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Astrophysical phenomena explainable by the particles' density levels in a Cold Genesis Theory

Abstract

The paper shows that some astrophysical phenomena such as the initial TOV limit of neutron stars' mass and the transition density interval from neutron star to a quark star, can be explained unitary, by the specific structure and the density levels of the fermionic elementary particles specific to the particle models of a Cold genesis theory of the author: superdense centroid, kerneloid and photonic shell maintained by etherono-quantonic vortex/vortices of magnetic moment(s), which explain and physical phenomena such as: the connection between the photon's structure and the electronic neutrinos, the scattering centers experimentally evidenced inside the proton at electron-proton scattering at high and very high energies and inside the electron by X-rays, the Compton effect, the nuclear and the strong force, in a fractalic scenario of particles' forming, from the considered etherono-quantonic energy.

Keywords: photon; neutrino; preon; electron radius; TOV limit; quark star's density; quantum vortex

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Introduction

In a Cold Genesis pre-quantum theory of particles and fields, (C.G.T.),[1,2] based on the Galilean relativity, the constituent quarks and the resulted elementary particles are explained as clusters of paired quasielectrons, i.e. pairs of negatrons and positrons with degenerate mas, charge and magnetic moment, named 'gammons' ($\gamma(e^-e^+)$), resulting that preonic bosons and quarks can be formed also 'at cold', as Bose-Einstein condensate of 'gammons' which form stable basic preons z^0 of mass ~34 m_e, forming constituent quarks, which were evidenced by a research team of Science' Institute for Nuclear Research in Debrecen (Hungary),[3] as neutral super-light particle with a mass of ~17 MeV/c^2 , named X17. Its stability was explained in CGT by the conclusion that it is formed as cluster of an even number n = 7x6 = 42 quasielectrons with mass $m_e^* \approx 34/42 = 0.8095\ m_e$, i.e. reduced to a value corresponding to the charge $e^* = \pm(^2/_3)e$ by a degeneration of the magnetic moment's quantum vortex $\boldsymbol{\Gamma_\mu = \Gamma_A + \Gamma_B}$ generated around superdense centroids by etherono-quantonic winds of the quantum vacuum, i.e. given by 'heavy' etherons of mass $m_s \approx 10^{-60} kg$ and 'quantons' of mass $m_h = h\cdot 1/c^2 = 7.37x10^{-51}$ kg .

The considered "gammons" were experimentally observed in the form of quanta of "un-matter" plasma.[4] In CGT, similarly to the S.M.'s constituent quark model, it was considered[5] that the electron's mass is formed by a 'kerneloid' containing the (super) dense centroid m_0 of radius $r_0 \le 10^{-18}$ m and by a shell of bosons which are 'naked' photons, in concordance with the evidenced possibility to obtain a B-E condensate of photons,[6] this electronic kerneloid being equivalent to an 'impenetrable' quantum volume (similar to that of the nucleon), having a radius $r_{ie} \approx 10^{-2}$ fm- in accordance to some high-energy scattering experiments reported by Milonni et al.[7] The last experimentally determined value for the quark's radius: ~ 4.3x10^{-19} m [8] corresponds in this case to the radius of the super-dense electronic centroid,[1,2] being close to the upper limit determined by X-rays scattering on electron.[9] It was also concluded[10] that the transition from neutron matter to quark matter begin at densities around (1.5 ÷ 4)x10^{18} kg/m3.

In 1939, by neglecting the nuclear forces between neutrons, using the Schwarzchild's equation and an equation of state P(ρ) specific to a highly compressed cold Fermi gas, $P = K\cdot\rho^{5/3}$, (polytropic form in the non-relativistic case of a Fermi gas of neutrons), the mass limit for neutron-degenerate matter was estimated at 0.7 solar masses, ($M_{TOV} = 0.7\ M_\odot$)- value representing the initial TOV limit', (Tolman–Oppenheimer–Volkoff),[11,12] the corresponding maximum mass before collapse being with ten percent higher than this, ($M_s^0 \approx 0.77\ M_\odot$).[12] So, the stars more massive than the TOV limit collapse into a black hole and if the mass of the collapsing part of the star is below the TOV limit, the end product is a compact star – either a white dwarf (for masses below the Chandrasekhar limit) or a neutron star or a (hypothetical) quark star.

