Simulation of the dynamics of integration of space-time-energy by Planck's temperature- black body emission spectrum

Dr. Alfred Bennun
Full Professor Emeritus of Biochemistry
Rutgers University

Abstract

The Big-Bang may have started from a single Planck particle, the maximum density of energy that is equivalent to a mini-black hole. The concept of an initial locus of the universe, allows predicting that in the bases of the fundamental constants, pre-horizon energy would undergo quantification and this would shape as a black body emission spectrum. This conform a sequential quanta-compounding mechanisms that plays the role of the horizon, for the emerged quantum structure energy-space-time, within the self-contained universe. The incorporation and quantification of the energy, during inflation by the joint or coupled: Cooperative interactions of Planck quanta-compounding and parametric down-conversion (PDC) interact to function cooperatively. Since the mechanism proposes, that along the cosmos radius integration of the radius of new photons determine inflationary velocity, the velocity of light is never exceed at any one point. However, it does predicts the exponential increase of the volume of the inflationary universe and the changing of energy density by a mechanism of photon spectrum-elongation and increase in the constitutive photon number, until arriving at the present CMB values. The newly form photons emerge distributed uniformly along the universe as a function of time and would be observable after galactic formation as a recessionary force, not subject of gravitation. The horizon role of recession velocity could be predicted, from the fact that if the Hubble's constant (H_0) 72 Km/s/Mpc multiplied by the total number Mpc in the universe radius (4134 Mpc) equals the velocity of light. The detection from all the space directions of the image of last dispersion (LD) may correspond with a holographic image reproduction. This is so, because holography allows obtaining multiple images of same event but at lower resolution, when a single photographic plate is divided. This effect, could be obtained because the same image becomes reproduced 1000 times, when the number of CMB photons increases by this number from the LD period to the present. Uniform amplification and dispersion of LD images becomes associated to the increase of the universe volume by 10^{12} during this time, which the resultant loss of resolution. The expansion dominated by radiation can be modeled by its spectrum according to Planck's law. The relative amount of the CMB photon population, its frequency *v*, and energy *hv* in a thermal radiation of temperature T, by unit of volume, were correlated by the Planck integral function. This allows showing the energy-space-time integration dynamics as a function of the relation temperature-emission spectrum. For which it was assumed that the time is proportional to the radius of the universe according to constant *c*, obtaining the CMB volume based on the temperature parameter and vice versa: $T_{(V)} = 4.841404\times10^{21}V^{-1/4}$, where [V] =$cm^3$ and [T] =K, concordant with a universe of 13,7 $\times10^9$ light-years of radius. This magnification of the CMB role can be explained because as a quantum process, could be correlated with the rest of the universe at a level non-affected by gravity. Therefore, it is possible to be inferred that its effects are in the galactic recessions, in the growth of vacuum and voids, but cannot prevent the gravity-dependent agglomeration of the galaxies in cumulus and super-cumulus.

Introduction

Big-Bang in a self-contained universe [1] can be described like a structure of quantum multiplication and continuous decrease in energy density, with conservation of the sum of enthalpy and entropy [2, 3, 4, 5, 6, 7]. This principle can be applied through mechanism of PDC (parametric down-conversion) [8, 9], verified experimentally like able to maintain the multiplications chain of photons. This would be equivalent to a system thermodynamically open [10], because the dissipative potential of the enthalpy maintains the dynamics of expansion away from equilibrium at every PDC cycle [11], because the product becomes the substrate for the next PDC cycle.

The reversibility tendency of a PDC cycle in the system diminishes because the probability of photons duplication kinetically surpasses the tendency to a superposition, which is not favored by a spectrum of different energy values [12, 13]. The interaction between photons diminishes still more, in agreement with a chronology of expansion since reversal requires a decrease in the entropy generated by the diminution of the spectrum density [14]. This directionality gives asymmetry to the system and conform the arrow of the time.

