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What Is a Way to Introduce a Huge Flux of Energy in the Initial Onset of Inflation? *i.e.* Use of Modified Hup and Torsion and a Possible Link to Quantum Number N Meant to Unify Black Holes, and a Quantum Universe

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Abstract

First, we consider if a generalized HUP set greater than or equal to Planck's constant divided by the square of a scale factor as well as an inflation field, yield the result that Delta E times Delta t is embedded in a 5 dimensional field which is within a deterministic structure. Our proof ends with Delta t as of Planck time yielding enormous potential energy. **Second**, we tie this energy to black hole physics and the early universe. *i.e.*, Our idea for black hole physics being used for GW generation, is using Torsion to form a cosmological constant. Planck sized black holes allow for a spin density term linked to Torsion. This is then linked to our **Third Idea**, which is a future linkage to Tokamak physics, and a quantum number *n*, for generation of gravitons as particles, which is the point of this document. *i.e.* to set the stage where Tokamaks may reproduce *n* as a quantum number.

Keywords

Inflationary Cosmology, Torsion Gravity, Gravitons, Gravitational Waves

1. Introduction and Summary as of the Ideas of This Document'

In this document, we are revisiting the following statement made earlier [1] [2]

Quote

Using the following

$$T_{ii} = diag\left(\rho, -p, -p, -p\right) \tag{1}$$

Then

$$\Delta T_{tt} \sim \Delta \rho \sim \frac{\Delta E}{V^{(3)}} \tag{2}$$

Then, Equation (1) and Equation (2) together yield

$$\delta t \Delta E \geq \frac{\hbar}{\delta g_{tt}} \neq \frac{\hbar}{2} \quad \text{Unless } \delta g_{tt} \sim O(1) \tag{3}$$

What we are going to do is to, in the initial variation of the GUP is to look hard at the initial idea given in Equation (3) is to make the following treatment at the start of expansion of the Universe [1] [2]

$$\delta g_{tt} \sim a^2(t) \cdot \phi \ll 1 \quad \text{Goes to become effectively almost ZERO.} \tag{4}$$

If this is effectively almost zero, the effect would be to embedd Quantum mechanics within a 5 dimensional structure.

Snip

i.e. this deterministic embedding is in part in spirit similar to what is given by Wesson [3]

End of Quote

What we will be doing is to add more context to this is to use the Wesson result directly in our own work and use it to in effect prove a deterministic contrubution in line with Equation (3) and Equation (4) of this document.

2. Modus Operandi, State Clearly What Is Given in Terms of an Inflaton Field

Before proceeding we should state that the inflaton field so used in Equation (3) and Equation (4) satisfies the following [2] [4]

$$\begin{aligned} & a(t) = a_{\text{initial}} t^{\nu} \\ & \Rightarrow \phi = \ln\left(\sqrt{\frac{8\pi G V_0}{\nu \cdot (3\nu - 1)}} \cdot t\right)^{\sqrt{\frac{\nu}{16\pi G}}} \\ & \Rightarrow \dot{\phi} = \sqrt{\frac{\nu}{4\pi G}} \cdot t^{-1} \\ & \Rightarrow \frac{H^2}{\dot{\phi}} \approx \sqrt{\frac{4\pi G}{\nu}} \cdot t \cdot T^4 \cdot \frac{1.66^2 \cdot g_*}{m_P^2} \approx 10^{-5} \end{aligned} \tag{5}$$

In the spirit of use of the inflaton field what we will propose is that [3]

$$\phi = \ln\left(\sqrt{\frac{8\pi G V_0}{\nu \cdot (3\nu - 1)}} \cdot t\right)^{\sqrt{\frac{\nu}{16\pi G}}} \approx \sqrt{\frac{\nu}{16\pi G}} \cdot \left(\sqrt{\frac{8\pi G V_0}{\nu \cdot (3\nu - 1)}} \cdot t - 1\right) \tag{6}$$

i.e. assume that if the initial time step is near Planck time which is normalized to 1 that

$$V_0 \approx \text{initial energy} \tag{7}$$

In addition we will go to Wesson [5] and to make the following adjustments.

