The vortical model of magnetic field and the Maxwell's laws

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Abstract. It was shown in the paper that the models of E- and B- fields obtained in a Cold genesis theory (CGT), supposing the kinetics of a flux of E-field's quanta, are compatible with Maxwell's equations by a vortical model of B-field and A- magnetic potential with a uniform speed of the etherono-quantonic vortex –given by heavy etherons ($m_s \approx 10^{-60}$ kg) and ‚quantons' ($m_h = h\cdot 1/c^2 = 7.37\times10^{-51}$ kg), specific in particular to a vortical electron model, with classical spin . The stability of the specific vortex of the electron's magnetic moment was explained by a centripetal force of Magnus type, generated at the quanton's passing through a low frictional etheronic medium. The resulting vortical model of magnetic moment is compatible with a multi-vortical model of electron, with classic quantum volume filled with vortical photons which can explain the Lorentz force as quantum force of Magnus type and a part of the electron's rest energy mc^2 as intrinsic energy. It was argued that these vortical models of magnetic field and of electron are compatible also with the Coulomb's law and with experiments concerning the Aharonov-Bohm effect.

Keywords: Maxwell's laws; electron model; vortical field; Lorentz force; cold genesis

I. Introduction.

Conform to the Sidharth's vortical model of electron [1], the vortex of the electron's mass is extended with a circulation $\Gamma_e(r) = 2\pi rc$, (c-the light's speed) until the limit $r \le r_\lambda = \hbar/m_v c$, explaining classically the electron's spin.

But in the classic electron model of a Cold Genesis Theory of Matter and Fields (CGT-[2-4]), based on the Galilean relativity [5], the electron's mass volume has a classic radius: $r_0 = a = 1.41$ fermi corresponding to e-charge in electron's surface (and close to the value of the nucleon radius resulted from the expression of the nuclear volume: $r_n \approx 1.25 \div 1.4$ fm), and with an exponential variation of its density and of quanta density variation inside the electron's quantum volume, the electron's spin $s_e = \hbar/2$ being given also by a vortex $\Gamma_e^s(r) = 2\pi rc$, extended until the limit $r \le r_\lambda = \hbar/m_v c$, (the Compton radius), but given by a total spinorial mass $m_s = m_e$ of light vector photons ($m_v \approx 10^{-40}$ kg [2-4]) which do not contribute to the electron's inertial mass- being weakly linked on it, conform to the same classic relation:

$$s_e = \Sigma m_{f\cdot}(\omega\cdot r)\cdot r \;= 4\pi\int r^2\rho_e(r)c\cdot r dr \approx \tfrac{1}{2} m_s\cdot c\cdot r_\lambda = \hbar/2\,, \quad (\omega\cdot r = c;\;\; a \le r \le r_\lambda = \hbar/m_e c;\; m_s \approx m_e), \tag{1}$$

specific to a spherical distribution of the m_f –photons: $\rho_e(r) = \rho_e(r)(r_0/r)^2$, an identical value, $\hbar/2$, being obtained also for a cylindrical distribution of photons in a volume of Compton radius $r_\lambda = \hbar/m_e c$ and high $l_a = 2a$, [2-4].

-The particle's magnetic moment μ_e^* results in CGT as etherono-quantonic vortex : $\Gamma^*_\mu(r) = \Gamma_A + \Gamma_B$, of heavy („sinergonic") etherons ($m_s \approx 10^{-60}$ kg)- generating the magnetic potential **A** and of ‚quantons' ($m_h = h\cdot 1/c^2 = 7.37\times10^{-51}$ kg, [6]) - generating vortex-tubes $\boldsymbol{\xi}_\mathbf{B}$ that materializes the **B**-field lines of the magnetic induction.

Conform to a classic vortical model of electron [2-4], its e-charge and its E-field are given by a flux of quanta: $\phi_E = \rho_c c^2$ of an homogenous E-field, generated vortically (figure 1, a), the intensity **E** of this field resulting in vacuum by the impulse of the light vector photons ('vectons' [2-4]), $\Sigma p_E = \Sigma\rho_c c$, according to relation: $E = k_1\rho_c c^2$.

If the electron has an impulse $\mathbf{p}_m = m\mathbf{v}_p \,||\, \mathbf{y}$, then the quanta that generate the component $\mathbf{E_x}$ have also an impulse density: $\mathbf{p}_H = \rho_c\mathbf{v}_p$ (parallel with the particle's impulse – figure 1, b) which generates a magnetic H_z -field with the induction given by:

$$\mathbf{B}_z = k_1\rho_c v_p\cdot\mathbf{u}_z = (1/c^2)\mathbf{v}_p \mathrm{x} \mathbf{E_x}\,, \quad (E = k_1\rho_c c^2\,;\; |\mathbf{u}_z| = 1), \tag{2}$$

conform to the basic relations of the electromagnetism, k_1 being a proportionality constant whose value is given by the equality between the electrostatic energy and the kinetic energy of E-field's quanta at the electron's surface:

$$\tfrac{1}{2}\rho_c(a)c^2 = \tfrac{1}{2}E(a)/k_1 = \tfrac{1}{2}\varepsilon_0 E^2(a)\ ,\ \Rightarrow\ k_1 = 1/\varepsilon_0 E(a) = 4\pi a^2/e = 1.56\times10^{-10}\ \mathrm{m^2/C},\ [2\text{-}4], \quad (3)$$

(a – 1.41 fm- classic radius of the electron, corresponding to the e- charge in the electron's surface).

The expressions of E-field and of B-field are obtained in CGT [2-4] by the expression of the force generated when a flux ϕ_E of quanta interacts elastically with the surface $S = \tfrac{1}{2}S^0$ of a charge or pseudo-charge $e_s = S^0/k_1$, ($S^0 = 4\pi a^2$), having a speed $\mathbf{v}_0 = \mathbf{v}_p\cdot\cos\theta \perp \mathbf{E}$, according to the impulse density theorem: $F_i = \int \Pi_{ik}\cdot dS_k$; $\Pi_{ik} = P_c\cdot\delta_{ik} + \rho_c(\mathrm{v_i}\cdot\mathrm{v_k})$, $(\delta_{ik} = (\mathrm{n_i n_k}) = \mathrm{n_j};\ \ \mathrm{dS_k} = n_k dS)$:

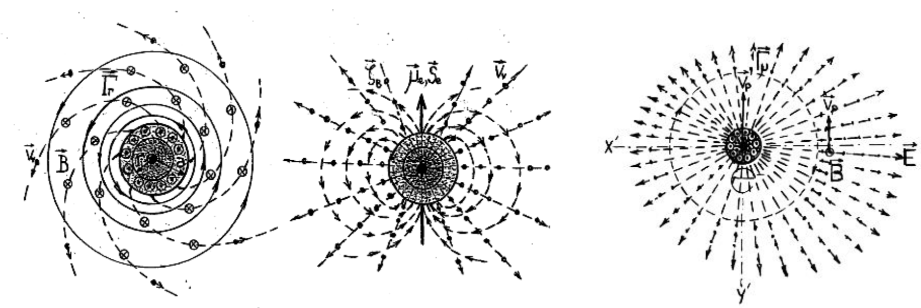
$$F_i = m_p a_i = \int \Pi_{ik}\cdot dS_k = \frac{S^0}{k_1}\left(k_1\rho_c \mathrm{v_c^2} + k_1\rho_c \mathrm{v_c v_0}\right)n_i = \mathrm{q_s}\left(E_i^0 + B_j\cdot \mathrm{v_0}\right) = F_i^0 + F_i^l\ ; \qquad \mathrm{v}_{\mathrm{c}} \cong c \quad (4)$$

With $\rho(r) = \rho_c(r)$, (density of E-field's quanta) and with $\mathbf{v} = \mathbf{v}_{p}||\mathbf{y}$, for the case conform to figure 1, the continuity equation can explain microphysically, by Eq. (2), also another known basic relation of the electromagnetism:

$$\frac{1}{c^2}\frac{k_1\partial\rho_c(r)c^2}{\partial t} = -\partial_y\left(k_1\rho_c(r)\cdot \mathrm{v_p}\right) = -\partial_y \mathrm{B_z}\ ;\ (\partial_z \mathrm{B_y} = 0)\ \Rightarrow\ \ \frac{1}{c^2}\frac{\partial \vec{E}}{\partial t} = \vec{\nabla} x \vec{B} \quad (5)$$

$\mathrm{v_p} = -\mathrm{v_c}$ being in this case the speed of the vector photons of the E-field in report with the quantons of the quantum vacuum in which they induce quantonic vortex-tubes that 'concretizes' the magnetic field's lines, $\boldsymbol{\xi}_\mathbf{B}$, ($\mathbf{v}_c$ - the relative speed of the quantons related to the E-field's quanta, considered as pseudo-radially emitted).

