The Vacuum Energy Expanding The Universe

A. A. Melegy
Geological Sciences Dept., National Research Centre

Fatma Ali
Physical Dept, Al-Azhar University

Abstract-It Was Shown Recently That The Cosmological Constant Has The Same Effect As Energy Density Of The Vacuum, when The Energy Density Is Positive, the Negative Pressure will produce and caused Accelerated Expansion Of The Universe. This Article Show Zero Vacuum Energy Density For The Universe led to The Threshold For The Creation Of this Universe, Firstly :Starting From Experimental Results Of Dynamical Casmir Effect and simple calculation, to show the Momentum Of The Atom is changing when it moves With A Relativistic Velocity Through Vacuum, this change caused by Interact With A Fraction Force of The Particles Which Created From Vacuum, Secondly: from connected Between Vacuum Energy And Cosmology Constant will predict that the value of vacuum energy density not equal (ρ_λ^i) but it equal the effective value, which produce from dynamical component$(\rho_{\lambda(H)})$,and this important result To Show A Non-Singular creation For our Universe.

I.INTRODUCTION

Generally the universe certain theories proposed that between $10^{-34} to\ 10^{-10}$ second [1] after the big bang singularity the universe inflationary expansion which served to push in homogeneity out beyond our horizon.
(1) the universe was merely empty space or vacuum, and the material universe was born when the vacuum energy converted into mater via quantum mechanical phase transition (2) the beginning of our universe does not represent an absolute beginning (3) according such models it is impossible to specify when and where an actuation will occur in the primordial vacuum which will then grow into a universe within any finite interval time there is assertive probability of such fluctuation occurring at any point in space.

1.1. Energy from nothing

Any point in space that contains energy having mass to create particles so Virtual particles spontaneously flash into existence at every point in space due to the energy of quantum fluctuations caused by the uncertainty principle[1] ,spontaneous emission depends upon the zero point energy fluctuations of the electromagnetic field a photon is annihilated (absorbed), the photon can be thought of as making a transition into the vacuum state. Similarly, when a photon is created (emitted), it is occasionally useful to imagine that the photon has made a transition out of the vacuum state[2].

1.2. Something from nothing

Dynamical Casmir effect (DCE), refers to phenomena of real particles created from the quantum vacuum , The creation of particles in a one dimensional cavity and the conversion of vacuum fluctuations into real field with a moving perfect mirror was first studied by Moore [3], since the highest velocity that a mirror can achieve is very small in comparison with the speed of light [3, 7,8], One of these experimental proposals, based on SQUID (Superconducting Quantum Interference Device),led to the announcement by Wilson et al [4] this allow to a single moving mirror whose effective velocity can achieve approximately 10% of the speed of light [5].
A dynamical casimir effect studied by moor proposed that the rate of photon creation is enhanced when the velocity increase , but many question arise when connected between cosmology constant and vacuum energy density , to answer this question we present an original approach which predict that the vacuum density change in dynamic effect from observer to another , to show the density of vacuum energy for the universe led to the threshold for the creation of our universe
This paper is organized as follows: in Section 2 describe the intensity of the relativistic band (relativistic effect) relative to non-relativistic result in the spectrum of creating particles, in Section 3 mention the connection between vacuum energy and Cosmology Constant, in Section 4 using the calculations to show that the interaction with the vacuum change the mass of atoms, Section 5 contains the conclusions of our work.

II. CREATED PARTICLES VIA RELATIVISTIC DCE

The DCE for a one-dimensional model with a single mirror moving in a vacuum, with oscillatory motion with frequency ω0, small amplitude and non-relativistic velocities, was investigated by Lambrecht et al [14]

These authors concluded that the spectral distribution of the created photons has a parabolic shape , and no particle created with frequencies higher than ω0 [14].

In contrast, if the oscillatory motion has relativistic velocities, the same authors pointed out the presence of additional frequency bands in the spectrum of the created particles.

Recently , several authors [5],[3] have proposed a new calculations obtain that, the rate of photon creation 5.8×10^6/sec in the non-relativistic approximation ($\varepsilon^2 N_2(w)$), and the range of frequencies of the created particles is 6.2×10^6/sec with relativistic correction ($\varepsilon^2 N_2(w) + \varepsilon^4 N_2(w)$).

