Inflation-Expansion characterized by relativistic space-time-velocity plus the quantum-dimensioning parameters of CMB-elongation

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Abstract

The results of a simulation by parametric down-conversion (PDC) fitted observational evidence. This data was plotted in relationship to the radius of the universe in Mpc multiplied by Hubble's constant (H_0), characterizing expansion as subject to velocity of light (c), functioning as a relativistic causality horizon. PDC allowed describing expansion as a function of the observable increment of photon number. This one multiplied by the increment of the quantum dimensional locus (Compton-volume) equals the increment of the universe volume. The nature and frequency of primordial energy differ by much that of its residual cosmic microwave background (CMB), but the simulation concerns only to relate their frequency by a mathematical treatment, and hereby both may be refer indistinctly. The following theoretical treatment, of the proposed quantum and relativistic parameters, were amalgamated into a single equation and verify by simulation. The plotting of the dimensions of radius of the Universe and the radius of CMB-photon vs time of the Universe and time of localization shows that all this parameters must increment simultaneously, in order to preserve the constants. A sequential cascade of PDC-cycles which by generating photons of lower and lowers energy, could maintain "a continuum of decreasing dissipative potential". Hence, because the product from a preceding PDC-cycle becomes the substrate for a subsequent one, accumulation of product is prevented, as if were open thermodynamic systems. This state of the system, without any considerable reversibility, would endure until near extinction of the energy of CMB. The continuum of lambda-CMB and its time of localization continuously generate entropy at the level of increment of photons and Compton-volume structuring the arrow of time.

Introduction

The Big-Bang [1] successfully predicted nucleosynthesis and a cosmic thermodynamic chronology. Friedmann [2] proposed that evaluation of the density of matter in the universe would allow distinguishing between a close and open geometric predictions of cosmic evolution.

Albert Einstein and Willem De Sitter [3] contributed the alternative flat model, a geometry that allows Euclidian triangles. The NASA observations correspond with a flat parameter of inflation-expansion.

There is a wide consensus in a Big-Bang, which does not start from a singularity, a non-dimensional point but still could be debated, if the generated velocity of particles, could overcame their own gravitational attraction to drive expansion. The origin could correspond to a quantum limit of very high energy density, the Planck mass [2-10].

An alternative model, could postulate a Big-Bang mechanism based in that a decrease in the energy of CMB-photons, links a decrease in their energy density to a quantum dimensional expansion in their space-time locus [11]. A mechanism that fits a gravity-independent requirement would be the splitting of the energy of photons by a concatenated sequence of PDC processes [12-16].

The latter allows a cosmic chronology of CMB [17, 18] that only from the Era of last dispersion to present, a change of temperature of black body emission, from T=3000 K to T=2.725 K. This, corresponds to a Doppler or shift of frequency spectra of z =1000 over. Hence, either a wavelength elongation process or the stretching-out of space became transducers of an increment of λ into and magnification of the space-time dimensions or vice versa.

However, the relationship which is cause and which effect, becomes clearer by noticing that expansion it's coupled [19, 20] to an increment of $n\gamma$, which is predicted by PDC-dependent elongation and not by black energy [21].

The simulation results, predicts that phenomena, like the Casimir effect [22, 23, 24], which has been attributed to virtual energy, could be alternatively explained by parametric up-conversion (PUC) [25, 26].

The universe has maintained an energy potential allowing expansion and life; therefore, it is still far away from equilibrium. However, if the cosmos is self-contained could not be and open thermodynamic system. This apparent contradiction was solved, by considering that the universe by photon elongation could be maintained for a long period of time, as a system away from its equilibrium [15, 27].

Elongation, allows a partial recreation of a non-equilibrium potential [27] by recycling photons, through the temporal bottleneck of the PDC process. Each PDC cycle results in less-energetic photons, which by reentering in the PDC chain, like quanta of less and less energetic content; prevent significant reversibility and product accumulation, conformed a temporal vector the arrow of time.

Results

The quantum dimensional chronology of CMB integrates as an expansionary space-time continuum

Gravity shapes the geometry of the universe; stellar light is curved by the gravitational field of the sun, but the expansion parameter has been characterized as showing cero (or *flat*) curvature [2, 3, 28]. This discrepancy in measurable effects may indicate different causes.

Thus, gravity may induce a close curvature, without preventing a thermodynamic-dependent progress of expansion. However, the latter requires being gravity-independent as is the case with the experimentally observable PDC. This spontaneous process, splits one photon into two, each one with half energy. The stretching-out of space by PDC could occur as a topological change, without affecting by much a gravitational-dependent curvature of the universe.

However, its may be possible to differentiate between the parameters of expansion and curvature. If that is the case, a flat curvature may represent a thermodynamic axis rather than a geometrical one.

These roles may be complementary rather than antagonistic, since the continuum-quantum elongation of CMB-radiation, would dimensions vacuum and galactic recession. The non-continuum quantum structure of matter by its gravitational attractions, could locally overcome uniform CMB-expansion, driving galaxies into clustering and forming cumulus.