In 1996, by an equation of state (EoS) based on a MIT bag-like model of quark's confining, it was deduced that the upper mass for neutron stars which are not collapsed into a black hole is in a range from 1.5 to 3 solar masses.[13] In 1932, Louis de Broglie[14-16] suggested that the photon might be the combination of a neutrino and an antineutrino. During the 1930s there was great interest in the neutrino theory of light and Pascual Jordan,[17] Ralph Kronig, Max Born, and others worked on the theory.

But in 1938, Maurice Pryce[18] brought work on the composite photon theory to a halt. He showed that the conditions imposed by Bose–Einstein commutation relations for the composite photon and the connection between its spin and polarization were incompatible. We will argue that the previous mentioned astrophysical phenomena can be explained unitary, by the specific structure and the density levels of the elementary particles specific to the CGT's particle models, in a fractalic scenario of particles forming from the considered etherono-quantonic energy.

The density' levels of the CGT's fermionic structure in a quasi-general model

The density levels of leptons in CGT

For electron, it results in CGT,[1,5,19] that there are three radius specific to the structure of its inertial mass, corresponding to three levels of mean density of confined 'naked' photons, (reduced at their inertial mass: m_f, considered as confined in the photon's kerneloid, of radius $r_f \leq 10^{-2}$ fm, for $m_f < m_e$ and having a Γ_μ^f-vortex sustained by a superdense centroid of radius $r_0^f \leq r_0 = 0.43 \times 10^{-3}$ fm):

a) the super-dense centroid's radius ($r_0^e \approx 0.43 \times 10^{-3}$ fm), corresponding to the highest density level ($\rho^0 \approx 1.4 \times 10^{20}$ kg/m^3) and to a mass ~ $0.5 \times 10^{-4} m_e$, (a half of an electronic neutrino having the mass limit: 60 eV/c^2,);[1,20]

b) the electron kerneloid' radius ($r_{ie} \to 10^{-2}$ fm), given by a dense shell of photons, corresponding to the mean density level, ($\rho_i^e \leq \rho_q^0 = m_q^n/\upsilon_q^0 = 7.5$ MeV/c$^2 \cdot 0.91 \times 10^{-47} = 1.46 \times 10^{18}$ kg/m^3 ; m_q^n –the current mass of the nucleon's quarks, contained by its volume υ_q^0 of 0K), and:

c) the electron's classic radius ($a_e \approx 1.41$ fm), corresponding to the low density level ($\rho_a(a) \approx 5.16 \times 10^{13}$ kg/m^3) and to a quasi-superficial distribution of the electron's e-charge.

This electron's structure explains in CGT the next phenomena evidenced by electron-proton scattering:

a. the a)-level explains the fact that -at very high electron energies $\lambda << r_p$, ($\lambda = hc/E$ –the wavelenght; r_p –the proton's radius), the proton appears to be a sea of gluons and current quarks evidenced as having a radius $r_0 = 0.43 \times 10^{-3}$ fm;[8]

b. the b)-level explains the fact that -at high electron energies $\lambda < r_p$, the proton appears to be a cluster of three constituent quarks;

c. the c)-level explains the electron's charge, the Lorentz force[1,21] and the fact that -at low electron energies $\lambda \sim r_p$, the scattering is equivalent to that from a extended charged object.

The electron's Compton radius $r_C^e = \lambda/2\pi = h/2\pi m_e c = 386$ fm corresponds in CGT to the radius of an evanescent part containing a spinorial mass $m_s \approx m_e$ of vector photons vortexed with the light's speed c, which are weakly bound to the electron's mass m_e (contained by its volume of classic a-radius) and does not contribute to their inertial mass.

A similar structure is considered in CGT also for heavy and light vector photons, whose inertial mass is considered as contained by a kerneloid of radius $r_{if} \to r_{ie}^{\ 0} = 10^{-2}$ fm[19] and which contains a super-dense centroid of radius $r_0^f < 0.43 \times 10^{-3}$ fm, with the difference that their kerneloid retains only their evanescent part, containing vortexed quantons and very light vector photons whose inertial mass does not contribute to the inertial mass of that vector photon, they being weakly linked to the vector photon's kerneloid.

