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ELECTRON RADIUS

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Abstract

This article is referred to the section of theoretical physics – “Elementary particles”. The author tries to explain some facts, applying methods of classical physics and local approach to microcosm, using the laws of motion of bodies in the potential field. The notion of mass is taken as the proportionality coefficient for energy in accordance with Einstein formula. The notion of energy connected with the center-of-mass reference frame underlies the reasoning. The energy level relative to the mass center can be simultaneously called the local reference frame. The local reference frames or energy levels in space differ in angular velocity. Having the local reference frame in the potential field, there is no need in the action at a distance principle [7].

Keywords: proton, electron, positron, photon, atom, reference frame.

Introduction

In order to calculate the interactions between elementary particles, it is necessary to use a demonstrative computational model. Such model suggests itself when observing the motion of planetary systems and is limited by the motion in closed systems in vacuum. The interactions between charged and neutral elementary particles are considered, as well as their structure and stability issues. All the calculations are given in International System of Units.

1. Potential field of elementary particles

Any elementary particle with the mass and energy equivalent to it generates potential field in space [5], or, otherwise, the system of local energy levels relative to the mass center in accordance with the following formula:

$$P1 = - G*M/R;$$

where P1 – potential of a space point; G – gravitational constant taken equal to 6.67*10^(-11); M – mass of an elementary particle; R – radius-vector of a space point in the reference frame of the particle mass center.

The spectrum of energy levels is continuous and balanced. Here we speak about a gravitational potential field. The gravitational potential field is an objective reality. If a sample mass unit gets into such field, its energy level is referenced from the local potential level in the mass center of the sample unit. The energy balance in the gravitational field for the mass center point of the sample unit is expressed by the following formula:

$$P = P1+P2 – P3 = 0;$$

where P – energy of a sample unit conditionally concentrated in its mass center; P2 – kinetic energy of a sample mass unit; P3 – own energy of a sample mass unit.

The kinetic energy of a sample mass unit is expressed by the following formula:

$$P2 = L^2/2*R^2;$$

where L – angular momentum of a sample mass unit in the mass center reference frame by the following formula:

$$L = R*V;$$

where V – tangent line modulus of the velocity vector component of a sample mass unit.

The acceleration of the force acting from the potential field side on the sample mass unit [4] equals:

$$g = dP3/dR= G*M/R^2 - L^2/R^3.$$

If the forces balance, the acceleration equals zero, the sample unit is in weightlessness and the following equality is true:

$$G*M = L^2/R; \text{ or } G*M/R = V^2.$$

It follows that value R*V^2 tends to constant value G*M with R change, i.e. to the force balance. If R increases, velocity V drops rapidly, in the limit of zero. If R decreases due to some reasons, velocity V rapidly grows. But its growth is limited by the impossibility to exceed the light speed. Therefore, in the gravitational field there is a minimally possible energy level with radius-vector R, found by the formula below, balanced for a sample unit:

$$R = G*M/c^2; \quad (1)$$

where M – mass located in this volume and being the gravitational field source. From the formula (1) it is seen that the radius of mass M tends to the constant value equal to G*M/c^2, since here there is the force balance. Mass M itself tends to compression, if its radius is greater than the one indicated in the formula (1). All real bodies in space are forced to experience the compression force by their existence, apart from elementary particles. Elementary particles can keep the force balance in their gravitational field.

2. Elementary contour of space

In 3D microcosm the energy is transported by photons. A photon is an elementary particle having mass-energy and obeying the gravitational field laws. A photon peculiarity is its motion with a constant velocity in the center-of-mass frame of reference of the potential field. Since a photon is a neutral particle, let us assume that it consists of two oppositely charged particles with the same mass located symmetrically on one axis. The photon kinetic energy by Einstein [1] equals:

$$h*n = 2*M*c^2; \quad (2)$$

where M – mass of each of the two elementary particles of the photon structure; c – light speed in vacuum taken equal to 2.998*10^8, n – photon frequency, h – Plank constant taken equal to 6.626*10^(- 34).

The formula (2) refers exactly to the photon energy relative to the frame of reference connected with the observer, as it comprises the energy of translational and local rotational motions of the photon.

If the photon frequency equals one, its energy by the formula (2) equals:

$$h = 2*Mo*c^2.$$

The corresponding mass equals:

$$Mo = h/2*c^2 = 0,368*10^{(-50)}. \quad (3)$$

A particle with mass Mo has the minimal possible volume in space, since it tends to the force balance of its potential field by the formula (1).

$$G*Mo = G*h/2*c^2; \; G*Mo/Ro = c^2.$$

So, as a result, we have the following equality:

$$Ro = 2.73*10^{(-78)};$$

Let this space volume be an elementary 3D contour. An elementary photon corresponds to the elementary contour. For the photon to move with the light speed relative to the observer being on the axis of symmetry, it is necessary that the number of revolutions of each of the two particles constituting the photon [3] satisfies the following dependence:

$$No = c/2*3.14*Ro = 1.75*10^{85}; \quad (4)$$

where No – number of revolutions of each of the two particles constituting the photon.