The newly formed CMB-photons, continuously and smoothly, spread their energy over a stretching-out space-time. However, because of their uniform emergence, would increase the size of the galactic voids at a greater recession velocity: $\vec{\mathrm{v}} = H_0 \times \vec{r}$, than at the intergalactic distances within clusters.

The energy of Planck particles, as primordial CMB generates matter and a leftover of residual CMB radiation, which was calculated: 2.35310^{-10} MeV$\times 3.7810^{87}\gamma = 8.89 \times 10^{77}$ MeV. The simulation checks this value, as a function of 411 CMB-photons per cm^3 multiplied by the present volume of the universe [17, 18].

However, since simulation adopted a critical energy (E_C) of two protons per m^3, total residual CMB-energy represents 0.005 % from E_C. If black energy would be detected, the indicated percentage could be decreased, according to a set of more endurable values.

The cosmos observed coordinates of expansion (r_U vs. t_U) plotted in figure 1, fits the predicted quantum structured-expansion of CMB, calculated by multiplying the $\Delta n\gamma$ by $\Delta V\gamma$ [cm^3] (Compton scattering volume). The CMB-photon enlargement (elongation), responds to the relationship: radius of the photon over its time of localization, $r\gamma / t\gamma_{\,loc} = c$, velocity of light [11].

Figure 1 shows that expansion, after the formation of galaxies could be measured by recession velocity (v), for galactic recession-distances: r [Mpc] = v/H_0. The summa of distances of the widening galactic voids plus galactic recessions integrates as a universe radius, which keeps the relation: r_U[Mpc]=c/H_0. Calculation shows that a galactic void 50 Mpc wide will increase by a linear recession velocity 50 times greater than for an inter-galactic distance of 1Mpc.

The figure illustrates by a diagonal intersecting the coordinates of space-time (r_U-t_U) that H_0 maintains a relativistic relationship of "space-time-velocity". The latter, is shown as complementarities to expansion, by a function of the quantum relationship "space-time-photon-elongation ($n\gamma \times V\gamma$)". Hence, expansion appears as an energy continuum, which through photon multiplication-elongation constructs a quantum-structured vacuum, which is the major contributor to the cosmos grow.

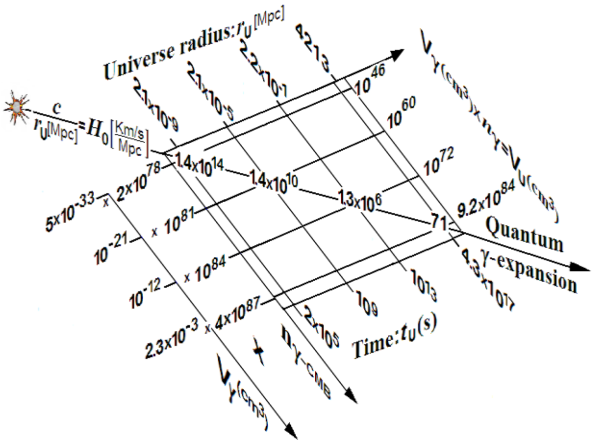

Figure 1: Observation vs. calculated Quantum Integrated Expansion. *The figure, shows that the multiplication:* $n\gamma \times V\gamma[cm^3] = V_U[cm^3]$, *determines the quantum-integrated volume of the universe in* cm^3, *under the relativistic restriction: radius of the universe in cm over its elapsed time in seconds:* $r_U[cm]/\ t_U[s] = c[cm/s]$. *If the chronological radius of the universe equals recession distance:* $r_U = \vec{r}$. *The velocity of expansion could be measure, after the appearance of galaxies, as a recession velocity:* $\vec{v} = \vec{r}[Mpc] \times H_0$ $\therefore$ $r_U[\cancel{Mpc}] \times H_0[km/s/\cancel{Mpc}] = c$, *as shown in the figure:* $c[km/s]\ /\ \vec{r}_U[Mpc] = H_0[km/s/Mpc]$. *Hence,* $r_U = t_U \times c$ $\therefore$ $t_U \times \cancel{c} \times H_0 = \cancel{c}$ $\Rightarrow H_0 = 1/t_U = 3.086 \times 10^{19}$ *km/* t_U */Mpc,* $t_U[s]$, *example:* $H_0 = 3.086 \times 10^{19}$ *km/4.34×10*^{17}*s /Mpc=71.1 km/s/Mpc.*

A after the CMB-radiation, becomes separated from matter, PDC-dependent photons multiplication of CMB, by emerging uniformly everywhere in the universe, could have proportionally greater number of photons increment ($\Delta n\gamma$) at larger volumes.

The relationship of the fundamental constants to the quantum parameters of CMB elongation

The simulation shows a role of c defining the causality horizon as a function of the rates of progress of CMB universe radius.

