We can't solve problems by using the same kind of thinking we used when we created them.

Albert Einstein

WORLD – UNIVERSE MODEL

COSMIC FAR-INFRARED BACKGROUND

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ABSTRACT

World – Universe Model is based on three primary assumptions:

1) The World is finite and is expanding inside the Universe with speed equal to the electrodynamic constant c. The Universe serves as an unlimited source of energy that continuously enters into the World from the boundary.

2) Medium of the World, consisting of protons, electrons, photons, neutrinos, and dark matter particles, is an active agent in all physical phenomena in the World.

3) Two fundamental parameters in various rational exponents define all macro and micro features of the World: Fine-structure constant α, and dimensionless quantity Q. While α is constant, Q increases with time, and is in fact a measure of the size and the age of the World.

In this paper, we introduce Cosmic Large Grains whose mass about equals to Planck mass, and their temperature is in the neighborhood of 29 K. These grains are Bose – Einstein condensates of cosmic dineutrinos, and are indeed responsible for the far-infrared background radiation.

1. INTRODUCTION

Cosmic infrared background (CIB) is a mysterious infrared light coming from outer space. It is slowly being resolved into specific sources by infrared telescopes. In some ways it is analogous to the cosmic microwave background, but at shorter wavelengths.

One of the most important questions about the CIB is the source of its energy. Dust in the host galaxies can absorb starlight and re-emit it in the infrared, contributing to the CIB. Although most of today's galaxies contain little dust (e. g. elliptical galaxies are practically dustless), there are some special stellar systems even in our vicinity which are extremely bright in the infrared and at the same time faint (often almost invisible) in the optical. These ultraluminous infrared galaxies are just in a very active star formation period [Wikipedia, Cosmic Infrared background].

The cosmic Far-Infrared Background (FIRB), which was announced in January 1998, is the part of the CIB with wavelengths near 100 microns that is the peak power wavelength of the black body radiation at 29 K.

In this work, we are going to introduce a new component of the Medium of the World – Bose-Einstein Condensate (BEC) drops of dineutrinos whose mass about equals to Planck mass, and their temperature is around 29 K. These drops are responsible for the FIRB.

The paper is organized as follows:

- In Section 2, we give an overview of the FIRB observations.
- In Section 3, we develop a model of large grains whose mass about equals to Planck mass, and calculate their temperature to be in the neighborhood of 29 K.
- In Section 4, we find the relation between the 29 K temperature of large grains and the 2.725 K temperature of the microwave background radiation.
- Section 5 discusses the key role of the Planck mass in the developed Model.
- Section 6 considers the mass varying quants: axions and dineutrinos.
- In Section 7, we calculate the energy density of dineutrinos and FIRB.
- In Section 8, we consider BEC of dineutrinos and calculate their mass and concentration in the Medium of the World.

2. OBSERVATIONS

The Infrared Astronomical Satellite (IRAS) was the first all-sky survey which used far-infrared wavelengths in 1983. Using IRAS, scientists were able to determine the luminosity of the galactic objects discovered. Over 250,000 infrared sources were observed during the 10 month mission.

M. G. Hauser *et al.* in the paper "IRAS Observations of the Diffuse Infrared Background" (1984) analyzed IRAS data and revealed bright emission from interplanetary dust at 100 micrometer, which is prominent only near the ecliptic plane. Diffuse galactic emission was found over the rest of the sky [1].

F. J. Low *et al.* in the paper "Infrared Cirrus: New Components of the Extended Infrared Emission" (1984) pointed out that the 100 micrometer cirrus may represent cold material in the outer solar system or a new component of the interstellar medium [2].

B. Wang in 1991 found that the integrated far-Infrared background (FIRB) from galaxies peaks at around 100 – 130 microns, with total radiation density from 0.5% to 6% of the cosmic microwave background radiation (MBR) [3].

E. L. Wright in 1999 made the recomputation of the FIRB (wavelength near 100 microns) and found its total intensity to be about 3.4% of the MBR intensity [4].

