Applied Physics Research; Vol. 8, No. 4; 2016
ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

Generalization of the Particle Spin as it Ensues from the Ether Theory

David Zareski[1]

[1] I.A.I, Yehud, Israel

Correspondence: David Zareski, I.A.I., Yehud, Israel. E-mail: zareski@inter.net.il

Received: April 21, 2015 Accepted: May 6, 2016 Online Published: July 29, 2016

doi:10.5539/apr.v8n4p58 URL: http://dx.doi.org/10.5539/apr.v8n4p58

Abstract

In previous papers we generalized the ether waves associated to photons, to waves generally denoted ξ, associated to $\mathrm{Par}(m,e)$s, (particles of mass m and electric charge e), and demonstrated that a $\mathrm{Par}(m,e)$ is a superposition $\hat{\xi}$ of such waves that forms a small globule moving with the velocity $V_{m,e}$ of this $\mathrm{Par}(m,e)$. That, at a point near to a moving $\hat{\xi}$, the ether velocity $\partial_t\xi$, i.e., the magnetic field **H**, is of the same form as that of a point of a rotating solid. This is the spin of the $\mathrm{Par}(m,e)$, in particular, of the electron. Then, we considered the case where e=0 and showed that the perturbation caused by the motion of a $\mathrm{Par}(m,0)$ is also propagated in the ether, and is a propagating gravitational field such that the Newton approximation (NA) is a tensor G_μ obtained by applying the Lorenz transformation for $\mathbf{V}_{m,0}$ on the NA of the static gravitational potential of forces $G_{\mu,S}$. It appeared that G_μ is also of the form of a Lienard-Wiechert potential tensor A_μ created by an electric charge.

In the present paper, we generalized the above results regarding the spin by showing that the ether elasticity theory implies also that like the electron, the massive neutral particle possesses a spin but much smaller than that of the electron, and that the photon can possess also a spin, when for example it is circularly polarized. In fact, we show that the spin associated to a particle is a vortex in ether which in closed trajectories will take only quantized values.

Résumé. Dans nos précédents articles nous avons généralisé les ondes d'éther associées aux photons en les ondes généralement dénotées ξ associées aux Par(m, e)s, (particules de masse m et de charge électrique e), et démontré qu'une Par(m, e) est une superposition $\hat{\xi}$ de ces ondes, formant un petit globule se mouvant a la vitesse $V_{m,e}$ de cette Par(m, e). Qu'en un point près d'un $\hat{\xi}$, la vitesse $\partial_t\xi$ de l'éther, i.e., le champ magnétique **H** est de la même forme que celle d'un point d'un solide en rotation. Ceci est le spin du Par(m, e) en particulier, de l'électron. Puis nous considérâmes le cas où e=0 et montrâmes que la perturbation causée par le mouvement d'un Par(m, 0) est propagée dans l'éther et est un champ gravitationnel se propageant de telle sorte qu'à l'approximation de Newton (NA), ce champ est un tenseur G_μ obtenu en appliquant la transformation de Lorenz pour $\mathbf{V}_{m_0}$ à la NA du potentiel gravitationnel statique de forces $G_{\mu,S}$. Il apparaît que G_μ est aussi de la forme d'un potentiel tenseur A_μ de Lienard-Wiechert créé par une charge électrique.

Dans le présent article, nous généralisons les ci-dessus résultats en montrant que la théorie de l'élasticité de l'éther implique aussi que comme pour l'électron, la particule massive et neutre possède aussi un spin, mais beaucoup plus petit que celui de l'électron, et que les photons peuvent posséder aussi un spin, quand par exemple le photon est circulairement polarisé. En fait nous montrons que le spin associé à une particule est un vortex dans l'éther qui dans des trajectoires fermées ne pourra prendre que des valeurs quantifiées.

