Gravity in the Microworld

Anatoly V. Belyakov
E-mail: belyakov.lih@gmail.com

A brief review article gives examples of using the physical model based on the mechanistic interpretation of J. Wheeler's geometrodynamics. The examples show the need to consider gravity in the microworld. The latter is based on the balance of magnetic and gravitational forces.The gravitational constant was used in calculating the masses of quarks, neutrinos, proton size, coupling constants, etc. A new deviation of 28 GeV in the physical experiments of CMS Collaboration was confirmed by calculations. The unusual value of s- quark and b- quark masses is explained.

1 Introduction

In the Standard Model of Fundamental Interactions (SM), gravitational forces are not taken into account. However, the model based on the geometrodynamics of John Wheeler (Wheeler John Archibald) has proved the need for introducing gravitational forces into the microworld.

In the mechanistic interpretation of J. A. Weheler's geometrodynamic, charged microparticles are singular points on a non-simply connected two-dimensional surface of our world, connected by a "wormhole" or a drain-source current line in an additional dimension, forming a closed contour. But "wormholes", by necessity and by virtue of physical analogy in their mechanistic interpretation, can only be vortex current tubes, where the charge is in the "coulombless" form proportional to the medium momentum along the vortex current tube, spin, respectively, to the angular momentum relative to the longitudinal contour axis, and the magnetic interaction between the conductors is similar to the forces acting between the current tubes [1].

In this model, the electron size with mass m_e and radius r_e is taken as a medium unit element, and then the contour mass becomes proportional to its length. It is this hidden mass and its motion that is responsible for gravity, charge, spin, and magnetic interaction in the microworld. The introduction of gravity into the microworld allows one to explain various micro-phenomena and in some cases to calculate some important parameters quite accurately, using only fundamental constants and an elementary mathematical apparatus.

2 On the structure of microparticles

Thus, microparticles are not point objects, but are likened to vortex formations in an ideal fluid, which can reside in two extreme forms — the vortex *on the surface* of radius r_x along the X-axis (let it be the analog of a fermion of the mass m_x) and the vortex thread *under the surface in depth* of radius r, of the angular velocity υ, and of the length l_y, filling the current tube of the radius r_e along the Y-axis (let it be the analogue of a boson of the mass m_y).

In a real medium these structures oscillate, passing into each other (oscillation of oscillators), where fermions retain part of the bosonic mass, introducing a half spin. Note that bosonic masses cannot in principle be stable, like their physical counterparts — vortex formations in a continuous medium (if they do not lean on a phase boundary). The parameters of the vortex thread m_y, υ, r, l_y for an arbitrary p^+- e^--contour were determined in dimensionless units of the electron mass m_e, its classical radius r_e, and the speed of light c [2]:

$$m_y = l_y = (an)^2, \tag{1}$$

$$\upsilon = \frac{c_0^{1/3}}{(an)^2}, \tag{2}$$

$$r = \frac{c_0^{2/3}}{(an)^4}, \tag{3}$$

where n is the main quantum number, a is the inverse fine structure constant, while c_0 is the dimensionless light velocity c/[m/sec].

It is further shown particles themselves to be similar to the contour and have their own quantum numbers n_i, which determine, as it were, the zone of influence of these microparticles with the size $l_i = (an_i)^2$. For the proton and electron n_i are 0.3338 and 0.5777, respectively. A vortex tube of radius r_e is filled spirally with a vortex thread; therefore, with extreme "compression" and full filling, its length along the Y-axis is shortened proportional to $1/r$. In this case its compressed length $L_p = l_y r$ coincides numerically with the boson contour mass energy of units $m_e c^2$, and then it is true:

$$L_p = l_y r = m_y r = m_y \upsilon^2 = \frac{c_0^{2/3}}{(an)^2}. \tag{4}$$

It is obvious that an arbitrary boson mass in the mass-energy units will match of its own numerical value m_y only when the vortex tube ultimate excitation's case, wherein we have $r \to r_e$, $\upsilon \to c$, and $n_i \to 0.189$ (in experiments at high energie, for example). According to [2], the standard contour bosonic mass m_y is $c_0^{2/3} = 4.48 \times 10^5$ (in units of m_e), which approximately corresponds to the summary mass of W, Z-bosons. Therefore, it can be argued the vortex current tube to be form by three vortex threads rotating around

m_x	6.10×10^6	2090	1	$(4.4 \pm 0.1) \times 10^{-7}$
n_i	0.189	0.334	0.577	1.643
r_x	669	2090	6270	5.07×10^4
$m_k = L_p$	1.02	1.80	3.10	8.83
n	4.88	3.64	2.77	1.643
$l_y = m_y$	4.48×10^5	2.49×10^5	1.44×10^5	5.07×10^4

a common longitudinal axis. These threads are finite structures. They possess, by necessity, the right and left rotation; the last thread (it is evidently double one) possesses summary null rotation. They can be associated with the vector bosons W^+, W^-, Z^0.

This model assumes that a closed contour is created between charged particles in a region X (a p^+- e^--contour, for example); and only a temporary contour appears in a region Y, when a case of the weak interaction occurs (when a proton absorbs an electron, for example). The temporary contour then loses its charge (longitudinal momentum) and becomes a one-dimensional neutrino vortex tube, retaining spin. Since current tubes (i.e. field lines of some field) are treated as material objects, there are gravitational and magnetic interactions between them.

For a counter-currents closed contour the characteristic contour size l_k, which is the geometric mean of two linear quantities, is derived. This size is based on the balance of gravitational and magnetic forces written in the "Coulomb-less" form [2]. Applied to the X-axis l_k is:

$$l_k = (l_x r_x)^{1/2} = \left(\frac{z_{g_1} z_{g_2}}{z_{e_1} z_{e_2}}\right)^{1/2} (2\pi\gamma\rho_e)^{1/2} \times [\text{sec}], \qquad (5)$$

where z_{g_1}, z_{g_2}, z_{e_1}, z_{e_2}, r_x, l_x are gravitational masses and charges expressed through the mass and charge of the electron, the distance between the current tubes (charges) and theirs length, γ is the gravitational constant, while ρ_e is the electron density $m_e/r_e^3 = 4.07 \times 10^{13}$ kg/m^3.

A vortex tube having a momentum equivalent to the electron charge was shown in [3] really to contain three single vortex threads (the calculated value is 2.973). These unidirectional vortex threads rotate about a longitudinal axis. Their peripheral speed υ_0 is derived from the balance of magnetic and inertial (centrifugal) forces. In the case of unit charges, it is equal to:

$$\upsilon_0 = \frac{r_e}{(2\pi)^{1/2} \times [\text{sec}]} = 1.12 \times 10^{-15} \text{ m/sec}, \qquad (6)$$

and does not depend on the length of the vortex threads and the distance between them.

3 On the weak interaction

The proton has a complex structure, and quarks are in this model an active part of its mass, a kind of ring currents inside the proton, where in three local sections the medium velocity reaches critical parameters [2]. In the p^+- e^--contour, proton quarks are involved in the circulation, and their mass as z_{g_1} is included in equation (5) and depends on the contour size. For the weak interaction, the contour is limited only by its influence zone $l_i = (an_i)^2$. Setting $r_x = l_i$ and taking into account formulas (1–5), for the mass of quarks at unit charges, we obtained:

$$m_k = z_g = \frac{an_i c_0^{1/3}}{2\pi\gamma\rho_e \times [\text{sec}^2]}. \qquad (7)$$

It should be noted that the quarks charges are integer ones inside the proton, and in the form of fractional quantities they are only projected onto the outer surface of the proton.

