EXPLANATION OF THE RADIATIVE CORRECTIONS WITH FLUID ELECTRODYNAMICS.

by

M. W. Evans and H. Eckardt,

Civil List and AIAS / UPITEC

(www.aias.us, www.upitec.org, www.archive.org, www.webarchive.org.uk)

ABSTRACT

Fluid electrodynamics is used to give a straightforward explanation to any degree of accuracy of two of the radiative corrections, the anomalous g of the electron and the Lamb shift. The former is explained with the fluid spacetime or aether vorticity set up by a static magnetic field, and the latter is explained with the fluid spacetime potential.

Keywords: ECE2 unified field theory, fluid electrodynamics, radiative corrections.

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1. INTRODUCTION

In recent papers of this series {1 - 12} fluid electrodynamics has been developed and applied to effects induced in matter by spacetime, and to effects induced in spacetime by matter. In this paper fluid electrodynamics is tested experimentally to any precision by using the experimentally measured g factor of the electron and the experimentally measured Lamb shift in atomic hydrogen. These are two of the well known radiative corrections, which prove beyond doubt that spacetime (oe aether or vacuum) produces effects in matter. It is shown that the anomalous g factor of the electron is due to the vortex of fluid spacetime (or aether or vacuum), and that the Lamb shift is due to the potential of fluid spacetime.

This paper should be read with the notes accompanying UFT357 on www.aias.us. Note 357(1) defines what is meant by the g factor of the electron, and defines the minimal prescription needed to calculate the g factor from fluid electrodynamics. Note 357(2) gives the complete details of the calculation of the anomalous g factor in fluid electrodynamics, showing that it is due to a vortex of fluid spacetime. Note 357(3) gives details of the Dirac theory of spin orbit splitting in atomic hydrogen, emphasizing that the Dirac theory does not give the Lamb shift as is well known. Finally Note 357(4) calculates the Lamb shift straightforwardly in terms of the potential of fluid spacetime. The calculation is compared with the well known Bethe calculation, based on a fluctuating Coulomb potential between the proton and electron of the H atom.

2. SUMMARY OF CALCULATIONS

This section is a summary of the detailed calculations in the notes. As described in Note 357(1) the Dirac theory (which has evolved into the theory of the fermion equation in ECE theory {1 - 12}) produces the following interaction hamiltonian between a magnetic flux density $\underline{B}$ and an electron of charge modulus e and mass m:

$$H = -\frac{e}{2m}\left(\underline{L} + 2\underline{S}\right)\cdot\underline{B}. \quad -(1)$$

Here $\underline{L}$ is the orbital angular momentum and $\underline{S}$ is the spin angular momentum of the electron. The factor of two premultiplying $\underline{S}$ is the g factor of the Dirac theory. However, the experimental g factor to nine decimal places is:

$$g = 2.002319314 \quad -(2)$$

and it is claimed in the literature that it is known with much greater precision. These claims have been criticised in UFT85. The experimental result (2) is considered to be due to the influence of spacetime (or ather or vacuum) and is known as a radiative correction - the anomalous g factor of the electron. It is clear, precise, and well established proof that there exists energy in spacetime.

The explanation of the anomalous g in fluid electrodynamics is simple. In addition to the ECE2 vector potential of the static magnetic field:

$$\underline{W} = \frac{1}{2}\underline{B}\times\underline{r} \quad -(3)$$

there is a fluid spacetime potential:

$$\underline{W}(vac) = \underline{v}(vac) \quad -(4)$$

where $\underline{v}$ is the velocity field of the fluid spacetime or fluid vacuum (UFT349, 351-353, 355 and 356). The fluid spacetime potential induces a potential:

$$\underline{W}_1 = \frac{m}{e}\underline{v}(vac) \quad -(5)$$

in an electron. So the minimal prescription becomes:

$$\underline{p} \rightarrow \underline{p} - e\underline{W} - m\underline{W}_1 \quad -(6)$$
$$:= \underline{p} - e\left(\underline{W} + \underline{W}_2\right)$$

Assume that:

$$\underline{W}_2 = x \underline{W} \quad -(7)$$

then as shown in Note 357(2) the interaction hamiltonian (1) is changed to:

$$H_1 = -\frac{e}{2m}\left((1+x)(2\underline{S}\cdot\underline{B}) + \underline{L}\right) \quad -(8)$$

so the electron g factor is:

$$g = 2(1+x). \quad -(9)$$

Therefore:

$$x = 0.002319314. \quad -(10)$$

The extra magnetic field induced in the electron by the fluid spacetime is:

$$\underline{B}_1 = \frac{m}{e}\underline{\nabla}\times\underline{v}(\text{vac}) = x\underline{B} \quad -(11)$$

where the spacetime vorticity is:

$$\underline{w}(\text{vac}) = \underline{\nabla}\times\underline{v}(\text{vac}). \quad -(12)$$