If the normal lines of the rotation planes of these particles are oppositely directed, the mass centers of the photon and its particles move with the light speed relative to the observer. The same speed corresponds to the energy level of points of external contours of the photon particles relative to their mass centers. All these conditions provide the existence of so-called charges of elementary particles. Actually, only two variants of particles are possible in 3D space, at any rotation of which around any axes, it is impossible to completely match their axes. At least one of their axes is always oppositely directed. This property of particles is called “opposite charges”.

It follows from the formula (4) that the product of the particle number of revolutions and its radius is a constant value for all photons. Based on the elementary contour parameters we find that it equals:

$$No*Ro = 0.478*10^8.$$

Let us find the numerical value of the elementary charge based on the aforementioned ideas and law of energy conservation, Laplace’s and Ampere’s laws. The kinetic energy of elementary contour rotation equals:

$$I*w^2/2 = Mo*c^2/2;$$

where w – contour angular velocity; I – contour inertia momentum, taken here as equal to: I = Mo*Ro^2.

Let us assume that the contour rotation energy is the circular electric current energy by the following formula [1]:

$$Io = q*No;$$

where q – charge of the contour rotating with the light speed and number of revolutions No.

Then the magnetic induction is generated inside the contour [9] by the following formula:

$$Bo = 1.25*10^{(-6)}*q*No/2Ro = 0.64*10^{138}.$$

From this: $$q = 2*Bo*Ro/1.25*10^{(-6)}*No; \quad (5)$$

Substituting the above values in the formula (5) we have:

$$q = 1.6*10^{(-19)}$$

We find the magnetic induction value inside the elementary contour based on the following ideas. Let us assume that a photon with sufficient energy consists of two particles: electron and positron. To move with the light speed relative to the observer, it needs to have the angular velocities of the particles equal to: w = c/Re [3]. Let the photon move along axis X and let the particles rotate around oppositely directed axes Y. We find the numerical value of the electron radius by the formula (1). It equals:

$$Re = G*Me/c^2 = 67.7*10^{(-59)}$$

The electron number of revolutions per second equals:

$$Ne = c/6.28*Re = 7.06*10^{64}$$

Knowing the electron charge value and its number of revolutions in the photon, let us find its circular electric current. It equals:

$$Ie = e*Ne = 1.6*10^{(-19)}*7.06*10^{64} = 11.3*10^{45};$$

where e – electron charge taken equal to $1.6*10^{(-19)}$ [7].

The inductivity of the circular current magnetic field inside the electron contour equals:

$$Be = 1.25*10^{(-6)}*Ie/2*Re = 1.06*10^{97}$$

Consequently, the magnetic flow through the electron contour equals the product of induction and contour section area. The contour section area equals:

$$Se = 3.14*Re^2 = 142*10^{(-116)};$$

The magnetic flow through the electron contour equals:

$$\Phi e = Be*Se = 1.5*10^{(-17)}$$

It should be assumed here that the contour of any elementary particle of radius R in space with circular angular velocity w = c/R penetrates into the constant magnetic flow equal to:

$$\Phi = 1.5*10^{(-17)} \qquad (6)$$

The magnetic flow, generated by the elementary particle contour outside it, is the same but it is distributed proportionally to the increase in the area section and produces the magnetic induction decreasing in the same proportion.

Let us prove this assumption on the example of other elementary particles calculating the magnetic induction values inside their contour section for them. All stable elementary particles have the potential level of their external contour equal to the squared light speed and angular velocity of the external contour equal to: c/R;

where R – radius-vector of the particle external contour.

The term “magnetic flow” is used here as a common one. Actually, it is necessary to speak about the intensity. Using the expression (6), we can find induction inside the elementary contour. It equals:

$$Bo = \Phi o/So = 0.64*10^{138};$$

where So – section area of the elementary contour equal to:

$$So = 3.14*Ro^2 = 25.4*10^{(-156)}.$$

So, the particle charge of any photon is simply the coefficient of proportionality between the light speed and magnetic flow in the closed contour of any elementary particle. The formula for the elementary charge is as follows:

$$e = 4*\Phi/1.25*10^{(-6)}*c = 1.6*10^{(-19)}\ ; \qquad (7)$$

where Φ – magnetic flow through the contour section of an elementary particle by the formula (6); c – light speed in vacuum.

