A Correspondence with the Bag Model of a Pre-quantum B.-E. Condensate Model of Nucleon

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1. Introduction

According to an etherono-quantonic theory of the author based on the galilean relativity, which sustains the possibility of particles cold genesis (CGT, [1]), the magnetic field is generated by an etherono-quantonic vortex \( \Gamma_M = \Gamma_\Lambda + \Gamma_B \) of 

\[ \Gamma_\Lambda = \Gamma_\Lambda_c + \Gamma_\Lambda_s \]

of s-ethers and of quantons with mass \( m_q = h/c^2 \), and which retrieve the exponential form of the nuclear potential by a pre-quantum nucleon model resulted as Bose-Einstein condensate of gammons formed as pairs of quasielectrons, is proposed a new, pre-quantum model for the proton's stability explaining, with repulsive "shell" of \( \approx 7.37 \times 10^{-5} \) fm radius, relative similar with the MIT, "Bag" Model but different from it, which explains the repulsive property of the impenetrable nucleonic volume in p-p scattering reactions by a repulsive property of its surface, given by a static pressure of internal kinetized quanta, with a Gaussian variation and with the maximal value corresponding to the B-constant of the MIT Bag Model. The resulted potential, acting over the impenetrable quantum volume of the quark- containing its current mass, can explain the quarks confining, in accordance with the known value of the deconfinement temperature, \( T_d \approx 2 \times 10^{12} \) K, without the hypothesis of intermediary gluons.

Abstract: By a pre-quantum theory of the author, which consider the magnetic moment as etherono-quantonic vortex \( \Gamma_M = \Gamma_\Lambda + \Gamma_B \) of 

\[ \Gamma_\Lambda = \Gamma_\Lambda_c + \Gamma_\Lambda_s \]

of s-ethers (sinergons-with mass \( m_s = 10^{-66} \) kg) - giving the magnetic induction \( \mathbf{B} = \frac{\mathbf{\rho}_s(r)}{c} \), and of quantons (h-quanta, with mass: \( m_h = h/c^2 \approx 7.37 \times 10^{-51} \) kg), giving the magnetic induction \( \mathbf{B} \) by an impulse density: \( \mathbf{p}_s(r) = (\mathbf{p}_s, c) \), generated by a magnetic moment of an atomic particle but also by a magnet or an electromagnet.

The known relation: \( \mathbf{B} = \mathbf{\rho}_s \cdot \mathbf{r} \) is explained in the theory by the conclusion that the \( \mathbf{\rho}_s \) field lines of the magnetic induction \( \mathbf{B} \) having a quantum density \( \mathbf{p}_s(r) \) are materialized as quantonic vortex-tubes formed around some oriented pseudostationary quanta of the electric field (named "vectons", i.e.-vectorial photons, with \( m_\gamma = 3 \times 10^{-34} \), \( m_h = 2.2 \times 10^{-40} \) kg) accumulated from the quantum vacuum by the quantonic vortex \( \Gamma_\Lambda \) of the \( \mathbf{B} \)-field, generated by the gradient of the sinergonic impulse density of the \( \Gamma_\Lambda \)-vortex: \( \mathbf{p}_s = \rho_s(r) \cdot c \), according to the equations:

\[
A = \frac{1}{2} B \cdot r = \frac{1}{2} k_1 \rho_s(r) \cdot c \cdot r = \frac{1}{2} k_1 \rho_s(r) \cdot v_c(r) \cdot r; \\
\Rightarrow A = \frac{1}{2} k_1 \rho_s(r) \cdot r \cdot c
\]

with: \( k_1 = S^0/e = 1.57 \times 10^{-10} \) [m^2/C], \( S^0 = 4 \pi a^2 \); \( a = 1.41 \) fm; \( r_\mu \) - the Compton radius of the considered electric charge and \( v_c(r) \approx (r_\mu/c) \cdot c \), (i.e.-with \( \rho_s(r) \approx \rho_c(r) \)).

Also, the expression of the electric field results in the form:

\[
E_c = B \cdot v_c = k_1 \rho_s(r) \cdot v_c^2(r) \quad (2)
\]

\[
\rho_s(r) = \rho_s^0 (a/r)^2 \quad \text{and} \quad \rho_s^0 = \mu_0 / k_1^2
\]

The theory deduces also a variation of the Compton radius and of the fermion’s magnetic moment, inverse proportional with the density in which is placed the particle’s super-dense kernel, (the particle’s centroid) and sustains the possibility of a cold genesis of particles, which results theoretically in a chiral soliton model as Bose-Einstein condensate of photons- in the electron’s case and of “gammons”: \( \gamma_c = (e^+ - e^-) \) - considered as pairs of...
degenerate electrons, i.e. of quasielectrons-in the case of mesons and baryons, with the inertial mass $m_e$, formed by a superdense centroid and a quantum volume of vexons (vectorial photons composed by vortexed vectons), in the same volume with radius equal with the electron’s Compton radius, $r_e = \lambda_e/2\pi = \hbar/m_e c$.

