

# DEVELOPMENT OF THE ECE2 VACUUM

by

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## ABSTRACT

It is shown that the ECE2 vacuum is defined entirely by the spin connection within the fluxon, the quantum of magnetic flux in weber. The ECE2 vacuum is richly structured and is defined by regions in which there exist potentials but no fields. The ECE2 vacuum can be used to describe the radiative corrections, notably the Lamb shift. The minimal prescription is defined by the physical  $W$  potential of the ECE vacuum, which can be developed in terms of a relativistic particle flux, thus defining the Tesla vacuum.

Keywords: ECE2 vacuum, Aharonov Bohn effect, minimal prescription, Tesla flux.

UFT 337



## 1. INTRODUCTION

The most recent papers of this series {1 - 12} have developed ECE2 special relativity and have applied it to indicate the existence of several novel types of ESR and NMR spectroscopy. The most recent paper developed the ECE2 Aharonov Bohm (AB) effect, which is the effect of potentials on material matter in regions where fields of force are absent. In ECE2 theory, the AB vacuum is richly structured, and is defined by the Cartan geometry of regions where the torsion and curvature are both zero, but in which the spin connection and tetrad are non-zero. In this paper the theory of the Lamb shift is developed in terms of the scalar and vector potentials of the ECE2 vacuum, a novel minimal prescription defined in terms of the physical  $W^\mu$  four potential of ECE2 theory, and the ECE2 vacuum developed using ECE2 relativity theory applied to particles of the ECE2 vacuum. These are identified as particles of the Tesla vacuum. It becomes transparent clear that there is energy momentum in the spacetime of the ECE2 vacuum, and that this energy momentum is transferred in a very simple way to material matter.

This paper is a condensed summary of detailed calculations found in the notes accompanying UFT337 on [www.aias.us](http://www.aias.us) and [www.upitec.org](http://www.upitec.org), archived in the United States national archives, [www.archive.org](http://www.archive.org), and the archives of the countries of Britain, [www.webarchive.org.uk](http://www.webarchive.org.uk). Note 337(1) develops the Lamb shift in terms of the vector potential of the ECE2 vacuum and defines the angular momentum of the ECE2 vacuum. Note 337(2) develops the effect on a matter wave of the vacuum scalar potential, and Note 337(3) develops Lamb shift in terms of the scalar potential of the ECE2 vacuum. In Notes 337(4) to 337(6) the ECE2 minimal prescription is developed in terms of the  $W^\mu$  four potential of ECE2, which is the spin connection four vector within the C negative fluxon, the quantum of magnetic flux. It is inferred that the physical potential is the  $W^\mu$  potential. Finally in Note 337(7) the ECE2 vacuum is developed as a flux of relativistic particles, and is identified with

the Tesla vacuum.

## 2. RELATIVISTIC PARTICLE THEORY OF THE ECE2 VACUUM.

Consider the ECE2 minimal prescription:

$$p^\mu \rightarrow p^\mu + e \underline{W}^\mu \quad - (1)$$

where:

$$p^\mu = \left( \frac{E}{c}, \underline{p} \right), \quad - (2)$$

$$\underline{W}^\mu = \left( \frac{\phi_{\underline{W}}}{c}, \underline{W} \right) \quad - (3)$$

Here  $E$  is the total relativistic energy,  $p$  the relativistic momentum,  $e$  the charge on the proton,  $\phi_{\underline{W}}$  is the scalar potential of UFT318 and  $\underline{W}$  the vector potential. The units of  $\phi_{\underline{W}}$  are volts, i.e. joules per coulomb. The units of  $\underline{W}$  are tesla meters, or  $J C^{-1} s m^{-1}$ . In ECE2 theory:

$$\underline{W}^\mu = W^{(0)} \left( -\underline{\Omega}^{(0)}, \underline{\underline{\Omega}} \right) \quad - (4)$$

where the spin connection four vector is

$$\underline{\Omega}^\mu = \left( -\underline{\Omega}^{(0)}, \underline{\underline{\Omega}} \right). \quad - (5)$$

