The nuclear force explaining by a bag model resulted from a vortextial, cold genesis model of nucleon

Abstract

In a pre-quantum theory developed by author, which considers the magnetic moment as etherono–quantonic vortex \( \Gamma_{\mathbf{A}} \) and of quarks and of quantum by an impulse density: \( \gamma = \left(e^+e^-\right) \) of axially coupled electrons with opposed charges, which gives a preonic, quasi–crystalline internal structure of cold formed quarks, with hexagonal symmetry, based on \( x^2 = 34 m_2 \) preonic–experimentally evidenced in 2015 but considered as X–boson of a fifth force, resulted in the model as cluster of 21 gammons, of \( \text{Fermions} \) with degenerate mass: \( m_2 = 0.0891 m_0 \), which explains the difference between the proton mass and the neutron mass \( \left( \text{~2.6 m}_2 \right) \) as “wesonic” couple: \( w = e^+ + s, \) \( \sigma \) being a “gluon”, i.e., a linking degenerate gammon: \( \gamma^* = (e^+e^-) = 2m_2^* = 1.62 m_1 \), which bind the neutralino electron to the protonic part: \( (N^2/m_0^* + 1 m_0^*) \).

According to CGT, based on the galilean relativity, the magnetic field is generated by an etherono–quantonic vortex: \( \Gamma_{\mathbf{M}} = \Gamma_{\mathbf{A}} + \Gamma_{\mathbf{\mu}} \) of s–etheron (sinergons with mass \( m_1 \approx 10^{-30} \text{kg} \) ) giving the magnetic potential \( \Lambda \) by an impulse density: \( p_{\mathbf{r}}(r) = (r \times c) \), and of quontons (h–quantum, with mass: \( m_3 = h/137^2 = 7.37 \times 10^{-51} \text{kg} \) ) giving the E–field, the magnetic moment and the magnetic induction \( \mathbf{B} \) by an impulse density: \( p_{\mathbf{r}}(r) = (r \times c) \).

\[
E(r) = k_1 \cdot \rho_{\mathbf{r}}(r) \cdot \nu_1 = \frac{1}{2} \frac{k_1}{k_2} \frac{\Lambda}{\mu} \cdot \frac{\nu}{\chi} = \frac{4 \pi \cdot q^2}{e} \cdot \nu_{\chi} \approx c
\]

\[
B = k_1 \cdot \rho_{\mathbf{r}}(r) \cdot \nu_1 \approx \frac{4 \pi \cdot q^2}{e} \cdot a = 1.41 \text{fm}
\]

the nuclear field resulting from the quantum impenetrable volume \( \nu_1 \) of a nucleon in the total field generated according to fields superposition principle, by the \( (N^2+1) \) superposed vortices \( \Gamma_{\mathbf{\mu}}(r) \) of the degenerate electrons of another nucleon, having an exponential variation of quanta impulse density:

\[
V_{\mathbf{\nu}}(r) = \left( -\frac{\nu_{\chi}}{\chi} \right) \cdot p_{\mathbf{r}}(r) = \frac{\nu_{\chi}}{\nu_{\chi}} \cdot e^{-\nu_{\chi} r} \cdot \nu_{\chi} = \frac{\nu_{\chi}}{2} \cdot p_{\mathbf{r}}^2 \cdot r \leq r^1
\]

The possibility of a cold genesis of particles, results theoretically in a chiral soliton model as Bose–Einstein condensate of photons–in the electron’s case and of “gammons”: \( \gamma_\mu = (e^+e^-) \) in the case of mesons and of baryons, with the inertial degenerate mass \( m_2^* \), formed by a superdense centroid \( m_0 \) contained by an impenetrable quantum volume and by vexons (vectorial photons composed by vortexed vectors: \( \rho = 2 \times 10^{-40} \text{kg} \) – the \( E \)–field quanta in CGT), contained by the electron’s volume, \( r_1 \) of radius \( r = 1.41 \text{fm} \), characteristic to a charge\(^*\) distribution on the electron’s surface.

In a previous paper of the author, the possibility of a cold genesis of particles, resulted theoretically in a chiral soliton model as Bose–Einstein condensate of photons–in the electron’s case and of “gammons”: \( \gamma_\mu = (e^+e^-) \) in the case of mesons and of baryons, with the inertial degenerate mass \( m_2^* \), formed by a superdense centroid \( m_0 \) contained by an impenetrable quantum volume and by vexons (vectorial photons composed by vortexed vectors: \( \rho = 2 \times 10^{-40} \text{kg} \) – the \( E \)–field quanta in CGT), contained by the electron’s volume, \( r_1 \) of radius \( r = 1.41 \text{fm} \), characteristic to a charge\(^*\) distribution on the electron’s surface.

Introduction

In a previous article\(^1\) were presented shortly some basic models resulted from a pre-quantum cold genesis theory of matter and fields\(^3\) of the author, (CGT), regarding the cold forming process of cosmic elementary particles, formed–according to the theory, as collapsed cold clusters of gammons–considered as pairs: \( \gamma = \left(e^+e^-\right) \) of axially coupled electrons with opposed charges, which gives a preonic, quasi–crystalline internal structure of cold formed quarks, with hexagonal symmetry, based on \( x^2 = 34 m_2 \) pre-on–experimentally evidenced in 2015 but considered as X–boson of a fifth force, resulted in the model as cluster of 21 gammons, of \( \text{Fermions} \) with degenerate mass: \( m_2 = 0.0891 m_0 \), which explains the difference between the proton mass and the neutron mass \( \left( \text{~2.6 m}_2 \right) \) as “wesonic” couple: \( w = e^+ + s, \) \( \sigma \) being a “gluon”, i.e., a linking degenerate gammon: \( \gamma^* = (e^+e^-) = 2m_2^* = 1.62 m_1 \), which bind the neutralino electron to the protonic part: \( (N^2/m_0^* + 1 m_0^*) \).

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\]
quasi–electrons, (n=1134 gammons), according to an empiric relation (3b), in which $k_g < 1$, $\Psi^e$ being interacting fields.

The value of the constant $\gamma$ in equation (3c) may be approximated by CGT with the case of a proton's N=0 neutral cluster, formed with the decreasing of the $\eta_0$–mean radius of the electron' mass, from $\eta_0 = 0.965 \text{ fm}$ (for the free electron)1,2 to: $\eta_0 = 0.87 \text{ fm}$ (the root mean square charge radius of proton, experimentally determined)–for the nucleon's quasi-electron, which results in the model, for a proton with a considered effective radius: $r_p = a = 1.41 \text{ fm}$, (equal to those of the electron with e–charge on surface, in accordance with equation (1) and with the nuclear radius formula: $R_N = r_p \cdot A^{1/3}$), by the mass integral equation:

$$m_p = \int 4\pi r^2 \rho_p (r) \, dr; \quad \rho_p (r) = \rho_0^p \cdot \frac{r}{m_p} = \rho_0^p \cdot \Psi_p^0;$$

$$\Rightarrow \rho_0^p = (2n + 1) \rho_c^0 = 4.54 \times 10^{-13} \text{ kg/m}^3$$

with: $\eta_0 = 0.87 \text{ fm}$ and: $\rho_0^p = f_c \cdot \rho_c^0 = 22.24 \times 10^{-13} \text{ kg/m}^3$ , [2,3], $f_c = 0.9$ being a coefficient of density reducing in the center of the (quasi)electron at its mass degeneration, with the value resulted from equation (4). Also, because that–according to CGT, the degenerate electrons of the protonic B–E cluster are quasi–electrons, with the charge $e^0 = \sqrt{2/3}$ characteristic to the up–quark, by the specific dependence: $e = \rho_0 (a)$, by equation (1) and (2), to the $\rho_0 (r)$–density variation of the quasi–electron's magnetic moment vortex $\mu_{\nu} = \gamma_\mu \cdot v_\mu \cdot r$, in which a mean radius of the $\mu_{\nu}^* –$vortex: $\mu_\nu = 0.801 \text{ fm}$. With $l = (2 + 3) \times 10^{-5} \text{ fm}$, (all $m_\nu$–centroids in $\mu_\nu$), it results that $\gamma = \mu_{\nu} / 2 \times 10^{-6}$ for the electron' mass decreasing and: $\gamma = \mu_\nu \approx 3.8 \times 10^{-6}$ for its charge and magnetic moment density decreasing.

