ECE THEORY OF MATTER FIELD INTERACTION

by

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ABSTRACT

The general theory of matter field interaction is developed for use with scattering phenomena and applied to Compton scattering of a photon from an initially stationary electron. The method is based on the ECE wave equation, which defines the R parameter of scattering theory. The wave equation is augmented by the minimal prescription and the relativistic Hamilton Jacobi

equation. An expression is obtained for the photon mass during a photon electron scattering event. This method can be applied to scattering of a particle of any mass from another of any mass, i.e. to scattering theory in general.

Keywords: ECE wave equation, field interaction theory, scattering theory.

1. INTRODUCTION

During the course of development of ECE theory {1 - 10} a wave equation for spacetime has been inferred from the tetrad postulate of Cartan {11}. The wave equation is therefore very fundamental and applies for all mathematical spaces of relevance to physics. The philosophy of relativity has been used to infer all the wave equations of physics from geometry, thus unifying general relativity and quantum mechanics. This unification comes about at the expense of the Heisenberg uncertainty principle, which in recent papers of this series has been shown to be incorrect by use of higher order commutators and related methods. For example, the ECE wave equation generalizes the Proca equation for a boson with mass, notably the photon with mass. If the photon has mass, longitudinal modes of electromagnetic radiation are allowed as well as transverse modes, and the U(1) sector symmetry is incorrect. The fundamental longitudinal mode is the $\underline{B}^{(3)}$ field {12}, which has recently been developed into technologies which promise to be most important {13, 14} for the production of clean burning biofuel and clean water from sea water, the use of sea water as fuel, and so forth. The $\underline{B}^{(3)}$ field is the central concept of non linear optics {1 - 10} as incorporated in ECE theory, and is observed routinely in the inverse Faraday effect. The new technologies based on $\underline{B}^{(3)}$ effectively amplify the inverse Faraday effect by means of moulds made by nanotechnology and by means of carefully made catalysts. This method brings about bond dissociation in hydrocarbons, and catalytically controlled recombination.

In UFT 131 ff of this series of papers (UFT section of www.aias.us) it was shown by consideration of relatively simple antisymmetry that the U(1) theory of electromagnetism cannot be correct, and this inference means that longitudinal modes such as $\underline{B}^{(3)}$ and the concept of photon mass are inferred by ECE theory within the philosophy of general relativity based on Cartan's geometry. The latter correctly incorporates torsion of spacetime, and in ECE theory the electromagnetic field is a manifestation of torsion. The same conclusion applies to the gravitational field, and in ECE theory both types of field are described by the same set of equations. The way in which these fields interact is important and can be addressed with a minimal prescription as in this paper and as in previous work.

In UFT 158 ff of this series it was shown that the standard theory of particle scattering is severely self inconsistent and the most recent papers begin to develop a matter field theory for particle interaction. In Section 2, generally valid expressions are obtained for matter field interaction using as a basis the R parameter of the ECE wave equation. The wave equation is augmented with the minimal prescription and the relativistic Hamilton Jacobi equation obtained by using the minimal prescription in the generalized Einstein energy equation. In Section 3 an expression is obtained for the photon mass in the scattering of a photon from a stationary electron. This scattering process is usually referred to as the Compton effect, but Compton used a hybrid theory based on the assumption of zero photon mass.

2. HAMILTON JACOBI EQUATION FOR MATTER FIELDS IN GENERAL

In the preceding paper UFT 181 the simplest type of Hamilton Jacobi equation was used based on:

$$(p^\mu - \hbar\kappa^\mu)(p_\mu - \hbar\kappa_\mu) = m_0^2 c^2 \quad -(1)$$

obtained from the minimal prescription for the interaction of a particle four momentum p^μ with a matter wave denoted $\hbar\kappa^\mu$. In eq. (1) m_0 is the measured or laboratory mass of the particle described by:

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

where E is the total relativistic energy, c the speed of light and $\underline{p}$ the relativistic momentum.

Here $\hbar$

is the reduced Planck constant and the wave four vector is defined by

$$\kappa^\mu = \left(\frac{\omega}{c}, \underline{\kappa} \right). \quad -(3)$$

Here ω is the angular frequency of the wave (a matter wave) and $\underline{\kappa}$ its wave vector.