In a previous paper of the author, [2], was argued the conclusion that-at very low temperature, $T \rightarrow 0K$, because the physical contact between component electrons surface, their inertial masses and magnetic moments may be diminished because the decreasing of the density variation mean radius, $\eta^*$, according to the relations:

$$
\rho(r) = \rho^0 \left| \Psi_e \right|^2; \left| \Psi_e \right|^2 = k_d \Psi_e^* \Psi_e; \quad (3)
$$

$$
\Psi_e^* = R e^{-i\delta}; \quad \Psi_e = R e^{i\delta} \quad \eta^* = \eta < \eta \quad (4)
$$

where: $\Psi_e^*$ -the wave function of the free negatron and positron structure and $k_d$ -degeneration coefficient, which depends on the distance $l$ between the component electrons, for a system with more electrons, $k_d$ depending also of the number $n$ of gammons forming the protonic neutral cluster $N^0$ of the particle, according to an empiric relation:

$$
k_d \approx e^{-\left(\alpha r+\gamma r\right)^2} \quad (5)
$$

The value of the constant $\gamma$ in eq. (5) is approximated by CGT with the case of a proton formed as B-E condensate of $N^0 = 2104$ quasi-electrons, i.e. of $n=1052$ gammons (degenerate hard-gamma quanta), the mean radius $\eta$ of the electron mass decreasing from $\eta = 0.965 fm$ (of the free electron) to: $\eta = 0.849 fm$ –for the quasielectron of the B-E condensate, according to CGT, value which is very close to the experimentally determined root-mean-square radius of proton’s charge density variation: $\eta = 0.841 fm$, [3] and which results- for a proton with a considered effective radius: $r_p = a = 1.41 fm$, by the mass integral equation:

$$
m_p = \frac{4}{3} \pi a^3 \rho_p(r) dr; \rho_p(r) = \rho_p^0 e^{-r^2/\sigma_p^2} = \rho^0 \left| \Psi \right|^2; \rho^0 = (\alpha n+i\beta) = 4.68 x10^{13} kg/m^3 \quad (6)
$$

with: $\rho_p^0 = 22.24 x10^{13} kg/m^3$, [1].

Also, because that- according to CGT, the degenerate electrons of the protonic B-E cluster are quasi-electrons, with the charge $e^+ = \left(\gamma / \alpha\right)e$ characteristic to quarks, by the specific dependence: $e \sim \rho_p(a)$, to the $\rho_p(r)-$density variation of the quasi-electron’s magnetic moment vortex, $\Gamma^\mu$, it corresponds a mean radius of the $\Gamma^\mu$ vortex: $\eta = 0.755 fm$, [1] and it results that $\gamma = \gamma_e = 6.75 x10^6$ for the electron mass decreasing and: $\gamma = \gamma_p = 1.35 x10^5$ for the electron’s magnetic moment density decreasing.

The virtual radius: $r_p^0$, of the proton $\mu^+$-magnetic moment, compared to the electron, decreases when the protonic positron is included in the $N^0$ cluster volume, from the value: $r_p^0 = 3.86 x10^{13} m$, to the value: $r_p = r_p^0 = 0.59 fm$, as a consequence of the increasing of the impenetrable quantum volume mean density in which is included the protonic positron centroid (central): $m_p$ from the value: $\rho_p$ to the value: $\rho_p = \frac{4}{3} \pi r_p^3 \rho_p^0$, conforming with the equations:

$$
\mu_p = k_p \rho_p^0 \mu_e = k_p \frac{1}{f_p} N^0 \mu_{n_p} = \frac{e c \rho_p}{2} \quad (7a)
$$

$$
k_p = \frac{g_p}{g_e} = 2.79 \frac{\rho_p(r^*)}{\rho_p^0} = e \frac{r^*}{\eta} \quad (7b)
$$

in which: $k_p$–the gyromagnetic ratio; $\rho_p$; $\rho_p^0$–the mean density of element and nucleus; $r^*$ –the position of protonic positron centroid in report with the proton centre; $f_p$ –the degeneration coefficient of the quasielectron mass, $m_e$.

