Exploration

The Connection between Quantum Mechanics & Gravity

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Abstract

It is argued in this paper that the gravitational field is some residual non-linear electromagnetic field. The equations of gravitation are interpreted as a manifestation of the elasticity of space-time. Gravitational Constant is derived based on quantum mechanics (*i.e.*, QCD), and the theory is tested on calculation of Earth's space-time curvature. The rotating power radiated as an electromagnetic (EM) wave cumulated to all particles that compose an object (due of superposition principle) is obtained based on the rotating magnetic field as generated by induction of the monopole current inside the nucleon. The reflection of this EM wave by other object represents the attraction force equivalent with Newton law and enables the calculations of the gravitation accelerations for Earth and Sun, and the forces of attraction of Sun-Earth system.
Further, the nature of dark matter is proposed based on vacuum (anti)monopole condensate particles participating in weak interaction and the theory is tested on the calculation of light bending by the Earth. It is also proposed that the gravitational interaction of two monopoles (Planck particles) situated at Compton wave-length of $W^{\pm}$ bosons is behind of the Higgs field. In short, it seems that there exists a firm connection between gravity and quantum mechanics and the Planck particles may play a major role in the explanation of gravity.

Keywords: gravity, quantum mechanics, Einstein equation, Schwinger effect, pair creation, monopoles condensate, dark matter, light bending.

1. Introduction

In [1] the possibility of calculating the gravitational constant from elementary particle theory was investigated. This approach of theoretical description of gravity is based on the quantum theory of elementary particles and relies on the "bending" of the field, not a massless mathematical object, to produce the matter. It follows that the gravitational field is some residual non-linear electromagnetic field.

Independent to these essential ideas, our work [2] advances a view the same vein. Here, QCD vacuum can be viewed as a dual superconductor characterized by a monopole condensate. When embedding a static quarks $q\bar{q}$ pair into this vacuum the latter expels by the dual Meissner effect the colour electric flux lines, thus giving rise to color confinement [2-4].

Now, if we consider the idea of [5], when the charge like the quarks from nucleon substructure is circumvolved by the *quantum fluid* as given by the condensate of monopoles of Plank particle mass, we have:

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(1) A quantum fluid has "quantum rigidity" due to the single-valuedness of the macroscopic wavefunction, which is absent in classical fluids. London called this property "the rigidity of the wavefunction" in the context of superconductivity, and Laughlin called this property in the context of the quantum Hall effect "an incompressible quantum fluid."

(2) A quantum fluid is "quantum dissipationless". The existence of persistent currents, such as those in the electron-vortex system, is evidence for this viscosity-free, zero-loss property of a quantum fluid.

Therefore, in place of quantum fluid (from Chiao model) is considerate a "monopole condensate" with a magnetic monopole current, that this current is a solenoidal (i.e. azimuthally), stabilizing the normal conducting vortex core, and fulfilling the dual Amp`ere Law.

Thus, in place of "each circular puddle which contains a Planck-mass amount of superfluid helium" as from [5], I have considered a monopole condensate of mass $M_{monop} = 2.15e19[GeV]$ at Planck length $r_{core} \cong l_{Planck}$, as discussed below. To note, that the mass of monopole is a function of its core radius considered, for example at $r = 0.2[fm]$, the mass decreases at $2.2[GeV]$, see [8].

But firstly, to note, that there are analytical examples which show how the monopole condensate appears in compact electrodynamics, also which justifies the monopole confinement mechanism that proves the existence of the monopole condensate. For lattice gluodynamics, there are a lot of numerical facts which confirm the monopole confinement mechanism. In [6] the underlying idea is that the QCD vacuum is filled by a chromomagnetic monopole condensate.

Therefore, Gravitational Constant is derived based on quantum mechanics (i.e., QCD), and the theory is tested on calculation of Earth's space-time curvature calculation. The rotating power radiated as an electromagnetic (EM) wave cumulated to all particles that compose an object (due of superposition principle) is obtained based on the rotating magnetic field as generated by induction of the monopole current inside the nucleon. The reflection of this EM wave by other object represents the attraction force equivalent with Newton law and enables the calculations of the gravitation accelerations for Earth and Sun, and the forces of attraction of Sun-Earth system.
Further, the nature of dark matter is proposed based on vacuum (anti)monopole condensate particles participating in weak interaction and the theory is tested on the calculation of light bending by the Earth.

