A 34 m_e NEUTRAL BOSON, PREDICTED BY A PARTICLES COLD GENESIS THEORY AND EXPERIMENTALLY EVIDENCED, AS ARGUMENT FOR A PREONIC QUARK MODEL

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Abstract: The new neutral boson of 34 m_e, experimentally evidenced and supposed to be an X-boson of a fifth basic force, was predicted as being a basic z_0 preon of cold formed quarks by a pre-quantum model of elementary particle resulted from an etherono-quantonic theory of the author, and can be a strong argument for a Bose-Einstein condensate model of particle, resulted by magnetically confined gammons formed as pairs of quasielectrons. A strong argument in the favour of the preonic structure of quarks and for the Cold Genesis of the elementary particles is proposed a new, pre-quantum model of quark resulted in theory with quasi-crystallin preonic structure, given by a quasi-crystallin form of the basic preon z_0, resulted as cluster of quasi-electrons. The brought arguments sustain also the conclusion that the z_0 boson can be a „dark matter” constituent.

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

1. Introduction

In a relative recent paper, [1], a research team of Science’s Institute for Nuclear Research in Debrecen, Hungary, after some experiments 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/c^2 , (~34 m_e), the excited Be8* state being obtained by proton interaction with a target of Li7, i.e. by a reaction of type:

\[ \text{Li}_7 + p^+ \rightarrow \text{Be}^* \rightarrow \text{Be}^8 + b^0; \quad b^0 \rightarrow e^+ + e^- \]

(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:

\[ X \rightarrow e^+ + e^- \quad \text{or} \quad X \rightarrow \nu^+ \bar{\nu} \text{(negligible)} \],

instead: \[ X \rightarrow u + u; \quad X \rightarrow e^+ + \bar{d} \].

Later, the considered X boson was theoretically identified as k = 113 light pion, by the p-Adic thermodynamics, [3].

But a particle with the same mass: 34 m_e, was considered by a cold genesis quark model as being the basic preon by which is composed the effective quark mass, according to a cold genesis pre-quantum theory of particles and fields of the author, (CGT), [4-6].

According to this theory, based on the galileian relativity, the magnetic field is generated by an etherono-quantonic vortex \[ F_d = F_\chi + F_\mu \] of s-etherons (sinergons-with mass \[ m_s \approx 10^{-60} \text{kg} \])- giving the magnetic potential \[ A \] by an impulse density: \[ p_s(r) = (\rho_s c) r \], and of quantons (h-quanta, with mass: \[ m_h = h/c^2 \approx 7.37 \times 10^{-31} \text{kg} \]), giving the magnetic moment and the magnetic induction \[ B \] by an impulse density: \[ p_c(r) = (\rho_v c) \nu_, \nu_\gamma \nu_\delta \] 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 \( m^e \), formed by a superdense centrod and a quantum volume of vexons (vectorial photons composed by vortexed vectons), the particle’s magnetic moment radius being given by its Compton radius, \( r_1 = \lambda/2\pi = \hbar/m_\mu c \).

The virtual radius: \( r^\mu \) of the proton’s magnetic moment, \( \mu_p \), results –in the theory, by a degenerate Compton radius of the attached positron, which decreased when the protonic positron was included in the \( N^P \) cluster volume, from the value: \( r^\mu = 3.86x10^{-11} m \), to the value: \( r_1 = r^\mu = 0.59 fm \), as a consequence of the increasing of the impenetrable quantum volume mean density in which is included the protonic positron centrod: \( m_0 \), from the value: \( \rho_0 \) to the value: \( \rho_0 \approx f_d\cdot N^0 \cdot \rho_\epsilon \), conformed with the equations:

\[
(2a) \quad \mu_\epsilon = k_\epsilon \cdot m_\epsilon / m_\mu \cdot \mu_\mu = k_\mu \cdot \mu_\mu = k_\mu \cdot \frac{1}{f_d} \cdot N^0 \cdot \frac{e^c \cdot r^\mu}{2} \cdot \mu_\mu \cdot \frac{g_\mu}{g_\epsilon} \cdot \frac{g_\epsilon}{g_\mu} \cdot e^\gamma \frac{g_\mu}{g_\epsilon} \quad (2b)
\]

in which: \( k_\epsilon \)–the gyromagnetic ratio; \( \rho_\epsilon \); \( \rho_\mu \)– the mean density of electron and nucleon; \( r^+ \)–the position of protonic positron centrod in report with the proton centre; \( f_d \)–the degeneration coefficient of the quasielectron mass, \( m_\epsilon^* \).