3. Wesson's Treatment of Embedding of the HUP in Deterministic Structure [5]

$$\left|\mathrm{d}p_\alpha \mathrm{d}x^\alpha\right| \approx \frac{L}{l}\cdot\frac{h}{c}\cdot\left[\frac{\mathrm{d}l}{l}\right]^2 \tag{8}$$

where we will define l and L as follows

First, define L in terms of the cosmological "constant" by [5]

$$\Lambda = \frac{1}{3L^2} \tag{9}$$

Also

$$\mathrm{d}S_{5\text{-d}}^2 = \frac{L^2}{l^2}\mathrm{d}S_{4\text{-d}}^2 - \frac{L^4}{l^4}\mathrm{d}l^2 \tag{10}$$

Also, 5 dimensional wave number is defined via [5]

$$K_l = 1/l \tag{11}$$

In the case of Pre Planckian space-time the idea is to do the following [5]

$$\begin{aligned}
&\left|\mathrm{d}p_\alpha \mathrm{d}x^\alpha\right| \approx \frac{L}{l}\cdot\frac{h}{c}\cdot\left[\frac{\mathrm{d}l}{l}\right]^2 \\
&\xrightarrow[\alpha=0]{} \left|\mathrm{d}p_0 \mathrm{d}x^0\right| \simeq \left|\Delta E \Delta t\right| \approx \left(h/a_{init}^2\, \phi(t)\right) \\
&\Rightarrow \frac{L}{l}\cdot\frac{h}{c}\cdot\left[\frac{\mathrm{d}l}{l}\right]^2 \approx \left(h/a_{init}^2\, \phi(t_{init})\right)
\end{aligned} \tag{12}$$

Making use of all this leads to [3] [4]

$$\int_{l_1}^{l_2} \mathrm{d}l/l^{3/2} \approx \frac{l_2 - l_1}{l^{3/2}(c)} \approx \frac{(3\Lambda)^{1/4}}{a_{init}\cdot\left(\dfrac{\nu}{16\pi G}\right)^{1/4}\cdot\left(\sqrt{\dfrac{8\pi G V_0}{\nu\cdot(3\nu-1)}}\cdot t - 1\right)^{1/2}} \tag{13}$$

4. Extracting Time Initial from Equation (13) and What If Time Is Equal to Planck Time? Extract V_0

Our approximation is to set $G = 1 = h$ (Planck units) with Planck time normalized to 1. Then

$$t = t_{\text{planck}} \to 1 = \sqrt{\frac{\nu(3\nu-1)}{8\pi V_0}} + \sqrt{\frac{2\cdot(3\nu-1)}{V_0}}\cdot\frac{a_{init}^2\cdot(l_2-l_1)^2}{l^3(c)\cdot(3\Lambda)^{1/2}} \tag{14}$$

Then we have that at Planck time, normalized to 1 we look at

$$V_0 = \left(\sqrt{\frac{\nu(3\nu-1)}{8\pi}} + \sqrt{2\cdot(3\nu-1)}\cdot\frac{a_{init}^2\cdot(l_2-l_1)^2}{l^3(c)\cdot(3\Lambda)^{1/2}}\right)^2 \tag{15}$$

5. End Game, in Initial Configuration in Planck Time, Make the Following Assumption

We assume that we have an emergent space-time. If so, and in the spirit of [6], we state

$$V_0 = \left(\sqrt{\frac{\nu(3\nu-1)}{8\pi}} + \sqrt{2\cdot(3\nu-1)} \cdot \frac{a_{init}^2 \cdot (l_2 - l_1)^2}{l^3 (c) \cdot (3\Lambda)^{1/2}} \right)^2 \approx \Delta E \tag{16}$$

This concludes having a linkage as to [6] in terms of a huge energy flux into the early universe

Having said this, what can we now say about graviton mass, in the early universe?

6. Starting off with a Classical Black Hole Treatment of the Early Universe. This Would Be the only Time When an Event Horizon Would Ever Be Entertained or Discussed

When initial radius $R_{\text{initial}} \to 0$ if Stoica [7] actually derived Einstein equations in a formalism which remove the big bang singularity pathology, then the reason for Planck length no longer holds. This incidently is not too dissimilar to what was brought up in [8] [9] However, we present entanglement entropy in the early universe with a shrinking scale factor, due to Muller and Lousto [10], and show that there are consequences due to initial entangled $S_{\text{Entropy}} = 0.3 r_H^2 / a^2$ for a time dependent horizon radius r_H in cosmology, with (flat space conditions) $r_H = \eta$ for conformal time. Even if the 3 dimensional spatial length goes to zero. This construction preserves a minimum non zero Λ vacuum energy, and in doing so keep the bits, for computational bits cosmological evolution even if $R_{\text{initial}} \to 0$. We state that the presence of computational bits is necessary for cosmological evolution to commence. Note that τ time is with regards to In the time domain, the usual choice to explore the time response is through the step response to a step input, or the impulse response to a Dirac delta function input In the frequency domain. Here the step input is with regards to initial conditions of the early universe. Also, conformal time $\mathrm{d}\eta = \mathrm{d}t / a(t)$, where what is called time *t*, is in this case identical to τ time.

