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

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Abstract: By a pre-quantum theory of the author, which consider the magnetic moment as etherono-quantonic vortex $\Gamma_M = \Gamma_A + \Gamma_B$ of etherons and of quantons with mass $m_h=h/c^2$, 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 ~0.6fm 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 deconfination temperature, $T_d \approx 2x10^{12}$K, without the hypothesis of intermediary gluons.

Keywords: Pre-quantum Model, MIT Bag Model, Repulsive Shell, Strong Force, Bose-Einstein Condensate

1. Introduction

According to an etherono-quantonic theory of the author based on the galileian relativity, which sustains the possibility of particles cold genesis (CGT, [1]), the magnetic field is generated by an etherono-quantonic vortex $\mathbf{\Gamma_M} = \mathbf{\Gamma_A} + \mathbf{\Gamma_C}$ of s-etherons (sinergons-with mass $m_s \approx 10^{-60}$kg) - giving the magnetic potential **A** by an impulse density: $p_s(r)=(\rho_s \cdot c)_r$ and of quantons (h-quanta, with mass: $m_h = h/c^2 \approx 7.37x10^{-51}$kg), giving the magnetic induction **B** by an impulse density: $p_c(r) = (\rho_c v_c)_r$, generated by a magnetic moment of an atomic particle but also by a magnet or an electromagnet.

The known relation: **B = rot. A** is explained in the theory by the conclusion that the ξ_B- field lines of the magnetic induction **B** having a quantum density $\rho_B(r)$ are materialized as quantonic vortex-tubes formed around some oriented pseudostationary quanta of the electric field (named "vectons", i.e.-vectorial photons, with $m_v = 3x10^{10} m_h = 2.2x10^{-40}$ kg) accumulated from the quantum vacuum by the quantonic vortex $\mathbf{\Gamma_c}$ of the **B**-field, generated by the gradient of the sinergonic impulse density of the $\mathbf{\Gamma_A}$-vortex: $p_s = \rho_s(r) \cdot c$, according to the equations:

$$A = ½\, B \cdot r = ½\, k_1 \rho_B(r) \cdot c \cdot r = ½\, k_1 \rho_c(r) \cdot v_c(r) \cdot r;$$
$$\Rightarrow A = ½\, k_1 \rho_s(r) \cdot r_\mu c \quad (1)$$

with: $k_1 = S^0/e = 1.57x10^{-10}$ $[m^2/C]_{si}$, ($S^0 = 4\pi a^2$; a = =1.41fm); r_μ- the Compton radius of the considered electric charge and $v_c(r) \approx (r_\mu/r) \cdot c$, (i.e.-with $\rho_c(r) \approx \rho_s(r)$).

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

$$E_c = B \cdot v_c = k_1 \rho_c(r) \cdot v_c^2(r) \text{ with:} \quad (2)$$

$$\rho_c(r) = \rho_a^0 (a/r)^2 \text{ and } \rho_a^0 = \mu_0 / k_1^2$$

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 centrod 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, η^*, according to the relations:

$$\rho(r) = \rho^0 |\Psi_e|^2; \ |\Psi_e|^2 = k_d \cdot \Psi_e^- \cdot \Psi_e^+; \quad (3)$$

$$(\psi_e^- = R\cdot e^{-iS/\hbar}; \ \ \psi_e^+ = R\cdot e^{iS/\hbar})$$

$$\psi_e^{\pm *} = R^* \cdot e^{\pm iS/\hbar}; \text{ with: } (R^*)^2 = e^{-r/\eta^*} = k_d\cdot R^2; \ R^2 = e^{-r/\eta}; \ \eta^* < \eta \quad (4)$$

where: Ψ_e^-; Ψ_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^p of the particle, according to an empiric relation:

$$k_d \approx e^{-(n\times\gamma/l)\times r} \quad (5)$$

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

$$m_p = \int_0^a 4\pi r^2 \rho_p(r)\,dr; \quad \rho_p(r) = \rho_p^0 \cdot e^{-\frac{r}{\eta_n}} = \rho_p^0 \cdot |\Psi_p|^2; \quad \rho_p^0 = (2n+1)\rho_e^0 = 4.68\text{x}10^{17}\,kg/m^3 \quad (6)$$

with: $\rho_e^0 = 22.24\text{x}10^{13}$ 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 $e^* = (^2/_3)\times e$ characteristic to quarks, by the specific dependence: $e \sim \rho_e(a)$, to the $\rho_e(r)$-density variation of the quasi-electron's magnetic moment vortex, Γ_μ^*, it corresponds a mean radius of the Γ_μ^*- vortex: η_μ = 0.755 fm, [1] and it results that $\gamma = \gamma_e \approx 6.75\text{x}10^{-6}$ for the electron mass decreasing and: $\gamma = \gamma_\mu \approx 1.35\text{x}10^{-5}$ for the electron's magnetic moment density decreasing.

