# ARE DARK MATTER AND DARK ENERGY OPPOSITE EFFECTS OF THE QUANTUM VACUUM?

Alfonso León Guillén Gómez

Independent scientific researcher, Bogotá, Colombia

E-mail: aguillen@gmx.net

## ABSTRACT

In the standard model of cosmology, λCDM, were introduced to explain the anomalies of the orbital velocities of galaxies in clusters highest according estimated by General Relativity the dark matter and the accelerated expansion of the universe the dark energy. The model λCDM is based in the equations of the General Relativity that of the total mass-energy of the universe assigns 4.9% to matter (including only baryonic matter), 26.8%, to dark matter and 68.3% to dark energy adjusted according observed in Planck mission, therefore, excluding bosonic matter (quantum vacuum). However, the composition of dark matter and dark energy are unknown. Due to that it lacks of a correct physical theory of gravity since General Relativity is only their powerful equations, which in their applications, their results are interpreted arbitrarily. Properties as curvature, viscous fluid, dragging frame and gravity action are attributed mistakenly to the spacetime by the materialist substantivalism, the most credible philosophical interpretation that complements the General Relativity, caused by its absence of physical definition of spacetime and static gravitational field as immaterial, but which violates, the conception of gravity as an effect of coordinates of the generalization of the inertial motion to the accelerated motion and, in particular, the description of the metric tensor of gravity as a geometric field. These properties are really of the quantum vacuum, the main existence form of the matter. In this paper we propose that the quantum vacuum is the source of dark matter and dark energy, therefore, the components of the quantum vacuum are of them. Both are opposite effects of the quantum vacuum that when gravitationally interacts with the cosmic structures, the vacuum it curves and when such interaction tends to cease by declination of the formation of these structures, occurring since near five milliard of years ago, vacuum it maintains quasi plane, since it interacts gravitationally very weakly with itself, accelerating expansion of the universe.

**KEYWORDS**: Relativity, dark matter, quantum vacuum

## 1. INTRODUCCION

As it is known, Quantum and Relativity theories dispute the physical conception on universe. Quantum theory based in quantum phase coherence (superfluidity), dynamical vacuum and complex scalar field existent in the vacuum, e.g. Higgs field (Quantum field theory) in the phase dynamics describes the universe as a superfluid [1] with its equations of motion. We have proposed a model on celestial mechanic in the solar system based in a quantum force of gravity that can be descript by Newton-Poisson equations and the parameters PPN α that measures the curvature of space of quantum vacuum produced by the mass of the rest of the solar system [2] and PPN λ, which measures the nonlinearity in the overlap of gravity called parametrized post-Newtonians equations [3], that is, these effects of curvature are not gravity that, therefore, even invalidating Relativistic Theory of Gravitation of Logunov since he considered curvature of spacetime, in the sense of Einstein, and virtual graviton causes of gravity [4] but external effects of the curvature of the space geometry of the vacuum (since according to author spacetime is the structural property of the dynamic matter) [5]. Due “Einstein´s theory of General Relativity describes gravity as the interaction of particles with spacetime geometry, as opposed to interacting with a physical fluid” [6] we abandon it and adopt Quantum theory. However, we recognize the great heuristic power of the Grossmann-Einstein equations that we consider they unify the effects of quantum gravity force and curvature of quantum vacuum describing as only the curvature of the spacetime [7] that according to the vision of the author based in the measurement of the deflection of photons of the electromagnetic wave traveling closed to the sun each contributes half. That is, both effects are by General Relativity interpreted mistakenly from the curvature of the spacetime. Newton in a note at the end of his treatise, Opticks, 1704, formulated that light particles should be affected by gravity in the same way as is ordinary matter; from the Newtonian mechanic, Henry Cavendish, 1784, and Johan Georg von Soldner, 1801 formulated deviation of light in the vicinity of the sun, such deflection by an angle of 0.875 arcseconds to the total by an angle of 1.75 arcseconds according Einstein, therefore, if it removes effect of gravity then from vision of the author it obtains the effect of curvature, since according the most recent observations as gamma rays in the GLAST project, the gravitational interaction between the photons and the vacuum is extremely weak, being quantitatively negligible, of course, no contributing to gravity. Too, we retain the equivalence between mass and energy [8] fundament of that energy gravitates.

Of other hand, we consider any material existence compound of fermionic matter as substance, bosonic matter as field of real bosons, that is, radiation and bosonic vacuum as field of virtual bosons and virtual gluons. Therefore, universe is matter, radiation and quantum vacuum. They are material forms of existence, by being objectives and, have physical reality, in last instance, they are the Matter. The quantum vacuum is filled with virtual particles, which are in a continuous state of fluctuation; these virtual particles are created in quantum vacuum fluctuations, which are the temporary change in the amount of energy in a point in space, as explained by Heisenberg uncertainty: $\Delta E.\Delta T \geq \hbar/4\pi$. According to the vision of the author, quantum vacuum satisfies the functions that were attributed to the aether without the inconvenient of its mechanical fermionic structure, because the quantum vacuum is a bosonic medium, elastic, gifted of inertia, subject to the superposition principle of Bose-Einstein, and viscous fluid nature that in the Gravity Probe-B, NASA [9], [10], [11] attributes mistakenly to the spacetime from the perspective of Einstein.