The relation \( 2b \) also gives: \( r^+ = 0.96 fm \) for the protonic positron axial position inside the protonic quantum volume, the theory giving for the electron a radius: \( a = 1.41 fm \) and a quanta density variation inside the electron’s quantum volume: \( \rho_\epsilon = \rho_\epsilon^0 \cdot e^{-\eta} \); with: \( \rho_\epsilon^0 = 22.24 \text{ kg/m}^3 \) and: \( \eta = 0.965 \text{ fm} \) for the electron mass quanta density variation, \([4-6]\).

The superposition of the \((N^P+1)\) quantic vortices: \( \Gamma^\mu \) of the protonic quasielectrons, generates inside a volume with the radius: \( r^\mu = 2.35 fm \), a total dynamic pressure: \( P_n = (1/2)\rho_n(r)\cdot c^2 \) which gives a nuclear potential: \( V_n(r) \), in an eulerian form, having a variation according to eq. \( 2b \), with: \( \eta^* = 0.755 fm \), that is: \( V_n(r) = \nu_0\cdot P_n = V_n^0 \cdot e^{-\eta^*} \); \( V_n(r) = \nu_0\cdot P_n^0 \); \( \nu_0(0.6fm) \approx 0.9 fm^3 \) - the impenetrable quantum volume.

-In a previous book, [4], the preon of 34 \( m_\epsilon \) was considered formed as cluster of 34 quasielectrons, \( e^*, \) with degenerate magnetic moment and electric charge corresponding to the value: \( \pm \sqrt{2}/e \), (specific to u-quark/antiquark), coupled in gammonic pairs: \( (e^* - e^*) \), but with un-degenerate mass.

- In the next variant, in english, [5, 6], the preon of 34 \( m_\epsilon \) was considered „quarcin“, with a charge \( e^* = \pm \sqrt{2}/e \), because that it was considered as formed by an odd number of 39 quasielectrons with degenerate mass: \( m_\epsilon^* \approx 0.872 m_\epsilon \). This \( m_\epsilon^* \) value was approximated considering that the confinement of vexorial (vectorial) photons inside the electron’s quantum volume and of gammonic pairs: \( \gamma^* = (e^* - e^*) \) inside the particles quantum volume, complies with the chiral sub-solitons forming condition, [7], which specifies that the energy density \( \epsilon_\gamma = \rho_\gamma c^2 \) of the mass-generating vexorial field should be double, at least, comparing to the mass energy density: \( \epsilon_w = \rho_\epsilon c^2 \) of the generated sub-solitons, \( \epsilon(m_\epsilon^*) = 2\epsilon(\Gamma^\mu) \), and considering a degeneration of \( \Gamma^\mu \) corresponding to the charge \( e^* = \pm \sqrt{2}/e \), (the decreasing of the mean radius of \( \Gamma^\mu \) from: \( \eta_c = 0.965 \text{ fm} \) to \( \eta_\mu = 0.755 \text{ fm} \)) and an un-degenerate \( \Gamma_A \) vortex.

