A particle-free model of matter based on electromagnetic self-confinement (II)

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ABSTRACT. This article sets out to demonstrate that electromagnetic radiation with an energy density in the order of magnitude of $10^{73}[J/m^3]$ satisfies the condition of stability for gravitational self-confinement, while its corresponding electromagnetic vector wave function satisfies the classic Schrödinger wave equation and the relativistic Dirac equation. The complex electromagnetic vector wave function is denoted in this article by $\vec{\Phi}(\vec{x},t)$ and exhibits a correspondence with the scalar quantum-mechanical complex probability function $\Psi(\vec{x},t)$, that cannot be explained by chance. The electromagnetic model also admits other forms of self-confinement of electromagnetic radiation, including electromagneto-static self-confinement at considerably lower energy densities, in which circumstances the descriptive complex electromagnetic wave function also satisfies the Schrödinger wave equation.

RESUMÉ. Il est montré dans cet article qu'un rayonnement électromagnétique à densité énergétique d'un ordre de grandeur de $10^{73}[J/m^3]$ *satisfait la condition de stabilité pour l'autoconfinement gravitationnel et que, par conséquent, la fonction d'onde vectorielle électromagnétique correspondante satisfait l'équation classique d'onde de Schrödinger et la relativiste équation d'onde de Dirac. Désignée* $\vec{\Phi}(\vec{x},t)$ *dans cet article, la fonction vectorielle d'onde électromagnétique complexe présente une concordance qui ne peut être considérée comme fortuite avec la fonction de probabilité complexe de la mécanique quantique scalaire,* $\Psi(\vec{x},t)$. *Le modèle électromagnétique autorise également d'autres formes d'autoconfinement du rayonnement électromagnétique, notamment l'autoconfinement électro-magnétostatique avec les densités énergétiques beaucoup plus faibles, en quel cas la fonction d'onde électromagnétique complexe descriptive satisfait également la fonction d'onde de Schrödinger.*

0. Introduction

Due to the length, this article is split up into 3 sections. Section 1 was published in the last edition and described the relation between the Maxwell equations and the Schrödinger wave equation. This section describes the correspondence between the electromagnetic Maxwell equations and the quantum mechanical (relativistic) Dirac equation.

3. The Dirac equation related to the Maxwell equations:

In what is undoubtedly one of the great papers in physics of this century, Dirac set up a relativistic wave equation which avoids the difficulties of negative probability density of the Klein-Gordon equation, and describes naturally the spin of the electron. Until Pauli and Weisskopf [23] reinterpreted the Klein-Gordon equation, it was believed that this Dirac equation was the only valid relativistic equation. It is now recognized that the Dirac equation and the Klein-Gordon equations are equally valid. The Dirac equation governs particles of spin 1/2, the Klein-Gordon equation those of spin zero [22,p.349]. Self confined electromagnetic radiation (EMS) presents a characteristic effect indicated as "spin". Spin is a fundamental key in relativistic quantum mechanics [1,4,5,7,10]. Dirac with his relativistic equation for the electron was the first to, as he put it, wed quantum mechanics and relativity together. The consequence of negative energies, that the Dirac equation presents when it is solved, introduces the existence of anti-particles, necessary to wed quantum mechanics and relativity together [21]. This can be worked out for any "spin" as showed by Pauli and Weisskopf [23]. In this article, electromagnetic radiation is considered as the building material of a simultaneous particle/anti-particle combination [5] which can under special conditions split up into two separate independent particles, both consisting of self confined electromagnetic radiation [3,4,9]. The Dirac equation [13,22] can be derived from the continuity equation (42) or the Maxwell equation (60). The continuity equation equals:

$$\nabla \cdot \vec{S}(x,t) = -\frac{\partial w(x,t)}{\partial t} \tag{57}$$

Substituting (14) and (15) in (57) results in:

$$ic\nabla' \cdot (\vec{\Phi}^* \times \vec{\Phi}) = -\frac{\partial(\vec{\Phi} \cdot \vec{\Phi}^*)}{\partial t} \tag{58}$$

Which can be written as:

$$ic\vec{\Phi}\cdot(\nabla'\times\vec{\Phi}^*) - ic\vec{\Phi}^*\cdot(\nabla'\times\vec{\Phi}) = -\vec{\Phi}\cdot\frac{\partial\vec{\Phi}^*}{\partial t} - \vec{\Phi}^*\cdot\frac{\partial\vec{\Phi}}{\partial t} \tag{59}$$

Equation (59) can be split up into two identical equations for $\vec{\Phi}$ and $\vec{\Phi}^*$ respectively, which only are distinguished in sign:

$$\nabla'\times\vec{\Phi} = -\frac{i}{c}\frac{\partial\vec{\Phi}}{\partial t} \tag{60}$$