It results also from Eqs. (2) and (3) that: $\rho_c(a) = E(a)/k_1c^2 = \mu_0/k_1^2 = 5.17\times10^{13}\ \mathrm{kg/m^3}$.



a) ***b)***

***Fig. 1**, a)* classic model of electron [6], with photons rotated by the quantum vortex Γ_μ and giving its rest energy and its E-field; b) the B-field generating by an e-charge with a $\mathrm{v_p}$- speed.

In the early 1860s, inspired by Kelvin's suggestion that magnetism must have some sort of rotational origin, Maxwell extended Kelvin's fluid flow analogy for electrostatics and used a 'sea' of ether vortices to model Faraday's lines of force and derive the equations of electromagnetism [7]. He told: "We have therefore warrantable grounds for inquiring whether there may not be a motion of the ethereal medium going on wherever magnetic effects are observed, and we have some reason to suppose that this motion is one of rotation, having the direction of the magnetic force as its axis." Its vertical model supposed a vortex with uniform angular speed of an ideal ethereal medium.

Although Maxwell subsequently discarded this heuristic model, he retained the mathematical analogy between the equations of the electromagnetic field and vortex dynamics [8–10]. In 1867, encouraged by Maxwell's success with vortex models, Kelvin exploited Helmholtz's observation that vortex rings in an incompressible frictionless fluid would be permanent and could not be destroyed, proposing a vortical atom model.

We can show that the CGT's model of E- and B- fields generating is compatible with a vortical model of B-field and A- magnetic potential but with a uniform speed of the etherono-quantonic vortex (instead of uniform angular velocity of an ethereal medium- as in Maxwell's model), specific in particular to a vortical electron model, with classical spin s generated conform to Eq. (1).

2. The explaining of the Maxwell's laws by a vortical model of electron

For a classic model of electron, the **B**-field results –conform to a vortical model [2-4] , by taking in eq. (4): $v_c = v_\omega$, with: $\mathbf{v}_\omega(r) = \mathbf{\Omega}(r) x \mathbf{r}$ - the local speed of quanta in the quantonic vortex of its magnetic moment μ_e having the circulation $\Gamma_\mu(r) = 2\pi r \cdot v_\omega(r)$, (figure 1), with $v_\omega \approx c$ for $r \le r_\lambda = \hbar/m_e c$, which – by the gradient of the impulse density of this $\mathbf{\Gamma}_\mu$ -vortex: $\nabla_r(\rho_c(r)v_\omega)$, generates quantonic vortex-tubes $\boldsymbol{\xi}_\mathbf{B}$, around 'vectons' of the **E**-field (whose inertial mass m_v induces the vortex-tube $\boldsymbol{\xi}_\mathbf{B}$ which 'concretizes' a **B**-field's line, as in fig. 1,a, the $\mathbf{\Gamma}_\mu$ -vortex being induced by etherono-quantonic winds, conform to the used model)).

With $\rho = \rho_c$ –the density of 'quantons' by the continuity equation used in Eq. (5) and with $\mathbf{B} = \nabla x \mathbf{A}$ one obtain another law of the electromagnetism: $\mathbf{E} = -\partial\mathbf{A}/\partial t = -\mathbf{v_B} x \mathbf{B}$ in the next way:

-Considering an etherono-quantonic vortex of circulation: $\mathbf{\Gamma}_z = 2\pi \mathbf{r}\cdot\mathbf{v}_\omega$ with $p_{sv} = \rho_{sv}v_\omega = \rho_c v_\omega = p_c$ for $r \le r_\mu = \hbar/mc$, (i.e. the same impulse density on a vortex line $l_r = 2\pi r$ for $\mathbf{\Gamma}_\mu$ and $\mathbf{\Gamma}_A$), using the Stoke's theorem the magnetic induction **B** and the **A**-potential have the form :

$$\mathbf{B}_z = k_1\rho_c v_\omega\cdot\mathbf{u}_z \,;\ \int_\Gamma A dl = \int_S(\nabla x A)dS, \Rightarrow\ 2\pi r A = (\nabla x A)\pi r^2; \qquad (6)$$

$$\Rightarrow\ A_\omega = \tfrac{1}{2}(\nabla x A)\cdot r = \tfrac{1}{2}B_z\cdot r = \tfrac{1}{2}k_1\rho_c v_\omega\cdot r = \tfrac{1}{2}k_1 p_c\cdot r \quad ;$$

In the same time, a similar equation results by the Stoke's theorem used for v_ω, p_c, i.e.: $\mathbf{\Gamma}_z = 2\pi\mathbf{r}\cdot\mathbf{v}_\omega = (\nabla x \mathbf{v}_\omega)\pi r^2$, resulting that:

$$\mathbf{v}_\omega = \tfrac{1}{2}(\nabla x \mathbf{v}_\omega)\cdot r = \mathbf{\Omega}(r) x \mathbf{r}\,,\ \text{and:}\ 2\pi\mathbf{r}\cdot\mathbf{p_c} = (\nabla x \mathbf{p}_c)\pi r^2, \Rightarrow \mathbf{p}_c = \tfrac{1}{2}(\nabla x \mathbf{p}_c)\cdot r \qquad (7)$$

In this case, $\mathbf{\Omega}(r) = \tfrac{1}{2}\boldsymbol{\omega}(r) = \tfrac{1}{2}\nabla x \mathbf{v}_\omega$ represents the angular velocity vector at r-distance of the $\mathbf{\Gamma}_\mu$ -vortex's center.

We can deduce also that the static ('cold') electron is pseudo-cylindrical, the spherical distribution of the E-field's quanta around the electron's mass resulting by the electron's spin precession.
In this case, we have an impulse density variation in the $\mathbf{\Gamma}_\mu$ -vortex: $p_c = \rho_c v_c \sim r^{-1}$ because $\rho_c \sim r^{-1}$ and $v_c \approx c$.

For a cylindrical section of a thickness approximated to the value $\delta r = 2d_v$ with $d_v < 1$ fm- the vecton's diameter, the variation: $p_c \sim r^{-1}$ is equivalent with the considering a mean density $\rho_c(r_n)$ –constant to the interval δr and a mean speed $v_c = v_\omega \approx c$ but given conform to: $\mathbf{v}_\omega = \tfrac{1}{2}(\nabla x \mathbf{v}_\omega)\cdot r = \mathbf{\Omega}(r) x \mathbf{r}$ with $\mathbf{\Omega}(r) = \tfrac{1}{2}\boldsymbol{\omega}(r)$ –constant to the interval δr, i.e.: $\mathbf{\Omega}(r) = \mathbf{\Omega}(r_n) = \mathbf{\Omega}_r$, ($r_n = n\cdot\delta r = 2nd_v$), $\boldsymbol{\omega}(r) = \boldsymbol{\omega}(r_n) = \nabla x \mathbf{v}_\omega$ representing the corresponding vorticity, in this case.

