ECE2 JITTERBUGGING THEORY

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ABSTRACT

Interaction with the vacuum in ECE2 theory is developed with the zitterbewegung
(jitterbugging) theory used to calculate the Lamb shift in atomic H. The jitterbugging vector
spin connection is calculated and is a simple quantity on the one electron level. This theory is
expected to be as accurate as the calculation of the Lamb shift, first carried out by Bethe as is
well known.

Keywords: ECE2, jitterbugging theory of vacuum interaction.
1. INTRODUCTION

In recent papers and books of this series {1 - 30}, interaction with the vacuum has been developed with the new law of conservation of antisymmetry. There are laws of conservation of trace, scalar and vector antisymmetry which must be obeyed throughout physics: notably in dynamics, gravitation, electrodynamics and fluid dynamics, but also in nuclear physics for example. The notes accompanying this paper (UFT392 on www.aias.us) provide examples in which antisymmetry is applied, and provide a background to the new theory of Sections 2 and 3: the use of zitterbewegung in ECE2. The notes contain detailed calculations and are intended to be read with this paper.

Note 392(1) develops the laws of conservation of antisymmetry in two dimensions. Note 392(2) defines a calculational methodology for two dimensional orbits. Note 392(3) develops tests of the Einstein theory in two and three dimensions. Note 392(4) proves violation of antisymmetry conservation in the Newton and Einstein theories of the standard model. Note 392(5) is a detailed review of the complete equations of ECE2 theory: the wave, field and antisymmetry equations. Note 392(6) finalizes the methodology of Note 392(5), giving a suggested order of calculation. Note 392(7) develops Note 392(6) in the electrostatic limit, and defines the electro vector potentials. Finally Note 392(8) introduces the zitterbewegung theory developed in Section 2 of this paper.

Section 3 is a computational and graphical development of section 2, notably illustrating the jitterbugging spin connection.

2. JITTERBUGGING IN ECE2 THEORY

This theory is a development of the scalar and vector potentials used in recent papers and notes to include the well known zitterbewegung (or "shivering") of the electron first introduced by Schroedinger in 1930 from the Dirac equation and used by Bethe in 1947
to calculate the Lamb shift very accurately. Therefore it follows that the Bethe theory extended to ECE2 physics will produce equally accurate results.

Consider the scalar potential of the Coulomb law in the zitterbewegung theory:

$$\phi_k = \frac{1}{4\pi \varepsilon_0} \int \frac{\rho(x')}{|x - x' - \delta(x - x')|} \, d^3x' - (1)$$

Here $\rho(x')$ is the charge density, $\varepsilon_0$ the vacuum permittivity, and in which the denominator defines the fluctuating position of the charge. This is the vacuum fluctuation used to calculate the Lamb shift. Note carefully that $\phi_k$ describes the interaction with the vacuum, which is responsible for the electron fluctuations - zitterbewegung or shivering. Therefore $\phi_k$ is the total scalar potential of a material in contact with the vacuum. In the simplest case this is one electron in contact with the vacuum. The total vector potential of magnetostatics is, similarly:

$$A_k = \frac{\mu_0}{2\pi} \int \frac{\mathbf{J}(x')}{|x - x' - \delta(x - x')|} \, d^3x' - (2)$$

where $\mathbf{J}(x')$ is the current density and $\mu_0$ is the vacuum permeability.

It follows that the ECE2 electric field strength in volts per metre of electrostatics is:

$$E_k(x) = -\frac{1}{4\pi \varepsilon_0} \nabla \int \frac{\rho(x')}{|x - x' - \delta(x - x')|} \, d^3x' - (3)$$

$$= -\nabla \phi + \omega \phi = \frac{\partial A_k}{\partial t} - \omega \cdot A_k$$

where $A_k$ is the electrostatic vector potential of Note 392(7), a concept that does not exist in the standard model, and where $\omega$ is the vector spin connection. In Eq. (3), $\phi$ is the scalar potential in the hypothetical absence of vacuum interaction, which is described by the
spin connection terms. Therefore:

\[
\phi = \frac{1}{4\pi} \epsilon_0 \int \frac{\rho(x')}{|x - x'|} \, d^3x' \quad - \quad (4)
\]

The spin connection four vector is:

\[
\omega^\mu = \left( \frac{\omega_0}{c}, \omega \right) \quad - \quad (5)
\]

The magnetic flux density of magnetostatics is:

\[
B_k = \frac{\mu_0}{4\pi} \nabla \times \int \frac{\Sigma(x')}{|x - x' - \delta(x - x')} \, d^3x' = \nabla \times A - \omega \times A \quad - \quad (6)
\]

where \( A \) is the vector potential in the hypothetical absence of the vacuum:

\[
A = \frac{\mu_0}{4\pi} \int \frac{\Sigma(x')}{|x - x'|} \, d^3x' \quad - \quad (7)
\]

The existence of the well known radiative corrections \( \{1 - 30\} \) such as the Lamb shift and anomalous g factors of elementary particles means that the vacuum is ubiquitous. Every material quantity is influenced by the vacuum. It is therefore clear that a circuit can take energy from the vacuum as in UFT311, UFT321, UFT364, UFT382 and UFT383 on www.aias.us.