The virtual radius: r_μ^n, of the proton μ_p-magnetic moment, compared to the electron, decreases when the protonic positron is included in the N^p cluster volume, from the value: $r_\mu^e = 3.86\text{x}10^{-13}$m, to the value: $r_i = r_\mu^p$ = 0,59fm , as a consequence of the increasing of the impenetrable quantum volume mean density in which is included the protonic positron centroid (centrol): m_0, from the value: $\overline{\rho}_e$ to the value: $\overline{\rho}_n \cong f_d \cdot N^p \cdot \overline{\rho}_e$, conformed with the equations:

$$\mu_p = k_p \frac{m_e}{m_p}\mu_e = k_p \frac{\overline{\rho}_e}{\overline{\rho}_n}\mu_e = k_p \frac{1}{f_d \cdot N^p}\mu_{Bp} = \frac{e.c\cdot .r_\mu^p}{2}; \quad (7a)$$

$$k_p = \frac{g_p}{g_e} = 2.79 = \frac{\rho_n(r^+)}{\rho_n^0} = e^{-\frac{r^+}{\eta_d}} \quad (7b)$$

in which: k_P-the gyromagnetic ratio; $\overline{\rho}_e$; $\overline{\rho}_n$ –the mean density of electron and nucleon; r^+ -the position of protonic positron centrol in report with the proton centre; f_d -the degeneration coefficient of the quasielectron mass, m_e*.

The virtual radius of the proton magnetic moment: r_μ^n = 0.59fm- resulting from eq. (7a), may be considered approximately equal to the radius of the impenetrable nucleon volume, of value: $r_\mu^n \cong r_i \cong$ 0.6fm- used in the Jastrow expression for the nuclear potential, [4], by the conclusion that the impenetrable nucleon volume being supersaturated with quantons, limitates the decreasing of $\Gamma_\mu^p = 2\pi r_\mu c$ -quantonic vortex radius, at the value: $r_\mu^n = r_i$.

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

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

$$\begin{aligned} V_s^n(r) &= -\upsilon_i \cdot P_d(r) = -\frac{\upsilon_i}{2}\rho_n(r)\cdot v_c^2 = V_s^0 \cdot e^{-\frac{r}{\eta^*}}; \\ V_s^0 &= -\frac{\upsilon_i}{2}\rho_n^0 \cdot c^2; \ r \le r_\mu^a = 2.35\text{fm} \end{aligned} \quad (8)$$

in which the proton density in its centre has the value: $\rho_n^o = (N^p+1)\cdot\rho_e^o = 2105\cdot\rho_e^o = 4.68\text{x}10^{17}$kg/m^3, ($\rho_e^0 = 22.24\text{x}10^{13}$ kg/m^3), giving-by eq. (6), an approximate mass of impenetrable quantum volume: $\upsilon_i(a_i)$ = 0.9 fm^3, of value: $m_i(a_i) \approx 2.55\text{x}10^{-28}$ kg and a value of the potential well:

$$V_s^0 = 118.4 \text{ MeV}.$$

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

$$E = (4\pi/3)B \cdot R^3, \text{ with } B \approx 60\text{MeV/fm}^3, \qquad (9a)$$

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]:

$$V_{qC} = -\frac{k_1}{r} + k_2 \cdot r \qquad (9b)$$

(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_2 representing the string tension: ~1GeV/fm, according to the quarkonium model, [8] and ~0.5 GeV/fm according to some other authors, [9]. According to another approach of asymptotic freedom, the force between quarks considered in QCD is of a value: $F_{qq} \approx 10^4$ N.