With $\rho_c(r) = \rho_c(r_n)$, (the mean density considered as constant to the interval δr but variable with $r_n = n\cdot\delta r$), the expression (6) of the **A**-potential verify the equation $\mathbf{B} = \nabla x \mathbf{A}$ **,** i.e.:

$$\mathbf{B}_z = k_1\rho_c v_\omega\cdot\mathbf{u}_z = k_1\rho_c(\mathbf{\Omega}\cdot r) = \tfrac{1}{2}k_1\rho_c(\nabla x \mathbf{v}_\omega)\cdot r\,;\quad (r = r_n,\ \rho_c = \rho_c(r_n);\ |\mathbf{u}_z| = 1), \Rightarrow \mathbf{B} = \nabla x \mathbf{A}. \qquad (8)$$

or, equivalently, by (7):

$$\mathbf{B}_z = k_1 p_c\cdot\mathbf{u}_z = \tfrac{1}{2}k_1(\nabla x \mathbf{p}_c)\cdot r\,;\quad (p_c = p_c(r)), \Rightarrow \mathbf{B} = \nabla x \mathbf{A}\,;\ (\mathbf{A} = \tfrac{1}{2}k_1\mathbf{p}_c\cdot r\,;\ |\mathbf{u}_z| = 1) \qquad (9)$$

The fact that the B-field's generating depends on $\mathbf{p}_c = \rho_c\mathbf{v}_\omega = \rho_c(\mathbf{\Omega} x \mathbf{r}) = \tfrac{1}{2}\rho_c(\nabla x \mathbf{v}_\omega) x \mathbf{r}$, is concordant with the conclusion that a **B**-field line $\boldsymbol{\xi}_\mathbf{B}$ corresponds to a quantonic vortex-tube ($\boldsymbol{\omega}_\xi = \nabla x \mathbf{v}_\xi \neq 0$) generated by the gradient: $\nabla_r p_c = \nabla_r(\rho_c v_\omega)$, as in an ideal fluid.

If ρ_c is variable by the generating of a radial flux ϕ_r^s of etherons and quantons having a radial speed $v_r \perp v_\omega$, ϕ_r^s –flux being equivalent with a sum: $\phi_r^s = \phi_x^s + \phi_y^s$, according to the continuity equation (5) it results that:

$$\frac{\partial A}{\partial t} = -\nabla\,(A\cdot v) = -[\partial_x\left(\tfrac{1}{2}k_1 p_c\cdot r_x\cdot v_x\right) + \partial_y\left(\tfrac{1}{2}k_1 p_c\cdot r_y\cdot v_y\right)] = -k_1 p_c\cdot v_r = E_r\,,$$

$$\Rightarrow -\frac{\partial A}{\partial t} = E_r = k_1 p_c(r)\cdot v_r = k_1\rho_c(r)\cdot v_\omega\cdot v_r = B_z\cdot v_r\,;\quad (\text{if } v_\omega = v_r = c, \Rightarrow\ E = k_1\rho_c(r)\cdot c^2) \qquad (10)$$

with: $v_x = v_y = v_r$ – constant; $v_\omega \approx c$; $r_x = r_y = r$; $\partial_x = \partial/\partial x$. The resulted $\mathbf{E}_r$ –field is equivalent with that generated by the displacing of the vector **B** with the speed $\mathbf{v}_B = -\mathbf{v}_\omega \perp \mathbf{B}$, i.e.: $\mathbf{E} = \mathbf{v}_\omega x \mathbf{B} = -\mathbf{v}_B x \mathbf{B}$.

Equation: $E = -\partial A/\partial t$, indicates that an E-field can be generated also only vortically, explaining and the Maxwell-Faraday eq.:

$$\nabla x\mathbf{E} = -\nabla x(\partial \mathbf{A}/\partial t) = -\partial(\nabla x\mathbf{A})/\partial t = -\partial\mathbf{B}/\partial t, \qquad (11)$$

The expression: $E = k_1\rho_c v_\omega v_r$, specific to Eqs. (10), (11), is concordant with that of Eq. (4).
Also, because from the Coulomb's law it results that $\nabla\cdot\mathbf{E} = \rho_e/\varepsilon_0$, applied to a charge density ρ_e which generates an electric current density: $\mathbf{j}_e = \rho_e\mathbf{v}_e$, By the continuity equation, Eqs. (2), (5) and (6) give:

$$\partial\rho_e/\partial t = \nabla j_e = \partial(\nabla\cdot\mathbf{D})/\partial t = \varepsilon_0\nabla(\partial E/\partial t) = (1/\mu_0)\nabla(\nabla x\mathbf{B}); \Rightarrow \nabla x\mathbf{B} = \mu_0\cdot\mathbf{j}_e , \qquad (12)$$

In the case of a stationary m-particle with e-charge having a spherical distribution of E-field's quanta and μ_z - magnetic moment given by a quantonic vortex of density $\rho_h(r) \sim r^{-2}$ and circulation: $\Gamma_\mu = 2\pi r\cdot v_\omega$, with: $v_\omega = c$ for $r \leq r_\mu = \hbar/mc$ [2-4] and $v_\omega = c\cdot(r_\mu/r)$ for $r > r_\mu$, the induced B-field has the value: $B = k_1\rho_h v_\omega$, (as in the case of the E- field's quanta rotation with $v_v = -v_\omega$), for $r > r_\mu$ resulting the classic relation:

$$B_z(r) = k_1(\rho_h\cdot v_\omega)_r = k_1\rho^a(a)\frac{a^2}{r^2}\frac{r_\mu c}{r} = k_1\frac{\mu_0}{k_1^2}\frac{r_\mu a^2}{r^3}c = \frac{\mu_0}{2\pi r^3}\frac{ecr_\mu}{2} = \frac{\mu_0}{2\pi}\frac{\mu_z}{r^3} \qquad (13)$$

where $\rho_h(r) = \rho_c(r) = \rho(a)\cdot(a/r)^2$, conform to eq. (2). For $r \leq r_\mu$, it results: $B_z(r) = E_r(r)/c$.

It results in consequence that the Maxwell's equations are concordant with a vortical model of electron in the sense that they can be explained also microphysically by the expressions of E- and B- fields resulted in CGT applied to the used vortical model of electron .

The previous conclusions are in concordance with the explanation given to the known Faraday paradox [11] by the conclusion that the magnetic field's lines do not rotate with the magnet, indicating that the B-field' 'lines' are formed as vortex- tubes of fine quanta, (i.e.-from the energy of the quantum vacuum) and argue the existence of the electron's vorticity.

It results also that the shape of the electron's super-dense kernel that favorizes the electron's magnetic moment forming and its precession movement is a cylindrical one, with a possible spiral form.

It is deductible from the model that even the electron's mass m_e is probably rotated with a speed $v = \omega\cdot r \rightarrow c$.

3. The stability of the electron's magnetic moment

Similarly to the case of a light vector photon (vecton [2-4]) of a pseudo-scalar light photon considered in a revised Munera vortical model [12], in the case of a vortical electron, the stability of the etherono-quantonic vortex $\mathbf{\Gamma}_\mu$ of the electron's magnetic moment can be explained as being given by etherono-quantonic winds of the quantum vacuum omnidirectionally distributed and having the mean speed c, the vortex Γ_μ corresponding by eq. (1) to a spinorial mass $m_s = \Sigma m_h$ equal to its inertial mass $m_e = \upsilon_e\rho_e$ of its kernel (confined in a dense volume υ_v), but which do not contribute to this inertial mass, (the vortexed quantons being weakly linked).

If ρ_{sv} is the density of 'heavy' etherons giving the magnetic potential A by an etheronic vortex $\mathbf{\Gamma}_A$, because the etherons must be tachyonic for explain the photon's blueshift in a gravitational field by an etheronic model of the Gravitation, of Fatio-LeSage type [13], i.e with a speed $w \approx \sqrt{2}c$, [2-4], the magnetic potential A can be expressed by Eq. (6) in the form:

$$A_\omega = \tfrac{1}{2}k_1\rho_c v_\omega\cdot r = \tfrac{1}{2}k_1\cdot\rho_{sv}w_\omega\cdot r \text{ with: } w_\omega \approx \sqrt{2}c ; \Rightarrow \rho_{sv}(r) = \rho_c(r)/\sqrt{2} \qquad (14)$$

The stability of the electron's vortex Γ_μ^e of its magnetic moment μ_e can be explained in this case as follows:

-For a cylindrical quantonic vortex $\Gamma_c(r_c) = 2\pi rc$ of quantons with mass m_h and radius r_h , a small etheronic vortex of lenght $l_h = 2r_h$ is induced around the quanton's kernel with the circulation $\Gamma_h(r_h) = 2\pi r_h v_h$ ($v_h = k_\omega c$; $0.5 \leq k_\omega \leq 1$) by the etheronic low frictional medium with density $\rho_s(r)$ in which the quantons have the c-speed generated by an etheronic (‚sinergonic' [2-4]) (pseudo)vortex $\mathbf{\Gamma}_a = 2\pi rw$, ($w = \gamma\cdot\sqrt{2}c$; $\gamma \rightarrow 1$ –eq. (14)).