3. Electron

Let us consider the photon by the energy equal to the sum of energies of the electron and positron, which, under certain conditions, can break down into two elementary particles – electron and positron [2]. The kinetic energy for it can be written down as follows:

$$P2 = 2*Me*c^2 = h*n;\ Me/n = h/2*c^2; \qquad (8)$$

where Me – mass of the electron or positron taken equal to $9.11*10^{(-31)}$; n – photon frequency.

From the formula (8) it is seen that each of the considered elementary particles consists of n smaller particles equal to Mo [8]. Let us find the number of smaller particles in the electron or positron. It equals:

$$n = Me/Mo = 24.8*10^{19}.$$

The electron estimated mass is located in the particle external layer. This layer represents the trajectory of elementary photons moving on it with the light speed.

4. Proton

The photon, by energy equal to the sum of energies of the proton and antiproton, can break down into two corresponding particles and is subordinated to the following formula:

$$2*Mp*c^2 = h*n; Mp/n = h/2*c^2;$$

where Mp – proton mass equal to 1.67*10^(-27) [7]; n – number of small particles in the proton.

Let us find the number of small particles in the proton or antiproton. It equals:

$$n = Mp/Mo = 4.54*10^{23}.$$

Let us calculate the proton radius by the formula (1). It equals:

$$Rp = G*Mp/c^2 = 1.24*10^{(-54)}.$$

The number of proton revolutions equals:

$$Np = c/6{,}28*Rp = 0.386*10^{62}.$$

The circular current equals:

$$Ip = e*Np = 617*10^{40}.$$

The magnetic induction in the proton contour equals:

$$Bp = 1.25*10^{(-6)}*Ip/2*Rp = 311*10^{88}.$$

Consequently, the magnetic flow through the contour equals:

$$\Phi p = Bp*Sp = 1.5*10^{(-17)}; \quad (9)$$

where Sp – section area of the proton contour taken equal to: Sp = 4.815*10^(-108).

The correlations (6) and (9) confirm that the magnetic flow, constant by the value and the same for all stable particles, passes through the contours of elementary particles.

The proton structure is similar to the electron structure. Instead of elementary photons, the photons, consisting of electrons and positrons, move with the light speed in the proton external layer.

5. Hydrogen atom with one electron

In the proton potential field, there are such points, in which the gravitational potential equals the following value:

$$G*Mp/Rb = G*h/Rb^2;$$

where Rb – radius-vector of these points equal to Rb = 3.97*10^(-7).

There is a stable particle among the elementary ones, having points with the same potential by the value relative to its mass center in its potential field. This particle is called “an electron”. When matching these points in space, a stable system of two particles, namely, a hydrogen atom, is formed.

A hydrogen atom with one electron has the point of balance of the potentials by the following formula:

$$Mp*Rbe = Me*Rb;$$

where Rbe – radius-vector of the point of balance of the potentials in the electron center-of-mass reference frame equal to Rbe = 21.64*10^(-11).

In the point of balance of the potentials of the obtained system, the level of the potentials of both fields is the same. It equals:

$$P1 = - G*Mp/Rb = - G*Me/Rbe.$$

The single angular momentum in the point of balance of the potentials squared equals:

$$Lb^2 = G*Mp*Rb = G*h.$$

The equality for a stable hydrogen atom follows from this:

$$Mp = h/Rb = 1.67*10^{(-27)}.$$

As well as the approximate squared value of the electron tangential velocity in the atom equal to:

$$V^2 = G*Mp/(Rb+Rbe) = 0.28*10^{(-30)}.$$

6. Interaction of electrical charges

6.1. Let us consider the photon with the energy corresponding to the pair of elementary particles – electron and positron. This photon represents the pair embedded into the general symmetrical system. Centers of the particles are fixed relative to each other. The interaction between them is based on Coulomb’s law. The distances between them equals: 2*Re = 135.4*10^(-59). Therefore, the attraction force in the photon by Coulomb’s law [6] equals:

$$Fe = 9*10^9*e^2/4*Re^2 = 1.25*10^{86} \quad (10)$$

By Ampere's law, the same interaction force is found by the following formula:

$$F = B*l*I;$$

$$Fe = 1,25*10^{86}; \quad (11)$$

where B – induction of the magnetic flow from the side of the electron in the positron center point, which equals: $B = \Phi/S = 0.26*10^{97}$;

where S – section area of the contour with the radius-vector of the positron mass center relative to the electron mass center equal to 2*Re:

$$S = 3.14*(2*Re)^2 = 5.67*10^{(-114)};$$

where l – length of the positron external contour equal to: $le = 2*3.14*Re = 425*10^{(-59)}$; Ie – positron circular current equal to $11.3*10^{45}$.

The expressions (10) and (11) demonstrate similar results with sufficient accuracy degree. It proves that the term "electron charge" means one of coefficients of the proportionality between the light speed and magnetic induction in an elementary contour.