Keywords: The Lagrange-Einstein function, the generalized Lienard-Wiechert potential tensor, the spin of the massive neutral or electrical particle and of the circularly polarized photon, spin and vorticity

1. Introduction

Maxwell and Einstein assumed the existence of an ether, Cf. e.g., Zareski (2001), Zareski (2014). In this context, we showed there, that the Maxwell equations of electromagnetism ensue from the case of elasticity theory where the elastic medium is the ether, of which the field ξ of the displacements is governed by the Navier-Stokes-Durand Cf., e.g., Equation (4) of Zareski (2001), or Equation (1) of Zareski (2014). Then we extended this elastic interpretation to the case where the particles were not only photons, but can also be Par(m,e)s, (particles of mass m and of electrical charge e), that can be submitted to electromagnetic and or a gravitational fields. This extension which is well in accord with Einstein's opinion: ... *the combination of the idea of a continuous field with the* *conception of a material point discontinuous in space appears inconsistent…*was achieved, in Zareski (2013). There we showed that the Lagrange-Einstein function L_G of such a Par(m,e) not only yields the particle four-motion equation, but also leads to the fact that φ, defined by $\hbar\, d\varphi/dt = L_G$, is the phase of a wave $\boldsymbol{\xi}$ [also denoted $\boldsymbol{\xi}(m,e)$ when there is ambiguity], associated to these particles. Such a $\boldsymbol{\xi}$ is a field of the displacement of the points of the ether, i.e., propagated there, and is a solution of an equation that generalizes the Navier-Stokes-Durand equation where now a particle trajectory is a ray of such a wave that generalizes the light ray. Furthermore we showed there, that a specific sum of waves $\boldsymbol{\xi}(m,e)$ forms a globule $\hat{\boldsymbol{\xi}}(m,e)$ that moves like the Par(m, e) and contains all its parameters and that, reciprocally, a wave is a sum of such globules $\hat{\boldsymbol{\xi}}(m,e)$, i.e., of particles. Then we showed that in its motion a $Par(m,e)$, i.e., a $\hat{\boldsymbol{\xi}}(m,e)$ creates a Lienard-Wiechert potential tensor A_μ from which one deduces the electromagnetic field and in particular the magnetic field **H** which, in the elasticity theory is the velocity $\partial_t\boldsymbol{\xi}$ of the ether points, Cf. Equation (6) of Zareski (2001) or Equation (3) of Zareski (2014). Then we demonstrated there that at a fixed observatory point $\mathbf{r}_{ob}$ near at a given instant to the moving electron, i.e., to the moving $\hat{\boldsymbol{\xi}}(m,e)$, the velocity of the ether denoted there by $\partial_t\boldsymbol{\xi}_{ob}$ is of the same form as that of a point of a rotating solid. This phenomenon is the electron spin which, as we showed, in a quantum state of an atom, can take only quantized values.

In the present article, we extend these results to the massive neutral particle and to the photon. It appears that the massive neutral particle possesses also a spin and that the circular polarization of the photon can be understood as an angular momentum that in fact is a spin. More generally, we show that this spin is in fact a vortex in the ether.

2. Notations

We denote by x^μ, ($\mu = 1,2,3,4$), the contravariant four- coordinates of a particle submitted to incident fields, the Greek indices taking the values 1,2,3,4, and the Latin, the values 1,2,3, these last refer to spatial quantities, while index 4 refers to temporal quantities. c denoting the light velocity in "vacuum", one always can impose $x^4 \equiv ct$. The Einstein summation will be used also with the Latin indices. As usual, we denote by $g_{\mu\nu}$ the co-covariant Einstein's fundamental tensor, by ds the Einstein infinitesimal element, by A_μ the Lienard-Wiechert electromagnetic potential tensor, by $\dot{f}$ the quantity defined by $\dot{f} \equiv df/dt$, in particular $\dot{x}^\mu$ denotes the four components of the velocity the particle, the expression for $\dot{s}$ is then $\dot{s} \equiv \sqrt{g_{\mu\nu}\dot{x}^\mu\dot{x}^\nu}$. The Newton approximation (**NA**), is the case where $V << c$.