The dynamic equilibrium for the vortexed quantons (or/and clusters of quantons) inside the electron's Compton radius: $r_\lambda = r_\mu = \hbar/m_e c$ is given by a pseudo-magnetic force of Magnus type, acting over the m_h -quantons circulated with the speed $\omega\cdot r = v_\omega = c$ on the vortex line $l_r = 2\pi r$ inside the low frictional etheronic medium, increased around the electron's centroid with radius r_0 by the $\mathbf{\Gamma}_a$ –vortex and having a linear variation of its density, $\rho_s(r) \sim r^{-1}$, i.e. :

$$F_{sl} = 2r_h \cdot \Gamma_c(r_h) \cdot \rho_s(r) \cdot c = 4\pi \cdot r_h^2 k_\omega \cdot c^2 \cdot \rho_s^0 \cdot (r_0/r) = m_h c^2/r = F_{cf} \quad (15)$$
$$r \leq r_\mu; \quad (\rho_s(r) = \rho_s^0 \cdot (r_0/r));$$

with: m_h –the quanton' mass; r_h –the quanton' radius; ρ_s^0- the density of sinergons at the surface of the electron's centroid of radius $r_0 \leq 10^{-18}$ m, [14] ; $\Gamma_h(r_h) = 2\pi v_\omega r = 2\pi c k_\omega r$ - the circulation of sinergons at the quanton's surface, (induced by $\nabla_r \rho_s(r)$ and maintained by etheronic winds).

So, this dynamic equilibrium (15) is realized by the condition: $4\pi r_h^2 k_\omega \rho_s^0 \cdot r_0 = m_h = h/c^2$ -constant, resulted from (15) by considering also the quanton as cylindrical, of lenght $l_h = 2r_h$ and density ρ_h .

With the value from CGT [4] for the ratio: $k_h = 2\pi r_h^2/m_h = 27.4$, ($r_h = 1.79 \times 10^{-25}$m, [4]), from Eq. (15) it results:

$$\rho_s(r) k_\omega \cdot r = \rho_s^0 k_\omega r_0 = m_h/4\pi r_h^2 = 1/2k_h = 1.825 \times 10^{-2} \text{ [kg/m}^2\text{]}. \quad (16)$$

The Γ_h- vortex of the quanton is explained- in consequence, by the gradient $\nabla p_s = \nabla \rho_s(r) c$ of the relative impulse density p_s .

A similar gradient, $\nabla \rho_{sv}(r) w$, of the $\mathbf{\Gamma}_a$ –vortex, generates a Γ_h- vortex to pseudo-stationary quantons which are attracted toward the vecton's center.

The quanton's c-speed can be maintained by an dynamic equilibrium of etheronic pressure forces F^t on the tangent direction, of Stokes type ($F^t \sim v$), given by the $\mathbf{\Gamma}_a$ –vortex having a density $\rho_{sv}(r)$ and by the density $\rho_s(r)$ which generates a drag force $F_r^t = F_a^t(r)$, at equilibrium:

$$\rho_{sv}(r) \cdot (w - c) = \rho_s(r) \cdot c; \quad (w \approx \sqrt{2}c), \Rightarrow \rho_{sv}(r) \approx \rho_s(r)/(\sqrt{2}-1), \quad (17)$$

Particularizing for the case of the electron's magnetic moment vortex, Γ_μ^e, for which CGT [2-4] gives a density: $\rho_c(a) = \rho_\mu(a) = \rho_e(a) = \mu_0/k_1^2 = 5.17 \times 10^{13} kg$, (a = 1.41 fm), and using the formula: $B = k_1 \rho_c v_v$ for the electron's B-field, with $v_\omega = c$ for $r \leq r_\mu$, by the expression (14) of the magnetic potential A_ω and by Eq. (16) it results that:

$$\rho_{sv}(a) = \rho_c(a)/\gamma\sqrt{2} \approx \rho_c(a)/\sqrt{2}; \quad \Rightarrow \quad \rho_s(a) \approx \rho_c(a)(1-1/\sqrt{2}) = 1.825 \times 10^{-2}/k_\omega a \quad (18)$$

With $w = \sqrt{2}c$, ($\gamma = 1$), and $\rho_c(a) = \mu_0/k_1^2 (CGT)$, conform to eq. (18) it results: $\rho_s(a) = 0.29\rho_c(a) \approx 1.5 \times 10^{13}\ kg/m^3$ and: $k_\omega \approx 0.86$, ($v_h \approx 0.86c$). With the value $r_0 \approx 10^{-18}$ m used in CGT (corresponding to an electronic centroid of mass $0.5 \times 10^{-4}\ m_e$ and density $\rho^0 \approx 10^{19}$ kg/m^3 [2-4]) by eq. (16) we obtain: $\rho_s^0 \approx a \cdot \rho_s(a)/r_0 \approx 2.1 \times 10^{16}\ kg/m^3$, (with one size order of magnitude lower than the nucleon's density: $\sim 4 \times 10^{17}$ kg/m^3).

The Magnus force F_{sl} results from an attractive potential $V_{sl}(r)$ that equilibrates the centrifugal potential: $V_{cf}(r) = ½ m_h c^2$.

A similar quantum force, of Magnus type, can explain also the maintaining of the vortex $\Gamma_e(r)$ of light vector photons which explains the maintaining of the electron's spin s_e in concordance with Eq. (1).

It can be shown also that- for a light vector photon (‚vecton', [2]) with $v_v = c$ and with $n = n_h$ quantons, ($m_v = n \cdot m_h$), the total potential: $Q_a = \sum_n V_{sl}(r) = -Q_c = \sum_n V_{cf}(r)$ corresponds to the Bohm's potential [15]: $Q = -(\hbar^2/2m)(\Delta\sqrt{\rho_m}/\sqrt{\rho_m})$, obtained by : $\rho_m = m \cdot R^2 = m\,|\psi|^2$, as in the Bohm's interpretation of the amplitude R of the wave function : $\psi = R \cdot e^{i(kx - \omega t)}$, with: $R = e^{-\varepsilon/2k} = e^{-S/\hbar}$, ($\varepsilon = -k_b \ln R^2$ –the associated entropy, k_b being the Boltzmann constant) and S –the vecton's total action ($\nabla S(c) = m_v c$; $\hbar = h/2\pi$;

For the centrifugal potential, Q_c , R is of complex form: $R_c = e^{i\theta} = e^{-\varepsilon_i/2k}$, with $\nabla \varepsilon_i/k_b = 2i \cdot \nabla S/\hbar$.

By expressing the centrifugal potential in the form: $Q_c = k_b T_i$, with $T_i = iT_r$ (T_r -the internal quantum temperature corresponding to the transforming of the vortical dynamic pressure associated to a negentropy into static pressure associated to a real entropy), it corresponds to a negentropy $\varepsilon_i = i \cdot \varepsilon = iQ_c/T_i = i \cdot k_b$, ($i = \sqrt{-1}$).

Because the total vecton's negentropy is related to the total action S_h of the quantons rotated on the vortex-line $l_r = 2\pi r$, i.e.: $S_h = \Sigma_n \delta S_h = \gamma_i . s_v = \gamma_i . (½ m_s \cdot c \cdot r_\lambda) = \gamma_i . \hbar/2$, ($s_v$ – the vecton's spin; γ_i – proportionality constant), by a relation of de Boglie's type ($\varepsilon/k_b \sim S/\hbar$, [16]) generalized by P. Constantinescu in the form: $\varepsilon/k_b = \gamma S/\hbar$, [17], it results:

$$\varepsilon_i/k_b = i = \gamma S_h/\hbar = \gamma_i . s_v/\hbar = \gamma_i . /2 \ , \Rightarrow \gamma_i . = 2i \ , \quad (19)$$

For $\gamma = \gamma_i$, it results that : $s_v = S_h$; $\nabla \varepsilon_i/k_b = 2i \cdot \nabla S_h/\hbar \Rightarrow \nabla \varepsilon/k_b = 2 \cdot \nabla S_h/\hbar = 2\nabla S(c)/\hbar$, i.e. $\gamma_i . = 2i$ corresponds to the Bohm's potential for a particle with the impulse $p = m \cdot v$ which- for the considered vecton, is: $p_v = m_v c$, with $m_s = m_v$ as in relation (1).