A. Connes [29] describes a universe integrating a continuum and non-continuum geometries. If these could be thermodynamic differentiable structures, would require separate energy transduction pathways, for the specific cosmic roles integrating CMB-radiation with ordinary matter. The model integrates within a quantum-structured universe a relativistic expansionary continuum.

This model was simulated by keeping track of the energy space-time relation using the transformation of particle energy into a Compton wavelength: $\lambda_c = h/2\pi mc$. Dimensionally λ_c is similar to γ, this relationship allows to reach from its duality the equivalence of γ in terms of a wavelength λ and frequency v.

These relationships reveal a thermodynamics structure with equivalence to the Planck mass m_{Pl}, and its relationship to the fundamental constants. According to Planck: $m_P = \hbar^{1/2} \times c^{1/2} \times G^{-1/2}$ =2.17645×10^{-5}g.

Equation 1: Planck's: $m_P = \sqrt{\hbar c/G}$ and Equation 2: Einstein's: $m_P = E_P/c^2$ since both share the same terms m_P became equalized:

Equation 3: $\sqrt{\hbar c/G} = E_P/c^2$

$r_{\gamma-\mathrm{CMB}}/t_{\gamma-\mathrm{CMB}} = c$ and $r_U/t_U = c$ an because:

$E_P = 2\pi\hbar \times \nu_P$ (ν_P Planck's frequency=2.952119155×10^{42}s^{-1})

Equation 4: $\sqrt{\hbar c / G} = \dfrac{2\pi\hbar \times \nu_P}{\dfrac{r_{\mathrm{U}}}{t_{\mathrm{U}}} \times \dfrac{r_{\gamma-\mathrm{CMB}}}{t_{\gamma-\mathrm{CMB}}}}$ introducing c

equivalent: $r_{\mathrm{U}} \times H_0 = c$.

Equation 5: $\sqrt{\dfrac{\hbar \times H_0 \times r_{\mathrm{U}}}{G}} = \dfrac{2\pi\hbar \times \nu_P}{\dfrac{r_{\mathrm{U}}}{t_{\mathrm{U}}} \times \dfrac{r_{\gamma-\mathrm{CMB}}}{t_{\gamma-\mathrm{CMB}}}}$

Equation 6:

$$2\pi\sqrt{\hbar \times G} = \frac{\dfrac{r_{\mathrm{U}}}{t_{\mathrm{U}}} \times \dfrac{r_{\gamma-\mathrm{CMB}}}{t_{\gamma-\mathrm{CMB}}}}{\nu_P} \times H_0^{1/2} \times r_{\mathrm{U}}^{1/2}$$

Because: $\nu_P = \nu_{CMB} \times 2^{\mathrm{n}}$

Equation 7: $2\pi\sqrt{\hbar \times G} = \dfrac{r_{\gamma-\mathrm{CMB}} \times H_0^{1/2} \times r_{\mathrm{U}}^{3/2}}{\nu_{CMB} \times 2^{\mathrm{n}} \times t_{\mathrm{U}} \times t_{\gamma-\mathrm{loc}}}$

Equation 8:

$$2\pi\sqrt{\hbar \times G} = \frac{r_{\gamma-\mathrm{CMB}} \times r_{\mathrm{U}}^{3/2}}{t_{\mathrm{U}} \times t_{\gamma-\mathrm{loc}}} \times \frac{H_0^{1/2}}{\nu_{CMB} \times 2^{\mathrm{n}}}$$

$E_P = E_{\gamma-CMB} \times 2^{\mathrm{n}}$ "n" could be calculated for present $\mathrm{CMB}_{2.725\mathrm{K}}$, predicting a PDC sequence of 105 cycles:

$$1.22 \times 10^{22}\,\mathrm{MeV} = 2.353 \times 10^{-10}\,\mathrm{MeV} \times 2^{\mathrm{n}} \Leftrightarrow \mathrm{n} \approx 105$$

The model is concordant with the observed behaviour of vacuum increasing the distancing between galaxies, but without apparently interfering with their gravity-dependent mutual approach.

Quantum gravitation would exercise attraction according to cosmic mass distribution, this leads to greater galactic density along the borders of the enclosed voids, producing the observed filamentary and laminar galactic structures reported by the CFA galactic survey.