D. P. Finkbeiner and D. J. Schlegel have this to say about Interstellar Dust Emission as a Cosmic Microwave Background (CMB) Foreground: *The different sources of radiation in the night sky from the near-infrared through radio are shown in Figure 1. These are to be compared with the CMB at a temperature of 2.73 K, and the fluctuations in the CMB which have amplitude lower by* $\sim 10^{-5}$ *(dashed line). On the Wien tail of the CMB, thermal emission from Galactic dust is the main source of confusion. This emission is now well-understood, thanks to the COBE / FIRAS experiment (Fixsen et al. 1996 [5]). We can predict the thermal emission at all frequencies* $\nu \lesssim 3000\,GHz$ *to a precision of* $\sim$ *10% (Finkbeiner, Schlegel & Davis 1999 [6]).*

At frequencies below $\sim$ *100 GHz, there are more possible sources of confusion with the CMB. Galactic dust may be one such source if it is rotating supra-thermally, as has been proposed by Draine & Lazarian 1998 [7]. Other possible sources are synchrotron emission, free-free emission from ionized hydrogen, and radio emission from extragalactic sources* [8].

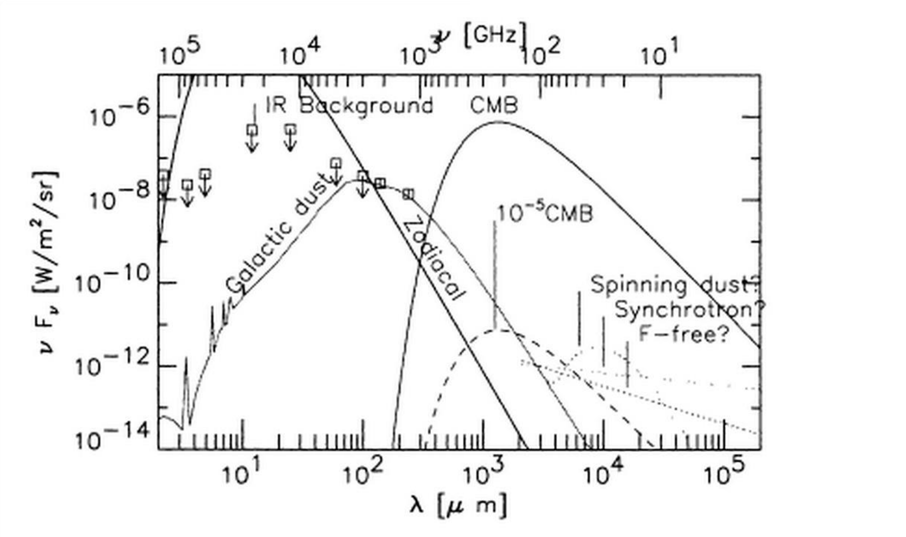

Figure 1. Contributions to the infrared/millimeter/radio sky above the Earth's atmosphere

In 1999, G. Lagache *et al.* described the Cosmic Far-Infrared Background (CFIRB) and announced that *"For the first time the far-IR emission of dust associated with the Warm Ionized Medium (WIM) is evidenced. The best representation of the WIM dust spectrum is obtained for a temperature of 29.1 K"* [9].

D. P. Finkbeiner *et al.* made analysis of the DIRBE weekly averaged sky maps and have detected substantial flux in the 60 and 100 micron channels in excess of expected zodiacal and Galactic emission. They concluded that *"there is currently no satisfactory explanation for the 60-100 micron excess"* [10].

P. H. Siegel has this to say about cosmic dust [11]: "*Results from the NASA Cosmic Background Explorer (COBE) Diffuse Infrared Background Experiment (DIRBE) and examination of the spectral energy distributions in observable galaxies, indicate that approximately one-half of the total luminosity and 98% of the photons emitted since the Big Bang fall into the submillimeter and far-IR. Much of this energy is being radiated by cool interstellar dust.*

Fig. 2 shows the radiated power versus wavelength for interstellar dust, light, and heavy molecules, a 30-K blackbody radiation curve, and the 2.7-K cosmic background signature. Besides the continuum, interstellar dust clouds likely emit some 40 000 individual spectral lines, only a few thousand of which have been resolved and many of these have not been identified".