The virtual radius of the proton magnetic moment: $r_p^0 = 0.59 fm$- resulting from eq. (7a), may be considered approximately equal to the radius of the impenetrable nucleon volume, of value: $r_p = r = 0.6 fm$- used in the Jastrow expression for the nuclear potential, [4], by the conclusion that the impenetrable nucleon volume being supersaturated with quants, limits the decreasing of $\Gamma^\mu = 2\pi r_c^* -$quantonic vortex radius, at the value: $r_c^0 = r_p$.

The relation (7b) also gives: $r_p^* = 0.96 fm$ for the protonic positron axial position inside the protonic quantum volume.

The superposition of the $(N^0+1)$ quantonic vortices: $\Gamma^\mu$ of the protonic quasielectrons, generates inside the volume with the radius: $r^* = 2.35 fm$, a total dynamic pressure: $P_n = (1/2)\rho_n(r) c^2$ which gives a nuclear potential in an eulerian form, having a variation according to eq. (6) and (7b), with: $\eta^* = 0.755 fm$, that is:

$$
V'\rho\left(r\right) = -\nabla \cdot \nabla \rho\left(r\right) \cdot \left(\frac{3}{2}\nabla \rho\left(r\right) - \nabla V\right) \rho' \cdot e^{-\eta^*} \quad (8)
$$

in which the proton density in its centre has the value: $\rho_p^0 = (N^0+1)\rho_p^0 = 2105 \rho_p^0 = 4.68 x10^{13} kg/m^3$, ($\rho_p = 22.44 x10^{15} kg/m^3$), giving by eq. (6), an approximate mass of impenetrable quantum volume: $V(a) = 0.9 fm^3$, of value: $m(a) = 2.55 x10^{29} kg$ and a value of the potential well:

$$
V^0 = 118.4 MeV.
$$

At the distance $d \equiv 2 fm$ between deuteron nucleons (generally considered as the dimension of the nuclear potential well), it results from the relation (8) that the scalar nucleonic potential $V_s^0\left(r\right)$ has the value: $V_s^0\left(d\right) = -8.37 \text{ MeV}$-value which corresponds to the known mean binding energy inside the stable nuclei: $-7.5...-8.5 \text{ MeV}$. According to eq. (8), it results also that the deuteronic self-resonance decreases the value of scalar nuclear potential, until a value: $V_s^0 = k_n V_s^0$, with $k_n \approx 0.72$, [1].

It is known also the MIT Bag Model of particle [5], based on Bogoliubov’s model (1967) and on the Quantum Chromodynamics, which consider the quarks moving inside a “bag” volume of radius $R \approx 1 fm$, 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”:

\[ E = (4\pi/3)B R^3, \quad \text{with} \quad B \approx 60 \text{MeV/fm}^3, \quad (9a) \]

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], [7]:

\[ V_{qc} = -k/r + k_s r \quad (9b) \]

(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, \( k_s \) representing the string tension: \( QCD \) is of a value: \( F_\mu^2 \sim \mu \) asymptotic freedom, the force between quarks considered in the quarkonium model, [8], and representing the string tension: \( \mu \) normal hadronic to the quarks-gluons phase is about \( 12 \mu \) MeV per particle, [10].

But it is known also that the d- quark current mass \( \mu \) is only \( 4/9 \) MeV/c\(^2\) and the conclusions of the Bag Model looking the strong confining force term), considering that when two color charges are separated, a string (flux tube) is formed in between, \( k_s \) representing the string tension: \( QCD \) is of a value: \( F_\mu^2 \sim \mu \) asymptotic freedom, the force between quarks considered in the quarkonium model, [8], and representing the string tension: \( \mu \) normal hadronic to the quarks-gluons phase is about \( 12 \mu \) MeV per particle, [10].

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If we maintain the value of the impenetrable quantum volume given by eq. (6) with \( \eta = 0.849\text{fm} \), the density \( \rho_n \) between quarks results in this case of \(-2.56\times10^{13}\text{kg/m}^3\), close to those at \( r_i = 0.6\text{fm} : \rho_n(0.6\text{fm}) = 2.3\times10^{12}\text{kg/m}^3 \).

The sense of \( F_q(r=r_0) \) 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).

According to the model, for quarks deconfinement is enough the energy nessary to the considered mass \( m_0 \) of the quark for penetrate the repulsive shell with repulsive potential \( V_{qr} \), because that- in the exterior of the impenetrable quantum volume, we have: \( F_{qr} = 0 \) and after the distance \( r = \eta = 0.849\text{fm} \), the attractive nuclear force acting toward \( v_i(t_i) \) is of \( (t_i^0,v_i^0) \approx 23 \) times smaller than those acting over \( v_i(t_i^0) \).