3. Similitude of the "NA" of the Field Due to a Moving Neutral Massive Particle and the Lienard-Wiechert Field Due to a Moving Electric Charge

3.1 Introduction

The expression for the Lagrange-Einstein function $L_{G,EM}$ of a particle of mass m, of electric charge q and of velocity **V**, submitted only to a Lienard-Wiechert electromagnetic potential tensor A_μ is

$$L_{G,EM} = -mc\sqrt{c^2 - V^2} + qA_\mu\dot{x}^\mu/c. \tag{1}$$

where the expression for A_μ created by an electric charge q_0 of four-velocity $V_{q_0,\mu}$ located at the vectorial distance **R** from q, is, Cf. Equation (28) of Zareski (2014a),

$$A_\mu \equiv -\frac{q_0}{4\pi\varepsilon_0}\frac{V_{q_0,\mu}}{\left(Rc - \mathbf{R}\cdot\mathbf{V}_{q_0}\right)}, \tag{2}$$

in the static case, (1) becomes

$$L_{G,EM} = -mc\sqrt{c^2 - V^2} - \frac{qq_0}{4\pi\varepsilon_0}\frac{1}{r}. \tag{3}$$

On the other hand, the expression for the Lagrange-Einstein function $L_{G,G}$ of a particle of mass m, submitted to only a gravitational field $g_{\mu\nu}$, is

$$L_{G,G} = -mc\sqrt{g_{\mu\nu}\dot{x}^\mu\dot{x}^\nu}. \tag{4}$$

3.2 "NA" of the Lagrange-Einstein Function of a Massive Neutral Particle in a Gravitational Field

The explicit form of $g_{\mu\nu}\dot{x}^\mu\dot{x}^\nu$ is

$$g_{\mu\nu}\dot{x}^{\mu}\dot{x}^{\nu} = g_{\mu\mu}\dot{x}^{\mu}\dot{x}^{\mu} + 2g_{4j}\dot{x}^{4}\dot{x}^{j} + 2\Delta_{i\neq j}\,, \tag{5}$$

where $\Delta_{i\neq j}$ is defined by

$$\Delta_{i\neq j} \equiv g_{12}\dot{x}^{1}\dot{x}^{2} + g_{13}\dot{x}^{1}\dot{x}^{3} + g_{23}\dot{x}^{2}\dot{x}^{3}\,, \tag{6}$$

and $g_{\mu\mu}$ as following

$$g_{\mu\mu} = g_{0,\mu\mu} + \delta g_{\mu\mu}\,, \tag{7}$$

where $g_{0,\mu\mu}$ denotes the free value of $g_{\mu\mu}$. With these notations (5) becomes

$$g_{\mu\nu}\dot{x}^{\mu}\dot{x}^{\nu} = c^{2} - V^{2} + \delta g_{\mu\mu}\dot{x}^{\mu}\dot{x}^{\mu} + 2g_{4j}\dot{x}^{4}\dot{x}^{j} + 2\Delta_{i\neq j}\,, \tag{8}$$

and (4) can be written as following

$$L_{G,G} = -mc\sqrt{c^{2}-V^{2}} - mc\frac{\left(\delta g_{\mu\mu}\dot{x}^{\mu}\dot{x}^{\mu} + 2g_{4j}\dot{x}^{4}\dot{x}^{j} + 2\Delta_{i\neq j}\right)}{2\sqrt{\left(c^{2}-V^{2}\right)}} + \cdots \tag{9}$$

It appears that the "NA" of $L_{G,G}$ denoted then $L_{G,G,NA}$ is

$$L_{G,G,NA} = -mc\sqrt{c^{2}-V^{2}} + mG_{\mu}\,\dot{x}^{\mu}/c\,, \tag{10}$$

where G_{μ} is the tensor defined by

$$G_{4} \equiv -c^{2}\,\delta g_{44}/2 \quad , \quad G_{j} \equiv -c^{2}g_{4j}\,, \tag{11}$$

