden contrivances with which QED is saturated.

This paper is a summary of the extensive calculations in the notes accompanying UFT338 on www.aias.us. It is essential to study these calculations along with the paper, which is meant to be a short summary of the main results. In Note 338(1) the minimal prescription is used to define the mass of the vacuum particle in terms of the scalar part of the

spin connection of the vacuum. This is an Aharonov Bohm (AB) vacuum in which there is finite spin connection and torsion but in which torsion and curvature vanish. Note 338(2) is a detailed development in which several new inferences are made. For example the interaction of the electron with the vacuum is shown to be a shift in the wave four vector of the electron. This means that the measured mass of any elementary particle always contains a contribution from the mass of the vacuum particle, denoted m(vac). One of the many consequences of this theory is that the g factor of the electron is 2.002319314 and not 2 as in the Dirac theory. Note 338(3) is a detailed summary of the conventional Dirac theory applied to the interaction of an electron with the AB vacuum characterized by the spin connection. It derives the conventional g factor of two, and demonstrates the contrived approximation made by Dirac, contrived in order to obtain the spectral fine structure of atoms and molecules. In fact this is an empirical process, because the approximation cannot be justified and makes no physical sense. The main results of Section 2 of this paper are given in detail in Notes 338(4) and 338(5).

2. THE RIGOROUS RELATIVISTIC QUANTUM THEORY.

Consider the relevant term in the rigorous relativistic quantum theory of the interaction of the electron with the ECE2 vacuum, defined as the Aharonov Bohm vacuum defined by the W four potential (see ECE2 papers on www.aias.us)

$$\left(H - e\phi_W - mc^2\right)\psi = ie\hbar\,\underline{\sigma}\cdot\underline{\nabla}\left(\left(\frac{c^2\,\underline{\sigma}\cdot\underline{W}}{H - e\phi_W + mc^2}\right)\psi\right) + \cdots \quad -(1)$$

where

$$\Omega^\mu = \left(\Omega^0, \underline{\Omega}\right) = \frac{e}{\hbar}W^\mu \quad -(2)$$

is the spin connection four vector of the vacuum. In Eq. (1) ψ is the wave function and H is the hamiltonian of ECE2 special relativity:

$$H = \gamma mc^2 + U \quad -(3)$$

where γ is the Lorentz factor. The potential energy in joules is defined by:

$$U = e\phi_w \quad -(4)$$

In the denominator on the right hand side of Eq. (1):

$$H - e\phi_w = \gamma mc^2 \quad -(5)$$

The Lorentz factor is defined by the de Broglie / Einstein equation:

$$\gamma = \frac{\hbar\omega}{mc^2} \quad -(6)$$

where ω is the angular frequency of the wave dual to the particle of mass m - an example of wave particle dualism. It follows that:

$$(H - e\phi_w - mc^2)\psi = \frac{ie\hbar}{(\gamma+1)m}\,\underline{\sigma}\cdot\underline{\nabla}\,\underline{\sigma}\cdot\underline{W}\,\psi \quad -(7)$$

whose real part (Note 338(4)) is:

$$\mathrm{Real}(H - e\phi_w - mc^2)\psi = \frac{-e\hbar}{(1+\gamma)m}\,\underline{\sigma}\cdot\underline{\nabla}\times\underline{W}\,\psi \quad -(8)$$

Therefore the g factor of the electron is:

$$g = 1 + \gamma = 1 + \frac{\hbar\omega}{mc^2} \quad -(9)$$

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For an electron at rest:

$$g = 1 + \frac{\hbar\omega_0}{mc^2} = 2 \quad -(10)$$

from the de Broglie rest particle equation:

$$\hbar\omega_0 = mc^2 \quad -(11)$$

where ω_0 is the rest angular frequency. From Notes 338(1) to 338(3), the frequency of an electron wave in contact with the vacuum is:

$$\omega_0 \rightarrow \omega_0 + \omega(vac) \quad -(12)$$

so the g factor of an electron at rest is:

$$g = 2 + \frac{\hbar\omega(vac)}{mc^2} = 2.00231931\,4 \quad -(13)$$

a result which is true to any experimental precision. Therefore:

$$\hbar\omega(vac) = 0.00231931\,4\, m(vac)c^2 \quad -(14)$$

The mass of the vacuum particle is given by the de Broglie / Einstein equation:

$$m(vac) = \frac{\hbar\omega(vac)}{c^2} = \frac{\hbar\Omega^0}{c} \quad -(15)$$

and is easily calculated to be:

$$m(vac) = 2.1127 \times 10^{-33}\ kg. \quad -(16)$$

This calculation infers the existence of a new elementary particle, the vacuum particle with well defined mass, and makes QED obsolete overnight. This is a healthy development because QED is full of adjustables and artificial processes such as renormalization, dimensional regularization, summation of hugely elaborate series that cannot be proven to converge, and virtual particles which cannot be observed. Feynman described it

as dippy hocus pocus, and Dirac described it as an ugly theory that removed infinites in an entirely arbitrary way, using methods unknown to mathematics. Feynman agreed with Dirac.

However, this calculation also refutes the claim by Dirac to have produced a fundamental explanation of spin orbit fine structure in spectroscopy. Clearly, there is no spin orbit term in the rigorous Eq. (7)! Note 338(5) shows how fine structure can be artificially reinstated in this rigorous ECE2, but this is possible only at the expense of introducing a new ESR type term which should be observable. This term has been discussed in recent UFT papers. If it is not observed, the Dirac theory is entirely refuted and a new method will have to be found to explains fine structure and the Thomas factor from relativistic quantum mechanics.

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