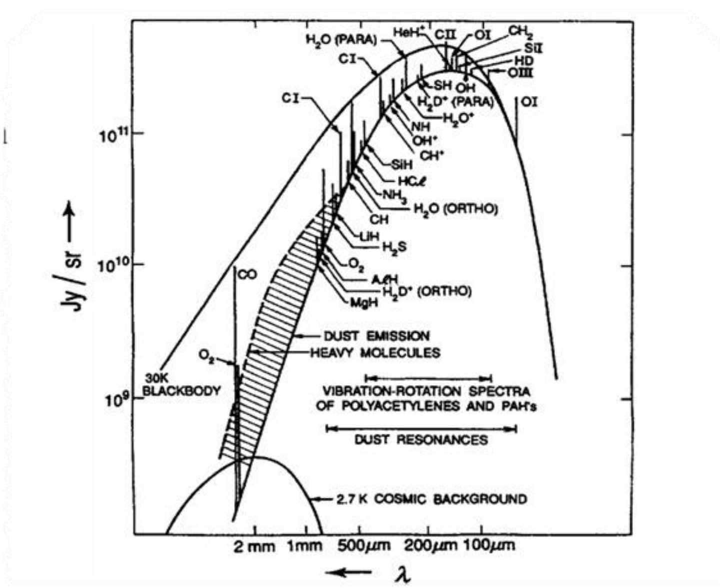

Figure 2. Radiated energy versus wavelength showing 30-K blackbody, typical interstellar dust, and key molecular line emissions in the submillimeter (reprinted from [12]).

X. Dupac *et al.* obtained the complete submillimeter spectrum of the nearby edge-on spiral galaxy NGC 891. Submillimeter maps of NGC 891 have been obtained with the PRONAOS balloon borne telescope and with the ISOPHOT instrument on board the ISO satellite. They also gather data from

IRAS and SCUBA. The modified blackbody fits, assuming a two dust component, lead to a warm component temperature of 29 K all along the galaxy with a cold component at 16 K [13].

Aguirre *et al.* (2003) observed Spectral Energy Distribution (SED) in the submm to mm wavelength of the Small Magellanic Cloud (SMC), the Large Magellanic Cloud (LMC) and 30-Doradus, and derived dust temperatures of (25.0 ± 1.8) K for the LMC (minus 30-Doradus), (26.2 ± 2.3) K for 30-Doradus alone, and (29.5 ± 2.7) K for the SMC. They determined the maximum large grains temperature as being 29 K [14].

Pope *et al.* (2006) have identified 35 secure 850 μm sources in the Great Observatories Origins Deep Survey Northern field (GOODS-N) submm super-map. They found that the best-fit submm SED peaks at ~ 100 μm (T ≃ 30 K) [15].

J. A. Marshall *et al.* presented a new multi-component SED decomposition method and use it to analyze the ultraviolet to millimeter wavelength SEDs of a sample of dusty infrared-luminous galaxies. Their decomposition of Mrk 463 includes contributions from 30K and 55K dust components, while a fit to NGC 6240 includes emission from dust at 29 K and 61 K [16].

M. J. Devlin *et al.* have this to say about a population of luminous, high-redshift, dusty starburst galaxies: *"In the redshift range 1 ≤ z ≤ 4, these massive submillimeter galaxies go through a phase characterized by optically obscured star formation at rates several hundred times that in the local Universe. Half of the starlight from this highly energetic process is absorbed and thermally reradiated by clouds of dust at temperatures near 30 K with spectral energy distributions peaking at 100 μm in the rest frame. Over half of the far-infrared background light comes from galaxies at z ≥ 1.2"* [17].

E. L. Chapin *et al.* presented a joint analysis of the overlapping BLAST 250, 350, 500 μm, and Large APEX Bolometer Camera 870 μm observations (from the LESS survey) of the Extended Chandra Deep Field South. They observed the SEDs for all 125 sources and for the 73 sources converted the observed temperatures from the modified blackbody fits to rest-frame temperatures, allowing probing the cold dust SEDs of the sample. The total distribution has a median T = 29 K and interquartile range 23–36 K [18].