Substituting equation (3A) in the appendix in (60) demonstrates that the Maxwell equations (29A) and (32A) follow straight from the continuity equation (57) [23,p.201]. To transform the electromagnetic vector wave function $\vec{\Phi}$ into a scalar (spinor or 1-dimensional matrix) representation, the Pauli spin matrices are introduced:

$$\sigma_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \sigma_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \tag{61}$$

which matrices are presented by the vector notation $\vec{\sigma}$. The Pauli spin matrices obey the equation:

$$\sigma_a\sigma_b = i\epsilon_{abc}\sigma_c + \delta_{ab} \tag{62}$$

in which ϵ_{abc} is the Levi-Civita tensor whose value is $+1$ or -1 if abc is an even or odd permutation respectively. The electromagnetic vector wave function $\vec{\Phi}$ is transformed into the matrix representation $\tilde{U}$ by the scalar product of the Pauli matrices $\vec{\sigma}$ and the vector wave function $\vec{\Phi}$:

$$\tilde{U} = \vec{\sigma}\cdot\vec{\Phi} = \begin{pmatrix} \Phi_Z & \Phi_x - i\Phi_u \\ \Phi_x + i\Phi_y & -\Phi_z \end{pmatrix} = \begin{pmatrix} u_3 & u_1 \\ u_4 & u_2 \end{pmatrix} \tag{63}$$

For a more common notation in the continuity equation the spinor $\overline{U}$ is presented as:

$$\overline{U} = \begin{pmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \end{pmatrix} = \begin{pmatrix} \Phi_x - i\Phi_y \\ -\Phi_z \\ \Phi_z \\ \Phi_x + i\Phi_y \end{pmatrix} \tag{64}$$

Both sides of equation (60) are multiplied scalar by the Pauli spin matrices:

$$\vec{\sigma} \cdot (\nabla' \times \vec{\Phi}) = -\frac{i\vec{\sigma}}{c} \cdot [\frac{\partial \vec{\Phi}}{\partial t}] \tag{65}$$

From equation (62) it follows that:

$$(\vec{\sigma} \cdot \nabla)(\vec{\sigma} \cdot \vec{\Phi}) = \delta_{ab}(\nabla \cdot \vec{\Phi}) + i\vec{\sigma} \cdot (\nabla \times \vec{\Phi}) \tag{66}$$

Substituting (66) in (65) results in:

$$(\vec{\sigma} \cdot \nabla)(\vec{\sigma} \cdot \vec{\Phi}) - \delta_{ab}(\nabla \cdot P\vec{h}i) = \frac{\vec{\sigma}}{c} \cdot [\frac{\partial \vec{\Phi}}{\partial t}] \tag{67}$$

From (61), (63) and (67) follows the equation:

$$(\vec{\sigma} \cdot \nabla)\vec{U} = \begin{pmatrix} \frac{\partial}{\partial z} & [\frac{\partial}{\partial x} - i\frac{\partial}{\partial y}] \\ [\frac{\partial}{\partial x} + i\frac{\partial}{\partial y}] & -\frac{\partial}{\partial z} \end{pmatrix} \begin{pmatrix} u_3 & u_1 \\ u_4 & u_2 \end{pmatrix} = \begin{pmatrix} y_3 & y_1 \\ y_4 & y_2 \end{pmatrix} \tag{68}$$

in which:

$$\begin{aligned} y_3 &= \frac{\partial u_4}{\partial x} - i\frac{\partial u_4}{\partial y} + \frac{\partial u_3}{\partial z} \\ y_4 &= \frac{\partial u_3}{\partial x} + i\frac{\partial u_3}{\partial y} - \frac{\partial u_4}{\partial z} \\ y_1 &= \frac{\partial u_2}{\partial x} - i\frac{\partial u_2}{\partial y} + \frac{\partial u_1}{\partial z} \\ y_2 &= \frac{\partial u_1}{\partial x} + i\frac{\partial u_1}{\partial y} - \frac{\partial u_2}{\partial z} \end{aligned} \tag{69}$$

Substituting (68) and (69) in (67) results in a matrix presentation for the Maxwell equations (29A) and (32A):

$$\begin{aligned} \frac{\partial u_4}{\partial x} - i\frac{\partial u_4}{\partial y} + \frac{\partial u_3}{\partial z} - \nabla \cdot \vec{\Phi} &= \frac{1}{c}\frac{\partial u_3}{\partial t} && (1) \\ \frac{\partial u_3}{\partial x} + i\frac{\partial u_3}{\partial y} - \frac{\partial u_4}{\partial z} &= \frac{1}{c}\frac{\partial u_4}{\partial t} && (2) \\ \frac{\partial u_2}{\partial x} - i\frac{\partial u_2}{\partial y} + \frac{\partial u_1}{\partial z} &= \frac{1}{c}\frac{\partial u_1}{\partial t} && (3) \\ \frac{\partial u_1}{\partial x} + i\frac{\partial u_1}{\partial y} - \frac{\partial u_2}{\partial z} - \nabla \cdot \vec{\Phi} &= \frac{1}{c}\frac{\partial u_2}{\partial t} && (4) \end{aligned} \tag{70}$$

The Maxwell equations (70) demonstrate an asymmetry in relation to the spatial charge density which is countered by adding and subtracting the equations (70-1), (70-3) and (70-2), (70-4) respectively.

