A preonic quasi-crystal quark model based on a cold genesis theory and on the experimentally evidenced neutral boson of 34 m₀

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Abstract

The new neutral boson of 34 m₀, experimentally evidenced, supposed to be an X-boson of a fifth basic force and predicted as being a basic Z³ preon of cold formed quarks, resulted as quasi-crystallin cluster of paired quasi-electrons by a cold genesis theory, allow- by a pre-quantum model of elementary particle and an etherono-quantic theory of the author, a quasi-crystallin model of quark, i.e. with quasi-crystallin preonic structure of its kernel, formed by the super-dense centroids of the component quasi-electrons and contained by its current mass. In accordance with a resulted quark mass relation, the proposed quark model may explain the known mass of the elementary particles discovered by decay induced of cosmic radiation and considered in the model as Bose-Einstein condensate cluster of degenerate gammons formed as pairs of quasi-electrons.

By a semi-empirc relation for the impenetrable quantum volume of particles, it results a more general form of the potential of strong interaction between two particles, which allow the propose of a quasi-unitary semi-classical equation of fields, specific to the theory and is argued the conclusion that the hypothesis looking the existence of a boson which binds the lepton to quarks is not strictly necessary. The brought arguments sustain also the conclusion that the Z⁰ boson can be a „dark matter” constituent.

Indexing terms/Keywords

Keywords: pre-quantum model, neutral boson, preon, quark model, B-E condensate, dark matter, X boson.

Academic Discipline and Sub-Disciplines

Elementary particles physics; Theoretical physics; Astrophysics

SUBJECT CLASSIFICATION

General theories of fields and particles; Beyond Standard Model

TYPE (METHOD/APPROACH)

Theory

1. INTRODUCTION

In a relative recent paper, [1], a research team of Science’s Institute for Nuclear Research in Debrecen, Hungary, after some experiment for the detection of dark photons, announced that significant deviation from the internal pair creation during the (e⁺ − e⁻) transition to the ground state of an excited Be⁸⁺ nucleus was observed at large angles, which indicates that, in an intermediate step, was formed a neutral super-light particle with a mass of ~17 MeV/c², (~34 m₀), the excited Be⁸⁺ state being obtained by proton interaction with a target of Li⁷, i.e. by a reaction of type:

Li⁷ + p⁰ → Be⁷⁺ → Be⁸⁺ + b⁰;  b⁰ → e⁺ + e⁻ .

(1)

In another paper, [2], a team of american physicists from California concluded that the evidenced new boson is not a dark photon and this experimental result could be the evidence for a fifth fundamental force mediated by the predicted X-boson, coupling quarks with leptons, which decay by a reaction of type: X → e⁺ + e⁻.

In a recent paper [3] was mentioned that a particle with the same mass: 34 m₀, was considered by a cold genesis quark model as being the basic preon, Z⁰, by which is composed the effective quark mass, according to a cold genesis pre-quantum theory of particles and fields of the author, (CGT), [4-7].

According to this theory, based on the galilean relativity, the magnetic field is generated by an etherono-quantic vortex \( \Gamma_\mu = \Gamma_\alpha + \Gamma_\nu \) of s-etherons (sinergons-with mass \( m_s = 10^{-60} \text{kg} \)) giving the magnetic potential \( A \) by an impulse density: \( p_s(f) = (p_s \cdot c) / h \), and of quantons (h-quanta, with mass: \( m_q = h/c^2 = 7.37 \times 10^{-45} \text{kg} \)), giving the magnetic moment and the magnetic induction \( B \) by an impulse density: \( p_s(f) = (p_s \cdot c) / h \), generated by a magnetic moment of an atomic particle but also by a magnet or an electromagnet.

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 of baryons, with the inertial mass m₀, formed by a superdense centroid and a quantum volume of...
vecons (vectorial photons composed by vorted vectors), the particle’s magnetic moment radius being given by its Compton radius, \( r_\gamma = \lambda \pi / m_e c \).

- The virtual radius: \( r_\nu = 3.86 \times 10^{-13} \text{m} \), to the value: \( r_\nu = r_\nu^0 = 0.59 \text{fm} \), as a consequence of the increasing of the inpenetrable quantum volume mean density in which is included the protonic positron central: \( m_0 \), from the value: \( \rho_0 \), to the value: \( \rho_n \equiv f_\nu \rho^0 \); \( \rho_0 \), conformed with the equations:

\[
(2a) \quad \mu_\pm = k_\pm \frac{m_\pm}{m_\nu} = \frac{e}{4 \pi \epsilon_0} \int_0^\infty \frac{1}{\kappa} d\kappa \frac{e^\kappa}{\pi} \mu_0 = \frac{e c \cdot r^2}{2} ; \quad k_\pm = g_\pm = 2.79 ; \quad k_\nu = \frac{\rho_\nu (r_\nu^*)}{\rho_n^0} = e \frac{r_\nu^*}{r_\nu^0} \tag{2b}
\]

in which: \( k_\pm \)-the gyromagnetic ratio; \( \rho_\nu^0 \), \( \rho_n^0 \)-the mean density of electron and nucleon; \( r^* \)-the position of protonic positron central in report with the proton central; \( f_\nu \)-the degeneration coefficient of the quasielectron mass, \( m_e^* \).

The theory gives: \( r_e = 0.96 \text{ fm} \) for the protonic positron axial position inside the protonic quantum volume, an electron radius: \( a = 1.41 \text{ fm} \) and a quanta density variation inside the electron’s quantum volume: \( \rho_0 = \rho_0^e e^{P_n V_0} \); with: \( \rho_0^e = 22.24 \text{ kg/m}^3 \) and: \( \eta = 0.965 \text{ fm for the electron mass quanta density variation} \),[4\,-7].