The virtual radius: $r_\nu^2$, of the proton $\mu_\nu$–magnetic moment, compared to the electron, decreases when the protonic positron is included in the N=0 cluster volume, from the value: $r_\nu^2 = 3.86 \times 10^{-3} \text{ m}$, to the value: $r_\nu^0 = 0.59 \text{ fm} \approx 0.6 \text{ fm}$, as a consequence of the increasing of the impenetrable quantum volume mean density in which is included the protonic positron centroid ("centrol"): $m_\nu$, from the value: $\bar{P}_\nu$ to the value: $\bar{P}_\nu = f_d \times N^0 \times \bar{P}_e$, confirmed with the equations:

$$\mu_\nu = k p \mu_c \cdot \frac{1}{f_d \times N^0 \times \bar{P}_e} = \frac{e_c \cdot r_\nu^0}{2};$$

$$k_p = \frac{q_p}{q_e} = 2.79 \frac{\rho_p (r)}{\rho_0^p} = e \cdot \eta_0 \cdot \gamma_\mu \cdot \mu_c = \frac{m_\nu}{\bar{P}_e}$$

in which: $k_p$ – the gyromagnetic ratio; $\bar{P}_e / \bar{P}_p$ – the mean density of electron and nucleon; $r_\nu$ – the position of proton positron centroid in report with the proton centre; $f_d$ – the degeneration coefficient of the quasielectron mass $m_\nu^* \cdot \nu_e$ – the nucleon’ volume, (containing all its inertial mass).

The dependence: $\mu \sim m_1^{-1}$ is explained in the model by the fact that the intensity of the electron’s magnetic moment $\Gamma_{\nu_1} = 2\pi r_\nu c$, is distributed to all $(N^0 + 1)$ degenerate electrons which compose the proton, i.e.:

$$\Gamma_{\nu_1} = 2\pi r_\nu c \cdot (N^0 + 1) \Gamma_{\nu_1} = \Gamma_{\nu_1}^* \cdot k_p \cdot \mu_\nu,$$

but because $N^0$ are paired vortices, only the remained unpaired vortex $\Gamma_{\nu_1}^* = 2\pi r_\nu c$, of the protonic positron gives the proton’s magnetic moment. The virtual radius of the proton’s magnetic moment: $r_\nu^0 = 0.59 \text{ fm}$ – resulted from equations (5) & (6), may be considered approximately equal to the radius of the impenetrable nucleon volume, of value: $r_\nu^0 \approx a \approx 0.6 \text{ fm}$–used in the Jastrow expression for the nuclear potential,3 by the conclusion that the impenetrable nucleon’ volume, $(u_i (r)) = 0.9 \text{ fm}^3$, being supersaturated with heavy photons, limits the radius decreasing to the quantonic vortex $\Gamma_{\nu_1}^* = 2\pi r_\nu c$, at the value: $r_\nu = r_\nu^0 = a = 0.6 \text{ fm}$.

The relation (5) also gives: $r_\nu^0 = 0.9 \text{ fm}$ for the protonic positron axial position inside the protonic quantum volume. The superposition of the $(N^0 + 1)$ quantonic vortices: $\Gamma_{\nu_1}$ of the protonic quasi-electrons, generates inside the volume with the radius: $r_\nu^0 = 2.35 \text{ fm}$, which is a total dynamic pressure: $P = (1/2) \rho_0 (r) \cdot c^2$ which gives a nuclear potential in an eulerian form (2), with: $\rho = 0.8 \text{ fm}^2$ and $V_\nu^0 = \frac{\rho}{2} \mu_\nu \cdot r_\nu^0 c^2 = 109.8 + 114.9 \text{ MeV}$, (the potential well), specific to $u_i (a) = 0.59 \times 0.6 \text{ fm}$.

At the distance $d \approx 2 \text{ fm}$ between deuteronic nucleons (generally considered as the dimension of the nuclear potential well), it results from the relation (2) that the scalar nucleonic potential has the value: $V_\nu^0 (d) = 8.98 + 9.4 \text{ MeV}$ (for $a = 0.59 \times 0.6 \text{ fm}$) which corresponds to the known mean binding energy inside the stable nucliei: 7.5…8.8 MeV and to those of the most strongly bound nucleons (56Fe, 60Ni.):

$\sim 9.15 \text{ MeV / nucleon}$.

According to equation (2), it results also that the deuteronic self–resonance decreases the value of scalar nuclear potential, until a value: $V_\nu^0 = k_\nu \cdot V_\nu^0$ with: $k_\nu = 0.72$.

It is known also the MIT bag model of particle,1 based on Bogoliubov’s model (1967) and on the Quantum Chromodynamics, which consider the quarks moving inside a „bag” volume of radius R =1fm, with the normal component of the pressure exerted by the free Dirac particles inside the bag balanced at the surface by the difference in the energy density of the quantum vacuum inside and outside the “bag”:

$$E = (4\pi / 3) B \times R^3, \text{ with } B \approx 60 \text{ MeV / fm}^3.$$ (7)

The B–constant having the meaning of a quantum vacuum pressure. The “bag” model allowed in particular a string model of hadrons, which describes the interaction force between two quarks by a potential of the Cornell form:6

$$V_\nu^0 = k_r / r + k_2 \cdot r$$

(with a pseudo–Coulombian term of gluon exchange and a strong force term), considering that when two color charges are separated, a string (flux tube) is formed in between, k representing the string tension: $\sim 1 \text{ GeV/fm}$, according to the quarkonium model, and $\sim 0.5 \text{ GeV / fm}$
and $B = 8 \times 10^{39} N$ according to some other authors. According to another approach of asymptotic freedom, the force between quarks considered in QCD is of a value: $F_{qq} \approx 10^{9} N$ .

It is known also that the nucleonic impenetrable volume is repulsive at distances between nucleons less than 0.7 fm, and attractive at higher distances, with maximum at $\approx 0.9 \text{ fm}$ . But it is known also that the d–quark current mass (corresponding to the quark’s mass inside the “bag”) is only $2.3 \text{ MeV} / c^2$ for u–quark and $4.8 \text{ MeV} / c^2$ for d–quark, the rest nucleonic mass being given by gluons, the cross–over temperature from the normal hadronic to the quark–gluons phase being about: $T_g \approx 2 \times 10^{12} K$, value at which the quark–gluon plasma can be created by heating matter up to $T_g$ –which corresponds to 172 MeV per particle.10

But even if we consider only two gluons, with an intrinsic energy $ε = (939 – 2 \times 2.3 – 4.8) / 2 = 465 \text{ MeV}$ , it results that almost entire intrinsic energy of the gluon must be used for the quarks retaining inside the nucleon’s quantum volume, being raised a bigger question, regarding the possible natural mechanism for this energy→mechanic work conversion.

In this case, a question which may be raised is: why it results as necessary an inter–quarks force of $\sim 10^{9} \text{ N}$ for maintain the quarks confination until $T_g \approx 2 \times 10^{12} K$ and how the color charge of the hypothetical gluons–considered by the Quantum Chromodynamics, generates phenomenologically the quarks binding potential? A relative correspondence between the vortexial model of nuclear force generating, resulted in CGT and the Bag Model of strong potential value increasing with the distance between quarks inside the particle, may result in concordance with the known quarks deconfination temperature $T_g \approx 2 \times 10^{12} K$ .

