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ECE THEORY OF MATTER FIELD INTERACTION

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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 nodes, and the U (1) sector symmetry is incorrect. The fundamental longitudinal mode is the $\vec{B}^{(3)}$ 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 $\vec{B}^{(3)}$ 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 $\vec{B}^{(3)}$ 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 [15] 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 $\vec{B}^{(3)}$ 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 [16] 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.

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2. HAMILTON JACOBI EQUATION FOR MATTER FIELDS IN GENERAL

In the preceding paper [17] the simplest type of Hamilton Jacobi equation was used based on:

$$\left(p^{\mu}-\hbar\kappa^{\mu}\right)\left(p_{\mu}-\hbar\kappa_{\mu}\right)=m_{o}^{2}c^{2}. \tag{1}$$

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

$$p^{\mu}=\left(\frac{E}{c},\vec{p}\right) \tag{2}$$

where E is the total relativistic energy, *c* the speed of light and *p* the relativistic momentum.

Here $\hbar$ is reduced Planck constant and the wave four vector is defined by

$$k^{\mu}=\left(\frac{\omega}{c},\vec{k}\right). \tag{3}$$

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

Equation (1) was transformed [17] into an ECE wave equation by writing it as:

$$p^{\mu}p_{\mu}-\hbar^{2}R_{1}=m_{o}^{2}c^{2}. \tag{4}$$

This procedure assumed that:

$$p^{\mu}=\hbar\kappa^{\mu}. \tag{5}$$

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^n the four momentum of particle 1, and *by* κ_2^n the wave four vector of matter wave 2. The particle 1 is also a matter wave by the Planck/de Broglie postulate:

$$p_{2}^{\mu}=\hbar\kappa_{2}^{\mu} \tag{6}$$

which is the same as the familiar:

$$\mathrm{E}^{2}=\hbar\omega_{2},\ \vec{p}=\hbar\vec{k}_{2}. \tag{7}$$

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

$$(p_{1}^{\mu}-\hbar\kappa_{2}^{\mu})(p_{\mu1}-\hbar\kappa_{\mu2})=m_{10}^{2}c^{2}. \tag{8}$$

Where m m_{10} is the measured mass of particle 1. Using the methods of [17] equation (8) is equivalent to the ECE wave equation:

$$\left(\square+R_{2}+\left(\frac{m_{10}c}{\hbar}\right)^{2}\right)\psi=0. \tag{9}$$

Expanding the left hand side of equation (8):

$$-\hbar^{2}R_{2}=p_{1}^{\mu}p_{\mu1}-\hbar\left(\kappa_{2}^{\mu}p_{1}^{\mu}+p_{1}^{\mu}\kappa_{\mu2}\right)+\hbar^{2}\kappa_{2}^{\mu}\kappa_{\mu2} \tag{10}$$

in which:

$$p_{1}^{\mu}=\hbar\kappa_{1}^{\mu},\ p_{\mu1}=\hbar\kappa_{\mu1}. \tag{11}$$

Therefore the following expression is obtained for R_2:

$$R_{2}=2\left(\frac{\omega_{1}\omega_{2}}{c_{2}}-\kappa_{1}\kappa_{2}\right)-\left(\frac{\omega_{2}^{2}}{c^{2}}-\kappa_{2}^{2}\right). \tag{12}$$

Finally as in [17] define:

$$R_{2}=\left(\frac{m_{2}c}{\hbar}\right)^{2} \tag{13}$$

and the interacting mass m_2 is:

$$m_{2}=\frac{\hbar}{c}\left[2\left(\frac{\omega_{1}\omega_{2}}{c^{2}}-\kappa_{1}\kappa_{2}\right)-\left(\frac{\omega_{2}^{2}}{c^{2}}-\kappa_{2}^{2}\right)\right]^{1/2} \tag{14}$$

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 [16].

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:

$$\gamma m_{10}c^{2}+m_{20}c^{2}=\gamma' m_{10}C^{2}+\gamma'' m_{20}C^{2} \tag{15}$$

and the equation of conservation of momentum is

$$\vec{p}=\vec{p}'+\vec{p}'' \tag{16}$$

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 equations (15) and (16) is

$$p_2^\mu \rightarrow p_2^\mu - \hbar\kappa_1^\mu \tag{17}$$

where p_2^μ is a matter wave:

$$p_2^\mu = \hbar\kappa_2^\mu . \tag{18}$$

Therefore, as in Section 2:

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

is the interacting mass associated with matter wave 1.

The same process may also be described by:

$$p_1^\mu \rightarrow p_1^\mu - \hbar\kappa_2^\mu . \tag{20}$$

leading to:

$$m_2 = \frac{\hbar}{c}\left(\kappa_2^2 - \frac{\omega_2^2}{c^2} + 2\left(\frac{\omega_1\omega_2}{c_2} - \kappa_1\kappa_2\right)\right)^{1/2} . \tag{21}$$

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

$$\left(\square + R_1 + \left(\frac{m_{20}c}{\hbar}\right)^2\right)\psi = 0 \tag{22}$$

and

$$\left(\square + R_2 + \left(\frac{m_{10}c}{\hbar}\right)^2\right)\psi = 0 \tag{23}$$

where:

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

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

$$m_{10} = 0 \tag{25}$$

which implies that:

$$\kappa_1 = \frac{\omega_1}{c} . \tag{26}$$

Therefore, the interacting mass of equation (19) becomes:

$$m_1 = \frac{\hbar}{c}\left(\frac{2\omega_1}{c}\left(\frac{\omega_2}{c} - \kappa_2\right)\right)^{1/2} \tag{27}$$

in which:

$$\omega_2 \neq \kappa_2 c . \tag{28}$$

for the electron.

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

Similarly, during interaction, the interacting electron mass is:

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

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

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

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

$$\hbar\omega + m_{20}c^2 = \hbar\omega' + \gamma'' m_2 c^2 . \tag{31}$$

and

$$\hbar\vec{\kappa} = \vec{\kappa}' + \vec{p}'' . \tag{32}$$

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

$$\hbar\omega = \gamma m_1 c^2 ; \hbar\vec{\kappa} = \gamma m_1 \vec{v} \tag{33}$$

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

$$\hbar\omega = \gamma m_2 c^2 ; \hbar\vec{\kappa} = \gamma m_2 \vec{v} . \tag{34}$$

From equations (27) and (33)

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

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

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

i.e.

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

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

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

then

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

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

4. CONCLUSION

ECE theory of matter field interaction has been analyzed in this paper. The method is based on the ECE wave equation, which defends the R parameter of scattering theory. The wave equation is augmented by the minimal prescription and the relativistic Hamilton Jacobi equation. On the basis of these results the angular frequency, wave vector and velocity can be measured experimentally.

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ЕCE ТЕОРИЈА ИНТЕРАКЦИЈЕ МАТЕРИЈЕ НА ТЕРЕНУ

Сажетак: Општа теорија интеракције материје и поља развијена је за употребу код феномена расијања и примијењена на Комптоново расијање, код фотона од иницијално стационарног електрона. Метод је заснован на ЕCE таласној једначини којом се дефинише параметар R теорије расијања. Таласна једначина повећана је минималним правилом и релативистичком Хамилтон−Јакобијевом једначином. Израз је добијен за фотонску масу за вријеме догађаја расијања фотона и електрона. Овај метод може се примијенити на расијање честице било које масе из друге честице било које масе, одн. на теорију расијања уопште.

Кључне ријечи: ЕCE таласна једначина, теорија интеракције поља, теорија расијања.