This article is to investigate what happens physically if there is a non pathological singularity in terms of Einsteins equations at the start of space-time. This eliminates the necessity of having then put in the Planck length since then ther would be no reason to have a minimum non zero length. The reasons for such a proposal come from [7] by Stoica who may have removed the reason for the development of Planck's length as a minimum safety net to remove what appears to be basic pathologies at the start of applying the Einstein equations at a space-time singularity, and are commented upon in this article. $\rho \sim H^2 / G \Leftrightarrow H \approx a^{-1}$ in particular is remarked upon. The idea is that entanglement entropy will help generate bits, due to the presence of a vacuum energy, as derived at the end of the article, and the presence of a vacuum energy non zero value, is necessary for cosmological evolution. Before we get to that creation of what is a necessary creation of vacuum energy conditions we refer to constructions leading to extremely pathological problems which could lead to minus the presence of initial non zero vacuum energy. [6] also adds more elaboration on this. Note a change in entropy formula given by Lee [9] about the inter relationship between energy, entropy and temperature as given by

$$m \cdot c^2 = \Delta E = T_U \cdot \Delta S = \frac{\hbar \cdot a}{2\pi \cdot c \cdot k_B} \cdot \Delta S \tag{17}$$

As a reviewer has asked about Equation (17) and the inter relationship of a mass m, and acceleration, the key point of this review is to look at if gravitons have a mass, m, in the beginning, and if Equation (17) is used, which the mass of a graviton is proportional to the following

$$m = \frac{\Delta E}{c^2} = \frac{T_U \cdot \Delta S}{c^2} = \frac{\hbar \cdot \hat{a}}{2\pi \cdot c^4 \cdot k_B} \cdot \Delta S \tag{18}$$

The reason why the mass of a graviton is stated as given by Equation (1a) is to presume that the relation ship given by Lee [9], as to any mass, is given by Equation (17) and Equation (18) so we can relate any presumed mass linked to gravitons to change in entropy. As to acceleration appearing, the acceleration, $\hat{a} \cong \frac{c^2}{\Delta x}$ was part of the formula given by Equation (17) and by default Equation (18). and also by thermodynamic reasoning the generalized temperature

$$T_U = \frac{\hbar \cdot \hat{a}}{2\pi \cdot c^2 \cdot k_B} \tag{19}$$

If we assume, in the onset of expansion of the universe, that Equation (19) holds, then we can review the application of Equation (18) to graviton mass, m, as $m = \frac{\Delta E}{c^2} = \frac{T_U \cdot \Delta S}{c^2}$, and to have acceleration, given by $\hat{a} \cong \frac{c^2}{\Delta x}$ as part of a definition of generalized temperature, given by Equation (19) with the rate of operations $< E/\hbar \Rightarrow \#\text{operations} < E/\hbar \times \text{time} = \frac{Mc^2}{\hbar} \cdot \frac{l}{c}$. Ng wishes to avoid black-hole formation $\Rightarrow M \le \frac{lc^2}{G}$. This last step is not important to our view point, Note the interesting interplay between entropy in Equation (18) and the Lousto result of the universe as given in [10] *i.e.* entangled $S_{\text{Entropy}} = 0.3 r_H^2 / a^2$ for a time dependent horizon radius r_H in cosmology, with (flat space conditions) $r_H = \eta$ for conformal time. Even if the 3 dimensional spatial length goes to zero. This construction preserves a minimum non zero Λ vacuum energy, and in doing so keep the bits, for computational bits cosmological evolution even if $R_{\text{initial}} \to 0$. We state that the presence of computational bits is necessary for cosmological evolution to commence. And this can lead to the following, *i.e.* Review of Ng, [11]-[13] with comments. First of all, Ng refers to the Margolus-Levitin theorem but we refer to it to keep fidelity to what Ng brought up in his presentation. Later on, Ng refers to the $\#\text{operations} \le (R_H/l_P)^2 \sim 10^{123}$ with R_H the Hubble radius. Next Ng refers to the $\#\text{bits} \propto [\#\text{operations}]^{3/4}$. Each bit energy is $1/R_H$ with $R_H \sim l_P \cdot 10^{123/2}$