**Theoretical “bag” model of quarks confining force**

Because the fact that the internal vortexiality of the photonic sub–structures forming the nucleonic quantum volume–according to CGT, are energetically maintained by the energy of the superposed vortices $Γ_{\mu}^i(\tau_i)$ of the degenerate electrons, the difference between the values $y_{\gamma}$ and $y_{\rho}$ resulted by the vortexial model of nucleon in CGT for the $γ$ constant used in the equation (5) suggests that a proportion: $k = \Delta m / m \leq 0.13$ of the nucleon’s mass is in the form of kinetized quantonic clusters $m_\gamma = 10^{-46} \text{ kg}$ , (vectoric inertial masses, resulted from destroyed vexons, according to CGT), vortexially retained at the surface of the impenetrable quantum volume of the nucleon $\tau_\gamma$ , of radius $r_\gamma = a_i \approx 0.6 \text{ fm}$ , by the total dynamic quantonic pressure: $P_{\gamma_{\mu}}^0 (\tau_i)$ of the $Γ_{\mu}^i$ vortices of the protonic quaislectrones and they generates a static quantum pressure of quantonic clusters, of maximal value: $P_{\gamma_{\mu}}^0 = P_{\gamma_{\mu}}^0 (\tau_i) r_i^2 c^2$ , acting uniformly on the surface of the nucleonic impenetrable volume $v_\gamma(a_i)$ for a free proton or neutron.11

It is possible to argue this conclusion considering the case of a simple stable vortex $Γ_\gamma$ of quantons–for example, particularly with an exponential variation (given by a Boltzmannian distribution around its (super) dense kernel) and with the impulse density $p_\gamma = p(\gamma)c$ , for which we consider a small volume $\delta\tau$ containing a small mass $\delta m_\gamma = \rho_\gamma (\tau) \delta\tau$ of the vortex.

The equilibrium condition imposes that the centrifugal potential: $V_{\gamma} = \frac{1}{2} \delta m_\gamma c^2$ to be equilibrated by a static pressure potential of eulerian form:

$$V_{\gamma} = \frac{1}{2} \delta m_\gamma c^2 = \rho_\gamma (\tau) \delta\tau \frac{\partial P_{\gamma_{\mu}}^0 (\tau_i)}{\partial \rho_\gamma (\tau)}$$

resulting the condition: $P_{\gamma} = P_{\gamma_{\mu}} = \frac{1}{2} \delta m_\gamma c^2 \rho_\gamma (\tau) = \frac{1}{2} \rho_\gamma (\tau)$ . This condition may result also by a non-linear Schrodinger equation with soliton–like solution resulted by a self–potential $V_{\gamma} = \frac{\mu_\gamma}{\delta} \rho_\gamma (\tau) = \rho_\gamma (\tau) \rho_\gamma (\tau) \delta \rho_\gamma (\tau) \delta\tau$ and corresponds to a simple Bernoulli equation:

$$P_{\gamma} (\tau) + P_{\gamma_{\mu}} (\tau) = \rho_\gamma (\tau) c^2$$

If a heavier mass: $m_\mu = \mu_\mu c^2 \rho_\mu$, having its own impenetrable quantum volume, obtains in the $Γ_\gamma$–vortex an upper kinetic energy $E$, than those imposed by the equation (9), it may be expelled from the vortex, but when $E_{\gamma} (\tau)$ is close to $V_{\gamma} (\tau)$ resulted from (9), the $\delta m$–mass loose quickly the kinetic energy excess and return to the initial vortex–line of circulation, resulting in this case also a radial vibratory displacing of the $\delta m$–mass. In the nucleon case, this effect is sustained by the vortex $1/\delta \rho_\gamma (\tau)$. Because for an unperturbed nucleon $\rho_\gamma (\tau)$ cannot exceed $\rho_\gamma (\tau)$, according to equation (9), in a simplified model, we will consider that $\rho_\gamma (\tau)$ is approximate equal with $\rho_\gamma (\tau)$ given by the vorticity of internal substructure, i.e:

$$P_{\gamma} (\tau) + P_{\gamma_{\mu}} (\tau) = \rho_\gamma (\tau) \frac{c^2}{\delta}$$

with $\rho_\gamma (\tau)$ –the nucleon’s density at the surface of the impenetrable nucleonic volume, $η = \eta_{\gamma} \approx 0.87 \text{ fm}$ and $P_{\mu} (\tau)$, $P_{\gamma} (\tau)$ –the static and the dynamic quantum pressure of the quantonic clusters (paired vectors) inside the nucleon.

The previous considered phenomenon may explain microphysically the repulsive property of the impenetrable quantum volume of the nucleon, evidenced by the experiments of nucleon–nucleon scattering at high energy and used by the nucleon model with repulsive kernel, experiments which indicated a value: $r_i = 0.45 \text{ fm} < r_\gamma = a_i \approx 0.6 \text{ fm}$ , the value $a_i \approx 0.6 \text{ fm}$ being used in the Jastrow nuclear potential.10

In the sametime, considering an gaussian variation of the $P_{\gamma} (\tau)$ in the considered repulsive “shell” it may be explained by the gradient: $\nabla P_{\gamma} (\tau)$ , also the strong nuclear force acting over a quark inside the nucleonic impenetrable quantum volume.

This force may be calculated in the model by the equations:

$$V_{\gamma} = V_{\mu} + V_{\gamma} = -\mu_{\gamma} c^2 \delta \phi (\delta) + V_{\mu} (\tau_{\mu})$$

(11)

$$p_{\gamma}^0 / \delta = \frac{1}{2} \rho_\gamma (\tau_{\gamma}) c^2 \approx 10.2x10^{10} \text{ N}/\text{m}^2 \quad a_i = 0.45 \text{ fm}$$

(12)

In which $\rho_\gamma (\tau_{\gamma}) m_\gamma$ is the quantum impenetrable volume of the quark and: $\delta = \sqrt{c^2 c}$, (c–the gaussian standard deviation $a_i \approx 0.6 \text{ fm}$ and $V_{\mu} = \mu_{\mu} c^2 B_{\mu}$ –the magnetic potential of interaction between two quarks with relative magnetic moment $\mu_{\mu} = \frac{1}{2} e c^2$ which generates an induction:

The nuclear force explaining by a bag model resulted from a vortexial, cold genesis model of nucleon. (19)

The mass \( m_q (r) \approx 0.2 \text{ fm} \) may be considered the equivalent of the current mass of \( \text{d}-\text{quark} \). We may consider also that: \( m_q = \nu_q / \rho^0 = 1.52 \times 10^{-29} \text{ kg} \), (\( m_{q} = 0.5 \text{ MeV}/c^2 \)), is equivalent to the current mass of \( \text{u} \) and \( \text{d} \)-quark, being close to those considered by the Standard Model of Q.M. for the \( \text{d}-\text{quark} \), according to CGT. If we maintain the value of the impenetrable quantum volume given by equation (6) with \( \eta = 0.87 \text{ fm} \), the density \( \rho^0 \) between quarks results in this case of \( 2.83 \times 10^{-17} \text{ kg} / \text{ m}^3 \), close to those at \( \eta = 0.6 \text{ fm} ; \rho_0 = (0.6 \text{ fm}) = 2.27 \times 10^{-17} \text{ kg} / \text{ m}^3 \).

The sense of \( F_r (r < a) \) is toward the nucleon center and its variation (increasing with \( r \)) corresponds qualitatively to the „asymptotic freedom” of the „bag” model of nucleon, the remained non–quark mass of the nucleon’s impenetrable quantum volume being the equivalent of the „confined gluons”, considered in the MIT bag model, (Figure 1).

![Figure 1 Model of nucleon with repulsive kernel.](image)

According to the model, for quarks deconfinement is enough the energy necessary to the considered current quark mass \( m_{q} = 0.5 \text{ MeV}/c^2 \) for penetrate the repulsive shell with repulsive potential \( V_{q\nu} \), because that in the exterior of the impenetrable quantum volume, we have: \( F_{q\nu} / \tau \) and after the distance \( r_q = \eta = 0.87 \text{ fm} \), the attractive nuclear force acting toward \( \nu_q (r_q) \) is of \( (r_q^2 / \tau_q^2) \approx 27 \) times smaller than those acting over \( \nu_i (r_i) \).

The model has partially phenomenological correspondence also with the “chiral bag” model, which replaces the interior of a skyrmion with the “bag” of quarks, of a radius smaller than the nucleon radius, with a pionic field outside of the bag, with a “bag” radius \( = 0.6 \text{ fm} \).