In this work it is analyzes the thermodynamic cosmic parameters by means of the quantum equivalence of temperature that arises from the Planck treatment of radiation of a black body [15]. This allows that temperature, a macroscopic random property with a non-uniform distribution of kinetic energy [16], results in a frequency spectrum at a quantum level.

With this conceptual tool the temperature-energy of the CMB is analyzed [17, 18, 19, 20] to systematize the evolution, of the universe, as a function of the asymmetry of the space-time. Hence, expansion is characterized by the dynamics of the CMB radiation spectrum.

Quanta-compounding of Planck photons for coupling of energy-space-time

The kinetic concept of the temperature lacks meaning for temperatures greater than 10^{12} K, or about 90 MeV [21]. Photons of high energy and matter (quarks) conforms a plasma state. These conditions correspond to 10^{-4} s after the Planck time [22, 23]. Reason why, to describe evolution of a universe as “hot” for the period previous to 10^{-4} s lacks a physical interpretation, which can take to incorrect conclusions, with respect to the evolution of enthalpy and entropy.

For this simulation the universe begins with a photon Planck (1.2×10^{22} MeV, equivalent to 10^{32} K), minimum black hole that dissipates in the time Planck (5×10^{-44} s). The energy of photons progressively would compound from 1.4×10^{60} Planck, to reach a total energy in the universe of 1.7×10^{82} MeV. This process would maintain the energy density almost constant [24, 25]. In order to assimilate this thermodynamically, the system was characterized as in a state of same “temperature”. The coupling connection during the Inflationary Era [26, 27, 28, 29] can be describe as similar to putting in contact fluids masses that share the same temperature. Accordingly, it could be assumes that the increase of the mass-energy and the volume of the system are in step to maintain the density constant.

The variation of a photon moment implies that it interacts with matter and that when hitting the atom arise a photon with longer wavelength. This a non-operative mechanism within the inflationary period, in which there are neither atoms nor could be observable the evolution of the emptiness’s of space. The latter one, equivalent to the expansion of residual-CMB containing voids, from which will be, generated the spongy structure of the universe observable as large voids, super-voids and lined with galactic cumulus. This path of evolution requires “interaction” similar to a photon division, with conservation of the moment within the newly generated photons, observable (in the laboratory) as photon multiplication by the mechanism of PDC [8, 9, 30].

The joint or coupled Planck quanta-compounding plus PDC interact to generate an inflationary process with velocity greater than that of light, but only because both functions interrelate cooperatively (sigmoid functions), effect known to generate growth curves under exponentials greater than one. This mathematics explains the exponential increase of the volume of the inflationary universe.

The Planck’s quanta-compounding entails that the universe could increase its enthalpy, with low entropy generation. The latter during inflation is a relatively small value with respect to that of the expansion. Therefore, when finalizing the inflationary period the universe has energy potential more than sufficient to allow the system to operate as thermodynamically open. Is a relation that PDC generated product becomes the substrate for a subsequent PDC cycle.

Results

Universe dominated by radiation

The Planck photon quanta-compounding during inflationary period, could be the initial state for the universe in expansion by PDC-mediated increment in number and wavelength of primordial photons. For an adiabatic expansion (without heat interchange) within a volume it must be fulfilled the first principle of thermodynamics, in such a form that the variation of the internal energy is equal to the work made by the expansion; ρ: the average density, in volume: V and c: the velocity of light.

$dE/dt = -P\, dV/dt \Rightarrow d/dt\,(\rho c^2 a^3) = -P\, d/dt\,(a^3)$

$\Rightarrow d\rho/dt = -3 H_0 (\rho + P / c^2)$

For a Universe dominated by the radiation

$P = 1/3\, \rho c^2$

$$d\rho/dt = -3 H_0 (\rho + P/c^2)$$

$$d\rho/dt = -3 H_0 (\rho + 1/3\, \rho c^2/c^2) = -4 H_0 \rho$$

$$\int d\rho/\rho = -4 H_0 \int dt$$

$$In\rho = -4 H_0 t + k_1 \Rightarrow \rho = \rho_{initial} \times e^{-4 H_0 t}$$

The equation is valid during the inflationary period, after the universe reached the temperature of 3000K approximately the equation changes. That is to say, the light was in close contact with the matter reaching both a perfect heat balance. Then the electrons began quickly to be combined with the nuclei forming atoms.