Finally assume that:

$$\underline{B} = B_Z\,\underline{k} \quad -(13)$$

to find:

$$x = \frac{m}{e}\frac{w_Z(\text{vac})}{B_Z} = 0.002319314. \quad -(14)$$

For a magnetic flux density $\underline{B}$ of one tesla the spacetime vorticity needed to produce the g factor of the electron is:

$$w_Z(\text{vac}) = -4.07923\times 10^{8}\, s^{-1} \quad -(15)$$

In general:

$$\omega_Z(\text{vac}) \doteq 0.002319314 \frac{e}{m} B_Z. \quad -(16)$$

This equation may be interpreted to mean that a static magnetic field induces a spacetime or vacuum vorticity around it.

In the Dirac theory of note 357(3) the following energy levels of the H atom are degenerate:

$$2S_{1/2} \; (n=2, \ell=0, j=1/2) \quad -(17)$$
$$2P_{1/2} \; (n=2, \ell=1, j=1/2). \quad -(18)$$

However it is observed experimentally that $2S_{1/2}$ is shifted to higher frequency by:

$$\omega = 6.64675 \times 10^{9} \text{ rad s}^{-1}. \quad -(19)$$

This is the Lamb shift, also known as a radiative correction, and also accepted as evidence that spacetime (or vacuum or aether) induces effects in matter, in this case the H atom. It is well known that the shift was first explained by Bethe by assuming that the Coulomb potential between the electron and proton fluctuates:

$$U = U(\underline{r} + \delta \underline{r}). \quad -(20)$$

In the Bethe theory the additional potential energy induced in the H atom by spacetime is:

$$\Delta U = \bar{U}(\underline{r} + \delta\underline{r}) - U(\underline{r}). \quad -(21)$$

For the $2S_{1/2}$ orbital of the H atom:

$$\langle \Delta \bar{U} \rangle = \frac{1}{6} \langle (\delta \underline{r})^2 \rangle \langle \nabla^2 \bar{U} \rangle \quad -(21)$$
$$= \frac{1}{6} \langle (\delta \underline{r})^2 \rangle \int \psi^* \nabla^2 \left(\frac{-e^2}{4\pi\epsilon_0 r} \right) \psi \, d\tau$$

where ϵ_0 is the vacuum permittivity and a_0 is the Bohr radius. Therefore the additional potential energy induced in the $2S_{1/2}$ orbital by spacetime (the aether or vacuum) is:

$$\langle \Delta U \rangle = \frac{e^2}{48\pi\epsilon_0 a_0^3} \langle (\delta \underline{r})^2 \rangle \quad -(22)$$

In fluid electrodynamics this additional energy is explained by the scalar potential Φ of fluid spacetime, which induces in the $2S_{1/2}$ orbital the potential energy:

$$\Phi_W = \frac{m}{e} \Phi . \quad -(23)$$

So:

$$U_W = e\Phi_W = m\Phi = \frac{e^2}{48\pi\epsilon_0 a_0^3} \langle (\delta \underline{r})^2 \rangle \quad -(24)$$

and this is the explanation of the Lamb shift in fluid electrodynamics. The spacetime potential is part of the four vector:

$$V^\mu = \left(\frac{\Phi}{a_0}, \underline{V} \right) \quad -(25)$$

where a_0 is the assumed constant speed of sound. The Lorenz condition of fluid spacetime gives:

$$\frac{1}{a_0^2} \frac{\partial \Phi}{\partial t} + \underline{\nabla} \cdot \underline{V} = 0 . \quad -(26)$$

The spacetime potential needed to explain the Lamb shift is:

$$\Phi = \frac{e^2}{48\pi\epsilon_0 m a_0^3} \langle (\delta \underline{r})^2 \rangle \quad -(27)$$

and is non zero if and only if the expectation value of $\nabla^2 U$ is non zero. It is non zero in the $2S_{1/2}$ orbital but zero in the $2P_{1/2}$ orbital. The potential energy may be expressed as:

$$U_W = m\Phi = \hbar\omega \quad -(28)$$

so can be calculated from the observed Lamb shift. It is:

$$\underline{\Phi} = 7.6947924 \times 10^{5} \, m^{2} s^{-2} \quad -(29)$$

and from this the Bethe radius can be calculated to be:

$$\left(\langle \Delta \underline{r}^{2} \rangle\right)^{1/2} = 7.35 \times 10^{-14} \, m. \quad -(30)$$

The free electron radius is:

$$r_e = 2.8 \times 10^{-15} \, m, \quad -(31)$$

and the Bohr radius is:

$$a_0 = 5.29 \times 10^{-11} \, m. \quad -(32)$$

This theory is much simpler and more powerful than quantum electrodynamics.

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