T. Mackenzie *et al.* in the paper "A Pilot Study for the SCUBA-2 'All-Sky' Survey" observed the SED of galaxy NGC 2559 which has relatively warm dust with the temperature around 26–29 K (see Fig. 3) [19].

P. Serra *et al.* have this to say about the far-infrared component of the CIB radiation: "*FIRB is primarily due to dusty, star-forming galaxies (DSFGs). The dust absorbs the optical and ultraviolet stellar radiation and re-emits in the infrared and submillimeter (submm) wavelengths. The rest frame spectral energy distribution (SED) of DSFGs peaks near 100μm, and it moves into the FIR/submm regime as objects at increasing redshifts are observed. Thus, a complete understanding of the star formation history (SFH) in the Universe must involve accurate observations in the FIR/submm wavelength range*" [20].

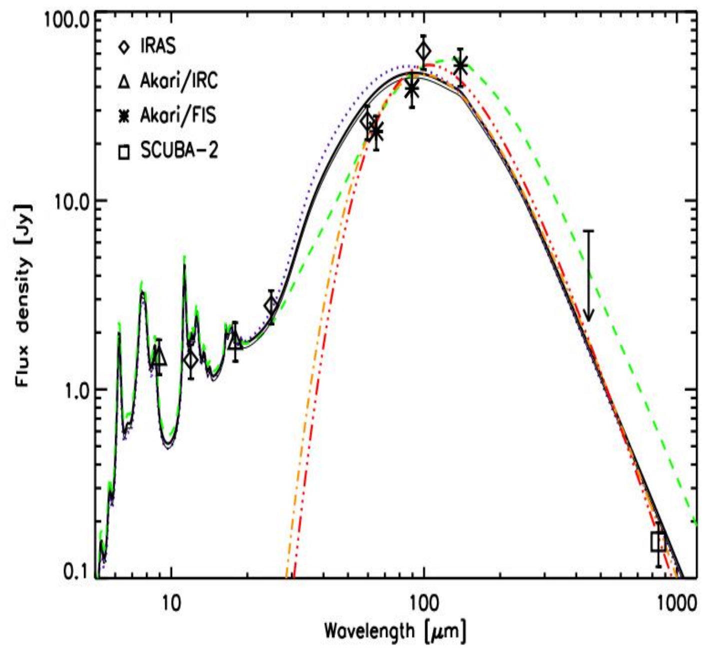

Figure 3. *The observed far-IR and submm SED of NGC 2559, together with dust model fits. An arrow marks the 3σ upper limit at 450 μm. The solid (black) line shows the best fit to all available data points. The dotted (blue) line is the best fit to the dataset excluding the Akari/FIS data. The thin solid (black) line is the best fit to the dataset excluding the IRAS data. The dashed (green) line is the best fit model without the SCUBA-2 points. The dot-dashed (orange) line is the modified blackbody fit with β = 2. The triple-dot-dashed (red) line is the modified blackbody fit with free β. Error bars include an uncorrelated 20 per cent uncertainty*. Figure adapted from [19].

To summarize:

- The FIRB is the part of the Cosmic Infrared Background with wavelengths near 100 microns that is the peak power wavelength of the black body radiation at 29 K;
- The total intensity of the FIRB is about 3% of the Microwave Background;
- There is currently no satisfactory explanation for the substantial 60-100 micron flux in excess of expected zodiacal and Galactic emission;
- FIRB represents relatively warm dust or a new component of the interstellar medium with the temperature around 29 K;
- Over half of the FIRB light comes from galaxies at z ≥ 1.2;
- There are some special ultraluminous infrared galaxies which are extremely bright in the infrared and at the same time faint (often almost invisible) in the optical spectrum.