Eq. (1) was transformed n UFT 181 into an ECE wave equation by writing it as:

$$p^\mu p_\mu - \hbar^2 R_1 = m_0^2 c^2. \quad -(4)$$

This procedure assumed that:

$$p^\mu = \hbar \kappa^\mu \quad -(5)$$

which means that the interacting matter waves are those of identical particles. More generally the two particles are not the same. Denote by p_1^μ the four momentum of particle 1, and by κ_2^μ

the wave four vector of matter wave 2. The particle 1 is also a matter wave by the Planck / de Broglie postulate:

$$p_2^\mu = \hbar \kappa_2^\mu \quad -(6)$$

which is the same as the familiar:

$$E_2 = \hbar \omega_2, \quad \underline{p}_2 = \hbar \underline{\kappa}_2. \quad -(7)$$

The Hamilton Jacobi equation for the interaction of particle 1 with matter wave 2 is

$$(p_1^\mu - \hbar \kappa_2^\mu)(p_{\mu 1} - \hbar \kappa_{\mu 2}) = m_{10}^2 c^2 \quad -(8)$$

where m_{10} is the measured mass of particle 1. Using the methods of UFT 181 Eq. (8) is equivalent to the ECE wave equation:

$$\left(\square + R_2 + \left(\frac{m_{10} c}{\hbar} \right)^2 \right) \phi = 0. \quad -(9)$$

Expanding the left hand side of Eq. (8):

$$-\hbar^2 R_2 = p_1^\mu p_{\mu 1} - \hbar \left(\kappa_2^\mu p_{\mu 1} + p_1^\mu \kappa_{\mu 2} \right) + \hbar^2 \kappa_2^\mu \kappa_{\mu 2} \quad -(10)$$

in which:

$$p_1^\mu = \hbar \kappa_1^\mu , \quad p_{\mu 1} = \hbar \kappa_{\mu 1}. \quad -(11)$$

Therefore the following expression is obtained for R_2:

$$R_2 = 2 \left(\frac{\omega_1 \omega_2}{c^2} - \kappa_1 \kappa_2 \right) - \left(\frac{\omega_2^2}{c^2} - \kappa_2^2 \right). \quad -(12)$$

Finally as in UFT 181 define:

$$R_2 := \left(\frac{m_2 c}{\hbar} \right)^2 \quad -(13)$$

and the interacting mass m_2 is:

$$m_2 = \frac{\hbar}{c} \left[2 \left(\frac{\omega_1 \omega_2}{c^2} - \kappa_1 \kappa_2 \right) - \left(\frac{\omega_2^2}{c^2} - \kappa_2^2 \right) \right]^{1/2} \quad -(14)$$

found from a theory of interacting matter waves. The interacting mass m_2 is not constant, in line with experimental data as first shown in UFT 158 ff.

3. PARTICLE SCATTERING AND COMPTON SCATTERING

The theory of Section 2 can be applied to the scattering of a particle of measured mass m_{10} from an initially stationary particle of measured mass m_{20}. The equation of conservation of energy for this process is:

$$\gamma m_{10} c^2 + m_{20} c^2 = \gamma' m_{10} c^2 + \gamma'' m_{20} c^2 \quad -(15)$$

and the equation of conservation of momentum is

$$\underline{p} = \underline{p}' + \underline{p}'' \quad -(16)$$

where γ, γ', and γ'' are the relevant Lorentz factors. In the theory of section 2, the same process is described by interacting matter fields. The minimal prescription for eqs. (15) and (16) is

$$p_2^\mu \rightarrow p_2^\mu - \hbar \kappa_1^\mu \quad -(17)$$

where p_2^μ is a matter wave:

$$p_2^\mu = \hbar \kappa_2^\mu . \quad -(18)$$

Therefore, as in Section 2:

$$m_1 = \frac{\hbar}{c} \left(\kappa_1^2 - \frac{\omega_1^2}{c^2} + 2 \left(\frac{\omega_2 \omega_1}{c^2} - \kappa_2 \kappa_1 \right) \right)^{1/2} \quad -(19)$$

is the interacting mass associated with matter wave 1.

The same process may also be described by:

$$p_1^\mu \rightarrow p_1^\mu - \hbar \kappa_2^\mu \quad -(20)$$

leading to:

$$m_2 = \frac{\hbar}{c} \left(\kappa_2^2 - \frac{\omega_2^2}{c^2} + 2 \left(\frac{\omega_1 \omega_2}{c^2} - \kappa_1 \kappa_2 \right) \right)^{1/2} \quad -(21)$$

which is the interacting mass associated with matter wave 2. Therefore in the theory of matter wave interaction there are two wave equations:

$$\left(\Box + R_1 + \left(\frac{m_{20} c}{\hbar} \right)^2 \right) \phi_2 = 0 \quad -(22)$$

and

$$\left(\Box + R_2 + \left(\frac{m_{10} c}{\hbar} \right)^2 \right) \phi_1 = 0 \quad -(23)$$

where:

$$R_1 = \left(\frac{m_1 c}{\hbar} \right)^2, \quad R_2 = \left(\frac{m_2 c}{\hbar} \right)^2. \quad -(24)$$

In the standard theory of Compton scattering of a photon from an electron, the photon is assumed to have no mass, so:

$$m_{10} = 0 \quad -(25)$$

which implies that:

$$k_1 = \frac{\omega_1}{c}. \quad -(26)$$

Therefore the interacting mass of Eq. (19) becomes:

$$m_1 = \frac{\hbar}{c} \left(2 \frac{\omega_1}{c} \left(\frac{\omega_2}{c} - k_2 \right) \right)^{1/2} \quad -(27)$$

in which:

$$\omega_2 \neq k_2 c \quad -(28)$$

for the electron.