But it is known also that the d- quark current mass (corresponding to the quark's current mass inside the "bag") is only $4 \div 9$ MeV/c^2 and the cross-over temperature from the normal hadronic to the quarks-gluons phase is about $2\text{x}10^{12}$K, i.e the QGP can be created by heating matter up to a temperature of 2×10^{12} kelvin, which correspond to 175 MeV per particle, [10].

In this case, a quescion which may be raised is: why it is necessary an inter-quarks force of $\sim10^4$ N for maintain the quarks confination until $T_d \approx 2\text{x}10^{12}$K and how the "color" charge of the hypothetical gluons- considered by the Quantum Chromodynamics, generates phenomenologically the quarks binding potential ?

The objective of the paper is to analyse the possibility of a phenomenological, at least qualitative, correspondence between the vortexial model of nuclear force resulted in CGT and the conclusions of the Bag Model looking the strong potential value increasing with the distance between quarks inside the particle, in concordance with the known quarks deconfination temperature.

2. Theoretical Model of the Quarks Confining Force

The difference between the values γ_μ and γ_e given by the vortexial model of nucleon in CGT for the γ constant used in the eqn. (5) suggests that a proportion: $k = \Delta m/m_n \approx 0.13$ of the nucleon's mass is in the form of vortexially retained kinetized quantonic clusters (vectonic inertial masses, resulted from destroyed vexons, according to CGT).

A structure with two parts of the intrinsic energy: mc^2, of an elementary particle was considered also by M. S. El Naschie, [11], but in a relative different way, considering an endophysical part $E(D) = (21/22)\cdot mc^2$ given by a dark energy density and an exophysical quantum part: $E(0) = (1/22)mc^2$.

We may consider - in consequence, by the vortexial model of nucleon used in CGT, that an important quantity of kinetized quantonic clusters forming vectonic pairs, which contributes to the inertial mass of the nucleon, are vortexially maintained in the greatest concentration at the surface of the impenetrable nucleonic volume surface of radius r_i^* by the total dynamic quantonic pressure: $P_{di}^0(r_i^*)$ of the Γ_μ^* vortices of protonic quasielectrons and they generates a static quantum pressure of quantonic clusters, of maximal value: $P_{si}^0 = \rho_c^i(r_i^*)\cdot c^2$, acting uniformly on the surface of the nucleonic impenetrable volume- for a free proton or neutron.

Because that -for an unperturbed nucleon, $P_{si}^0(r_i^*)$ cannot exceed $P_{di}^0(r_i^*)$, [1] in a simplified model, we will consider that $P_{si}^0(r_i^*)$ is approximate equal with P_{di}^0 –given by the vorticity of internal vexons, i.e:

$$P_{sc}(r) + P_{dc}(r) = \rho_n(r)\cdot c^2; \qquad (10a)$$

$$P_{si}^0 \approx P_{di}^0 \approx \tfrac{1}{2}\rho_n^i\cdot c^2;\ \rho_n^i(r_i^*) = \rho_n^0 e^{-r_i/\eta^*} \qquad (10b)$$

with ρ_n^i –the nucleon's density at the surface of the impenetrable nucleonic volume, $\eta^* = \eta_n = 0.849$fm and $P_{sc}(r)$, $P_{dc}(r)$ – the static and the dynamic quantum pressure of the quantonic clusters (paired vectons) 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: $r_i^* = 0.45\text{fm} < r_\mu^n \cong 0.6$fm, [12], the value $r_\mu^n \cong 0.6$fm being used in the Jastrow nuclear potential, [4].

In the sametime, considering an gaussian variation of the $P_{sc}(r)$ in the considered repulsive "shell", it may be explained, by the gradient: $\nabla P_{sc}(r)$, 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:

$$V_q = V_{qe} + V_{qr} = -\frac{k_e}{r} + \upsilon_q \cdot P_{sc};\quad P_{sc} \approx P_{si}^0 \cdot e^{-\left(\frac{r-a_i}{\delta}\right)^2}; \qquad (11)$$

$$P_{sc} = \frac{1}{2}\rho_n^i(r^*)\cdot c^2$$

$$F_q = F_{qe} + F_{qr};\qquad F_{qr} = -\nabla V_{qr} = -\upsilon_q \cdot \nabla P_{sc} = 2\frac{\upsilon_q\cdot(r-a_i)}{\delta^2} P_{si}^0 \cdot e^{-\left(\frac{r-a_i}{\delta}\right)^2} \qquad (12)$$

in which $\upsilon_q(r_q, m_q)$ is the quantum impenetrable volume of the quark and: $\delta = \sqrt{2}c$, (c- the gaussian standard deviation), $a_i \approx r_i^*$ and k_e, –specific constant of the electric and magnetic interaction between quarks.