3. MODEL

According to the World – Universe Model (WUM) [21], the size of large cosmic grains D_G is roughly equal to the Fermi length L_F :

$$D_G \sim L_F = a \times Q^{1/4} = 1.6532 \times 10^{-4}\, m \qquad 3.1$$

and their mass m_G is close to the Planck mass M_P :

$$m_G \sim (10^{-9} \Leftrightarrow 10^{-7})\, kg \qquad 3.2$$

The density of grains ρ_G is close to the rock density ρ_{rock} :

$$\rho_G \sim \rho_{rock} = \frac{6}{\pi}\frac{M_P}{L_F^3} = 9.2008 \times 10^3\, \frac{kg}{m^3} \qquad 3.3$$

WUM introduces a dimensionless time-varying quantity Q that represents, among other things, the Age of the World A_t [22]:

$$Q = \frac{c}{a} \times A_t = 0.76 \times 10^{40} \qquad 3.4$$

where c is the gravitoelectrodynamic constant, a is the radius of the World's Core at the Beginning (Q = 1), and a_0 is the classical electron radius:

$$a = 2\pi a_0 \; = 1.7705645 \times 10^{-14}\, m \qquad 3.5$$

According to WUM, Planck mass M_P equals to

$$M_P = 2m_0 \times Q^{1/2} \qquad 3.6$$

where m_0 is a basic unit of mass

$$m_0 = \frac{h}{ac} = 70.025267\, MeV/c^2 = 1.2483143 \times 10^{-28}\, kg \qquad 3.7$$

and h is Planck constant. Note that the value of M_P is increasing with time, and is proportional to $t^{1/2}$. Then,

$$\frac{d}{dt}M_P = \frac{M_P}{2t} \qquad 3.8$$

A grain of mass B_1M_P and radius B_2L_F is absorbing energy from the Medium of the World at the following rate:

$$\frac{d}{dt}(B_1M_Pc^2) = \frac{B_1M_Pc^2}{2t} \qquad 3.9$$

where B_1 and B_2 are parameters.

The absorbed energy will increase the grain's temperature T_G , until equilibrium is achieved: power absorption equals to the power irradiated by the surface of a grain in accordance with the Stefan-Boltzmann law

$$\frac{B_1 M_P c^2}{2t} = \sigma_{SB} T_G^4 \times 4\pi B_2^2 L_F^2 \qquad 3.10$$

where σ_{SB} is the Stefan-Boltzmann constant and k_B is the Boltzmann constant:

$$\sigma_{SB} = \frac{2\pi^5 k_B^4}{15 h^3 c^3} \qquad 3.11$$

With Nikola Tesla's principle at heart – *There is no energy in matter other than that received from the environment* – we apply the World equation [21] to a grain:

$$B_1 M_P c^2 = 4\pi B_2^2 L_F^2 \sigma_0 \qquad 3.12$$

where the surface enthalpy of the World – Universe Front is

$$\sigma_0 = \frac{hc}{a^3} \qquad 3.13$$

We then calculate the grain's stationary temperature T_G to be

$$T_G = (\frac{15}{4\pi^5})^{1/4} \frac{hc}{k_B L_F} = 28.955\ K \qquad 3.14$$

This result is in an excellent agreement with experimentally measured value of $29\ K$ [9-20].

4. Relation to Microwave Background

The black body spectrum of the cosmic microwave background radiation is due to thermodynamic equilibrium of photons with low density intergalactic plasma consisting of protons and electrons [21]. The calculated value of the microwave background radiation temperature T_{MBR} is:

$$T_{MBR} = (\frac{15\alpha}{2\pi^3} \frac{m_e}{m_p})^{1/4} \frac{hc}{k_B L_F} = 2.7252\ K \qquad 4.1$$

where α is the fine-structure constant (FSC), m_e and m_p are masses of electron and proton respectively. The calculated value of T_{MBR} is in excellent agreement with experimentally measured value of $2.72548 \pm 0.00057\ K$ [Wikipedia, Cosmic microwave background radiation].