So the rate of photon creation is enhanced to (6% greater in relation to the non-relativistic result) [5]

the number created particles in vacuum per unit frequency is given by ;

$$N(w) = <0_{in} \vdots a_{out}^+(w) a_{out}(w) \vdots 0_{out}> \cong \sum \int_{-\infty}^{\infty} \frac{e^{j+k}\theta(\varepsilon)}{i\varepsilon(1+\varepsilon^2\delta^2)} g^i(w,\varepsilon) g^k(w,\varepsilon) \quad (1)$$

$$N(w) = \varepsilon^2 N_2(w) + \varepsilon^4 N_2(w) \quad (2)$$

spectrum of created particles via dynamical Casimir effect for non relativistic and relativistic band the spectrum found in Ref [5].
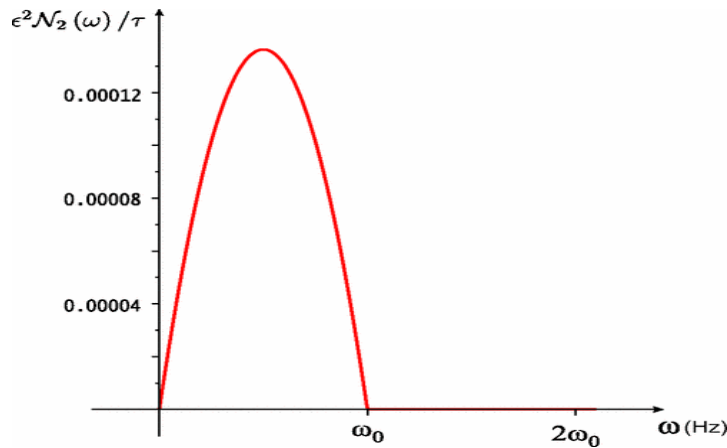

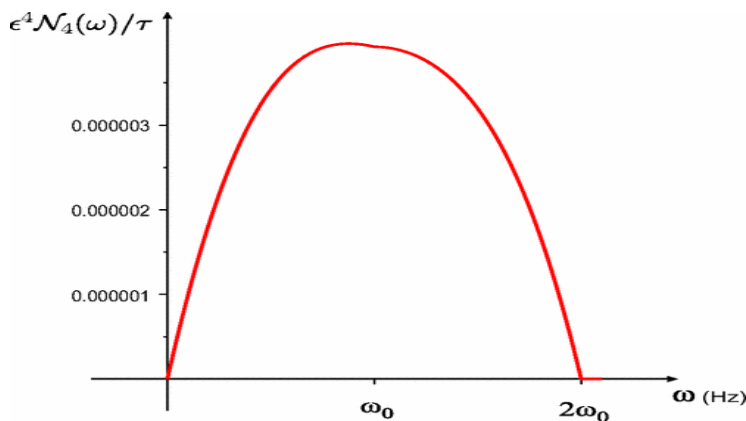Fig. 1. (Non-Relativistic) Parabolic Band.

Fig.2 Relativistic Correction

III. INTERACTION WITH THE VACUUM

Atoms moving and interacting with electromagnetic field of vacuum and feel a force according to $\frac{dp}{dt} = f$, this force depend n the velocity of this atom[7] , the interaction between atom and filed [8-10] equation is given by :

$$H_{AF} = -d.E - \frac{1}{2M}[P.(B \times d) + (B \times d).p] \quad (3)$$

Where, d electric dipole operator , E, B electric and magnetic fields

And Hamiltonian $\quad$ H=$H_0 + H_{AF}$ $\quad$ (4)

$$H_0 = \frac{\dot{P}^2}{2M} + \hbar w_A + \sum \hbar W_K a^+ a \quad (5)$$

The electric filed strength per photon is given by

$$\varepsilon_k = \sqrt{\frac{\hbar w_k}{2\epsilon_0 V}} \quad (6)$$

Einstein's special relativity

In general change in momentum (P=MV) is produce from change of mass and velocity and when we take into account special theory of relativity[15] momentum will became (p = γ m v) and the first order v\c for the binding energy

$$E_{BIN} = [M - (m_1 + m_2)]c^2$$

which tell us the total mass of atom is not the sum of it is consistent particles but there is a mass reduced in a binding energy.

The change of mass at rate of decay which is proposed by authors [6]

$$\dot{M} = -\Gamma \frac{\hbar w_A}{C^2} \quad (7)$$

$$p = -\Gamma \frac{\hbar w_A}{C^2} V_0 \quad (8)$$

The change in momentum depends on velocity, when we take the change of mass of an atom interacted with particles created from the vacuum, we can calculate the change of velocity of atom, particularly in relativistic velocity, when atom moves with relativistic velocity it will be interacting with a number of photons which created from vacuum which is what we expected from relativistic correction [5], so the frequency at initial photon w_0 and according to Doppler effect the frequency change and become

$$w^\backslash = w_0 \gamma \left(1 - \frac{v}{c}\right) \quad (9)$$

Where $\gamma = \left(\sqrt{1 - \frac{v^2}{c^2}}\right)$,Then change in energy of energy and momentum are given by

$$E_F = \hbar W^\backslash + E_I = 2\hbar W_0 \gamma \quad (10)$$

P=$\hbar w_0 \gamma \frac{V}{C^2}$ $\quad$ (11)

