

THE SHIVERING (ZITTERBEWEGUNG) INDUCED BY THE VACUUM OF THE  
ELECTRIC DIPOLE POTENTIAL AND FIELD.

by

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Civil List and UPITEC

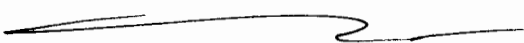
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ABSTRACT

The well known zitterbewegung (shivering) theory of the Lamb shift in quantum mechanics is adapted for classical electrostatics within the structure of the ECE2 unified field theory. A simple and new fundamental postulate replaces the position vector  $\underline{r}$  wherever it occurs by  $\underline{r} + \underline{\delta r}$ , where  $\underline{\delta r}$  is the fluctuation or shivering induced by the vacuum. Using this postulate the well known dipole potential and electric field strength of electrostatics are calculated using the type of ensemble averaging used in the accurate shivering theory of the Lamb shift.

Keywords: ECE2 theory, zitterbewegung or shivering induced by the vacuum.

UFT 393



## 1. INTRODUCTION

In recent papers of this series {1 - 41} the law of conservation of antisymmetry has been inferred and vacuum effects of various kinds mapped with the spin connection, antisymmetry being rigorously conserved. In the preceding paper UFT392 the well known zitterbewegung (shivering) theory of the influence of the vacuum was introduced into ECE2 unified field theory. In this paper the ensemble averaged dipole potential and electric field strength of electrostatics are calculated in the presence of shivering due to the vacuum. It is found that the vacuum produces an intricate structure which is wholly unknown in the standard model of macroscopic electrodynamics

This paper is a short synopsis of detailed calculations given in the notes accompanying UFT393 on [www.aias.us](http://www.aias.us) and [www.upitec.org](http://www.upitec.org). Note 393(1) is the calculation of the mean spin connection due to the vacuum for the Coulomb field of one electron. Note 393(2) calculates the shivering Coulombic electric field strength and discusses the conservation of scalar antisymmetry. Some discussion is given of the calculation of the mean square fluctuation using mode theory and the statistical mechanics of the vacuum. Note 393(3) is a preliminary calculation of the shivering electric dipole field. Section 2 of this paper is based on Notes 393(4) to 393(6), and gives the ensemble averaged shivering electric dipole potential and field strength.

Section 3 is a numerical and graphical development of Section 2.

## 2. THE SHIVERING DIPOLE POTENTIAL AND FIELD STRENGTH

With reference to Note 393(4) the calculation of the dipole electric field strength  $\underline{E}$  from the dipole potential  $\phi_0$  is given in all detail. This is a baseline calculation which is extended to include vacuum effects. The dipole potential in the hypothetical absence of the vacuum is the well known:

$$\phi_0 = \frac{1}{4\pi\epsilon_0 r^3} \underline{r} \cdot \underline{p} \quad - (1)$$

where:

$$\underline{r} = \underline{x} - \underline{x}_0 \quad - (2)$$

and

$$|\underline{r}| = |\underline{x} - \underline{x}_0| \quad - (3)$$

The dipole moment  $\underline{p}$  is an intrinsic property of the charge distribution in for example a molecule. Here  $\epsilon_0$  is the vacuum permittivity. The dipole electric field strength  $\underline{E}$  in volts per metre at point  $\underline{x}$  due to a dipole moment  $\underline{p}$  at point  $\underline{x}_0$  is:

$$\underline{E}_0 = -\underline{\nabla} \phi_0 \quad - (4)$$

Therefore:

$$\underline{E}_0 = -\frac{1}{4\pi\epsilon_0} \underline{\nabla} \left( \frac{\underline{r} \cdot \underline{p}}{r^3} \right) \quad - (5)$$

The gradient is most clearly worked out using Cartesian coordinates as detailed in Note 393(4)

$$\underline{E}_0 = -\frac{1}{4\pi\epsilon_0} \frac{d}{dx} \left( \frac{x p_x + y p_y + z p_z}{(x^2 + y^2 + z^2)^{3/2}} \right) \underline{i} + \dots \quad - (6)$$

so:

$$\underline{E}_0 = \frac{1}{4\pi\epsilon_0 r^3} \left( \frac{3\underline{r}(\underline{p} \cdot \underline{r})}{r^2} - \underline{p} \right) \quad - (7)$$

The effect of the vacuum is introduced using a simple new axiom:

$$\underline{r} \rightarrow \underline{r} + \delta \underline{r} \quad - (8)$$

So  $\underline{r}$  is replaced by  $\underline{r} + \delta \underline{r}$  wherever the former occurs. Here  $\delta \underline{r}$  is the shivering or zitterbewegung term due to the influence of the vacuum. The latter is always present, so the complete theory of classical electrodynamics must always consider Eq. ( 8 ). This is true for the whole of physics. For example, the position vector is:

$$\underline{r} = X \underline{i} + Y \underline{j} + Z \underline{k} \quad - (9)$$

so:

$$X \rightarrow X + \delta X \quad - (10)$$

$$Y \rightarrow Y + \delta Y \quad - (11)$$

$$Z \rightarrow Z + \delta Z \quad - (12)$$

The effect of the vacuum on the  $\underline{\nabla}$  operator is given by:

$$\underline{\nabla} \rightarrow \frac{\partial}{\partial (X + \delta X)} \underline{i} + \frac{\partial}{\partial (Y + \delta Y)} \underline{j} + \frac{\partial}{\partial (Z + \delta Z)} \underline{k} \quad - (13)$$