and that Equations (1) and (10) are of the same form. Therefore, one can suppose that the tensor qA_{μ} plays the same role as the tensor mG_{μ}. This supposition is reinforced by considering that in the static case then $\delta g_{44} = -\alpha/r$, where $\alpha \equiv 2m_{0}k/c^{2}$, and $g_{4j} = 0$, i.e., the expression for $G_{4,S}$, (S for stationary), is

$$G_{4,S} = m_{0}k/r\,. \tag{12}$$

Therefore, in the static case $L_{G,G,NA}$ denoted then $L_{G,G,NAS}$ becomes

$$L_{G,G,NAS} = -mc\sqrt{c^{2}-V^{2}} + m\,m_{0}k/r\,. \tag{13}$$

One sees that Equation (13) is of the same form as Equation (3), and that $-qq_{0}/4\pi\varepsilon_{0}$ and $mm_{0}k$ are equivalent. So, the electrostatic field created by an immobile electric charge, i.e., Coulomb's field, differs from the "NA" of the gravitational field created by an immobile point mass, i.e., from the "NA" of Schwarzschild's field, by only a constant coefficient of proportionality. It appears that:

Electrostatic is of the same form as stationary gravitation where $-qq_{0}/4\pi\varepsilon_{0}$ and $mm_{0}k$ are analogous.

Now, **as shown in Equations (23)-(27) of Zareski (2014a)**, the expression for G_{μ} created by a neutral massive particle of mass m_{0} of covariant four-velocity $V_{m_{0},\mu}$ located at the vectorial distance **R** from m, is

$$G_{\mu} \equiv m_{0}k\frac{V_{m_{0},\mu}}{\left(Rc - \mathbf{R}\cdot\mathbf{V}_{m_{0}}\right)}\,. \tag{14}$$

One sees that G_{μ} is of the same form as the Lienard-Wiechert potential A_{μ}, Cf. Equation (2), therefore G_{μ} will be called: gravitational Lienard-Wiechert potential. It is the gravitational potential field seen at an observation point R_{ob}, due to the particle of mass m_{0} that moves with the velocity $\mathbf{V}_{m_{0}}$, and R is the distance between the position of m_{0} at the time t' where the signal was emitted and reaches the point R_{ob} at the time t such that $\left(t-t'\right)c = R$.

One sees the similarity of the electromagnetic Lienard-Wiechert potential tensor A_{μ} (2) with the gravitational Lienard-Wiechert potential tensor G_{μ} (14), that is the similarity of the electromagnetic Lagrange-Einstein function $L_{G,EM}$ (1) with the "NA" of the gravitational Lagrange-Einstein function $L_{G,G,NA}$ (10).

Since an electric charge possesses also a mass it follows that, in the NA, the expression for the total Lagrange-Einstein function $L_{G,G\,NA,EM}$ of a particle of mass m and electrical charge q submitted to the potential tensors G_μ and A_μ due respectively to m_0 and to q_0, is

$$L_{G,G\,NA,EM} = -mc\sqrt{c^2 - V^2} + \left(qA_\mu + mG_\mu\right)\dot{x}^\mu \big/ c\,. \tag{15}$$

4. Review of the Ether Elastic Property of the Electron Spin

We recall how in Zareski (2014) we demonstrated that the spin of the moving electric charge is due to the ether elastic property. At the observatory point $\mathbf{R}_{ob}$, let consider the electromagnetic field created by a moving electric charge q_0 of velocity $\mathbf{V}_{q_0}$. This field derives from the Lienard-Wiechert potential tensor A_μ for which the expression is given in (2). If **A** denotes the vector of defined by the spatial components of the tensor A_μ, then the expression for the magnetic field **H** created by q_0 is

$$\mathbf{H} \equiv \left(\mathbf{curl\ A}\right)\big/\rho_0\,. \tag{16}$$

where ρ_0 denotes the density of the ether, one remind that ρ_0 is classically called, Cf. Zareski (2001), "coefficient of magnetic induction". On account of Equations (2) and (16) defined here above, and of Equations (63.8) and (63.9) of Landau and Lifshitz (1962), expressed in MKSA units, the explicit expression for $\mathbf{H}$ at the observation point $\mathbf{R}_{ob}$ of distance vector **R** from the charge at the retarded time, is