And from equation (8)

$$\frac{d}{dt} < p(t) > \approx -\Gamma \frac{2\hbar^2 w_0 w_A v}{MC^2} \gamma \quad (12)$$

And The binding energy of decaying atom move with relativistic speed:

$$\hbar w_0 \gamma = E_{BIN} = [M - (m_1 + m_2)]c^2 \quad (13)$$

Here we obtain the change of mass result in the relative velocity of an atom due to increase in number and frequency of the photon created from the vacuum.

IV. THE CONNECTION BETWEEN VACUUM ENERGY AND COSMOLOGY CONSTANT

The cosmological constant is observed to be close to zero could suggest that there is no real vacuum energy of empty space, when The cosmological constant has the same effect as an intrinsic energy density of the vacuum, the leading proton contribution to the ZPE is overwhelmingly large as compared to any cosmic density

$$\rho_c^0 = \frac{3H_0^2}{8G\pi} = \frac{3}{8\pi} H_0^2 M_P^2 \sim 10^{-47} GEV \quad (14)$$

Where $H^0 \sim 10^{-42}$GEV . is the current value of the happily rat The plank mass

$$M_P = \frac{1}{\sqrt{G}} \sim 10^{-19}\ GEV$$

$$\rho_c \approx GM_P^6 = \frac{m_p^6}{M_P^2} \sim 10^{-38} GEV \quad (15)$$

Where m_e is the electron's mass, m_P is the proton mass and α the electromagnetic fine structure constant. In terms of vacuum energy density

And $\quad \lambda = \frac{1}{\hbar^4} G^2 \left(\frac{m_e^6}{\alpha^6} \right)$

where $\quad . \quad \alpha\ is\ electromagnatic\ filed\ stracture\ constant$ which determines the strength of the interactions

$$\rho_\lambda = \frac{1}{8\pi M_P^2} \left(\frac{m_e^6}{\alpha^6} \right) \sim 10^{-47}\ GEV$$

in attempted to clarify the origin of the understanding of the cosmological constant problem ,Zel'dovich notes that , relation $\Lambda \approx \frac{G^2 m_P^6}{\hbar}$ is approximately 7 orders of magnitude larger than the observational constraint [16]. But, Zel'dovich showed that numerical agreement could be obtained by replacing m_P^6 with $m_P^4 m_e^2$, or by choosing other powers and replacing hc with e2, this is essentially what Dirac and Eddington did. However, even a discrepancy of "only" 10^7 times is an accomplishment compared with the discrepancy of the estimates by a factor 10^{46} .

But a new proton mass measurement by Sven Sturm from the Max Planck Institute for Nuclear Physics, Germany, and colleagues is 3 times more precise than past observations [17], this value of the mass of the proton has affected the calculations of the actual value of the cosmic constant Λ,

So obviously it is the concept of vacuum is observer dependent , and it consider the main factor leads to the obvious difference between the vacuum energy density and cosmological constant , where observers with different notions of positive and negative frequency modes cannot agree on the vacuum state as we see DCE

So QFT prediction of the physical value of the vacuum energy density must be equal to the observational measured value $\rho_{vac} = \rho_\lambda^0 \cong 2.5 \times 10^{-47}\ Gev$, where The Cosmology Constant problem dynamically the value we measure is not ρ_λ^0 but the effective value $\rho_\lambda^{eff} = \rho_\lambda^i + \rho_{(H)}$

Where $\rho_{(H)} is\ the\ dynamical\ compensatin$, so the vacuum density change in dynamic effect from observer to another , this change can produce the relativistic motion and interaction with a particles in vacuum , and no vanishing of (Λ) lead to no vanishing of density of vacuum , so the density of Vacuum Energy For This Universe consider The Threshold For The Creation , and there a non singular origin of universe.

V. CONCLUSIONS

The mass of atom change proportional to the relativistic velocity of the atom through vacuum , due to the interaction with created particle from vacuum, this particles produce (friction) forces leading to a true change in internal mass energy of atom ,and showed that the vacuum energy density does not has only the effect as cosmology constant which caused expending of universe put it can become the source of matter for all universe , Finally, we would like to point out that creation is not quantum creation from nothing but there is the emergent creation from vacuum energy , and answer the follow question : What is the amount of energy that the universe needs to get all its particles out of the vacuum into the real universe ? , which will be the topic of a future work

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