The key point as seen by Ng [11]-[13] *and the author is in*

$$\#\text{bits} \sim \left[\frac{E}{\hbar} \cdot \frac{l}{c}\right]^{3/4} \approx \left[\frac{Mc^2}{\hbar} \cdot \frac{l}{c}\right]^{3/4} \tag{20}$$

Assuming that the initial energy E of the universe is not set equal to zero, which the author views as impossible, the above equation says that the number of available bits goes down dramatically if one sets $R_{\text{initial}} \sim \frac{1}{\#}\ell_{Ng} < l_{\text{Planck}}$? *Also Ng writes entropy S as proportional to a particle count via N.*

$$S \sim N \cong [R_H/l_P]^2 \tag{21}$$

We rescale R_H *to be*

$$R_H\big|_{\text{rescale}} \sim \frac{l_{Ng}}{\#} \cdot 10^{123/2} \tag{22}$$

The upshot is that the entropy, in terms of the number of available particles drops dramatically if # *becomes larger.*

So, as $R_{\text{initial}} \sim \frac{1}{\#}\ell_{Ng} < l_{\text{Planck}}$ *grows smaller, as* # *becomes larger but as we state, we do NOT have a working almost singular start, i.e. close but no singularity at the start of expansion. Having said this, we will conflate this discussion with Gravitons, and black holes, with a venture into Torsion and dark energy* [14] [15].

7. Having Said this, Its Now Time to Go to Torsion for Application of This to Tie It into the Cosmological Constant Problem and Black Holes

One, of the things to check into, is do we have Equation (19) going up say close to Planck temperature? *If so we can then to to the idea of a BEC scaling argument as to the formation of early niverse structure, and the link to primordial gravitons.*

To do this review how Torsion may allow for understanding a quantum number *n*? And Primordial black holes and the cosmological constant.

Following [14] [15], we do the introduction of black hole physics in terms of a quantum number *n*.

$$\sqrt{\Lambda} = \frac{k_B E}{\hbar c S_{\text{entropy}}} \qquad S_{\text{entropy}} = k_B N_{\text{particles}} \tag{23}$$

And then a BEC condensate given by [14]-[17] as to

$$m \approx \frac{M_P}{\sqrt{N_{\text{gravitons}}}}$$
$$M_{BH} \approx \sqrt{N_{\text{gravitons}}} \cdot M_P$$

$$\begin{aligned} R_{BH} &\approx \sqrt{N_{\text{gravitons}}} \cdot l_P \\ S_{BH} &\approx k_B \cdot N_{\text{gravitons}} \\ T_{BH} &\approx \frac{T_P}{\sqrt{N_{\text{gravitons}}}} \end{aligned} \tag{24}$$

This is promising but needs to utilize [4] [14] in which we make use of the following. First, a time step. Here, Equation (25) to Equation (28) are with respect to Planck era physics

$$\tau \approx \sqrt{GM\delta r} \tag{25}$$

By use of the HUP [14] [15], we use Equation (25) for energy [14] [15] for radiation of a particle pair from a black hole,

$$|E| \approx \left(\sqrt{GM\delta r}\right)^{-1} \hbar \tag{26}$$

Here we assert that the spatial variation goes as

$$\delta r \approx \ell_P \tag{27}$$

This is of a Plank length, whereas we assume in Equation (28) that the mass is a Planck sized black hole [14] [15]

$$M \approx \alpha M_P \tag{28}$$

This mass of primordial black holes is part of the first table, *i.e.* keep in mind that is with regards to a Plank length value as given in Equation (27) where likely Equation (27) as Planck length was formed in the pre Plank era and holds with respect to the Planck physics domain.

Table 1. From [14] [15] assuming Penrose recycling of the Universe as stated in that document.

End of Prior Universe time frame	Mass (black hole): super massive end of time BH 1.98910^{+41} to about 10^{44} grams	Number (black holes) 10^6 to 10^9 of them usually from center of galaxies
Planck era Black hole formation Assuming start of merging of micro black hole pairs	Mass (black hole) 10^{-5} to 10^{-4} grams (an order of magnitude of the Planck mass value)	Number (black holes) 10^{40} to about 10^{45}, assuming that there was not too much destruction of matter-energy from the Pre Planck conditions to Planck conditions
Post Planck era black holes with the possibility of using Equation (1) and Equation (2) to have say 10^{10} gravitons/second released per black hole	Mass (black hole) 10 grams to say 10^6 grams per black hole	Number (black holes) Due to repeated Black hole pair forming a single black hole multiple time. 10^{20} to at most 10^{25}

As to **Table 1**, we obtain, due to the quantum number n, per black hole

The **Table 1** data will be connected to the following given consideration of spin density, as to Planck sized black holes.