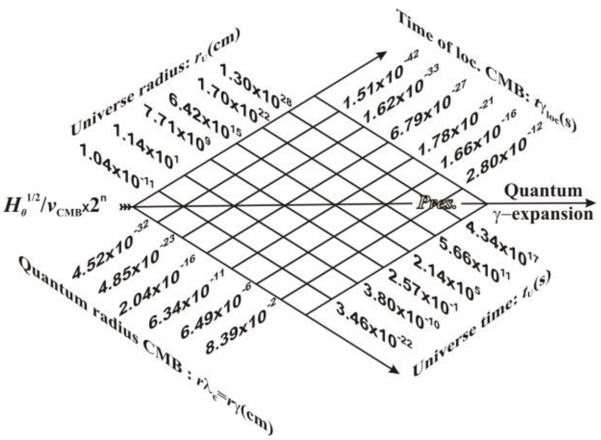

Figure 2: Plotting merging quantum and relativistic parameters. *The quantum dimensions starting as:* $\mathbf{r}\gamma_{Pl} / \mathbf{t}\gamma_{Pl} = c$*, are quantum dimensions which interrelate with c a relativistic parameter. The photon radius* $\mathbf{r}\gamma$ *as* $4/3\times\pi\times(\mathbf{r}\gamma)^3$ *adds to the observable universe volume dimensions,* $\mathbf{t}\gamma_{-loc}$ *does not, but c links universe radius as a function of the universe time. Total energy (*E_T *= entropy + enthalpy) for its conservation at the level of CMB, requires a compensatory mechanism like the spontaneous PDC-process, in which the halving of the energy of 1 photon generates 2 of twice the original-*λ *and conservation of momentum. Accordingly, even if photons are subject to Gravity, a dynamic CMB structured-vacuum could expand by a PDC-dependent* $\Delta n\gamma$ *and* $\Delta V\gamma$*, a process independent of Gravity.*

As the universe expands, the relative contribution to expansion of voids vs. intergalactic space, leads to the eventually predominance of the former. Voids by becoming larger over time, changes the distances in-between cumulus which is participating in the encircling of the voids. This lowers their mutual gravitatory attractions.

The formula predicts that Hubble's constant, a measure of cosmic expansion, could also encompass a function of a quantized treatment of critical energy. Thus a decrease in CMB-photon density, quantum dimensionally relates to a radius and nγ simultaneous increments with that of the universe time and the time of CMB-localization.

Quantum-parameters of Inflation

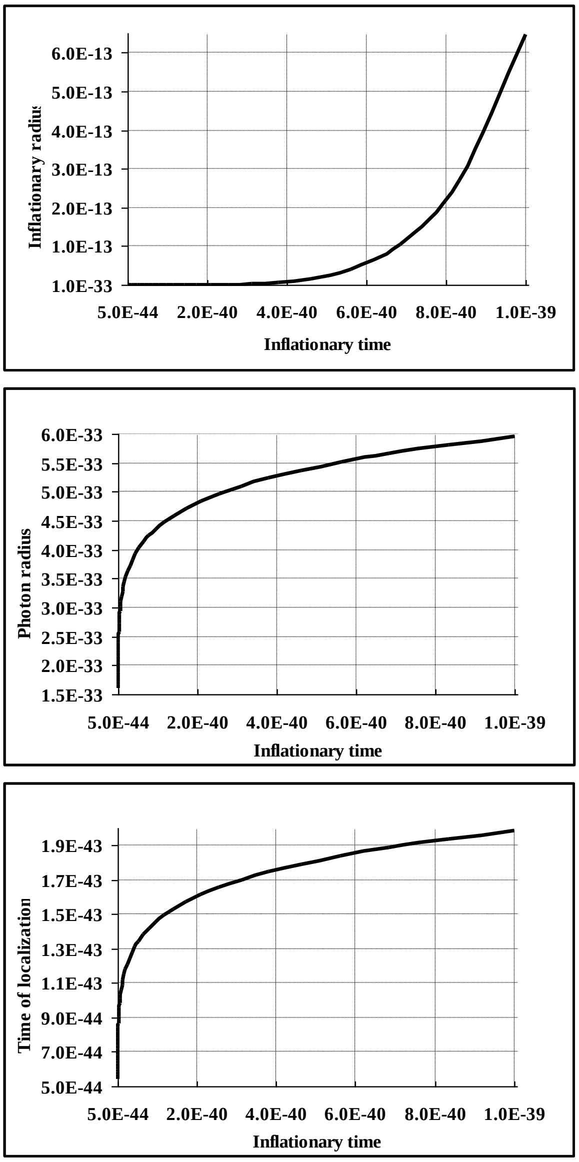

Figure 3: Inflation. *Illustrates that the total energy E_T (or critical energy E_c) becomes quantized in the course of inflation as Planck (Pl) particles each one generating by PDC two photons of half energy. Thus, expanding by $2\times8=16$ the space-time locus, allowing a chain reaction of additional Planck photons incoming into the inflationary universe, up to summa of their energy equals E_T.*

A Physical worthless description of an origin preceding the Planck, could be based in that whereas there is a physical limit for mass, there is not a gravitational limitation of how high could be the frequency. However, the causality horizon could not be exceeding for the future or the past.

It is widely accepted, than from a source outside the actual parameters of physics, the universe started at the Planck dimensions, creating a "quantum universe" that could be defined by: $m_P = (\hbar c / G)^{1/2}$. The Planck limit: 1.22×10^{22} MeV, could be described as a theoretical particle, but also corresponds to the minimum dimensions for a black hole, according to quantum mechanics.

