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Speed of Atomic Particles and Physical Constants

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Abstract

This is a new updated and corrected version of the work with the same name published on January 31, 2008. With the acquired experience during the research of nuclear stability of hydrogen and helium family, I have already been able to determine with great precision the magnetic constant correlation taking as to the other well-known fundamental constants and solving an old question about the "Fine-structure constant". Another question resolved is the Planck constant that result to be exactly equal to the product of the period per the kinetic energy of the particle in rest (in the orbit of cardinal radius – quantum unitary state–). Also, I give an appropriate answer to the question on trajectory of atomic particles in orbit to the speed of the light, because in their displacement the helix forms a toroidal magnetic field, the resulting force of this magnetic field establishes the equilibrium in magnetic-dynamics form with enormous inertial resultant of particles in orbit and determined by the traverse component of spin vector speed on the spin, near to the speed of the light.

Keywords: Fine-structure constant, physical constants, Planck constant, speed atomic particles, spin magnetic-dynamics auto-equilibrium.

1. Introduction

In the following study I carry out the analysis of three possible situations: when the orbit radius of particles are bigger than the cardinal orbit (quantum state bigger to the unit - In the atom this state exists in all electron and nuclear proton), when the orbit radius of particles are exactly the cardinal orbit (unitary quantum state –This situation is not given in any case in the atoms–) and lastly when the orbit radius are smaller to the cardinal orbit (quantum state smaller to the unit - In the atom it occurs only in the case of negatrons, the most internal layer in the atomic nucleus), seen the previous publications [5], [6] and [7].

2. Analysis of speeds

Because atomic particles travels to the speed of the light describing a helix around the trajectory in orbit, the resulting vector can be decomposed in two vectors: one normal and tangential to orbit, that gives us the speed tangential medium, and another that is transverse to orbit and tangent to the torus helix of spin, that gives us the speed of spin tangential medium.

2.1. Radius of atomic orbit

Starting from the Law of Bohr [3] – extended postulate of Bohr in [5], [6], [7] and [8] –, I have determined the expressions of cardinal orbit radius and the atomic orbit of any other radius. The postulate of Bohr is

$$m_x v_x r_x = nh\left(2\pi\right)^{-1} \ , \tag{1}$$

where m_x is the inertial mass of particle x (e: electron, p: proton and n: negatron), v_x can be of any lower speed than the speed of light, r_x is the orbit radius of particle x and n is quantum status an integer number. While that the Law of Bohr is

$$m_x c r_x = \alpha h\left(2\pi\right)^{-1} \ , \tag{2}$$

where α is a function of quantum status (it's always a real number) and c is the speed of light. Then, the orbit radius of the particle x in radius smaller than the cardinal radius (2), see [5], is

$$\alpha = {}^{\mathrm{v}}Q_x\,{}^{\mathrm{r}}Q_x^{-1}, {}^{\mathrm{v}}Q_x = 1, {}^{\mathrm{r}}Q_x \succ 1 \ \text{ then } \alpha \prec 1 \quad \therefore \ \ r_x = h\left(2\pi c m_x\,{}^{\mathrm{r}}Q_x\right)^{-1}, \tag{3}$$

where ${}^{\mathrm{v}}Q_{\mathrm{x}}$ is the quantum vectorial number calculated with the stability expression for the particle x and ${}^{\mathrm{r}}Q_{\mathrm{x}}$ is the quantum radial number calculated with the stability expression for the particle x. The orbit radius of particle x in cardinal radius (2), see [5], is

$$\alpha = {}^{\mathrm{v}}Q_x\,{}^{\mathrm{r}}Q_x^{-1}, {}^{\mathrm{v}}Q_x = 1, {}^{\mathrm{r}}Q_x = 1 \ \text{ then } \alpha = 1 \quad \therefore \ \ {}^{\mathrm{cd}}r_x = h\left(2\pi c m_x\right)^{-1}, \tag{4}$$

where ${}^{\mathrm{cd}}r_{\mathrm{x}}$ is the cardinal orbit radius of particle x (when the quantum state α of particle is exactly equal to the unit, that's a physical constant characteristic of each atomic particle). The orbit radius of particle x in radius bigger than the cardinal radius (2), see [5], is

$$\alpha = {}^{\mathrm{v}}Q_x\,{}^{\mathrm{r}}Q_x^{-1}, {}^{\mathrm{v}}Q_x \succ 1, {}^{\mathrm{r}}Q_x = 1 \ \text{ then } \alpha \succ 1 \quad \therefore \ \ r_x = h\left(2\pi c m_x\right)^{-1}\,{}^{\mathrm{v}}Q_x \tag{5}$$

In the appendix **A** you can see the calculation of the cardinal radius deduced with Einstein's relationship [10] and De Broglie [4].

2.2. The period of an orbit

The traveling time of an only orbit or period is a function of the real space and of speed of light and being the step or pass P_x equal to an multiple integer number of cardinal radius orbit given by a wave restriction then is

$$t_x = 2\pi\left({}^{\mathrm{cd}}r_x\right)P_x c^{-1} = 2\pi\left[h\left(2\pi c m_x\right)^{-1}\right]P_x = h\left(c m_x\right)^{-1} P_x, \tag{6}$$

where t_{x} it's the orbit period of a particle x.

The orbit period of a particle x in radius equal and smaller than the cardinal radius is constant because the space traveled is always equal to 2π per the cardinal radius then (4)

$$t_x = (2\pi)\left[h(2\pi c m_x)^{-1}\right](c^{-1}) = h m_x^{-1} c^{-2} \ , \tag{7}$$

and the period orbit of a particle x in radius bigger than the cardinal radius being the spin turns P_x equal at the quantum state ${}^{v}l_x$ to the second power (6) is

$$t_x = h m_x^{-1} c^{-2} \left({}^{v}l_x\right)^2 \ , \tag{8}$$

where ${}^{v}l_x$ is the quantum state of the particle x (the bigger integer most closely whereby the value ${}^{v}Q_x$ has been calculated).