The mass $m_q(r_q \approx 0.21\text{fm})$ may be considered the equivalent of current mass of d- quark.

We may consider also that: $m_q \approx \upsilon_q \cdot \rho_n^0$, according to CGT.

If we maintain the value of the impenetrable quantum volume given by eq. (6) with $\eta = 0.849$fm, the density ρ_n^* between quarks results in this case of ~2.56×10^{17}kg/m^3, close to those at $r_\mu^n \cong 0.6$fm: $\rho_n(0.6\text{fm}) = 2.3\times10^{17}$kg/m^3.

The sense of $F_q(r<a_i)$ 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 deconfination is enough the energy nessary to the considered current mass m_q 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: $\mathbf{F}_{qr} // \mathbf{r}$ and after the distance r = $\eta \approx 0.849$ fm, the attractive nuclear force acting toward $\upsilon_q(r_q)$ is of $(r_\mu^n/r_q)^3 \approx 23$ times smaller than those acting over $\upsilon_i(r_\mu^n)$.

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 ~0.6 fm, (as in the proposed model).

The electric potential V_{qe} of eq. (11) depends also of the value of $k_e = 1/4\pi\varepsilon$, but inside of υ_i we have a modified electric permitivity, which may be approximated in CGT by the relation: $\rho\cdot v_l \approx \rho_c^0\cdot c$, [2], with v_l –the light speed inside the quantonic density ρ and ρ_c^0 –the quantonic density of the quantum vacuum.

Considering that $v_l \approx c$ at the electron surface, (for which $\rho_c^0 \approx \rho_e(a) = 5.17\times10^{13}$ kg/m^3), it results that inside the nucleonic kernel we have:

$$c/v_l \approx \sqrt{(\varepsilon\mu/\varepsilon_0\mu_0)} \approx \rho_n^0/\rho_e^a = 9\times10^3 \qquad (13)$$

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

For $\eta^* = \eta_n = 0.849$fm and $r_q \approx 0.21$ fm, [13], (i.e. - $\upsilon_q \approx 3.88\times10^{-47}$ m^3), with a value: $a_i \approx 0.6$ fm, by eqs. (10) and (11) it results that: $P_{si}^0 \approx 10.35\times10^{33}$ N/m^2 and $V^0_{qr} \approx 2.5$ MeV.

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

$$\sim 60 \text{ MeV/fm}^3 \approx 9.6\times10^{33} \text{ J/m}^3, (\text{N/m}^2).$$

Because that: $\upsilon_q\cdot\rho_{mi} < m_q \leq \upsilon_q\cdot\rho_n^0$ with ρ_{mi} – the mean density of the nucleon's impenetrable quantum volume, (i.e.- $6.2 < m_q \leq 10.2$ MeV/c^2), we may approximate also in the model that: $m_q \approx \upsilon_q\cdot\rho_n^0 \approx 1.81\times10^{-29}$ kg, ($m_q \approx 10.2$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: $m_d \approx 9$ MeV/c^2).

The maximal value of the force $F_{qn} = -\nabla V_{qn}$ is obtained when the quark enters with its surface in the repulsive shell $S(a_i)$, i.e.- when its center is positioned at $r_f \approx 0.4\div0.45$ fm from the nucleon center, position in which the quark is "attracted" toward this center by a potential:

$$V_{qr} = \upsilon_q\cdot P_{sc} = \upsilon_q\cdot P_{si}^0\cdot e^{-\left(\frac{r-a_i}{\delta}\right)^2} = V_{qr}^0\cdot e^{-\left(\frac{r-a_i}{\delta}\right)^2} \qquad (14)$$

Because that for $r_f < r \leq a_i$ the value of F_{qr} decreases, we may approximate that –for a low centrifugal potential, the quarks deconfination at T_d is produced when the total kinetic energy of the quark becomes equal with the value of $V_{qr}(r^*)$ with: $r^* \approx r_i^* = 0.45$fm, ($E_{qv}^* \approx V_{qr}^*(r^*)$).