$$\begin{aligned}
&\frac{\partial(u_2+u_4)}{\partial x} - i\frac{\partial(u_2+u_4)}{\partial y} + \frac{\partial(u_1+u_3)}{\partial z} - \nabla\cdot\vec{\Phi} = \frac{\partial(u_1+u_3)}{\partial ct} \quad (1)\\
&\frac{\partial(u_1+u_3)}{\partial x} + i\frac{\partial(u_1+u_3)}{\partial y} - \frac{\partial(u_2+u_4)}{\partial z} - \nabla\cdot\vec{\Phi} = \frac{\partial(u_2+u_4)}{\partial ct} \quad (2)\\
&\frac{\partial(u_2-u_4)}{\partial x} - i\frac{\partial(u_2-u_4)}{\partial y} + \frac{\partial(u_1-u_3)}{\partial z} + \nabla\cdot\vec{\Phi} = \frac{\partial(u_1-u_3)}{\partial ct} \quad (3)\\
&\frac{\partial(u_1-u_3)}{\partial x} + i\frac{\partial(u_1-u_3)}{\partial y} - \frac{\partial(u_2-u_4)}{\partial z} - \nabla\cdot\vec{\Phi} = \frac{\partial(u_2-u_4)}{\partial ct} \quad (4)
\end{aligned} \tag{71}$$

In a charge-free region it follows from (3A), (30A) and (31A) that $\vec{\Phi}(\vec{x},t)$ is divergence-free and the matrix presentation (71) for the Maxwell equations equal the Dirac equation for elementary particles (e.g. photons) with rest mass which equals zero [22,p.351,p.379]. In a charge-free region, $\nabla\cdot\vec{\Phi}=0$ and the Maxwell equations (71) can be rewritten as:

$$\begin{aligned}
&\frac{\partial(u_2+u_4)}{\partial x} - i\frac{\partial(u_2+u_4)}{\partial y} + \frac{\partial(u_1+u_3)}{\partial z} = \frac{1}{c}\frac{\partial(u_1+u_3)}{\partial t} \quad (1)\\
&\frac{\partial(u_1+u_3)}{\partial x} + i\frac{\partial(u_1+u_3)}{\partial y} - \frac{\partial(u_2+u_4)}{\partial z} = \frac{1}{c}\frac{\partial(u_2+u_4)}{\partial t} \quad (2)\\
&\frac{\partial(u_2-u_4)}{\partial x} - i\frac{\partial(u_2-u_4)}{\partial y} + \frac{\partial(u_1-u_3)}{\partial z} = \frac{1}{c}\frac{\partial(u_1-u_3)}{\partial t} \quad (3)\\
&\frac{\partial(u_1-u_3)}{\partial x} + i\frac{\partial(u_1-u_3)}{\partial y} - \frac{\partial(u_2-u_4)}{\partial z} = \frac{1}{c}\frac{\partial(u_2-u_4)}{\partial t} \quad (4)
\end{aligned} \tag{72}$$

The corresponding spinor $\bar{U}_c$ is given by (64):

$$\overline{U}_c = \begin{pmatrix} u_1+u_3 \\ u_2+u_4 \\ u_1-u_3 \\ u_2-u_4 \end{pmatrix} = \begin{pmatrix} \Phi_X - i\Phi_Y + \Phi_Z \\ \Phi_X + i\Phi_Y - \Phi_Z \\ \Phi_X - i\Phi_Y - \Phi_Z \\ -\Phi_X - i\Phi_Y - \Phi_Z \end{pmatrix} \tag{73}$$

Because mass is a relativistic effect of (confined) energy, it is a reasonable suggestion to couple the coordinate system of the electromagnetic energy confinement relativistically to the coordinate system of the observator to introduce the relativistic effects of confined energy, observed as finite rest mass, into the continuity equation (57) or its equivalent, the Maxwell equations (72). It is taken into account that the Maxwell equations (72) describe in principle particles with a rest mass zero (e.g. photons). To derive from (72) the Dirac equation, describing elementary particles with a finite rest mass, a simultaneous particle/anti-particle combination is chosen which particle pair has to satisfy the Maxwell equations (72). This was done before by the relativistic derivation of the Schrödinger equation (56) from the continuity equation (42) and in a comparable way in the following by the derivation of Newton's law (111) from the relativistic radiation pressure derived from (108).

This will be realised by defining the relativistic vector wave function $\Phi(\vec{x}, t)$ in (13), describing the electromagnetic field configuration, which is split up into two parts:

$$\vec{\Phi} = \vec{\Phi}_1 + \vec{\Phi}_2 \tag{74}$$

Equation (74) applies to a monochromatic electromagnetic wave with frequency ω_0 which is observed by an observer with a relative velocity $\vec{v}_G$ with respect to the confined electromagnetic wave. In this relation the function $\vec{\Phi}$ consists of an elementary function $\vec{\Phi}_1$ a relativistic function $\vec{\Phi}_2$ which describes the transformed relativistic part. For the elementary function $\vec{\Phi}_1$ we have the relation:

$$\begin{aligned}\vec{\Phi}_1 = {} & \frac{\gamma\Phi_R}{8}(e^{i\alpha} + e^{-i\alpha})(e^{i\beta} + e^{-i\beta})\vec{e}_H \\ & - \frac{i\gamma\Phi_R}{8}(e^{i\alpha} - e^{-i\alpha})(e^{i\beta} - e^{-i\beta})\vec{e}_E\end{aligned} \tag{75}$$

in which $\Phi_R(\vec{x}', t')$ is a real scalar wave function representing the position and time-dependent amplitude of the electromagnetic wave confinement and β and α are represented by (28) and (29) respectively. The vectors $\vec{e}_H$ and $\vec{e}_E$ are unit vectors in the direction of the magnetic field intensity and the electric field intensity, respectively. For the relativistic function $\vec{\Phi}_2$ we have the relation:

$$\begin{aligned}\vec{\Phi}_2 = {} & \frac{i\gamma\Phi_R}{8c}(e^{i\alpha} + e^{-i\alpha})(e^{i\beta} + e^{-i\beta})\vec{v}_G \times \vec{e}_H \\ & + \frac{\gamma\Phi_R}{8c}(e^{i\alpha} - e^{-i\alpha})(e^{i\beta} - e^{-i\beta})\vec{v}_G \times \vec{e}_E\end{aligned} \tag{76}$$

Assuming a monochromatic electromagnetic wave packet with rest frequency ω_0, for the electric field intensity $\vec{E}(\vec{x}', t')$ according to (22) in the coordinate system of an observer moving at a relative velocity $\vec{v}_G$ with respect to the confined wave, the following relation applies:

$$\vec{E}'(\vec{x}', t') = \frac{\gamma c \Phi_R}{\sqrt{2\epsilon}} [\vec{e}_E \sin(\alpha)\sin(\beta) + \frac{\vec{v}_G \times \vec{e}_H}{c} \cos(\alpha)\cos(\beta)] \tag{77}$$

for the observed electric field intensity and according to (23):

$$\vec{H}'(\vec{x}', t') = \frac{\gamma \Phi_R}{\mu\sqrt{2\epsilon}} [\vec{e}_H \cos(\alpha)\cos(\beta) - \frac{\vec{v}_G \times \vec{e}_E}{c} \sin(\alpha)\sin(\beta)] \tag{78}$$

for the observed magnetic field intensity. When the observer is at rest, relative to the electromagnetic field confinement (77) reduces, using (28) and (29), to:

$$\vec{E}'(\vec{x}', t') = \frac{c\Phi_R(\vec{x}, t)}{\sqrt{2\epsilon}} \sin(\vec{k}\cdot\vec{x})\sin(\omega_0 t)\vec{e}_E \tag{79}$$

and a magnetic field intensity is observed equal to:

$$\vec{H}'(\vec{x}', t') = \frac{\Phi_R(\vec{x}, t)}{\mu\sqrt{2\epsilon}} \cos(\vec{k}\cdot\vec{x})\cos(\omega_0 t)\vec{e}_H \tag{80}$$

To split up the spinor (73) into two parts, describing the part "$+i\omega$" and "$-i\omega$" respectively, equation (74) is rewritten into:

$$\vec{\Phi} = \vec{\Phi}_A + \vec{\Phi}_B \tag{81}$$

In which the vector wave function $\vec{\Phi}_A$ yields the relation:

$$\vec{\Phi}_A = \frac{\gamma\Phi_R}{4}\big[1 + \frac{i\vec{v}_G}{c}\times\big]\big(\cos(\alpha)\vec{e}_H + \sin(\alpha)\vec{e}_E\big)e^{i\beta} = \vec{\Phi}_{RA}e^{i\beta} \tag{82}$$

and the vector wave function $\vec{\Phi}_B$ yields:

$$\vec{\Phi}_B = \frac{\gamma\Phi_R}{4}\big[1 + \frac{i\vec{v}_G}{c}\times\big]\big(\cos(\alpha)\vec{e}_H - \sin(\alpha)\vec{e}_E\big)e^{-i\beta} = \vec{\Phi}_{RB}e^{-i\beta} \tag{83}$$

where $\vec{\Phi}_{RA}$ and $\vec{\Phi}_{RB}$ are real vector functions for the terms $e^{i\beta}$ and $e^{-i\beta}$. From (82) and (83) it follows that the complex vector wave function

$\vec{\Phi}$ can be divided into terms of $e^{i\beta}$ and $e^{-i\beta}$ which has already been reported by Pauli [11]. For the electromagnetic mass distribution of a monochromatic (self-) confined electromagnetic wave it follows from (14) and (81) that:

$$\rho_{em}(\vec{x},t) = (\vec{\Phi}_A + \vec{\Phi}_B)\cdot(\vec{\Phi}^*_A + \vec{\Phi}^*_B) \tag{84}$$