1. The universe dominated by the radiation photon-energy-mass has a density according to the relation: $\rho = \rho_{initial} \times e^{-4 H_0 \times t}$ (1).

2. Let us consider the spectral density of Planck like the factor fundamental to evaluate a relation of energy-space-time idealized like an expansion in analogy to the radiation of a black body.

$$\rho_T = \frac{8\pi h v^3}{c^3} \times \frac{1}{e^{\frac{hv}{kT}} - 1} \therefore$$

$$\rho_T = \int_0^\infty \rho_T(v) dv = \frac{8\pi h}{c^3} \int_0^\infty \frac{v^3}{e^{\frac{hv}{kT}} - 1} dv$$

Denominating: $x = \frac{hv}{kT}$, $dx = \frac{h}{kT} dv \therefore$

$v = \frac{kT}{h} x$ and $dv = \frac{kT}{h} dx \Rightarrow$

$$\rho_T = \frac{8\pi h}{c^3} \frac{k^4 T^4}{h^4} \int_0^\infty \frac{x^3}{e^x - 1} dx \wedge \int_0^\infty \frac{x^3}{e^x - 1} = \frac{\pi^4}{15} \Rightarrow$$

Stefan's Law: $\rho_T = \frac{8\pi^5 k^4}{15 h^3 c^3} T^4$ (2.1)

3. The elongation of the wavelength due to the expansion, considering that λ_i is the initial wavelength, λ_f is the wavelength after a chronological time interval (t), $H_{(t)}$ is the Hubble's constant in time dependence and a(t): is the parameter of expansion based on the time.

(a) $1 + z = \frac{\lambda_f}{\lambda_i} \wedge 1 + z = \frac{a_{(t)}}{a_i} \Rightarrow \frac{\lambda_f}{\lambda_i} = \frac{a_{(t)}}{a_i}$

(b) $H_{(t)} = \frac{1}{a} \frac{da}{dt}$ Integrating $\int \frac{da}{a} = \int H_{(t)} dt \Rightarrow$

$\ln a = H_{(t)} t + k \Rightarrow a_{(t)} = a_i \times e^{H(t)t}$

(a) $\wedge$ (b) $\Rightarrow$ (c)

$$\frac{\lambda_f}{\lambda_i} = \frac{a_{(t)}}{a_i} = \frac{\not{a}_i \times e^{H(t)t}}{\not{a}_i} = e^{H(t)t} \Rightarrow$$

$\lambda_f = \lambda_i \times e^{H(t)t}$ (3.1)

4. Relating equations 1 and 2.1 it is obtained:

(1) $\wedge$ (2.1) $\Rightarrow \frac{8\pi^5 k^4}{15 h^3 c^3} T^4 = \rho_i \times e^{-4H_0 t}$ (4.1)

Accordingly to equation 3.1 in the 4.1:

$$\frac{8\pi^5 k^4}{15 h^3 c^3} T^4 = \rho_i \times \left(e^{H0t}\right)^{-4} \wedge \quad e^{H(t)\times t} = \frac{\lambda_f}{\lambda_i} \Rightarrow$$

$$\frac{8\pi^5 k^4}{15 h^3 c^3} T^4 = \rho_i \times \frac{\lambda_i^{\ 4}}{\lambda_f^{\ 4}} \Rightarrow$$

$$\lambda_f = \left(\frac{15 h^3 c^3}{8\pi^5 k^4}\right)^{1/4} \frac{\rho_i^{1/4} \times \lambda_i}{T} \quad (4.2)$$