In the case of the weak interaction (electron absorption by the proton) the quark mass-energy is assumed to compar with the compressed bosonic contour mass-energy L_p in the Y-region, which, having lost a longitudinal momentum (charge), becomes the bosonic neutrino vortex tube [4]. This process is something similar to the charge and spin separation — a phenomenon registered in ultrathin conductors [5], which can be likened to a one-dimensional vortex current tube. Under this condition $m_k = L_p$, the quantum number n of Y-contour is calculated from formula (4), and the mass m_y (relative length) according to formula (1).

Table 1 that above shows the calculated parameters under various conditions of the weak interaction, i.e. for various distances between the proton and the electron, namely: the characteristic masses of fermions m_x, their own quantum numbers n_i, distances between charges r_x, quark masses m_k, boson tube quantum numbers and masses n and m_y.

The relationship between the fermion and bosonic masses was established in [2]. The most probable fermionic mass of neutrinos was determined in [4] under the additional condition of symmetry, when $r_x = l_y$ and $n = n_i$ (see Table 1); moreover, there are three more independent formulas containing the gravitational constant and giving actually that the result, equal to 4.4×10^{-7} (0.225 eV). It is not known whether neutrinos appear as a fermion at higher n; in these cases, their masses would be negligible, because they are inversely proportional to n^{14}. As for the structure of the neutrino, then, having no charge, it should have a closed shape. Apparently, the bosonic vortex tube, consisting a total of four vortex threads, is as a result organized into a pair of closed vortex threads with left-right rotation and, conversely, with right-left rotation (with respect to the motion axis direction).

The minimum quark mass, as follows from the table, matches to the electron mass, and the most probable one (when neutrino is released) matches to the d-quark mass of 8.83 (4.8 MeV). The bosonic masses m_y are close to the masses of three, two (Higgs mass), one and one third of the W, Z particles masses. Although the last boson with a mass of 5.07×10^4 (26 GeV) has not yet been detected, events with close energies of about 28 GeV have already been recorded in the CMS Collaboration experiments [6].

These bosons are considered, on the one hand, to be truly fundamental particles, and on the other, to be pointlike virtual particles, moreover having enormous mass-energy. This fact is in no way compatible with the particles or atoms internal energy. They exist only about 10^{-25} seconds, although the duration of the weak interaction is $t > 10^{-12}$ seconds. The latter in this model is understandable, because t determines the time of a medium runing with speed v around the entire "extended" contour length. That is, given (1–4), we have:

$$t = \frac{a^8 n^8}{c_0} \frac{r_e}{c}\,, \tag{8}$$

that in the indicated range n gives $10^{-9} \ldots 10^{-13}$ seconds, there is an interval corresponding to possible times of the weak interaction.

Given the inconsistencies in the W and Z bosons properties and based on the calculated masses m_y, these bosons (including the Higgs boson) are probably not fundamental particles, but rather the excited boson forms of neutrinos, which during high energy experiments acquired (or did not have time to lose) for a short time a longitudinal momentum (charge).

4 On the coupling constants

It was found [7] that the formula for the number of threads in a vortex tube, cubed, is the ratio of the inertia forces arising from the acceleration of the bosonic standard contour mass and acting towards the periphery, to the gravitational forces acting between fermionic masses of m_e at a distance r_e. The numerator is a constant, so this dependence is only determined by gravity, i.e. interacting masses and the distance between them

$$n_i^3 = \frac{m_e c_0^{2/3} r_e / ((2\pi)^{1/2} \times [\text{sec}^2])}{(2\pi)^{1/2}\, \gamma m_e^2 / r_e^2} = 26.25. \tag{9}$$

