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INTERRELATION OF CALCULATION FORMULAS AND A GEOMETRIC MODEL OF MICROPARTICLES IN THE FUNDAMENTAL FIELD THEORY OF I.L. GERLOVIN

The Fundamental Field Theory (FFT) developed by I.L. Gerlovin [1] presents a model of microparticles in the computational functional-geometric subspace (2 →1), which explains the absence of field radiation in stable microparticles.   This model is represented by two current rings (birotator) of discrete subparticles rotating with sublight linear velocities located in the plane. On the first ring of radius $R1$ there are $n1$ charged subparticles rotating with linear relative velocity $b1$, on the second ring with radius $R2<R1$ there are $n2<n1$ charged subparticles rotating with linear relative velocity $b2$.

It is known [2] that for a moving charged point particle, the electric component of the field of this particle is compressed in the direction of the velocity vector, and the magnetic component of the field appears in the perpendicular plane. According to the book [2, p.170], the compression coefficient of the electric field is determined by the linear velocity of the particle b and the angle γ between the velocity vector and the field direction.

$$K=(1-b^2)/(1-(b_* sin(\gamma))^2)^{3/2} \tag{1}$$

Taking into account this phenomenon, Fig. 1 shows the geometrical location of the electric components vectors for the subparticle fields in the orbital and axial planes in the birotator model.
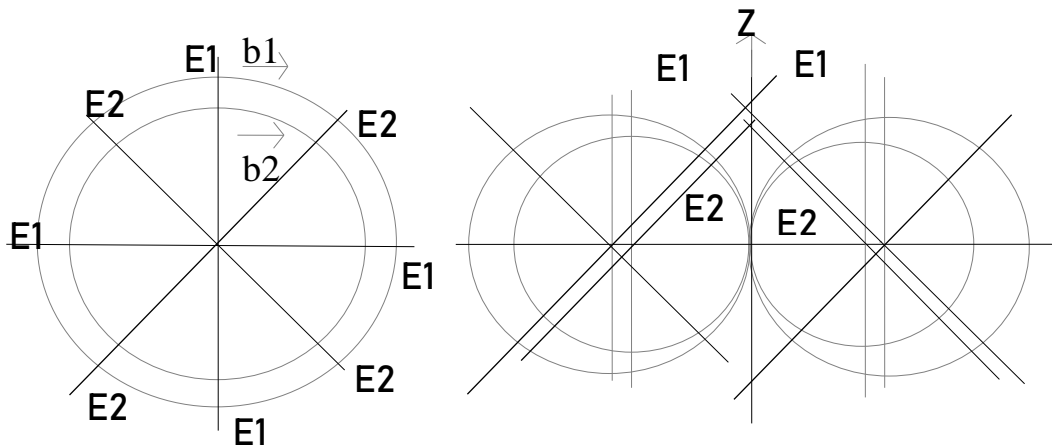

Fig. 1. Direction of the electric components of the subparticle fields in the orbital and axial, along the Z rotation axis, planes in the birotator model.

In the birotator model, electric and magnetic forces act between the subparticles. Taking into account the result of electric interaction of subparticles in an orbit with the same sign of charge under the condition $R1- R2 >>2\pi R2/n2,$ it is

necessary to assume their equidistant location in their orbits. As a result, the partial orbital angle between the subparticles for the outer orbit will be $\varphi 1=2\pi/n1$, and for the inner one - $\varphi 2=2\pi/n2$. According to the FFT equations, the condition $n2<n1$ is satisfied for the subparticles and, correspondingly, the condition $\varphi 1 <\varphi 2$ is satisfied for the partial angles. This inequality means that in one outer segment of the orbital plane there is no more than one subparticle of the inner orbit between two subparticles of the outer orbit. According to the formula in Table 16.1 in book [1], the ratio of orbital radiuses $R1/R2=b1/b2*n1/n2$. Since the angular velocities of rotation of subparticles on their orbits are equal to $\omega 1=b1/R1$ and $\omega 2=b2/R2$ and their ratio will be equal too: $\omega 1/\omega 2=n2/n1$, i.e. $\omega 1<\omega 2$. Also for the values of angular velocities the condition $\omega 1,\omega 2 >>(\omega 2 -\omega 1)$ is fulfilled. The latter condition allows us to perform in the quasi-static regime an approximate calculation of the instantaneous electric interaction forces between three subparticles for one external segment of the model with their subsequent addition for all $n2$ subparticles of the inner orbit.