Exceeding the Planck time of localization: $t_{P-loc} = 5.39\times10^{-44}\text{s}$, the particle or black hole energy, is released ("vaporized") as a photon [30], which may indicate that the quantum universe, could be initiated by a single particle opening the space-time to subsequently incoming particles. An increment in the number of particles will change the temporal relationship from $r_\gamma = c\times t_{\gamma-loc}$ for a single particle to the universe time $r_U = c\times t_U$.

Time of the universe increments in relationship to the universe radius, and vaporization time would exceed that of Planck. Calculation shows that if all the critical energy would be incorporated into the quantized universe at once, the resulting increase in mass would not allow the Big-Bang.

Figure 2, inflation for a Planck or quantum structured universe may implicate that the initial cosmic increment in volume, would be dominated by the dynamics of increment in the number of Planck particles. This because, even to the end of inflation the number of Planck particles, which PDC degraded to lower energy levels, would be smaller than the lastly incorporated as Planck. Hence, at the end of inflation the energy spread would have frequency dispersion with some similarity to that of a black body spectrum.

It is in the realm of causality descriptions, to use quantum parameters to theoretically evaluate inflation. This was done, as shown in the figure by assuming that the space-time grows as a function of dual dimensional parameters, the simultaneous incorporation of new photons and their PDC-dependent elongation. Under this condition of a quanta increasing and expanding universe, energy density would not decrease nor would increase entropy. Unfortunately, physics could not reveal, if there is any causality relationship that could link such a process with a primordial donor.

Entropy and the arrow of time

A flat universe requires some form of smoothly extending space without significant energy expenditure. The pattern of PDC uniformly spreading the energy of the CMB system would expand vacuum without an observable influence in preventing local galactic clustering or any disruptive effects over solar systems. The calculation shows that the number of newly generated photons, $\Delta n\gamma$, as a function of time and volume may require elaborating detection experiments according to following projection:

$$\frac{\Delta n\gamma / \Delta V}{\Delta t} = \frac{1.86\times10^{87}\gamma / 8.63\times10^{84} cm^3}{1.72\times10^{17} s}$$

$$= \frac{3.95\times10^{7}\gamma / Km^3}{year}$$

The surging of new photons may be detected as vacuum fluctuations, if the later exceed by much this number, may be due to partial reversibility between PDC and PUC cycles.

The Planck density, δ_{Pl}, evolves as a dissipative function of PDC incrementing photon number progressively, but each PDC cycle leading to less and less photon energy density, $\delta_{E\gamma} = E_T / V_U = E_\gamma \times \cancel{n\gamma} / V_\gamma \times \cancel{n\gamma} \therefore \delta_{E\gamma} = E_\gamma / V_\gamma$, a quantum relation linking the increment of γ-volume to the V_U chronology.

$$\Delta\delta_U = \frac{E_T}{V_T} = \frac{E_T}{4/3\times\pi\times(\Delta r_U)^3}$$

$$= \frac{E_T}{4/3\times\pi\times c^3\times(\Delta t_U)^3}$$

$$\Delta\delta_U = \frac{E_T}{V_T} = \frac{E_T}{V_\gamma \times n\gamma} = \frac{E_T}{4/3\times\pi\times(\Delta r_\gamma)^3\times n\gamma}$$

Penrose [8], calculate the entropy of the primordial cosmos to present as 10^{150}. Gravitational entropy $S_{grav}=10^{121}$ [30].

The entropy based in the disorder increment for the summa of photons and baryons for the period $\Delta S_{\gamma+B[n\gamma=nB/prs]} = 10^{88} k$. Thermal of relic CMB and gravitational entropies have been considered the main components of the universe entropy that up to present volume equals 10^{88} k (Boltzmann constant's) units (30).