The magnetic potential \( V_{q\nu} \) of equation (11) depends on the value of the relative magnetic moment \( \mu_q \) of the quark and on the B–field generated by the interacting quark, with the inter–distance \( d_r \), \( = 0.45 \text{ fm}, \) given in CGT, has the form:14

\[
\mu_q = \frac{\sqrt{2}}{3} \frac{e^2}{4 \pi a^2} \frac{d_r}{kd_r} \quad \text{and} \quad B_q = k_r \mu_q d_r c = \frac{1}{3} \mu_q d_r c e / a^2;
\]

resulting: \( \mu_q = 0.05 \mu_{\gamma} ; \quad B = 1.98 \times 10^{12} \mu_{\gamma} ; \quad V_{q\nu} = 0.0087 \text{ MeV} \). For \( \eta = \eta_q = 0.87 \text{ fm} \) and \( r_q = 0.2 \text{ fm}, \) (i.e. \( v_q = 3.35 \times 10^{-17} \text{ m}^3 \)), with a value: \( a_q = r_q^2 \approx 0.6 \text{ fm} \), by equations (10) and (11) it results that:

\[
P_{q\mu} = \frac{2}{3} \rho_0 (a_q) c^2 = 10.2 \times 10^{13} \text{ N} / \text{ m}^2 ; \quad V_{q\nu} \approx 2.13 \text{ MeV}.
\]

It is observed that the resulted value of \( P_{q\mu} \) is close to but bigger than the \( B \)-constant value resulted from the MIT Bag model: \( 60 \text{ MeV} / \text{ fm}^2 \approx 9.6 \times 10^{13} / \text{ m}^2 \), \( (N / \text{ m}^2 \) \). The maximal value of the force \( F_{q\nu} = -V_{q\nu} \) is obtained when the quark enters with its surface in the repulsive shell \( S (a_q) \), i.e. when its center is positioned at \( r_q \approx 0.45 \text{ fm} \) from the nucleon center, position in which the quark is “attracted” toward this center by a potential given by equation (11).

Because for \( r_q < r < a_q \), the value of \( F_{q\nu} \) decreases, we may approximate that–for a low centrifugal potential, the quarks deconfinement at \( T_q \) is produced when the total kinetic energy of the quark becomes equal with the value of \( V_{q\nu} (r) \) with: \( r_q = r_q = 0.45 \text{ fm} \), \( (E_{q\nu} \approx V_{q\nu} (r_q)) \).

At \( T \rightarrow 0 \text{K}, \) i.e. in unperturbed conditions, because the un–compensated vortex of the proton’s magnetic moment, two nucleonic quarks are rotated around the third quark, with supposed charge \( e^* = 2/3 e \), by the density of \( \Gamma_q \) vortex \( \rho_q \), in dynamic equilibrium with the resistance force given by the quanta remained in the impenetrable nucleonic volume \( \nu_q (r_q) \):

\[
\rho_q (r_q) c^2 = \rho_q (r_q) \frac{2}{3} \rho_0 c^2 e^* \quad \text{or} \quad r_q \approx 0.45 \text{ fm} \quad (15)
\]

With: \( \rho_q (r_q) = 12.6 \times 10^{13} \text{ kg} / \text{ m}^3 \) and \( \rho_q (r_q) = 2.8 \times 10^{17} \text{ kg} / \text{ m}^3 \), (CGT) \( v_q = 2.12 \times 10^{-2} \text{ c} \approx 6.36 \times 10^{10} \text{ m} / \text{s} \) and correspond to a centrifugal potential: \( V_q \approx (\nu_q) \cdot m_{q} \nu_q \approx 1.9 \times 10^{-3} \text{ MeV} \).

Supposing that a supplementary kinetic energy of quark: \( E_{q\nu} \) is obtained by a vibration energy of the nucleon \( E_{q\nu} \), this kinetic energy of the quark at \( T_q \) must be comparable with \( V_{q\nu} (r_q) \), according to the equations:

\[
E_{q\nu} = \frac{1}{2} m_{q} \nu_q \nu_q \approx (V_{q\nu} (r_q)) + V_{q\nu} - V_{q\nu} \quad (16)
\]

\[
E_{q\nu} = \frac{m_{q}}{2} m_{q} \nu_q \nu_q = \frac{m_{q}}{m_{q}} (V_{q\nu} (r_q)) + V_{q\nu} \nu_q \approx k_{q} T_{q} \quad (17)
\]

(\( m_{q} \)–the nucleon mass), because only a fraction \( k_{q} = m_{q} / m_{q} \) of \( E_{q\nu} \), is transmitted to the current mass of the quark, (contained into the impenetrable quantum volume of the quark). It results in consequence–by the model, that the known quarks deconfinement temperature: \( T_q = 2 \times 10^{12} \text{ K}, \) (10, Karsch, 2001) is given in the model in accordance with the equation (17) in \( E_{q\nu} = E_{q\nu} \approx 172 \text{ MeV} \) resulting that:

\[
E_{q\nu} = \frac{1}{2} m_{q} \nu_q \nu_q \approx (m_{q} / m_{q}) E_{q\nu} \approx 1.565 \text{ MeV} \quad (18)
\]

With \( V_{q\nu} \approx 2.1 \times 10^{-3} \text{ MeV} \) and \( r_q \approx 0.45 \text{ fm} \), it results:

\[
V_{q\nu} (r_q) = (E_{q\nu} + V_{q\nu} - V_{q\nu}) \approx 1.56 \text{ MeV} \quad (19)
\]

resulting by equation (11), with \( V_{q\nu} \approx 2.13 \text{ MeV} \) that: \( \delta = 0.27 \text{ fm} < r_q \).

It is observed also that because the fraction: \( m_{q} / m_{q} \), the previous

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The nuclear force explaining by a bag model resulted from a vortexial, cold genesis model of nucleon.

result for \( E_q \) value not depends on the speed-depending mass variation: \( m = m_0 / \beta \). Considering–according to CGT, a classical expression of \( \beta \), in the form: \( \beta_0 = 1 - v^2 / 2c^2 \), it results from eqn. (19), that: \( v(\mathbf{r}) = v_0 \approx 0.56 \) c and for an einsteinian form: \( \beta_0 = \beta_\gamma = \sqrt{1 - v^2 / c^2} \), it results that: \( v_\gamma \approx 0.45 \) c. It results also, by equation (12), that the quark is “pushed” toward the nucleon center with a force: \( F_q = -V_q(\mathbf{r}) \approx 1029 \text{ N} \) (compared to: \( F_q = \frac{\pi r^2 m_0 c^2}{1256 \text{ N}} \)), which corresponds to a centrifugal force acting over a quark current mass \( m_q \) with almost the same speed: \( v_q = v_\gamma \approx 0.54 \) c, (with \( \beta = \beta_\gamma = 1 - v_\gamma^2 / 2c^2 \)).

The potential \( V_q(\mathbf{r}) \) explains similarly the results of quarks–gluons plasma production experiments using lead or gold nuclei collision,\(^{16}\) by the conclusion that a fraction \( m_q / m_0 \) of the nucleon’s kinetic energy was maintained by each internal quark in report with the rest of the nucleon’s mass contained by the stopped nucleonic volume.

Also, the vortexial structure of the nucleon, considered in CGT, indicates that during the p–p or n–n collision, when deconfining between nucleon centers becomes: \( d_4 < 2a_0 \approx 1.2 \) fm, the proportion of destroyed internal vexons is increased, increasing also the value of \( P_0^0 \), until a value \( P_0^0 \) :

\[
2P_0^0 \geq P_0^0 > P_0^0, \quad (20a)
\]

explaining by equations (18)–(20) the usual energy necessary for strong interactions and for quarks–gluons plasma production by gold nuclei of \( \sim 100 \text{GeV} \), \( (m_q c^2 \approx 1.26 \text{GeV} / \text{nucleon}, \quad T_0 \approx 27\text{GeV}, \quad E_0^0 \approx 321 \text{MeV}) \).\(^{16}\) This effect may be equated by CGT multiplying the repulsive shell potential \( V_0(\mathbf{r}) \) with a term \( e^\beta \mathbf{r} \), in which \( \beta \) is the vibration ‘liberty’ (amplitude) of the quark inside the ‘bag’:

\[
V_0(\mathbf{r},\beta) = V_0^{0}(\mathbf{r}) \exp \left( \frac{\beta_0}{\beta} \mathbf{r} \right) = V_0^{0}(\mathbf{r}) \exp \left( \frac{\beta_0}{\beta} \mathbf{r} \right) \exp \left( \frac{1}{\beta} \right) \approx \frac{1}{2} k_T \beta = \frac{1}{2} k_T \beta = \frac{1}{2} k_T \beta \quad (20a)
\]

Considering the limit:\( e^{\Delta T} = 2 \) for \( T = T_0 \approx 27\text{GeV} \), it results:

\[
T_0 \approx 47\text{GeV} \rightarrow V_0^{0}(\mathbf{r}) \approx 1.65 \times V_0^{0}(\mathbf{r}) \). At usual nuclear temperatures \( T \approx 10^{10} K \), \( V_0^{0}(\mathbf{r}) \rightarrow V_0^{0} \). According to the model, when the first u- or d-quark penetrates the repulsive shell of the impenetrable quantum volume at \( T_0 \) it will carry \( 1 / 3 \) from the rest of the nucleon, \( (\frac{1}{3} m_0 - m_q) \approx 0.46 \times 10^{-27} \text{kg} \approx 259 \text{MeV} / c^2 \), representing the vexonic mass which is the equivalent to the “gluonic” field considered in QCD and giving a constituent mass: \( m_q^0 \approx 267.5 \text{MeV} / c^2 \).