The previous relations/conclusions can be extended for the explaining also the stability of a heavy vector photon (¸'vexon', in CGT [2-4]) considered with a spinorial vortex of light vector photons around its inertial mass, (as the electron- considered as cluster of confined photons, but with the difference that the electron's mass is given approximately as sum of inertial masses of the vector photons contained by its volume of classic radius a = 1.41 fm- conform to the CGT's model).

The obtained result correspond to a total energy of the pseudo-scalar photon composed by two vector photons with opposed spins (as in the Munera's model, but dimensioned conform to a revised model [12]), given as sum of the kinetic translational and rotational energy of these vector photons in conformity with the Schrödinger's equation, i.e.

$$E_f = E_k + Q_c = 2(\tfrac{1}{2}m_v \cdot c^2 + \tfrac{1}{2}m_s \cdot c^2) = 2m_v c^2 = m_f c^2 = h\nu \qquad (20)$$

with $\nu = 2n_h$ –conform to the known relation: $h\nu = m_f c^2$ of the quantum mechanics and corresponding to a plane wave having the wave function: $\psi = R \cdot e^{i(kx - \omega t)}$, ($k = 2\pi/\lambda$; $\omega = 2\pi\nu$).

By $v = c/n_g$, (n_g –refractive index of a non-dispersive medium), with $\gamma_i = 2i$ the previous interpretation of the quantum potential Q is maintained corresponding to the relations: $\nu(v) = \nu_0$, (corresponding to the photon's mass invariance); $\lambda = \lambda_0/n$ and $E_f = m_f v^2$ –specific to the light's passing through a non-dispersive medium.

This correspondence with the previous mentioned relation of quantum mechanics sustains the previous arguments for the vortical nature of the vector photon but also of the electron's magnetic moment, μ_e , vortically generated.

4. The electron's forming as Bose-Einstein condensate of photons

The similitude between a vector photon of a pseudoscalar photon in a revised Munera' model [12] and a vortical electron, is in concordance with the possibility to create matter from electromagnetic fields if they are strong enough, evidenced also experimentally [18] and with the observation [19] that from the Maxwell theory and Helmholtz decomposition, one can derive not only the wave equation of photons, but also quantum wave equations for electrons, by the assumption that both the matter wave and the radiation wave are excitation waves of the quantum vacuum.

In the paper were presented arguments that these excitation waves are pairs of chiral excitations of the quantum vacuum, generated by etherono-quantonic winds around dense kernels, in the form of vector photons, respective – in the form of electrons, at enough higher density of quantons and photons which generates also the e-charge, vortically induced –conform to CGT [2-4].

A supplementary argument in this sense is given by the possibility to explain the fact that the vibrated electron emits photons by a Lorenzian electron model, with the m_e -mass given by 'frozen' photons, ('vexons'- in CGT), i.e. as Bose-Einstein condensate of photons - considered as confined electromagnetic energy, in this case.

In this sense we can transform the Gross-Pitaevskii equation of the Bose-Einstein condensate into a superfluid' hydrodynamic equation by a Madelung transformation: $\Psi = \sqrt{n} \cdot e^{iS}$, ($n=R^2$), [20]:

$$m \cdot n\left(\frac{dv}{dt} + (v \cdot \nabla) \cdot v\right) = -\nabla(P_c + P_q) - n\nabla V = -\nabla\mu \qquad (21)$$

where P_c and P_q are the pressure: $P_c = \tfrac{1}{2}gn^2 = \tfrac{1}{2}n^2U_0$, ($U = nU_0$ –the interaction energy term) and the quantum pressure: $P_q = -(\hbar^2/2m\sqrt{n})n\nabla^2\sqrt{n} = n \cdot Q(n)$ (m –the particle's mass, n –the density of particles and $g = 4\pi\hbar^2 a_s/m$, at low interaction energy, a_s –the s-wave scattering length).

The interaction between particles can be repulsive or attractive ($U_0 = \pm|U_0|$), the lowest energy solution being a wave-packet of (almost) zero width, i.e. an unstable collapsed state [21]. If (P'; V) $\to$ 0, it is obtained the Euler's equation.

It is observed that the term $Q = P_q/n$ has the form of a quantum potential q corresponding to Bohm's potential by: $Q_a = \Sigma q$. The convective acceleration term can be written as: $v \cdot \nabla v = (\nabla \times \mathbf{v}) \times \mathbf{v} + \tfrac{1}{2}\nabla v^2$, where the vector $(\nabla \times \mathbf{v}) \times \mathbf{v}$ is the Lamb vector.

Considering a quantum fluid rotated with $v = \omega\cdot r$ –constant on a given vortex-line $l_r = 2\pi r$, with $r = r_o - u\cdot t$, ($u = \partial r/\partial t$), for null expansion/contraction ($u = 0$), with: $\partial n/\partial t = 0$; $\partial v/\partial t = u(\partial v/\partial r) = 0$ and U ; Q ; V –of constant values on l_r , (stationary vortex), by Eq. (21) we have: $\nabla(n\cdot v) = 0$ and:

$$mu\frac{\partial \mathrm{v}}{\partial \mathrm{r}} = -\nabla\left(\tfrac{1}{2}\mathrm{mv}^2 + n\cdot U_0(r) - \frac{\hbar^2}{2m\sqrt{n}}\frac{\partial^2\sqrt{n}}{\partial r^2} + V(r)\right) = -\frac{\partial}{\partial r}(\mathrm{E_C} + \mu) = 0 \qquad (22)$$

with: $E_C = \frac{1}{2}mv^2$ –the centrifugal potential and: $\mu = U(r) + Q(n) + V(r)$ - the chemical potential, $U(r) = n\cdot U_0$ being a potential generated by n particles contained by the volume of r-radius over a m-particle rotated on the vortex–line l_r.

- In the case of a vortical electron, the fluid of density $\rho = n\cdot m$ is a photonic fluid, ($m = m_f$ -the mean mass of a photon), which is formed as mixture of pseudoscalar and vector photons vortexed around the electron's centroid by the dynamic pressure of a quantonic vortex of the electron's magnetic moment: $\Gamma_\mu = 2\pi rc$, ($r \le r_\mu = \hbar/m_e c$) having the same density variation as the electron's photonic volume: $\rho_\mu(r) = \rho_e(r)$, [6].

Taking $n = R^2 = n_0\cdot e^{-r/\eta} = n_0\cdot e^{-\delta\varepsilon/k}$, (exponential decreasing of n(r), conform to a Boltzmann-type distribution characterizing also a mixture of fermions and bosons), with $\delta\varepsilon(r) = -k_b\ln(n/n_0)$ – relative entropy density of the electron, by eq. (19) we can write also:

$$\delta\varepsilon/k_b = \gamma_r\delta S_m/\hbar = r/\eta, \quad (\delta\varepsilon = -k_b\cdot\ln(n/n_0);\ \delta S_m = \textstyle\int_{2\pi} m_h\cdot c\cdot dx;\ dx = r\cdot d\theta) \qquad (23)$$

with: $\delta S_m = 2\pi r m_h\cdot c$ -the total action of a quanton on a vortex -line l_r of the Γ_μ-vortex, and:

$\gamma_r = \hbar/2\pi\eta m_h\cdot c = c/4\pi^2\eta$ –constant; ($\eta \approx 10^{-15}$m –constant [2-4]; $m_h = h/c^2$).

The increasing of $\delta\varepsilon$ with r is explained by the fact that $\delta\varepsilon$ is associated with the static etherono-quantonic pressure, $P_s(r)$, in this case, (being real value).