In 1981, the authors of the theory of Quantum Origin of the Universe Structure: Viatcheslav Mukhanov and Gennady Chibisov published their theoretical discovery that in the present the structure of the Universe in the scale ≤ $10^{-27}$ cm are quantum fluctuations, that produced originally the spectrum of inhomogeneities, as the galaxies and their clusters, in the early Universe [12]. The numerous experiments, during the era of the high precision cosmology, characterized by the use of the satellites COBE, in 1992, WMAP, in 2003, and completed by mission Planck, in 2013, in which there were measured the temperature fluctuations of the Cosmic Microwave Background Radiation, CMB, experimentally discovered by Penzias and Wilson in 1965, are in highly agree with their predictions confirmed definitely that assures us that everything in our Universe was originated from quantum fluctuations. CMB measurements have robustly proved quantum origin of the Universe structure irrespective of any alternative theories to inflation [13].

Since the perspective of the author, especially remarkable of the work of Mukhanov and Chibisov is their correct understanding on the great division of the physical existence: in the bosonic matter (quantum vacuum and radiation) and the fermionic matter (the rest) fixing the quantitative limit between both and deducing the existence of the second from the first, i.e., without quantum vacuum no would exist fermionic matter.

Inside of previous context the dark energy and dark matter are necessarily aspects of the quantum vacuum. Although, we consider the universe as a superfluid, we defer of the dark energy as energy density of the superfluid, and dark matter as fluctuations of the superfluid of Kerson Huang [1] because we believe are opposite effects of the dynamical vacuum as a fluid under the action of their two opposite gravity and pressure forces. When pressure is negligible the effects of dark matter occur and when gravity is negligible the effects of dark energy are produced. This is the thesis that it presents in this work.

With such objective, as Matter cosmologically is considered a fluid, we describe it through of the relativistic equation of fluid perfect, i.e, when there is no dissipative current in it, building a very simple cosmological model through equation (1) using variables (ρ, p, u), representing respectively: energy/mass rest density, pressure and velocity vector field of a matter flow, the constant c of the electromagnetic wave speed in vacuum, the metric tensor $g_{\mu\nu}$ that describe the geometry of spacetime structural form of the dynamic Matter, i.e., in the sense of the author and the Matter tensor $T_{\mu\nu}$ according equation (2). Therefore:

$$T^{Matter}_{(\mu\nu)} = (\rho c^2 + p) u_\mu u_\nu + p g_{(\mu\nu)} \quad \text{(Eq. 1)}$$

$$T^{Matter}_{(\mu\nu)} = T^{vacuum}_{(\mu\nu)} + T^{(bosonic\ radiation)}_{(\mu\nu)} + T^{(fermionic\ matter)}_{(\mu\nu)} \quad \text{(Eq. 2)}$$

Too, we use the cosmological equation of state:

$$w = p/\rho \quad \text{(Eq. 3)}$$

In the current bibliography we find that on quantum vacuum our previous considerations coincide in general with the alternative theory of Vacuum dark fluid proposing that dark matter and dark energy are two different manifestations of the vacuum dark fluid. On galactic scales, the dark fluid behaves like dark matter, and at larger scales it behaves like the dark energy [14], [15], [16], [17], [18]. Our differences are: that vacuum fluid is feedbacked by the bosonic disintegration, of the fermionic matter, therefore energy of vacuum is not constant, although , according to the observations, its increase tends to 0; its gravitational interaction with itself is low, tending to 0, and causing that at larger scales, away of the galactic structures its geometry, it becomes flat Minkowskian, while when it is trapped its gravitational interaction with the galaxies is strong, causing, in the terms of its geometry, spheroidal curves.

## 2. QUANTUM VACUUM

Quantum vacuum is a medium that permeates totally the Universe, mainly the called outer space believed by the antiques as absolutely empty space giving as outcome the mistaken theory of the space existing itself fundament of the philosophical school of the substantivalism [19]; that is, the space apparently emptiness between stars, where the density is $10^{-24}$ g/cm$^3$, in the Universe $10^{-30}$ g/cm$^3$, and in apparent empty space regions with density of $10^{-33}$ g/cm$^3$ [20]. Too, in the microcosm, where in the atoms is mostly empty space, more than 99,999 percent. This means that Matter is mainly quantum vacuum.