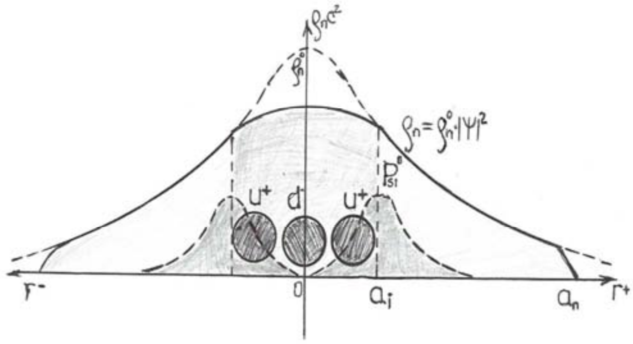

Fig. 1. *Nucleon model with repulsive kernel.*

At T→0K, i.e- in unperturbed conditions, because the un-compensed vortex of the proton's magnetic moment, two nucleonic quarks are rotated around the third quark, with charge $e^* = {}^2/_3\cdot e$, by the density of Γ^*_μ vortex, $\rho_\mu(r_i^*)$, in dynamic equilibrium with the resistance force given by the quanta remained in the impenetrable nucleonic volume, $\rho_n^*(r_i^*)$:

$$\rho_\mu(r_i^*)\cdot c^2 = \rho_n^*\cdot v_r^2 \;;\; \rho_\mu(r_i^*) \approx \frac{2}{3}\rho_\mu^0\cdot e^{-\frac{r^*}{\eta_\mu}} \;;\; \rho_\mu^0 = 22.24\times10^{13}\ \text{kg/m}^3 \qquad (15)$$

With: $\rho^*_\mu(r_i^*) \approx 8\times10^{13}$ kg/m^3 and $\rho_n^*(r_i^*) = 2.56\times10^{17}$kg/m^3, (CGT), it results that: $v_r = 1.76\times10^{-2}c \approx 5.3\times10^6$ m/s and correspond to a centrifugal potential: $V^*_c = (½)\cdot m_q v_r^2 \approx 1.6\times10^{-3}$ MeV - value close to those resulted by eq. (7) used for a nucleon model with attached degenerate positron positioned at: $r_e^+ = 0.96$ fm from the nucleon center.

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

$$E^*_{qv} = ½\cdot m_q v_q^2 \approx (V_{qn}(r^*) - V^*_c), \qquad (16)$$

$$E^*_{nv} = \frac{1}{2} m_n v_q^2 = \frac{m_n}{m_q} E^*_{qv} = \frac{m_n}{m_q}(V_q^*(r^*) - V_c^*) \approx k_B T_d \qquad (17)$$

(m_n –the nucleon mass), because that only a fraction: $k_q = m_n/m_q$ 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 deconfination temperature: $T_d \approx 2\times10^{12}$K, (10, Karsch, 2001), is given in the model in accordance with the equation:

$$E_D = k_B T_d = \frac{m_n}{m_q}(V_q^*(r^*) - V_c^*) = \frac{m_n}{m_q}(V_{qn}^0 \cdot e^{-\left(\frac{r^*-a_i}{\delta}\right)^2} - V_c^*) \approx 175MeV \quad (18)$$

resulting by eq. (17), that:

$$E_{qv}^* = ½\cdot m_q v_q^2 \approx (m_q/m_n)\cdot E_D = 1.896 \text{ MeV} \quad (19)$$

and –with $V^*_c \approx 2.6x10^{-3}$ MeV , $m_q \approx 10.2$ MeV/c^2 and $r^* \approx r_i^*$ = 0.45fm, it results that:

$$V_q^*(r^*) = (E_{qv}^* + V_c^*) \approx 1.898 \text{ MeV}; \quad (20)$$

resulting that $\delta \approx 0.286$ fm < r^*. If $m_q \approx 9$MeV/c^2, $\delta \approx 0.24$ 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 β, in the form:$\beta = \beta_c = 1- v^2/2c^2$, it results from eq. (19), that: $v_q(r^*) = v_q^* \approx 0.56\cdot c$, and for an einsteinian expression: $\beta = \beta_e = \sqrt{(1- v^2/c^2)}$, it results that: $v_q^e \approx 0.45\cdot c$.