The dipole moment  $\underline{p}$  has no intrinsic dependence on X, Y, and Z because by definition, the dipole moment is a fundamental molecular property listed for examples in the tables of standard laboratories. So the dipole moment is not affected by the vacuum, and in the calculation leading to Eq. ( 7 ), the dipole moment is a constant.

Therefore the shivering dipole potential is:

$$\phi = \frac{1}{4\pi \epsilon_0 |\underline{r} + \delta \underline{r}|^3} (\underline{r} + \delta \underline{r}) \cdot \underline{p} \quad - (14)$$

where:

$$|\underline{r} + \underline{\delta r}| = \left( (\underline{r} + \underline{\delta r}) \cdot (\underline{r} + \underline{\delta r}) \right)^{1/2} \\ = r \left( 1 + 2 \frac{\underline{r} \cdot \underline{\delta r}}{r^2} + \frac{\underline{\delta r} \cdot \underline{\delta r}}{r^2} \right)^{1/2} \quad - (15)$$

So:

$$|\underline{r} + \underline{\delta r}|^3 = r^3 \left( 1 + 2 \frac{\underline{r} \cdot \underline{\delta r}}{r^2} + \frac{\underline{\delta r} \cdot \underline{\delta r}}{r^2} \right)^{3/2} \quad - (16)$$

Similarly the shivering dipole electric field strength is:

$$\underline{E} = \frac{1}{4\pi\epsilon_0} \left( \frac{(\underline{r} + \underline{\delta r})(\underline{p} \cdot (\underline{r} + \underline{\delta r}))}{|\underline{r} + \underline{\delta r}|^5} - \frac{\underline{p}}{|\underline{r} + \underline{\delta r}|^3} \right) \quad - (17)$$

By conservation of scalar antisymmetry {1 - 12}:

$$\underline{E} = -\underline{\nabla} \phi = -\underline{\nabla} \phi_0 + \underline{\omega} \phi_0 = -\frac{\partial \underline{A}_0}{\partial t} - \underline{\omega}_0 \underline{A}_0 \quad - (18)$$

in which  $\underline{A}_0$  is the electric vector potential in the hypothetical absence of the vacuum, and

where:

$$\omega^\mu = \left( \frac{\omega_0}{c}, \underline{\omega} \right) \quad - (19)$$

is the spin connection four vector or "vacuum map" of ECE2 unified field theory. Therefore:

$$\underline{E} = \underline{E}_0 + \underline{\omega} \phi_0 \quad - (20)$$

is the experimentally observed electric field strength in the presence of the ubiquitous

vacuum. The spin connection, or vacuum map, is always observed experimentally. Similarly

the Lamb shift and other radiative corrections are always observed and are always present.

Standard model classical electrodynamics ignores the effect of the vacuum, and ignores half of physics.

Following the well known {1 - 12} theory of the Lamb shift the ensemble averaged potential and field strength must be calculated because  $\underline{\delta r}$  is a fluctuating property of the vacuum. Denoting:

$$\alpha := \frac{1}{r^2} \left( 2 \underline{r} \cdot \underline{\delta r} + \underline{\delta r} \cdot \underline{\delta r} \right) \quad - (21)$$

then:

$$\phi = \frac{(\underline{r} + \underline{\delta r}) \cdot \underline{p}}{4\pi \epsilon_0 r^3 (1 + \alpha)^{3/2}} \quad - (22)$$

and

$$\underline{E} = \frac{1}{4\pi \epsilon_0} \left( \frac{(\underline{r} + \underline{\delta r})(\underline{p} \cdot (\underline{r} + \underline{\delta r}))}{r^5 (1 + \alpha)^{5/2}} - \frac{\underline{p}}{r^3 (1 + \alpha)^{3/2}} \right) \quad - (23)$$

In an isotropic vacuum:

$$\langle \underline{\delta r} \rangle = \underline{0} \quad - (24)$$

but

$$\langle \underline{\delta r} \cdot \underline{\delta r} \rangle \neq 0 \quad - (25)$$

For:

$$\alpha \ll 1 \quad - (26)$$

the binomial expansion gives:

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \dots \quad (27)$$

so:

$$(1+x)^{-3/2} = 1 - \frac{3x}{2} + \frac{15}{8}x^2 + \dots \quad (28)$$

and

$$(1+x)^{-5/2} = 1 - \frac{5x}{2} + \frac{35}{8}x^2 + \dots \quad (29)$$

It follows that:

$$\phi \sim \frac{(\underline{r} + \underline{\delta r}) \cdot \underline{p}}{4\pi\epsilon_0 r^3} \left( 1 - \frac{3x}{2} + \frac{15x^2}{8} + \dots \right) \quad (30)$$

and

$$\underline{E} = \frac{1}{4\pi\epsilon_0} \left( \frac{(\underline{r} + \underline{\delta r})(\underline{p} \cdot (\underline{r} + \underline{\delta r}))}{r^5} \left( 1 - \frac{5x}{2} + \frac{35}{8}x^2 + \dots \right) - \frac{\underline{p}}{r^3} \left( 1 - \frac{3x}{2} + \frac{15x^2}{8} + \dots \right) \right) \quad (31)$$

To first order in  $x$ :

$$\langle \phi \rangle = \frac{1}{4\pi\epsilon_0 r^3} \left( \underline{r} \cdot \underline{p} + \langle \underline{\delta r} \cdot \underline{p} \rangle \right) - \frac{3\underline{p}}{8\pi\epsilon_0 r^5} \cdot \left\langle (\underline{r} + \underline{\delta r})(2\underline{r} \cdot \underline{\delta r} + \underline{\delta r} \cdot \underline{\delta r}) \right\rangle \quad (32)$$

By vacuum isotropy:

$$\langle \underline{\delta r} \cdot \underline{p} \rangle = 0. \quad (33)$$

In Eq. (32):

$$\begin{aligned} & \langle (\underline{r} + \delta \underline{r}) (2 \underline{r} \cdot \delta \underline{r} + \delta \underline{r} \cdot \delta \underline{r}) \rangle \\ &= \underline{i} \langle (\underline{x} + \delta \underline{x}) (2 (\underline{x} \delta \underline{x} + \underline{y} \delta \underline{y} + \underline{z} \delta \underline{z}) + \delta \underline{x}^2 + \delta \underline{y}^2 + \delta \underline{z}^2) \rangle \\ & \quad + \dots \end{aligned} \quad - (34)$$

By vacuum isotropy:

$$\langle \delta \underline{x} \delta \underline{y} \rangle = \langle \delta \underline{x} \delta \underline{z} \rangle = \langle \delta \underline{y} \delta \underline{z} \rangle = 0 \quad - (35)$$

so

$$\langle (\underline{r} + \delta \underline{r}) (2 \underline{r} \cdot \delta \underline{r} + \delta \underline{r} \cdot \delta \underline{r}) \rangle = 3 \underline{r} \langle \delta \underline{r} \cdot \delta \underline{r} \rangle. \quad - (36)$$

Therefore to first order in  $x$  the shivering dipole potential is:

$$\langle \phi \rangle = \frac{\underline{p} \cdot \underline{r}}{4\pi \epsilon_0 r^3} \left( 1 - \frac{9}{2r^2} \langle \delta \underline{r} \cdot \delta \underline{r} \rangle \right) \quad - (37)$$

The standard model dipole potential is given in Eq. ( 1 ).

The potential energy from the vacuum is given from the mean square displacement term. Therefore energy can be transferred from the vacuum, aether or spacetime to a circuit as in UFT311, UFT321, UFT364, UFT382 and UFT383 on [www.aias.us](http://www.aias.us) and [www.upitec.org](http://www.upitec.org). The mean square vacuum fluctuation can be calculated or computed as in Note 393(2) from mode theory or from statistical mechanics. The result for the Lamb shift gives an accurate agreement with experimental data. So there can be great confidence in the shivering or zitterbewegung theory extended to the whole of physics.

After a long but straightforward calculation given in all detail in Note 393(6), it is found that the shivering dipole electric field strength is:



$$\begin{aligned}
 \underline{E} &= \frac{1}{4\pi\epsilon_0 r^3} \left( \frac{(\underline{r} \cdot \underline{p})\underline{r}}{r^2} - \underline{p} \right) + \frac{11}{24} \frac{p}{4\pi\epsilon_0 r^5} \langle \underline{\delta r} \cdot \underline{\delta r} \rangle \\
 &- \frac{35}{24\pi\epsilon_0 r^5} \underline{r} (\underline{p} \cdot \underline{r}) \langle \underline{\delta r} \cdot \underline{\delta r} \rangle + \frac{1}{9} \frac{p}{r} \langle (\underline{\delta r} \cdot \underline{\delta r})^2 \rangle \\
 &- (38)
 \end{aligned}$$

to first order in  $x$ .

A very rich new physics emerges.

In general these calculations must be carried out with computer algebra to eliminate or minimize human error and in order to compute higher order terms in the binomial expansion. The calculations of Notes 393(5) and 393(6) are checked by computer algebra in Section 3, and sample results graphed.

### 3. COMPUTATION AND GRAPHICS

(Section by Dr. Horst Eckardt)

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