The superposition of the \((N^4+1)\) quantonic vortices: \( \Gamma_\nu \) of the protonic quasielectrons, generates inside a volume with the radius: \( r_\nu^* = 2.35 \text{fm} \), a total dynamic pressure: \( P_n = (1/2)\rho_\nu(r_\nu^*)c^2 \), which gives a nuclear potential: \( V_n(t) \), in an eulerian form, having a variation according to eq. (2b), with:

\[
V_n(t) = V_\nu P_n V_\nu^0 e^{-\eta/\nu} ; \quad V_n^0 = V_\nu P_n^0 ; \quad P_n(t) = (1/2)\rho_\nu(r_\nu^*)c^2
\]

\((\nu/0.6 \text{fm}) = 0.9 \text{fm}^3\) the inpenetrable quantum volume of the nucleon; \( \rho_\nu^e = (N^4+1)\rho_n^0 \),[4\,-7]

Also, the neutron results in CGT by a specific “dynamid” model, with a degenerate electron with degenerate magnetic moment: \( \mu_e^2 = -4.597 \mu_\mu \) rotated inside the quantum volume of a proton by the etheronano-quantum vortex \( \Gamma_\nu \) of its magnetic moment \( \mu_\nu \), with a speed \( v_e = 1.7 \times 10^{-5} \text{c} \), to an orbital with a radius: \( r_e = 1.283 \text{ fm} \), under dynamic equilibrium of forces on tangent and radial directions,\,[3].

The necessity of the preon with \(-34 \text{ m}_e \) was considered in CGT by the conclusion that in a cold genesis scenario, the elementary particles could be formed in a magnetaric superstrong magnetic field, with \( B \rightarrow 10^{13} \text{ T} \), in a cascade particles forming process, by masses given according to the sum rule and equal or very close to a value given as integer number of basic preons, \( c_0 \). As helpful theory for this issue was used a theoretical result of Olavi Hellman which deduces the value of elementary particles mass, by a simplified relation:

\[
M_p = (K_0 c_0) m_e, \quad \text{with } a = e^2/\hbar c = 1/137
\]

with a tolerance under 1%, neglecting the electromagnetic field contribution, by integer values of \( K_0 \), as a multiple of the mass: \( M_p = 68.5m_e \); \( K_0 = 3 ; 4 \); 14 for the mesons \( \mu, \pi, K \).

In the paper \[3\], was argued that in a cold genesis model, the preon \( z^0 \) may results as cluster of \( n = 42 \) degenerate electrons with the mass: \( m_e^* = 0.8 m_e \) and with the superdense kernels (centroids) vortexally confined in a volume of radius \( r_\nu < 0.2 \text{ fm} \), which explain the observed reaction (1) by the conclusion that the \( z^0 \)-boson is given as a pair of quarcins: \( c^* = 21 m_e^* \), which decay in the form:

\[
z^0(c_0^* + \bar{c}_0^*) \rightarrow c_0^* + c_0^* \rightarrow e^+ + e^-
\]

\((5)\)

The resulted sub-structure of the fundamental elementary particles, considered as formed “at cold”, by quarks with effective mass (giving the particle’s mass by the sum rule) and fractional electric charge \( q^* = (\pm 2/3)e; 1/3e \), formed as preonic clusters, is given by the preon \( z^0 \) with the following sub-structures, \[4\];

**Table 1:** The preonic particles substructure of cold genesis

<table>
<thead>
<tr>
<th>a) basic zerons (preons)</th>
<th>( z^0 = 34m_e ); ( z^2 = 2z^0 = 68m_e ); ( Z_1 = 3z^0 = 102m_e )</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) derived zerons: ( Z_3 = 2(Z_1 + Z_2) = 476m_e ); ( Z_4 = 3(Z_1 + Z_2) = 714m_e )</td>
<td></td>
</tr>
<tr>
<td>c) basic quarks: ( m^s = (Z_3 - m_e^<em>) = 135.2m_e ) ( \text{(mark}_1, +2e/3) ); ( m_e^</em>(e^*) = 0.8m_e )</td>
<td></td>
</tr>
<tr>
<td>d) derived quarks ( \text{(effect mass)} ):</td>
<td></td>
</tr>
<tr>
<td>( m_1 = m^s + e^+ + \sigma = 137.8m_e ) ( \text{(mark}_2, -e^* = +2e/3) ); ( \sigma = e^+ - e^- = 2m_e^* \text{ – gluon})</td>
<td></td>
</tr>
<tr>
<td>( p^* = m_1 + Z_2 = 611.2m_e ) ( \text{(park,} +2e/3) ); ( n = m_2 + Z_2 = 613.8m_e ) ( \text{(mark,} -e/3) );</td>
<td></td>
</tr>
<tr>
<td>( \chi = m_2 + Z_4 = 850.8m_e ) ( \text{lark,} -e/3) ); ( \psi^* = \lambda + Z_2 = 987.8m_e ) ( \text{lark,} -e/3) );</td>
<td></td>
</tr>
<tr>
<td>( v^* = s + Z_2 = 1123.8m_e ) ( \text{vark,} -e/3) ); ( m_2 \rightarrow m_1 + e^+ + v_e^* ); ( n \rightarrow p^* + e^- + \bar{v}_e )</td>
<td></td>
</tr>
</tbody>
</table>
d) Elementary particles:

**Mesons**: (theoretic mass) / (experimentally determined mass)

\[ \mu^\pm = 221 \times 10^6 \text{m}_e; \quad \bar{\mu}^\pm = 206.7 \text{m}_e \]

\[ \pi^0 = m_1 + \bar{m}_1 = 270.4 \text{m}_e; \quad \bar{\pi}^0 = 264.2 \text{m}_e \]

\[ \rho^* = m_1 + \bar{m}_2 = 273 \text{m}_e; \quad \bar{\pi}^* = 273.2 \text{m}_e \]

\[ K^* = m_1 + \bar{\Lambda} = 987 \text{m}_e; \quad \bar{K}^* = 966.3 \text{m}_e \]

\[ K^0 = m_2 + \bar{\Lambda} = 989.6 \text{m}_e; \quad \bar{K}^0 = 974.5 \text{m}_e \]

\[ n^0 = m_2 + \bar{s} = 1125.6 \text{m}_e; \quad \bar{n}^0 = 1073 \text{m}_e; \quad (\bar{s} = \text{s-antiquark}) \]