In 1916, Walther Nernst based in the Quantum theory and Planck's law for the radiation from a black body, theoretical discovered that the vacuum is not empty i.e. devoid of matter and radiation but it is a medium that he believed filled with radiation, which contains a large amount of energy. Near 1925, with the developments in Quantum electrodynamics (QED), the energy density of the vacuum acquired credibility, since the electromagnetic field is treated as a collection of quantized harmonic oscillators, and contrary to a classical harmonic oscillator, which can be completely at rest and have zero energy, each quantized harmonic oscillator has non-vanishing zero-point energy [21]. Ernst Pauli pointed about the gravitational effects of such zero-point energy. In the equations of General Relativity, this vacuum energy is represented by the cosmological constant Λ, which implies an expanding Universe. In 1927, Lemaıtre constructed a non-static model of the universe with a cosmological constant. In 1930, Paul Dirac considered vacuum as an infinite sea of particles with negative energy. During that decade similar models to Lemaitre were referred to the so-called age problem, but more exact measurements of the Hubble constant annulated them.

In 1948, experimentally was confirmed in the Philips laboratories, the vacuum energy effect that Casimir theoretical discovered. The Casimir energy is a pure vacuum energy; real particles are not involved, only virtual particles [22]. The Casimir effect is a small attractive force which acts between two closed parallel uncharged conducting plates. It is due to quantum vacuum fluctuation of the electromagnetic field. All fields, in particular electromagnetic fields, have fluctuations. This effect proves that the vacuum is not really empty as Nernst discovered. It is filled with virtual particles, which are in a continuous state of fluctuation. Virtual particle-antiparticle pair are created from vacuum and annihilated back to vacuum during the uncertainty lapse explained by Heisenberg. Therefore, these virtual particles are created in quantum vacuum fluctuations, during the temporary change in the amount of energy in a point in space. Virtual photons are the dominant virtual particles, but other particles produced as well. As vacuum is as a superposition of many different states of electromagnetic field, the creation and subsequent absorption of a photon by the vacuum implies the vacuum fluctuates [23].

In 1967, Zel'dovich calculated the contribution of quantum fluctuations to the cosmological constant, without resolve why the zero-point energies of the fields do not build up a huge cosmological constant. So, he assumed that the zero-point energies, as well as higher order electromagnetic corrections to this, are effectively cancelled to zero. In 1968, Zel'dovich denoted that zero-point energies of particle cannot be ignored when gravitation is taken into account. In mid-1970s, Linde, Dreitlein and Veltman pointed out the connection between cosmology and spontaneous symmetry breaking mechanism invoked in the electroweak theory. In 1977, Bludman and Ruderman argued that the vacuum energy density was very large at the time of the symmetry breaking. Near 1980, with the advent of inflationary cosmology, it stimulated further interest in vacuum energy with cosmological effects.

In the late 1960s, Petrosian, Salpeter and Szekeres re-introduced the cosmological constant to explain some peculiar observations of quasars indicating a non-conventional expansion of the universe, but the later data about quasars annulated it [24].

The Standard Model particles includes an additional coupling of its constituent fields to Higgs fields which play a crucial role both in constructing the electroweak theory, and in generating the masses of the particles. The Higgs boson was experimentally confirmed by the CERN on 4 July 2012 that permeates totally the vacuum.

The energy estimated for the ground state (the vacuum state) of the Standard Model particles is in terms of individual vacuum contributions. The vacuum energy density receives contributions from any quantum fields which may exist [21]. Thus, according to general assumptions of Quantum physics and Quantum field theory, the vacuum in the universe is filled with a collection of quantum fields, in special with low-energy electromagnetic waves, random in phase and amplitude and propagating in all possible directions. Everywhere space exhibits zero-point fluctuations, even in regions devoid of matter and radiation. These zero-point fluctuations of the quantum fields, as well as other vacuum phenomena of quantum field theory, give rise to an enormous vacuum energy density that implies a huge cosmological constant not in terms of General Relativity but from the vision of the Quantum theory known as the problem of the cosmological constant yet without resolve [24], [25]. “Quantum field theory and General Relativity have really different attitudes towards the energy density of the vacuum. The reason is that quantum field theory only cares about energy differences. If you can only measure energy differences, you can't determine the energy density of the vacuum - it's just a matter of convention. As far as we know, you can only determine the energy density of the vacuum by experiments that involve General Relativity - namely, by measuring the curvature of spacetime” [26]. So, energy density in General Relativity is very close to zero that is almost inarguable while in Quantum file theory the most credible answer is not determined [26].

The vacuum state exists, inside the region of space, of lowest possible energy which can be reached giving the evolutionary boundary conditions of the physical system. But may correspond to a local minimum of energy, since exist two states of vacuum according its energy. One is the true vacuum, that is the lowest minimum in energy and the other is false vacuum that correspond to one of the other minima. When does it have absolute lowest minimum energy? Taking all the states? If exist two minima energy local vacuum states separated by a potential barrier, they can remain almost an unlimited time, since there is not flux between them, but if the transition from false vacuum, to the true vacuum is triggered then, there would be an explosion [27].