Because in CGT the pseudo-scalar photon is formed as pair of two vector photons with antiparallel spins and magnetic moments, the mentioned similitude can explain the Compton effect (the partial transferring of photon's kinetic energy to an atomic electron) as consequence of elastic interaction between the kerneloids of the interacting photon and electron and the upper limit of the electron's center' radius determined by X- rays scattering on electron, (~10^{-18} m),[9] –as consequence of elastic interaction between the superdense centroids of X-ray photons and the electron's centroid.

Regarding to the possible mechanism of the centroids' and of kerneloids' forming, in CGT are considered chiral fluctuations in a primordial dark energy medium, formed by a brownian component (generating static pressure) and a dynamic component of the primordial quantum vacuum, given by etherono-quantonic winds which can produce vortices of a fluctuating magnetic-like field B = rot A of a cosmic A-field. Without a dense centroid, these etherono-quantonic vortices are un-stable, but in an energetic Proto-Universe with a high density of the primordial dark energy, they could have been enough strong for generate tiny stable chains of confined quantons, which- in the actual Universe, could be formed at the level of the magnetic field, lines' (etherono-quantonic vortex-tubes – in CGT) of the magnetars' field.

Also in the Primordial Universe, these quantonic chains could be joined into twisted (chiral) bundles, representing the centroid(s) of light photons which obtained their inertial mass (of their kerneloid) by confining of quantonic clusters in a stable etherono-quantonic vortex of their magnetic moment μ_f whose sense and value are given by the centroid's -chirality ($\xi_f = \pm 1$) and mass (m_0^f).

It is logical- in this case, to exist a proportionality between the mass of the vector photon's kerneloid (its inertial mass) and that of its centroid, the electron's mass resulting as given by a saturation value of confined photons number. Because the paired electronic centroids with opposed chiralities not ensures the maintained of the electron's magnetic moment μ_e, (i.e. of its etherono-quantonic vortex Γ_μ^e), a pair of coupled electronic centroids represents in CGT an electronic neutrino (of Majorana type) and this explains the fact that it can easily penetrate large solid bodies.

Similarly, it results that vector photons of opposed chiralities can annihilate each other's vortexial structure at their collision, phenomenon observed at the interference of two laser radiation waves in antiphase. The remained paired centroids of vector photons can be considered pseudo-neutrins of lower mass, which contribute to the total mass of the Universe's dark matter and a classic equivalent to the so-named ‚axion' of the Standard Model (of mass from 10^{-5} to 1 eV/c^2).[22] These pseudo-neutrins explain in CGT the alleged connection between photons and neutrins.[14-18]

The density levels of quarks and of mesons and baryons, in CGT

Relating to the mesons and baryons, in CGT these particles are formed by constituent quarks of mass M_q formed by layers of a light mesonic quark $M_m^{\pm} \approx [z_2(4z^0) \pm m_e^*]$ and a number of two preonic bosons: $z_2 = 4z^0$ and $z_\pi = 7z^0$, (Figure 1) composed by z^0-preons of mass $M_z = 34\ m_e$, obtained as prismatic (crystalline) arrangement of 21 pairs of quasielectrons of opposed charges: $e^* = \pm(^2/_3)e$ and mass $m_e^* \approx 0.81\ m_e$, (Figure 2), the kerneloids of these quasielectrons form a quasi-crystalline cluster representing the kerneloid of the z^0-preon, the number: $n_z = M_q/M_z$ of z^o-preons' kerneloids giving the mass m_q of the current quark which –by the total vortical field of the magnetic moments of its quasielectrons, generate a vortical potential V_Γ and a vortical force $F_v(r)$ which attracts and retains ‚naked' thermalised photons, forming the quark's bosonic shell, in CGT's model:[1]

$$F_v(r) = -\nabla V_\Gamma = -\nabla N^e \cdot V_\Gamma^e(r); \quad (V_\Gamma^e = -½\upsilon_f \rho_s c^2) \qquad (1)$$

(υ_f –the volume of the photon's kerneloid, containing its inertial mass; ½$(\rho_s c^2)_r$ –the dynamic etherono-quantonic pressure in the Γ^e –vortex of a bound quasielectron at r -distance).