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

The electric potential \( V_{qe} \) of eq. (11) depends also of the value of \( k_e = 1/4\pi\varepsilon_0 \), but inside of \( v_i \) we have a modified electric permittivity, which may be approximated in CGT by the relation: \( \rho \cdot v_i \approx \rho_0^e c \), [2], with \( v_i \rightarrow \) the light speed inside the quantonic density \( \rho \) and \( \rho_0^e \rightarrow \) the quantonic density of the vacuum.

Considering that \( v_i \rightarrow c \) at the electron surface, (for which \( \rho_0^e \approx \rho_0(a) = 5.17\times10^{13}\text{kg/m}^3 \)), it results that inside the nucleon mass we have:

\[
c/c \approx \gamma(v_e/c) \approx \rho_0(c) \rho_0^e = 9\times10^3\text{kg/m}^3 \quad (13)
\]

So we may approximate that \( V_{qe} \approx V_{qr} \) neglecting the \( V_{qe} \) part.

For \( \eta^* = \eta_0 \approx 0.849\text{fm} \) and \( r_i \approx 0.21\text{fm} \), [13], (i.e. - \( v_q \approx 3.88\times10^{14}\text{m/s} \)), with a value: \( a_i \approx 0.6\text{fm} \), by eqs. (10) and (11) it results that: \( P_{ni}^0 \approx 10.35\times10^{13}\text{N/m}^2 \) and \( V_{qr}^0 \approx 2.5\text{MeV} \).

It is observed that the resulted value of \( P_{ni}^0 \) is close to the B- constant value resulted from the MIT Bag model:

\[
\sim 60\text{MeV/fm}^3 \approx 9.6\times10^{13}\text{J/m}^3 \approx (\text{N/m}^2) .
\]

Because that: \( v_q(r_{mi}) \leq m_i \approx v_p^0 \rho_n^0 \) with \( \rho_n^0 \rightarrow \) the mean density of the nucleon’s impenetrable quantum volume, (i.e. - \( 6.2 \leq m_n \leq 10.2 \text{MeV/c}^2 \)), we may approximate also in the model that: \( m_i \approx v_q \rho_n^0 \approx 1.81\times10^{-29}\text{kg} \), \( (m_i \approx 10.2\text{MeV/c}^2) \), is equivalent to the current mass of u- and d- quark, being close to those considered by the Standard Model of Q.M. for the d- quark (down - quark: \( m_i \approx 9 \text{MeV/c}^2 \)).

The maximal value of the force \( F_q(r) = -\nabla V_q(r) \) is obtained when the quark enters with its surface in the repulsive shell \( S(a_i) \), i.e. when its center is positioned at \( r_i = 0.4\pm0.45\text{ fm} \) from the nucleon center, position in which the quark is “attracted” toward this center by a potential:

\[
V_q(r) = u_q \cdot P_{qe} = u_q \cdot P_{ni} \cdot e_{-} \cdot \frac{(r_0 - r)^2}{\sigma} = V_{qr} \cdot e_{-} \cdot \frac{(r_0 - r)^2}{\sigma} \quad (14)
\]

Because that for \( r_i < r < r_0 \), the value of \( F_q(r) \) decreases, we may approximate that –for a low centrifugal potential, the quarks deconfinement at \( T_d \) is produced when the total kinetic energy of the quark becomes equal with the value of \( V_q(r^0) \) with: \( r^0 = r_i = 0.45\text{fm} \), \( (E_{nv}^* = V_q^*(r^0)) \).

![Fig. 1. Nucleon model with repulsive kernel.](image)

At \( T\rightarrow0\text{K} \), i.e. in unperturbed conditions, because the uncompensated vortex of the proton’s magnetic moment, two nucleonic quarks are rotated around the third quark, with charge \( e = \frac{2}{3}e \), by the density of \( \Gamma_{nu}^u \) vortex, \( \rho_n(r_i^0) \), in dynamic equilibrium with the resistance force given by the quanta remained in the impenetrable nucleonic volume, \( \rho_n(r_i) \):

\[
\rho_n(r_i) = \rho_n^0(c) \cdot v_q(r_i^0) = \frac{2}{3} \rho_n^0(c) \cdot v_q^0 \cdot r_i^0 \approx 22 \times 10^{16} \text{kg/m}^3 \quad (15)
\]

With: \( \rho_n(r_i^0) \approx 8 \times 10^{13} \text{kg/m}^3 \) and \( \rho_n^0(r_i^0) \approx 2.56\times10^{13}\text{kg/m}^3 \) (CGT), it results that: \( v_q \approx 1.76\times10^{12} \text{c} \approx 5.3\times10^{12} \text{m/s} \) and correspond to a centrifugal potential: \( V_{qr}^* = (\frac{1}{2}) m_v v_i^2 \approx 1.6\times10^{15} \text{MeV} - \) value close to those resulted by eq. (7) used for a nucleon model with attached degenerate positron positioned at: \( r_i^* = 0.96\text{fm} \) from the nucleon center.