In 1981, Chibisov and Mukhanov “in the context of the Starobinsky model of eternal inflation of Universe, i.e, most of the volume of the universe at any given time is inflating, that the accelerated expansion can amplify the initial quantum perturbations of metric up to the values sufficient for explaining the large-scale structure of the Universe. A few years later, Mukhanov developed the general theory of inflationary perturbations of metric, valid for a broad class of inflationary models, including chaotic inflation. Since that time, his approach has become the standard method of investigation of inflationary perturbations. He begins with a reminder of the simple Newtonian approach to the theory of density perturbations in an expanding universe, then extends this investigation to the General Relativity, and finishes with the full quantum theory of production and subsequent evolution of inflationary perturbations of metric” [28], “adopting a perturbation of the curvature scalar as a physical variable” [12]. In 2008 Mukhanov said: “G. Chibisov and I were fortunate to discover that quantum fluctuations could be responsible for the large scale structure of the Universe, we hardly thought it would be possible one day to verify this prediction experimentally. We wrote a paper where we derived the spectrum of cosmological metric perturbations generated in a de Sitter stage of accelerated expansion (the word inflation had not been invented at this time) from quantum fluctuations. The spectrum came out to be logarithmically dependent on the scale. Our results were obtained for the first particular working model of inflation based on $R^2$−gravity, which is conformally equivalent to a model with a scalar field” [29], that is, with gravitons as in Relativistic Theory of Gravitation of Logunov [4].

Two independent groups: the High-Z Supernova Search Team formed by Brian Schmidt and the study headed by Adam Riess (1998) and the Supernova Cosmology Project led by Saul Perlmutter (1999) realized the experimental discovery of accelerating expansion of the universe that definitely pointing to the existence of the energy of the vacuum as a positive constant energy, equivalent a positive cosmological constant in General Relativity, or dark energy, force that is causing this acceleration.

In this work, we use the simplification of a perfect fluid by the viscous fluid of the quantum vacuum, therefore, we describe dynamic vacuum through of the relativistic equation of fluid perfect through equation (4) using variables (ρ, p, u), representing respectively: energy density of vacuum, pressure vacuum and velocity vector field of energy flow of vacuum, the constant c of the electromagnetic wave speed in vacuum and the metric tensor $g_{\mu\nu}$ that describe the geometry of spacetime of vacuum and the vacuum tensor $T^{vacuum}{}_{\mu\nu}$. In such case:

$$T_{\mu\nu}^{vacuum} = (\rho^{vacuum} c^2 + p^{vacuum}) u_{\mu}^{vacuum} u_{\nu}^{vacuum} + p^{vacuum} g_{\mu\nu}^{vacuum} \quad \text{(Eq. 4)}$$

## 3. DARK ENERGY

With new evidences it confirmed the accelerated expansion of the universe and the alternative explications has been discarded; "it was suggested that distant supernovae could appear fainter due to extinction by hypothetical gray dust rather than acceleration (Aguirre 1999; Drell, Loredo and Wasserman 2000). Over the intervening decade, the supernova evidence for acceleration has been strengthened by results from a series of supernova surveys. Observations with the Hubble Space Telescope have provided high-quality light curves (Knop et al. 2003) and have extended supernova measurements to redshift z  1.8, providing evidence for the expected earlier epoch of deceleration and disfavoring dust extinction as an alternative explanation to acceleration (Riess et al. 2001, 2004, 2007). Two large ground-based surveys, the Supernova Legacy Survey (Astieret al. 2006) and the ESSENCE (Equation of State: Supernovae Trace Cosmic Expansion) survey (Miknaitis et al. 2007), have been using 4-m telescopes to measure light curves for several hundred SNe Ia over the redshift range $z \sim 0.3 - 0.9$ with large programs of spectroscopic follow-up on 6- to 10-m telescopes. The quality and quantity of the distant supernova data are now vastly superior to what was available in 1998, and the evidence for acceleration is correspondingly more secure" [30].

To explain the accelerating expansion of the universe has been proposed the dark energy that would be highly homogeneous, lowly dense and interacting only with the gravity force [30]. Dark energy is formulated in two main forms:

- Constant energy density filling vacuum homogeneously i.e cosmological constant.
- Scalar field such as quintessence whose energy density would change extremely very slowly in time and space, filling the vacuum with minimum low inhomogeneity, very difficult of distinguish of cosmological constant.

In both cases such energy may be identified with energy of vacuum. Although, other alternatives exist we do not consider because they would violate the identity of dark energy with energy of vacuum.

Accelerating expansion of the universe it produces since the past 5 thousand million years; after universe passed the eras: radiation domain and baryonic matter domain; if acceleration begins after of inflation then the great cosmic structures never have had time to form. Current era is of dark energy domain, i.e. each era corresponds to domain of a form of the material existence. Of course, the current era is of vacuum domain. As there is no compelling explanation for cosmic acceleration; we believe that with final of the domain of the formation of the great cosmic structures of the era of matter domain the contrary phenomenon of the "quantum fluctuations, that produced originally the spectrum of homogeneities, as the galaxies and their clusters" [4] currently it occurs, therefore, these structures could are contributing in a very low magnitude to vacuum, that is, the matter could be submitted to two tendencies: quantum fluctuations of the vacuum that produce matter and pass of matter to virtual bosonic fields, increasing softly energy of vacuum. The Matter could be ruled by the contrary tendencies: bosonic fields pass to matter and matter passes to bosonic fields like real (radiation) and virtual (vacuum) bosonic fields. Thus, we prefer dark matter as quintessence in the sense of dynamic field but with extreme high restriction being really dynamic vacuum.