Considering that the density of locus initial (Planck) is ρ_i =2.8933×10^120 MeV/cm^3 and the associate wavelength is λ_i = 1.616×10^{-33}*cm*, then:

$$\lambda_f = \left(\frac{15 \cdot \left(4.14\times10^{-21}\text{MeV}\cdot\text{s}\right)^3 \left(2.99\times10^{10} cm/\text{s}\right)^3}{8\pi^5 \left(8.614\times10^{-11}\text{MeV/K}\right)^4}\right)^{1/4} \times$$

$$\times \frac{\left(2.89\times10^{120}\text{MeV/cm}^3\right)^{1/4} 1.61\times10^{-33} cm}{T}$$

$$\lambda_f = \frac{2.5434\times10^{-1} cm\text{K}}{T} \quad (4.3)$$

Omitting the inherent errors to the calculation, expression 4.3 is similar to the law of Wien:

$$\lambda_{max} = \frac{0.2898 cm\text{K}}{T}$$

This makes clear that the initial hypotheses can be considered valid.

Number of photons and density of CMB radiation in the universe

For a given temperature the density of energy of the CMB radiation is obtained from the integral:

$$\rho_T = \frac{8\pi h}{c^3} \int_0^\infty \frac{v^3}{e^{\frac{hv}{kT}} - 1} dv$$

$$\Rightarrow \rho_{(T)} \approx 3.80418\times10^{-9} T^4 \quad [\rho_{(T)}] = \text{MeV}/cm^3$$

The relative amount of the population of CMB photon: (N_T), of frequency: v, and energy: hv in a thermal radiation of temperature: T, by unit of volume, is given by the integral of Planck:

$$N_{(T)} \approx \frac{8\pi}{c^3} \int_0^\infty \frac{v^2}{e^{hv/kT} - 1} dv,$$

replacing $x = \dfrac{hv}{kT}$,

$$dx = \frac{h}{kT} dv \Rightarrow v = \frac{kT}{h} x \text{ and } dv = \frac{kT}{h} dx$$

$$\therefore N_T = \frac{8\pi}{c^3} \frac{k^3 T^3}{h^3} \int_0^\infty \frac{x^2}{e^x - 1} dx$$

$$N_T \approx 20\times T^3 \quad [N_T] = cm^{-3}$$

Total CMB volume

For a homogenous and isotropic adiabatic system the energy E and volume V are related by E=V×ρ (1), where ρ is the density of energy.

On the other hand, CMB radiation covers the universe totality, for what it is possible to be inferring that this volume is that of the universe itself, V_U. It is considered that the period in which the matter forms the energy remaining in the form of radiation CMB is only 1/20000 of the initial total energy. Then energy remaining for the system is 2.09×10^{78} MeV. This magnification of the CMB role can be explained as a quantum process correlated with the rest of the universe at a level not affected by gravity.

Therefore, it is inferred that its effect is mainly in recession, in the growth of voids, but cannot have the strength to oppose gravity and prevent the agglomeration of the galaxies in cumulus and super-cumulus.

Considering the radiation density $\rho_{(T)} \approx 3.80418\times10^{-9} T^4$ and energy CMB E_{CMB}=2.09×10^{78} MeV based on the expression (1) is obtained:

$$2.09\times10^{78}\text{MeV} = V\times3.8\times10^{-9} \frac{\text{MeV}}{\text{cm}^3\text{K}^4} T^4 \Rightarrow$$

$$V_{U(T)} = \frac{5.49\times10^{86}\text{cm}^3\text{K}^4}{T^4} \quad [V_U] = \text{cm}^3$$

CMB after inflation

After the Planck time of 10^{-33} s “temperature” fell to the 10^{27} K. The energy density in the universe (or radiation):

$$\rho_T \approx \frac{8\pi h}{c^3} \int_0^\infty \frac{v^3}{e^{hv/kTv} - 1} dv$$

$$\rho_T \approx \int_0^\infty \frac{3.86\times10^{-51} v^3}{e^{4.80\times10^{-11} v/10^{27}} - 1} dv \Rightarrow$$

$$\rho_T \approx 4.71\times10^{99}\,\mathrm{MeV/cm^3}$$

The photons density for this temperature:

$$N_{(T)} \approx \int_0^\infty \frac{9.33\times10^{-31} v^2}{e^{4.80\times10^{-11} v/10^{27}} - 1} dv = 2.03\times10^{82}$$

$$N_{(T)} \approx 2.03\times10^{82}/cm^3$$

The universe volume based on the wavelength Compton

The wavelength Compton is the smallest distance in which a particle of mass *m* can be located: $\lambda_c = h/2\pi mc = hc/2\pi E = \lambda/2\pi$. This work uses the concept with two restrictions. 1st, the energies of the fundamental photons are very great with energy locus very small which may allow properties to be defined as that of true particles with resting mass *m* and volume V. 2nd, mass *m* is replaced by the equivalent in energy *E* fundamental photons. With these conditions the following steps were applied.

1. The length of Compton based on the energy of the photon is: $\lambda_c = \dfrac{hc}{2\pi E}$

2. The energy of the photon can be represented as contained in a sphere whose diameter is the wavelength Compton λ_c. Therefore the volume of the particle Compton is:

$$V_c = \frac{\pi}{6}[\lambda_c]^3 = \frac{\pi}{6}\left[\frac{hc}{2\pi E}\right]^3 \Rightarrow$$

Volume Compton: $V_c = \dfrac{h^3c^3}{48\pi^2E^3}$

3. The total energy in the universe is estimated 1.71×10^{82} MeV

The volume of locus of energy of the particle increases as duplicates to its wavelength Compton. For an initial volume of λ_c: $V_{c2} = \dfrac{\pi}{6}[2\lambda_c]^3$, by elongation is obtained.

The relation is then

$$\frac{V_{c2}}{V_{c1}} = \frac{\frac{\pi}{6}[2\lambda_c]^3}{\frac{\pi}{6}[\lambda_c]^3} \Rightarrow \frac{V_{c2}}{V_{c1}} = 8$$ the volume of locus by elongation increases of the following form $V_{c\text{-}n} = 8^n \times V_c$, where $0 < n < 50$.

If we interpreted the elongation as a continuous process implies a change of the energy of his locus. But, by the principle of conservation of the moment and the energy this process must dissipate energy in some form, that is to say, is forced to release another photon. When a photon duplicates its wavelength, its energy diminishes by half, because another photon forms with that energy. The variation of the volume produced by the process of elongation-duplication of locus is compound of two factors, increases 8 times by elongation and 2 by duplication. In summary the volume of Compton within the process elongation-duplication is expressed in the following way.

$$V_{c\text{-}n} = \overbrace{8^n \times V_c}^{Elongation} \times \overbrace{2^n}^{Duplication}$$

$$\Rightarrow V_{c\text{-}n} = 2^{3n} \times 2^n \times V_c \Rightarrow V_{c\text{-}n} = 2^{4n} V_c$$

It could be shown that the evolution of volume follows a sequence according: $V_{c\text{-}n} = 2^{4n} V_P$

The property of connectivity at the quanta level, involves the processes of elongation-duplication of particle (photon) and Planck quanta-compounding. This as was shown could be related to the overall volume changes in the universe itself. The inflationary universe from 10^{-43} to 10^{-33} second could be defined, like the sum of the volume Compton (by elongation-duplication) and the compounding (connected) volume of the Planck in exponential interrelationship. At each level n it is necessary to multiply $V_{c\text{-}n} = 2^{4n} V_P$ by the number of compounding photons Planck until the universe has around 10 cm of diameter.