The necessity of the preon with \( \sim 34 m_\epsilon \) resulted in CGT by the conclusion that –in a cold genesis scenario, the elementary particles could be formed in a magnetaric super-strong magnetic field, with \( B_T \rightarrow 10^{15} \text{ T} \), 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:

\[
M_p = \frac{K_m}{2\alpha} m_\epsilon; \quad \alpha = \frac{e^2}{\hbar c} = \frac{1}{137}; \quad m_\epsilon = 9.1x10^{-31} \text{ kg}
\]

with a tolerance under 1%, neglecting the electromagnetic field contribution, by integer values of \( K_m \) as a multiple of the mass: \( M_0 = 68.5m_\epsilon \); \( (K_m = 3; 4; 14 \text{ for the mesons } \mu, \pi, K) \).
2. Theoretical arguments for a preonic structure of quarks

It may be observed that for nucleons, the theory of O. Hellman gives by \( K_{\alpha} = 27 m_e \): \( p/n = 1849.5 \) \( m_e \) instead \( \sim 1836m_e \), i.e. - a difference which indicated that the \( M_0 = 68.5m_e \) value is not enough plausible. Also, we may observe that the value \( M_0 = 68m_e \) gives a very good correspondence with the nucleon mass but not gives a good correspondence with the mass of \( \Sigma \)-particle; ( \( m_e = 2312 m_e \) or \( 2380 m_e \) instead \( 2327; 2333; 2342 m_e \) ). This fact indicated in CGT as the most plausible value for the mass of the basic preon which may explain the mass of the elementary particles by quark masses obtained according to the sum rule (i.e. effective mass), the value: \( z^0 = 68/2 = 34.25 \) \( m_e \). If we consider as real the value: \( z^0 = 68.5/2 = 34.25 \) \( m_e \), the difference: \( \Delta z = (z^0 - z^2) \) \( = 0.25 \) \( m_e \) may be considered as a cold genesis binding energy per \( z^0 \)-preon, which is released at the cold genesis of quarks.

The obtained effective masses of the resulted quarks and their preonic sub-structure was presented in the book: „The Cold Genesis of Matter and Fields”, [5, 6] and in the previous book, [4].

The experimentally evidenced particle with \( 34m_e \) as neutral boson which decay into a \((e^+e^-)\) pair suggests that- in accordance with CGT, in the decay of Be8* to its ground state, the excess energy was emitted in the form of a neutral preon, formed as cluster of an even number of quasi-electrons (by an integer number of degenerate gammons), of \( n = 40 \) or \( n = 42 \) quasi-electrons with: \( 34/42 = 0.80 \) \( m_e \), which can form derived “zerons”.

The case: \( n = 42m_e \) may be explained by the predicted quarcin: \( c_0^+ = 39 m_e \), \( (m_e^e \approx 0.872 m_e) \), considering that the expelled quarcin has left the nucleon with the un-paired quasi-electron of the basic „zeron“ \( z^0 = (c_0 + c_0^*) \), forming a neutral boson which decayed in the form:

\[
b^0 (c_0^0 + e^+ + e^-) \rightarrow \gamma + e^+ + e^- \quad (4)\]

by the transforming of quasi-electron into electron, in a free state, [5, 6].

The case: \( n = 42m_e \) may be explained considering a quarcin \( c^e = 21 m_e \), \( (m_e^e \approx 0.8095 m_e) \) and considering that the expelled boson \( b^0 \) is a basic preon: \( z^0 = (c_0^0 + c_0^+ + c_0^-) = 34m_e \), which decayed in the form:

\[
z^0 (c_0^0 + c_0^-) \rightarrow c_0^0 + c_0^- \rightarrow e^+ + e^- \quad (5)\]

by the transforming of the quarcin into a heavier electron, in the free state, by the transfer of the un-paired quasi-electron (which gives the quarcin’s charge) in the external part of its impenetrable quantum volume,[5, 6].