2. The Derivation of Gravity Constant from Quantum Mechanics

In [2] it was established that the force $q\bar{q}$ pair flux tube squeezing inside the nucleons due to interaction with induction generated by the monopole condensate (superconductive vortexes), see figures 1a;1b, as to be equally to the Lorentz' force, and this is, also, the force of gravity.

Below we give a breakthrough possible explanation for such gravity force. Thus, if we look at a very simplified (scalar form) of Einstein's equation after multiplying with curvature radius ζ^2, the radius (object radius) R of curvature of spacetime is given as:

$$\varepsilon = \frac{2\zeta^2}{R^2} = \frac{8\pi G.p\zeta^2}{c^4}$$

If the pressure p on the surface of the tube is considered to be generated by the gravitation force equal to the *contra- Lorenz' force* $|F_L|$ applied on the curvature of space-time ζ situated in the center of vortex, its role being counteracting the destruction of superconductivity:

$$4\pi\zeta^2 p = F_L = \frac{c^4}{G}\varepsilon = \mathrm{K}\varepsilon$$

With Lorentz' force calculated, we see below:

$$|F_L| = \mathrm{K}\varepsilon = \mathrm{K}(\frac{\zeta_{nucleon}}{R})^2 = \mathrm{K}(\frac{l_p}{R})^2 = 2.25e5[N]$$

$$\rightarrow \mathrm{K} = \frac{2.25e5}{(1.85e-39)^2} = 1.21e44$$

$$\zeta_{nucleon} \cong l_P = \sqrt{\frac{\hbar G}{c^3}} = 1.61e-35$$

where

$$\varepsilon = \left[\frac{l_p}{R}\right]^2 = (\frac{1.61e-35}{3.75e-16})^2 = 1.85e-39$$

and K is "the vacuum elasticity"

$$\mathrm{K} = \frac{c^4}{G} = 1.21e44$$

Therefore, if we use in place of the curvature ζ, the Planck length, an invariant and surprising result is obtained:

$$l_P = \sqrt{\frac{\hbar G}{c^3}}$$

$$\frac{2}{R^2} = \frac{8\pi G}{c^4}\frac{F_L}{4\pi l_P^2} = \frac{8\pi G}{c^4}\frac{c^3}{4\pi\hbar G}\frac{ec\pi\hbar c}{\pi\lambda^2 ec} \cong \frac{1}{\lambda^2}$$

$$\frac{1}{R^2_{Curv-nucleon}} = \frac{6.67e-11*2.25e5}{1.6e-35^2 2.997e8^4} \Rightarrow R_{Curv-nucleon} \cong 3.75e-16[m] \cong \lambda$$
$$\lambda = 0.117[fm]$$

Also, we have in case of Earth:

$$(\frac{\zeta_{earth}}{R_{earth}})^2 = \frac{4\pi G F_G}{c^4} = \frac{4\pi G*5.86e25}{c^4} = 6.e-18;$$

where

$$F_G = \frac{GM^2}{R^2} = \frac{6.67e-11*5.97e24^2}{6.37e6^2} = 5.86e25; \quad U_G^{earth} = F_G R = 5.86e25*6.37e6 = 3.73e32[J]$$

Now, in the same way as for a nucleon we can derive a similar formula for the Earth, where we account for Lorenz force F_L (as calculated below) in place of the gravitational pressure due of two particles on the curvature radius ζ_{Earth} of Earth, which is:

$$(\frac{\zeta_{earth}}{R_{earth}})^2 = \frac{4\pi G F_L n_{nucleons}}{c^4} = \frac{4\pi G*1.8e-26*3.57e51}{c^4} = 6.7e-18$$

where the number of nucleons inside the Earth is:

$$597.e24/1.67e-27 = 3.57e51,$$

and the Earth radius is

$$R_{Earth} = 6.37e6[m],$$

and the Schwarzschild radius

$$\zeta = \frac{2GM}{c^2} = 8.86e-03[m],$$

or

$$\frac{\zeta^2}{R^2} = \frac{0.01^2}{6.37e6^2} = 2.4e-18$$

that proves the theory of these monopoles inside the nucleons.