An "$x-y-z$" coordinate system is introduced, which is rotated in such a way that the velocity $\vec{v}_G$ of the observer relative to the confinement is along the z-axis. A linear superposition of confined waves propagating along the z-axis is considered, describing a monochromatic electromagnetic wave-packet. A monochromatic wave packet around frequency ω_0 is considered, which is determined by:

$$\Phi(\vec{x}',t') = \int_{k_0-\Delta k}^{k_0+\Delta k}\int_{\omega_0-\Delta\omega}^{\omega_0+\Delta\omega} \phi(\vec{k}',\omega')e^{i(\vec{k}'\vec{x}'+\omega' t')}d\vec{k}'d\omega' \tag{85}$$

in which $\Phi(\vec{x},t)$ presents the scalar components in (82) and (83) and $\Delta\omega/\omega_0 \ll 1$ as well as $\Delta k/k_0 \leq 1$. The vector function $\vec{\Phi}_Z$ represents the part of the vector wave function describing waves propagating only in the z-direction. From (82) and (83) it follows for the x and y components, under the restriction that the electric field intensity is oriented along the x-axis:

$$\vec{\Phi}_{AZ} = \frac{\gamma\Phi_{RX}}{4}[1+\frac{i\vec{v}_G}{c}\times](\cos(\alpha)\vec{e}_Y + \sin(\alpha)\vec{e}_X)e^{+i\beta} = \vec{\Phi}_{RAX}e^{i\beta}$$

$$\vec{\Phi}_{BZ} = \frac{\gamma\Phi_{RX}}{4}[1+\frac{i\vec{v}_G}{c}\times](\cos(\alpha)\vec{e}_Y - \sin(\alpha)\vec{e}_X)e^{-i\beta} = \vec{\Phi}_{RBX}e^{-i\beta} \tag{86}$$

The vector wave function, describing the confined electromagnetic wave packet equals:

$$\vec{\Phi}(\vec{x}',t') = \vec{\Phi}_{RAX}e^{i\beta} + \vec{\Phi}_{RBX}e^{-i\beta} \tag{87}$$

The observer is moving in positive direction along the z-axis. The coordinate system is oriented in such a way that yields: $\vec{e}_X \times \vec{e}_Y = \vec{e}_Z$. This results in a relation for the relativistic terms in (82) and (83) which equals: $\vec{v}_G \times \vec{e}_H = -v\vec{e}_X$ and $\vec{v}_G \times \vec{e}_E = v\vec{e}_Y$. Substituting (82) and (83) in (87) and using (73) and (3A) results in:

$$\overline{U}_c = \frac{\gamma\Phi_R(\vec{x}',t')}{4}\begin{pmatrix} -i[1+\frac{v}{c}]e^{i(\beta+\alpha)} - i[1+\frac{v}{c}]e^{-i(\beta+\alpha)} \\ i[1-\frac{v}{c}]e^{i(\beta-\alpha)} + i[1-\frac{v}{c}]e^{-i(\beta-\alpha)} \\ -i[1+\frac{v}{c}]e^{i(\beta+\alpha)} - i[1+\frac{v}{c}]e^{-i(\beta+\alpha)} \\ -i[1-\frac{v}{c}]e^{i(\beta-\alpha)} - i[1-\frac{v}{c}]e^{-i(\beta-\alpha)} \end{pmatrix} \tag{88}$$

The A-part in (82) is describing the $e^{i\beta}$ terms and the B-part in (83) describes the $e^{-i\beta}$ terms for the two constituent parts. To describe a particle/anti-particle combination, the spinor in (73) is split up into two parts, presented by (89):

$$\overline{U}_c = \begin{pmatrix} u_1 + u_3 \\ u_2 + u_4 \\ u_1 - u_3 \\ u_2 - u_4 \end{pmatrix} = \overline{V}^+ + \overline{U}^- = \begin{pmatrix} \tilde{u}_1 \\ \tilde{u}_2 \\ \tilde{u}_3 \\ \tilde{u}_4 \end{pmatrix} + \begin{pmatrix} \tilde{u}_3 \\ -\tilde{u}_4 \\ \tilde{u}_1 \\ -\tilde{u}_2 \end{pmatrix} \tag{89}$$

Because new spinor components are created which essentially differ from the original spinor components in (64), these components are indicated by $\tilde{u}$. Combining (73) and (88) defines the way to split up both spinors.

$$\begin{aligned} \overline{U}_c = \overline{V}^+ + \overline{V}^- = & \begin{pmatrix} (\Phi_{ARX} - i\Phi_{ARY} + \Phi_{ARZ})e^{i\beta} \\ (\Phi_{ARX} + i\Phi_{ARY} - \Phi_{ARZ})e^{i\beta} \\ (\Phi_{BRX} - i\Phi_{BRY} - \Phi_{BRZ})e^{-i\beta} \\ (-\Phi_{BRX} - i\Phi_{BRY} - \Phi_{BRZ})e^{-i\beta} \end{pmatrix} \\ & + \begin{pmatrix} (\Phi_{BRX} - i\Phi_{BRY} + \Phi_{BRZ})e^{-i\beta} \\ (\Phi_{BRX} + i\Phi_{BRY} - \Phi_{BRZ})e^{-i\beta} \\ (\Phi_{ARX} - i\Phi_{ARY} - \Phi_{ARZ})e^{i\beta} \\ (-\Phi_{ARX} - i\Phi_{ARY} - \Phi_{ARZ})e^{i\beta} \end{pmatrix} \end{aligned} \tag{90}$$