In this last case, the nucleon results as formed by \( N^0 \approx 54x42 = 2268 \) quasi-electrons which gives- by the superposed vortexes of their magnetic moments, \( \Gamma_{\mu} (e^±) \), a nuclear potential at \( d \approx 2fm \):

\[
V^\prime (r) = -\mu_e \cdot p_\mu (r) = -\frac{\mu_e}{2} \rho_\mu (r) \cdot c^\mu = V^0 \cdot e^\gamma \quad ; \quad V^0 = -\frac{\mu_e}{2} \rho_\mu \cdot c^\mu \quad ; \quad r \leq r_\mu = 2.35fm \quad (6)
\]

in which the proton density in its centre has the value: \( \rho_\mu \approx N_e \rho_e^e = 5.04x10^{13} kg/m^3 \), \( (\rho_e^e = 22.24 \times 10^{13} kg/m^3) \), giving- with \( \mu_e (a_e) = 0.9 \text{ fm}^2 \), \( V^0 = 127.5 \text{ MeV} \), \( V_e (d=2fm) = 9 \text{ MeV} \) – value specific to the mean binding energy per nucleon in the nuclei with the most strongly bound nucleons: 9.14 \( \pm 9.15 \) MeV/nucleon for \( ^{56}\text{Fe}, ^{58}\text{Fe}, ^{60}\text{Ni}, ^{62}\text{Ni} \); (i.e. it results a better fit with the experimental data).

In the same time, taking into account the experimental value for the mean radius of the nucleon density variation: \( \eta^e = 0.841 \text{ fm} \), the proton mass and the \( m_i^e \) mass of the specific bound quasi-electron, results for an effective radius: \( a_e \approx 1.363 \text{ fm} \), (closer to the value: \( \sim 1.25 \text{ fm} \) used by the equation of empirical nuclear radius: \( R_e = r_0 A^{1/3}, (r_0 \approx 1.25 \text{ fm}) \).

By the basic \( z^e \)-zeron it is possible to deduce a quark model of cold formed particles with effective mass of quarks, which gives the particle mass by the sum rule, considering as stable solitonic constituent of mesons and baryons, the basic preon \( z^0 = 42 m_e \) \( \approx 34 m_e \), which can form derived “zerons”.
The resulted structure of the fundamental elementary particles, considered as formed "at cold" by quarks with current mass and fractional electric charge $q^* = (+2e/3)$, formed as preonic clusters, is given by the following sub-structures, [4]:

Conform acestui rezultat, intr-un model de formare "la rece" a particulelor elementare, prin vortex cuantic $\lambda$, de forță suprapotenti (generată de potențial cuantic de Broglie-Bohm), particulele elementare rezultate formează din grupuri cu mase curente rezultate în model tip cluster de electroni degenerați, prin considerarea asupra unității constitutive a particulelor elementare compuse, a unui cluster neutrul pe care îl denumim "zero‖ $Z^* = Z^*/2 = 34 m_e$, format din electronii degenerați dispusi în perechi negațion-potențion, de spin și moment magnetic nul și cu volumul cuantic de rază $\lambda < a$, comun.

Figure 1: the prediction for $z^0$-preon ; ([4], 2006, p. 58)

a) –basic zerons (preons): $z^0 = 34 m_e$; $z^* = 2Z^0 = 68 m_e$; $Z_4 = 3Z^0 = 102 m_e$; $Z_2 = 4Z^0 = 136 m_e$;
b) -derived zerons: $Z_3 = 2(Z_4 + Z_2) = 476 m_e$; $Z_4 = 3(Z_4 + Z_2) = 714 m_e$;
c) basic quarks: $m_1^+ = (Z_2^* - m_e^*) = 135.2 m_e$, (marki, $+2e/3$); $m_e^*(e^*) \approx 0.8 m_e$;
d) derived quarks, (effective mass):

- derived quarks, (effective mass):

\[ m_2 = m_1 + e^+ + \sigma = 138.7 m_e; \] (mark$_2$ - q$^* = +2e/3$); \( \sigma = e^+ e^- = 2 m_e^- - gluol \)
\[ p^+ = m_2 + Z_3 = 611.2 m_e; \] (park, $+2e/3$); \( n = m_2 + Z_3 = 613.8 m_e, \) (nark, $-e/3$);
\[ \lambda = m_2 + Z_3 = 851.8 m_e; \) (lark, $-e/3$); \( s = \lambda + Z_3 = 987.8 m_e, \) (sark, $-e/3$);
\[ \nu = s + Z_2 = 1123.8 m_e; \) (vark, $-e/3$); \( m_2 \rightarrow m_1 + e^+ + \nu_e; \) \( n \rightarrow p^+ + e^- + \nu_e \)

d) Elementary particles:

Mesons: (theoretic mass) / (experimentally determined mass)
\[ \mu^* = 2Z_i^* + e^0 = 205 m_e; / \mu = 206.7 m_e \]
\[ \pi^0 = m_1 + m_2 = 270.4 m_e; / \pi^0 = 264.2 m_e \]
\[ \pi^+ = m_1 + m_2 = 273 m_e; / \pi^+ = 273.2 m_e \]
\[ K^* = m_1 + \bar{\lambda} = 987 m_e; / K^+ = 966.3 m_e \]
\[ K^0 = m_2 + \bar{\lambda} = 989.6 m_e; / K^0 = 974.5 m_e \]
\[ \bar{\eta} = m_2 + s = 1125.6 m_e; / \bar{\eta} = 1073 m_e; (s = s-antiquark) \]

Barvons:
\[ p = 2p + n = 1836.2 m_e; n_e = 2n + p = 1838.8 m_e; / p^+ = 1836.1 m_e; n_e = 1838.7 m_e \]
\[ \Lambda^0 = s + n + p = 2212.8 m_e; / \Lambda^0 = 2182.7 m_e \]
\[ \Sigma^+ = v + 2p = 2346.2 m_e; \Sigma = v + 2n = 2351.4 m_e; / \Sigma^+ = 2327 m_e; \Sigma = 2342.6 m_e \]
\[ \Sigma^0 = v + n + p = 2348.8 m_e; / \Sigma^0 = 2333 m_e \]
\[ \Xi^+ = 2s + p = 2586.8 m_e; \Xi = 2s + n = 2589.4 m_e; / \Xi^0 = 2572 m_e; \Xi = 2587.7 m_e \]
\[ \Omega = 3v = 3371.4 m_e; / \Omega = 3278 m_e \]

Some “resonance” particles may be formed also “at cold‖, in:
\[ \Lambda^\prime = 2v + p = 2858.8 m_e; \Lambda = 2v + n = 2861.4 m_e; (known mass: 2850 m_e), and:
\[ \Xi = 3s = 2963.4 m_e; (known mass: 3004 m_e) \]

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:
\[ \Phi = 2v + \lambda = 3099.4 m_e; \Phi^* = 2v + s = 3235.4 m_e; 2s + \lambda = 2827.4; 3s = 2963.4 m_e \]
\[ \Lambda^\prime = s + 2p = 2210.2 m_e; \Lambda = s + 2n = 2215.4 m_e; Z_3 = (Z_4 + Z_2) = 238 m_e \]

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 zerons: $z^* = 2z^0 = v^+_\mu = 68 m_e$, having the form:

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

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

\[ a): n = 1 \rightarrow (m_{1,2}); \] \[ n = 2 \rightarrow (\pi^{\pm}); \] \[ n = 4 \rightarrow (\eta^0); \] \[ n = 5 \rightarrow (\Lambda^0); \]
(specific specially to the mesons), or triplets (specific to baryons), in a b)- or c)-form:

b): n = 0 → (µ⁺); n = 1 → (z₃); n = 2 → (K₀⁺); n = 3 → (p, n);

c): 3x2ⁿz*; n = 4 → (∏); d): [(4x2ⁿ+n)z* - z⁰]; n = 3 → (Σ⁺, Σ⁺);

e) [(3x2ⁿ+n)z*]; n = 2 → Θ₀, Θ⁺;

i.e.-a tendency specific also to the quarks theory of the particle standard model.

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 N⁰ cluster.

3. A possible explanation for the proton’s stability

According to the theory, the possibility of a z⁰-preon decaying into component quarcins c*± may result–by the interaction energy of (Li⁷, p⁺ ) couple, by a resulted resonant state of the (2p+n) quarks system of the captured proton.