6.2. Interaction of particles in photon consisting of elementary contours.

By Coulomb's law, the interaction of elementary contours equals:

$$Fo = 9*10^9*e^2/4*Ro^2 = 7.72*10^{126}.$$

The same interaction by Ampere's law is subordinated to the formula:

$$Fo = Bo*lo*Io = 7.74*10^{126};$$

where Bo – induction inside the contour with the radius-vector equal to 2*Ro taken equal to $1.62*10^{137}$;

where lo – length of the particle external contour taken equal to $17.1*10^{(-78)}$; Io – electric current in the particle external contour taken equal to $0.28*10^{67}$.

6.3. Interaction of particles in photon consisting of proton and antiproton.

By Coulomb's law the interaction equals:

$$Fp = 9*10^9*e^2/4*Rp^2 = 3.75*10^{79}.$$

The same interaction by Ampere's law equals:

$$Fp = Bp*lp*Ip = 3.75*10^{79};$$

where lp – length of the antiproton external contour taken equal to $7.75*10^{(-54)}$; Bp – magnetic flow induction inside the contour with the radius-vector equal to 2*Rp taken equal to: $7.8*10^{89}$; Ip – circular electrical current of the proton taken equal to: $Ip = 0.62*10^{43}$.

6.4. Interaction of elementary particles in hydrogen atom.

Let us consider a hydrogen atom with one electron. Let us assume that the electron is on some orbit. Let us apply Coulomb's law for this case, considering that the electron moves but the proton does not produce a magnetic field. By Coulomb's law, their interaction equals:

$$F = 9*10^9*e^2/(Rb + Rbe)^2 = 1.47*10^{(-15)};$$

where Rb – radius-vector of the point of balance of the potentials in the proton center-of-mass reference frame taken equal to $3.97*10^{(-7)}$; Rbe – radius-vector of the point of balance of the potentials in the electron center-of-mass reference frame taken equal to $21.64*10^{(-11)}$.

By Ampere's law, the same interaction equals to:

$$F = B*le*Ie = 1.47*10^{(-15)};$$

where B – induction of the magnetic flow produced by the proton in the electron mass center taken equal to: $3.06*10^{(-5)}$;

where le – length of the electron external layer taken equal to $425*10^{(-59)}$; Ie – circular electric current of the electron taken equal to $11.3*10^{45}$.

6.5. Interaction of elementary particles in atom nucleus.

Positively charged particles are observed in an atomic nucleus [6]. But as we have found out above, the volume less than elementary contour volume or the volume occupied by an elementary particle cannot exist in space, therefore, an atom nucleus is constructed by the same principle as an elementary particle. It represents a circular contour, by which photons move with the light speed. Electrons are added to this contour into the gaps between the photons, having the same potential relative to their mass centers. It happens so, if there is one proton in the atom nucleus. If there are k protons in the atom nucleus, the nucleus radius is found by the following formula:

$$Ra = k*Mp*G/c^2. \quad (12)$$

The correlation (12) shows that protons in the atom nucleus are added to each other by the points with the same energy levels relative to their mass centers. The electrons act in the same way. The photons are uniformly and symmetrically distributed along the ring, in complex atoms – along the axes of 3D space. The electrons are inserted between them. All interactions between particles in an atom follow Ampere's law.

Thus, an atom nucleus does not consist of protons and neutrons [6], it consists of protons and antiprotons, constituting photons moving along the nucleus contour.

An atom is constructed due to the balance of energies of the particles in the gravitational potential field. An electron is attracted to such nucleus not because it is negatively charged, but because its potential level relative to the nucleus mass center is the same and it is added to the nucleus ring into the gaps between the photons. It happens successively along all three Cartesian axes, as a result, an atom represents a 3D spatial structure.

Conclusions

1. Space is a 3D system of energy levels around elementary contours corresponding to the correlation of their elementary mass to the radius of the volume occupied equal to: Mo/Ro = c^2/G.

2. Elementary contour of space is the least existing volume. Its energy level corresponds to the rotation energy value with the angular velocity equal to: w = c/Ro.

3. All photons consist of a pair of elementary particles and antiparticles.

4. All particles consist of elementary contours.

5. Particle stability is determined by the stability of its gravitational field.

6. There are no special charges of particles. Interactions are determined by Ampere's law.

7. Nuclei of atoms do not consist of protons and neutrons but of protons and antiprotons in the form of photons corresponding by energy.

8. All bodies experience a compression force in their own potential field because they have the following correlation of their parameters: M/R < c^2/G. This is a mysterious force of the universal gravitation.

9. Stable elementary particles have the following correlation of the parameters:

M/R = c^2/G.

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