A clear explanation of the above FFT dependences is given by analyzing the geometrical representation of the instantaneous interaction of point charges with one internal and two external subparticles in one external segment on the orbital plane, as shown in Fig. 2.
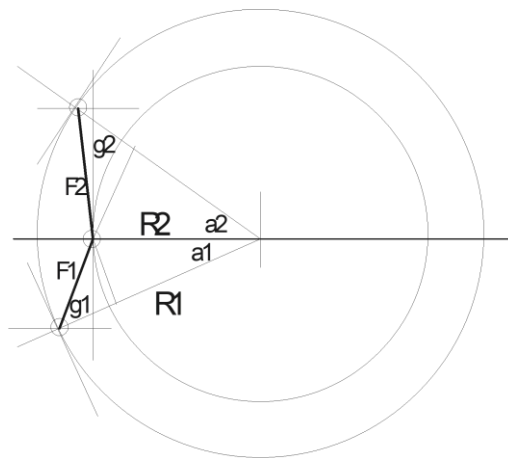

Figure 2. Calculated segment of the microparticle model on the orbital plane.

This figure shows the formation of the interaction force vectors of two charged subparticles on the external (charges "q11i" = "q12i") and one on the internal (charge "q2i") orbits. In a rotating with velocity $b0=(b1+b2)/2$ coordinate system the electric component of the interaction forces of one internal subparticle with two external subparticles of the same segment under the condition $b0 >>(b1-b2)$ can be calculated by Coulomb's law

$$F_{E\,i} \approx 4* q1i* q2i /e_{o*} (r1^{-2} +r2^{-2}), \qquad (2)$$

where $q1i, q2i$ are charges of subparticles of external and internal orbits,
e_o - dielectric permittivity of vacuum,

r1, r2 - distances between interacting subparticles on orbits.

In absolute value the calculated product Q of point charges of single subparticles of external and internal orbits for stable microparticles can be approximately determined by FFT formulas from Table №16.1 of the book [1]:

$$Q=q1_i * q2_i \approx q1 /n1 * (q1 - q)/n2, \qquad (3)$$

where *q1 is the* total charge of subparticles of the outer orbit and
q is the total charge of the microparticle in units *(√hi* c).*

Consider the geometry of an individual segment shown in Figure 2. In each *n (n=1: n1)* segment of the outer orbit, the values of the angles are equal:

$$a1= (\varphi2- \varphi1) * (n-1) = 2\pi * (n-1) * (n1-n2)/n1/n2,$$
$$a2 = 2\pi/n1 - a1 = 2\pi/n1/n2 * (n2 - (n-1) * (n1-n2)). \qquad (4)$$

At known angles *a1, a2* indicated in Figure 2 design angles *g1, g2* are calculated by the formulas:

$g1=arctg (R2 * sin(a1) /(R1-R2 * cos(a1)), g2=arctg (R2 * sin(a2)/(R1- R2 * cos(a2)),$

and the squares of distances between interacting subparticles of the segment:

$$r1^2 =R1^2 +R2^2 - 2R1 * R2 * cos(a1), r2^2 =R1^2 +R2^2 - 2R1 * R2 * cos(a2). \qquad (5)$$

Using the above equations by formulas (2-5), we can calculate for one segment the interaction forces between the subparticles of the outer *F1* and the inner *F2* orbits, as well as the radial and orbital projections of these forces. Taking into account the direction and influence of orbital velocities of subparticles according to formula (1), these projections of forces are equal:

$$F1_{ri} = (F12 * cos(g1)+ F32 * cos(g2))/(1-b1)^{21/2} , \qquad (6)$$
$$F2_{ri} = - (F12 * cos(g1+a1)+ F32 * cos(g2+a2))/ (1-b2)^{21/2} , \qquad (7)$$
$$F1_{vi} = (F12 * sin(g1)- F32 * sin(g2)) * (1-b1^2), \qquad (8)$$
$$F2_{vi} =(-F12 * sin(g1+a1) +F32 * sin(g2+a2)) * (1-b2^2). \qquad (9)$$

In the above expressions for the projections of forces, it is assumed that positive radial projections correspond to centripetal forces, and positive orbital projections correspond to forces with the right direction of rotation. In the case of opposite charges of subparticles of external and internal orbits, the influence of the electric component of the field leads to the appearance of mutual attraction forces.