In this sense, it may be observed the fact that- even if the proton is formed by three quarks like other baryons, it is a very stable particle until a critical temperature, T_c ≈ 2x10¹² K, of quarks deconfination, compared to other baryons, for which may be considered a semi-empiric relation for the particle’s lifetime resulted dependent of the total intrinsic vibration energy of the internal quarks, εᵣ, in the form:

$$\tau_i = \frac{\tau_0}{k_i \cdot 10^{n_i}}; \quad \tau_0 \approx 10^{13} \text{sec}.; \quad k_i = \frac{\Delta m_i}{m_i} = \frac{n \cdot \varepsilon_i}{\varepsilon_i}; \quad T_d \approx 2 \times 10^{12} \text{K}$$  \hspace{1cm} (8)

in which: $$\varepsilon_i^0 = k_0 T_d \approx h \nu_c^0$$ represent the critical phononic energy of the particle vibration which determines the quark deconfination, at: $$T_d \approx 2 \times 10^{12} \text{K}, \quad \text{(Arghirescu, 2006, 2012, 2015)}$$.

This fact was explained by the pre-quantum model of nucleon derived from CGT, by a new proposed Bag Model for the nucleon’s stability, [8], of type with repulsive shell of the impenetrable quantum volume given by a static pressure of kinetized quanta, with a Gaussian variation and maximum value corresponding to the constant B of model “bag” of MIT, without intermediaries gluons hypothesis.

In the mentioned paper was hypothesized also- by eq. (8), that the higher stability of the proton indicates an axially magnetic coupling of the proton’s quarks along its magnetic moment vector, µₚ, favored by the quasi-equality between the effective mass of n- and p- quark deduced in CGT, this arrangement reducing the total intrinsic vibration energy of quarks inside the impenetrable quantum volume. An argument for this conclusion may be the result of some high energy p-p elastic scattering experiments in the TeV region, based on an effective field theory model of the proton [9], which deduced - from the hard collision of a valence quark of one proton with that of the other, the existence of a core region of size ~ 0.2 fm, where the current mass of the valence quarks are confined and of a layer of scalar particles that envelops the baryonic charge shell of the proton, which originates from a scalar field, (i.e- similar to the repulsive shell of the impenetrable quantum volume considered in the Bag model of CGT), resulting that the proton is a “condensate enclosed Chiral Bag”.

But according to other experiments, [10], the value of ~ 0.2 fm corresponds to the current mass quark radius, so the mentioned result of p-p elastic scattering indicates an alignment of current masses of the protonic quarks along the proton’s magnetic moment, in our opinion.

A less stable state of proton is obtained when the current masses of quarks- totally included into the impenetrable quantum volume of nucleon considered with a radius of ~ 0.6 fm [8], are aligned perpendicular to the proton’s magnetic moment, position in which the u-quarks (the p-quarks –in the CGT model), are rotated around the d-quark (the n-quark –in the CGT model). According to this conclusion, it results that – before the quarks deconfining at T_c ≈ 2x10¹² K, it is possible to exist another critical thermic point, T_m, of proton’s transition into a meta-stable state with current mass quarks aligned perpendicular to the proton’s magnetic moment, (figure 2, a).
The experimentally evidenced boson of \( \sim 34 \, \text{me} \) in p-Li\(_7\) interaction at low energy, identified as the predicted preon \( z_0 \) in CGT, indicates according to the previous conclusions, the possibility of \( z_0 \) preon(s) emission at the considered \( T_m \) transition temperature and by nuclei with giant resonance.