The fields in the hypothetical absence of the vacuum are:

\[
E = -\nabla \phi \quad - \quad (8)
\]

and

\[
B = \nabla \times A \quad - \quad (9)
\]

It follows that:
\[
\begin{align*}
\frac{E_k - E}{\hbar} &= -\alpha \phi \quad (10) \\
\frac{B_k - B}{\hbar} &= -\alpha \times A \quad (11)
\end{align*}
\]

where:
\[
E = -\frac{1}{4\pi \varepsilon_0} \nabla \cdot \int \frac{\rho(x')}{|x - x'|} \, d^3x' \quad (12)
\]
and
\[
B = \frac{\mu_0}{4\pi} \nabla \times \int \frac{\Sigma(x')}{|x - x'|} \, d^3x' \quad (13)
\]

It follows that:
\[
\nabla \cdot \int \rho(x') \left( \frac{1}{|x - x' - \delta(x - x')|} - \frac{1}{|x - x'|} \right) \, d^3x' = \alpha \int \frac{\rho(x')}{|x - x'|} \, d^3x' \quad (14)
\]

Similarly:
\[
\nabla \times \int \Sigma(x') \left( \frac{1}{|x - x' - \delta(x - x')|} - \frac{1}{|x - x'|} \right) \, d^3x' = -\alpha \times \int \frac{\Sigma(x')}{|x - x'|} \, d^3x' \quad (15)
\]

On the one electron level:
\[
\frac{E}{\hbar} = -\frac{e}{4\pi \varepsilon_0} \frac{e_k}{(r - \delta r)^3} \quad (16)
\]

and
so the vector spin connection of this zitterbewegung theory is:

\[ \mathbf{\omega} = \left( \frac{1}{(r-\delta r)^2} - \frac{1}{r^2} \right) \mathbf{e}_r \]  

Therefore \( \mathbf{\omega} \) can be worked out with for the Lamb shift for example using quantum mechanical methods. The fluctuations can also be calculated with Brownian motion theory, or used as an input parameter with which to model the spin connection as in UFT311, which describes the result of a circuit with great accuracy by modelling the spin connection. This circuit is reproduced experimentally in UFT364, and the method further developed in UFT321, UFT382 and UFT383. The spin connection can now be modelled by modelling the zitterbewegung or shivering of one electron, a macroscopic charge, or charge density.

The vacuum electric field strength in volts per metre is defined by the ECE2 scalar antisymmetry law. So:

\[ E_{(\text{vac})} = \mathbf{\omega} \cdot \mathbf{\varepsilon} = -\frac{e}{4\pi \varepsilon_0} \left( \frac{1}{(r-\delta r)^2} - \frac{1}{r^3} \right) \mathbf{e}_r \]  

is the shivering electric field strength of the vacuum. The ECE2 theory shows that the origin of this field is the shivering spin connection (18).

The vacuum magnetic flux density is not considered in the Bethe theory but in ECE2 is defined by:

\[ \mathbf{B}_{(\text{vac})} = -\mathbf{\omega} \times \mathbf{A} \]
where:
\[
\frac{\alpha}{\omega} = \left( \frac{1}{(r-\delta)^2} - \frac{1}{r^2} \right) - \frac{r}{2} - (21)
\]
and
\[
\frac{A}{\omega} = \frac{\mu_0}{4\pi} \int \frac{\Xi(x')}{|x-x'|} d^3x' - (22)
\]

The potential \( A \) in the hypothetical absence of the vacuum must be calculated from the vector antisymmetry law:
\[
\frac{\partial A_z}{\partial y} + \frac{\partial A_y}{\partial z} = \omega_y A_z + \omega_z A_y - (23)
\]
\[
\frac{\partial A_x}{\partial z} + \frac{\partial A_z}{\partial x} = \omega_z A_x + \omega_x A_z - (24)
\]
\[
\frac{\partial A_y}{\partial x} + \frac{\partial A_x}{\partial y} = \omega_x A_y + \omega_y A_x - (25)
\]

and the shivering spin connection \( \mathcal{A} \). The total vector potential \( \mathcal{A} \) must be used in the design of circuits. The relation between \( \mathcal{A} \) and \( A \) is:
\[
\frac{\mathcal{A}}{A} = \frac{\nabla \times A}{A} = \frac{\nabla \times A}{A} - \frac{\omega \times A}{A} - (26)
\]

The trace antisymmetry law of Lindstrom is:
\[
\frac{1}{c^2} \left( \frac{\partial \phi}{\partial t} + \omega_0 \phi \right) - \nabla \cdot \mathcal{A} + \omega \cdot A = 0 - (27)
\]

for electromagnetism in general. Note 392(8) shows that it can be analysed into two parts, a trace antisymmetry law for electrostatics:
\[
\frac{\partial \phi}{\partial t} + \omega_0 \phi = 0 - (28)
\]
and its equivalent for magnetostatics:
The potential $\phi$ is not time dependent, so it follows that:

$$\omega_0 = 0 \quad (30)$$

The law (29) gives the divergence of $A$. In the standard model the divergence is gauge dependent and not well defined.
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