Being vacuum dark fluid the most credible source of dark energy because "the vacuum has a pressure equal to minus its energy density, $p_{VACUUM} = -\rho_{VACUUM}$. This also means that the energy of vacuum is mathematically equivalent to a cosmological constant" [30] , [31], with $w = -1$, including the referred cosmological constant problem.

In orthodox quintessence models of dark energy, the accelerated expansion is caused by the ratio of the kinetic and potential energy of a scalar field, varying w between−1 and 1, that lead to new fundamental force without yet experimental evidence. "Some scientists think that the best evidence for quintessence would come from violations of Einstein's equivalence principle and variation of the fundamental constants in space or time" [30], however, the recent updated observations put very severe limit to the variations in the universe of dark energy being very similar in the time and space favoring strongly cosmological constant. But, vacuum as source of fermionic matter necessarily must feedback of its disintegration returning to its origin. In these changes between vacuum and fermionic matter the energy of the vacuum must change according the observations very softly due to the very large magnitude of the vacuum.

If we considered vacuum very distant of the gravitational influence of the great cosmic structures then we find vacuum as dark energy from equations (5, 6 and 7), using variables ($\rho$, p, u), representing respectively: energy rest density of vacuum, pressure vacuum and velocity vector field of energy vacuum flow, cosmological constant $\Lambda$, the metric tensor of Minkowski $\eta_{\alpha\beta}$ that describe the geometry of flat spacetime of vacuum since we supposed 0 gravity and the vacuum tensor $T_{\mu\nu}$.:

Energy of dynamic complex scalar vacuum =

$$\rho_{\Lambda} + \rho_{\text{bosonic disintegration matter}} - \rho_{\text{lost by quantum fluctuations that produces matter}} \quad \text{(Eq. 5)}$$

Energy of dynamic complex scalar vacuum according observations $\approx \Lambda \rightarrow \rho \approx 0$ (Eq. 6)

$$w = -1 \rightarrow -p \quad \text{(Eq. 7)}$$

$$T_{\alpha\beta}^{vacuum} = -p^{vacuum} u_{\alpha}^{vacuum} u_{\beta}^{vacuum} - p^{vacuum} \eta_{\alpha\beta}^{vacuum} \quad \text{(Eq. 8)}$$

Thus vacuum accelerated expansion of the universe.

## 4. DARK MATTER

The method used in cosmology to determine the mass of stars and the great cosmic structures as a galaxy, or a cluster of galaxies is measuring how its gravity determines the motion of other stars or cosmic structures around it, using Newton's form of Kepler's third Law rewritten as: $m = v * r^2 / G$, variables (m, v, r), represent respectively: mass enclosed by orbit, orbital velocity and average orbital separation and the gravitational constant G. In 1922, Jacobus Kapteyn, in 1932, Fellow Dutchman and Jan Oort and finally, in 1933, Fritz Zwicky discovered that the motion of galaxies externs gyrate more rapidly for their gravity to maintain them in a group, in last case, of more of 1000, of the Coma cluster, being necessary 100 times more hide mass to explain such speed of those galaxies [32]. But, It took 38 more years until near 1970 it was accepted this discovery when Vera Rubin and Kent Ford showed, measuring the Doppler shift of clouds of hydrogen gas, in several distances, around the center of their galaxies to require far more mass than by its optical detectable matter. Depending on the gravity, the hydrogen gas clouds or galaxies closer to the center they would have a greater speed than the external, since the gravity diminishes in inverse proportion to the square of the distance. However, the observations give a result different since the speeds are higher than the expected. The discrepancy between the amount of visible matter and the strength of gravity is most pronounced in some of the very smallest galaxies, known as dwarf spheroidals [32]. In summary, the hide mass is obtained from motions of galaxies in clusters, hot gas in galaxy clusters and gravitational lensing z and it observes at the periphery of the galaxies, while no in their centers.

Oort explained as dark matter the possible hide matter; in its searches, after excluding all the particles of the Standard Model it has explored various possible sources that insufficient or don't emit radiation electromagnetic, interact gravitationally and they are detectable by gravitational lensing as black holes, all kind of Machos (massive compact objects hide out halo of a galaxy), like brown dwarf. But there weren't enough to account for the amount of dark matter needed [33]. Too, neutrinos that were discarded by their high speed since they would have prevented the clumping of the universe and thus the density fluctuation would have collapsed on large scales [33].