Another possibility for experimentally verifying of the preonic nature of the 34 me boson is to determine the mass of the Be8 nucleus resulted after the reaction: 

\[
(p; \text{Li}^7) \rightarrow (\text{Be}^8; z_0),
\]

which must be:

\[
M(\text{Be}^8) = M(\text{Li}^7) + m_p - m(z_0) = [(7,016u + 1)x1836 -34]/1836 = 7.997u \tag{9}
\]

The stability of \( z^0 \) preon may results as consequence of a quasi-cristalline form of the component quarcins:

\[
c^\pm = 7x3= 21\text{m}_e^* = 17 \, \text{m}_e, \text{ (i.e.-hexagonal)} - \text{considered by CGT, (figure 1, b), given by the specific interaction and arrangement between the component quasi-electrons with superdense centroids of } \sim 10^{-18} \text{m radius.}
\]

The quark structure resulted from CGT is shown in figure 2, c), in which \( r_q \) is the radius of quark’s current mass, given by its impenetrable quantum volume and the maximal density of the particle’s kernel, [8], \( v_q(r_q) \) is the quantum volume of its effective mass (which gives the particle’s mass according to the sum rule), which is composed by confined vectorial photons (vexons), which forms in CGT, the vortexial equivalent of the gluonic shell considered in Quantum Chromodynamics, ‘Ss’ being a scalar shell of \( \sim 0.1\text{fm} \) thickness, which envelops the current mass of quark and which may explain according to CGT, the value of \( \sim 0.3 \text{ fm} \) for the quark radius determined by some scattering experiments as those made at Fermilab, [10]. This scalar shell, evidenced for proton by p-p scattering at few TeV, [9], 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 (vectonic inertial masses) by the vortexial field: \( \Gamma_q = \Sigma(\Gamma_{\mu}^q) \), may generate a small scalar shell of scalar field quanta also around the current mass of an individual quark, according to the model.

According to the theory, the 34 me boson may be also a „dark matter” particle which may form in the quantum vacuum, bigger bosons and quark-antiquark pairs.

\[
\begin{align*}
&M(\text{Be}^8) = M(\text{Li}^7) + m_p - m(z_0) = [(7,016u + 1)x1836 -34]/1836 = 7.997u \tag{9}
\end{align*}
\]

The mesons results by eq. (10) with: \( m = (m_1^+, m_2^-) \), the baryons results as combinations (q-q-q) but not only, by the equation:

\[
q = m + k \cdot z_n + n \cdot (k-2) \cdot z_2; \quad k = 0 \div 3; \quad n = 0 \div 2; \quad n < k; \quad (m = (m_1^+, m_2^-)), \tag{10}
\]

with: \( m = (m_1^+, m_2^-) \), the quasicrystalline form of quarks resulting from the quasicrystallin form with hexagonal simmetry of the considered \( z^0 \) and \( z_\pi = 7z^0 \) zeron(s), like in figure 3, i.e.:

- \( k, n = 0 \Rightarrow q = m_2^-; \quad (k = 1, n = 0) \Rightarrow q = r^\pm, \text{ (rank- un-stable quark)}; \quad (k = 2) \Rightarrow q = p^+, n^-; \)
- \( k = 3, n = 0 \Rightarrow q = \lambda^-, (k = 3, n = 1) \Rightarrow q = s^-; \quad (k = 3, n = 2) \Rightarrow q = v^- .
\]

The mesons results by eq. (10) with: \( m = (m_1^+, m_2^-), i, k = 1, 2, \) 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:
\[ b = M + k \cdot z_\pi + n \cdot (k - 6) \cdot z_2; \quad M = \sum_{i=1}^{3} m_i; \quad m_i = (m_{i1}^{\prime} ; m_{i2}^{\prime}); \quad k = 6 + 9; \quad n \leq 2 \]  

\[ \Psi = \Psi(r, t); \quad q^* = (q_e^*; q_G^*); \quad Q^* = (Q_e^*; Q_G^*); \quad q_i^*(m_i) = n_i \cdot e; \quad \Psi_0^* = \frac{m_i \cdot e}{\beta_i \cdot m_i}; \]  

\[ \beta_i^2 = 1 + \frac{\gamma_i^2}{2c^2}; \quad Q_G^* = 4\pi Ge_i \cdot \frac{m_i}{e} \left( 1 + \frac{\gamma_v}{c} \right); \quad \Psi = \Psi \cdot e^{-i \cdot \beta_i \cdot n_i \cdot \cdot \cdot}; \quad R^* = R^* \cdot e^{i \cdot \cdot \cdot}; \]  