Evolution of the inflationary volume

The sequence that shows to the evolution of the volume of the inflationary universe from the initial volume Planck (V_{Pl}), considering that the number photons (p) begin to elongate and duplicate is:

n= 0, $V_0 = V_P(p^0 2^{4\times0})$

n= 1, $V_1 = V_P(p^0 2^{4\times1} + p^1 2^{4\times0})$

n=2, $V_2 = V_P(p^0 2^{4\times2} + p^1 2^{4\times1} + p^2 2^{4\times0})$

n=3,

$V_3 = V_P(p^0 2^{4\times3} + p^1 2^{4\times2} + p^2 2^{4\times1} + p^3 2^{4\times0})$

n=4,

$V_4 = V_P(p^0 2^{4\times4} + p^1 2^{4\times3} + p^2 2^{4\times2} + p^3 2^{4\times1} + p^4 2^{4\times0})$

Hence

$$V_n = V_P(p^0 2^{4\times n} + p^1 2^{4\times(n-1)} + p^2 2^{4\times(n-2)} + + p^3 2^{4\times(n-3)} + \ldots + p^4 2^{4(n-m)})$$

$$V_n = V_P(p^0 \frac{2^{4\times n}}{2^{4\times0}} + p^1 \frac{2^{4\times n}}{2^{4\times1}} + p^2 \frac{2^{4\times n}}{2^{4\times2}} + + p^3 \frac{2^{4\times n}}{2^{4\times3}} + \ldots + p^4 \frac{2^{4n}}{2^{4m)}})$$

$$V_n = V_P 2^{4\times n}(\frac{p^0}{2^{4\times0}} + \frac{p^1}{2^{4\times1}} + + \frac{p^2}{2^{4\times2}} + \frac{p^3}{2^{4\times3}} + \ldots + \frac{p^m}{2^{4m)}})$$

$$V_U = V_P\ 2^{4\times n} \sum_{m=0}^{n} \frac{p^m}{2^{4m)}} \Rightarrow$$

$$V_U = \frac{p^{n+1} - 16^{n-1}}{p-16} V_P$$

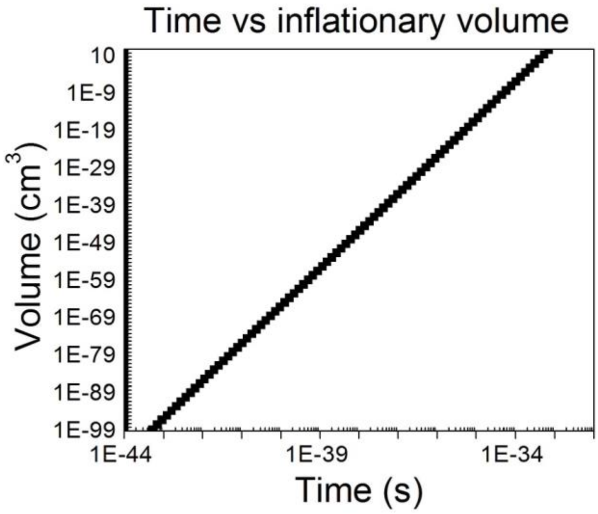

Figure 1: Logarithmic Graphic of time vs inflationary volume.

Connection between Planck photons

The sequence of compounding-connection of photons is appraised in the following way:

n= 0, $\gamma_0 = p^0$;

n= 1, $\gamma_1 = p^0 + p^1$;

n= 2, $\gamma_2 = p^0 + p^1 + p^2$;

Hence, $\gamma_n = \sum_{n=0}^{n} p^n \Rightarrow$

$$\gamma_n = \frac{p^{n+1} - 1}{p-1}$$

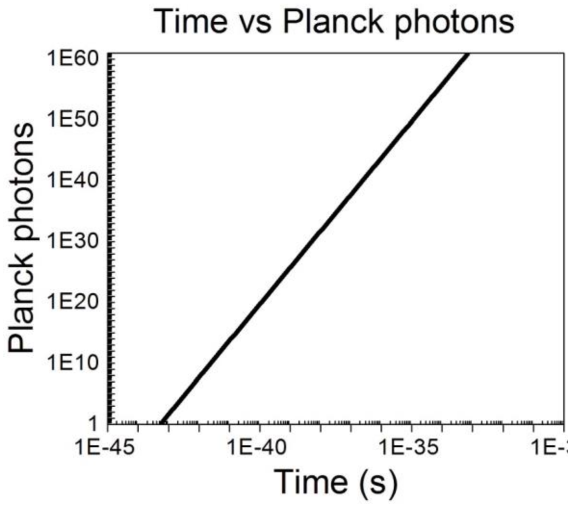

Figure 2: Logarithmic graphic of the time vs Planck photons.