2.3. The speed tangential medium

The inertial resultant to the speed tangential medium $\overline{v_x}$ on atomic particles is due always to the equilibrium in form dynamics-potential, just as we have already seen in the analysis of atomic and nuclear equilibrium [5], [6] and [7] except in cardinal radius that it is magnetic-dynamic, the mathematical expressions being the medium speed equal to the space (longitude of orbit) per time^{-1}, then the speed tangential medium of particle x in radius smaller than the cardinal radius (3) and (7) is

$$\overline{v_x} = 2\pi\left[h\left(2\pi c m_x {}^{r}Q_x\right)^{-1}\right]\cdot\left[h\left(c^2 m_x\right)^{-1}\right]^{-1} = c\,{}^{r}Q_x^{-1} \ , \tag{9}$$

the speed tangential medium of particle x in cardinal radius (4) and (7) is

$$\overline{v_x} = 2\pi\left[h\left(2\pi c m_x\right)^{-1}\right]\cdot\left[h\left(c^2 m_x\right)^{-1}\right]^{-1} = c \ , \tag{10}$$

and the speed tangential medium of particle x in radius bigger than the cardinal radius (5) and (8) is

$$\overline{v_x} = 2\pi\left[h\left(2\pi c m_x\right)^{-1}\,{}^{v}Q_x\right]\cdot\left[h m_x^{-1} c^{-2}\left({}^{v}l_x\right)^2\right]^{-1} = c\,{}^{v}Q_x\,{}^{v}l_x^{-2} \tag{11}$$

2.4. The speed vector of the spin tangential medium

The magnitude of speed vector of the spin tangential medium $\overline{v_{sx}}$ was easily determined by Pythagoras relationship, knowing that the speed on the helix is always equal to the speed of the light and then their mathematical expression, then the speed vector of the spin tangential medium of particle x in cardinal radius (10) is

$$\overline{v_{sx}} = \sqrt{c^2 - \left(\overline{v_x}\right)^2} = \sqrt{c^2 - c^2} \quad \therefore \quad \overline{v_{sx}} \to 0 \ , \tag{12}$$

the speed vector of the spin tangential medium of particle x in radius smaller than the cardinal radius (9) is

$$\overline{v_{sx}} = \sqrt{c^2 - \left(c\,{}^{r}Q_x^{-1}\right)^2} = c\sqrt{1 - {}^{r}Q_x^{-2}} \ , \tag{13}$$

and the speed vector of the spin tangential medium of particle x in radius bigger than the cardinal radius (11) is

$$\overline{v_{sx}} = \sqrt{c^2 - \left(c\,{}^{\mathrm{v}}Q_x\,{}^{\mathrm{v}}l_x^{-2}\right)^2} = c\sqrt{1 - {}^{\mathrm{v}}Q_x^2\,{}^{v}l_x^{-4}} \tag{14}$$

3. Analysis of inertial resultants

3.1. The inertial resultants for the speed tangential medium

According to Newton Laws [15] the inertial resultants are always given by the following expressions and for the speed tangential medium ${}^{\mathrm{i}}F_x$ in cardinal radius (4) and (10) is

$${}^{\mathrm{i}}F_x = m_x\left(\overline{v_x}\right)^2 r_x^{-1} = m_x c^2\left[h\left(2\pi c m_x\right)^{-1}\right]^{-1} = 2\pi h^{-1} m_x^2 c^3 \ , \tag{15}$$

the inertial resultants for the speed tangential medium in radius smaller than the cardinal radius (3) and (9) is

$${}^{\mathrm{i}}F_x = m_x\left(c\,{}^{\mathrm{r}}Q_x^{-1}\right)^2\left[h\left(2\pi c m_x\,{}^{\mathrm{r}}Q_x\right)^{-1}\right]^{-1} = 2\pi\left(h\,{}^{\mathrm{r}}Q_x\right)^{-1} m_x^2 c^3 \ , \tag{16}$$

and the inertial resultants for the speed tangential medium in radius bigger than the cardinal radius (5) and (11) is

$${}^{\mathrm{i}}F_x = m_x\left(c\,{}^{\mathrm{v}}Q_x\,{}^{\mathrm{v}}l_x^{-2}\right)^2\left[h\left(2\pi c m_x\right)^{-1}\,{}^{\mathrm{v}}Q_x\right]^{-1} = 2\pi\,{}^{\mathrm{v}}Q_x\left(h\,{}^{\mathrm{v}}l_x^4\right)^{-1} m_x^2 c^3 \tag{17}$$

This inertial resultant in all the cases it's balanced by the potential resultants, for this reason it was included inside the atomic and nuclear calculation expressions [5], [6] and [7], except the cardinal radius (15) that doesn't correspond to any particle in atomic orbit.

3.2. The spin radius

The spin radius can be determined by Pythagoras relationship. The spin radius r_{sx} in cardinal radius (4) being the spin turns equal to one is

$$r_{sx} = \sqrt{\left(Sh_x\right)^2 - \left(Lp_x\right)^2} = \left[\left({}^{\mathrm{cd}}r_x\right)^2 - \left({}^{\mathrm{cd}}r_x P_x^{-1}\right)^2\right]^{1/2} = \left[\left({}^{\mathrm{cd}}r_x\right)^2 - \left({}^{\mathrm{cd}}r_x\right)^2\right]^{1/2} \quad \therefore \quad r_{sx} \to 0 \ , \tag{18}$$

where Sh_x it's the space traveled by step of helix spin of a particle x, Lp_x it's the longitude of each step of spin helix of particle x. The spin radius in radius smaller than the cardinal radius (3) being the space traveled equal to the cardinal radius orbit (constant for all smaller orbit than the cardinal radius orbit) and the spin turns equal the quantum status ${}^{\mathrm{r}}l_x$ then is

$$r_{\mathrm{sn}} = {}^{\mathrm{r}}l_{\mathrm{n}}^{-1}\sqrt{\left({}^{\mathrm{cd}}r_{\mathrm{n}}\right)^2 - r_{\mathrm{n}}^2} = {}^{\mathrm{r}}l_{\mathrm{n}}^{-1}\left\{\left[h\left(2\pi c m_{\mathrm{n}}\right)^{-1}\right]^2 - \left[h\left(2\pi c m_{\mathrm{n}}\,{}^{\mathrm{r}}Q_{\mathrm{n}}\right)^{-1}\right]^2\right\}^{1/2} = h\left(2\pi c m_{\mathrm{n}}\,{}^{\mathrm{r}}l_{\mathrm{n}}\right)^{-1}\sqrt{1 - {}^{\mathrm{r}}Q_{\mathrm{n}}^{-2}}, \tag{19}$$