The electromagnetic force F_L produces the curvature ζ. Here, the force F_L between the vortexes, which are viewed as "*quantum drops/vortexes*", see fig.1b, that interact weakly at the distance $\approx 73.8\lambda[fm]$; $\lambda = 0.117[fm]$ [2], from the axis of the vortex line, and of magnitude equally to its position to the vortex of neighborhood nucleon, that in the frame of the atom's nucleus.

The interaction between a pair of vortexes at distance *x* and of separation

$$d = x - \lambda = 8.63[fm]$$

(in the category of *weak interactions* – QCD; QED) is given by the folllowing, see figure 1a; 1b.:

$$\varepsilon_{\text{int}-pair} = c^2 \varepsilon_0 \frac{4\Phi_0^2}{2^{7/2}\pi^{3/2}\lambda^2}\left(\frac{\lambda}{d}\right)^{1/2} e^{-x/\lambda} =$$
$$\frac{1.e17*8.82e-12*4*2.06e-15^2}{2^{3.5}3.14^{1.5}0.117e-15*0.117}\left(\frac{\lambda}{72.8*\lambda}\right)^{1/2} EXP\left(-\frac{73.8*\lambda}{\lambda}\right) =$$
$$1.6e-41[J/fm]$$

In terms of force between two *monopoles* vortexes:

$$F_L = \varepsilon_{inter-pair} / 73.8\lambda = 1.8e-26[N]$$

Gravitation as an electromagnetic wave

Or, if we assimilate the Giant vortex [2-4] , see figure 1b, as to be formed by the 3 pairs of vortexes with a rotating monopole of rotating magnetic field given by eq. (47) from [2]

$$B(x) = \frac{2\Phi_0}{c(8\pi x\lambda^3)^{1/2}} e^{-x/\lambda}\ ,\ x \rhd\rhd \lambda$$

or,

$$B_{GV} = \frac{2*2.06-15}{(8\pi 0.899*0.117^3)^{1/2}} EXP(-0.899/0.117)*1.e30 = 1.e13[J/Am^2],$$

,where $\lambda = 0.117[fm]$; $x = 7.6\lambda$

, and its magnetic moment being

$m_0 = \frac{4\pi r^3 B_{GV}}{\mu_0} = 8.6e-28[Am^2]$; with vacuum permeability is $\mu_0 = \frac{1}{c^2\varepsilon_0}$;

$\varepsilon_0 = 8.82e-12[C^2/Jm]$, and $r_{Compton-nucleon} = \hbar/mc = 1.96e-16[m]$; $m = m_{nucleon} = 1.67e-27[kg]$

The radiative circulating power of this electromagnetic wave results from the Poynting vector[9], as: $P_{wave} = \frac{c^2\varepsilon_0 m_0^2 \varpi^4}{32\pi^2 c^3}\frac{\sin^2\theta}{r^2}\vec{r} = 1.4e14[w/m^2]$;

With $\theta = 90^\circ$ to have the maximum, and for $r = 2\lambda \cong 0.2e-15[m]$, the radius of of penetration of superconductive layer of GV, we have

$P_{wave} = 1.4e14 * r = 5.7e-18[w]$ for each nucleon.

Here, the frequency ν is
$1/\varpi = \nu = c/d_{pairs} = 3.8e22[Hz] \rightarrow \tau = 2.63e-22[s]$, or the wave period is: $\varpi = 1/\tau[s^{-1}]$
$d_{pair} \cong r_{inter\_nucleon} = 67.4\lambda = 7.89e-15[m]$, the distance where the nucleon begins to interact with the neighbored (next-nucleon into an atom) space-time
The energy of the wave is $E_{wave} = P_{wave} * \tau = 1.5e-40 \approx \varepsilon_{inter\_pairs} = 1.6e-41[J/fm]$
The transmitted wave force per nucleon to space-time is
$F_{wave} = P/c = E/\varpi c = 1.92-26[N] \cong F_L$, or the same as above, and the circulating power is
$E = P/\varpi = 1.51e-40 \approx \varepsilon_{inter-pairs} = 1.6e-41[J]$.