Without this part of vortexial energy (\( m_q c^2 \)), the nucleon becomes an unstable hadron with the repulsive potential of the impenetrable quantum volume decreased to a value: \( V_q = 2 (m_0 - m_q) / m_q \), which is easier penetrated–at the same \( T_0 \) deconfining temperature, by the current mass \( m_0 \) of a remained quark.

In this way, the observed quark–gluons droplets explosion with almost the speed of light may be explained by the releasing of the remained intrinsic energy of the impenetrable quantum volume:

\[
\Delta E = (m_0 - 3m_q)^2 / c^2 = 117.7 \text{MeV},
\]

which increases locally the quantum static pressure during the quarks deconfining and gives to each quark \( \sim 39 \text{MeV} \) kinetic energy, being the equivalent of the “quarks binding energy”, according to the model.\(^{11}\) Inversely, at quarks confinement, \( T_0 \) corresponds to a plasma of quarks with \( m_q^0 \)--constituent mass, previously kinetized to a relativistic speed \( v_q \approx 0.88c \), (with \( \beta = \beta_\gamma \)) and their conflation occur when the energy released by destroyed internal photons (vexons) during the quarks collision becomes lower than the binding energy given by the potential \( V_q(\mathbf{r}_q) \) generated by the interacting quarks.

It results that initially, at \( T \) close to \( T_0 \), are formed unstable systems with two quarks, with the \( V_q(\mathbf{r}_q) = 1.04 \text{MeV} \), which becomes more stable when \( T \) decreases at \( T \approx (2/3) T_0 \approx 1.33K \) and may form a baryon by a third quark.

It is observed that–even if the potential \( V_q(\mathbf{r}_q) \) is much smaller comparative with those used by the Standard model and the Quantum chromodynamics, if the quarks are not kinetized at a relativistic speed \( v_q > V_q(\mathbf{r}_q) \), the resulted force is still enough strong for retain the quark inside the impenetrable quantum volume of the nucleon. It is logical also that–without high energy of kinetic interactions between nucleons, the kinetic energy \( E_q \) of quarks inside the nucleon’s impenetrable quantum volume cannot exceed the critical value \( E_q^* \), because that the high density of light quanta (quarks and vekons) inside the nucleon’s impenetrable quantum volume generates a deceleration force: \( F_q = S \rho c \), which equilibrates the acceleration force given by the quantonic vortex of the proton’s magnetic moment: \( F_q = S \rho c \), \( (S \approx r^1 \), equation (15)), explaining–by the model, the high stability of the proton.

It results in consequence, according to the proposed model of CGT,\(^{11}\) that the hypothesis of quarks interaction by intermediary gluons is more formal than natural, the nucleon mass part which corresponds to a “gluonic” shell of the quarks being explained in the model as a vexonic mass, vortexially confined. A strong argument for the model–comparative with the known model of QCD, is the natural conclusion that the interaction energy between quarks inside the impenetrable quantum volume of the nucleon, cannot be equal with or higher than the intrinsic energy: \( m_q c^2 \), of this quantum volume, so–cannot be higher than \( m_q c^2 \approx 0.5 \text{MeV} \)–because the quantum volume of a hypothetic gluon must be smaller than \( T_0 \) and–in consequence, its intrinsic energy cannot be higher than \( m_q c^2 \). Extremely, supposing a supersdense gluon with \( E > m_q c^2 \), it would be necessary to re-explain the “color” force.

The nuclear force between two nucleons

Because in accordance with equation (10a), the gradient of the total dynamic quantum pressure: \( \nabla P_0 \) produced by another nucleon and acting over the impenetrable quantum volume \( T_0 \), generates an equal but inverse gradient of static quantum pressure of quantic clusters:
The nuclear force explaining by a bag model resulted from a vortexial, cold genesis model of nucleon. 

\[ \nabla p_n^i = \nabla p_i(\tau_j) \cdot r^j = -\nabla p_{ai}^i, \quad (21) \]

The previous model of nucleon explains microphysically—by equation (8) of CGT, also the nuclear force of nucleon attraction in the field of another nucleon, by the conclusion that the difference of the total dynamic quantonic pressure: \( \Delta p_n^i(r) = p_n^i(r) - p_n^i(r + r_0) \) produced by the total vortexial field of a nucleon, generates in the positions: \( r \neq r_0 \) in which is found another nucleon, an equal but opposed difference of static pressure of quantonic clusters: \( \Delta p_n^i (r) \), acting over the impenetrable quantum volume of this nucleon, which—in this way is “attracted” by the first nucleon, with a force:

\[ F_n^i = -V_n^i = -\nabla p_n^i = -\nabla p_i(\tau_j) \cdot r^j = -\nabla p_{ai}^i; \quad (22) \]

\[ F_n^i = -V_n^i = -\nabla p_n(\tau_j) \cdot r^j = -\nabla p_{ai}^i; \quad (22) \]

(difference of static quantum pressure generated by difference of dynamic quantum pressure, introduced by the vortexial field). For example, if the intrinsic energy: \( \delta m_i \cdot c^2 \) of the parts \( \delta m_i \) of the nucleon’ quantum volume is given as in CGT,\(^1\) by internal vortic quantum pairs (“naked” photons), by the kinetic energy of vortexed vectons which composes the vexons:

\[ E_v = \frac{1}{2} \sum m_i (a_i \cdot r)^2 = \frac{1}{2} \delta m_i \cdot c^2 \]

and the kinetic energy of vortexed quanton of the vexon’s magnetic moment:

\[ E_v = \frac{1}{2} \sum m_i (a_i \cdot r)^2 = \frac{1}{2} \delta m_i \cdot c^2 \]

which is maintained by the vortexial energy of the nucleoic degenerate electrons’ magnetic moments, \( \mu_e : \Gamma_p^i(r) \), it results that the transforming of the vortexial energy \( E_v \) into an internal Boltzmannian energy: \( E_v^i (a_i) = E_v = \sum m_i k_B T_i, \) at surface of impenetrable quantonic volume of the nucleon \( \tau_j (a_i) \) not decreases in the same measure the vortexial quantonic energy of the degenerate electrons’ magnetic moments, (maintained by the action of quantum and subquantum winds), so the force of dynamic quantum pressure gradient which retains the quantity \( \sum m_i = \delta m_i \) of vectons at the surface of \( \tau_j \)—quantum volume is still enough strong, resulting—at the surface of \( \tau_j \), according to equation (10a), that:

\[ P_v^i (r) + P_v^i (r) = \rho_v^i (r) \cdot c^2 \]

\[ P_v^i (a_i) = P_v^0 (a_i) = \frac{1}{2} \delta m_i \cdot c^2 \]

\[ (23a) \quad (23b) \]