$$\mathbf{H} = \frac{q_0\mathbf{R}}{4\pi c\rho_0\varepsilon_0 R\left(R - \mathbf{R}\cdot\mathbf{V}_{q_0}/c\right)^3} \wedge \left\{\frac{\left(\mathbf{R} - \mathbf{V}_{q_0}R/c\right)}{\beta^2} + \frac{\mathbf{R}\wedge\left[\left(\mathbf{R} - \mathbf{V}_{q_0}R/c\right)\wedge\dot{\mathbf{V}}_{q_0}\right]}{c^2}\right\}, \tag{17}$$

where $\beta^2 \equiv 1\big/\left(1 - \mathbf{V}_{q_0}{}^2/c^2\right)$, and where $\dot{\mathbf{V}}_{q_0} \equiv d\mathbf{V}_{q_0}\big/dt$. As shown in Zareski (2014), when $\mathbf{R}_{ob}$ is very close to q_0 and then denoted $\mathbf{r}_{ob}$, i.e., where **R**, denoted then **r,** is very small, then at $\mathbf{r}_{ob}$, the expression for **H** denoted then $\mathbf{H}_{ob}$, considering also that $c^2\rho_0\varepsilon_0 = 1$, Cf. Zareski (2014), is the following:

$$\mathbf{H}_{ob} = \rho_{q_0}\mathbf{V}_{q_0} \wedge \mathbf{r}\,, \tag{18}$$

where ρ_{q_0}, for which the expression is

$$\rho_{q_0} \equiv q_0\big/\left(4\pi r^3\right), \tag{19}$$

denotes the volumetric density of electrical charge. Yet, as shown in Zareski (2001, 2014), the magnetic field **H** is the field of the relative velocities $\partial_t\boldsymbol{\xi}$ of the points of the ether, therefore, since at $\mathbf{r}_{ob}$ the expression for $\partial_t\boldsymbol{\xi}$ denoted more specifically by $\partial_t\boldsymbol{\xi}_{ob}$, is

$$\partial_t\boldsymbol{\xi}_{ob} = \rho_{q_0}\mathbf{V}_{q_0} \wedge \mathbf{r}\,, \tag{20}$$

it follows that the velocity $\partial_t\boldsymbol{\xi}_{ob}$ of a point of the ether at $\mathbf{r}_{ob}$, i.e., of a vortex, Cf. Durand (1963), defined by (20), is of the same form as the velocity $\mathbf{V}_\Omega$ of a point on a rotating solid of rotation vector $\boldsymbol{\Omega}$ and of radius r, since $\mathbf{V}_\Omega$ is of the form

$$\mathbf{V}_\Omega = \boldsymbol{\Omega} \wedge \mathbf{r}\,. \tag{21}$$

One sees, by considering (18) and (21), that

$$\rho_{q_0}\mathbf{V}_{q_0} = \boldsymbol{\Omega}\,, \tag{22}$$

that is to say that $\rho_{q_0}\mathbf{V}_{q_0}$ is a rotation vector, on can remark that this vector has the same dimension [1/T] as $[\Omega]$, indeed in Zareski (2012), we have shown that the ether elasticity theory implies that $\dim[\rho_{q_0}] = \dim[1/L]$. Now let us take $r = r_{q_0}$, where r_{q_0} is the radius of q_0, in this case $\boldsymbol{\Omega}$ denotes the spin $\boldsymbol{\Omega}_{q_0}$ of the electrically charged particle. And this is what we wanted to demonstrate, (CQFD). The quantum spin, e.g., of an electron in hydrogenous atom, is treated in Zareski (2014b).