**Baryons**:

\[ p = 2p + n = 1836.2 \text{m}_e; n = 2n + p = 1838.8 \text{m}_e; \quad \rho^* = 1836.1 \text{m}_e; \quad n_e = 1838.7 \text{m}_e \]

\[ \Lambda = s + n + p = 2212.8 \text{m}_e; \quad \Lambda^0 = 2182.7 \text{m}_e \]

\[ \Sigma = v + 2p = 2346.2 \text{m}_e; \quad \bar{\Sigma} = v + 2n = 2351.4 \text{m}_e; \quad \Sigma^* = 2327 \text{m}_e; \quad \bar{\Sigma}^* = 2342.6 \text{m}_e \]

\[ \Sigma^0 = v + n + p = 2348.8 \text{m}_e; \quad \Sigma^0 = 2333 \text{m}_e \]

\[ \Xi = 2s + p + 2586.8 \text{m}_e; \quad \Xi^* = 2s + n + 2589.4 \text{m}_e; \quad \Xi^* = 2572 \text{m}_e; \quad \Xi = 2587.7 \text{m}_e \]

\[ \Omega = 3v = 3371.4 \text{m}_e; \quad \Omega = 3278 \text{m}_e \]

Some “resonance” particles (*) may be formed also “at cold”, in:

\[ \Delta^* = 2v + p = 2858.8 \text{m}_e; \quad \Delta^* = 2v + n = 2861.4 \text{m}_e; \quad (\text{known mass}: 2850 \text{m}_e) \]

\[ \Xi^* = 3s = 2963.4 \text{m}_e; \quad (\text{known mass}: 3004 \text{m}_e) \]

The differences between the theoretic mass and the experimental mass may constitute a photonic energy of quarks, (“gluonic” in QM), which is released in the cold genesis process of particles.

The theory predicts also the existence of the next particles:

\[ \Phi = 2\nu + \lambda = 3099.4 \text{m}_e; \quad \Phi^* = 2\nu + s = 3235.4 \text{m}_e; \quad 2s + \lambda = 2827.4; \quad 3s = 2963.4 \text{m}_e \]

\[ \Lambda^* = s + 2p = 2210.2 \text{m}_e; \quad \Lambda = s + 2n = 2215.4 \text{m}_e; \quad Z_n = (Z_1 + Z_2) = 238 \text{m}_e \]

It can be observed also that: excepting the particles \( \Sigma \) and \( \Xi \), the masses of the principal elementary particles can be found as cluster of zeros:

\[ z^* = 2z = \nu^* = 68 \text{m}_e \]

having the form:

\[ a) \quad 2^* z, (n = 1...5); \quad b) \quad (3 \times 2^* + n) z^*, (n = 1...3); \quad c) \quad 3x2^* z^*, (n = 4) \]

(6)

which indicates the tendency of clusters forming, in the a)-form:

\[ a): \quad n = 1 \rightarrow (m_1); \quad n = 2 \rightarrow (n^0); \quad n = 4 \rightarrow (\Lambda^0); \]

\[ (\text{specific specially to the mesons}), \quad \text{or triplets (specific to baryons), in a} \quad \text{b)- or c)-form:} \]

\[ b): \quad n = 0 \rightarrow (\mu^\pm); \quad n = 1 \rightarrow (\zeta); \quad n = 2 \rightarrow (\Lambda^0); \quad n = 3 \rightarrow (p, n_3); \]

\[ c): \quad 3x2^* z^*; \quad n = 4 \rightarrow (\Omega); \quad d): \quad [(4x2^* + n) z^* - \zeta]; \quad n = 3 \rightarrow (\Sigma^0); \quad e): \quad [(3x2^* + n) z^*; \quad n = 2 \rightarrow \Xi^0. \]

The obtaining of the particle’s charge as sum of the internal quarks charge is equivalent- according to CGT, with an attached positron, negatron or a negatron- positron pair, giving the same charge, to a neutral \( N^0 \) cluster , phenomenon which may explain the \( \beta^- \) - disintegration of the electron and the \( \beta^+\) - disintegration of the proton induced by an electronic neutrino.

2. The preonic quasi-crystal quark model

The structure of a quark with effective mass which gives the particle’s mass according to the sum rule, results in CGT by a current quark mass, of \( 6 \times 10 \text{ MeV/c}^2 \), given by its impenetrable quantum volume: \( \nu_{qi}(r_0) \) and the maximal density of the particle’s kernel, [9] and a quantum volume \( \nu_{qr} \) of confined vectorial photons (vexons), which forms- in CGT, the vortexial equivalent of the gluonic shell considered in Quantum Chromodynamics, the current quark mass having – in the model, a scalar shell of \(-0.1fm\) thickness, which envelops the current mass of quark and which may explain- according to CGT, the value of \(-0.3 \text{ fm} \) for the quark radius determined by some scattering experiments as those made at Fermilab, [11], evidenced for proton by p-p scattering at few TeV [10], which may be considered also for the quark because that the same cause which forms the repulsive, scalar shell of the protonic impenetrable quantum volume, according to CGT, i.e : the attraction of kinetized quantonic clusters (vectoric inertial masses) by the vortexial field: \( \Gamma = \Sigma (\Gamma_x) \), may generate a small scalar shell of scalar field quanta also around the current mass of an individual quark, according to the model, [9].
The importance of this scalar shell of the quark is given in CGT by the fact that similar to the nucleon case, it allow a strong interaction between two, three or more quarks, generated by the diminishing of the repulsive gradient of static quantum pressure in the zone of cold contact, (at very low temperature), by the vortexial field of quark's electronic quasi-electrons.

In the previous paper [3] were brought arguments for a quasi-crystalline structure of the preon \( z^0 \), with hexagonal symmetry (with 7x6= 42 quasi-electrons, \( m_0 \)). In this case, it is deductible the conclusion that the quark's stability may result as consequence of a possible quasi-crystalline structure with hexagonal symmetry, given by the \( z^0\)-preon.