The particles of the dark matter would have the properties: strong gravitational interaction, uncharged since they doesn't respond to electromagnetic force, color force does not appear, massive, stable (13,7 billion years) [34], freely-slowly motion. There are various types of particles proposed as: weakly interacting massive particles –WIMPs-, axion and very heavy Planckian interacting massive particle [35]. Such particles have been proposed from theories searching unify General Relativity and Quantum theory like superstring theory. But, why do not dark matter compound starts? [33]. Why do large clumps of dark matter surrounding the galaxies? Of all the mass and energy in the universe, the 95.1% is considered dark matter and dark energy, therefore, its proportion with respect of baryonic matter would be 19.4 to 1, being 2.5:1 ratio of dark energy to dark matter and by each gram of baryonic matter there would be 5.68 grams of dark matter at least on cosmological scales [36].

Changing of scenery, in 1983, Mordehai Milgrom proposed that the anomaly of the higher speeds respect expected although with low accelerations, can be explained if gravity worked differently to the esteemed by the equations of Newton or Einstein; he proposed posteriorly the “modified Newtonian dynamics” -MOND-, which modifies second Newton´s law for that in its formulation as third Kepler´s law adjust it to the anomalous speeds observed but without that could explain totally the dynamics of galaxies within clusters in particular Bullet cluster [32]. Too, there are other alternatives related or derived of MOND for e.g.: Bekenstein, 2004, relativistic version adapted to test of General Relativity and significant gravitational lensing [37], Brownstein and Moffat, 2007 based in modified gravity, a covariant generalization of General Relativity with auxiliary (gravitational) fields, adjusted to include Bullet cluster [36].

A new experimental discovery realized in 2006 appoint to the existence of hide matter in form of energy of vacuum since it did not interact during crash of two galaxies. ”A clash of two galaxies of Bullet Cluster occurred. The components of the galaxy clusters were strong separated. The stars and galaxies passed each other without interaction. The homogeneously distributed gas clouds interacted significantly and created the bullet like image. The maxim of the gravitational potential is not on the maxima of the visible matter density. Therefore there has to be an additional contribution of hide matter. The lager amount of matter is at the position of the galaxies and not, as expected, with the more massive gas clouds. Before the clash, the hide matter was homogeneously distributed in the galaxies as well as in the gas clouds. But while the gas interacted due to the crash the hide matter not, neither with itself nor with others” [34]. Can be dark matter a form of energy of vacuum?

The theory of Vacuum dark fluid considers that “when the dark fluid is in the presence of the matter, it slows down and coagulates around it; this then attracts more dark fluid to coagulate around it, thus amplifying the force of gravity near it. This effect is always present but only becomes noticeable in the presence of a really large mass, like a galaxy.” [38]. Alexandre Arbey considers vacuum dark fluid based on a complex scalar field with a conserved charge and associated to a specific potential. He shows that this scalar field can play the role of dark matter at galactic scale under the assumptions: a galaxy evolves in a space represented by a static and isotropic metric, a spherical symmetry for the system and the scalar field has an internal uniform rotation. Then at the Newtonian limit the scalar field contributes to the mass of the galaxy by adding an effective density fading away the effective pressure and the scalar field behaves like pressureless matter [15].

Of other hand, the author considers that the geometry of the vacuum dark fluid, trapped by structures of the fermionic matter under its gravitational action, it curves. In the scale of our solar system the maxim curvature exists closed to the Sun causing the deflection of the electromagnetic wave by an angle of 0.875 arcseconds that it can assume like the curvature of the vacuum at such position. In the scale of galaxies and cluster the curvature of vacuum, it should close spheroidally, due to the great gravitational force exerted from the gravity center of the galaxy or cluster in rotation, causing furthermore its rotation and concentration of its density peripherally by the action of the centrifugal force, producing the observed effect that dark matter it concentrates peripherally and of course annulling its pressure, unavoidable consequence of the closed curvature since the energy of vacuum lost its pressure and only gravity remains. Due to that the geometry of the vacuum, it curves spheroidally, exactly coinciding with the geometry of the dwarf spheroidals, it produces the maximum exploitation of energy of vacuum as dark matter, effect also observed. Therefore under this condition of the vacuum completely trapped by the fermionic matter the cosmological model that it should apply is of dust matter, thus "the gravitational field is produced entirely by the mass, momentum, and stress density of a perfect fluid which has positive mass density but vanishing pressure", therefore, fluid acts like only gravity [39] being we suppose:

$$T_{(\mu\nu)}^{(galaxy\, cluster)}=T_{(\mu\nu)}^{(fermionic\, matter\ of\ galaxy\, cluster)}+T_{(\mu\nu)}^{(vacuum\ trapped\ by\ galaxy\, cluster)} \qquad \text{(Eq. 9)}$$

$T_{(\mu\nu)}^{(galaxy\, cluster)}$ 3 dimensional spheroid immerse in a 4-dimensional Euclidean spacetime of the existent vacuum beyond galaxy cluster, that is, of the vacuum no trapped, therefore, with metric:

$$ds^2=e^{(\nu(r))}dt^2-e^{(\lambda(r))}dr^2-r^2 d\,\theta^2-r^2\sin^2\theta\, d\,\varphi^2 \qquad \text{(Eq. 10)}$$