In [14] [15] we have the following, *i.e.*, we have a spin density term of [14]-[16]. And this will be what we input black hole physics into as to forming a spin density term from primordial black holes.

$$\sigma_{Pl} = n_{Pl}\hbar \approx 10^{71} \tag{29}$$

And, also, the initial energy, *E*. from [18] per black hole given as

$$E_{Bh} = -\frac{n_{\text{quantum}}}{2} \tag{30}$$

We then can use for a Black hole the scaling,

$$\begin{aligned} |E| &\approx \left(\sqrt{G\cdot(\alpha M_P)\cdot \ell_P}\right)^{-1}\hbar \\ &\xrightarrow[G=M_P=\hbar=k_B=\ell_P=c=1]{} \left(1/M_{BH}\right)^{1/2} \approx \frac{n_{\text{quantum}}}{2} \end{aligned} \tag{31}$$

We then reference Equation (24) to observe the following.

$$\begin{aligned} &M_{BH} \approx \sqrt{N_{\text{gravitons}}}M_P \\ &\Rightarrow \left(1/M_{BH}\right)^{1/2} \approx \frac{n_{\text{quantum}}}{2} \approx \frac{1}{\left(N_{\text{gravitons}}\right)^{1/4}} \\ &\Rightarrow n_{\text{quantum}} \approx \frac{2}{\left(N_{\text{gravitons}}\right)^{1/4}} \end{aligned} \tag{32}$$

This is a stunning result. We interpret as the mass of a Black hole becomes smaller that the black hole heats up. As the heat up occurs, this generates more energy. More energy leads to a higher count of $n_{\text{gravitons}}$ *i.e.* Equation (24) is BEC theory, but due to micro sized black holes, that we assume that the number of the quantum number, n associated goes way UP. Is this implying that corresponding increases in quantum number, per black hole, n, are commensurate with increasing temperature? We start off with **Table 1** for conditions with the entropy as given in Equation (23) and Equation (24), for primordial black holes as brought up in **Table 1**. Whereas for the Tokamaks, we eventually have [14] [15]

$$\begin{aligned} n\big|_{\text{massive gravitons/second}} &\propto \frac{3\cdot\hbar\cdot e_j}{\mu_0\cdot R^2\cdot \xi^{1/8}\cdot\tilde{\alpha}} \times \frac{\left(T_{\text{Tokamak temperature}}\right)^{1/4}}{\lambda^2_{\text{Graviton}}\cdot m_{\text{graviton}}\cdot c^2\cdot 0.87^{5/4}} \\ &\sim 1/\lambda^2_{\text{Graviton}} \text{ scaling} \end{aligned} \tag{33}$$

This value of Equation (33) as to the number of gravitons, would be then related to the quantum number N(gravitons) as related to a quantum number n *i.e.* only in the very onset of the operation of the Tokamak. *i.e.* we would have the number of gravitons go UP as we would have a shrinking graviton wavelength for a massive graviton. *i.e.* more on this later. However, the wave length of the massive graviton as in Equation (33) as related to GW frequency and Tokamaks will be described when we conclude our document with respect to the Wavefunction of the Universe, *i.e.* a work partly drawing upon Kieffer, and also Weber. The wave-function of the universe condition heavily is influenced by the similarities as to Equation (33) with the quantum number n, per black hole, and the number *N*, of black holes, as brought up in Table 1, initially presented. To do so we consider Table 1 as giving a template as to a wormhole connecting a prior universe to the present universe. This Equation (33) as far as quantum number, n, and its relationship to gravitons, is contingent upon Equation (11) yielding Planck temperature. *i.e.* note the following, *i.e.* the HUP for universe contributions all come from the radial equation, which greatly simplifies our picture as far as nucleation of early universe black holes, *i.e.* see the following treatment of the HUP which enables this alteration.