The spinor (90) is split up into two parts, describing respectively a particle/anti-particle presentation which results into:

$$\overline{U}_c = \frac{\gamma\Phi_R}{4} \begin{pmatrix} -i[1 + \frac{v}{c}]e^{i(\beta+\alpha)} \\ i[1 - \frac{v}{c}]e^{i(\beta-\alpha)} \\ -i[1 + \frac{v}{c}]e^{-i(\beta+\alpha)} \\ -i[1 - \frac{v}{c}]e^{-i(\beta-\alpha)} \end{pmatrix} + \frac{\gamma\Phi_R}{4} \begin{pmatrix} -i[1 + \frac{v}{c}]e^{-i(\beta+\alpha)} \\ i[1 - \frac{v}{c}]e^{-i(\beta-\alpha)} \\ -i[1 + \frac{v}{c}]e^{i(\beta+\alpha)} \\ -i[1 - \frac{v}{c}]e^{i(\beta-\alpha)} \end{pmatrix} \tag{91}$$

By splitting up the spinor [1] into two anti-symmetric parts (anti-symmetric in the arguments α and β, presented by 28 and 29), the Maxwell equations also have to be split up in into the anti-symmetric corresponding parts, with the restriction that the superposition of both spinors and corresponding equations equals the Maxwell equations (72). The Maxwell equation (72) are split up in the following way. The Maxwell equations (72-1) and (72-2) are split up in the Dirac equation with positive time derivatives.

$$\begin{aligned}
&\frac{\partial(\tilde{u}_4)}{\partial x} - i\frac{\partial(\tilde{u}_4)}{\partial y} + \frac{\partial(\tilde{u}_3)}{\partial z} = \frac{1}{c}\frac{\partial(\tilde{u}_1)}{\partial t} && \text{(1-A)}\\
&\frac{\partial(\tilde{u}_2)}{\partial x} - i\frac{\partial(\tilde{u}_2)}{\partial y} + \frac{\partial(\tilde{u}_1)}{\partial z} = \frac{1}{c}\frac{\partial(\tilde{u}_3)}{\partial t} && \text{(1-B)}\\
&\frac{\partial(\tilde{u}_3)}{\partial x} + i\frac{\partial(\tilde{u}_3)}{\partial y} - \frac{\partial(\tilde{u}_4)}{\partial z} = \frac{1}{c}\frac{\partial(\tilde{u}_2)}{\partial t} && \text{(2-A)}\\
&\frac{\partial(\tilde{u}_1)}{\partial x} + i\frac{\partial(\tilde{u}_1)}{\partial y} - \frac{\partial(\tilde{u}_2)}{\partial z} = \frac{1}{c}\frac{\partial(\tilde{u}_4)}{\partial t} && \text{(2-B)}
\end{aligned} \tag{92}$$

The Maxwell equations (72-3) and (72-4) are split up into the Dirac equation with negative time derivatives:

$$\begin{aligned}
&\frac{\partial(\tilde{u}_4)}{\partial x} - i\frac{\partial(\tilde{u}_4)}{\partial y} + \frac{\partial(\tilde{u}_3)}{\partial z} = -\frac{1}{c}\frac{\partial(\tilde{u}_1)}{\partial t} && \text{(3-A)}\\
&\frac{\partial(\tilde{u}_2)}{\partial x} - i\frac{\partial(\tilde{u}_2)}{\partial y} + \frac{\partial(\tilde{u}_1)}{\partial z} = -\frac{1}{c}\frac{\partial(\tilde{u}_3)}{\partial t} && \text{(3-B)}\\
&\frac{\partial(\tilde{u}_3)}{\partial x} + i\frac{\partial(\tilde{u}_3)}{\partial y} - \frac{\partial(\tilde{u}_4)}{\partial z} = -\frac{1}{c}\frac{\partial(\tilde{u}_2)}{\partial t} && \text{(4-A)}\\
&\frac{\partial(\tilde{u}_1)}{\partial x} + i\frac{\partial(\tilde{u}_1)}{\partial y} - \frac{\partial(\tilde{u}_2)}{\partial z} = -\frac{1}{c}\frac{\partial(\tilde{u}_4)}{\partial t} && \text{(4-B)}
\end{aligned} \tag{93}$$

Restricted to (confined) electromagnetic waves propagating along the z-axis, it follows from (21), (28) and (29) that the relations for the time- and spatial derivatives of the spinor components $e^{i\beta}$ and $e^{i\alpha}$ in (91) are:

$$\begin{aligned}
-i\hbar\frac{\partial e^{i\beta}}{\partial t} &= \gamma\omega_0\hbar e^{i\beta} = We^{i\beta}\\
-i\hbar\frac{\partial e^{i\beta}}{\partial z} &= \frac{\gamma\omega_0\hbar v_z e^{i\beta}}{c^2} = \frac{Wv_z}{c^2}e^{i\beta} = p_z e^{i\beta}\\
-i\hbar\frac{\partial e^{i\alpha}}{\partial t} &= \frac{\gamma\omega_0\hbar v_z e^{i\alpha}}{c} = \frac{Wv_z}{c}e^{i\alpha} = cp_z e^{i\alpha}\\
-i\hbar\frac{\partial e^{i\alpha}}{\partial z} &= \frac{\gamma\omega_0\hbar v_z e^{i\alpha}}{c} = \frac{W}{c}e^{i\alpha}\\
\frac{\partial e^{i\beta}}{\partial x} &= \frac{\partial e^{i\alpha}}{\partial x} = \frac{\partial e^{i\beta}}{\partial y} = \frac{\partial e^{i\alpha}}{\partial y} = 0
\end{aligned} \tag{94}$$