$T_{(\mu\nu)}^{(galaxy\, cluster)}$, to Einstein clusters on pseudo spheroidal space-times, should satisfy Einstein-Florides´ field equations (13). Einstein cluster (dust matter) is a special type of anisotropic distribution of fluid for which the radial stress is zero (lacking of radial pressure that produces an ideal model), since is at rest, and non-vanishing tangential stress maintaining the equilibrium, i.e. counter gravitational collapse. Florides (1974) provides a scheme for construct solutions from Einstein's field equations for Einstein clusters [40] with metric:

$$R_{\mu}^{\nu}-\frac{1}{2}R\,\delta_{\mu}^{\nu}=-8\,\Pi\, T_{\mu}^{\nu} \qquad \text{(Eq. 11)}$$

From,

p=0 according to observations (Eq. 12)

and equations (9) and (11) we obtain:

$$T_{(\mu\nu)}^{(dust\ matter)}=T_{(\mu\nu)}^{(galaxy\, cluster)} \qquad \text{(Eq. 13)}$$

Like according to ρ:

$$T_{(\mu\nu)}^{(fermionic\ matter\, of\ galaxy\, cluster)}=\rho^{(fermionic\, matter\ of\ galaxy\, cluster)}c^2 u_{\mu}u_{\nu} \qquad \text{(Eq. 14)}$$

$$T_{(\mu\nu)}^{(vacuum\ trapped\ by\ galaxy\, cluster)}=\rho^{(vacuum\ traped\ by\ galaxy\, cluster)}c^2 u_{\mu}u_{\nu} \qquad \text{(Eq. 15)}$$

Therefore:

$$T_{(\mu\nu)}^{(dust\ matter)}=\rho^{(fermionic\ matter\, of\ galaxy\, cluster)}c^2 u_{\mu}u_{\nu}+\rho^{(vacuum\ traped\ by\ galaxy\, cluster)}c^2 u_{\mu}u_{\nu} \qquad \text{(Eq. 16)}$$

Thus vacuum dark fluid acts like dark matter.

## 6. CONCLUSIONS

Dark matter and dark energy, it can explain from energy of the vacuum under the thinking that vacuum is a dark fluid, subject to the two opposite tendencies of the forces of gravity and pressure, present in its typical configuration of perfect fluid. Since, the dark vacuum as matter it gravitates and the dark vacuum as energy it presses. That is, as matter the vacuum attracts and as energy the vacuum repels. Thus, under external influences can arise, from dark vacuum, two extreme states:

- When the dark vacuum is trapped inside great cosmic structures of dominion of the matter like galaxy cluster, it vanish the pressure and, therefore, dark vacuum it manifests only as a quantum force of gravity.

- When the dark vacuum is free of the dominion of the matter due to that its gravity self it tending to 0, dark vacuum it manifest only as a force of pressure.

The existence of these two states of the vacuum dark fluid are supported in the astronomic register of the anomalies of the orbital velocities of peripheral galaxies in the galaxy clusters highest according is estimated by equations of the celestial mechanic, that driving to dark matter and the accelerated expansion of the universe that driving to dark energy.

As theoretical discoveries, two special proposals the author makes:

- The two most general opposite tendencies that rule the dynamic Matter are the energy of the vacuum is feedbacked from the disintegration of the fermionic matter in bosonic matter and the fluctuations of the quantum vacuum generates the fermionic matter.

- The presence or absence of fermionic matter generates the two opposite geometric states of the configuration of the vacuum. The geometry of the spacetime of the vacuum, it curves under the action of the fermionic matter, causing on spheroids, null pressure and the Euclidean spacetime of the vacuum free of fermionic matter produces null gravity.

## REFERENCES


[1] Huang, Kerson. (2013). *Dark energy and dark matter in a superfluid universe: Physics Department, MIT, Cambridge, USA, Institute of Advanced Studies, NTU, Singapore, Talk given at Dyson 90th birthday symposium, 26-29 AUG, NTU, Singapore*

[2] Guillen, Alfonso. (2006 ). *Gravity is a quantum force: Philpapers*

[3] Guillen, Alfonso. (1996). *La gravedad: Researchgate*

[4] Logunov, A. and Mestvirishvili, M. (1989). *The Relativistic Theory of Gravitation. Moscow*

[5] Guillen, Alfonso. (2010). *Spacetime structural property of matter in movement: Petrov`s Symposium Contributed papers. Kazan University pp 101-109.*

[6] Afshordi, Niayesh. (2010). *Reviving gravity´s aether in Einstein´s universe: University of Waterloo. Canada. Physics in Canada, vol 66, no 2, pp 107-110*

[7] Guillen, Alfonso. (2015). *Einstein's gravitation is Einstein-Grossmann's equations: Journal of Advances in Physics, Vol. 11, No. 3, pp. 3099-3110*

[8] Guillen, Alfonso. (2004). *La inercia de la energía y la velocidad de la gravedad: Researchgate*