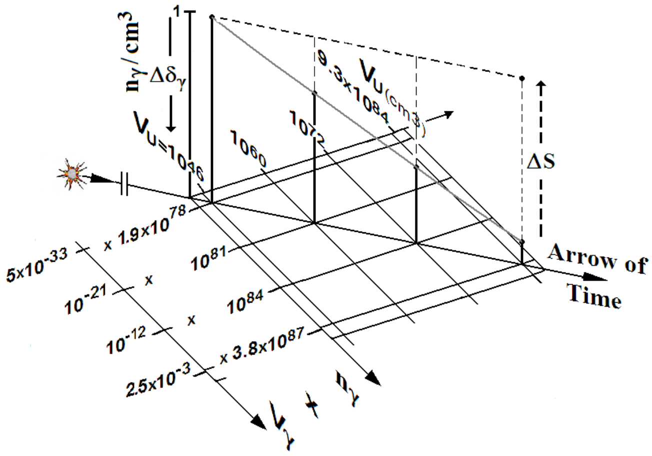

Figure 4: Increment of CMB system entropy (ΔS_{CMB}). *The chronology of CMB density ($\Delta\delta\gamma$: $n\gamma/cm^3$), was used to plot normalized the entropy change from the Era of equal number of photons and baryons to present,* $S_{CMB[n\gamma=nB/prs]}$*. The latter, is illustrated by vertical lines, which integrate the decreasing enthalpy (ΔH: full lines) with its corresponding entropy increase (ΔS: broken lines). The cosmos volume increases from 1.5×10^{48} cm^3 to 9.3×10^{84} cm^3. Photon density decreases according to a geometric progression 1.25×10^{-1}. The c appears to indicate the presence of a space-time restriction to expansion. As described: $V_{\gamma\text{-RELIC-CMB}} = 2.5\times10^{-3}$ cm^3 $\times$ $n\gamma_{prt}$ = total $V_{U\text{-RELIC-CMB}}$ or $V_{U\text{-prt}} = 9.3\times10^{84}$ cm^3.*

The quantum-dimensioning entropy gain of the PDC expansionary process was specifically evaluated by considering only the contributions of $\Delta n\gamma$ and ΔV_γ.

The mol a unity of density was used as a function of V_U, to assay entropy of the CMB system, which according to Boltzmann for an x state of a box volume: the constant: $k = 1.38\times10^{-23}$ J/K = 8.614×10^{-11} MeV/K and entropy $\Delta S = k \times \log V$.

If the initial number of Planck particles ($n\gamma_P$) could had remain constant, n that represents the number of photons should not be included in the equation. For the period $n\gamma = n_B / prs$: $S_{CMB[n\gamma=nB/prs]}$:

$$S_{CMB[n\gamma=nB/prs]} = k\times\log\left(\frac{\mathrm{V_{U[prs]}}}{\mathrm{V_{U[n\gamma=nB]}}}\right)$$

$$= k\times\log\left(\frac{9.3\times10^{84}cm^3}{1.5\times10^{48}cm^3}\right) = k\times\log\left(6.2\times10^{36}\right)$$

PDC continuously increases $n\gamma$ because each Planck particle spreads its energy to reach the actual value of CMB.

However, for the Era of equals number of photon and baryons, the increment was only between $n\gamma$ =1.9×10^{78} and $n\gamma_{CMB}$ =3.8×10^{87}, because most of the primordial photons were consumed in the generation of matter. The increment requires introducing this difference as $\Delta n\gamma_{CMB}$.

$$S_{CMB[n\gamma=nB/prs]} = k\times\log\left(\frac{\mathrm{V}_\gamma\times n\gamma_{\text{present}}}{\mathrm{V}_\gamma\times n\gamma_{n\gamma=\text{nB}}}\right)$$

$$= k\times\log\left(\frac{2.5\times10^{-3}\times3.8\times10^{87}}{8.8\times\times10^{-31}\times1.7\times10^{78}}\right) = k\times\log\left(6.2\times10^{36}\right)$$

R=8.314472 J/mol×K =5.189486×10^{13}MeV/mol×K

$$\Delta S_{CMB[n\gamma=nB/prs]} = \frac{\Delta n_\gamma}{6.023\times10^{23}}\times R\times\log\left(\frac{\mathrm{V_{U[prs]}}}{\mathrm{V}_{\mathrm{U}[n\gamma=\mathrm{nB}]}}\right)$$

$$= \frac{\left(3.8\times10^{87}-1.9\times10^{78}\right)}{6.023\times10^{23}}\times5.2\times10^{13}\,\frac{\text{MeV}}{\text{K}}\times\log 6.2\times10^{36}$$

$$= 1.19\times10^{79}\,\frac{\text{MeV}}{\text{K}}$$

The very low, remaining energy in residual CMB, about only 1/20000 of E_C, reduces its role after having transfer energy for the formation of matter, to only its elongation. Hence, spontaneous PDC is a process with entropy gain, which as shown in the preceding equations, is mainly a function of expanding vacuum and the increment in $n\gamma$.

Evaluation of PDC-entropy

PDC as a spontaneous process does not implicate, at its own quantum dimensioning level, any significant energy expenditures.

PDC at the cosmos level could magnify its entropy impact by the space-time changes incrementing quantum disorder over the totality of E_c. This one implicates at least an energy dimension 20000 times larger, than that of residual CMB. The resulting quantum disorder is additional, but could be differentiated and separately calculated.

Taken in account the Planck or initial to inflation volume:

$$S_{PDC} = k\times\log\frac{V_U}{V_{Pl}} = k\times$$

$$\times\log\frac{9.2\times10^{84}cm^3}{1.768\times10^{-98}cm^3} = 183k$$

However, quantification of the universe energy leads to $n\gamma$ =1.51×10^{60} Planck particles which requires the aggregated volume =1.14×10^{-36} cm^3.

$$\Delta S_{PDC} = \frac{\left(3.8\times10^{87}-1.5\times10^{60}\right)}{6.023\times10^{23}}\times$$

$$\times5.2\times10^{13}\,\frac{\text{MeV}}{K}\times\log\frac{9.2\times10^{84}}{1.14\times10^{-36}}$$

$$\Delta S_{PDC} = 3.94\times10^{79}\,\frac{\text{MeV}}{K}$$

The space-time parameters for quantum dimensions

The known relationships, between particle radius and time of localization: $\lambda_c = h/2\pi mc$, define the minimum localization distance or radius for a particle of mass m and for De Broglie's $\lambda_{\text{deB}} = h/2\pi m\text{v}$, when velocity v=$c$ [11].