\[ \Psi(r, t) = V(r) \cdot \Psi(r, t); \quad V(r) = \Psi \cdot \Psi^* = \Psi \cdot \Psi^* = R^2; \quad \Psi = R \cdot e^{i \cdot \cdot \cdot}; \]  

\[ V^0 = V^0_n = \frac{\nu_0}{2} \cdot \rho_0^0 \cdot e^2; \quad |\Psi|^2 = \Psi \cdot \Psi^* = R^2; \quad \Psi = R \cdot e^{i \cdot \cdot \cdot}; \quad S_{\mu} = (\delta \mu), c \cdot l, \; R^2 = e^2 \cdot \eta^* \]  

\[ \eta^* = 0.755 \text{ fm}, \text{ for the inter-nucleons scalar nuclear field, and:} \]
\[ V^0 = V_n^0 = \frac{U_n}{2} \rho_n \alpha^2 \; ; \quad |\Psi|^2 = R_{n^2} = e^{-r} \cdot e^{-\frac{\zeta}{2}} \; ; \quad 1_v = l^0_v = \left( \frac{3}{2} - \frac{1}{2} \tau \cdot \tau_n \right) ; \quad \tau = \frac{s}{s} \] 

(15)

for the tensorial interaction between two nucleons, with: \( \eta^* \approx 0.755 \text{ fm}, \ l_v^* \) - the vibration liberty, \( l_v^0 \approx 1 \text{ fm} \) – for deuteron and \( l_v(E_v=0) = 0 \) ; ( \( \vec{s} \) - the nucleon spin ; \( E_v \) – the vibration energy).

For the inter-quarks strong field, according to CGT, \( [8] \), we have:

\[ V^0 = V_q^0 = \frac{U_q}{2} \rho_q \left( a_i \right) c^2 \; ; \quad |\Psi|^2 = R_q^2 \; ; \quad \Psi = R_q \cdot e^{\frac{s_z}{s}} \; ; \quad S_\mu = (\delta m_\mu), c \cdot 1_i \; ; \quad R_q^2 = e^{-\frac{(r-a_i)^2}{\delta}} \] 

(16)

with: \( u_q = u_q(r_q \approx 0.21 \text{ fm}) ; \delta = 0.28 \pm 0.24 \quad \text{and} \quad a_i \approx 0.6 \text{ fm} \), (force of static quantum pressure gradient in the field of a repulsive shell of the nucleon's impenetrable quantum volume \( u_i(a_i) \) acting over the \( u_q \) volume of the current mass of quark).

For: \( u = 1 \) and \( \sigma \) - the medium conductivity, from eq. (12) 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: \( m_e \approx m_g \approx 10^{-6} \text{kg} \):

\[ \nabla^2 \Psi - \frac{1}{c^2} \frac{\partial^2 \Psi}{\partial t^2} - 2 \frac{\sigma}{c} \frac{\partial \Psi}{\partial t} - i^2 \Psi = - \sum \left( \frac{Q^* \cdot q^e}{\varepsilon_o m_g} \right) \delta(r) ; \quad \Psi(r, \sigma = 0) = \sum \left( \frac{Q^* \cdot q^e}{4 \pi \varepsilon_o m_g} \right) ; e^{i k r} ; \quad a(r) = \frac{dv}{dt} = \frac{\partial \Psi}{\partial \xi} \] 

(17)

The eq. (17) may be transformed into a generalized wave equation of Klein type, for the case of a source field with spatial-extended density, \( \varepsilon = \rho / \varepsilon_0 \) and into a Maxwell type equation, for \( m_e = 0 \).

The “splitting of eqn. (12) into two derived equations by the field rank coefficient, \( u \), may be written also in a matricial form:

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

(18)

The weak interaction may be partially described mathematically by equation (7), in CGT.

REFERENCES