For this electron model used in CGT [2-4], by the operatorial identity: $\Delta a/a = \Delta\ln a + (\nabla\ln a)^2$ it results in this case, with η -constant, (the mean radius of the density variation), that:

$$\mathrm{F_q} = -\frac{\nabla_r P_q}{n} = \nabla\left(\frac{\hbar^2}{2m}\frac{\nabla^2\sqrt{n}}{\sqrt{n}}\right) = \nabla\left(\frac{\hbar^2}{4m}\nabla^2\ln n + \frac{\hbar^2}{8m}(\nabla\ln n)^2\right) = \nabla\left(\frac{\hbar^2}{8m\eta^2}\right) = 0 \qquad (24)$$

Eq. (22) is reduced in this case to the form: $\nabla(n\cdot U_0 + V + E_C) = 0$.

Even if the potential $U(r) = n\cdot U_0$ of the photon's interaction with other n photons results as attractive at $T\to 0K$, (explaining the possibility of photonic Bose-Einstein condensate forming [22]), it cannot equilibrate the centrifugal potential E_C at $v\to c$ and it can be neglected, in this case. So, only the existence of another centripetal force: $F_a(r) = -\nabla V_a(r)$ can equilibrates the repulsive (centrifugal) force $F_c(r) = \nabla E_c(r) = m_f\omega^2 r = m_f v^2/r$, at $v\to c$.

A possible hypothesis is that the attractive potential $V = V_a(r)$ and the centripetal force $F_a(r)$ are given in the electron's case by the dynamic pressure $P_\mu(r)$ of quantonic Γ_μ-vortex, in accordance with the Bernoulli's law: $P_c(r) + P_\mu(r)$ = constant, with $P_\mu(r) = \frac{1}{2}\rho_\mu(r)c^2$ and $P_c(r)$ - the static etherono-quantonic pressure, the centripetal force per unit volume f_a resulting according to Euler's equation:

$$P_c(r) + P_\mu(r) = P_\mu^0(r = 0);\ (P_\mu = \tfrac{1}{2}\rho_\mu c^2) \Rightarrow \nabla P_\mu = -\nabla P_c = f_a = F_a/\upsilon \qquad (25)$$

Eq. (25) show that over a photon with mass $m_f = \upsilon_f\cdot\rho_f$ rotated on the vortex-line l_r acts a centripetal force $F_a(r)$:

$$F_a(r) = m_f\frac{\partial \mathrm{u}}{\partial \mathrm{r}} = \upsilon_f f_a(r) = -\nabla V_a(r) = \nabla(\frac{1}{2}\upsilon_f\rho_\mu \mathrm{c}^2);\ \Rightarrow \mathrm{V_a}(\mathrm{r}) = -\frac{1}{2}\upsilon_f\rho_\mu \mathrm{c}^2 = -\frac{1}{2}\upsilon_f|\psi|^2\mathrm{c}^2 \qquad (26)$$

For v < c, the photonic electron's vortex imply- in consequence, the equality:

$$|F_a| = F_c, \Rightarrow |\nabla(\tfrac{1}{2}\upsilon_f\rho_\mu(r)c^2)| = m_f v_c^2/r;\ \Rightarrow (v_c/c)_r = \sqrt{(r/2\eta)}\sqrt{(\rho^0_\mu/\rho_f)}\cdot e^{-r/2\eta} \qquad (27)$$

For $r \approx \eta$, $\Rightarrow (v_c/c)_\eta \approx 0.4\sqrt{(\rho^0_\mu/\rho_f)}$. Taking a classic electron's radius a = 1.41 fm, conform to CGT [2-4], with the conditions: $\rho_e(a) = \rho_\mu(a) = \rho_c(a) = \mu_0/k_1^2$, ($k_1 = 4\pi a^2/e$, Eq. (3)) and $m_e = \int_a[\rho_e(r)]d\upsilon_e \approx 4\pi\int_a[r^2\rho_e(r)]dr$, it results:

$\eta = 0.965$ fm and: $\rho^0_e = \rho^0_\mu = 2.22\times 10^{14}$ kg/m^3.

But because we must logically suppose that the photon's inertial mass m_f has a diameter smaller than that of the electron's kernel ($d_f < 10^{-18}$ m), its density ρ_f results higher than the nucleon's density: $\rho_f > 10^{18}$ kg/m^3, giving: $(v/c)_\eta < 0.64\times 10^{-2}$; (for example, the density ρ_f of a semi-light photon of mass $m_f \approx 10^{-38}$ kg (of 1THz –IR radiation) and diameter $d_f \approx 2\times 10^{-18}$ m is ~ 2.5×10^{18} kg/m^3). It results that- because $\rho_f \ll \rho^0_\mu$, we have $v \ll c$.

- So, the considered V_a -potential given by Eq. (26) can explain the forming of a photonic rotational Bose-Einstein condensate (of 'slowed' photons, with $v < v_c$), but it cannot explain the electron's rest energy $m_e c^2$ as intrinsic energy.

However, a half of this energy $m_e c^2$ is given by the energy $E_s = \frac{1}{2} m_s c^2$ of the spinorial vortex $\mathbf{\Gamma}_e^s$ of the electron's spin s_e , (because $m_s \approx m_e$ –conform to Eq. (1)), another half being given by the spinorial energy of the internal vector photons of the electron's volume, conform to Eq. (20), which is maintained conform to Eqs. (15) - (18).

In the same time, Eq. (27) argue that only a quantum force $f_a = -\nabla U(r)$ of Magnus type can explain the photon's energy $m_f c^2$ in conformity with Eq. (20).

An argument for the conclusion that the electron's photonic shell is rotated with the light speed as consequence of the spinorial rotation of the vector photons contained in the electron's surface (whose magnetic moments are oriented by the quantonic vortex-tubes $\boldsymbol{\xi}_B$ of the electron's B-field' lines) results by the form of Magnus type of the Lorentz magnetic force [2-4], by considering a 'cold' cylindrical electron with radius $r_e = a = 1.41$ fm and high

$l_e = 2a$ and an electron's surface circulation: $\Gamma_e^a = \Gamma_e(a)$ depending on the charge's sign ζ_e and resulted from the circulation of the vectons which compose the vexons contained in the surface of the electron's quantum volume of a- radius:

$$\Gamma_e^a = \Gamma_e(a) = 2\pi a v_\omega \cdot \zeta_e; \quad (\zeta_e = \pm 1 \ ; \ v_\omega = k_c \cdot c \ ; \ k_c \leq 1) \tag{28}$$

For an electron that passes with $\mathbf{v}_e$ - speed through a magnetic field $\mathbf{B}$ of another electron having the $\rho_B(r)$- mean density of quantonic ξ_B vortex-tubes, the circulation $\mathbf{\Gamma}_e^a$ of electron's surface generates a quantonic force $\mathbf{F}_L$ of Magnus type [2-4], acting on the moving electron with the $\boldsymbol{\mu}_e$-magnetic moment oriented parallel with the $\boldsymbol{\xi}_B$ vortex-tubes of the external $\mathbf{B}$-field having the microphysical expression (2): $B = k_1 \rho_B v_c$, $(k_1 = 4\pi a^2/e \ ; \ v_c \leq c)$.

For $r \leq r_\mu = \hbar/m_e c$ we have $E(r) = c \cdot B(r)$, relation which can be verified for $r = r_\mu$ by the known relation: $B(r_\mu) = (\mu_0/2\pi) \cdot \mu_e/r_\mu^3 = E(r_\mu)/c$, (re-obtained by eq. (13)), resulting that: $B(r_\mu) = k_1 \rho_B \cdot c$ and:

$$\begin{gathered} F_L = 2a \cdot \Gamma_a^* \cdot \rho_B \cdot v_e = 4\pi a^2 v_\omega \cdot \rho_B \cdot v_e \cdot \zeta_e = e\zeta_e \cdot k_c (k_1 \rho_B c) \cdot v_e = \zeta_e e \cdot B \cdot v_e ; \ \Rightarrow k_c = 1; \\ (v_\omega = k_c c; \quad k_1 = 4\pi a^2/e; \quad \Gamma_e^a = 2\pi \cdot a \cdot k_c c \cdot \zeta_e \ ; \ \zeta_e = \pm 1) \end{gathered} \tag{29}$$

(e-charge depending on Γ_e^a). So, it results from eq. (29) that $v_\omega = k_c c = c$; $\Gamma_e^a = 2\pi ac$.