Indeed, we may observe according to the model, considering also the existence of the zeron: \( z_0 = (z_1 + z_2) = 7z^0 \), that the deduced quasicrystalline structure of the \( z^0 \)-preon explains the value of the resulted quark masses (table 1) by a quasicrystalline model of quark (figure 3) and by a quark equation:

\[
q = m + k \cdot z_2 + n \cdot (k - 2) \cdot z_2; \quad m = (m_1^*; m_2^*); \quad k = 0 \div i = 3; \quad n < k, \quad (n = 0 \div 2)
\]  

(7)

with: \( m = (m_1^*, m_2^*) \), the quasicrystalline form of quarks resulting from the quasicrystalline form with hexagonal symmetry of the considered \( z^0 \)-preon and \( z_0 = 7z^0 \) zeron, like in figure 3, i.e.:

\( (k, n = 0) \Rightarrow q = m_1; \quad (k = 1, n = 0) \Rightarrow q = r^+ \) (rark- un-stable quark); \( (k = 2) \Rightarrow q = p^* \), \( n^* \);

\( (k = 3, n = 0) \Rightarrow q = q^*; \quad (k = 3, n = 1) \Rightarrow q = s^0; \quad (k = 3, n = 2) \Rightarrow q = v \).

The mesons results by eq. (7) with: \( m = (m_1 + m_0) \), \( i = 1, 2 \), like in the old theory of quark, as combinations: \( q_1 - q_2 \) and the baryons results as combinations (q-q-q) but not only, by the equation:

\[
b = M + k \cdot z_2 + n \cdot (k - 6) \cdot z_2; \quad M = \sum_{i=1}^{6} m_i; \quad m_i = (m_1^*; m_2^*); \quad k = 6 \div 9; \quad n = 2
\]  

(8)

The previous structure of elementary particles explains theirs weak reactions by quarks transforming reactions, like in the example:

\[
(\text{Exp.}); (\text{Exp.}); \quad \Omega (3\bar{v}) \rightarrow \Xi^0(2s + p) + (\bar{m}_1 + m_2) + Q; \quad (Q\text{- reaction energy});
\]

\[
(\text{theor.}); \quad 2v \rightarrow 2s^+ + 2z_1; \quad v \rightarrow \lambda + 2z_1 \rightarrow m_2 + z_4 + 2z_2; \quad 2z_1 \rightarrow m_1 + \bar{m}_1;
\]

\[
z_0 \rightarrow z_2 + z_3; \quad \bar{m}_1 + m_2 \rightarrow \pi^0; \quad m_1 + z_3 \rightarrow p^+; \quad p^+ + 2s \rightarrow \Xi^0; \quad \Omega \rightarrow \Xi^0 + \pi^0 + (2z_1 + z_2); \quad (2z_1 + z_2) \rightarrow Q;
\]  

(9)

The generating particles of bigger mass than those of particles that enter in reaction is explained- in CGT, by the decomposing of quantum vacuum “zerons” of \( m_z \)-mass and a- radius in real \((q-\bar{q})\)-pairs, by the \( Q\) - interaction energy, when \( O_1 = E_2 = m_z^* \). So, the polarised quantum vacuum contains also bosons as the zeron: \( z^0 \), \( z_2 \), \( z_3 \), \( z_4 \) and \( z_5 \), but in a weakly thermalised state, i.e. which may be components of the “dark” matter, according to CGT.

The degenerated mass of the quasielectron results by the degeneration of the vortex \( \mathbf{F}_\mu = \mathbf{F}_A + \mathbf{F}_p \) of its magnetic moment, according to the sub-solitons forming condition [8] which imply that the energy of the vortex \( \mathbf{F}_\mu \) must be: \( E_p (\mathbf{F}_A) \geq 2m \cdot c^2 \).

With a mean value: \( M = 3z_2 = 408 m_e \), the mean mass of the baryons known as elementary particles formed by three quarks, results from eqn. (8) according to the table 2:
Table 2: theoretically resulted baryons

<table>
<thead>
<tr>
<th>K / n</th>
<th>n = 0</th>
<th>n = 1</th>
<th>n = 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>k = 6</td>
<td>p : n, (~ 1836 mₐ)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>k = 7</td>
<td>? (~ 2074 mₐ)</td>
<td>Λ (~ 2210 mₐ)</td>
<td>Σ (~ 2346 mₐ)</td>
</tr>
<tr>
<td>k = 8</td>
<td>? (~ 2312 mₐ)</td>
<td>Ξ (~ 2584 mₐ)</td>
<td>? (~ 2856 mₐ)</td>
</tr>
<tr>
<td>k = 9</td>
<td>? (~ 2550 mₐ)</td>
<td>Ω (~ 2938 mₐ)</td>
<td>--</td>
</tr>
</tbody>
</table>

It is observed that there are possible – according to eqn. (8), some “exotic” particles (?) which may be formed also “at cold”, according to CGT. For example, the combination of 2856 mₐ is close to the known “strange” particle: Σ⁰ (2714 mₐ) theoretically resulted in QCD.

Also, by the selection rule: Q(M) = (0; ± 1, 2) e, (integer charge of the M-cluster), it results as possible the existence of particles formed also “at cold” as penta-quark or hexa-quark cluster, with quasi-crystallin kernel of the impenetrable quantum volume.

Also, if we take in eqn. (7) for quarks: k = 0 + i; i ≥ 5, we obtain some other cold genesis quarks, with bigger mass, which– for i = 5, for example, are included in the table 3:

Table 3 : theoretically resulted quarks

<table>
<thead>
<tr>
<th>K / n</th>
<th>n = 0</th>
<th>n = 1</th>
<th>n = 2</th>
<th>n = 3</th>
<th>n = 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>k = 1</td>
<td>r⁺ (374 mₐ)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>k = 2</td>
<td>p⁺, n (613.8 mₐ)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>k = 3</td>
<td>λ (851.8 mₐ)</td>
<td>s (967.8 mₐ)</td>
<td>ξ (1123.8 mₐ)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>k = 4</td>
<td>t₀ (1089.8 mₐ)</td>
<td>t (1351.8 mₐ)</td>
<td>t₂ (1633.8 mₐ)</td>
<td>t (1905.8 mₐ)</td>
<td>-</td>
</tr>
<tr>
<td>k = 5</td>
<td>w₀ (1327.8 mₐ)</td>
<td>w₁ (1735.8 mₐ)</td>
<td>w₂ (2143.8 mₐ)</td>
<td>w₃ (2551.8 mₐ)</td>
<td>w₄ (2959.8 mₐ)</td>
</tr>
</tbody>
</table>

In the same time, it results that the model allow the existence of a correspondent quark with positive charge (+½ e) for each quark with negative (-½ e) electric charge.