Comparing equations 4.1 and 3.14, we can find the relation between the grains' temperature and the temperature of the microwave background radiation:

$$T_G = (3\Omega_e)^{-1/4} \times T_{MBR} = 28.955\ K \qquad 4.2$$

where Ω_e is the ratio of the energy density of electrons ρ_e to the critical energy density ρ_{cr} that equals to

$$\Omega_e = \frac{\rho_e}{\rho_{cr}} = \frac{2\pi^2\alpha}{3} \frac{m_e}{m_p} \qquad 4.3$$

Cosmic FIRB radiation is not black body radiation. Otherwise, its energy density ρ_{FIRB} at temperature T_G would equal to

$$\rho_{FIRB} = \frac{8\pi^5}{15}\frac{k_B^4}{(hc)^3}T_G^4 = \frac{2}{3}\rho_{cr} = \rho_M \quad 4.4$$

where ρ_M is the energy density of the Medium of the World [21]. The total flux of the FIRB radiation is the sum of the contributions of all individual grains.

5. Planck Mass

The developed model of the FIRB introduces large grains whose mass about equals to Planck mass M_P . Recall Dirac's quantization condition:

$$\frac{e\mu}{4\pi\varepsilon_0} = n\frac{hc}{4\pi} \quad 5.1$$

where n is an integer, ε_0 is the electric parameter, e and μ are electron and Dirac's monopole charges respectively.

Taking into account the analogy between electromagnetic and gravitoelectromagnetic fields, we can rewrite the same equation for masses of a gravitoelectromagnetic field:

$$\frac{mM}{4\pi\varepsilon_g} = \frac{hc}{2\pi}\frac{mM}{M_P^2} = n\frac{hc}{4\pi} \quad 5.2$$

where ε_g is the gravitoelectric parameter. Taking $n = 1$, we obtain the minimum product of the masses

$$mM = \frac{1}{2}M_P^2 = 2.36904 \times 10^{-16}\ kg^2 \quad 5.3$$

Two particles or microobjects will not exert gravity on one another when both of their masses are smaller than the Planck mass. Planck mass can then be viewed as the mass of the smallest macroobject capable of generating the gravitoelectromagnetic field, and serves as a natural borderline between classical and quantum physics. Incidentally, in his "Interpreting the Planck mass" paper, B. Hammel showed that the Plank mass is *a lower bound on the regime of validity of General Relativity* [23].

In our opinion, cosmic large grains with mass around M_P are the smallest building blocks of all macroobjects. Since these grains possess Planck mass, they can be reasoned about from the standpoint of classical physics, validating our calculations of the grains' masses and temperatures.

6. Mass Varying Quants. Axions and Dineutrinos

According to WUM, all "elementary" particles of the World are fermions and they possess masses. Bosons such as photons, X-rays, and gamma rays are composite particles and consist of an even numbers of fermions.

An axion is a boson possessing the lowest mass m_a :

$$m_a = \left(\frac{m_e}{m_p}\right)^{1/2} m_0 \times Q^{-1/2} = 1.8743 \times 10^{-14}\ eV/c^2 \quad 6.1$$

An axion consists of two interacting neutrinos (one of the possible super-weak interactions [21]).

Gamma rays are usually distinguished from X-rays by their origin: *X-rays are emitted by electrons outside the nucleus, while gamma rays are emitted by the nucleus* [Wikipedia, Gamma ray]. A better way to distinguish the two, in our opinion, is the type of fermions composing the core of X-quants and Gamma-quants.

Super soft X-rays [Wikipedia, Super soft X-ray source] have energies in the 0.09 to 2.5 keV range, whereas soft Gamma rays have energies in the 10 to 5000 keV range. We assume that X-quants are dineutrinos $\nu\bar{\nu}$ with the rest mass m_X (see Section 8):

$$m_X \propto m_0 \times Q^{-1/4} \sim 10^{-4}\ eV/c^2 \tag{6.2}$$

which is 10 orders of magnitude larger than the axion mass and is decreasing in time: $m_X \propto t^{-1/4}$. We will name these dineutrinos "Xions". New Physics with the dineutrinos in the Rare Decay $B \to K\nu\bar{\nu}$ is actively discussed in literature in recent years (see, for example [24, 25]).