and the spin radius in radius bigger than the cardinal radius (5) is

$$r_{sx} = \sqrt{\left({}^{\text{cd}}r_x\right)^2 - \left(r_x P_x^{-1}\right)^2} = \left\{\left[h\left(2\pi c m_x\right)^{-1}\right]^2 - \left[h\left(2\pi c m_x\right)^{-1}\,{}^{\text{v}}Q_x\left({}^{\text{v}}l_x\right)^{-2}\right]^2\right\}^{1/2} = h\left(2\pi c m_x\right)^{-1}\sqrt{1-{}^{\text{v}}Q_x^2\,{}^{\text{v}}l_x^{-4}} \qquad (20)$$

The radius of the spin helix for the cardinal orbit tends to zero because it is unitary quantum state and one only spin turn is completed on one orbit and for that reason the toroidal magnetic field in cardinal orbit doesn't exist.

3.3. The inertial resultants for the speed of spin tangential medium

Knowing the calculation expression of the spin radius, we can determine the inertial resultants for the speed of spin tangential medium ${}^{\text{i}}F_{sx}$ in all quantum state. The inertial resultants for the speed of spin tangential medium in cardinal radius (12) and (18) is

$${}^{\text{i}}F_{sx} = \frac{m_x \cdot \left(\overline{v_{sx}}\right)^2}{r_{sx}} \quad \text{being} \quad \overline{v_{sx}} \to 0 \quad \therefore \quad {}^{\text{i}}F_{sx} \to 0\,, \qquad (21)$$

the inertial resultants for the speed of spin tangential medium in radius smaller than the cardinal radius (13) and (19) is

$${}^{\text{i}}F_{\text{sn}} = m_{\text{n}}\left(c\sqrt{1-{}^{\text{r}}Q_{\text{n}}^{-2}}\right)^2\left(h\left(2\pi c m_{\text{n}}\,{}^{\text{r}}l_{\text{n}}\right)^{-1}\sqrt{1-{}^{\text{r}}Q_{\text{n}}^{-2}}\right)^{-1} = 2\pi\,{}^{\text{r}}l_{\text{n}} h^{-1} m_n^2 c^3\left(1-{}^{\text{r}}Q_{\text{n}}^{-2}\right)^{1/2}\,, \qquad (22)$$

where being ${}^{\text{r}}l_{\text{n}}$ (the smaller integer most closely whereby the value ${}^{\text{r}}Q_{\text{n}}$ has been calculated) for the negatron. The inertial resultants for the speed of spin tangential medium in radius bigger than the cardinal radius (14) and (20) is

$${}^{\text{i}}F_{sx} = m_x\left(c\sqrt{1-{}^{\text{v}}Q_x^2\,{}^{\text{v}}l_x^{-4}}\right)^2\left[h\left(2\pi c m_x\right)^{-1}\cdot\sqrt{1-{}^{\text{v}}Q_x^2\,{}^{\text{v}}l_x^{-4}}\right]^{-1} = 2\pi h^{-1} m_x^2 c^3\sqrt{1-{}^{\text{v}}Q_x^2\,{}^{\text{v}}l_x^{-4}} \qquad (23)$$

The inertial resultant for the speed of spin tangential medium for radius smaller or bigger than the cardinal radius is not included inside the atomic and nuclear calculation expressions because there is an auto-equilibrium of magnetic-dynamic type as we will see later into this work.

The (19) and (22) only correspond with the negatron, because it's the unique atomic particle with smaller orbit than the cardinal radius orbit.

4. Analysis of electric intensities

4.1. The nodal frequency to pass particles

The frequency to pass particles f_x by the nodal point [5], [6] and [7] is directly proportional to the speed and inversely proportional to the traveled space. The frequency in cardinal radius being the space traveled equal to the orbit of cardinal radius (4) is

$$f_x = c\left(2\pi\,{}^{\mathrm{cd}}r_x\right)^{-1} = c\left\{2\pi\left[h\left(2\pi c m_x\right)^{-1}\right]\right\}^{-1} = m_x h^{-1} c^2, \tag{24}$$

the frequency in radius smaller than the cardinal radius and being the wavelength equal to the length of the orbit of cardinal radius (3) and (4) is

$$f_x = c\left(2\pi r_x\right)^{-1} = c\left(2\pi\,{}^{\mathrm{cd}}r_x\right)^{-1} = c\left\{2\pi\left[h\left(2\pi c m_x\right)^{-1}\right]\right\}^{-1} = m_x h^{-1} c^2\,, \tag{25}$$

the frequency in radius bigger than the cardinal radius being spin turns or pass P_x equal at the quantum state ${}^{\mathrm{v}}l_x$ to the second power is

$$f_x = c\left(2\pi\,{}^{\mathrm{cd}}r_x P_x\right)^{-1} = c\left\{2\pi\left[h\left(2\pi c m_x\right)^{-1}\right]\left({}^{\mathrm{v}}l_x\right)^2\right\}^{-1} = m_x h^{-1} c^2 \left({}^{\mathrm{v}}l_x\right)^{-2} \tag{26}$$

4.2. The electric intensity

The electric intensity I_x is directly proportional to the frequency of particle passage per elementary charge according to the Ampere Law [1], is given for in radius smaller or in cardinal radius (24) and (25) is

$$I_x = q f_x = q m_x h^{-1} c^2\ , \tag{27}$$

the electric intensity in radius bigger than the cardinal radius (26) is

$$I_x = q f_x = q m_x h^{-1} c^2 \left({}^{\mathrm{v}}l_x\right)^{-2} \tag{28}$$

Therefore the electric intensity is constant for smaller orbit or cardinal orbit and in to bigger orbit that of cardinal orbit, is inversely proportional to the quantum state and for this reason the electric intensity diminishes in the measure that increases the orbit radius of the particle.