This theoretical possibility, resulted phenomenologically as consequence of the resulted quasi-crystallin form of the quark, may explain the possibility of heavy and ultra-heavy particles forming, with mass over 4 GeV/c², and because that the increasing of the quark’s length gives a higher instability to the quarks cluster which forms the particle, the particles formed with heavy and ultra-heavy quarks are more unstable and – when are formed “at hot”, in particles collision of high energy, are identifiable specially as “resonances”.

For example, the couple: (t₀ - t₁) corresponds to the scalar meson a₁ (2465.7 mₐ), the triplet: (ν + t₀ + w₂) corresponds to the charmed Sigma: Σ⁺ (4929 mₐ) and so on.

This fact may be important also for the case of the transition of baryonic matter to quark matter which is supposed to occur inside the neutron star core when the matter density exceed the neutron’s density, [12], being sustained also the possibility that the accreting X-ray binary pulsars are strange stars that are composed of color-flavor locked quark matter throughout, [13] and the hypothesis that a possible crystalline phase of quark matter may explain the “glitch” of the neutron star observed as pulsar [12], consisting in the increase of the angular velocity at the crust of the star.

According to the proposed quasi-crystalline quark model, inside a rotational neutron star with an enough strong magnetic field and a mass which allow its transforming into “black hole”, it is possible the forming not only of a quark matter crystalline phase but also of super-quarks, corresponding- in eqn. (7), to i ≥ 3, by the increasing the matter density until the density of the current mass of the neutron quarks, (u, d), which- according to CGT [9], is the maximal density of the proton's mass distribution, of value: ρₚ⁰ = 5 x 10¹⁷ kg/m³, [3], by the radiative partial loosing of the gluonic mass, (given by vectorial photons- according to CGT).

In this state, at T -> 0K, the cold contact between the surfaces of the impenetrable quantum volume of neutrons, by the increasing of the value of dynamic quantum pressure P_r(a) in the contact region, is reduced proportionally (according to the Bernoulli law for ideal fluids) the value and the gradient of the static quantum pressure P_r(a) and implicitly- is reduced also the repulsive force: F = V_P_r(a) of the repulsive scalar shell of the nucleon's impenetrable quantum volume which- according to the "bag" model of quarks confining resulted in CGT [9], impede the transfer of quarks from a nucleon to an adjacent interaction nucleon. In this case, the current masses of the first cluster of quarks enters in contact...
with the current masses of the second cluster of nucleonic quarks and – because that – in a similar way, is reduced locally, in the contact region, also the repulsive scalar shell of the interacting quarks, resulted by the model [9], it results in consequence the possibility of the quark’s quasi-crystalline kernel transferring from a current quark mass to another, with the increasing of the current mass of the resulted new quark by the repeatability of the process.

The “hot” equivalent of this process is – according to CGT, the forming of heavier quarks and particles from strong interaction between lighter quarks and particles, with the contribution of quarks resulted from bosons of the polarized quantum vacuum, when the interaction energy, \( Q \), is at least equal with the intrinsic energy \( m_e c^2 \) of the “splitted” boson and allow the transforming of its ‘virtual’ quarks in real (stable individualized) quarks, like in the reaction:

\[
\begin{align*}
\text{(Exp.)} & \quad \pi^+ (m_1 + m_2) + p_0 (2p^* + n) + Q \rightarrow \Lambda^0 (s + n + p) + K^0 (m_2 + \Lambda) ; \\
& \quad \tilde{m}_1 + p^* + Q \rightarrow \tilde{m}_1 + m_1 + z + h \rightarrow Q \rightarrow z + z + Q \rightarrow (s + \tilde{s}) ;
\end{align*}
\]

\[\tilde{s} \rightarrow \tilde{\Lambda} + z ; \quad \tilde{\Lambda} + m_2 \rightarrow K^0 ; \quad (\text{permitted reaction}). \tag{10}\]

According to the previous theoretical conclusion it is possible that some massive bosons experimentally evidenced at very high energies, of few TeV, such as the Higgs boson, are produced by the reaction energy, with the participation of the mass/energy of lighter bosons, more probably than detected as previously existents in the quantum vacuum.

The strong and the weak interactions

It is know that the \( \pi \)-mesons are attracted by the nuclear field, but a strong nuclear forces acting over the electron was not evidenced. It is raised in this case the question if the nuclear field acts also over the \( Z^0 \)-preon.

According to CGT, the current mass of quarks is contained by their impenetrable quantum volume \( v_{qi}(q) \) which – for concordance with the experiments, is considered with a radius \( r_q \approx 0.21 \text{fm} \), [9], resulting that: \( v_{qi} \approx 3.87 \times 10^{-4} \text{fm}^3 \).