It follows that:

$$\phi_{\underline{W}} = c W^{(0)} \underline{\Omega}^{(0)} \quad - (6)$$

and:

$$\underline{W} = W^{(0)} \underline{\underline{\omega}}. \quad - (7)$$

Therefore the units of  $W^{(0)}$  are those of magnetic flux

$$W^{(0)} = \text{weber} = \text{volt sec} = J C^{-1} s. \quad - (8)$$

A summary of units is given below:

$$\phi_w = \text{volt} = \mathcal{J}C^{-1} - (9)$$

$$\underline{W} = \text{tesla metres} = \mathcal{J}C^{-1} \text{sm}^{-1} - (10)$$

$$\underline{\Omega}^{(0)} = \underline{\Omega} = \text{m}^{-1} - (11)$$

$$\underline{W}^{(0)} = \text{weber} = \text{volt second} = \mathcal{J}C^{-1} \text{s} - (12)$$

In ECE2 the magnetic flux density  $\underline{B}$  in tesla is defined {1 - 12} as:

$$\underline{B} = \underline{\nabla} \times \underline{W} = \underline{\nabla} \times \underline{A} + 2\underline{\omega} \times \underline{A} - (13)$$

where the  $\underline{A}$  potential of ECE theory is defined by the tetrad vector:

$$\underline{A} = A^{(0)} \underline{v} - (14)$$

The electric field strength in volts per metre is:

$$\underline{E} = -\underline{\nabla} \phi_w - \frac{\partial \underline{W}}{\partial t} = -\underline{\nabla} \phi - \frac{\partial \underline{A}}{\partial t} + 2(c\underline{\Omega}^{(0)} \underline{A} - \phi \underline{\Omega}) - (15)$$

where:

$$A^\mu = \left( \frac{\phi}{c}, \underline{A} \right) - (16)$$

and where

$$v^\mu = \left( v^{(0)}, \underline{v} \right) - (17)$$

is the tetrad four vector. The units of  $\phi$  are the same as those of  $\phi_w$ , and the units of  $\underline{A}$  are the same as those of  $\underline{W}$ .

In ECE2 the magnetic flux density  $\underline{B}$  is defined as:

$$\underline{B} = \underline{W}^{(0)} \underline{R}(\text{spin}) - (18)$$

where  $\underline{R}(\text{Spin})$  is the spin curvature vector in units of  $\text{m}^{-2}$ . The electric field strength in

volts per metre is defined by the orbital curvature (UFT314 - UFT318):

$$\underline{E} = c \underline{W}^{(0)} \underline{R}(\text{orbital}) - (19)$$

The elementary quantum of magnetic flux is {1 - 12}:

$$W^{(0)} = \hbar / e \quad - (20)$$

where  $\hbar$  is the reduced Planck constant, the quantum of angular momentum in J s. Therefore:

$$\phi_w = \left( \frac{\hbar c}{e} \right) \Omega^{(0)} \quad - (21)$$

The Aharonov Bohm spacetime may therefore be defined in terms of the vacuum potential

$$W^\mu(\text{vac}) = \left( \frac{\phi_w(\text{vac})}{c}, \bar{W}(\text{vac}) \right) \quad - (22)$$

On the most fundamental level:

$$W^\mu(\text{vac}) = \frac{\hbar}{e} \Omega^\mu(\text{vac}) \quad - (23)$$

so the Aharonov Bohm (AB) spacetime is defined by the spin connection four vector within

the proportionality quantum  $\hbar/e$ . The latter is negative under charge conjugation

symmetry. In the absence of electric and magnetic fields the AB spacetime (loosely known

as "the vacuum") is defined by Eq. (23). The fields  $\underline{E}$  and  $\underline{B}$  on the other hand are defined

by the curvature. The latter is zero in the AB spacetime. In minimal notation the geometry of

the AB spacetime is defined by {1 - 12}:

$$T = d\wedge q + \Omega \wedge q = 0 \quad - (24)$$

$$R = d\wedge \Omega + \Omega \wedge \Omega = 0 \quad - (25)$$

where T and R denote torsion and curvature,  $\Omega$  denotes the spin connection, q the tetrad and  $\wedge$  the wedge product.