Therefore during interaction with the electron, the photon acquires a finite interacting mass.

Similarly, during interaction, the interacting electron mass is:

$$m_2 = \frac{\hbar}{c}\left(\kappa_2^2 - \frac{\omega_2^2}{c^2} + 2\frac{\omega_1}{c}\left(\frac{\omega_2}{c} - \kappa_2\right)\right)^{1/2} \quad -(29)$$

and no longer the measured mass m_{20}. The latter is constant and is given from the Einstein energy equation as:

$$m_{20} = \frac{\hbar}{c}\left(\frac{\omega_2^2}{c^2} - \kappa_2^2\right)^{1/2}. \quad -(30)$$

From experimental data it is known that Eqs. (15) and (16) describe Compton scattering of a photon from an initially stationary electron if:

$$\hbar\omega + m_{20}c^2 = \hbar\omega' + \gamma'' m_2 c^2 \quad -(31)$$

and

$$\hbar\underline{\kappa} = \hbar\underline{\kappa}' + \underline{p}''. \quad -(32)$$

Therefore the correct de Broglie Einstein equations for the photon during interaction are

$$\hbar\omega = \gamma m_1 c^2, \quad \hbar\underline{\kappa} = \gamma m_1 \underline{v} \quad -(33)$$

equations which use the interacting mass (27). Similarly the de Broglie Einstein equations for the electron in interaction are:

$$\hbar\omega = \gamma m_2 c^2, \quad \hbar\underline{\kappa} = \gamma m_2 \underline{v}. \quad -(34)$$

From Eqs. (27) and (33)

$$\omega = \frac{\gamma m_1 c^2}{\hbar} = \gamma c\left(2\frac{\omega_1}{c}\left(\frac{\omega_2}{c} - \kappa_2\right)\right)^{1/2} \quad -(35)$$

which means that the initial frequency ω_1 of the photon is shifted to ω by interaction with the electron. However, it is well known that Eqs. (31) and (32) lead to:

$$\frac{m_{20}c^2}{\hbar} = \frac{\omega_1 \omega}{\omega_1 - \omega}\left(1 - \cos\theta\right) \quad - (36)$$

i.e.

$$\frac{1}{\omega} - \frac{1}{\omega_1} = \frac{\hbar}{m_{20}c^2}\left(1 - \cos\theta\right) \quad - (37)$$

Therefore Eqs. (35) and (37) are equivalent descriptions of the same scattering phenomenon. If the Lorentz factor in Eq. (35) is defined in terms of the photon velocity v by:

$$\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2} \quad - (38)$$

then

$$v = c\left(1 - \frac{2\omega_1 c}{\omega^2}\left(\frac{\omega_2}{c} - \kappa_2\right)\right)^{1/2} \quad - (39)$$

The angular frequency ω_2 of the scattered electron may be measured experimentally, so its wave-vector can also be found experimentally from Eq. (30). So the velocity v can be found experimentally and therefore the interacting photon mass.

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REFERENCES

{1} M. W. Evans, H. Eckardt and D. W. Lindstrom, "Generally Covariant Unified Field Theory" (Abramis Academic, 2005 onwards), in seven volumes.

{2} M. W. Evans, S. Crothers, H. Eckardt and K. Pendergast, "Criticisms of the Einstein Field Equation" (Cambridge International Science Publishing, 2011).

{3} Kerry Pendergast, "The Life of Myron Evans" (Cambridge International Science Publishing, 2011).

{4} M. W. Evans, Ed., J. Found. Phys. Chem., first 24 issues in press (Cambridge International Science Publishing, from May 2011).

{5} L. Felker, "The Evans Equations of Unified Field Theory" (Abramis, 2007).

{6} M. W. Evans, ed., "Modern Nonlinear Optics" (Wiley, New York, 2001, second edition), in three volumes, second edition.

{7} M. W. Evans and S. Kielich, eds., "Modern Nonlinear Optics" (Wiley, New York, 1992, 1993, 1997), in three volumes, first edition.

{8} M. W. Evans and L. B. Crowell, "Classical and Quantum Electrodynamics and the B(3) Field" (World Scientific, 2001).

{9} M. W. Evans and J.-P. Vigier, "The Enigmatic Photon" (Kluwer, Dordrecht, 1994 to 2002), in ten volumes hardback and paperback.

{10} M. W. Evans and A. A. Hasanein, "The Photomagneton in Quantum Field Theory" (World Scientific, 1994).

{11} S. P. Carroll, "Spacetime and Geometry: an Introduction to General Relativity" (Addison Wesley, New York, 2004).

{12} M. W. Evans, Physica B, 182, 227, 237 (1992).

{13} Taishi Kurata, A.I.A.S. Fellow, communications from 1995.

{14} Kenzo Matsunami, President, B(3) Field Productive Energy Institute, Kobe, Japan,

communication of May 2011.