The attraction between objects

Due to the superposition principle the effect of the totally waves cumulate, mainly in the amplitudes, out of the object, and when due of refraction indices of value $n=1$, the wave is totally reflected when meets a next object, like of the other planet.
Therefore, in case of $m = 1kg \cong 5.98e26 particles$,the attraction of Earth is
$F_{attraction-1kg} = F_{wave} \times n_{1kg-particles} = 1.92e-26 \times 5.98e26 \cong 11 \cong mgH = 9.81$
,where $m = 1kg$; $H = 1[m]$
A more complex problem is that related with stars-planet system, that due of the constitution of star, like the Sun. when the nucleons fusion, reduce the distance between nucleons d_{pairs}. This could be calculated, also from my seminal papers [2-4], as in case 2 of eq. (61), the fluctuation in the distance between vortexes becomes:

case **2**, $1 - T_{FM}/T_c \cong c^{-1}B^{5/4}$;

, where, T_{FM} -the flux-lattice melting temperature, and $c = 0.1$ from Lindemann criterion of lattice melting when $d^2 = c^2 l^2$, and the flux quantization condition $l^2 = \Phi_0/B$, $B = 2\pi n/\kappa$, $n=1$ units of quantized flux Φ_0.
For numerical values $T_c = 175[MeV]$, in case of symmetry breaking, the case 1, results $T_{FM} \approx T_c$, and in case 2, to obtain the fusion temperature of $T_{FM} \cong 0.957[keV]$ or $1.1 \times 10^7 {}^\circ K$, by using eq. (56) of [ ], given bellow, $\Phi_0/B \cong d^2$ it results $d = 0.3981063[fm]$(a very precisely value), and $\kappa \cong 1$. Since, the vortices of two nucleons melt on this distance, the frequency modifies to $r = 2d = 7.84\lambda = 0.917e-15[m]$ in place of $r \cong 0.2[fm] \cong 2\lambda$, for not melted nucleons (Earth, Moon). Here, it allows magnetic flux Φ to penetrate the superconductor in a regular array quantized in units of elementary flux quantum $\Phi = \pi\hbar c/e$.Important was the quantization in a ring , flux $\Phi = \left(n + \frac{1}{2}\right)\frac{\hbar c}{e}$. A simple geometrical argument for the spacing, d of a triangular lattice then gives the flux quantization condition eq. (56) from [2],

$$Bd^2 = \frac{2}{\sqrt{3}}\Phi_0$$

, where B, is the induction.
With these new data in case of Sun, we have $P_{wave}^{Sun} = 1.22e-16[w]$ per nucleon

The force is $F_{wave}^{Sun} = 4.e-25[N]$, and the attraction for a mass of $m = 1kg$ at 1 m, i.e. g_{Sun} is

$$F_{Sun-1kg} = 4.e-25 * n_{particles\_In\_1kg} = 243 \cong mg_{Sun}1 = 274[N]$$

For the attraction between Sun-Earth is needs to amendate with densities ratio, since even the quantity GM/D is not sole G, it depend of some distance, or intrinsically of the *compactness* of particles, or, of how long the radiatiative power (cumulative wave) it spread in the space.
Thus $F_{Earth-Sun} = F_{wave}^{Sun} \times n_{particles\_Eart}\, \rho_{Sun} \Big/ \rho_{Earth} = 4.e-25 \times 3.57e51 \frac{1.622e5}{5.515} = 4.93e22[N]$

And, by Newton law $F_{Newton} = \frac{GM_{Sun}M_{Earth}}{d_{Sun\_Earth}^2} = \frac{G1.99e30 \times 5.97e24}{1.5e11^2} = 3.54e22[N]$.
Or, the results are comparable, here, we considerate that the Sun resultant wave is much greater (~ 21-the ratio of radiated powers), when it interferes with that of Earth, and when is reflected by Earth attracting it. This process of attraction is specifically to reflected waves, for example, when the water waves move a boat longer of the coast.

The calculation of G constant

Let us return to the problem of the ratio of the forces of gravity and electricity for a nucleon, but now in the context of two well-separated electron (quark) -vortex composites at a distance *r* from each other.