It results also, by eq. (12), that the quark is "pushed" toward the nucleon center with a force: $F_{qr} = -\nabla V_{qr} \approx 1115$ N, which corresponds to a centrifugal force acting over a quark current mass m_q with almost the same speed:

$$v_q^r = v_q^m \approx 0.52c, \text{ (with: } \beta = \beta_c = 1- v^2/2c^2).$$

The potential V_q^* explains similarly the results of quarks-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 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 the distance between nucleons centers becomes: $d_n < 2a_i \approx 1.2$fm, the proportion of destroyed internal vexons is increased, incresing also the value of P_{si}^0, until a value P_{si}^0, i.e.:

$$2P_{di}^0 \geq P_{si}^0 \geq (2- k_v)\cdot P_{di}^0;\ k_v \approx 0.72, \text{ (CGT, [1])},$$

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

According to the model, when the first current mass of u- or d- quark penetrates the repusive shell of the impenetrable quantum volume at T_d, it will carry ~1/3 from the rest of the nucleon, ($^1/_3(m_n - m_i) \approx 0.471x10^{-27}$kg = 265MeV/$c^2$), representing the vexonic mass which is the equivalent to the "gluonic" field considered in QCD and giving a constituent mass: $m_q^c \approx 275.2$ MeV/c^2 which afterward is increased vortexially by the quantum vacuum energy until a value:$m_q^c \approx (^1/_3)\cdot m_n \approx 313$ MeV/c^2, according to CGT, [1].

Without this part of vortexial energy ($m_q^c c^2$), the nucleon becomes an instable hadron with the repulsive potential of the impenetrable quantum volume decreased to a value: $V_q \approx [(m_n - m_q^c)/m_n]\cdot V_q^*$, which is easier penetrated at the same T_d deconfination 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:

$$\Delta E_i \approx (m_i - 3m_q)\cdot c^2 = 113 \text{ MeV},$$

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

Inversely, at quarks confination, T_d corresponds to a plasma of quarks with the m_q^c constituent mass, previously kinetized by the released energy ΔE_i to a relativistic speed: $v_d \approx 0.84c$, (with $\beta = \beta_c$) and their confination 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 $V_q(r^*) \approx (^2/_3)\cdot V_q^* \approx 1.26$ MeV, which becomes more stable when $T_c = (^2/_3)\cdot T_d \approx 1.33$K and may form a baryon by a third quark.

It is observed that- even if the potential V_{qn} 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: $F_d \approx S_q \rho_n v_q^2$ which equilibrate the acceleration force given by the quantonic vortex of the proton's magnetic moment: $F_d \approx S_q \rho_\mu c^2$, ($S_q \approx \pi\cdot r_q^2$, 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: $m_i c^2$, of this quantum volume and - in fact, neither higher than $m_q c^2 \cong 10$ MeV, because that the quantum volume of a hypothetic gluon must be smaller than υ_q and –in consequence, its intrinsic energy cannot be higher than $m_q c^2$.

Also, because that- in accordance with eq. (10a), the gradient of the total dynamic quantum pressure: ∇P_{di} produced by another nucleon and acting over the impenetrable quantum volume $\upsilon_i(r_i)$ generates an equal but inverse gradient of static quantum pressure of the quantonic clusters:

$$\nabla P_{si} = \nabla \rho_c(r_i) \cdot c^2 = -\nabla P_{di} \quad (21)$$

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:

$$F_N(\mathbf{r}) = -\nabla V_N(\mathbf{r}) = -\frac{1}{2}\upsilon_i \cdot \nabla P_{sc} = \frac{1}{2}\upsilon_i \cdot \nabla P_d(r);$$

$$\Rightarrow F_N(\mathbf{r}) = -\frac{1}{\eta^*} V_N^0 \cdot e^{-\frac{r}{\eta^*}}; \quad (22)$$

$$\upsilon_i = \upsilon(r_i); \quad r_i \approx 0.6 \text{ fm}$$

(difference of static quantum pressure generated by difference of dynamic quantum pressure, introduced by the vortexial field given by the Γ_μ^* - 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 Γ_μ^* of the nucleonic quasielectrons.