According to WUM, the total neutrinos energy density in the World is almost 10 times greater than baryonic energy density, and about 3 times greater than Dark Matter energy density (see Section 7). At such a high neutrino concentration, "neutrinos pairs" $\nu\bar{\nu}$ (Xions) can be created. The concentration of Xions may indeed be sufficient to undergo Bose-Einstein condensation (BEC), and as a result create BEC drops (large grains), possessing masses roughly equal to Planck mass (see Section 8).

7. Energy Density of Dineutrinos and FIRB

It is now established that there are at least three different types of neutrinos: electronic ν_e, muonic ν_μ, and tauonic ν_τ, and their antiparticles. Pontecorvo and Smorodinskii discussed the possibility of energy density of neutrinos exceeding that of baryonic matter [26]. Neutrino oscillations imply that neutrinos have non-zero masses. According to WUM [21], electronic, muonic, and tauonic neutrinos have masses equal to

$$m_{\nu_e} = \frac{1}{24} m_\nu \cong 3.1 \times 10^{-4}\ eV/c^2 \tag{7.1}$$

$$m_{\nu_\mu} = m_\nu \cong 7.5 \times 10^{-3}\ eV/c^2 \tag{7.2}$$

$$m_{\nu_\tau} = 6 m_\nu \cong 4.5 \times 10^{-2}\ eV/c^2 \tag{7.3}$$

Our Model holds that the energy densities of all types of Dark Matter (DM) particles are proportional to the proton energy density ρ_p in the World's Medium:

$$\rho_p = \frac{2\pi^2\alpha}{3} \rho_{cr} \tag{7.4}$$

In all, there are 5 different types of DM particles. Then the total energy density of DM ρ_{DM} is

$$\rho_{DM} = 5\rho_p = 0.24007327 \rho_{cr} \tag{7.5}$$

which is close to the DM energy density discussed in literature: $\rho_{DM} \cong 0.23\, \rho_{cr}$ [Wikipedia, Dark Matter].

The total neutrino energy density ρ_{vtot} equals to

$$\rho_{vtot} = \frac{45}{\pi}\rho_p \tag{7.6}$$

The total baryonic energy density ρ_B is:

$$\rho_B = 1.5\rho_p \tag{7.7}$$

The sum of electron and MBR energy densities ρ_{eMBR} equals to

$$\rho_{eMBR} = \rho_e + \rho_{MBR} = 1.5\frac{m_e}{m_p}\rho_p + 2\frac{m_e}{m_p}\rho_p = 3.5\frac{m_e}{m_p}\rho_p \tag{7.8}$$

We took additional energy density ρ_{ADD}

$$\rho_{ADD} = (2 + \frac{1}{5\pi})\frac{m_e}{m_p}\rho_p \tag{7.9}$$

so that the energy density of the World ρ_W equals to the theoretical critical energy density ρ_{cr}

$$\rho_W = \left[\frac{13}{2} + \left(\frac{11}{2} + \frac{1}{5\pi}\right)\frac{m_e}{m_p} + \frac{45}{\pi}\right]\rho_p = \rho_{cr} \tag{7.10}$$

From equation 7.10 we can calculate the value of the FSC, using electron-to-proton mass ratio

$$\frac{1}{\alpha} = \frac{\pi}{15}\left[450 + 65\pi + (55\pi + 2)\frac{m_e}{m_p}\right] = 137.03600 \tag{7.11}$$

which is in an excellent agreement with the commonly adopted value of 137.035999074(44).

It follows that there is a direct correlation between constants α and $\frac{m_e}{m_p}$ expressed by equation of the total energy density of the World (7.10). As shown above, $\frac{m_e}{m_p}$ is not an independent constant, but is instead derived from α.

In Section 8 we will connect the chosen value of ρ_{ADD} with energy density of dineutrinos and FIRB radiation.

8. Bose-Einstein Condensate

New cosmological models employing the Bose-Einstein Condensates (BEC) are actively discussed in literature in recent years.

S.-J. Sin considered the ultra-light pseudo Nambu-Goldstone boson appearing in the recent cosmological phase transition theories as a DM candidate. According to his model, the galactic halos are giant systems of condensed Bose liquid [27].