Since the angular velocity of rotation of internal subparticles exceeds the angular velocity of external subparticles, the values of angles *a1, a2* within the calculation segment will change in time. The period of repetition of phase states of subparticles in the calculation segments is determined by the difference of orbital angular velocities *(ω2 - ω1)*:

$$T =2\pi/(\omega2 - \omega1)=2\pi R1 * n2 /(c * b1 * (n1-n2)) =2\pi R2 * n1/(c * b2 * (n1-n2)), (10)$$

where *c* is the speed of light in vacuum.

Taking this condition into account leads to the necessity of temporal integration of the calculated projections of the interaction forces (6 - 9) with discretization of the integration period *T* by at least *n1* ∗ *n2* samples:

$$F = \sum_1^T (F_t) / n1/n2. \tag{11}$$

For more accurate calculation of the integral value of the interaction forces it is required to perform discretization of the repetition period by *n1* ∗ *n2* ∗ *(n1-n2)* samples, at which the required time for performing integration calculations increases significantly.

As a result of calculation of integral values of radial projections of interaction forces and subsequent summation of simultaneous interaction for all *n2* subparticles of the inner orbit, we can determine the values of centrifugal and centripetal forces for the total masses of subparticles of the outer *m1* and inner *m2* orbits and the total mass *M* of the microparticle:

$$F1 = \sum_1^{n2} (F1_{ri}), \quad F2 = \sum_1^{n2} (F2_{ri}), \tag{12}$$
$$m1 = F1 * R1/(c * b1)^2, \quad m2 = F2 * R2/(c * b2)^2, \tag{13}$$
$$M = m1 + m2. \tag{14}$$

The presence of centrifugal forces in the birotator explains the reason for the appearance of the calculated negative orbital masses. The microparticles with total negative masses caused by the excess of centrifugal forces over centripetal forces must decay.

The summation of the integral values of the orbital projections of the interaction forces allows us to find the total moments of the rotational forces of the orbital subparticles:

$$MV1 = R1 * \sum_1^{n2} (F1_{vi}), \quad MV2 = R2 * \sum_{*1}^{n2} (F2_{vi}). \tag{15}$$

The emergence of these moments of rotational forces is the reason for the existence of orbital currents from rotating discrete subparticles in the birotator. These orbital currents, depending on their direction, lead to the origin of magnetic forces, which influence the attraction and splitting of orbits. But since the relative velocity of subparticles in orbits is insignificant compared to their linear velocities: *(b1-b2)<<b1,b2,* the influence of magnetic forces in the general interaction can be neglected.

On the rotation axis *Z* perpendicular to the orbital plane passing through the center of the birotator, the projections of the electric field strength vectors of all subparticles will be summed up taking into account the sign of the charge forming them: $E_z = \sum q1i / e_o / r^2$. The geometrical representation of this process is shown in Fig. 3.
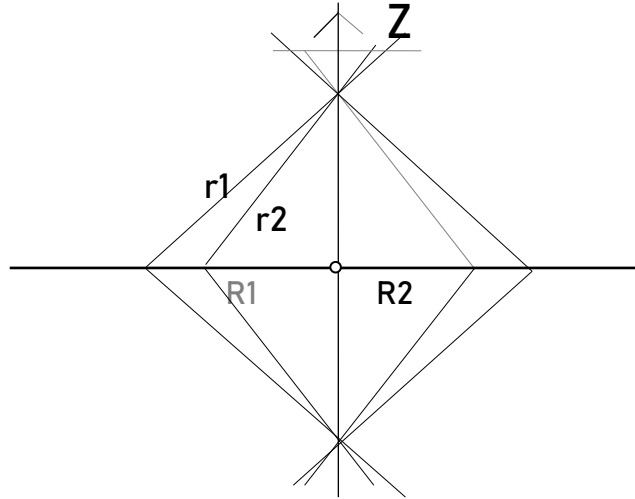
Fig.3. Projections of subparticle electric field strength vectors on the Z axis.