Supposing that a supplementary kinetic energy of quark: \( E_{nv}^* \) is obtained by a vibration energy of the nucleon, \( E_{nv}^* \), this kinetic energy of quark at \( T_d \) must be comparable with \( V_{qr}^*(r^0) \), according to the equations:

\[
E_{nv}^* = \frac{1}{2} m_n v_n^2 \approx \frac{m_n}{m_q} E_{nv} = \frac{m_n}{m_q} (V_{qr}^*(r^0) - V_{qr}^*) = k_B T_d \quad (17)
\]

(\( m_q \rightarrow \) the nucleon mass), because that only a fraction: \( k_
u = m_n/m_q \) of \( E_{nv}^* \) 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: \( T_d \approx 2\times10^{15}\text{K} \), \( (10, \text{ Karsch, 2001}) \), is given in the model in accordance with the equation:
resulting by eq. (17), that:

\[ E_{q^*} = \frac{m_q}{m_q} \left( V_q^* (r^*) - V_c^* \right) = \frac{m_q}{m_q} \left( \frac{r - r_c}{\delta} \right)^2 - V_c^* \approx 175 MeV \]  \hspace{1cm} (18)

\[ E_D = k_q T_d = \frac{m_q}{m_q} (V_q^* (r^*) - V_c^*) = \frac{m_q}{m_q} \left( \frac{r - r_c}{\delta} \right)^2 - V_c^* \approx 1.896 MeV \]

resulting by eq. (17), that:

\[ V_q^* (r^*) = \left( E_{q^*} + V_c^* \right) \approx 1.898 MeV; \]

resulting that \( \delta \approx 0.286 \text{ fm} < r^* \). If \( m_q \approx 9 \text{ MeV/c}^2, \delta = 0.24 \text{ fm.} \)

It is observed also that- because the fraction: \( m_q/m_n \), the previous 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: \( \beta = \beta_c = 1 - v^2/2c^2 \), it results from eq. (19), that: \( v_q (r^*) = v_q^* \approx 0.56c \), and for an einsteinian expression: \( \beta = \beta_c = v(1 - v^2/c^2) \), it results that: \( v_q^* \approx 0.45c \).

It results also, by eq. (12), that the quark is “pushed” toward the nucleon center with a force: \( F_{q^*} = -V c_{q^*} \approx 1115 \text{ N,} \) which corresponds to a centrifugal force acting over a quark current mass \( m_q \) with almost the same speed:

\[ v_q = v_q^* \approx 0.52c, \] (with: \( \beta = \beta_c = 1 - v^2/2c^2 \)).

The potential \( V_q^* \) explains similarly the results of quark-gluons plasma production experiments using lead or gold nuclei collision, [14] by the conclusion that a fraction \( m_q/m_n \) of the nucleon’s kinetic energy was maintained by each quark inside the nucleon’s quantum volume contained by the stopped nucleon volume.

Also, the vortexial structure of the nucleon, considered in CGT, indicates that during the p-p or n-n collision, when the distance between nucleons centers becomes: \( d_\Delta < 2a_\beta \approx 1.2f \text{m}, \) the proportion of destroyed internal vexons is increased, also increasing the value of \( P_{d_v} \), until a value \( P_{d_v} \), i.e.:

\[ 2P_{d_v} \geq P_{d_v} \geq (2 - k_v) P_{d_v}; k_v \approx 0.72, \] (CGT, [1]),

explaining by eqs. (18)-(20) the value of the usual energy necessary for strong interactions and for quark-gluons plasma production by gold nucleus of \( \sim 100 \text{ GeV}, \) (i.e. \( m_{q\text{c}} \text{c}^2 \approx 1.26 \text{ GeV/nucleon and } E_D \approx 321 \text{ MeV}, [14]). \)

According to the model, when the first current mass of u- or d- quark penetrates the repulsive shell of the impenetrable quantum volume at \( T_d \), it will carry \( \sim 1/3 \) from the rest of the nucleon, \( (1/3)m_n - m_i \approx 0.471 \times 10^{-27} \text{ kg} = 265 \text{ MeV/c}^2 \), representing the vexonic mass which is the equivalent to the “gluonic” field considered in QCD and giving a constituent mass: \( m_q^c \approx 275.2 \text{ MeV/c}^2 \) which afterward is increased vortexially by the quantum vacuum energy until a value: \( m_q^c \approx (1/3)m_n \approx 313 \text{ MeV/c}^2 \), according to CGT, [1].