This formula indicates the strength of bonds between the structural elements of microparticles (quarks) and, as it turns out, can serve as the equivalent of the coupling constant a_s for weak and strong interactions. Suppose that quarks are located in the corners of a regular triangle at a distance r_e. Then, taking into account the geometry of their interaction and after calculating the constants, the formula (9) can for the general case be represented in a dimensionless form:

$$a_s = 15.15\,(r/m)^2. \tag{10}$$

At low energies of interacting particles, affecting only the external structure of nucleons (small "depth" along Y), the peripheral inertia forces exceed the attractive forces, therefore quarks are weakly coupled to each other within a vortex tube of radius r_e, and they interact with quarks of nearby nucleons. At high energies (about 100 GeV, a great "depth" along Y) they reach within the proton itself vortex thread the minimum distance of $r \sin 60°$ (here r is calculated from (3)); in this case the mutual attraction forces keep the quarks in a bound state within the nucleon size. Then, with the quark minimum mass, $m_k = 1$, substituting $r = 1$ and $r = 0.0887$ in (10), we obtain: $a_s = 15.15$ and $a_s = 0.119$. These values coincide with the actual ones.

The validity of the above is also convincingly confirmed by the determination of the proton radius r_p provided that $a_s = 1$ and $m_k = 1$. Obviously, it is the vortex tube circumferential size and it is equal to $r/\sin 60°$. Revealing the constant in (10) and using the above formulas, we finally get:

$$r_p = \left(\frac{8\pi\gamma\rho_e}{3^{1/2} c_0^{2/3}}\right)^{1/2} \times [\text{sec}] = 0.297 \ \text{ or } \ 0.836\ \text{Fm}, \tag{11}$$

which *exactly coincides* with the value obtained in recent experiments (0.833 femtometers, with an uncertainty of ±0.010 femtometers) [8].

In the weak interactions, bosonic vortex tubes take part in, but since their mass is high, the coupling constant for the weak interaction is very low (about 10^{-5}). With increasing interaction energy, vortex tubes are excited and their radius increases, and then this constant increases significantly. Thus, the coupling constant determines neither the nature of nuclear forces, nor the strength of interaction, but only indicates the strength of bonds within the complex structure of nucleons.

5 On the masses of s- and b- quarks

In [2] the total masses of the second and third generation quarks were approximately determined. But the masses of negative s- and b- quarks was in experiments found to be much smaller than the masses of their positive partners, and it can not be explained in SM. In this model the mass order of these quarks is at least reliably determined when using formula (5), derived from the balance of magnetic and gravitational forces. It was shown in [2] that any contour connecting charged particles can consider similar to a particle that is part of a larger contour, where the smaller contour mass is assumed to be a hypothetical fermion mass (a proton analog) for the larger one. Thus three generations of elementary particles are formed.

For the second generation (μ-contour), the proton analog is the mass of the standard contour $c_0^{2/3}$, for the third (τ-contour) one is the mass of the μ-contour, determined from the limiting conditions at $n_i = 0.189$ and equal to 6.10×10^6. Thus, for contours of subsequent orders it can be assumed of linear scale unit's increasing in proportion to the ratios of the μ-contour and τ-contour masses to the proton mass m_p. Since quarks masses is directly proportional to $l_x r_x$, i.e. to a linear parameter square, and inversely proportional to leptons masses, then, bearing in mind (5), we can write the relation:

$$\text{s- quark mass} \quad m_{k\,s} = \frac{m_k (c_0^{2/3}/m_p)^2}{m_\mu} = 222\, m_k\,,$$

$$\text{b- quark mass} \quad m_{k\,b} = \frac{m_k (6.10 \times 10^6/m_p)^2}{m_\tau} = 2450\, m_k\,,$$

where m_μ and m_τ are the μ- and τ- particles masses.

Consequently, the s- and b- quarks masses order is determined correctly: for the s- quark it is several hundred masses of the first generation quark, for b- quarks it is several thousand masses of the first generation quark.

6 Conclusion

Thus, the above examples show that gravity has a significant effect in the microworld, and the gravity constant should inevitably be included in the more accurate theories describing the microworld. Perhaps it is just this factor that may contribute to the further creation of the "theory of everything".

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