5. The Ether Elasticity Implying that Like the Electron, the Massive Neutral Particle Possesses a Spin but much Smaller

From (1), (10), (2), and (14), it appears that $q_0 q\big/\left(4\pi\varepsilon_0\right)$ and $m_0 mk$ play the same role and as one can verify,

$$\dim\left[q_0 q/(4\pi\varepsilon_0)\right] = \dim\left[m_0 m k\right]. \tag{23}$$

It follows that for the neutral massive particle submitted to gravitation the coefficient which is equivalent to $q_0/(4\pi)$ of (19) is

$$m_0\sqrt{\varepsilon_0 k/(4\pi)}. \tag{24}$$

Therefore, if $A_{G,\mu}$ denotes the gravitational Lienard-Wiechert potential created by m_0 to which is submitted the massive neutral particle of mass m, then, considering (24) and (14), one has

$$A_{G,\mu} \equiv m_0\sqrt{\frac{k}{4\pi\varepsilon_0}}\frac{V_{m_0,\mu}}{\left(Rc - \mathbf{R}\cdot\mathbf{V}_{m_0}\right)} \quad , \tag{25}$$

and by the same reasoning as made in **Sec. IV**, one has, denoting $\mathbf{H}_{G,ob}$ the equivalent of $\mathbf{H}_{ob}$,

$$\mathbf{H}_{G,ob} = \rho_{m_0}\sqrt{4\pi\varepsilon_0 k}\,\mathbf{V}_{m_0}\wedge\mathbf{r}, \tag{26}$$

where ρ_{m_0} is the mass volumetric density of the neutral massive particle defined by

$$\rho_{m_0} \equiv \frac{m_0}{4\pi r^3}. \tag{27}$$

As shown above, $\mathbf{H}_{G,ob}$ is the velocity $\partial_t\boldsymbol{\xi}_{G,ob}$ of the points of the ether at $\mathbf{r}_{ob}$. Therefore, one has

$$\partial_t\boldsymbol{\xi}_{G,ob} = \rho_{m_0}\sqrt{4\pi\varepsilon_0 k}\mathbf{V}_{m_0}\wedge\mathbf{r}, \tag{28}$$

and if we denote $\mathbf{\Omega}_{m_0} = \rho_{m_0}\sqrt{4\pi\varepsilon_0 k}\,\mathbf{V}_{m_0}$, then,

$$\partial_t\boldsymbol{\xi}_{G,ob} = \mathbf{\Omega}_{m_0}\wedge\mathbf{r} \quad . \tag{29}$$

That is, $\rho_{m_0}\sqrt{4\pi\varepsilon_0 k}\mathbf{V}_{m_0}$ denotes a rotation vector, i.e., a spin that plays the same role as the spin $\rho_{q_0}\mathbf{V}_{q_0}$. We show now that for the same velocity the proton spin is much smaller than that of the electron. Indeed, let us compare the coefficients ρ_{q_0} of (19) and $\rho_{m_0}\sqrt{4\pi\varepsilon_0 k}$ of (28) for the same r, that is, let us compare $m_0\sqrt{4\pi\varepsilon_0 k}$ and q_0. If m_0 is the mass of the proton and q_0 is the electric charge of the electron, then, in MKSA units, one has: $m_0 = 1.6\times10^{-27}$, $q_0 = 1.6\times10^{-19}$, $\varepsilon_0 = 8.9\times10^{-12}$, and $k = 7\times10^{-11}$, it follows that $m_0\sqrt{4\pi\varepsilon_0 k} = 5\times10^{-38}$ which is much smaller than $q_0 = 1.6\times10^{-19}$. This shows that the for the same velocity the spin of the electron is very very much greater than the spin of the proton, in fact the proton spin, i.e., the vorticity of the ether that it creates is negligible in front of that of the electron.