From figure 2 it is deduced that the radius value: $r_{ie}^{\ 0} \approx 10^{-2}$ fm[7] of the quasielectron's kerneloid, ensures a mean distance: $d_i \approx (^2/_3) \cdot r_z =$

2×10^{-2} fm between the electronic centroids m_0 on the radial direction at T = 0K, which gives a value: $r_{iz} = 3\times10^{-2}$ fm for the radius of the kerneloid of the cold z^0-preon, the minimal value of the cold z^0-preon's length resulting of value: $l_z^0 = 6xd_i \approx 0.12$ fm and a volume of the cold z^0-preon's kerneloid:

$\upsilon_{zi}^0 = 0.34\times10^{-48}$ m^3.

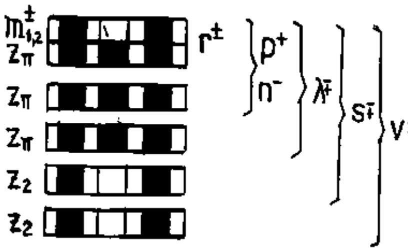

Figure 1 The cold forming of semi-light quarks.

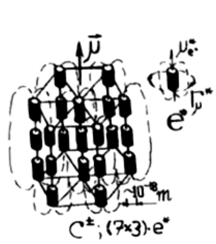

Figure 2 Kerneloid of a half of z^0-preon.

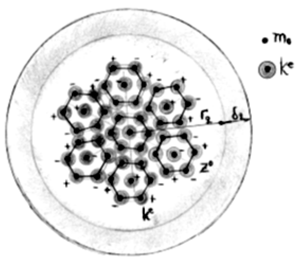

Figure 3 Preonic z_π -layer of a quarcic kerneloid.

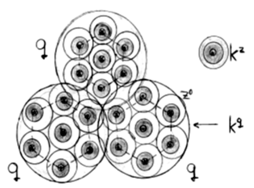

Figure 4 Baryonic kerneloid formed by current quark.

The CGT's explanation of the initial TOV limit of neutron stars' mass

Because the quasi-crystalline structure of (u, d)- quark's kerneloid have three layers- in CGT, ($m_{1;2}$; z_π ; z_π -Figure 1), with (4; 7; 7) z^0-preons, it results a length of the (u; d)- quark' kerneloid at T = 0K: $l_q^0 = 3l_z^0 = 0.36$ fm, and double ($l_q^{0'} = 6l_z^0 \approx 0.72$ fm) for the v-quark of CGT.

The minimal radius of the quark's kerneloid (specific to its ultra-cold state, T = 0K) results of value: $r_q^0 \approx 3xr_z = 0.09$ fm - which gives a current quark's volume: $\upsilon_q^0 = \pi r_q^2 l_q^0 = 0.91\times10^{-47}$m^3.

A cold cluster of three u-d-current quarks will have a radius $r_i^0 \approx 2r_q^0 = 0.18$ fm at T = 0K. In report to these theoretic values of T = 0K, the value: $r_q^i \approx r_i/2 = 0.2$ fm used in the CGT's model as radius of a spherical current u/d-quark in concordance with older experiments[23,24] represents a radius of dilated volume of current (u/d)-quark: $\upsilon_q^n \approx (3.35\div3.38)\times10^{-47}$ m^3, that corresponds to a small vibration liberty l_v^z of the z^0-preos inside the quark's kerneloid, which generate a current quark's dilated volume and its repulsive shell, of thickness $\delta_q(l_v^z) \approx (0.01\div0.03)$ fm,[25] giving a scalar repulsive charge, q_s, and an interaction radius: $r_q^i = r_q + \delta_q$, ($r_q = 0.2$ fm), specific to an ordinary temperature associated to the nucleon's vibration: $T_n^j \approx 1$ MeV/k_B.