[9] Turishev, V. G. (2011). *Gravity Probe-B History, Mission Performance and Current Status: Jetpropulsion Laboratory, California Institute of Technology, USA*

[10] Worden, P. (2012). *Gravity Probe B and other Fundamental Physics Experiments In Space: CERN*

[11] Delplace, F. (2014). *Liquid spacetime (aether) viscosity, a way to unify physics: GSJ*

[12] Chibisov, Gennady and Mukhanov, Viatcheslav. (1981). *Quantum fluctuations and a nonsingular Universe: P. N. Lebedev Physics Institute, Academy of sciences of the USSR, Pis'ma Zh. Eksp. Theor. Fiz. 33, No.10, pp 549-553*

[13] Mukhanov, Viatcheslav. (2015). *Quantum Universe: Conference, MG14, Rome*

[14] Arbey, Alexandre. (2005). *Is it possible to consider dark energy and dark matter as a same and unique dark fluid?: arXiv:astro-ph/0506732v1*

[15] Arbey, Alexandre. (2006). *Dark Fluid: a complex scalar field to unify dark energy and dark matter: arxiv.org/abs/astro-ph/0601274*

[16] Zong-Kuan, Guo and Yuan-Zhong, Zhang. (2005). *Cosmology with a Variable Chaplygin Gas: arXiv.org > astro-ph > arXiv:astro-ph/0506091*

[17] Anaelle, Halle; HongSheng, Zhao and Baojiu, Li. (2008). *Perturbations in a non-uniform dark energy fluid: equations reveal effects of modified gravity and dark matter: arXiv.org > astro-ph > arXiv:0711.0958*

[18] Dymnikova, Irina and Galaktionov, Evgeny. (2006). *Vacuum dark fluid: Editor: N. Glover*

[19] Guillen, Alfonso. (2014). *Is gravity, the curvature of spacetime or a quantum phenomenon?: Journal: Journal of Advances in Physics, Vol 4, No. 1, pp. 194-203*

[20] Marquardt, N. (1999). *Introduction to the principles of vacuum physics: CERN-99-05*

[21] DeWitt, B. (1967). *Quantum theory of gravity. I. The canonical theory:Phys. Rev. 160, 1113–1148*

[22] DeWitt, B. (1996). *The Casimir Effect in Field Theory:A. Sarlemijn and M. J. Sparnaay, 247–272*

[23] Nguyen, T. (2003). *Casimir Effect and Vacuum Fluctuation:Spring*

[24] Rugh, S. E and Zinkernagely, H. (2000). *The Quantum Vacuum and the Cosmological Constant Problem:arXiv*

[25] Oldershaw, R. (2009). *Towards A Resolution Of The Vacuum Energy Density Crisis:arxiv.org*

[26] Baez, John. (1999). *What's the Energy Density of the Vacuum?*

[27] Rafelski, J and Muller, B. (1985). *The structured vacuum: Deutsch Publisher*

[28] Mukhanov, V. (2005).*Physical foundations of cosmology: Ludwig-Maximilians-Universitat Munchen, Cambridge university press, USA*

[29] Mukhanov, V. (2008). *CMB, Quantum Fluctuations and the Predictive Power of Inflation, Munchen, Germany*

[30] Frieman, Joshua; Turner, Michael and Huterer, Dragan. (2008). *Dark Energy and the Accelerating Universe: Annu. Rev. Astron, Astrophys46, pp. 385–432*

[31] Saha, Bijan. ( 2008). *Anisotropic cosmological models with a perfect fluid and a Λ term: Russia*

[32] Hooper, Dan. (2011). *Dark matter: The evidence: DOI: 10.1016/s0262-4079(11)60277-7*

[33] Clowe, Douglas; Brada, Marusa; Gonzalez , Anthony; Markevitch, Maxim; Randall, Scott W; Jones, Christine and Zaritsky, Dennis. (2006). *A direct empirical proof of the existence of dark matter: ApJ Letters in press*

[34] Gotz, Marlene. (2013). *Dark matter. Proceedings Astronomy from 4 perspectives 1. Cosmology. Heidelberg. Germany.*

[35] Savage, Neil. (2016). *The dark universe: 4 big questions: Nature 537, S206*

[36] Brownstein, J. R. and Moffat, J. W. (2007). *The Bullet Cluster 1E0657-558 evidence shows Modified Gravity in the absence of Dark Matter: arXiv:astro-ph/0702146*

[37] Bekenstein, Jacob. (2004). *Relativistic gravitation theory for the MOND paradigm: arXiv:astro-ph/0403694*

[38] Betts, Patrick (Editor). (2016). *Astrophysics An A-Z Introduction: PediaPress, p. 141*

[39] Wikipedia (2016). Dust solution.

[40] Thomas V. O and Tikekar, Ramesh. (1998). *A study of some relativistic fields of gravitation:* Einstein clusters on pseudo spheroidal space-times: *Shodhganga,Thesis,Chapter 6*

http://shodhganga.inflibnet.ac.in:8080/jspui/handle/10603/75928