At arrangement on current rings of charges of opposite sign the total field strength at the opposition distances along the Z axis will be equal to the difference of the projections of the strengths:

$$r1 = (R1^2 + z^2)^{1/2}, \quad r2 = (R2^2 + z^2)^{1/2},$$

$$E_z = E1 - E2 = z/e_{o*}[q1/(1-b1^2)^{1/2}/r1^3 - (q1-q)/(1-b2^2)^{1/2}/r2^3], \quad (16)$$

where z is the distance along the Z axis relative to the center.

The integral value of the magnetic field strength along the axis Z is created by the orbital currents of the external $I1$ and internal $I2$ orbits, which, taking into account the one-sided rotation of opposite charges and the above-mentioned condition of the direction according to the source [2, p.208], is equal:

$$H_z = 2\pi * [R2^2 * I2/(R2^2 + z^2)^{3/2} - R1^2 * I1/(R1^2 + z^2)^{3/2}] =$$
$$= c * ((q1-q)*b2*R2/r2^3 - q1*b1*R1/r1^3). \quad (17)$$

In the center of the orbital plane magnetic field is equal

$$H_0 = c * ((q1-q)*b2/R2^2 - q1*b1/R1^2).$$

Based on the above formulas (6-17), a calculation program was developed using the MATLAB program package and the calculation was performed for the optimal particle of the first row 1.19.1 ("proton"). The initial data of this microparticle were taken from Table №18 of the source [1]:

$n1=6330, n2=5494, R1=2.20712e-16(m), R2=1.91304e-16(m), q1=1.24052(\sqrt{hi} * c), q=1.0(\sqrt{hi} * c), b1=0.9988374223667, b2=0.9987217396663.$

Reference values of physical constants and experimental data as of 2022 were used in the calculation:

$c=2.99792458e8(m/s), e_o=(4\pi * 9e9)^{-1}(F/m), \mu_o=4\pi * 1e-7(H/m),$
$e=1.602176634e-19(C); Ai=7.2973525356e-3;$
$mp=1.672621192369e-27(kg).$

For this microparticle, the integral values of the masses of the external and internal rotators are obtained as a result of PC calculations:

$$m1 = 1.01234217783030671e-26(kg), \quad m2 = -8.453407829166879e-27(kg),$$

and total mass of a microparticle 1.19.1

$$M = 1.670013949139830e-27(kg).$$

At more complete time integration the calculated value is obtained
        M= 1.67003161212e-27(kg).
        The calculation results show that even for the minimum discretization at time integration the deviation of *the* calculated value of the proton mass relative to the experimental value is *minus 0.00156.*