It can be observed that the density of a black hole corresponding to the initial TOV limit: $M_S^0 = 0.7\ M_\odot$, by the known Equation:

$$\rho_{bh} = 3c^6/32\pi G^3M^2 = 1.85\times10^{19}/M^2\ ,\ (M \text{ in } M_\odot) \quad (2)$$

is: $\rho_{bh}^0 = 3.775\times10^{19}$ kg/m^3 and may be explained in CGT as corresponding to a black hole that resulted by the conversion of a cold t-quark star with current top quarks formed as compact clusters of z^0 –preons with inflated volume of their kerneloid, to a mean apparent value: $\upsilon_z^a = m_t/(\rho_{bh}^0 n_z) = 0.8\times10^{-3}$fm^3, (instead of 0.34×10^{-3}fm^3 –for the cold kerneloid of z^0-preon), that corresponds- in spherical model, to a radius: $r_z^s = 0.058$fm, and in a prismatic (cold) form- to an inflated kerneloid's volume: $\upsilon_z^i = \pi(3r_{ie})^2(12r_{ie})$ that corresponds to an apparently inflated volume of the quasielectrons' kerneloid, of radius:

$r_{ie} = 1.33\times10^{-2}$fm, given by "zeroth" vibrations of amplitude: $\delta r_{ie} = (r_{ie} - r_{ie}^0) = 0.33\times10^{-2}$ fm, vibrations whose existence is considered also by the Quantum Mechanics.

So, the CGT's model of quarks can explain microphysically also the initially calculated value of the Tolman–Oppenheimer–Volkoff mass limit of the neutron stars.[11,12]

The CGT's explanation of the transition density interval at a quark star

For a composite current quark Q , its dilated volume $\upsilon_Q(T_q)$ results as sum of apparent volumes $\upsilon_q(T_z)$ of its lighter quarks q, and it depends on the current quark's mass m_q and on its intrinsic temperature $T_i^q = T_z$ given by the vibrations of the kerneloids k_z of their z_0 –preons, conform to the dilation' law:

$$\upsilon_Q(T_q) = \upsilon_Q^0(1 + \alpha_Q\Delta T_q) \approx N_q\upsilon_q^0(1 + \alpha_q\Delta T_z) \quad (3)$$

from Eq.(3) resulting that: $\alpha_Q = \alpha_q(\Delta T_z/\Delta T_q) \approx \Delta\upsilon_q^a/\upsilon_q^0\Delta T_q$ with T_q –the temperature associated to the q-quarks' vibrations and T_z –the temperature associated to the z^0-preons' vibrations.

Because in CGT the volume υ_{qN} of a possible composite current quark: $q_N = (u\ \bar{u}d)$ is approximately equal to the volume of a protonic kernel υ_p , we can approximate the value of the quark kerneloid's radius $r_k^z(T_q)$ at an intrinsic temperature $T_Q^j \approx T_n^j$ corresponding to that of a vibrated nucleon with the energy $E_n^j \approx 1$MeV by extrapolating the case of the nucleon's impenetrable volume $\upsilon_n(r_i^n)$ at nucleon's temperature: $T_n^j \approx 1$MeV/k_B, considered spherical and filled with dilated kerneloids of z^0-preons of its dilated q-quarks, to the case of a composite current quark (tri-quark) at ordinary temperature $T_Q^j \approx T_n^j$, whose kerneloid's mass is: $m_q^n > 3m_q^{n-1}$ by photons acquiring and with the apparent volume υ_z^a approximated by a relation similar to that specific to a nuclear volume:[19]

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$$\upsilon_k^n \approx \upsilon_z^{a\cdot} \cdot N_z^n ; \Rightarrow \upsilon_k^q \approx \upsilon_z^{a\cdot} \cdot N_z^q \quad (4)$$

$$\Rightarrow r_k^n \approx r_z^{a\cdot} \cdot N_z^{1/3}; \quad r_k^q \approx r_z^{a\cdot} \cdot N_z^{1/3};$$

(N_z –the number of particle's z^0-preons, having an apparent volume υ_z^a). A similar relation is also used- in some papers for the strangelet's radius.[26]

With: r_i^n = (0.44÷0.45) fm [23]; $N_z \approx 1836m_e/34m_e = 54$, (for proton), it results by Eq. (4) that:

r_z^a = 0.118 fm 0.12 fm, ($\upsilon_z^a = 0.723x10^{-47}$ m^3), at $T_n^j \approx$ 1MeV/k_B , the kerneloid of a protonic u/d-quark having -by Eq. (4), at ordinary nucleons' temperature T_n^j, an apparent radius: $r_q^a = (r_q^r + \delta_q) = 0.118x18^{1/3} \approx 0.31$ fm, (given by its real radius $r_q^r \approx 0.2$ fm and its vibration amplitude δ_q).