A space-time of the Planck dimension of a single photon, as soon as the Planck time elapses re-dimensions to include 5 or 6, there after 5^2 or 6^2, and subsequent 5^3 or 6^3, and successively creating a continuum. The total number of steps or necessary connections required in order to fit markers is 84, this number allows conciliating the Compton volume values with the ones for the volume of the universe and for total energy.

Accordingly, $\gamma_{84} = \dfrac{5^{84+1} - 1}{5 - 1}$ $\therefore$

$\gamma_{84} \approx 10^{60}$ Planck photons

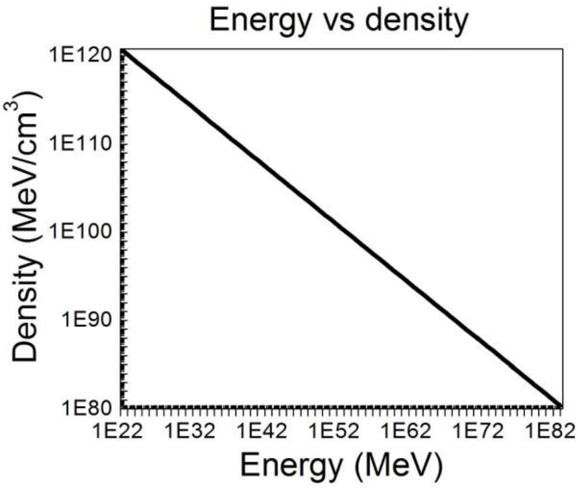

Figure 3: Logarithmic graphic of the energy vs the density.

CMB in the LD period

In the LD period at the temperature of 3000 K ($\lambda_{máx}$=8.48×10^{-5} cm), the photons density and energy density becomes:

$$N_{(T)} \approx \int_0^\infty 9.33\times10^{-31} v^2 \times \frac{1}{e^{4.80\times10^{-11} v/3000} - 1} dv \Rightarrow$$

$$N_{(T)} \approx 5.5\times10^{11}\, photons/cm^3$$

$$\rho_T \approx \frac{8\pi h}{c^3} \int_0^\infty \frac{v^3}{e^{hv/kT} - 1} dv$$

$$\Rightarrow \rho_{(T)} = 3.80\times10^{-9}\,\mathrm{T}^4 \Rightarrow$$

$$\rho_{(3000)} \approx 3.08\times10^5\,\mathrm{MeV/cm^3}$$

Volume of the LD universe (V_{LD}) is calculated based on the radiation density and the total energy of radiation, distributed in the totality of the universe.

$$V_U = \frac{5.5\times10^{86}\,\mathrm{cm^3K^4}}{(3000\mathrm{K})^4} \Rightarrow V_U \approx 6.8\times10^{72}\,\mathrm{cm^3}$$

CMB in the Present

The temperature of the CMB in the present is T=2.725 K, the density of photons N_T:

$$N_T \approx \int_0^\infty \frac{9.33\times10^{-31} v^2}{e^{1.76\times10^{-11} v} - 1} dv \Rightarrow$$

$$N_T \approx 405\ \text{photons/cm}^3$$

The energy density:

$$\rho_{(2.725)} = 2.098\times10^{-7}\,\mathrm{MeV/cm^3}$$

Universe volume at present:

$$V_U = \frac{5.49\times10^{86}\,\mathrm{cm^3K^4}}{(2.725\mathrm{K})^4} \approx 9.9\times10^{72}\,\mathrm{cm^3}$$

Remembering which the radiation energy is in its majority CMB, 2.09×10^{78} MeV corresponds to 9.9×10^{84} cm^3, occupying the totality of the vacuum. As the galactic volume is despicable with respect to the galactic emptiness, the latter one approximately represents the total universe volume.

Figure 4 shows the correlation between parameters from the LD period to the present.