Suppose that each circular puddle (vortex) contains a Planck-mass amount of superfluid like of Helium from [5],

$$m_{Planck} = \sqrt{\frac{\hbar c}{G}} = 2.14e-08[Kg]$$

where $\hbar$ is Planck's constant, *c* is the speed of light, and G is Newton's constant. Planck's mass sets the characteristic scale at which quantum mechanics ($\hbar$) impacts relativistic gravity (c, G)

The ratio of the forces of gravity and electromagnetic between the vortex and the quark flux tube (electric field), see figures 1a;1b, now becomes:

$$\frac{|F_G|}{|F_{M\_condensate}|} = \frac{\frac{Gm_{Planck}^2}{r^2}}{\frac{ec\pi\hbar c}{\pi ec\lambda^2}} = \frac{G\hbar c}{r^2 G} * \frac{\lambda^2}{\hbar c} = 1$$
;

for $\lambda \cong r$, where the Lorentz force is $F_{M-condensate} = ecB$

$$B\Big|_{x \triangleleft\triangleleft \lambda} = \frac{2\Phi_0}{2\pi\lambda^2 c}$$

$$\Phi_0 = \pi\hbar c/e \rightarrow usually \frac{\pi\hbar}{e} = 2.07e-15[Tm^2]$$

If we consider only an the electric Coulomb field of the quark dipole in the middle of the condensate, we obtain an another very important result, namely, the value of fine structure constant α_s:

$$\frac{|F_G|}{|F_{quark}|} = \frac{\frac{Gm_{Planck}^2}{r^2}}{\frac{e^2}{4\pi\varepsilon_0\lambda^2}} = \frac{G\hbar c}{r^2 G} * \frac{4\pi\varepsilon_0\lambda^2}{e^2} = \alpha_s = 137$$

Therefore, if we consider the string force due of the Coulomb flux tube as given by the quarks $\bar{q}q$ pairs, results

$$G = \frac{\alpha_s F_{quarks}\lambda^2}{m_{Planck}^2} = \frac{137*1636*3.75e-16^2}{2.2e-08^2} = 6.65e-11 m^3/kg \cdot s$$

From [2-4], the Lorentz' force is:

$$F_L = ecB \cong 2.25.e5[N]$$

when *B* is given by (46) of [2], and $x \cong \lambda$, for the upper limit:

$$B(\lambda) \cong 4.7e15[J/Am^2]$$

Therefore,

$$F_G = F_{m-condensate}, \text{ or } G = F_{m-condensate}\lambda^2/m_{Planck}^2 = 6.67e-11$$

$$F_{m-condensate} = \hbar c/\lambda^2 = \frac{1.e-34*2.998e8}{3.75e-16^2} = 2.25e5$$

These results convince the author to propose the idea that, at "confinement" moment of Universe evolution and when the temperature was 200MeV, the monopoles condensate (vortex) around quark pairs were generating the nucleons. But, it will remains a lot of monopoles outside, which can constitute the dark matter, see bellow.

Therefore, we cannot comprehend gravitation without the quantity of an quantum fluid of Planck mass embedded in monopoles.

3. Light bending calculation

In [1], it is assumed that quantum effects alone completely determine the vacuum elasticity. The details of the calculations can be found in the original work of Sakharov [1]. In order to obtain the observed value of the elasticity, one must put the cut-off momentum equal to an enormously large value, a value corresponding to the mass 10^{-5}g. Sakharov has conjectured that the gravitational constant is entirely determined by vacuum polarization. The equations of gravitation can be perspicuously interpreted as a manifestation of the elasticity of space-time". If we talk about the fields of the particles, the critical value of the external field is a field, in which the particle has simultaneously an electric and gravitational field.

In classical optics a light ray can be bent if there is a gradient in the refractive index.
However in QED it is possible by the vacuum polarization that allows the photon to exist as a virtual e^- - e^+ pair via which the external field can couple. The first study on nonlinear effect in the presence of an external electromagnetic field was performed by Euler and Heisenberg.

Thus, the total bending angle can be obtained with Kim's formula [7]:

$$\varphi_{mag} = -\frac{41\pi a\alpha^2\varepsilon_0 c\hbar B_0^2 r_0^6}{3*2^7 e^2 B_c^2 b^6}$$

where: a=8; $b \cong r_0$

It is known that the curvature angle is given by:

$$\varphi_{grav} = \frac{4GM}{bc^2} = 1.39e-09[radians];$$

and

$$\frac{4\pi\varepsilon_0\hbar c}{e^2} = 1/\alpha = 137$$

The value of critical magnetic field for pair creation is determined below [8].

The magnetic moment of the electron results from equations (A.33-A.44) of [8]:

$$m_s = -\frac{g_s\mu_B S}{\hbar}$$

where $\mu_B = 9.27\times10^{-24}[JT^{-1}]$, μ_B is the Bohr magneton, $S = \hbar/2$ is electron spin, and the g-factor g_s is 2 according to Dirac's theory, but due to quantum electrodynamic effects it is slightly larger in reality: 2.002, for a muon $g = 2$.