For the quarks obtained in CGT: u/d(312; 313 MeV); s-sark (504 MeV); v-vark (574 MeV); c-chark (1700 MeV); b-bark (5000 MeV); t-top(175 GeV), it results by Eq.(4) the next values of their kerneloid's volume: $\upsilon_{u/d}$(0.2fm) ≈ 0.0335 fm^3; $\upsilon_{s\bullet}$(0.486fm) ≈ 0.2 fm^3; υ_s(0.5fm) ≈ 0.212 fm^3; υ_v(0.574fm) ≈ 0.239 fm^3; υ_c(1.7fm) ≈ 0.696 fm^3; υ_v(5fm) ≈ 2.064 fm^3.

Also, in CGT was obtained a semi-empiric relation for the current quark's mass m_q function of the ratio between the mass $M_{S\bullet}$ of the constituent s$^\bullet$-quark of the Standard Model (486 MeV) and the mass M_q of the constituent q-quark, in the form:[19]

$$m_q = M_q - \Delta_q = M_q - A_q \cdot e^{k_q \cdot \left(1 - \frac{M_{S\bullet}^2}{M_q^2}\right)} \; MeV/c^2; \quad (5)$$

with $M_{s\bullet} = M_s^\bullet$(486MeV) – the constituent mass of s$^\bullet$ –quark.

The constants A_q, k_q, were obtained by taking: m_d = 7.5 MeV/c^2 for the d-quark having in CGT a constituent mass $M_d \approx$ 313 MeV/c^2 and $m_{S\bullet} \approx$

91 MeV/c^2 -obtained in CGT,[19] resulting:

$A_q = \Delta_{s\bullet} = 395$ MeV/c^2 ; $k_q = 0.182$ and the values:

($m_s^\bullet$ = 91; m_s' = 104; m_v' = 158; m_c' = 1233) MeV/c^2; m_b' = 4527 MeV/c^2, and m_t = 174.5 GeV/c^2, values which are close to that obtained by the S.M.:

($m_s^\bullet$ = 92; $m_c^\bullet$ = 1275 ; $m_b^\bullet$ = 4420) MeV/c^2 and

m_t = 173 GeV/c^2, currently accepted in S.M.[27]

With the previous values of the bare quarks' volumes, it results for their densities the values:

$\rho_k^s = 0.8x10^{18}$; $\rho_k^s = 0.87x10^{18}$; $\rho_k^v = 1.17x10^{18}$; $\rho_k^c = 3.15x10^{18}$; $\rho_k^b = 3.9x10^{18}$ [kg/m^3] and: $\rho_k^t \approx 4.2x10^{18}$ kg/m^3 , at $T_q \approx T_q^j$.

The obtained values for the mean density of current quarks at $T_q \approx T_q^j$, ($\rho_k^q = (0.8 \div 4.2)x10^{18}$ kg/m^3), can also be specific to the density of some quark stars having the same ordinary internal temperature T_q^j and formed inside a neutron star for which the necessary pressure for its forming is given by the gravitation force and the strong force, and they are in concordance with previous results, based on theoretical models for the density variation inside a neutron star, which concluded that the transition from neutron matter to quark matter begins at densities around (1.5 ÷ 4)x10^{18} kg/m^3.[10]

The previous result argues the naturalness of the CGT's model of quarks and indicates that the black holes having heavy mass and a mean density lower than 10^{19} kg/m^3, even if they can have the Hawking temperature at their surface, as preon stars they have inflated quarks and z^0-preons, at least in their core, where they have an intrinsic temperature

$T_z > 0$K.