When an adjacent nucleon positioned on the direction \( r \) at the distance \( d_i \) intervenes with a supplementary dynamic quantonic pressure: \( p_n^i (d_i) \rightarrow \frac{1}{2} \rho_n^0 \cdot c^2 \cdot e^{-d_i / \rho_i} \) given by equation (2), the equation (10a) is transformed in the form:

\[ p_n^i (a_i) + p_n^i (a_i) + p_n^i (d_i) = \rho_n^i (a_i) \cdot c^2; \quad (24) \]

with: \( p_n^i (d_i) \rightarrow \frac{1}{2} \rho_n^0 \cdot c^2 \cdot e^{-d_i / \rho_i} \) resulting that \( p_n^i (a_i) \) is decreased by \( p_n (d_i) \). But because \( p_n^i \) and \( p_n^i (a_i) \) have null difference between two diametrically opposed points: \( x_1 = d_i - a_i \) and \( x_2 = d_i + a_i \) of the \( \tau_j \)—volume’ surface \( P_{ab}(d_i - a_i) = P_{ab}(d_i - a_i) \), it results that only \( p_n (d_i) \) is variable on the direction \( r \), between \( x_1 \) and \( x_2 \) the nuclear force: \( F_i = -V_n = -\nabla p_n(\tau_j) \cdot r^j \) resulting in the form:

\[ F_i = -V_n = -\nabla p_n(\tau_j) \cdot r^j \]

\[ (25a) \quad (25b) \]

being retrieved the form (2) of the nuclear potential. The fact that the nuclear interaction is still attractive at distance \( d_i = 2a_i \), is explained by the fact that the \( p_n(\tau_j) \) is recirculatedly reduced between the interacting nucleons (in the point \( x_j \) ), by their vortexial field, being maximally reduced when the “impenetrable quantum volumes \( \tau_j \) in mutual contact, (at \( \sim 0.9 \) fm—when \( p_n(\tau_j) \) action only to the surface \( \tau_j(x_{ij}) \) ), (Figure 2—the red zone), the interaction becoming repulsive only when is realized the mechanic interaction between the quarks of an nucleon and the quarks of another nucleon, at relative high interaction energies which may reduce the inter–distance \( d_i \) at the value: \( d_i = 4r_i = 0.8 \) fm, according to the model.

We can verify the previous conclusion calculating the nuclear force for \( d_i = 2r_i = 0.9 \) fm with the equation (22) but also with the relation:

\[ F_n^i (d_i) = S_i \times \Delta p_n^i = S_i \times p_n^i (r_i); \quad d_i = 2r_i; \quad r_i = \pi (r_i) \]

\[ (26) \]

obtaining: \( F_n^i (d_i) = 4.66 \times 10^{3} N \), \( d_i = 2r_i = 0.9 \) fm and the same: \( F_n^i (d_i) = 4.66 \times 10^{3} N \)—with equations (26) and (11).

According to the previous results, we may conclude that \( a_i = 0.6 \) fm is the radius of the equivalent quantum impenetrable volume, specific to the form (2) of the nuclear potential, (‘equivalent radius’ or ‘interaction radius’, characteristic to the nuclear interaction with the field of another baryon or meson), and the value \( r_i = 0.45 \) fm is the ‘effective radius’ of the impenetrable quantum volume \( \tau_i \), of mechanical interaction with other nucleons, experimentally determined.\(^1\)

The previous model of nucleon, with repulsive shell of the impenetrable volume, explains also why a lepton like the electron is not incorporated into the impenetrable volume of the nucleon but may be incorporated into the nucleon’ surface (in the case of neutron—according to CGT).\(^2\)

\[ \text{Figure 2 Model of interaction between nucleons with repulsive kernel.} \]

A suggestive comparison with the magnetic interaction of the nuclear potential may be given associating to the repulsive shell of the \( \tau_i \)—volume a static repulsive (pseudo)charge \( q_i \) and to the attractive shell—given by the vortexial field an attractive (pseudo)charge \( q_i \), which in CGT has the expression:

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The nuclear force explaining by a bag model resulted from a vortexial, cold genesis model of nucleon. Given by equation (24), the gradient:

\[ \nabla^2 \psi \]

being the gradient of "coldness" between the points \( x_i \) and \( x_j \) of the \( S(a_i) \) surface of the nucleon's impenetrable volume \( V_1 \), (marked by blue and red colors in Figure 2) in correlation with equation (32), in the form:

\[ F_n = \frac{\nabla \cdot \mu}{\mu_n} c^2 \]  

(34)

with \( B_n^0 = k_0 (p_n^0)^2 \) in accordance with equation (1).

Other explicative implications of the model

The antigravitation

A direct explicative consequence of the quasi--electrons cluster model of mesons and baryons proposed in CGT, is the conclusion that the nuclear energy generated in a nuclear fission or fusion reactions consists in fluxes \( \phi_e \) of emitted photons, quanta and sinergons by destruction of bounded photons of the nucleonic quantum volume, the sinergonic (etheronic) component \( \phi_e \) of this flux generating an antigravitic pseudocharge of the emitting nuclei.2,3

The hypothesis may explain--according to the theory, the field–like nature of the "dark energy", evidenced by astrophysical observations4–3 identifying the quasars and the super/hyper–novae as possible sources of "dark energy", by the hypothesis of a pulsatory antigravitic (pseudo)charge generating, by periodically repeated phases of matter accretion and destroying at the surface of a massive "black hole" and energy releasing, also in the form of quantonic and etheronic winds, particularly detectable as gravitational waves.

But this hypothesis is not enough fitted with the fact that--for create a luminosity of \( 10^{46} \) watts (the typical brightness of a quasar), a super–massive black hole must consume the material equivalent of 10 stars per year. So, the hypothesis regarding the pulsatory antigravitic (pseudo)charge generating, may explain better the quasar’s energy.4–3

According to this hypothesis, the generation of an antigravitic (pseudo)charge releases also gammons from the nucleon’s structure, partially transformed into electronic neutrinos (by the loose of the quantum volume, (CGT)),5–7 even in the case of a “black hole”, the frequency of the pulses being logically proportional with the star’s mass, because the field force to accelerate the process.

Is relevant in this sense also the case of the supernova SN1987A, which released an intense flux of gamma rays and electronic neutrinos8,9 and the case of “kilonova” star SSS17 (of 1,000 times stronger than a typical nova) which quickly changed from bluer to redder light---a sign that its debris expanded rapidly at speeds close to the speed of light and cooled as it went, for which the researchers estimated that about 30 percent of future neutron–star mergers will generate bright gamma--rays detectable from Earth.10

A discovery which is concordant with the considered hypothesis2,3 is the detection of ripples known as gravitational waves resulted from a colliding pair of neutron stars,11 with a period sensible higher than those produced by a "black hole" (almost Imunutes, compared to 1–2 seconds in the case of BH).12 According to CGT, these gravitational waves but also the “dark energy” which generates cosmic expansion, have resulted as sinergonic winds, (s–etheron, with \( m_n \approx 10^{46} \) kg), by the destruction of quasielectrons from the nucleon’s sub–structure, more probable than as fluxes of gravitons \( m_n \approx 10^{49} \) kg, even if it is logical that the density of gravitons is higher than the density of sinergonic etheron.

The hypothesis has concordance with the hypothesis of ‘dark energy star’,20 which also supposes the matter conversion into ‘dark energy giving a negative pressure, specific to \( \Lambda \)–constant.

Another phenomenon implying a possible antigravitic force is linked to an un–desired enigma of the Tchernobyl accident,21 consisting in the fact that is not known the nature of the force which had pushed the cover of almost 2000 tons of the reactor called Elena, moved without distortion of the reactor walls in the accident, being formulated the hypothesis of the generation of an un–known anti–gravitic force.22 This conclusion is consistent with the experiments performed by Shaw & Davy23 who have obtained a relation for the decreasing of the gravitational mass with the temperature:

\[ F_n(T) = F_n(1 - \alpha T) \]

(35)

with an experimentally determined value of the coefficient:

\[ \alpha = 1 / T_0 = 2 \times 10^{-16} \text{ (} T_0 = 5 \times 10^{10} \text{ K)} \]. 

Other research24 indicated a decrease with \( \sqrt{T/T_0} \) with \( T_0 = 6.25 \times 10^{10} \text{ K} \) for vibrated dural, which is the temperature of nuclear fusion in stars.