It is outside the scope of this work, to advance the understanding of the physical nature of time, but t_U a relativistic parameter and t_{loc}, a quantum parameter appear as linked as shown by Eq.8. This one, incorporate as a function of *G*, a constant involved into the warping of relativistic space, both dimensions of time which also became link as interdependent with simultaneous increments of the CMB-quantum and cosmic radiuses.

Equation 8:

$$2\pi\sqrt{\hbar \times G} = \frac{\Delta r_{\gamma-\mathrm{CMB}} \times \Delta r_{\mathrm{U}}{}^{3/2}}{\Delta t_{\mathrm{U}} \times \Delta t_{\gamma-\mathrm{loc}}} \frac{\Delta H_0{}^{1/2}}{\Delta \nu_{CMB} \times 2^{\mathrm{n}}}$$

Time of localization results from an inverse relationship of frequency: $1/\nu$. This allows inferring that t_{loc} encompass an oscillatory relationship to space because $\nu = c/\lambda \therefore t_{loc} = \lambda / c$ that by increasing t_{loc} would decrease the energy of λ or vice versa.

Experimentally, the velocity of light-propagation could be slow down until it stops, becomes in a confinement state [32, 33, 34]. The latter, may result from the uncoupling between energy and its oscillatory characteristics, which define a photon locus. The energy transfer as vibracional, oscillatory or rotational to a lattice (semi-crystal) media, may not increase molecular collisions (heat) as could be the case within a liquid phase.

The sodium atoms in the confinement media respond to the light by entering into superposition. The atoms may acquire two energy states simultaneously [31], in where the photons become entangled, transferring into the atoms the light's characteristics of shape, amplitude and phase [35]. Subsequent excitation of the atoms, returns into emitted light the original information

Hence, the thermodynamic structure within a confinement locus, allows that the quantum dimensions and the "energy parameters" of a light pulse, become uncoupled [19, 20], suggesting that their link was mediated by t_{loc}.

Thus, confinement may be one of the phenomena that could be described by space-time parameters, because suggest reversible time-dependent delocalization, of the energy and quantum information parameters.

Conclusions

The premise of an earlier universe dominated by radiation was evaluated by a simulation seeking a better-fit with astronomical observations. These empirical calculations, became supported by a simulation based in equation 8, which was develop from a framework of quantum mechanics and relativity postulations.

This mathematical treatment allows a cosmic chronology of CMB, which by decreasing frequency, an equivalent value to the black body emission temperature, allows a formula to be use as a "*quantum-transducer*" into a formalized model mechanism, for describing an expansionary continuum of the dimensions of the space-time.

The cosmos if self-contained could not be open. This apparent contradiction was solved, by considering that the universe by photon elongation could be maintained for a long period of time, as a system away from its equilibrium. Elongation, allows a partial recreation of the non-equilibrium potential by recycling photons, through the temporal bottleneck of the PDC process, reentering in the PDC chain like quanta of less and less energetic content.

References

[1] Gamow G., *Mr. Tompkins*, Cambridge University Press, Cambridge (1993).

[2] Grib A.A., Dorofeev V. Yu., Creation of particles in the early Friedmann Universe. Proc. of the Second A.A.Friedmann Intern. Seminar on Gravitation and Cosmology, 117 (1994).

[3] Einstein, A. & W. de Sitter, "On the Relation between the Expansion and the Mean Density of the Universe," *Proceedings of the National Academy of Sciences* **18**, 213 (1932). [Reprinted, with commentary, in Lang, Kenneth R. & Owen Gingerich, eds., *A Source Book in Astronomy & Astrophysics, 1900-1975* (Harvard Univ. Press, 1979), 849-50.].

[4] Borner, G.: 1988, "*The Early Universe*", New York. Springer-Verlag, Second Ed. (1992).

[5] Liddle, A., "*An introduction to Modern Cosmology*", John Wiley & Sons Ltd. Second Edition (2004).