        The dependences of electric and magnetic field strengths of the microparticle 1.19.1 calculated by formulas (16, 17) along the rotation axis Z are presented in Figs. 4, 5. These dependences show the maximum value of the electric field strength at a distance of *0.7R1* from the center of the birotator and the maximum (modulo) value of the magnetic field strength in the center of the birotator.
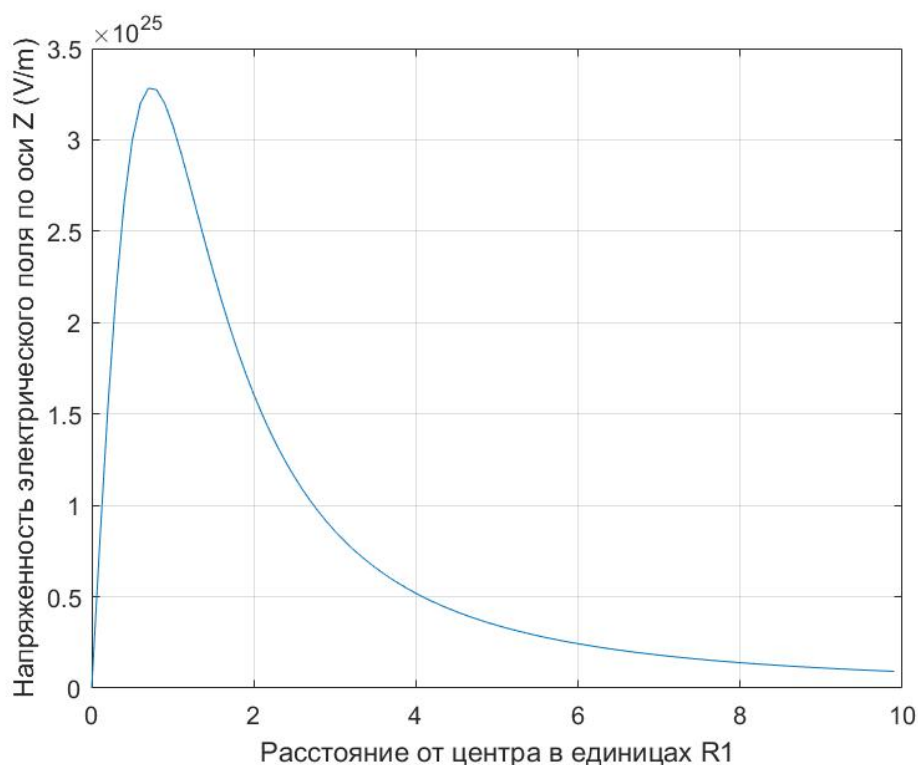

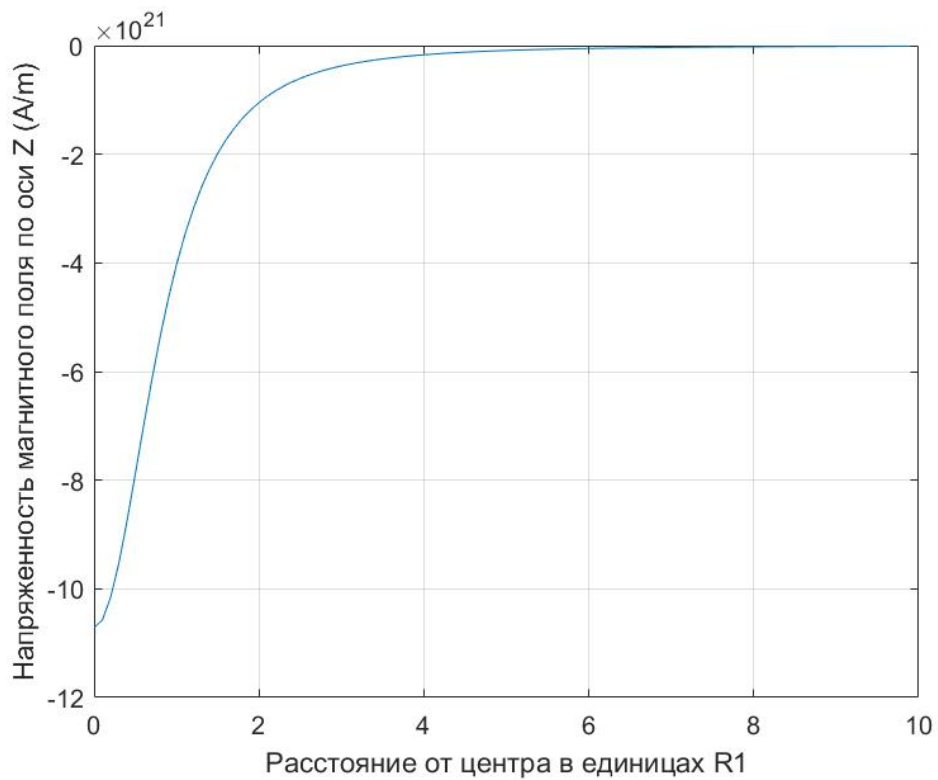Fig.4. Electric field strength of microparticle 1.19.1 on the rotation axis.

Fig.5. Magnetic field strength of microparticle 1.19.1 on the rotation axis.

Literature.
1. Gerlovin I.L. Fundamentals of the Unified theory of all interactions in matter. - L. Energoatomizdat, 1990.
2. Э. Parcell. Electricity and magnetism. Berkeley course of physics, T2. - M. Nauka, 1975.