This possibility is in concordance with the fact that the electric interaction quanta must be logically vector photons (with opposed chiralities for opposed electric charges [2-4])..

- Conform to eq. (29), the difference between the e-charge of the negatron and those of the positron is given by the coefficient $\zeta_e = \pm 1$ of parallelism between $\boldsymbol{\mu}_e$ and $\mathbf{\Gamma}_e^a \uparrow\uparrow S_e$ ($\mathbf{S}_e$ –the electron's spin), $\mathbf{\Gamma}_e^a$ being given- in a classic model [6], by the circulation $\mathbf{\Gamma}_v = 2\pi rc \cdot \boldsymbol{\zeta}_e$ of the light vector photons ('vectons') which compose the w-vexons of the electron's surface and is explained by the fact that –in the negatron's case, if the speed of these vexons is: $v_v \leq v_f^0 < c$, (lower than the critical value v_f^0), then the sense of their 'vectonic' circulation $\mathbf{\Gamma}_v = 2\pi rc \cdot \boldsymbol{\zeta}_e$ (maintained by etherono-quantonic vortex acting over the vecton's inertial mass, m_v) is given by the gradient: $\nabla P_d \sim c\nabla(\rho_{sv} + \rho_\mu)_{r \approx a}$ at the level of the vexonic shell characterized by $r_n \approx a$ and it is antiparallel to $\boldsymbol{\mu}_e$, (fig. 2).

If these 'vexons' of the electron's surface attract and retain an equal number of other vexons but with antiparallel

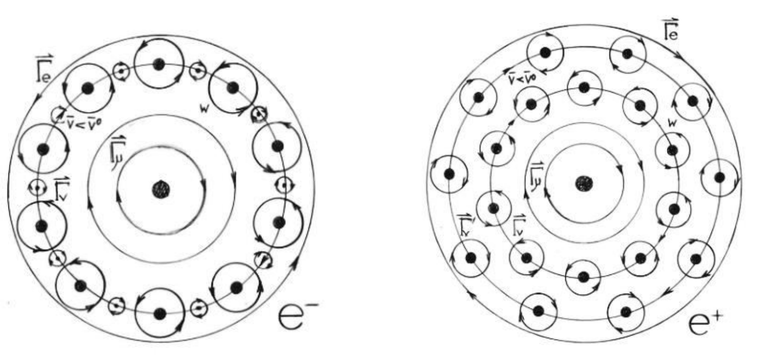


Fig. 2. The explaining of the difference between the e- charges of the negatron and of the positron by the circulation Γ_v of the 'vexons' contained by the electron's surface, which gives its circulation $\mathbf{\Gamma}_e \sim \mathbf{S}_e$, (classic model) .

magnetic moment and spin, the vectons of these attracted vexons, having a circulation $\mathbf{\Gamma'_v}\uparrow\uparrow\boldsymbol{\mu}_e$, ($\mathbf{\Gamma'_v} = 2\pi\mathbf{r}\times\mathbf{c} = 2\pi rc\cdot\boldsymbol{\zeta}_e$), they will give a circulation of the electron's surface: $\mathbf{\Gamma_e^a}\uparrow\uparrow\boldsymbol{\mu}_e$, corresponding to the positron's case and to the positron's spin, $\mathbf{S_e} = (m_e/q_e)\cdot\boldsymbol{\mu}$, with $q_e = e\cdot\zeta_e = +e$, (figure 2).

5. The compatibility with the Coulomb's law

In the used electron model, obtained in CGT, we considered photons with non-null rest mass and comparable with their motion mass. This conclusion seems to be in contradiction with equations of Quantum mechanics for the action range of the electrostatic forces: $r_\lambda = h/m_v c$, (m_v –the rest mas of a vector photon, in this case).

As it is known, a non-null photon mass m_f corresponds to a Proca equation for the electromagnetic field which- in the electrostatic case, has the form: $\nabla^2\varphi + \mu^2\varphi = 0$ with $\mu = m_f c/h$, the electrostatic potential function $\varphi(r)$, taking the Yukawa's potential form:

$$\nabla^2\varphi + \mu^2\varphi = 0\ ;\ \Rightarrow\ \varphi(r) = (1/r)\cdot e^{-\mu r}, \quad (\mu = m_f c/h) \tag{30}$$

which states that when an interaction is mediated by the exchange of a massive gauge particle, the interaction must have a finite range , inversely proportional to the m_f -mass.

The physical explanation of the Yukawa form of the electric potential $\varphi(r)$ can be given by the expression: $E = k_1\rho_v c^2$, (in vacuum, the impulse of the vector photons which give the E-field being $\rho_v c$), with the E-field's energy given by a radially emitted flux of quanta ('vectons', [2-4]), that- for an un-changed impulse $p_v = m_v c$ of the considered vectons, maintains the proportionality: $E \sim r^{-2}$ (specific to $V \sim r^{-1}$), by the constancy of the total flux, i.e.: $\Phi_T = 4\pi r^2\rho_v(r)c^2 =$ constant.

It results that the exponential decreasing with $e^{-\mu r}$ of $\varphi(r)$ can be generated only by the vecton's impulse decreasing, as consequence of the drag force generated by its passing with the speed $v \le c$ through the quantum vacuum's low frictional medium, of density ρ_b^0 .

The concordance with the fact that we receive photons also from far galaxies results by the conclusion that this low frictional medium is a super-fluid with very low kinematic viscosity that- according to the d'Alembert paradox [23], generates a low drag force: $F_R \approx f_a\cdot S_v\rho_b^0 v^2$, ($S_v$ = section of vecton's interaction with the quantum vacuum's medium), corresponding to a variation of the photon's speed (in the hypothesis of photon's mass invariance) of the form:

$$v^2 = c^2\cdot e^{-k'r}\ ,\ \text{with:}\quad k' = m_f^0 c/\hbar = f_a\cdot m_v c/\hbar\ ,\quad (m_f^0 \approx 1.7\times10^{-50}\text{Kg},\ [21]) \tag{31}$$

with: $f_a = f_a(d,\nu)$- form factor, taking into account the d'Alembert's paradox (depending on the diameter d of the photon's inertial mass and the kinematic viscosity ν of the etherono-quantonic medium) ; m_v - the mass of the vector photons that give the E-field. With $m_v \approx 10^{-40}$ kg, (the vecton's mass –conform to Ref. [6]), it results: $f_a = m_f^0/m_v \approx 10^{-10}$.

This explanation imply the conclusion that the main component of the quantum vacuum is given by the smallest quanta that can explain the photon's forming (its mass and its electro-magnetic properties) and the super-fluidity of the quantum vacuum, i.e.- by etherons, in concordance with the hypothesis of the etherono-quantonic medium, considered in the paper. Also, eq. (31) explains why one can use Maxwell's laws (instead of the Maxwell-Proca equations, specific to field' quanta with rest mass).

In concordance with other theoretical conclusions [8], if the same etheronic sub-quantum medium causes not only gravitational interactions but also the inertial forces, the form factor f_a being with the same value in both cases, it can explain the equality between the gravitational mass and the inertial mass.

6. The correspondence with the Aharonov-Bohm effect

It is well-known the Aharonov-Bohm effect [24] which evidenced by interferometry that a phase shift occurs when an electron beam passes around a magnetic solenoid after its splitting, of value: $\Delta\phi = k_\lambda\Delta x = (mv_0/\hbar)\Delta x = -(e/\hbar)\int A\cdot dl$, (e –the electron's charge, A- the magnetic potential), which –for the case of a solenoid, gives: $\Delta\phi = -(e/\hbar)B_0\cdot S_B$, ($S_B = \pi r_0^2$ - the section of the solenoid generating the magnetic field B_0 = rot A).