[6] Linde A. D., "*Particle Physics and Inflationary Cosmology*", Phys. Lett. 129B, 177.(1983)

[7] Weinberg, S., "*Gravitation and Cosmology*", New York, John Wiley. (1972)
[8] Penrose Roger, "*El camino a la realidad*", Randon House Mondadori, Barcelona, (2006)
[9] El Hasi C. "*Non Trivial Dynamics and Inflation*", en "*Chaos in Gravitational N-Body Systems*" de J.C. Muzzio et al (*Kluwer Academic Publishers*) 239-244. (1996)
[10] Calzetta, E. and El Hasi C., "*Nontrivial Dynamics in the Early Stages of Inflation*", *Phys. Rev*. D51, 2713. (1995).
[11] L. de Broglie, *Tentative d`Interpretation Causale et Non-Liniare de la mècanique Ondulatoire*. Gauthier-Villards, Paris (1956); D. Bohm, *Phys. Rev*. 85, 166, 180 (1952).
[12] M. Torres Cisneros, J.W. Haus, P. Powers, P.Bojja, M. Scalora, M.J. Bloemer, N.Akozbek, L.A. Anguilera Cortes, R. Guzmán Cabrera, R.Castro Sánchez, M.A. Meneases Nava, J.A. Andrade Lucio y J.J. Sánchez Mondragon. *Conversión Parametrica en un Cristal fotónico no-lineal.* Revista Mexicana de Física **51**,pp 258-264 (2005).
[13] Bennun, A.: "A Model Dimensioning the Space-Time by Parametric Down-Conversion", The general science journal, Astrophysics: Sep. 5, (2007).
[14] Bennun, A.: "*Changes in Space-Time Configuration of CMB for a Role in Vacuum Fluctuations*", The general science journal, Astrophysics: Sep. 13, (2007).
[15] Bennun, A.: "*A Simulation Shows the Distinct Roles of Matter Curving and CMB Expanding Space*", The general science journal, Astrophysics: Dec. 18, (2007).
[16] *Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?,* A. Einstein, B. Podolsky and N. Rosen, *Institute for Advanced Study, Princeton, New Jersey. Physical Review,* volume 47 May 15, (1935).
[17] Smoot, G. and Scott, D., **Cosmic Background Radiation**, in Hagiwara, K. *et al*., Physical Review D**66**, 010001-1, 2002.
[18] G. Smoot, *COBE Observations and Results*, <arXiv:astro-ph/9902027> (1999).
[19] Bennun, A. Hypothesis for coupling energy transduction with ATP synthesis or ATP hydrolysis (1971). **Nature (New Biology) 233**, 5-8.
[20] Bennun, A. The unitary hypothesis on the coupling of energy transduction and its relevance to the modeling of mechanism. In "**Mechanism of Energy Transduction in Biological System"** (D.E. Green, ed.). (1974). **Annals New York Academy of Sciences, 227**, 116-145.
[21] D. B. Cline, Sources and Detection of Dark Matter and Dark Energy in the Universe, Springer Verlag (2001).
[22] Belinfante, F., the Casimir effect revisited, American Journal Physics 55 (2), February (1987).
[23] Hushwater, V., Repulsive Casimir force as a result of vacuum radiation pressure, American Journal Physics 65 (5) (May 1997).
[24] Lamoreaux, S. K., Resource Letter CF-1: Casimir Force, American Journal Physics 67 (10) (October 1999).
[25] Bennun, A.: "*CMB Radiation and the Casimir Effect*", The general science journal, Quantum Physics: Dec. 12 (2007).
[26] Brida, G., Genovese, M., Novero, C., "Experimental limit on spontaneous parametric up conversion", Journal of Modern Optics, Vol. 50, N° 11, pp. 1757-1762 (6) (2003).
[27] Prigogine, *El Nacimiento del Tiempo*, Tusquets Editores, Buenos Aires (2006).
[28] Liddle, A. R., and Lyth, D. H., "*Cosmological Inflation and Large-Scale Structure*", Cambridge University Press, Cambridge. 2000.
[29] A. Connes and M. Marcolli, *International Math. Research Notices* 76, 4073 (2004).
[30] Reeves H., "*El primer Segundo*", Editorial Andrés Bello, 1998.
[31] Babin, W., "Relativistic Transformation Equations: Additional Support for the Existence of Dual States" The general science journal, Astrophysics: Mar. 15, 2006
[32] Kramper, P., Kafesaki, M., Soukoulis, C., Birner, A., Müller, F., Gösele, U., Wehrspohn, R., Mylnek, J., Sandoghdar, V., "Near-field visualization of light confinement in a photonic crystal micro-resonator", Optics Letters, Vol. 29, N° 2, pp. 174-176 (2004)
[33] Cao, H., Xu, J., Zhang, D., Chang, S., Ho, S., Seelig, E., Liu, X., Chang, R., "Spatial Confinement of a Laser Light in Active Random Media", Physical Review Letters, Vol. 84, N° 24, pp. 5584-5587 (2000)
[34] Fedotov, A., Bugar, I., Naumov, A., Chorvat, D., Sidorov-Biryukov, D., Chorvat, D. and Zheltikov, A., "Light confinement and supercontinuum generation switching in photonic-molecule modes of a microstructure fiber", JETP Letters, Vol 75, N° 7, pp. 304-308 (2002)
[35] C. Liu, Z. Dutton, C. H. Behroozi, L. V. Hau, Nature 409, 490 (2001).