5. Magnitude analysis in magnetic forces resultant

5.1. The magnetic vector in cardinal orbit

In the cardinal orbit magnetic torus field doesn't exist, because their spin radius and speed vector of the spin tangential medium tend to zero. The magnitude of magnetic vector $\overline{B}_x$ transverse at the orbit plane (an only spire) according to the Biot and Savart Law [2], (4) and (27) is

$$\overline{B_x} = k_m 2\pi I_x r_x^{-1} = k_m 2\pi\left(q m_x h^{-1} c^2\right) \cdot \left[h\left(2\pi c m_x\right)^{-1}\right]^{-1} = 4 k_m q h^{-2} \pi^2 m_x^2 c^3\ , \tag{29}$$

where k_m is a magnetic constant see section **9**.

5.2. The magnetic force resultant in cardinal orbit

The magnitude of the magnetic force resultant ${}^{\mathrm{m}}F_x$ and being L_x it's the space traveled by each cardinal orbit or also longitude of the spire (4), (28) and (29) is

$$^{\mathrm{m}}F_x = I_x L_x \overline{B_x} = \left[q m_x h^{-1} c^2 \left(^{\mathrm{v}}l_x \right)^{-2} \right]$$
$$\cdot \left[2\pi h \left(2\pi c m_x \right)^{-1} \right] \left[4 k_m q h^{-2} \pi^2 m_x^2 c^3 \right] = 4 k_m h^{-2} \pi^2 q^2 m_x^2 c^4 \qquad (30)$$

5.3. Equilibrium condition of all atomic particles in cardinal orbit

The condition is magnetic-dynamics, the resultant inertial (15) dependent of speed tangential medium should be exactly equal to the magnetic resultant (30), because both vectors are annulled among themselves, just as I show in

$$2\pi h^{-1} m_x^2 c^3 = 4 k_m h^{-2} \pi^2 q^2 m_x^2 c^4 \qquad (31)$$

Therefore, we can make the following operation to know the magnitude of the magnetic constant and to verify this equality I solve for k_m in (31) and see section **9** then

$$k_m \rightarrow h\left(2\pi c q^2\right)^{-1} = 1.37035999694076 \times 10^{-5} \ \mathrm{N.A^{-2}} \qquad (32)$$

then the magnitudes of forces in cardinal radius for all the atomic particles are

$$\text{Electron} \quad {}^{\mathrm{i}}F_{\mathrm{e}} = {}^{\mathrm{m}}F_{\mathrm{e}} = 0.21156441702105 \ \ \mathrm{N} \qquad (33)$$
$$\text{Proton} \quad {}^{\mathrm{i}}F_{\mathrm{p}} = {}^{\mathrm{m}}F_{\mathrm{p}} = 712384.994103690 \ \ \mathrm{N} \qquad (34)$$
$$\text{Negatron} \quad {}^{\mathrm{i}}F_{\mathrm{n}} = {}^{\mathrm{m}}F_{\mathrm{n}} = 1.90407975318941 \ \ \mathrm{N} \qquad (35)$$

In order to establish the difference among NIST [9] and QEDa [5] magnetic constant; we calculate the existent relationship among their magnitudes and we reach the conclusion that the difference is exactly the inverse magnitude 137.036 of the denominated “fine-structure constant” in [9]. The relationship is

$$\frac{k_m}{\mu_0 \left(4\pi\right)^{-1}} = 10^7 h\left(2\pi c q^2\right)^{-1} = \frac{\left(10^7\right)\left(6.62606896\times10^{-34}\right)}{2\pi\left(299792458.\right)\left(1.602176487\times10^{-19}\right)^2}$$
$$= 137.035999694076 \simeq \frac{1}{\alpha} \simeq 137.036 \qquad (36)$$

The established correlation of magnetic constant with other constants is fundamental, as you can appreciate in the section **6**. The equation (31) is of fundamental importance because it correlates Newton [15], Ampere [1], Biot and Savart [2] Laws.

5.4. Electrons and protons in atomic orbit

The atomic particles have a trajectory in orbit on helix form -spin helix- at the speed of the light, whenever their quantum state is smaller or bigger to the unit, which creates a magnetic torus field content inside it. The magnitude of magnetic vector $\overline{B}_{sx}$ -tangent at orbit- of the toroidal magnetic field formed by the spin helix being P_x is the quantity step or pass of the spin helix (quantity of spires) and ${}^{\mathrm{cd}}r_x$ is

$$\overline{B_{sx}} = k_m \left[2\pi \left(^{\mathrm{cd}}r_x \right)^{-1} P_x \right] I_x = k_m \left[2\pi \left(h \left(2\pi c m_x \right)^{-1} \right)^{-1} \right.$$
$$\left. \cdot \left(^{\mathrm{v}}l_x \right)^2 \right] q m_x h^{-1} c^2 \left(^{\mathrm{v}}l_x \right)^{-2} = 4 k_m q h^{-2} \pi^2 m_x^2 c^3 \ , \qquad (37)$$

the cardinal orbit radius, per 2π is longitude of each step or pass then is given by the magnitude of magnetic force resultant ${}^{\mathrm{m}}F_{sx}$ of the toroidal magnetic field formed by the spin helix (20), (28) and (37) is

$$ {}^{\mathrm{m}}F_{sx} = I_x\left(L_{sx}\right)\overline{B_{sx}} = I_x\left(2\pi r_{sx}P_x\right)\overline{B_{sx}} = \left[qm_x h^{-1}c^2\left({}^{\mathrm{v}}l_x\right)^{-2}\right] $$

$$ \cdot\left[2\pi h\left(2\pi c m_x\right)^{-1}\sqrt{1-{}^{\mathrm{v}}Q_x^2\,{}^{\mathrm{v}}l_x^{-4}}\left({}^{\mathrm{v}}l_x\right)^2\right]\left[4k_m q h^{-2}\pi^2 m_x^2 c^3\right] $$

$$ = 4k_m h^{-2}\pi^2 q^2 m_x^2 c^4\sqrt{1-{}^{\mathrm{v}}Q_x^2\,{}^{\mathrm{v}}l_x^{-4}}\ , \qquad (38) $$

this resultant is exactly equal to the inertial resultants for the speed of spin tangential medium ${}^{\mathrm{i}}F_{sx}$ calculated with the (23).