The obtained value of \( v_{qi} \) may be obtained by a semi-empirical equation:

\[ g_{sl} \approx g_{mi} \cdot e^{-k \left( \frac{m_i}{m_p} \right)} , \quad k = e^{\frac{m_i}{m_p}} , \quad K = 8.97 ; \quad g_{sl}(m_p) \approx 0.9 \text{fm}^3 ; \quad m_p \approx 1836 m_e \]  

\[ \tag{11} \]

in which the term ‘k’ take into account the fact that inside the quantum volume of a bigger particle, the value \( v_{sl} \) of a smaller particle increases proportional with the local density, as in the case of quarks. For (quasi) free \( m_i \)-particles or particles with \( m_{k_i} > m_p \), we have: \( k = 1 \). By eqn. (11), for \( m_i = m_e \approx 270 \text{ m } \) and \( m_i = m_k \approx 974 \text{ m } \), \( v_{qi} \approx 2.5 \times 10^{-4} \text{ fm}^3 \); \( v_{qi} \approx 2.3 \times 10^{-4} \text{ fm}^3 \). It results also that for: \( m_i = m_k \approx 34 \text{ m } \), \( v_{qi} \approx 1.77 \times 10^{-4} \text{ fm}^3 \); \( r_i \approx 3.48 \times 10^{-17} \text{ m } \), inside a bigger particle and: \( v_{qi} \approx 1.35 \times 10^{-4} \text{ fm}^3 \); \( r_i \approx 3.2 \times 10^{-17} \text{ m } \), the free state, so we may conclude that the proton cluster of 42 nuclear superdense centroids with mass \( m_0 \approx 5 \times 10^{14} \text{ m } \) and radius \( r_0 \approx 10^{-18} \text{ m } \), [4-7] has the radius: \( r_i \approx 3 \times 10^{-17} \text{ m } \).

In consequence, according to CGT, it results also that the \( Z^0 \)-boson is attracted by the scalar nuclear field with a pseudo-“strong” force: \( F_{Z} = V v_{ei}(t) \) with: \( v_{ei}(t) = 0.6 \text{fm} \approx 11.3 \text{ keV} \).

Because that the \( Z^0 \)-preon is leptonic, like the muonic neutrino, \( \nu_{\mu} \), it results that the hypothesis of a quantum mediating the binding of leptons to quarks is not strictly necessary.

By the eqs. (3) and (11), it results by the model a more general form of the scalar strong potential of the strong interaction between two composed particles, with the masses \( m_{sl}(m_a) \) and \( m_{sl}(m_p) \). \( m_{p0} = 0 \); \( m_{p0} = 0 \); \( m_{p0} = (m_0 m_{p0}) = (m_{p0} m_{p0}) ; \) \( f = 0.8 \):

\[ V_{ef} = \frac{1}{2} g_{sl} \rho_{0}^0 e^2 \frac{m_{sl}}{m_p} \tilde{e} \frac{V_{0}^0}{V_{0}^0} ; \quad g_{sl} = \frac{m_{sl}}{m_p} \frac{V_{0}^0}{V_{0}^0} e^{\frac{k m_i}{m_p}} ; \quad m_{p0} = 0 ; \quad V_{0}^0 = 127.5 \text{MeV} ; \quad \eta^* = 0.755 \text{fm} \]  

\[ \tag{12} \]

where \( m_p \) is the proton mass, \( K = 8.97 \), \( k = e^{(1 - m_{p0} / m_{p0})} \) and \( \eta^* \) is the vibration liberty of the \( m_a \)-particle.

In the case of beta disintegration, according to the dynamic model of neutron of CGT, because that inside the protonic quantum volume may be neglected the electrostatic force between the protonic center and the neutronic electron, which is diminished by the increasing of the electrostatic permitivity \( e \) proportional with the local quantum density, \( (e \sim \rho_{sl}(a)) \), [14], it results that its centrifugal potential of the neutronic electron is equilibrated by a pseudo-strong scalar force given according to eqs. (3) and (11), i.e.:

\[ V_{ef} = \frac{1}{2} \left( l + 2 \right) m_{ei} \frac{V_{0}^0}{V_{0}^0} e^{\frac{k m_{ni}}{m_{ni}}} \frac{V_{0}^0}{V_{0}^0} \frac{\tilde{r}_{i} l}{\tilde{r}_{i} l} ; \quad \tilde{e} = \frac{g_{sl} e^2}{g_{sl} e^2} ; \quad V_{0}^0 = 127.5 \text{MeV} ; \quad \eta^* = 0.755 \text{fm} \]  

\[ \tag{13} \]

where \( v_{sl}(r_0) \) is the impenetrable quantum volume of the neutronic electron, resulted by eq. (11) of value: \( v_{sl} \approx 1.15 \times 10^{-4} \text{ fm}^3 \) and \( \tilde{r}_{i} \) is the vibration liberty of the neutronic electron.

With the values: \( v_{sl} \approx 0.9 \text{ fm}^3 ; \quad v_{ei} \approx 1.7 \times 10^{-4} \text{ fm}^3 ; \quad r_0 \approx 1.283 \text{ fm } \), obtained in CGT, [3], it results that: \( V_{ef} = V_{ei} = 74 \text{ eV} \); \( V_{ei}(r_0) ; f = 0 \approx 2.98 \text{ keV} \gg V_{ei} \), being explained in this way the lifetime of the neutron in free state: \( \tau_n = 881 \text{ s } \), by the
conclusion that the electron's rotation induces an electron's vibration, of amplitude \( l < l_M \) and a reciprocal vibration of the superdense centroids of the linking degenerete gammonon: \( \gamma = \sigma = e^i = 2 \, m_a^* \) -which explains in CGT the beta disintegration by its transforming into an electronic antineutrino by the loosing of the quantum shell, when \( l \rightarrow l_M \), [4-7].

This conclusion is sustained by the fact that the value \( l_M \) resulted from eqn. (13) is: \( l_M = 2.7 \) fm., of two time greater than the proton's effective radius, with the value \( E_c = E_c(l_\nu) \). Even if it decreases at a value of \(-2\)fm at \( r = 1.4 \), when the electron rotates with the superdense centroid exited from the protonic quantum volume, with a speed \( \nu_c \approx 2.6x10^{-2}c \) given by the dynamic etherono-quantonic pressure of the vortex: \( E_c = E_c + l_M \) of the proton's magnetic moment, \( \mu_c \), the resulted \( l_M \) value, which explain the lifetime of a free neutron, indicates that the cause of \( \beta \) disintegration is the intrinsic energy of the \( \alpha \)-gluor consided in CGT: \( E(\nu) = E(\nu_e) = 2 \, m_a^* \, c^3 = 817 \) keV, which is released by its transforming into an electronic antineutrino formed by the doubelt of electronic centroids: \( 2m_0 \approx 10^{-4} \) kg., [4-7].

