DOES TEMPERATURE QUENCHING IN THE EARLY UNIVERSE EXIST IN PART DUE TO PARTICLE PRODUCTION? OR QUANTUM OCCUPATION STATES ?

ANDREW WALCOTT BECKWITH

abeckwith@uh.edu

Chongqing University department of physics, Chongqing, PRC, 400044

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Abstract

We examine the role of particle nucleation in the initial universe, and argue that there is a small effect due to particle nucleation in terms of lowering initial temperature, in tandem with energy density and scale factor contributiosn. If such scaling exists as a major order effect, then quenching of temperature proportional to a vacuum nucleation at or before the electroweak era is heavily influenced by a number, n, which is either a quantum number (quantum cosmology) or a 'particle count at/before the electro weak era.

A Introduction

We start off with a treatment of entropy initially using Muller and Loustos results [1] as of 2007 as to black hole entropy and also the entropy of the early universe. Afterwards, we refer to a paper by Crowell [2] as to a treatment of black hole entropy and a partition function argument which we generalize to work with early entropy. In dong so, we also refer to an argument given by Park et al [3] as far as the temperature dependence of the vacuum energy via quintessence (string theory result) to come up with an early universe model as far as how to isolate temperature of the early universe. Once this is done, the next step will be, seeing that this derived temperature, which is decreased by a certain amount depending upon energy, numerical count and also other factors while being divided by a time interval to a given power. This relationship as stated establishes the role which nucleation of particles or essential quanta plays in lowering temperature. Afterwards, the author initiates a discuxsion as to what role a re interpretation of the HUP as far as uncertainty may play as far as entropy-temperature dynamcics as well as what may initiate the quinessence phenomenon, as alluded to in [3]

B. **Construction of Temperature quenching. Preliminary argument.**

The main point of the formalism is to establish first order contributions as to the quenching of temperature phenomena. We will set up the initial phenomenological formula for temperature quenching and sequentially explain its constiuent parts.

To begin with. Look at how to construct entropy for black holes and also the early universe.

Note that for gravity one has , if k is Boltzmans constant, and N the number of Microstates.. Note that formula 1 turns to formula 2 if N is large

$$S = k \ln N \tag{1}$$

Now, by Muller and Luosto [1] as well as Crowell [2] one can write for the early universe:

$$S = kA / 4l_P^2 \tag{2}$$

B1. What if one looks at a treatment of black holes?

The area A is such, that by Crowell [2] we can write this area as, for a black hole of mass M

$$A = 16\pi M^2 \tag{3}$$

For a string theory treatment of black holes we will write [2]

$$A = 16\pi\alpha \sum_{i=1}^{N} n_i \tag{4}$$

So what is α ?

If what Ng writes for Quantum infinite statistics [4], [5] is true, then

$$E = \alpha E_P \sqrt{n} \Leftrightarrow \alpha = \frac{1}{2}\frac{\sqrt{\ln 2}}{\pi} \tag{5}$$

B2 . Partition function treatment of black holes. [2]

Crowell wrote having a partition function for Black holes defined by

$$Z = \sum_n \exp\left[4\pi\omega_n\right]\cdot \exp\left[-\beta\alpha\sqrt{n}\right] \tag{6}$$

This was achieved by a normal modes for black holes, of mass M which was of the form [2]

$$\omega_n = \alpha^2 = \frac{\ln 3}{8\pi M} + \frac{i}{4M}\cdot\left(n+\frac{1}{2}\right) + \tag{7}$$

The imaginary componet to (7) above is what is not used if one uses the (5) result, which will lead to a bridge to early universe results. We will differentiate between the early universe result and (7) above by keeping fidelity with respect to the early universe, if one is looking at the real component of (7) above, while not looking at the imaginary results. This is in tandem with looking at the full expression of (7) for black holes, with real and imaginary results, while speculating that by way of contrast, if we have only the real part of (7), we are looking at a re do of the Ng entropy result,which would be in tandem with having (6) having no appreciative imaginary component.

How we wish to intepret how to interpret the rise of entropy from a black hole and entropy of the early universe. Note that [1] has an alternative expression for the early universe which can be written as, if a is the scale factor, of radii r_H for a hoizon radius, with

$$S = \frac{.3 r_H^2}{a^2} \tag{8}$$

And [1], [4]

$$r_H = \sqrt{3/\Lambda} \tag{9}$$

Here, the cosmological constant as given by [4] by Park, et al is of the form with T the background temperature, as given by

$$\Lambda \propto T^{\tilde{\beta}} \sqrt{3/\Lambda} \Rightarrow r_H = \sqrt{3/\Lambda} \cong \sqrt{3} T^{-\tilde{\beta}/2} \Rightarrow S \approx .3 \cdot 3T^{-\tilde{\beta}} / a^2 \qquad (10)$$

Above almost scales exactly as having the universe with entropy proportional to one over the temperature to the minus beta power times one over the square of the scale factor for early universe conditions.