5.5. Equilibrium condition of electrons and protons in atomic orbit

The electron and the proton only remain in orbit if these two conditions are necessarily satisfied

(a) The first condition is dynamics-potential, the resultant inertial (17) dependent of the speed tangential medium plus the potential resultant of electron or proton attracted among themselves should be exactly equal to the potential resultant; condition that we have already seen in the previous publications [5], [6], [7] and [8].

(b) The second condition is magnetic-dynamics, the inertial resultants for the speed of spin tangential medium ${}^{\mathrm{i}}F_{sx}$ (23) dependent of the vector speed of spin tangential medium v_{sx} should be equal to the magnitude resultant of magnetic force ${}^{\mathrm{m}}F_{sx}$ (38), due to the exact opposition of vectors, just as is showed in the following equation and being for hypothesis

$$ 2\pi h^{-1}m_x^2 c^3\sqrt{1-{}^{\mathrm{v}}Q_x^2\,{}^{\mathrm{v}}l_x^{-4}} = 4k_m h^{-2}\pi^2 q^2 m_x^2 c^4\sqrt{1-{}^{\mathrm{v}}Q_x^2\,{}^{\mathrm{v}}l_x^{-4}}\ , \qquad (39) $$

and k_m given by the equation (32) then it is verified

$$ 2\pi h^{-1}m_x^2 c^3\sqrt{1-{}^{\mathrm{v}}Q_x^2\,{}^{\mathrm{v}}l_x^{-4}} = 4h\left(2\pi c q^2\right)^{-1}h^{-2}\pi^2 q^2 m_x^2 c^4\sqrt{1-{}^{\mathrm{v}}Q_x^2\,{}^{\mathrm{v}}l_x^{-4}} \qquad (40) $$

5.6. Negatrons – Quantum states in atomic orbit

The negatrons have a smaller orbit radius than the cardinal radius, always the quantity of steps or pass of the spin helix is equal to the quantum status, and the travelled orbit longitude of the negatrons it is always equal to the longitude of cardinal radius orbit.

The magnitude of magnetic vector $\overline{B}_{\mathrm{sn}}$ -tangent at orbit- of the toroidal magnetic field formed by the spin helix, is given by

$$ \overline{B_{\mathrm{sn}}} = k_m\left[2\pi\,{}^{\mathrm{r}}l_{\mathrm{n}}\left({}^{\mathrm{cd}}r_{\mathrm{n}}\right)^{-1}\right]^{-1}I_{\mathrm{n}} $$

$$ = k_m\left[2\pi\,{}^{\mathrm{r}}l_{\mathrm{n}}\left(h\left(2\pi c m_{\mathrm{n}}\right)^{-1}\right)^{-1}\right]^{-1}qm_{\mathrm{n}}h^{-1}c^2 = 4k_m q\,{}^{\mathrm{r}}l_{\mathrm{n}}h^{-2}\pi^2 m_{\mathrm{n}}^2 c^3\ , \qquad (41) $$

then, the magnitude of magnetic force resultant ${}^{\mathrm{m}}F_{\mathrm{sn}}$ of the toroidal magnetic field formed by the spin helix is given by the following expression

$$
\begin{aligned}
{}^{\mathrm{m}}F_{\mathrm{sn}} = I_{\mathrm{n}}\left(L_{\mathrm{sn}}\right)\overline{B_{\mathrm{sn}}} &= qm_{\mathrm{n}}h^{-1}c^{2}\left(2\pi r_{\mathrm{sn}}\right)4k_{m}q\,{}^{\mathrm{r}}l_{\mathrm{n}}h^{-2}\pi^{2}m_{\mathrm{n}}^{2}c^{3} \\
&= qm_{\mathrm{n}}h^{-1}c^{2}\left[2\pi h\left(2\pi cm_{\mathrm{n}}\,{}^{\mathrm{r}}Q_{\mathrm{n}}\right)^{-1}\right]4k_{m}q\,{}^{\mathrm{r}}l_{\mathrm{n}}h^{-2}\pi^{2}m_{\mathrm{n}}^{2}c^{3} \\
&= 4k_{m}\,{}^{\mathrm{r}}l_{\mathrm{n}}h^{-2}\pi^{2}q^{2}m_{\mathrm{n}}^{2}c^{4}\sqrt{1-{}^{\mathrm{r}}Q_{\mathrm{n}}^{-2}}
\end{aligned}
\qquad (42)
$$

5.7. Equilibrium condition of negatrons in atomic orbit

The negatrons remain in orbit if only a condition necessarily is completed:

(a) The magnetic-dynamic equilibrium (22) and (42) is absolute and with dynamics-potential condition, the inertial resultant (16) of the speed medium plus the potential resultant of negatrons among each other should be exactly equal to the potential resultant of proton layer, condition that we have already seen in the previous publications [5], [6], [7] and [8]. Then being k_m given by the equation (32) then it is verified

$$
2\pi\,{}^{\mathrm{r}}l_{\mathrm{n}}h^{-1}m_{n}^{2}c^{3}\sqrt{1-{}^{\mathrm{r}}Q_{\mathrm{n}}^{-2}} = 4h\left(2\pi cq^{2}\right)^{-1}\,{}^{\mathrm{r}}l_{\mathrm{n}}h^{-2}\pi^{2}q^{2}m_{\mathrm{n}}^{2}c^{4}\sqrt{1-{}^{\mathrm{r}}Q_{\mathrm{n}}^{-2}} \qquad (43)
$$

5.8. Magnitudes in the toroidal magnetic field of spin

In the following table 1 have calculated the magnitude of spin inertial resultants and the magnitude of spin magnetic force for electrons, protons and negatrons in the whole hydrogen family and helium family, based on the calculations of atomic and nuclear equilibrium that I published in [5], [6], [7] and [8].