Consider now the Einstein energy equation of ECE2 special relativity {1 - 12}:

$$P^\mu P_\mu = m^2 c^2 \quad - (26)$$

Using the minimal prescription (1) the effect of the AB spacetime on material matter

such as an electron is described by:

$$(p^\mu + eW^\mu)(p_\mu + eW_\mu) = m^2 c^2 \quad - (27)$$

If the electron is at rest then:

$$p^\mu = \left( \frac{E_0}{c}, 0 \right), \quad W^\mu = \frac{\hbar}{e} \left( \Omega^{(0)}, 0 \right) \quad - (28)$$

In this case:

$$\left( E_0 + \hbar \Omega^{(0)} \right) \left( E_0 + \hbar \Omega^{(0)} \right) = m^2 c^4 \quad - (29)$$

The AB spacetime contains an angular frequency in radians per second:

$$\omega(\text{vac}) = c \Omega^{(0)} \quad - (30)$$

so Eq. (29) becomes:

$$\left( E_0 + \hbar \omega(\text{vac}) \right) = mc^2 \quad - (31)$$

from which it is clear that the rest frequency of a particle of material matter is increased by:

$$E_0 \rightarrow E_0 + \hbar \omega(\text{vac}) \quad - (32)$$

due to the presence of the AB spacetime. The mechanism of energy form spacetime becomes transparently clear.

The AB spacetime imparts energy / momentum to material matter as follows:

$$p^\mu \rightarrow p^\mu + p^\mu(\text{vac}) \quad - (33)$$

where the energy momentum of the AB spacetime is defined by:

$$p^\mu(\text{vac}) = eW^\mu = \hbar \Omega^\mu \quad - (34)$$

The angular frequency of the AB spacetime is therefore the spin connection scalar multiplied by c:

$$\omega(\text{vac}) = c\Omega^{(0)} - (35)$$

and its wave vector is the spin connection vector:

$$\underline{\kappa}(\text{vac}) = \underline{\Omega} - (36)$$

The de Broglie Einstein equations of the AB spacetime (or "vacuum") are:

$$E(\text{vac}) = \hbar\omega(\text{vac}) = \gamma m(\text{vac})c^2, - (37)$$

$$\underline{p}(\text{vac}) = \hbar\underline{\kappa}(\text{vac}) = \gamma m(\text{vac})\underline{v}(\text{vac}) - (38)$$

where the vacuum Lorentz factor is:

$$\gamma = \left(1 - v^2(\text{vac})/c^2\right)^{-1/2} - (39)$$

A vacuum particle of mass  $m(\text{vac})$  has been introduced via the de Broglie / Einstein equations. In general there is a statistical ensemble of such particles.

The AB spacetime is quantized according to:

$$E(\text{vac})\psi(\text{vac}) = i\hbar \frac{\partial \psi(\text{vac})}{\partial t} - (40)$$

and

$$\underline{p}(\text{vac})\psi(\text{vac}) = -i\hbar \underline{\nabla} \psi(\text{vac}) - (41)$$

where  $\psi(\text{vac})$  is the wave function of the vacuum particle. According to de Broglie's wave particle dualism, the relativistic vacuum particle is also a relativistic vacuum wave. The latter obeys the ECE wave equation {1 - 12} in the limit:

$$\left(\square + \kappa^2(\text{vac})\right)\psi(\text{vac}) = 0 - (42)$$

where:

$$k(\text{vac}) = \frac{m(\text{vac})c}{\hbar} \quad - (43)$$

The wave function of the AB spacetime or "vacuum" is therefore

$$\psi(\text{vac}) = \exp\left(-i\left(\omega(\text{vac})t - \underline{k}(\text{vac}) \cdot \underline{r}\right)\right) \quad - (44)$$

where  $t$  denotes time and where  $\underline{r}$  is a position vector.

The ECE wave equation of the vacuum is:

$$\left(\square + R(\text{vac})\right)\psi(\text{vac}) = 0 \quad - (45)$$

Eq. (42) is the quantized version of the Einstein energy equation of the AB spacetime or vacuum:

$$E^2(\text{vac}) = c^2 p^2(\text{vac}) + m^2(\text{vac})c^4 \quad - (46)$$

Therefore the AB spacetime is understood as a relativistic particle of mass  $m(\text{vac})$ . The process of taking energy and momentum from the AB spacetime or vacuum become<sup>s</sup> simple to understand:

$$E \rightarrow E + E(\text{vac}) \quad - (47)$$

$$\underline{p} \rightarrow \underline{p} + \underline{p}(\text{vac}) \quad - (48)$$

It appears that such a particle vacuum was proposed, but not proven, by Tesla.

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