Without this part of vexorial energy (\( m_q^c \)), the nucleon becomes an instable hadron with the repulsive potential of the impenetrable quantum volume decreased to a value: \( V_q^* \approx \) \[ [(m_n - m_q^c)/(m_q^c)] V_q^* \], which is easier penetrated at the same \( T_d \) deconfinement temperature by the current mass (\( m_q \)) 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:

\[ \Delta E_i = (m_n - 3m_q) c^2 = 113 \text{ MeV}, \]

which increases locally the quantum static pressure during the quarks deconfining, being the equivalent of the “quarks binding energy” for the quarks confining, according to the model.

Inversely, at quarks confinement, \( T_d \) corresponds to a plasma of quarks with the \( m_q^c \) constituent mass, previously kinetized by the released energy \( \Delta E_i \), to a relativistic speed: \( v_q \approx 0.84c \), (with \( \beta = \beta_c \)) and their confinement occur when the energy released by destroyed vexons during the quarks collision becomes lower than the binding energy given by the potential \( V_q^* (r^*) \) generated by the interacting quarks.

It results that initially, under \( T_c \), are formed instable systems with two quarks, with the \( V_q^* (r^*) \approx 1/3 V_q^* \approx 1.26 \text{ MeV}, \) which becomes more stable when \( T_c \approx (1/3) T_d \approx 1.33 \text{K} \) and may form a baryon by a third quark.

It is observed that- even if the potential \( V_q^* \) 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 \( v_q > v_q^* \), 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 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 (quantons and vectons) inside the nucleon’s impenetrable quantum volume generates a deceleration force: \( F_d = S_q p_q V_q^* \), which equilibrate the acceleration force given by the quantonic vortex of the proton’s magnetic moment: \( F_d = S_q p_q V_q^* \), (\( S_q \approx \pi r_q^2 \), eq. (15)), explaining- by the model, the high stability of the proton.

It results in consequence, according to the proposed model, that the hypothesis of quarks interaction by intermediary gluons is not strictly necessary, the nucleon mass part which correspond to a “gluonic” shell of the quarks being explained in the model as a vexonic mass, vortexially confined, so- the mechanism of quarks interaction by gluons results as formal, in CGT.

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: \( m_q^c \), of this quantum volume and - in fact, neither higher than \( m_q^c \geq 10 \text{ MeV}, \)
because that the quantum volume of a hypothetic gluon must be smaller than \( v_\Omega \) and – in consequence, its intrinsic energy cannot be higher than \( m_e c^2 \).

Also, because that- in accordance with eq. (10a), the gradient of the total dynamic quantum pressure: \( \nabla p_{\text{si}} \) produced by another nucleon and acting over the impenetrable quantum volume \( v_\Omega (r_i) \) generates an equal but inverse gradient of static quantum pressure of the quantonic clusters:

\[
\nabla p_{\text{si}} = \nabla p_d (r_i) = - \nabla p_{\text{si}}
\]

the previous model of nucleon explain microphysically – by eqn. (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: \( \Delta P_d (r) = P_d (r - r_i) - P_d (r + r_i) \), produced by the total vortexial field of a nucleon, generates- in the positions: \( r \pm r_i \) in which is found another nucleon, an equal but opposed difference of static pressure of quantonic clusters acting over the impenetrable quantum volume of this nucleon, which is – in this way, “attracted” by the first nucleon, with a force:

\[
F_i(r) = - \nabla V_i(r) = - \frac{1}{\eta} v_i \nabla p_{\text{si}} = \frac{1}{2} v_i \cdot \nabla p_{\text{si}} (r);
\]

\[
F_i(r) = - \frac{1}{\eta} v_i \nabla p_{\text{si}} = \frac{1}{2} v_i \cdot \nabla p_{\text{si}} (r);
\]

\[
\frac{1}{v_i \cdot \nabla p_{\text{si}}} = \frac{1}{\eta}; \quad \tau = 0.6 \text{ fm}
\]

(difference of static quantum pressure generated by difference of dynamic quantum pressure, introduced by the vortexial field given by the \( \Gamma_{\mu}^+ \) - vortices of the component quasielectrons).

The previous conclusions- considering the model of strong interaction by gluons as formal, are 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 \( \Gamma_{\mu}^+ \) of the nucleonic quasielectrons.