We see in this chart that the resulting magnitudes in electrons and protons vary in very small magnitude, independent of the quantum state of the same one, maintaining the existent conditions of stability in the quantum unitary state and calculated with the equation (31). While in the negatrons the auto-balanced resultants are being exactly equal to the product of the magnitude given for the orbit of cardinal radius in the expression (15) or (30) per the quantum state of the negatronic layer.

Table 1. The magnitudes of spin inertial resultants and spin magnetic force.

Substance	Particle	Quantum status Q_x	l_x	Eq. (22) (23) Newton[a]	Eq. (38) (43) Newton[a]	Eq. (15) (30) Newton[a]
^1H	e	136.94	137.	0.21156	0.21156	0.21156
^2H	e	136.99	137.	0.21156	0.21156	0.21156
^3H	e	136.99	137.	0.21156	0.21156	0.21156
^3He	e	174.03	175.	0.21156	0.21156	0.21156
^4He	e	174.03	175.	0.21156	0.21156	0.21156
^5He	e	174.03	175.	0.21156	0.21156	0.21156
^6He	e	174.03	175.	0.21156	0.21156	0.21156
^1H	p[b]	1.	1.	712384.99	712384.99	712384.99
^2H	p	16.87	17.	711170.76	711170.76	712384.99
^3H	p	27.29	28.	711953.25	711953.25	712384.99
^3He	p	19.17	20.	711566.33	711566.33	712384.99
^4He	p	15.01	16.	711159.44	711159.44	712384.99
^5He	p	20.90	21.	711584.21	711584.21	712384.99
^6He	p	17.32	18.	711366.87	711366.87	712384.99
^2H	n	59.44	59.	112.32481	112.32481	1.90408
^3H	n	38.34	38.	72.33041	72.33041	1.90408
^3He	n	55.92	55.	104.70764	104.70764	1.90408
^4He	n	66.82	66.	125.65519	125.65519	1.90408
^5He	n	44.58	44.	83.75843	83.75843	1.90408
^6He	n	54.84	54.	102.80321	102.80321	1.90408

[a] All calculations are carried out with expressions (15) or (30).
[b] The proton is in the cardinal radius –in quantum unitary status–.

In the case of the electrons that there are liberated of the orbital one that they occupied inside the atom, for any external action, these after a certain time always changes their energy state until arriving to the rest and occupying some inter-atomic interstice in the quantum unitary state, due to the collisions with the atoms of their domain and assuming finally in rest on the cardinal radius orbit.

6. Determination of dimensional constants

Knowing the relationship of magnetic constant k_m and electric constant k_e with the speed of the light we can determine the expression of electric constant

$$\text{being } c = \left(k_e k_m^{-1}\right)^{1/2} \text{ and } k_m = h\left(2\pi c q^2\right)^{-1} \quad \therefore \quad k_e = ch\left(2\pi q^2\right)^{-1} \tag{44}$$

We know that the Ampere [1] and Faraday Laws [11] in simultaneous form fulfill and knowing their relationship with the speed of the light, we can establish the calculation expressions of the permeability of free space μ_0 and the permittivity of free space ε_0

being $c = \left(\mu_0 \varepsilon_0\right)^{-1/2}$; $\mu_0 = 4\pi k_m$ and $\varepsilon_0 = \mu_0^{-1} c^{-2}$ then $\mu_0 = 2hc^{-1}q^{-2}$ (45)

and $\varepsilon_0 = q^2 \left(2ch\right)^{-1}$ (46)

Finally with the relationships already well-known of these constants, we can obtain the magnitude of impedance of free space Z_0

being $Z_0 = \overline{EH}^{-1} = \left(\mu_0 \varepsilon_0^{-1}\right)^{1/2} = \left[\left(2hc^{-1}q^{-2}\right)\left(2^{-1}c^{-1}h^{-1}q^{2}\right)^{-1}\right]^{1/2} = 2hq^{-2}$ (47)

then $Z_0 = 51625.6151202962\ \Omega$ (48)

The mass of the electron was calculated starting from the value of the frequency of wave 2.46606141318734(0.03)×10^{15} Hertz for Lyman's quantum skip ^{1}s←^{2}s, with enormous precision, obtained by Gross, Hansch, Huber, Prevedelli, Reichert, Udem and Weitz [12]. The calculation expression of the inertial mass of the electron [5] on p.115 and [8] on p.15, negatron and proton are

$$m_\mathrm{e} = 8h\left(137^2\right)\left(3c^2\right)^{-1}\left(2.46606141318724\times10^{15}\,\mathrm{Hz.}\right)$$

$$= 9.09972567274628\times10^{-31}\ \mathrm{kg} \quad (49)$$

$$m_\mathrm{n} = 3\times m_\mathrm{e} = 2.72991770182389\times10^{-30}\ \mathrm{kg} \quad (50)$$

$$m_\mathrm{p} = 1835.\times m_\mathrm{e} = 1.66979966094894\times10^{-27}\ \mathrm{kg} \quad (51)$$

The relationship of elementary charge q with of the constant of Planck [16], the speed of the light and the electric constant or magnetic constant are

$$q = \left[h\left(2\pi c k_m\right)^{-1}\right]^{1/2} \quad \text{or} \quad q = \left[ch\left(2\pi k_e\right)^{-1}\right]^{1/2} \quad (52)$$

Starting up from the inertial resultant for the speed tangential medium in cardinal radius $^{\mathrm{i}}F_\mathrm{x}$ (15), the total energy of each particle E_x could be calculated, in this case equal to their kinetic energy K_x because it is in quantum unitary state, making the product of the resulting force per the corresponding distance –cardinal radius (4)–, the following magnitudes can be obtained in each case in this way

$$E_x = {}^{\mathrm{i}}F_x r_x = \overbrace{2\pi h^{-1}c^3 m_x^2}^{\text{Force in Newton}} \cdot \overbrace{h\left(2\pi c m_x\right)^{-1}}^{\text{Distance in meter}} = m_x c^2\ \mathrm{J}, \quad (53)$$

then for each particle is

Electron $E_\mathrm{e} = m_\mathrm{e}c^2 = 8.178425574\times10^{-14}\ \mathrm{J.} = 510457.22115038\ \mathrm{eV}$ (54)