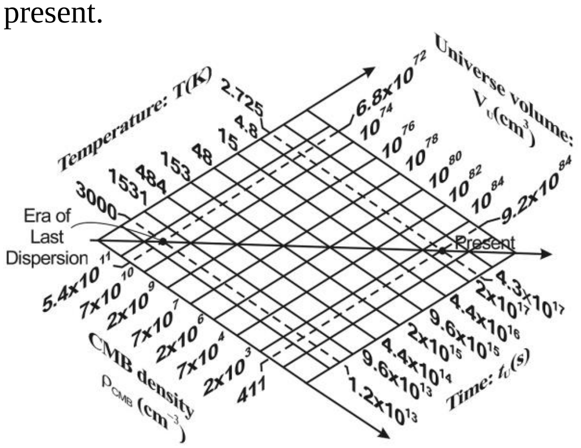

Figure 4: Relation between radiation of black body and the space-time dimensions. *From the concepts evolved from the Planck's law, it is possible to obtain a formula that relates volume of the universe to radiation temperature: $T_{(V)}$=4.84×10^{21} $T^{-1/4}$ where [V] =cm^3 and [T] =K. Assumptions: that the time is proportional to the radius of the universe according to the constant c. In other words: time=1.37×10^{10} years, radius=*

1.37×10^{10} light-years. And that the volume of CMB is equivalent to the one of the universe.

Discussion

The percentage of matter of the universe is constituted by a 5% of baryonic matter and a 25% of dark matter that would be equivalent to an average density of two protons by m^3, which is the value, observed and confirmed by multiple measurements, was the one used in this simulation. This value, allows to dismiss the concept of dark energy [31, 32], and still allows to maintain the universe flat. The evolution of the PDC produces a constant rate of expansion, by being a process of quantum division that is not subject to gravitation although the photons themselves are.

Conclusions

Two protons per m^3 differ from the calculated to include dark energy which is 6 protons per m^3. As shown, there is no need to postulate a 70% of dark energy not yet detected. The dark energy postulation fits only the need to increases the density of the universe to account for the need to find a force that opposes gravity.

However, photon elongation and their multiplication are not affected by gravitation. The simulation shows that the expansion could be consistent with parametric down-conversion of CMB radiation. Therefore, PDC even it is not a force that works against gravitation, it does replaces the cosmological constant, the quintessence, etc. [33, 34, 35, 36, 37, 38, 39], allowing the description of a Big-Bang scenario. The simulation tables up to the end of the inflationary period show that photons Planck accumulation could replace the concepts that inflation is driven by the energy transfer between universes. The alternative explanation shows that inflation could be reconciled with a geometric progression in base between 5 or 6 in the quanta-compounding required to restructure the space-time parameters within the self-contained universe.

The observation shows to a universe constituted by enormous empty regions (voids) and the galaxies in its edges grouped in accumulations and super-cumulus, with a despicable volume in comparison. It is possible to be assumed in this way that the sum of all voids constitutes the volume of the universe. This allows inferring that the cause that increases the volume of voids should escape of the action of gravity of necessity in order to maintain the attraction between the galaxies.

The galactic recession is not only is detectable, but that can be inferred like related to the evolution of the universe, in which the emptiness increases until reaching a volume million thousands times superior one to the galactic one.

The search of a solution for the galactic recession lead to postulate that CMB photons are divided and elongated, in an iterative process which obtained its first impulse during inflationary period and still maintains expansion because the energy potential related to temperature still is far from its equilibrium.

If it is accepted that the increase of the vacuum is correlated with the division and elongation of CMB makes unnecessary to resort arbitrarily to the concept that dark energy can have mass and still opposes gravity. No measurement until the present manages to find a “missing” energy on the other hand CMB is detectable.

The decrease of frequency based on the process of splitting and elongation of CMB photon, in spite of being a spontaneous reaction, increases the space and the entropy, by decreasing energy density. The expansion arrow is associated to a temporary arrow because kinetically the division of a photon predominates restricting the reversibility, which depends on the superposition of two photons of equal quantum identity.

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