The Bohr magneton is defined in SI units by:

$$\mu_B = \frac{e\hbar}{2m_e}$$

The vector potential of magnetic field produced by magnetic moment m_{Mo} is

$$A(r) = \frac{\mu_0}{4\pi}\frac{m_{Mo}\times\vec{r}}{r^3}$$

and magnetic flux density is:

$$B(r) = \nabla\times A = \frac{\mu_0}{4\pi}\left(\frac{3\vec{r}\left(m_{Mo}\cdot\vec{r}\right)}{r^5} - \frac{m_{Mo}}{r^3}\right) \cong A/r$$

$$j_e = -\frac{c}{4\pi}\frac{dB}{dr}\left(4\pi c\varepsilon_0\right) = -\frac{c^2\varepsilon_0 A}{r^2}$$

We can calculate the observable spin magnetic moment (a vector), $\vec{\mu}_S$, for a sub-atomic particle with charge q, mass m, and spin angular momentum (also a vector), $\vec{s}$, via:

$$\vec{\mu}_S = g\frac{q}{2m}\vec{s}$$

Therefore, for a monopole:

$$\mu_{Mo} = \frac{gQe\hbar}{2m_{Mo}}, \quad Q = 68.5, \quad \vec{s} = \hbar, \quad g \cong 2$$

and

$$m_{Mo} = -\frac{\mu_{Mo}S}{\hbar} \cong \mu_{Mo}$$

Numerically, we obtain:

$$\mu_{Mo} = 2.7e-25[J/T], \quad A = 0.6[N/A], \quad r = 2.11e-16 \cong 0.2[fm]$$

$$B = A/r = 2.86e15[J/Am^2]$$

Therefore, the critical magnetic field is:

$$B_{cr} = 2.86e15[T]$$

and the magnetic field of monopoles condensate (vortexes) outside of the object (planet) is

$$B_0(67.4*\lambda) = 3.9e-14[T] \cong 4.e-5[nanoT] << 0.25 \div 0.65[T]$$

which is much smaller than the magnetic field of Earth as induced by the internal causes (movement of internal melted core). Here, the distance $67.4\lambda = 7.88 fm$ results from an inverse calculation as beginning from the known Earth curvature, as to be the distance of free (anti)monopoles as the constituents of dark matter, at all viewed as a *web* of their weak interacting particles (WIMP).

With these values, and with $r_0 \cong b$, the deflection of light viewed as the refraction of $\gamma \leftrightarrow e^+ - e^-$ due of interaction with the dense population of these (*anti)monopole* condensate (vortexes) or WIMPS of *dark matter* which surround the object (Earth) to compensate the monopoles condensate (see the insertion in figure 1a.) embedded in mater (in nucleons), becomes:

$$\varphi_{mag} = 1.02e-09 \cong \varphi_{grav} = 1.39e-09[radians]$$

Now, the total energy of this condensate of (*anti)monopoles-vortexes* which surround the object (planet) could be obtained as shown below. In our approach, the number of (*anti)monopoles* (like the negative electrons of Dirac sea) is considered to corresponds to the number of *monopoles* embedded in matter (i.e. nucleons) and that surround them.

4. The Nature of Dark Matter

The interaction between a pair of vortexes at distance *x* and of separation $d = x - \lambda \cong 7.8 fm$ (being in the category of *weak interactions* –QCD; QED) is given by using equation from [2], see figure 1a; 1b:

$$\varepsilon_{\text{int}-pair} = c^2 \varepsilon_0 \frac{4\Phi_0^2}{2^{7/2}\pi^{3/2}\lambda^2}\left(\frac{\lambda}{d}\right)^{1/2} e^{-x/\lambda} =$$
$$\frac{1.e17*8.82e-12*4*2.06e-15^2}{2^{3.5}3.14^{1.5}0.117e-15*0.117}\left(\frac{\lambda}{67.4*\lambda}\right)^{1/2} EXP\left(-\frac{(67.4-1)*\lambda}{\lambda}\right) =$$
$$1.02e-38[J/fm]$$

In terms of force between two (*anti)monopoles* vortexes

$$F = \varepsilon_{\text{int}er-pair} / 67.4\lambda = 1.36e-24[N],$$

Similar value could be obtained, if we consider the above value of induction:

$$B_0 = 3.9e-14[T],$$

thus,

$$F = ecB_0 = 1.87e-24[N]$$

The most widely accepted explanation for these phenomena is that dark matter exists and that it is most probably composed of weakly interacting massive particles (WIMPs) that interact only through gravity and the weak force. It also cannot interact with ordinary matter via electromagnetic forces.