Negatron $E_\mathrm{n} = m_\mathrm{n}c^2 = 2.453527672\times10^{-13}\ \mathrm{J.} = 1.5313716634511\ \mathrm{MeV}$ (55)

Proton $E_\mathrm{p} = m_\mathrm{p}c^2 = 1.500741093\times10^{-10}\ \mathrm{J.} = 936.68900081096\ \mathrm{MeV}$, (56)

we can observe that the energy calculated in each particle is the maximum given by Einstein's relationship [10]. Continuing with the analysis, with expression (6) we will calculate the periods of orbit of each particle in the cardinal radius

Electron $t_{\mathrm{e}} = hm_{\mathrm{e}}^{-1}c^{-2} = 8.10188819410215\times10^{-21}$ s (57)

Negatron $t_{\mathrm{n}} = hm_{\mathrm{n}}^{-1}c^{-2} = 2.70062939803405\times10^{-21}$ s (58)

Proton $t_{\mathrm{p}} = hm_{\mathrm{p}}^{-1}c^{-2} = 4.41519792594123\times10^{-24}$ s (59)

If now we make the product of the total energy in the orbit of cardinal radius per the time that takes each particle in traveling the orbit, we will see just as it is shown in the following expressions that the obtained magnitudes are constant and exactly equal to the constant of Planck [16]

Electron $E_{\mathrm{e}}t_{\mathrm{e}} = 8.178425573\times10^{-14}$ J

$\times8.101888194\times10^{-21}$ s. $= 6.62606896\times10^{-34}$ J.s (60)

Negatron $E_{\mathrm{n}}t_{\mathrm{n}} = 2.453527672\times10^{-13}$ J

$\times2.700629398\times10^{-21}$ s. $= 6.62606896\times10^{-34}$ J.s (61)

Proton $E_{\mathrm{p}}t_{\mathrm{p}} = 1.500741093\times10^{-10}$ J

$\times4.415197926\times10^{-24}$ s. $= 6.62606896\times10^{-34}$ J.s (62)

because it is $E_x t_x = m_x c^2\left(hm_x^{-1}c^{-2}\right) = h$ J.s (63)

Note: I believe that it's time to remove the "fine-structure constant" inside the theoretical physics due to the error made by Niels Bohr [3], who assigned the quantum unitary state to the hydrogen 1 atom electron, instead of 136.93825632739532 for ${}^{\mathrm{v}}Q_{\mathrm{e}}$ and 137 exact value for ${}^{\mathrm{v}}l_{\mathrm{e}}$ quantum state of the electron, as I have demonstrated in my previous reports [5], [7] and [8]. This difference in approximate form was discovered by Arnold Sommerfeld [17] in 1916 when he studied the atomic spectral lines of this substance.

7. Summary

With the present work there are demonstrated the following properties theoretically

(a) All the atomic particles always move to the speed of the light.

(b) All atomic particles in state of rest, rotates at speed of the light in a tiny orbit, denominated cardinal radius orbit because it possess the quantum unitary state, maintaining a magnetic-dynamic absolute equilibrium.

(c) All electron, proton and negatron in atomic orbit or nuclear orbit, moves in a trajectory in helix form on orbit -spin- to the speed of the light. The movement of the charges determines an electric current, the intensity of this it induces a magnetic torus field in ring form into the spin helix that establishes a magnetic vector that annuls totally the inertial resultant of spin, maintaining a magnetic-dynamic absolute equilibrium, free the nuclear and atomic dynamic-potential equilibrium.

(d) The constant of Planck [16] result to be exactly equal to the kinetic energy of the particle in rest (in the orbit of cardinal radius - Quantum unitary state) multiplied by the period of orbit of the same one.

(e) The carried out analysis arises that the magnetic constant is directly proportional to the constant of Planck [16] and inversely proportional to the product of two Pi per the speed of the light and the square of the elementary charge.

8. Consequences

As consequence of the carried out analysis, there is not room for the smallest doubt that the mass of the atomic particles doesn't grow in function of the speed, although the speed of the light is reached, in opposition to derived theories of the Lorentz transformations [14].

The return property to the quantum unitary state (orbit of cardinal radius) in all free electron of atomic orbit has notable consequences in the interpretation of the physical phenomena that there is not clearly understood until today.

The electric and dielectrics properties of the substances, the capacitance, resistance and inductance phenomena by accumulation of free electrons in rest in the crystalline interstices, there are clearly explained. This will cause an important advance in the theoretical calculation and in the development of new technologies inside the field of electronic components.

One of the possible applications with more significance that we can achieve, due to the knowledge of all the physical implications of the electrons in rest, is the development of conductors without electric resistance that works with environment temperature, with the wanted longitude and flexibility (flexible superconductor), using molecular nanotubes with unidirectional magnetic canalization.

Another technological application that we can achieve is into the field of computation: the dimension can be decreased and the energy consumption of the devices process and memory can be reduced drastically too, if the architecture of crystalline nets is used with designed interstices in a way that allows the carry out individual and controlled operations to keep and to contain or to exchange free normalized electrons.

9. Dimensional and constant units

The system of dimensional units that I use is the IS (International System). I give the inertial mass of particles in function of the inertial mass of electron; therefore, I take as unit the inertial mass of other particles in function of the electron inertial mass. It’s expressed the electric constant and the magnetic constant respecting classic and old expression. I have calculated derived constants in function of the fundamentals constant. The value obtained for derived constants are 137.036 -the inverse “fine-structure constant”- times greater than the present magnitude except permittivity of free space and the impedance of free space that are in inverse form. I use the values published by NIST – National Institute of Standards and Technology (CODATA 2006) [9] for the constant of Planck [16], the elementary charge and the speed of the light. All the calculations of previous section were carried out with the magnitudes of these tables.

Table 2. Fundamental constants.

Symbol	Constant	Magnitude	Unit
c	Speed of the light	299792458.	m.s^{-1}
h	Planck constant (60, 61, 62)	6.62606896×10^{-34}	J.s
q	Elementary charge (52)	$1.602176487\times10^{-19}$	C
m_e	Inertial electron mass (49)	$9.09972567274628\times10^{-31}$	kg

Table 3. Derived constants.