Restricted to the conditions of propagation of the (confined) waves in the z-direction, it follows from (94):

$$\begin{aligned} -i\hbar\frac{\partial e^{i(\beta+\alpha)}}{\partial t} &= W[1+\frac{v_z}{c}]e^{i(\beta+\alpha)} \\ -i\hbar\frac{\partial e^{i(\beta-\alpha)}}{\partial t} &= W[1-\frac{v_z}{c}]e^{i(\beta-\alpha)} \\ -i\hbar\frac{\partial e^{-i(\beta+\alpha)}}{\partial t} &= -W[1+\frac{v_z}{c}]e^{-i(\beta+\alpha)} \\ -i\hbar\frac{\partial e^{-i(\beta-\alpha)}}{\partial t} &= -W[1-\frac{v_z}{c}]e^{-i(\beta-\alpha)} \end{aligned} \tag{95}$$

When the observer is at rest relative to the electromagnetic confinement, the time derivative of the spinor $\overline{V}^+$ is considered:

$$\begin{aligned} \frac{4}{c}\frac{\partial\overline{V}^+}{\partial t'} &= \begin{pmatrix} -\frac{i}{c}\frac{\partial(\Phi_R e^{i(\beta+\alpha)})}{\partial t} \\ \frac{i}{c}\frac{\partial(\Phi_R e^{i(\beta-\alpha)})}{\partial t} \\ -\frac{i}{c}\frac{\partial(\Phi_R e^{-i(\beta+\alpha)})}{\partial t} \\ -\frac{i}{c}\frac{\partial(\Phi_R e^{-i(\beta-\alpha)})}{\partial t} \end{pmatrix} \\ &= \begin{pmatrix} -i[\frac{im_E c}{\hbar_E}\Phi_R + \frac{1}{c}\frac{\partial\Phi_R}{\partial t}]e^{i(\beta+\alpha)} \\ i[\frac{im_E c}{\hbar_E}\Phi_R + \frac{1}{c}\frac{\partial\Phi_R}{\partial t}]e^{i(\beta-\alpha)} \\ -i[\frac{-im_E c}{\hbar_E}\Phi_R + \frac{1}{c}\frac{\partial\Phi_R}{\partial t}]e^{-i(\beta+\alpha)} \\ -i[\frac{-im_E c}{\hbar_E}\Phi_R + \frac{1}{c}\frac{\partial\Phi_R}{\partial t}]e^{-i(\beta-\alpha)} \end{pmatrix} \end{aligned} \tag{96}$$

in which the notation m_E denotes an electromagnetic mass. In stationary conditions of the confinement yields $\partial_t\Phi_R = 0$, on which condition substitution of (96) in (93) results in the stationary Maxwell equation for confined monochromatic radiation with rest frequency $\omega_0 = m_E c^2/\hbar_E$:

$$\begin{aligned} \frac{\partial\tilde{u}_4}{\partial x} - i\frac{\partial\tilde{u}_4}{\partial y} + \frac{\partial\tilde{u}_3}{\partial z} + \frac{im_E c}{\hbar_E}\tilde{u}_1 &= 0 \qquad \text{(3-A)} \\ \frac{\partial\tilde{u}_3}{\partial x} + i\frac{\partial\tilde{u}_3}{\partial y} - \frac{\partial\tilde{u}_4}{\partial z} + \frac{im_E c}{\hbar_E}\tilde{u}_2 &= 0 \qquad \text{(4-A)} \\ \frac{\partial\tilde{u}_2}{\partial x} - i\frac{\partial\tilde{u}_2}{\partial y} - \frac{\partial\tilde{u}_1}{\partial z} - \frac{im_E c}{\hbar_E}\tilde{u}_3 &= 0 \qquad \text{(3-B)} \\ \frac{\partial\tilde{u}_1}{\partial x} + i\frac{\partial\tilde{u}_1}{\partial y} - \frac{\partial\tilde{u}_2}{\partial z} - \frac{im_E c}{\hbar_E}\tilde{u}_4 &= 0 \qquad \text{(4-B)} \end{aligned} \tag{97}$$

The non-stationary Maxwell equations for confined monochromatic radiation follows from (96), in which the time derivative is related to the mode fluctuation of the (confined) electromagnetic wave and is expressed by $\partial_t \Phi_R$, which leads to the restriction that the time derivatives in (98) are not operating on the rest frequency ω_0 but only on the relative slow fluctuations expressed by $\partial_t \Phi_R$.