This property of the quarks- given by the component quasielectrons, explains also –according to CGT, the forming of quantonic vortex Γ_μ of the magnetic moment generating vortex-tubes ξ_B which materializes the magnetic field lines, in correlation with the fact that the normal density of the quantum vacuum must be enough low ($\rho_c^0 \sim 1/c = \sqrt{(\varepsilon_0\mu_0)}$) 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 ϕ_E of emitted photons, quantons and sinergons by destruction of bounded photons of the nucleonic quantum volume and the sinergonic (etheronic) component ϕ_s 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 ^{0}n flux), in the form:

$$U238 + {}^0n \rightarrow \beta^- \rightarrow Np239 \rightarrow \beta^- \rightarrow Pu239 \rightarrow \beta^- \rightarrow U235 + \alpha \rightarrow Pb208 + Al27 + 3\beta^-$$

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, ($E_P \rightarrow E_D = 175$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 ~180MeV, 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 $q = +(^2/_3)e$ as being a B-E condensate of gammons with an un-paired quasi-electron with: $e^* = +(^2/_3)e$, the fermionic spin is a consequence of the magnetic moment generation and not inverse, in the sense that the known relation:

$$\mu = (q/2m)g \cdot S; \quad (23)$$

(g – the Landé factor), must be writted correctly in the form:

$S = (2m/g\cdot q)\cdot\mu$.

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

In the case of a quasi-electron of the neutral protonic N^p-cluster, because that we have: g = 2, $e^* = \pm (^2/_3)e$ and a degenerate value of the magnetic moment: $\mu_e^*(e^*) \approx (1/N^p).\mu_B$ –according to eq. (7) of CGT, the spin of the quasi-electron with: $m(e^*) = f\cdot m_e$, ($f \approx 0.8722$, [1]), results in the form:

$$S(e^*) \approx \left(\frac{\mathbf{m_e}^*}{\mathbf{e}^*}\right)\cdot\frac{1}{\mathbf{N^p}}\mu_B = \left(\frac{\mathbf{3f\cdot m_e}}{2\cdot\mathbf{e}}\right)\cdot\frac{1}{\mathbf{N^p}}\mu_B = \frac{3}{2}\frac{\mathbf{f}}{\mathbf{N^p}}\mathbf{S_e}\ ;\qquad S_e = \frac{1}{2}\hbar\ ;\quad f = 0.8722;\quad \text{(CGT)} \tag{24}$$

For the spin of a protonic quark formed by $k = N^q$ quasi-electrons and for the spin of the entire N^p 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:

$$S(q) = \mathbf{N^q S(e^*)} \approx \frac{\mathbf{3f}}{2}\frac{\mathbf{N^q}}{\mathbf{N^p}}\mathbf{S_e} \approx 1.3\frac{\mathbf{N^q}}{\mathbf{N^p}}\mathbf{S_e}\ ;\qquad S(p^+) \approx 1.3\cdot S_e\ ;\quad S_e = \frac{1}{2}\hbar \tag{25}$$

The difference between the resulted proton spin value and the value $S_p = \frac{1}{2}\hbar$ considered by quantum mechanics may be assigned to a degeneration coefficient k_d^s of the electron spin, bigger than those of the magnetic moment, k_d^μ, 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, (Δ++), 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 deconfination 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 ~1fm, 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 quantonic 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 quantons 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") photonic 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, ε_v:

$$\tau_k = \frac{\tau^0}{k_v\cdot 10^{2n}}\ ;\ \tau^0 \cong 10^{13}\text{sec.};\ k_v = \frac{\Delta m_p}{m_p} = \frac{n\cdot\varepsilon_v}{\varepsilon_v^o} = \frac{n\cdot T}{T_d} \tag{26}$$

in which: $\varepsilon_c^0 = k_B T_d \cong h\nu_c^0$ represent the critical phononic energy of the particle vibration which determines the quark deconfination, at: T_d.

It may be hypothesized 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, μ_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:

$$m_q^c(e^*) \rightarrow m_{pq}(e); (m_q^c \approx 275.2 \text{ MeV}/c^2) \quad (27)$$

by the transforming of the un-paired quasielectron with charge: $e^* = (^2/3)e$, 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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