This property of the quarks- given by the component quasielectrons, explains also – according to CGT, the forming of quantonic vortex \( \Gamma_{\mu} \) of the magnetic moment generating vortex-tubes \( \xi_\mu \) which materializes the magnetic field lines, in correlation with the fact that the normal density of the quantum vacuum must be enough low (\( p_{\text{si}}^{b} - 1/c = \sqrt{(\xi_\mu \xi_\mu)} \)) for permit the receiving of photons emitted by far galaxies.

3. Other Explicative Implications of the Model

3.1. The Hypothesis of 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 nuclear fission or fusion reactions consists in a flux \( \phi_e \) of emitted photons, quants and sinergons by destruction of bounded photons of the nucleonic quantum volume and the sinergonic (etheronic) component \( \phi_i \) of this flux generates an antigravitic pseudocharge of the emitting nuclei, [1].

The hypothesis may explain - according to the theory, an un-desired enigma of the Tchernobyl accident, 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, [15].

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, by the hypothesis of a chain nuclear fast reaction producing, (favoured by the increasing of \( ^{9}\text{nu} \) flux), in the form:

\[
U238 + ^{0}\text{n} \rightarrow ^{\beta-} \text{Np}239 \rightarrow ^{\beta-} \text{Pu}239 \rightarrow ^{\beta-} \text{U}235 + ^{\alpha}\text{Pb}208 + ^{\alpha}\text{Al}27 + 3^{\beta}\text{B}
\]

so- stimulating nuclear transformings by the released energy, Pb208 being a “magic” A- number, according to a quasi-crystallin nuclear model, [1].

The energy of an anti-gravitic (pseudo)charge of the vibrated nucleon may be produced- according to the model, also by quanta or pseudo-quanta of very high energy, (E \( \rightarrow E_p \rightarrow E_D = 175\text{MeV} \)), transmitted with high frequency alternatively from two diametrically opposed sources or by repeated very fast inversion of the proton’s magnetic moment.

The probability of a such phenomenon during the Tchernobyl accident results by the fact that the releasing binding energy of U235 has a value of \( \sim 180\text{MeV} \), i.e.- close to the value of E_D.

3.2. The Problem of the Nucleon’s Spin

It is know that the nucleon spin \( S_n = \frac{1}{2} \hbar \) cannot be explained by the quark theory – according to the experimental results of EMC (European Muon Collaboration, [16, Ashman, 1988], which shown that the number of quarks with spin in the proton's spin direction was almost the same as the number of quarks whose spin was in the opposite direction, (“the proton spin crisis”, 17, J. Hansson, 2010).

According to the quasi-electrons cluster model of mesons and baryons proposed in CGT, which consider also the quark with \( q = + (\sqrt{2}/c) \) as being a B-E condensate of gammons with an un-paired quasi-electron with: \( e^* = + (\sqrt{2}/c)e \), the fermionic spin is a consequence of the magnetic moment generation and not inverse, in the sense that the known relation:

\[
\mu = (q/2m)g \cdot S;
\]

(\( g \) – the Landé factor), must be writted correctly in the form:
For example, if we consider the hard-gamma quanta as being a gammonic pair \((e^-e^+e^-)\) with the light speed, \(c\), the spin value \(S_e = 1\), results as sum of the magnetically paired electrons, \(S_B = \frac{\hbar}{2}\), given in accordance with eq. (23), if we consider un-degenerate values of the e-charge and \(\mu_e\) – magnetic moment.

In the case of a quasi-electron of the neutral protonic \(N^0\)-cluster, because that we have: \(g = 2\), \(e^* = \pm (\vec{\gamma}/\hbar)c\) and a degenerate value of the magnetic moment: \(\mu_e^* = (1/N^0)\mu_B\) –according to eq. (7) of CGT, the spin of the quasi-electron with: \(m(e^*) = f_m\), \((f \approx 0.8722, [1])\), results in the form:

\[
S(e^*) = \left(\frac{m_e^*}{e}\right) \frac{1}{N^0} \mu_e = \frac{3 f m_e}{2 e} \frac{1}{N^0} \mu_e = \frac{3}{2} \frac{f}{N^0} S_e ;
\]

\[
S = \frac{1}{2} \hbar ; \quad f = 0.8722 ; \quad (CGT)
\]

For the spin of a protonic quark formed by \(k = N^0\) quasi-electrons and for the spin of the entire \(N^0\) protonic cluster, because that the gammonic quasi-electrons are paired with opposite charges but also with opposite magnetic moments, it may be applied the sum rule, in the form:

\[
S(q) = N^0 S(e^*) = \frac{3 f m_e}{2 e} \frac{1}{N^0} S_e ;
\]

\[
S(p^+) = 1.3 S_e ; \quad S_e = \frac{1}{2} \hbar
\]

(24)

The difference between the resulted proton spin value and the value \(S_B = \frac{1}{2} \hbar\) considered by quantum mechanics may be assigned to a degeneration coefficient \(k_d^*\) of the electron spin, bigger than those of the magnetic moment, \(k_d\), at its incorporation into the protonic volume.