6. The Photon Circular Polarization as Identical to a Spin

Let $\mathbf{e}_x$, $\mathbf{e}_y$, $\mathbf{e}_z$ denote the unitary vectors along Resp. the x, y, z axes, and **E** the electrical field of an electromagnetic plane wave propagated along the x axe for which the expression is

$$\mathbf{E} = E\left(\mathbf{e}_y\cos\theta + \mathbf{e}_z\sin\theta\right), \tag{30}$$

where $E \equiv |\mathbf{E}|$, and where the expression for the phase θ is

$$\theta \equiv \omega(-t + x/c). \tag{31}$$

Since the vector potential **A** is related to **E** by the relation $\mathbf{E} = -\partial_t\mathbf{A}$, it follows that

$$\mathbf{A} = (E/\omega)\left(\mathbf{e}_y\sin\theta - \mathbf{e}_z\cos\theta\right). \tag{32}$$

Now, as one can verify

$$curl\mathbf{A} = (E/c)\left(-\mathbf{e}_y\sin\theta + \mathbf{e}_z\cos\theta\right), \tag{33}$$

therefore,

$$\partial_t \boldsymbol{\xi} = \mathbf{H} = (1/\rho_0)\, curl\mathbf{A} = \left[E/(\rho_0 c)\right]\left(-\mathbf{e}_y \sin\theta + \mathbf{e}_z \cos\theta\right). \tag{34}$$

But since, considering (30), $\mathbf{e}_x \wedge \mathbf{E} = E\left(-\mathbf{e}_y \sin\theta + \mathbf{e}_z \cos\theta\right)$, it follows that

$$\partial_t \boldsymbol{\xi} = \mathbf{H} = \left[1/(\rho_0 c)\right]\mathbf{e}_x \wedge \mathbf{E} \tag{35}$$

that can be written

$$\partial_t \boldsymbol{\xi} = \left[\, E/(\rho_0 r c^2)\right]\mathbf{c} \wedge \mathbf{r}\,. \tag{36}$$

Let us show now that the dimension of $\mathbf{E}/(\rho_0 r c)$ is 1/T that is, the vector $\left[\, E/(\rho_0 r c^2)\right]\mathbf{c}$ is a rotation vector $\boldsymbol{\Omega}$. Indeed, as shown in Sec. VI of Zareski (2012), $\dim E = \dfrac{M}{LT^2}$ which implies $\dim \dfrac{E}{\rho r c} = \dfrac{1}{T}$, that is to say that

$$\left[\, E/(\rho_0 r c^2)\right]\mathbf{c} = \boldsymbol{\Omega}\,, \tag{37}$$

and

$$\partial_t \boldsymbol{\xi} = \boldsymbol{\Omega} \wedge \mathbf{r}\,. \tag{38}$$

This shows that the photons created by the moving electron that itself possesses a spin, can possess also a spin this is the case where the photon is circularly polarized. Finally, an EM field is a vibration of the ether, this vibration can be linear, elliptic or circular, in this last case the photon possesses a spin, which in fact is a vortex in the ether.

6. Conclusions

We have shown that like the electron, the massive neutral particle possesses a spin, that the circular polarization of the photon is also a spin, and that the particle spin is in fact a vortex in the ether that in closed trajectories can take only quantized values.

Acknowledgments

I thank Professor Lawrence Horwitz from Tel-Aviv and Bar-Ilan Universities Israel, for his encouragements and his precious counsels.

References

Durand, W. F. (Ed.). (1963). *Aerodynamic Theory*. New York: Dover.

Landau, L. D., & Lifshitz, E. M. (1962). *The classical theory of field*. Pergamon Press.

Zareski, D. (2001). The elastic interpretation of electrodynamics. *Foundations of Physics Letters, 14*(5), 447-469.

Zareski, D. (2012). On the elasto-undulatory interpretation of fields and particles. *Physics Essays*, *25*(2).

Zareski, D. (2013). Fields and wave-particle reciprocity as changes in an elastic medium: The ether. *Physics Essays*, *26*(2), 288-295.

Zareski, D. (2014). The Electron Spin as Resulting From the Ether Elasticity. *Applied Physics Research*, *6*(5), 41.

Zareski, D. (2014a). The ether theory as implying that electromagnetism is the Newtonian approximation of general relativity. *Physics Essays*, *27*(4), 517-522.

Zareski, D. (2014b). The Quantum Mechanics as Also a Case of the Ether Elasticity Theory. *Applied Physics Research*, *6*(4), 48.