Although the Aharonov-Bohm effect is well-verified experimentally, it is not clear whether this phase shift occurs because of classical forces or because of a topological effect occurring in the absence of classical forces as claimed by Aharonov and Bohm. The mathematics of the Schrödinger equation itself does not reveal the physical basis for the effect. However, the experimentally observed Aharonov-Bohm phase shift is of the same form as the shift observed due to electrostatic forces for which the consensus view accepts the role of the classical forces.

Also, it resulted experimentally the absence of time delays associated with forces of the magnitude needed to explain the A-B-phase shift for a macroscopic system [25].

In the late 1990's, the existence of a quantum force was predicted as physical explanation for the Aharonov-Bohm effect, elucidated by Berry [26] . Relative recently, this force was evidenced in an experiment [27] as transverse force derived from a potential of Bohm type: $Q = -(\hbar^2/2m)(\nabla^2 R/R)$.

Qualitatively, this result corresponds to the obtained physical interpretation of A-potential, of Q_c and of Q_a by the conclusion that A-potential is given as (pseudo)vortex of heavy etherons ('sinergons', [2-4]) induced around elementary particles by etheronic winds which penetrates the space surrounding the atomic particles and which can exists also around a magnetically shielded solenoid.

If the impulse density $p_s = \rho_s w$ ($c \le w \le \sqrt{2}c$) of this 'sinergonic' vortex, remained in the proximity of the shielded solenoid, has a non-null gradient $\nabla_r p_s(r)$ on the radial direction, then it will produce a weak vortex Γ_s around the electron's kernel, which will be oriented as in the presence of a quantonic vortex-tube $\boldsymbol{\xi_B} \sim \nabla_r p_s$ corresponding to a B-field line, with the magnetic moment rectangular to electron's impulse: $\mu_e \perp m_e v_e$. Also, the gradient $\nabla_r p_s(r)$ will generate an increasing of ρ_b -density of the frictional component of the etherono-quantonic medium – compared to that of the quantum vacuum in the absence of the magnetic A-potential, the action of this component $\rho_b \sim \nabla_r p_s$ on electronic and photonic (super)dense kernels generating a pseudo-magnetic force of Magnus type, (eq. (15)), which can explain the deflection of the electrons beam in the proximity of a shielded solenoid, experimentally observed as phase-shift effect [27].

The fact that it resulted experimentally the absence of time delays associated with forces on the longitudinal direction $x // v_e$ can be explained in this case by the d'Alembert' paradox [23] which can also explain the possibility of receiving photons from far galaxies, by the property of superfluid of the etherono-quantonic medium (preponderant etheronic) with very low kinematic viscosity, that generates a low drag force, specific to a redshift effect given by 'radiation's aging': $F_R \approx f_a \cdot S_v \rho_b^0 v^2$, ($S_v$ = section of vecton's interaction with the quantum vacuum's medium), corresponding to a variation of the photon's speed (in the hypothesis of photon's mass invariance), giving an exponential variation of the electron's E-field by eq. (2), of the form (31).

7. Conclusions

It was shown in the paper that the CGT's model of E- and B- fields generating is compatible with a vortical model of B-field and A- magnetic potential but with a uniform speed of the etherono-quantonic vortex (instead of uniform angular velocity of an ethereal medium- as in Maxwell's model), specific in particular to a vortical electron model, with classical spin .

The resulting vortical model of magnetic moment is compatible with a multi-vortical model of electron, with classic quantum volume filled with vortical photons which can explain the Lorentz force as quantum force of Magnus type and a part of the electron's rest energy mc^2 as intrinsic energy.

The stability of the specific vortex of the electron's magnetic moment was explained by a centripetal force of Magnus type, generated at the quanton's passing through a low frictional etheronic medium.

The super-fluidity of the etherono-quantonic component of the quantum vacuum is in concordance with the fact that the vacuum is a dielectric medium, in which the displacement current ($\partial D/\partial t$) does not vanish.

In correlation with the effect of the etheronic vortex of the nuclear magnetic moment, this property of the quantum vacuum can also explain the perpetual rotation of the atomic electrons around the atomic nucleus [2-4].

The considered etherono-quantonic vortical nature of the magnetic field is concordant not only with the basic laws of electromagnetism but also with the observations regarding the generating of quantized vortices in a superconducting thin film of Nb, [28], which reported the observing of vortices and antivortices which annihilate each other, generated when a 100 Gs magnetic field applied to the thin film of Nb is suddenly reversed and its magnitude increases (generating the anti-vortices).

In our opinion, this phenomenon indicates the quantum-vortical nature of the magnetic field, whose vortical dynamic pressure can induce quantum vortices also to atomic level and it can bring arguments for an elementary particle model considered as clusters of degenerate electrons ($(e^-e^+)^*$-pairs) with diminished values of mass, charge, and magnetic moment [2-4].

For example, the decreasing of the particle's magnetic moment proportional with the particle's mass can be explained by the vortical model of electron and by a degenerate electrons cluster model of particle [2-4]- which can explain the experimentally evidenced possibility of quark-antiquark –pairs obtaining by the interaction of relativist fluxes of negatrons and positrons [29], by the conclusion that the Γ_μ^e – vortex of the magnetic moment of an attached positron which gives the proton's charge: $\mu_p = g_p \cdot \mu_N = g_p \cdot (m_e/m_p) \cdot \mu_e$, is diminished by the distribution of its vortical energy to all degenerate electrons of the particle's N^p –cluster of 'gammons' (e^{*-}-e^{*+}-pairs), giving the particle's magnetic moment by its un-paired quantonic vortex, of radius r_μ^p equal to the reduced Compton wavelength and of circulation:

$$\Gamma_\mu^p = 2\pi c \cdot r_\mu^p = g_p(m_e/m_p) \cdot \Gamma_\mu^e ; \Rightarrow r_\mu^p = g_p(m_e/m_p) \cdot r_\mu^e , (r_\mu^e = \hbar/m_e c) ; \ \mu_p = \tfrac{1}{2} e c r_\mu^p = g_p(m_e/m_p) \cdot \mu_e , \quad (32)$$

with the value of g_p given by the local density of proton's volume in which the protonic positron's centroid is found [2-4], ($g_p = 2.79$ - for proton).

- Related to the discrepancy between the density of the vacuum energy of the free space resulting from the upper limit of the cosmological constant: $\sim 10^{-26}$ kg/m^3, and that estimated in quantum electrodynamics: 10^{94} kg/m^3, [30], it can be observed that the resulted model supposing etherono-quantonic and photonic vortices, do not imply the necessity of an etheronic density of the lepton's central part higher than the nuclear density, this maximal value resulting much more plausible.

Also, the electron's density and the density of the E- and B- fields quanta at the electron's surface: $\rho_e(a) = \mu_0/k_1^2 = 5.17 \times 10^{13}$ kg/m^3, ($k_1 = 4\pi a^2/e$), specific to the used electron model [2-4], compared with the density of quantons that gives the strongest magnetic field considered as possible for magnetars: $\sim 10^{11}$ T, (which- by the resulted expression (5) for the B-field, ($B = k_1 \rho_\mu c$), corresponds to a density of quanta: $\rho_\mu = 2.1 \times 10^{12}$ kg/m^3) is of only 24.6 times higher, also being of only 246 times higher than that corresponding to the magnetic field of the known magnetar SGR J1745–2900, (which orbits the supermassive black hole Sagittarius A*) , resulted from astrophysical data [31], ($\sim 10^{10}$ T).

The value of 10^{-26}kg/m^3 resulting in cosmology as those of the dark energy density can be explained in this case as the density of un-compensated etheronic winds, generated by black holes which produce matter→energy conversion (similar to gravitational waves), which explains the cosmic expansion as in CGT [2-4].

The possibility of receiving photons from far galaxies is explained by the property of superfluid of the etherono-quantonic medium (preponderant etheronic), with very low kinematic viscosity, that generates a low drag force

The resulting vortical models of magnetic field and of electron are compatible –in this case, also with the Coulomb's law and with experiments concerning the Aharonov-Bohm effect.

These arguments sustain indirectly a particles cold genesis scenario supposing vortices in a quantum and sub-quantum (etheronic) medium, generated as effect of chiral fluctuations at high densities of this medium, comparable to those of a magnetaric magnetic field .

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