A similitude between the quark of the Standard Model and the CGT's model

Supposing that at a critical temperature $T_c \to T_d$, (T_c –phase transformation temperature; T_d –the quarks deconfining temperature: ~ 2x10^{12} K –for nucleons) some paired kerneloids of paired quasi-electrons (‚gammons' –in CGT,[1,2]) are released and transferred from the quasicrystalline cluster of its kerneloid in the volume of its photonic shell, then their behavior will be relative similar to that of the polarised gluons in S.M. (whose mass has an experimentally determined limit: 1÷1.3 MeV/c^2 -approximately equal to that of an (e^-e^+)- pair),[28] with the difference that these, gammons' will interact by electric and magnetic interactions, (having the tendency to form clusters with 8 quasi-electrons at T →0K) but being maintained inside the constituent quark's volume by the force generated by the total vortical field of the current quark, (Eq. 1).

After partial deconfining of a current quark, its reconfining at T < T_c could generate a quasi-crystal or amorphous state- similar to the so-named ‚glasma' in the S.M.,[29] with the difference that this state is considered in S.M. as specific to a saturation state in high energy hadronic collisions and not to a low temperature quarcic state.

The case of a neutron star's cooling

It is well known that neutron stars, which are extremely hot when they are formed, (~10^{11} ÷ 10^{12} K), cool down thereafter to ~(10^7 ÷10^6)K through processes including thermal radiation, neutrino emission and the formation of a solid crust.[30] Comparing the cooling of a rotated neutron star with a cooling metal drop, it results that – because the star's crust is cooled faster than the star's interior, the formed solid crust (whose ground state corresponds microscopically to a body-centered cubic (bcc) crystal lattice and macroscopically- to an isotropic bcc poly-crystal with elastic properties, given and by 'nuclear pastas')[31] is contracted conform to Eq. (3) by the aid of the strong forces, given –in CGT by a vortical field which generates an attraction force of the form (1), these forces $F_v(y) = -\nabla V_\Gamma(y)$, generating a superficial tension σ_q which –by the aid of the gravitation force $F_g(R)$ equalizes the internal pressure P_i:

$$\Delta P \cdot dV(R') = \sigma_q \cdot \mathcal{S}(R'); \;\Rightarrow\; \Delta P = P_i - G\frac{M(R')}{R'^2}\rho_c(R')\cdot\delta R = \frac{2\sigma_q}{R}; \quad (6)$$

$$(\sigma_q = \frac{F_n(y)}{2l_y}; \; R = R - \frac{\delta R}{2})$$

(ρ_c, δR – the solid crust's density and thickness; M, R – the neutron star's mass and radius).

It results that for the same star' mass M, P_i decreases with R but increases with ρ_c , δR and σ_q.

This analogy is concordant with the known fact that if the conversion of neutron-degenerate matter to quark matter is total, the formed quark star can be imagined as a single gigantic hadron bound by gravity, rather than by the strong force that binds ordinary hadrons. The recent discovery[32] of a possible quark star having a radius of about 10.4 kilometers, a surface temperature of approximately 2x10^6 °C and a mass equal to only 0.77M$_\odot$, (almost 1.5 times less than the theoretical limit for neutron stars), corresponding to a mean density: $\rho_m = 3.27x10^{17}$ kg/m^3, is in concordance with the conclusion that a such star can have a neutronic inner crust ($\rho_s \approx 2.8x10^{17}$ kg/m^3) and a nucleus formed by current u/d-quarks.

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By this supposition, taking for a single layer of nucleonic quarks: $\sigma_q \approx 9$ MeV/fm^2 at 0K –considered in some papers for strangelets,[33] for $n = \delta R/2r_q$ layers of nucleonic quarks (r_q –the u/d- quark's radius), with $M(R') = 0.77M_{\odot}$; $R' = 10.4$ Km, ($\rho_m = 3.27\text{x}10^{17}$ kg/m^3), Eq. (6) can be written in the form:

$$\Delta P = P_i - G\frac{M(R')}{R'^2}\rho_c(R')\cdot n\cdot d_q = \frac{2n\sigma_q}{R'}; \qquad (d_q = 2r_q \approx 0.4\text{fm})$$
$$P_i = \frac{\rho_m}{m_q}k_B T_i; \quad \left(\frac{\rho_m}{m_q} = \frac{1}{\upsilon_q^a};\ \sigma_q \approx 9MeV/fm^2;\ R' = R - \frac{\delta R}{2} = R - n\cdot r_q\right) \tag{7}$$