We may suppose that--because the negentropy given by etherono–quantonic winds, an antigravitic charge is generated at temperatures comparable with the nuclear temperature, i.e.: \( T > 6 \times 10^{10} \text{ K} \). According to the model, the released binding energy in the form of quantum energy producing static quantum pressure, may explain the kinetic energy of the U–fission products but also another Tchernobyl accident enigma: the disappearance of 90% of nuclear fuel and the discovery of 10 tons of aluminum, with the increasing of U235 amount and of Pu239/U235 ratio.21

The problem of dark matter

As it is known, a ‘dark matter’ particle must be low interacting with the usual matter and with upper stability, a proposed candidate being the neutrino particle. A known reaction:\(\left( e^+ e^- \right) \rightarrow \mu^+ + \mu^- \) suggests that the muonic neutrino pairs: \((\nu, \overline{\nu})\) may exist in the quantum vacuum as bosons with null charge and magnetic moment and null spin, (sterile’ boson), as paired rings of \(6\pi^0\)-preons—according to CGT, which—by electron capture, gives a muon, resulting also the conclusion that \(z^0\)-preons (of \(\sim 34m_n\)) may be dark matter components of the quantum vacuum. We may suppose in this case that also bigger neutral quasi–cystallin clusters of \(z^0\)-preons or cubic clusters of magnetically paired gammons, may constitute dark matter bosons.

The problem of the black hole’s density

As it is known, it is believed that a ‘black hole’ have usual densities of \(10^{18} + 10^{21} \text{ kg/m}^3\), because a neutron stars with mass above the limit TOV (Tolman–Oppenheimer–Volkoff) would collapse further, being formulated also the hypothesis that the neutronic matter degeneracy into a quark network state, may stop the star’s collapse, creating a ‘quark star’. According to CGT, this scenario is plausible, because the ‘zeroth’ vibrations of superdense kernels (centroids) of quaselectrons forming the B–E (collapsed) condensate of gammons which gives the neutronic quarks, vibrations which stop the quark collapse by the generating of an internal short range repulsive field.\(^{1}\) Because this phenomenon, it results in consequence that the current quark mass density: \(m_q / u_q \approx \rho^0_q = 4.54 \times 10^{13} \text{ kg/m}^3\) (CGT) is a plausible value for the density of a collapsed star even in the case of a ‘black hole’, excepting the case in which we consider also a decreasing of interdistance 1, between the quaselectrons’ kernels—caused by the internal pressure in the collapsed star’s center, until the forming of a heavy–quark star (with heavier quarks with approximate the same quantum volume as u– and d–quarks, for example—with double density: \(2\rho^0_q\), corresponding to \(v\)-quark–in CGT),\(^ {1}\) process which may indicate as plausible also the value of \(10^{14} \text{ kg/m}^3\).

The result limit is—in this case, a ‘neutrinic star’, formed by totally collapsed nucleons, i.e.—only by electronic centroids \(m_e\) having—in CGT,\(^ {2,3}\) the mass \(\approx 0.5x10^{-4} m_p\) (half of the electronic neutrino rest mass resulted from the old experiments), the radius \(\approx 10^{-18} m\) (resulted by X–rays scattering to electron and confused with the effective electron radius—by some theoreticiens) and the density \(\rho^0_e = 10^{19} \text{ kg/m}^3\) results as the maximal density of a ultra–cold ‘black hole’. We may suppose that also the \(m_e\)-centroids results as formed ‘at cold’, as compact cluster of quantons—in CGT.

A new model of pulsar

It results—from the previous conclusions regarding the antigravitic charge generation, the possibility of a periodically (pulsatile) radiative “black hole”, (pulsating “black hole”, PBH), as consequence of the antigravitic (pseudo)charge generation (by matter—energy conversion) at maximal values comparable with the gravitic charge (with the BH’s mass), which emits simultaneously and omni–directionally but intermittently not only gamma–rays, X–rays and visible light but also \(z^0\)-preons, neutrinos fluxes, and gravitational waves, in form of periodic fluxes of sinergons (s–etherons, \(m_e \approx 10^{-40} \text{ kg}\), (CGT)), generated at the transforming of gammons into electronic neutrinos: \((e^- e^+) \rightarrow (\nu, \overline{\nu}) + \phi_1\), by losing the photonic quantum volume of electrons. For example, considering an accretion disk with \(n_0\) nucleons density at the Schwarzschild radius: \(r_s = 2.95x10^{10} \text{ km}\) of a super–massive ‘black hole’ of \(M = 10^9 m_s\) (solar masses), with the equilibrium equation:

\[
G M \rho / r = n_0 k_b T; \quad (r = n_0 m_p) \quad (36)
\]

it results as necessary for impede the gravitational collapse of the accretion disk, a temperature \(T \approx 5x10^{25} K \times T_s\), which may transform also the quarks into preons according CGT, so the matter destroying occurs certainly in this case.

More probable, the cosmic sources which may have a PBH—according to the hypothesis, are some super/hypervacua–known as potential sources of gravitational waves,\(^ {24}\) such as the collapsar SN 1998bw—known as source of gamma–rays bursts, the OVV quasars (optically violent variable quasars), having emissions of high–energy photons, cosmic rays and neutrinos, and some blazars, (active galactic nuclei) such as BL Lac., (BL Lacertae) characterized by rapid and large–amplitude flux variability and the blazar TXS 0506+056 having neutrinos emission—recently observed as being coincident in direction and time with a gamma–ray flare from it,\(^ {21}\) (phenomenon predicted by the author in CGT—p. 90 and 99, as resulted from the matter-energy conversion at \(T \geq 10^{11} K\), by gammons–neutrinos transforming).

According to the model the effect is increased by particles acceleration in the BH’s field, particularly—by increasing the rotation of an accretion disk (transforming \(10–40\%\) of matter into energy) in a magnetic or gravitastic field (vortex of primordial, etherono–quantonic dark energy’ around a rotating BH).\(^ {2}\) In CGT, the inertial, ‘material’ mass results by the mass of electronic centroids and the mass of the vexons+vectons forming the particle’s quantum volume as bound vectorial photons, their transforming into energy meaning that they are converted into un–bound (quasi)free quanta or into fluxes of (quasi)free quanta and sinergonic etherons.

This hypothesis may explain also the excess of 0.511 MeV gamma rays coming from the galactic center, observed by the INTEGRAL satellite,\(^ {26}\) considered as arising from positron annihilation,\(^ {27}\) by the conclusion of matter destroying in the field of a massive PBH star, with neutronic matter transforming into \(z^0\)-preons—detectable as \(\gamma –\text{rays of energy} \approx 17 \text{ MeV (CGT)}\), but also into constituent \(\gamma –\text{gammons resulted in CGT as degenerate (} e^+ e^-\text{) pairs which may be transformed–at high energies, into electronic neutrinos, } (\nu, \overline{\nu})\), (which is pseudo–scalar–in CGT, but also into pairs of \(\gamma –\text{quanta of 0.511MeV, by mutual annihilation of the (} e^+ e^-\text{)–pairs.})\(^ {2}\)

The conclusion is in accordance with the fact that it is argued that the observed \(\gamma –\text{rays emission corresponds to the presence of a dark matter with a mass less than about 20 MeV, (given by neutral } z^0\)-preons—according to CGT). The proposed hypothesis is also in concordance with those formulated by Boehm et al.\(^ {28}\) which have argued that all of the characteristics of the observed signal of \(\gamma –\text{rays could be well fit by a scenario in which light dark matter particles (1–100 MeV) annihilate only into (} e^+ e^-\text{) pairs, but also with the observations in the energy range: } 100 \text{ keV} + 10 \text{ MeV of } \gamma –\text{rays is not known the type of sources, in the context in which for } \gamma –\text{rays with energies below 100 keV it is believed that the main contribution comes from Seyfert galaxies and for energies above 10 MeV a simple
model for blazars reproduces both the amplitude and the slope of the data.\(^{29}\)

**The ‘bag’ model’s generalizability**

A question which may be raised is: if the used nucleonic ‘bag’ model, may gives a generalized model, with scalar repulsive field superposed on a vortexial field at the impenetrable quantum volume’s surface, for the explaining of other fundamental field forces of attractive type. Because that the model is based on the magnetic interaction between (quasi)electrons and because in CGT even the electron has a small impenetrable quantum volume of radius: \(r_e = 3 \times 10^{-2} \text{ fm}\), it results that the magnetic interaction may be explained by the considered generalizable model, because that the magnetic potential \(A\) (which is parallel with the impulse density \(p\) of the \(B\) quantum vortex of the particle’s magnetic moment, \(\mu\)), for two antiparallel magnetic moments \(\mu_1\) and \(\mu_2\), has reciprocally opposed sense between \(\mu_1\) and \(\mu_2\), which indicates that the quantonic static pressure is increased by reciprocally partial destruction of laminarity, determining repulsion between \(\mu_1\) and \(\mu_2\). At the antiparallel orientation of \(\mu_1\) and \(\mu_2\), \(A_1\) and \(A_2\) have reciprocally parallel sense between \(\mu_1\) and \(\mu_2\), the quantonic static pressure being decreased by reciprocally partial increasing of laminarity (of quantonic dynamic pressure), determining attraction between \(\mu_1\) and \(\mu_2\).