To make it more revealing, note from [1] that one can write

$$S_{Early-Universe} \sim 16\pi\alpha^2 n \qquad (11)$$

Here also, from [1] we have an energy expression from (5) above, as well as employing the string theory result of

$$\begin{aligned} &S_{Early-Universe} \sim 16\pi\alpha^2 n \sim T^{-\tilde{\beta}} / a^2 \Rightarrow T^{-\tilde{\beta}} \propto 16\pi\alpha^2 n a^2 \\ &\Rightarrow T \approx 1 \Big/ \left(16\pi\alpha^2 n a^2\right)^{\beta} \end{aligned} \qquad (12)$$

Assuming we have a condition for which α is in a short period of time a constant in the early universe and also that we have for H the initial Hubble expansion parameter, and t the time , then if what is below, is

$$a \sim a_0 \exp(H \cdot t) \sim a_0 (Plank - time) \qquad (13)$$

Then in the regime of Planck time we are looking at

$$T \approx 1 \Big/ \left(16\pi\alpha^2 n a^2\right)^{\beta} \sim \left[\frac{(1 - H \cdot t)^{\tilde{\beta}}}{a_0^{\tilde{\beta}}}\right] \cdot \frac{1}{n^{\tilde{\beta}}} \propto \frac{1}{n^{\tilde{\beta}}} \qquad (14)$$

The proportionality of temperature, T, in the Planck time regime is saying that as n is “nucleated” or created, that the temperature scales down. Note that beyond the Planck interval of time, one will be beginning to look at a time dependence, according to the coefficient $\left[\frac{(1 - H \cdot t)^{\tilde{\beta}}}{a_0^{\tilde{\beta}}}\right]$ with H a constant. Before then the dominant effect of scaling down will be on the creation of $\frac{1}{n^{\tilde{\beta}}}$ contributions to dropping of the temperature.

C**. Conclusion. Looking at Arguments as to applying Eq. (14) in the vicinity of the big bang**

Equation (14) is, if Stoica is correct about there being no cataclysmic real time break with physics at the beginning of the big bang [6] and if Beckwith is also correct in saying a string theory embedding of the initial cosmic singularity is mandatory [6] , saying something very profound. Note that Beckwith earlier [7] wrote that earlier, that

"*The main problem as the author sees it, is insuring the existence of disjoint sets at a point of space-time. If one views a finite, infinitely small region of space-time, as given by Plank's interval as 1.616 times 10 ^-35 meters as contravening a space-time singularity, in relativity, then even in this incredibily small length, there can be disjoint sets, and then the math construction of Surya[8] goes through verbatim. Classical relativity theory though does not have a Planck interval, i.e. the singularity of space-time, so in effect in General relativity in its classical form will not have the construction (…) . [6] written by Cristi Stoica gives a view of a beginning of space-time starting that does away completely with the space-time singularity, so mathematically, in a cosmos as constructed, if there is no singularity problem, there is then no restriction as to the collapse of space-time to an infinitely small point. In which then there would be no reason to appeal to a Planck's length graniness of space-time to enforce some rationality in the behavior of (quantum?) cosmology*."

The existence of n can be as given by [1] also predicated upon

$$n = \sum_{i=1}^{N} n_i \tag{15}$$

The problem with Eq. (15) above can be states simply in that one does not have a finite basis in a point of space time [1] , [7] . As in the argument by Beckwith [7]

In essence, for making a consistent cosmology, our results argue in favor of a string theory style embedding of the start of inflation and what we have argued so far is indicating how typical four dimensional cosmologies have serious mathematical measure theoretic problems. These quantum measure theoretic probem are unphysical espeecially in light of the Stoica findings [6]

Temperature scaling initially at the start of a big bang, according to (14) then raises the issue of where did the 'information' for Eq. (15) come from ? We guess it is from the embedding structure alluded to by Beckwith in [7]. The main issue to clarify in future research is , if Eq. (15) is due to occupation numbers of early variants of particle production, or are an artifact of quantum states in the guise of the SHO, damped or otherwise as is seen in elementary physics quantum texts world wide.

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The temperature scaling themes of Eq. (14) and by extension Eq (15) are extensions of the same issue, albeit from a different perspective.

My second word of thanks goes to my recently deceased father who discussed decades ago with me as to the worth of five dimensional gemoetry, in cosmology. This docunment is a testimony to the continuing influence his early life guidance in this issue has on his son to this very day.

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