Scalar Field Dark Matter [28-31] or Ultra-light Boson particles like axion in the form of BEC [32-36] are alternative candidates to be the DM of the Universe. In these models the DM is more like a wave than a particle, and the galactic halos are giant drops of condensed Bose liquid.

Structure formation processes are discussed in the BEC cosmological model, in which, the boson DM gradually condenses into the uniform dark energy [37].

Sonic analog of gravitational black holes in BEC is analyzed in [38]. The opening and closing of a black hole region in BEC with attractive interaction is discussed in [39]. The reliability of supermassive BEC as alternative to supermassive black holes is examined in [40]. Although less stable than black holes, all self-bound graviton BEC are shown to be stable in the limit of large mass in [41].

The transition to BEC occurs below a critical temperature T_c *, which for a uniform three-dimensional gas consisting of non-interacting particles with no apparent internal degrees of freedom is given by* [Wikipedia, Bose-Einstein condensate]:

$$T_c = [\zeta(3/2)]^{-2/3} \frac{h^2 n_X^{2/3}}{2\pi m_X k_B} \approx \frac{h^2 n_X^{2/3}}{11.918 m_X k_B} \qquad 8.1$$

where n_X is the particle density, m_X is the mass per boson, ζ is the Riemann zeta function:

$$\zeta(3/2) \approx 2.6124 \qquad 8.2$$

According to our Model, we can take the value of the critical temperature T_c to equal the stationary temperature T_G of large grains (see equation 3.14). Let's assume that the energy density of boson particles ρ_X equals to the MBR energy density (see equation 7.8):

$$\rho_X = n_X m_X = 2\frac{m_e}{m_p}\rho_p = 4\pi^2\alpha\frac{m_e}{m_p}\frac{hc}{L_F^4} = 0.00015690 \times \frac{hc}{L_F^4} \qquad 8.3$$

Taking into account equations 3.14, 8.1 and 8.3, we can calculate the value of n_X :

$$n_X = [47.672\pi^2\alpha\frac{m_e}{m_p}\left(\frac{15}{4\pi^5}\right)^{1/4}]^{3/5} \times L_F^{-3} =$$

$$= 0.011922 \times L_F^{-3} = 2.6386 \times 10^9\ m^{-3} \qquad 8.4$$

and the value of the mass m_X :

$$m_X = \frac{\rho_X}{n_X c^2} = 0.013161 m_\nu = 0.987 \times 10^{-4}\ eV/c^2 \qquad 8.5$$

m_X is 10 orders of magnitude larger than the axion mass (see 6.1).

The calculated values of the mass and concentration of dineutrinos satisfy the conditions for their Bose-Einstein condensation. Consequently, the BEC drops whose masses about equal to Planck mass can be created. The stability of such drops is provided by the discussed mechanism of the energy absorption from the Medium of the World and re-emission of this energy in FIRB at the stationary temperature $T_G = 29\ K$.

The FIRB energy density ρ_{FIRB} equals to

$$\rho_{FIRB} = \rho_{ADD} - \rho_X = \frac{1}{5\pi}\frac{m_e}{m_p}\rho_p \qquad 8.6$$

which is 10π times smaller than the energy density of MBR and dineutrinos:

$$\rho_{FIRB} = \frac{1}{10\pi}\rho_{MBR} \approx 0.032\rho_{MBR} \qquad 8.7$$

The ratio between FIRB and MBR corresponds to the value of 3.4% calculated by E. L. Wright [4].

In this paper we proposed a new component of the Medium of the World – BEC drops of dineutrinos whose mass about equals to Planck mass, and temperature of around 29 K. BEC drops are responsible for the FIRB and explain the substantial 100 micron flux in excess of expected zodiacal and Galactic emission.

The BEC drops do not absorb and re-emit starlight. Instead, they absorb energy directly from the Medium of the World. We can thus explain the existence of ultra-luminous infrared galaxies in a very active star formation period, which are extremely bright in the infrared spectrum and at the same time faint (often almost invisible) in the optical.

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