By the previous model, may be explained also the contradiction with the Pauli principle of the observed \(\Delta^{++}\) particles, \((A^{++})\), baryons consisting of three identical u quarks, with a calculated total spin of 3/2, by the conclusion that the resulted value of the spin is given with the same value as in the proton case, by the eq. (25).

But remains yet the contradiction with the EMC experiments in the sense that the proton spin results –by the sum rule, as given by three quarks with approximate the same value and polarization of the spin.

An alternative less explicative to avoid this contradiction is the use of quantum mechanics conclusion that the proton’s spin is more a quantum value without correspondence with the classic sense of the spin.

4. Conclusions

It results -by the pre-quantum model of nucleon resulted in CGT [1] as Bose-Einstein condensate of gammons formed as pairs of quasielectrons, that the repulsive property of the impenetrable nucleonic volume in p-p scattering reactions may be explained by a model with repulsive “shell” of the impenetrable quantum volume of nucleon, the considered repulsive property of its surface being given in the model by a static pressure of internal kinetized quanta with a gaussian variation and with the maximal value corresponding to the B-constant of the MIT Bag Model. The resulted potential, acting over the impenetrable quantum volume of the quark-containing its current mass, may explain the quarks confining in accordance with the known value of the deconfinement temperature, \(T_d\).

The resulted pre-quantum model may explain the proton’s stability in a way relative similar with those of the MIT Bag model, which consider, at the surface of a “bag” volume with radius of \(-1\)fm, a difference in the energy density of the quantum vacuum inside and outside the “bag”, but with essential differences, considering that a proportion: \(k \approx 0.13\) of the nucleon’s mass is in the form of kinetized quantic clusters, (inertial masses of light kinetized photons), vortexially maintained at the surface of the nucleonic impenetrable quantum volume, with a gaussian variation of the quantum static pressure inside and outside of its surface, caused by the specific vortexiality of the quasielectrons and the confined photons which gives the inertial mass of the nucleon, which maintains a higher value of the vorticity inside and outside of the impenetrable quantum volume by the vortexes of the specific magnetic moments, according to the pre-quantum CF-model of nucleon used in CGT.

Also, the considered radius of the “bag” is the same as those used by the “Chiral Bag” Model of nucleon, which considers a pionic chiral field outside of the bag having a radius of \(-0.6\) fm, [19].

The fact that –compared with the vectorial photons of the electric field and the quants of the magnetic field, the considered kinetized inertial masses of light photons contributes to the total inertial mass of the nucleon, is explained by the fact that they are vortexially bounded (“entrapped”) photonics masses, and each action over their mass is transmitted at least partially to the particle.

The proposed “repulsive shell” model of impenetrable quantum volume of nucleon, may be generalised for all baryons but also for mesons and it is in accordance also with a semiempiric relation for the particles lifetime proposed in CGT, dependent of the total intrinsic vibration energy of the internal quarks, \(\varepsilon_i\):

\[
\tau_i = \frac{\phi}{k_i \cdot 10^{12}} ; \quad \phi \equiv 10^{12} \text{sec} ; \quad k_i = \frac{\Delta m_p}{m_p} = n \cdot \varepsilon_i = n \cdot \frac{T}{T_d} (26)
\]

in which: \(\varepsilon_i = k_i T_d \equiv h \nu_c^0\) represent the critical phononic energy of the particle vibration which determines the quark deconfinement, at \(T_d\).

It may be hypothesised also- by eq. (26), that the higher stability of the proton indicates an axially magnetic coupling of the proton’s quarks along its magnetic moment vector, \(\mu_p\), this arrangement reducing the total intrinsic vibration energy of quarks inside the impenetrable quantum volume.

Also, according to CGT [2], it results by the model the possibility of quark-particle transforming, at \(T_d\):
by the transforming of the un-paired quasielectron with charge: $e^* = (\frac{2}{3})e$, into simple degenerate electron, (with degenerate magnetic moment only), positioned outside of the impenetrable quantum volume, in the particle’s strong (nuclear) interaction volume.

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