The volume υ_q of an internal current u/d-quark at temperature $T_i \approx 2\text{x}10^6$ °K can be approximated by Eq. (3) with the values: $\upsilon_q^0 = N_z\upsilon_z^0 \approx \pi r_q^2 l_q^0 = 0.91\text{x}10^{-47}$ m^3 and α_q^a obtained in CGT,[19] knowing that –at $T_q^j = (m_d/M_n)T_n^j \approx 9.27\text{x}10^7$ K, ($m_d = 7.5$ MeV/c^2; N_z –the number of q-quark's z^0-preons;

$M = 938$ MeV/c^2; $T_n^j \approx 1\text{MeV}/k_B = 1.16\text{x}10^{10}$ K), we have: $r_q^r(T_q^j) \approx 0.2$ fm (the dilated real radius) and an apparent radius: $r_q^a(T_q^j) = (r_q^r + \delta_q) \approx 0.31$ fm, corresponding to an apparent volume:

$\upsilon_j^a(r_q^a) = 0.1247$ fm$^3 \approx (1/3)\upsilon_n(r_i = 0.447\text{fm})$,

(Eq. (4)), resulting that:

$$\Delta\upsilon_q^a = \upsilon_q^0\alpha_q^a\Delta T_q; \Rightarrow \Delta\upsilon_1^a/\Delta\upsilon_j^a = T_{q1}/T_q^j; \tag{8}$$
$$(\Delta\upsilon_j^a = \upsilon_j^a - \upsilon_q^0)$$

which gives: $\Delta\upsilon_j^a = 0.1156\text{x}10^{-45}$ m^3; $\Delta\upsilon_1^a = (\upsilon_1^a(T_i) - \upsilon_q^0) = \Delta\upsilon_j^a(T_{q1}/T_q^j)$; $\Rightarrow \upsilon_1^a(T_i) = 0.0116\text{x}10^{-45}$ m^3;

$P_i = 86.25\text{x}10^{45}\text{x}1.38\text{x}10^{-23}\text{x}2\text{x}10^6 = 2.38\text{x}10^{30}$ N/m^2;

$r_q^a = 0.14$ fm; ($d_q^a = 0.28$ fm).

From Eq. (7), with $\rho_c(R') \approx m_d/\upsilon_1^a(T_i) \approx 1.15\text{x}10^{18}$ kg/m^3, by $d_q \approx d_q^a$, it results that:

$\Delta P = 2.38\text{x}10^{30} - 3.08\text{x}10^{14}\cdot n = n\text{x}2.77\text{x}10^{14}$, resulting that: $n = 4\text{x}10^{15}$; $\delta R = 1.12$ m.

Conclusion

The paper shows that the specific structure and the density levels of the fermionic elementary particles specific to the particle models of CGT: superdense centroid, kerneloid and photonic shell maintained by etherono-quantonic vortex/vortices of magnetic moment(s), can explain unitary and naturally not only physical phenomena such as: the connection between the photons' structure and the electronic neutrinos, the scattering centers experimentally evidenced inside the proton at electron-proton scattering at high and very high energies and inside the electron by X-rays, the Compton effect, the nuclear and strong interaction,[25] but also some astrophysical phenomena such as the initial TOV limit of neutron stars' mass and the transition density interval from neutron star to a quark star, in an unitary way, in a fractalic scenario of particles' forming from the etherono-quantonic energy considered in CGT. The mentioned explanations argue the CGT¨s scenario of particles' cold genesis in a cold Universe, having initially a primordial etherono-quantonic ¨dark¨ energy, which generated initially (pseudo)neutrins and light photons from chiral (vortical) quantum fluctuations and thereafter –electrons and heavier particles. This scenario responds partially to an older question: ¸how was the primordial hot Universe created from almost nothing, i.e. from a cold Universe ?¨.[34]

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