The total mass of this veritable "*dark wool(web)*" as composed of these (*anti)monopoles vortexes* , that surrounds the objects (planets, stars, etc.) is:

$$M_{dark-wool} = \varepsilon_{inter-pair} * n_{pairs} \frac{0.25}{c^2} = 1.e-04[kg] \rightarrow 5.7e22[GeV]$$

These (*anti)monopoles* which in fact are superconductive vortexes around Plank particles interact gravitationally as:

$$E_G = \frac{GM^2_{dark-wool}}{R} = 1.8e-27[J] \rightarrow 6.7e-18[GeV],$$

or, as *weak* interaction:

$$\left(\frac{\zeta}{2R}\right)^2_{dark-inter-mag} = \frac{4\pi GF_{inter-pair} * n_{pair-dark\_wool} * 0.25}{K} = 1.2e-16 \approx 6.e-18$$

or, gravitationally:

$$\left(\frac{\zeta}{2R}\right)^2_{dark-int-gravit} = \frac{GM_{dark-wool}}{2Rc^2} = 5.9e-39$$

Therefore, it result in the *dark wool* not interacting gravitationally in order to curve space-time but as *weak interaction*, which justifies light deflection due to this *dark energy* concentration at the surface of a planet. This interaction pushes the vacuum realizing the expansion of Universe.

Now, the sum of total dark vortexes energy is given by using eq. (71.1) from [2] as:

$$\varepsilon_{\sum vortex} = Vc^2 \varepsilon_0 B^2_{cr} / 8\pi * n^{Earth}_{nucleons} * 0.25 = 3.5e41[J]$$

Here, we assume:

$$V = 1.e-45[m^3]$$

which is the volume (~ of nucleon), the number of nucleons calculated above is $3.57e51$, and 0.25 is the fraction of this *dark matter*.

The correspondent sum of *dark mass* is

$$M_{\sum dark} = 3.5e41/c^2 \cong 3.93e24[kg] \cong 75\% M_{Earth}.$$

This gives the curvature

$$\left(\frac{\zeta}{2R}\right)^2_{Mdark-\text{int}-gravit} = \frac{GM_{\sum dark}}{2Rc^2} = 5.22e-20 \approx 6.e-18.$$

This mass does not respect the planet's gravitational laws, since the (anti)monopoles vortexes interaction is small, i.e. only that given by B_0).

Now, the cosmological constant is:

$$\Lambda = 1.e-47GeV^4$$

or

$$\Lambda = 1.77e-12GeV$$

The interaction energy of the "*dark wool*" around the planet is given by the following equation when $B_0 = 3.9e-14[T]$:

$$\varepsilon_{\sum vortex} = 6.61e-17[J] \to 4.13e-07[GeV]$$

In terms of mass, we have:

$$\varepsilon^{mass}_{\sum vortex} = 7.35e-34[Kg]$$

which is neglectable.

5. What Could Be behind the Higgs Field

At distances around 10^{-18} meters, the weak interaction has similar strength to that of the electromagnetic force; but at distances of around 3×10^{-17} m the weak interaction is 10,000 times weaker than the latter.

An interesting aspect of virtual particles (in vacuum) both theoretically and experimentally is the possibility that they can become real by the effect of external fields [8]. In this case, real particles are excited out of the vacuum. In the framework of quantum mechanics by Klein, Sauter, Euler and Heisenberg, who studied the behavior of the Dirac vacuum in a strong external electric field, the energy of the vacuum can be lowered by creating an electron-positron pair, if the field is sufficiently strong. The strong field makes the vacuum unstable and polarizable.