$$\begin{aligned}
&\frac{\partial \tilde{u}_4}{\partial x} - i\frac{\partial \tilde{u}_4}{\partial y} + \frac{\partial \tilde{u}_3}{\partial z} + \frac{i m_E c}{\hbar_E}\tilde{u}_1 + \frac{\partial \tilde{u}_1}{\partial t} = 0 \qquad \text{(3-A)}\\
&\frac{\partial \tilde{u}_3}{\partial x} + i\frac{\partial \tilde{u}_3}{\partial y} - \frac{\partial \tilde{u}_4}{\partial z} + \frac{i m_E c}{\hbar_E}\tilde{u}_2 + \frac{\partial \tilde{u}_2}{\partial t} = 0 \qquad \text{(4-A)}\\
&\frac{\partial \tilde{u}_2}{\partial x} - i\frac{\partial \tilde{u}_2}{\partial y} - \frac{\partial \tilde{u}_1}{\partial z} - \frac{i m_E c}{\hbar_E}\tilde{u}_3 + \frac{\partial \tilde{u}_3}{\partial t} = 0 \qquad \text{(3-B)}\\
&\frac{\partial \tilde{u}_1}{\partial x} + i\frac{\partial \tilde{u}_1}{\partial y} - \frac{\partial \tilde{u}_2}{\partial z} - \frac{i m_E c}{\hbar_E}\tilde{u}_4 + \frac{\partial \tilde{u}_4}{\partial t} = 0 \qquad \text{(4-B)}
\end{aligned} \tag{98}$$

Within the scope of an electromagnetic model of matter, a particle/anti-particle combination is described by the superposition of both Maxwell equations (92) and (93), operating on the superposition of the spinors $\overline{V}^{+}$ and $\overline{V}^{-}$, which equals the Maxwell equation (72). The following matrices are introduced:

$$\overline{\alpha} = \begin{pmatrix} 0 & \vec{\sigma} \\ \vec{\sigma} & 0 \end{pmatrix}$$

$$\overline{\beta} = \begin{pmatrix} \delta_{AB} & 0 \\ 0 & -\delta_{AB} \end{pmatrix} \tag{99}$$

Using (99) and (89): $\overline{V}^{-} + \overline{V}^{+} = \overline{U}_c$, the Maxwell equations (72) are split up in the equations (92), which is presented as:

$$-\frac{1}{c}\frac{\partial \overline{V}^{-}}{\partial t} + \overline{\alpha} \cdot \nabla \overline{V}^{-} + \frac{i m_E c}{\hbar E}\overline{\beta}\,\overline{V}^{-} = 0 \tag{100}$$

and (93), which equals:

$$\frac{1}{c}\frac{\partial \overline{V}^{+}}{\partial t} + \overline{\alpha} \cdot \nabla \overline{V}^{+} + \frac{i m_E c}{\hbar E}\overline{\beta}\,\overline{V}^{+} = 0 \tag{101}$$

in which "m_E" is the total electromagnetic mass of a particle/anti-particle combination, originating from an electromagnetic confinement.

The quantum mechanical (relativistic) Dirac equation [22,p.351] is presented by:

$$\frac{1}{c}\frac{\partial\overline{\Psi}}{\partial t}+\overline{\alpha}\cdot\nabla\overline{\Psi}+\frac{imc}{\hbar}\overline{\beta}\,\overline{\Psi}=0 \tag{102}$$

The summation of (100) and (101) operating on the spinor $\overline{V}=\overline{V}^{-}+\overline{V}^{+}$ equals the Maxwell equation (72) operating on an electromagnetic (monochromatic) confinement with rest frequency $\omega_0=m_E c^2/\hbar_E$.

The description of electro-magnetism employed in this section refers to an earlier idea of Lorentz. Namely the basic idea that the observed relativistic effects of space and time transformations are essentially based on electromagnetic transformations which are in this theory considered as the basic fundamentals of space and time. This implies that the idea of a fundamental aether in this section is not principally excluded. The theory however requires that the rest mass of the hypothetical aether is zero, and that the observed energy has to be described in terms of an aether tension due to an electromagnetic effect, while this tension is represented by a specific local mass density due to an electromagnetic energy density. This implies that in absolute empty space (without the presence of any energy) the aether does not physically exist, but is created by the presence of electromagnetic energy.

The theory requires that the observed aether phenomena do not contradict special or general relativity. This requirement can only be fulfilled by the assumption that observers are essentially made of AEON's (Auto Confined Electromagnetic Entities) combinations, with the observer's own system variables Σ in which the time is determined by the rest frequency ω_0 of the concerned AEON's and space is prescribed by the corresponding rest wavelengths, indicated by $\vec{k}_0$ which transform according to (25). Only in that special circumstance, space and time, as discerned by the observer, are fundamentally supported by electromagnetic effects and the speed of light, described by an electromagnetic effect, will be observed as being independent of the velocity relative to the observer.

Due to the length, this article is split up into 3 sections. The last section 3 will be published in the next edition and describes the possibilities of space-time enclosures on electromagnetic basis, and the theoretical possibilities of Auto Confined Electromagnetic Entities (AEON's).

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