The sinergono–quantonic vortex \(\Gamma_{\mu}\) of the electron’s magnetic moment may explain also the electric interaction as in CGT,\(^{2,3}\) by the capture of vectonic pairs (‘naked’ 3k photons) which generate a homogenous static pressure at the free electron surface \(S(a)\), but which are ‘split’ into vectons with opposed chirality (pseudo–charge), the vectons with the pseudo–charge’ sign as the electron’s surface being rejected as E–field quanta which interact attractive or repulsive with the vectonic quanta of another \(e^+\)–charge, reducing or increasing the pressure on the corresponding surface generating electric attraction or repulsion.

A verifying experiment may be made by measuring the electrostatic force between two different charged balls placed in a electrically isolated cavity, with walls of lead (Pb). If external fluxes of quanta pairs are the cause of electrical attraction, the electric force must be diminished. If it is not diminished, it means that the E–field quanta results from the quantum vacuum existent inside the cavity or that they may penetrate a dense matter such as a wall of lead.

In the case of gravitation, it seems that the Fatio/LeSage model of “pushing” gravity, is enough for explain phenomenologically the gravitation force. However, it exists theories that try to explain the gravitation force by a ‘holographic’ scenario, deducing the gravitation force from space’s entropy: \(F_G = (\mathcal{S} / \mathcal{Ax}) \cdot T\).\(^{30}\) But if we associates the entropy \(S\) with the quantum or sub–quantum static pressure \(P_s = n_s k_BT\) (equation (36)), i.e.: \(S = uP / T = n_s k_BT\), (the negentropy being associated with the dynamic pressure, \(P_D\)), \(F_G\) results in the form:

\[
F_G = -\nabla V_G = \frac{\mu_G}{d} \cdot (\hat{\partial} / \hat{\partial x}) \cdot T \approx \nu c^2 (\hat{\partial} / \hat{\partial x}) \quad (37)
\]

i.e.: \(V_G = u_m \cdot \rho_c c^2\) (as in equation (22)), with: \(\rho_c \sim M\) and \(u_m \sim m\) but as repulsive force. So–the gravitationnal force cannot result from entropy but from negentropy, i.e.–either from the energy of cosmic etheronic winds, as in the Fatio/LeSage theory, or in a ‘gravitonvortex’ type theory,\(^{2}\) i.e.–by the dynamic quanta pressure of the sinergonic \(\Gamma_A\)–vortex of particles, (gravito–magnetic force–in CGT).\(^{2,3}\) It is known also the Casimir effect, of attraction between two parallel plates of \(A\)–surface, caused by the quantum fluctuations in the zero–point electromagnetic field energy\(^{25}\) according to equation.

\[
\Delta P = \frac{F_C}{A} = \eta R / d^4; R = \hbar c^2 / 240 \quad (38)
\]

in which \(d\)–the distance between plates. If we consider that \(\Delta P = P_C - P_s\) results as quantum pressure difference between external \(A_1\) and inter–plates \(A_2\) faces, we may interpret its form (38) as resulted from the reducing of quantum pressure \(P_s\) by an additional dynamic quantum pressure \(P_C\) in the inter–plates interval, at the level of \(A_1\) face, by thermalised photons attraction (considered as standing waves of quantum vacuum) by superposed \(\Gamma_{\mu}\)–remanent vortexes of atomic particles magnetic moments of the ajacent plate and by supplementary dynamic quantum pressure \(P'_{C}\) at the nuclear level of \(A_1\) (on the ‘i’ nuclear face, according to equations (10a) and (21)), introduced by \(\Gamma_{\mu}\)–quantic vortexes.

This interpretation is concordant with the CGT’s explaining of the electrostatic interaction and with the fact that the variation with \(d^4\) is characteristic also to the magnetic force between two e–charges. The resulted interpretation is in accordance also with the known conclusion that the Casimir energy is the difference in zero–point energies between any two well defined physical situations \(a, b\), i.e.:

\[
E_{\mu}(a, b) = \sum(n) = \frac{1}{2} h [a_\mu(b) - a_\mu(b)] \quad (39)
\]

identifying–by CGT, the zero–point energy of photon with the intrinsic, vortexial energy of its rest mass \(\sqrt{h c m / \sqrt{m c^2}}\) (CGT).\(^{2,3,5}\) A connex question is if the decreasing of the nuclear potential \(V_N\) by deuteron self–resonance of a weakly linked nucleus inside a nucleus, which reduces periodically and locally the inter–nucleons potential at a mean value \(V_N(d) = 2.226\text{MeV}\),\(^{2,3}\) (explaining also the nuclear fission) reduces periodically also the electric charge of the vibrated nucleon or/and nucleus at a mean value \(Q_j < Q\).

The hypothesis of nuclear electric charge value oscillating was formulated in a previous paper\(^{28}\) in another way for explain the Kervran effect of biological nuclear transmutations and is in concordance with the used vortexial model of nucleon, with electric charge in the nucleus’ surface shell of destructible vectorial photons.

**Conclusion**

It is argued in the paper that both strong forces: between quarks and between nucleons, may be satisfactory described in a gluonless and pionless vortexial cold genesis model of nucleon, resulted as collapsed Bose–Einstein condensate of gammons of cold formed preonic quarks–based on \(x^2\)–preon resulted as cluster of 21 gammons–considered as (\(e^- e^+\))–pairs of degenerate electrons with vortexial structure, the nuclear force resulting by the gradient of static quantum pressure generated on diametrically opposed parts of the impenetrable quantum volume of the nucleus resulted in the nuclear interaction, of radius \(a = 0.6\text{ fm}\), with the aid of the dynamic quantum pressure gradient generated by an interacting nucleus, by the etherono–quantonic vortexes \(\Gamma_j\) of s–etherons and of quantons with mass \(m_B = h / c^2\), of the nucleonic quaselectrons.

The resulted model explains the nuclear force generating in correlation with the fact that the normal density of the quantum vacuum must be enough low \((\rho_c^0 \sim 1 / (\sqrt{\varepsilon} \sigma_N a))\) for permit the receiving of photons emitted by far galaxies. The quarks confining force results–by the same model of nucleon, in a pre–quantum “bag” model, with repulsive shell of the impenetrable quantum volume of
nucleon, in accordance with the known value of the deconfinement temperature $T_d \approx 2 \times 10^{-14}$ K, without the hypothesis of intermediary gluons.

The basic model of $\Psi^0$–preon–resulted in CGT as B–E condensate of $n_\Psi = 42$ degenerate electrons incomplete collapsed, with non–collapsed kernel of 42 electronic centroids $m_\Psi$ with a supposed twisted bar form (instead of a single superdense centroid) results in accordance with the interpretation by equation (5) of the proportionality: $\mu = m^{-1}$ (distribution of the $\Gamma_\Psi$) intensity of a quasi–electron ‘magnetic moment to $n_\Psi/2$ paired quasielectrons +1, equation (6)) and with the existence of an intrinsic energy $E = m_\Psi c^2$ of the particle. Compared with the MIT “bag” model or with the known chiral “bag” model resulted in CGT is unitary and more natural, explaining by the natural intrinsic energy and properties of the nucleon also the nuclear force between nucleons.

The previous result imply the conclusion that the model of strong interaction by gluons is more formal than natural, in relative accordance with the fact that free gluons have never been observed and with the known conclusion that the quarks may locally deform the quantum vacuum–conclusion which corresponds–in the quasielectrons cluster model of quarks, (by the vortexial model of electron), to the property of vacuum quanta confining by the sinergono–quantonic vortices $\Gamma_\Psi$ of the nucleonic quasielectrons. It results also that if the proton’s charge is given by an attached positron (explaining the $\mu_\Psi$ generation), the quarks deconfining temperature $T_d$ generates neutral (pseudo) quarks.

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**Conflict of interest**

Author declares there is no conflict of interest.

**References**


32. Cosmin HBG. On the attraction between two perfectly conducting plates. *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen*.