Now, if we consider the gravitational interaction of two monopoles (Planck particles), we have:

$$\varepsilon_{Higgs} = \frac{Gm_{monop}^2}{r} = 4.27e-08[J] \rightarrow 267[GeV]$$

where the mass of monopole is:

$$m_{monop} = \frac{E_{monopol} * 1.e9 * 6.25e18}{2.9987e8^2} = 3.84e-08[kg],$$

with

$$E_{monop} = 2.15e19[GeV],$$

And, the distance is

$$r = \hbar / m_{W^{\pm}}\ c = 2.3e-18[m]$$

which is the Compton wavelength of $W^{\pm}$ bosons [8].

In [8] it was discovered that *v.e.v.* (Higgs field) is in fact the Schwinger critical field E_{cr} for a pair of $W^{\pm}$ production:

$$E_{cr} = m_W^2 c^3 / e\hbar = 3.5e+28[N/C] \leftrightarrow v.e.v = 267GeV$$

Therefore, to realize this interaction it needs either to apply a external field like that of the pp impact obtained at LHC, or to apply the monopoles field as existing inside the nucleon [8].

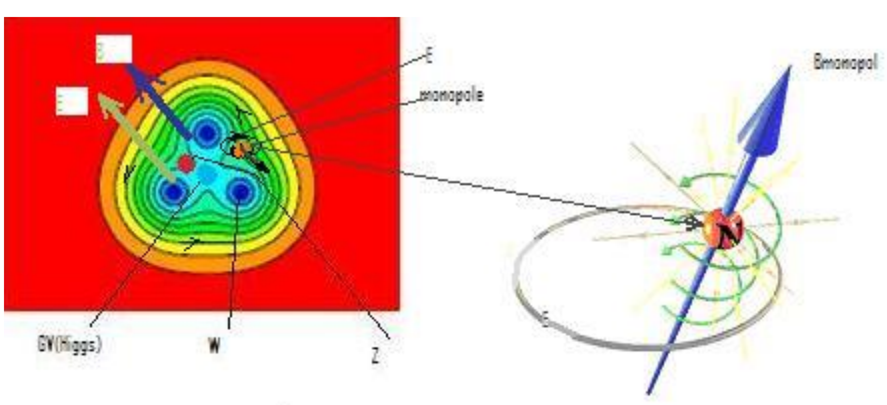

Fig.1a. The monopoles embedded in the Giant-Vortex [2] that could be also the arrangement for the nucleon (only illustration). A spin-orbit nonabelian field is shown.

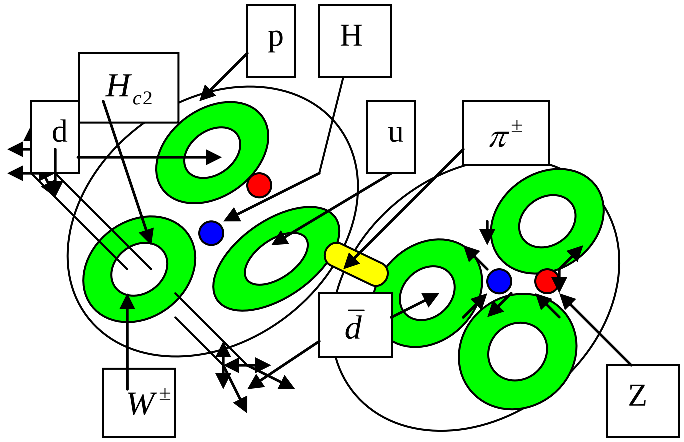

Fig.1b. Abrikosov's triangular lattice for a nucleon [2]

6. Conclusions

The gravitational constant G seems to be an intrinsic physical constant that characterizes the entropy of the electromagnetic quantum fluids confined in matter particles. It was demonstrated that the gravitational field is some residual non-linear electromagnetic field. The equations of gravitation can be interpreted as a manifestation of the elasticity of space-time.

It is argued in this paper that the gravitational field is some residual non-linear electromagnetic field. The equations of gravitation are interpreted as a manifestation of the elasticity of space-time. Gravitational Constant is derived based on quantum mechanics (*i.e.*, QCD), and the theory is tested on calculation of Earth's space-time curvature calculation. Further, the nature of dark matter is proposed based on vacuum (anti)monopole condensate particles participating in weak interaction and the theory is tested on the calculation of light bending by the Earth. It is also proposed that the gravitational interaction of two monopoles (Planck particles) situated at Compton wave-length of $W^{\pm}$ bosons is behind of the Higgs field. In short, it seems that there exists a firm connection between gravity and quantum mechanics and the Planck particles may play a major role in the explanation of gravity.

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