In the sametime, it results that the radius \( r_e^* \) is a mean radius for the orbital: \( 2r_e^* \) of the neutronic electron, because of its oscillation with a mean amplitude: \( \Delta r_e = (r_e - a_i) = 0.68 \) fm under the action of the attractive potential: \( V_i(r_e) \) and the repulsive potential: \( V_i(r_i) = V_i^0 \exp(-(r_i - a_c)^2/\delta) \) of the scalar repulsive shell of the proton's impermeable quantum volume, which- with the values: \( V_i^0 = 2.5 \) MeV and \( \delta = 0.24 \), obtained in CGT [9], gives: \( V_i(r_e, u_0) = 2.3 \) eV \(< \ V_i(r_i, l = 0) \) and:

\[
V_j(0.65 fm, u_0) = 7.5 \text{ keV} \approx V_j(0.65 fm, u_0) = 6.88 \text{ keV}, \ (i.e. the electron is re-sent toward its mean position } r_e^* .
\]

Even if the effective electron radius \( (a = 1.41 fm) \) is a little higher than those of the proton, the fact that the electron's impermeable quantum volume is much smaller than those of the proton is normal because that a less dense quantum volume is more penetrable by the \( V_j \) field quanta (by quantons , with \( m_n = 1 \, h/c^2 \)- according to the model, [4-7]).

4. A pre-quantum quasi-unitary equation of fields

A pre-quantum quasi-unitary image over the basic fields conformed to the particle and field models specific to CGT, [4-7], including also the eqn. (13), may be mathematically synthesized by an semi-empirc equation similar to the telegraphist equation which may be generalized also for the case of the fundamental fields [15] if we use a field rank coefficient, \( u \), and a specific field source term, in the form specific for a source \( Q^* \) placed in the center of the coordinate system:

\[
V_i \Psi - i \frac{\partial^2 \Psi}{c^2 \partial t^2} - \frac{2 \sigma}{c} \frac{\partial \Psi}{\partial t} - \frac{1}{2} \frac{\partial^2 \Psi}{c \partial t^2} - (1 - a) \frac{2m}{h^2} \Psi - u \cdot \sum \frac{(Q \cdot q^*)}{c_m} \delta(t, r); \quad \Psi = \Psi(r, t) ; \quad u = 0, 1; \quad \sigma_i = i \cdot mc / h \tag{14}
\]

in which we have: \( u = 0 \) and \( \sigma = \sigma_n = i \cdot mc / h \), for the short-range field (of nuclear type) and \( u = 1 \) for the long-range field, (of gravitic and electro-magnetic type field), and:

\[
k = \frac{m_e c}{h} ; \quad V_i \Psi = V_i(r, t, \omega) ; \quad q^* = (q_i^*, q_0^*) ; \quad Q^* = (Q_0^*, q_0^*); \quad q_i^* = \frac{m_i e}{\beta_j m_e}; \quad q_0^* = \frac{m_0 e}{\beta_j m_e} ; \tag{15}
\]

\[
(r_i = 1 - \frac{\beta_j}{2 \sqrt{c}} ; \quad Q_0^* = - 4 \pi \cdot G_{n,0} \cdot M_{n,0} \frac{m_n}{c}; \quad \Psi = \Psi(r, t, \omega); \quad v_+ = v_0 \frac{\sin (v_0, r)}{v_0} ; \quad v_\perp = v_0 \frac{\sin (v_0, r)}{v_0}; \quad \Psi^0 = R^2 \Psi = R \cdot e^{i \theta};
\]

with: \( q^*, Q^* \) - generalized charges of electric, \( q_0 \) or electro-gravitic, \( q_0 \) type, or charge operator: \( Q \Psi \); \( v_0 \) -the speed of the electro-gravtic charge \( Q^* \); \( k \) -wave number associated to field quantum: \( m_e \).

For: \( u = 0 \) and \( \sigma = \cdot mc / h \), is obtained the Schrödinger equation, particularly- with soliton-type solutions, with: \( V(i) = V^0 \cdot |\Psi|^2 \), in which, according to eq. (12), we have:

\[
V^0 = \frac{m_b}{m_p} \cdot V^0 \frac{e}{k} \frac{(m_n - m_0)}{m_n} ; \quad |\Psi|^2 = \Psi \cdot \Psi^* = R_n^2 \gamma_s ; \quad \Psi = \Psi_n \cdot e^{i \theta}; \quad S_{\mu} = (\delta m_0), c \cdot y_1 ; \quad R_n^2 = e^{-\frac{r + i \theta}{\eta}} \tag{16}
\]

with: \( V^0 = V^0 \left( \frac{m_b}{m_p} \right) \); \( (\delta m_0) = \mu_n \cdot H(r) \); \( \gamma_s \perp r ; \quad \eta^* = 0.755 \) fm and \( V^0_\nu = 127.5 \) MeV, for the scalar nuclear field between two particles (bosons, mesons , baryrons), [3], and:

\[
V^0 = V^0_{\nu} \frac{\nu_0}{2} \rho \nu_0 c^2 \; \gamma_s ; \quad |\Psi|^2 = R^2_{\nu \nu} \frac{e^{-\frac{r}{\eta}}}{\eta} \cdot \frac{e^{-\frac{\nu_0}{\eta}}} {\nu_0} ; \quad \gamma_s = \frac{1}{2} \left( \frac{1}{\nu_0} - \frac{\nu_0}{\nu_0} \right) ; \quad \tau = \frac{2}{s}; \tag{17}
\]

for the tensorial interaction between two nucleons, with: \( \eta^* = 0.755 \) fm, \( l^\nu \)-the vibration liberty, \( l^\nu \approx 1 \) fm – for deuteron and \( l(E = 0) = 0 \); \( s \) - the nucleon spin ; \( E_j \)-the vibration energy, [4-6]).