Symbol	Constant	Magnitude	Unit
k_e	Electric constant (44)	$1.23161814398427\times10^{12}$	N.m^2.C^{-2}
k_m	Magnetic constant (44)	$1.37035999694076\times10^{-5}$	N.s^2.C^{-2}
μ_0	Permeability of free space (45)	$1.72204515966497\times10^{-4}$	W.A^{-1}.m^{-1}
ε_0	Permittivity of free space (46)	$6.46121299321843\times10^{-14}$	N^{-1}.m-^{2}.C^2
Z_0	Impedance of free space (47)	51625.6151202962	Ω
m_n	Inertial negatron mass (50)	$2.72991770182389\times10^{-30}$	kg
m_p	Inertial proton mass (51)	$1.66979966094894\times10^{-27}$	kg

Appendix A

In the cardinal radius orbit the speed of the particle is equal to speed of the light and the kinetic energy is maximum and equal to total energy, then this expression is given by Einstein's relationship [10]

$$^{\mathrm{cd}}E_x = {}^{\mathrm{cd}}K_x \text{ and } \overline{v_x} = c \qquad \text{then} \qquad {}^{\mathrm{cd}}E_x = m_x c^2 \ , \tag{A.1}$$

where $^{\mathrm{cd}}E_x$ is total energy of particle x in cardinal radius orbit, $^{\mathrm{cd}}K_x$ is the kinetic energy of particle x in cardinal radius orbit, $\overline{v}_x$ is speed of particle x in cardinal radius orbit and c is speed of the light. With the postulate of De Broglie [4] we can obtain the correlation of particle inertial mass with wavelength

$$^{\mathrm{cd}}\lambda_x = h\left(m_x \overline{v_x}\right)^{-1} \quad \therefore \quad m_x = h\left({}^{\mathrm{cd}}\lambda_x \overline{v_x}\right)^{-1} = h\left({}^{\mathrm{cd}}\lambda_x c\right)^{-1} \ , \tag{A.2}$$

where $^{\mathrm{cd}}\lambda_x$ is wavelength of particle x in cardinal radius orbit. Even though, being the wavelength equal to the orbit longitude in cardinal radius orbit is

$$^{\mathrm{cd}}\lambda_x = 2\pi\left({}^{\mathrm{cd}}r_x\right) \ , \tag{A.3}$$

where $^{\mathrm{cd}}r_x$ is orbit radius of particle x in cardinal orbit. If we replace in Einstein's relationship [10] the particle inertial mass by the mass relationship of De Broglie [4] is

$$m_x c^2 = \left[h\left({}^{\mathrm{cd}}\lambda_x c\right)^{-1}\right]c^2 = ch\left({}^{\mathrm{cd}}\lambda_x\right)^{-1} = ch\left(2\pi\,{}^{\mathrm{cd}}r_x\right)^{-1} \ , \tag{A.4}$$

then solving for the cardinal orbit radius in this last expression we can obtain

$$\text{Solve for } {}^{\mathrm{cd}}r_x \text{ in } m_x c^2 = ch\left(2\pi\,{}^{\mathrm{cd}}r_x\right)^{-1} \qquad \therefore \quad {}^{\mathrm{cd}}r_x \to h\left(2\pi c m_x\right)^{-1} \tag{A.5}$$

The expression (A.5) is what we were looking for and that is exactly equal to expression (4) on page 2.

See the excellent work of Dr. Bo Lehnert [13].

Glossary

Symbol	Definition
m_x	Inertial mass of particle x.
r_x	Atomic or nuclear orbit radius of particle x, always smaller or bigger than the cardinal radius.
${}^{cd}r_x$	Cardinal orbit radius of particle x, when the quantum state of particle is exactly equal to the unit, that it's a physical constant characteristic of each atomic particle.
r_{sx}	Radius of spin helix of particle x.
P_x	Quantity of step or pass of the spin helix of particle x.
${}^{v}Q_x$	Quantum vectorial number calculated with the atomic or nuclear stability expression for the particle x, when the quantum state of particle is bigger than the cardinal radius.
${}^{r}Q_x$	Quantum radial number calculated with the atomic or nuclear stability expression for the particle x, when the quantum state of particle is smaller than the cardinal radius.
${}^{v}l_x$	Quantum state of the particle x, the bigger integer most closely whereby the value of quantum vectorial number has been calculated.
${}^{r}l_x$	Quantum state of the particle x, the smaller integer most closely whereby the value of quantum radial number has been calculated.
t_x	Time in traveling an orbit of particle x.
$\overline{v}_x$	Speed vector of tangential medium of particle x.
$\overline{v}_{sx}$	Speed vector of the spin helix tangential medium of particle x.
${}^{i}F_x$	Inertial resultant to the speed tangential medium of particle x.
${}^{i}F_{sx}$	Inertial resultant to the speed for the spin helix tangential medium of particle x.
f_x	Frequency to pass particle x to the nodal points (extreme of the atomic axis where the passage of the atomic particles converges).
I_x	Electric intensity induced by the movement of particle x.
$\overline{B}_x$	Magnetic vector of particle x, transverse at the orbit plane for an only spire when particle x it is in orbit of cardinal radius. The particle is not in atomic or nuclear orbit.
${}^{m}F_x$	Magnetic force resultant on particle x in orbit of cardinal radius determined by the magnetic vector $\overline{B}_x$.
$\overline{B}_{sx}$	Magnetic vector of particle x, tangent at orbit of the toroidal magnetic field formed by the spin helix. For all particle that is in atomic or nuclear orbit.
${}^{m}F_{sx}$	Magnetic force resultant on particle x that is in atomic or nuclear orbit caused by the magnetic vector $\overline{B}_{sx}$.
E_x	Total energy resultant of particle x.
K_x	Kinetic energy resultant of particle x.

Note:

Left superscript	cd: respecting to cardinal orbit	i: inertial interaction
	m: magnetic interaction	e: electric interaction
	r: quantum state denominator	v: quantum state numerator
Right subscript	s: respecting to spin	x: any atomic particle
Particle subscript	e: electron n: negatron	p: proton

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