For the inter-quarks strong field, according to CGT, [9], we have:
\[
V^0 = V_q^0 = \frac{\mathbf{q}}{2} \rho_i(a_i) \cdot c^2; \quad |\Psi|^2 = R_q^2; \quad \Psi = R_q \cdot e^{i \Phi}; \quad S_\mu = (\Delta m_\mu/c) \cdot \mathbf{y}_\mu; \quad R_q^2 = e^{-\frac{(r - a_i)^2}{\delta}}
\]

with: \( \mathbf{v}_q = v_q(q_0 \approx 0.21 \text{fm}) ; \delta = 0.28 \pm 0.24 \) and \( a_i = 0.6 \text{ fm} \), (force of static quantum pressure gradient in the field of a repulsive shell of the nucleon’s quasielectron volume \( v_0(a_i) \) acting over the \( v_0 \) volume of the current mass of quark, \( m_q \approx 4.5 \pm 10 \text{ MeV/c}^2 \), [9]). At \( T \approx 10^{-10} \text{K}, V_q^0 \) and \( \delta \) increases with \( T \) until a value: \( V_q^0(T) \approx 2V_q^0, \delta \approx \delta( V_q^0(T)/V_q^0) \).

Also, for the neutron electron of the free neutron, we have, according to eqn. (13):

\[
V^0 = \frac{\partial}{\partial s} \cdot V^0_m = e^{-\frac{2}{\eta}}; \quad |\Psi|^2 = R_q^2; \quad \Psi = R_q \cdot e^{i \Phi}; \quad S_\mu = m_e \mathbf{y}_e; \quad \mathbf{y}_e \perp r; \quad R_q^2 = e^{-\frac{(r - a_e)^2}{\eta}}
\]

with \( v_{n_e} \approx 3.24 \times 10^{-51} \text{ m}^3 \) and \( \mathbf{y}_e \) the amplitude of electron’s vibration which generates its release.

For: \( u = 1 \) and \( \sigma \) the medium’s conductivity, from eq. (14) is obtained a generalized form of the telegraphist equation, which for \( \sigma = 0 \), gives an equation of Proca-Maxwell type specific to a field of electro-magnetic type, with mediating quanta with rest mass: \( m_e \) and confined field source, (generalized charge, \( Q \)), in which for an unitary form, we must choose: \( m_e = m_\mu = 10^{-55} \text{kg} \):

\[
\nabla^2 \Psi - \frac{1}{c^2} \frac{\partial^2 \Psi}{\partial t^2} - \frac{2 \sigma}{c^2} \frac{\partial \Psi}{\partial t} - k^2 \Psi = \frac{1}{e_0 m_\mu} \sum (Q^e \cdot q^e) \delta(r); \quad \Psi(r, \sigma = 0) = \frac{1}{4\pi e_0 m_\mu} e^{-k r}; \quad a(r) = \frac{dv}{dt} = \frac{\partial \Psi}{\partial \mathbf{x}}
\]

The eq. (20) may be transformed into a generalized wave equation of Klein type, for the case of a source field with spatial-extended density, \( g = \rho/\mu \) and into a Maxwell type equation, for \( m_e = 0 \).

The “splitting of eqn. (14) into two derived equations by the field rank coefficient, \( u \), may be written also in a matricial form:

\[
\left( \begin{array}{c}
\nabla^2 + i \frac{2m}{\hbar} \frac{\partial}{\partial t} \\
\nabla^2 \cdot \frac{1}{c^2} \frac{\partial^2}{\partial t^2} - \frac{2 \sigma}{c^2} \frac{\partial}{\partial t}
\end{array} \right) \left( \begin{array}{c}
- \frac{2m}{\hbar^2} |\Psi|^2 \\
- \frac{m_e c^2}{\hbar^2}
\end{array} \right) \cdot |\Psi|^2 = \left( \begin{array}{c}
0 \\
\sum (Q^e \cdot q^e) \delta(r, t)
\end{array} \right); \quad \Psi = \Psi(r, t)
\]

5. Conclusions

According to the etherono-quantonic theory resulted in CGT, based on the gallelian relativity, which sustains the possibility of particles cold genesis by a vortexial nature of the magnetic field- given by an etherono-quantonic vortex: \( \Gamma_m = \Gamma_a + \Gamma_c \), of sinergons and of quantons, the new experimentally evidenced neutral boson of 34 m.e. supposed to be an X- boson of a fifth basic force but predicted in CGT as being a basic \( Z \) preon of cold formed quarks, may constitute a strong argument for the pre-quantum Bose-Einstein condensate Model of elementary particle, resulted in CGT, and it may be also a bosonic component of the „dark“ matter. The principal argument for this conclusion is the possibility to explain the sub-structure of the elementary particles and their weak and strong interactions, in accordance with their known mass, by a preonic structure of quarks, based on the \( Z \) preon, resulted as cluster of quasi-electrons, in a quasi-crystallin quark model with hexagonal symmetry, i.e. – with quasi-crystallin preonic structure of its kernel, formed by the super-dense centroids of the component quasi-electrons and contained by its current mass.

In accordance with a resulted quark mass relation, the proposed quark model may explain the known mass of the elementary particles discovered by decay induced of cosmic radiation and considered in the model as Bose-Einstein condensate cluster of degenerate gammons formed as pairs of quaselectrons, the model explaining also the quark’s relative stability.

According to CGT, the nucleon but also other composed particles attracts also the \( Z \) basic preon, by a weak force of nuclear type, as consequence of a non-null impenetrable quantum volume of the preon, which- for other particles, increases with the particle’s mass according to a semi-empiriel relation. A consequence of this theoretical model is the conclusion that- even if the \( Z \) boson can be also –by the vortexial field of the quasi-electrons, an intermediary gluon between a quark and a lepton, i.e. a X-boson, as component of quarks, the hypothesis looking the existence of a boson which binds the lepton to quarks and a heavy boson for the neutron’s transforming is not strictly necessary.

Based on the deduced relation for the impenetrable quantum volume of particles, it results a more general form of the potential of strong interaction between two particles, which complete the pre-quantum quasi-unitary theoretical image and understanding of the fundamental interactions and allow the propose of a quasi-unitary semi-classical equation of fields, specific to the particles and fields models of CGT.
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