8. How We Can Justifying Writing Very Small $\delta g_{rr} \sim \delta g_{\theta\theta} \sim \delta g_{\phi\phi} \sim 0^+$ Values. Very Important to the Initial Geometry of Space-Time

To begin this process, we will break it down into the following coordinates [1] and keep in mind this is when $a(t)$ is a scale factor, as specified in [1]. In the *rr*, $\theta\theta$ and $\phi\phi$ coordinates, we will use the Fluid approximation, $T_{ii} = diag(\rho, -p, -p, -p)$ [1] with

$$\begin{aligned}
\delta g_{rr} T_{rr} &\geq -\left|\frac{\hbar \cdot a^2(t) \cdot r^2}{V^{(4)}}\right| \xrightarrow[a \to 0]{} 0 \\
\delta g_{\theta\theta} T_{\theta\theta} &\geq -\left|\frac{\hbar \cdot a^2(t)}{V^{(4)}\left(1 - k \cdot r^2\right)}\right| \xrightarrow[a \to 0]{} 0 \\
\delta g_{\phi\phi} T_{\phi\phi} &\geq -\left|\frac{\hbar \cdot a^2(t) \cdot \sin^2\theta \cdot d\phi^2}{V^{(4)}}\right| \xrightarrow[a \to 0]{} 0
\end{aligned} \tag{34}$$

If as an example, we have negative pressure, with T_{rr}, $T_{\theta\theta}$ and $T_{\phi\phi} < 0$, and $p = -\rho$, then the only choice we have, then is to set $\delta g_{rr} \sim \delta g_{\theta\theta} \sim \delta g_{\phi\phi} \sim 0^+$, since there is no way that $p = -\rho$ is zero valued.

i.e. this is a semi classical embedding via a use of the modification of the HUP as given, as to how we could have a semi classical embedding of QM within a "higher dimensional" structure. This is also linked to the blend of semi classical and quantum structure seen in Table 1, above. *i.e.* after we do this we have to determine if our use of black holes, gravitons and all that will lead to GW generation, as to the formation of Table 1. *i.e.*

9. Issues about Coherent State of Gravitons (Linking Gravitons with GW) with Yet Another Take on Early Universe HUP

In the quantum theory of light (quantum electrodynamics) and other bosonic quantum field theories, coherent states were introduced by the work of Glauber (1963) [19]. Now, it is well appreciated that Gravitons are NOT similar to light. So what is appropriate for presenting gravitons as coherent states? Coherent states, to first approximation are retrievable as minimum uncertainty states. If one takes string theory as a reference, the minimum value of uncertainty becomes part of a minimum uncertainty which can be written as given by Venziano (1993) [20] [21], where $l_S \cong 10^{\alpha} \cdot l_{\text{Planck}}$, with $\alpha > 0$, and $l_{\text{Planck}} \approx 10^{-33}$ centimeters

$$\Delta x > \frac{\hbar}{\Delta p} + \frac{l_S^2}{\hbar} \cdot [\Delta p] \quad (35)$$

To put it mildly, if the author is looking at a solution to minimize graviton position uncertainty, the author, will likely be out of luck if string theory is the only tool the author has for early universe conditions. Mainly, the momentum will not be small, and uncertainty in momentum will not be small either. Either way, most likely, $\Delta x > l_S \cong 10^{\alpha} \cdot l_{\text{Planck}}$ In addition, it is likely, as Klaus Kieffer (2008) [22] in his book "Quantum Gravity" that if gravitons are excitations of closed strings, then one will have to look for conditions for which a coherent state of gravitons, as stated by [23] Mohaupt (2003) occurs. What Mohaupt is referring to is a string theory way to reproduce what [24] Ford gave in 1995, *i.e.* conditions for how Gravitons in a squeezed vacuum state, the natural result of quantum creation in the early universe will introduce metric fluctuations. Ford's (1995) treatment is to have a metric averaged retarded Green's function for a mass less field becoming a Gaussian. The condition of Gaussianity is how to obtain semi classical, minimal uncertainty wave states, in this case de rigor for coherent wave function states to form. [24] Ford uses gravitons in a so called 'squeezed vacuum state' as a natural template for relic gravitons. *i.e.* the squeezed vacuum state (a squeezed coherent state) is any state such that the uncertainty principle is saturated. In QM coherence would be when $\Delta x \Delta p = \hbar/2$. In the case of string theory it would have to be

$$\Delta x \Delta p = \frac{\hbar}{2} + \frac{l_S^2}{2 \cdot \hbar} \cdot [\Delta p]^2 \quad (36)$$

Begin with noting that if one is not using string theory, the author, Beckwith, merely set the term $l_S \xrightarrow[\text{non string}]{} 0$, but that the author is still considering a variant of the example given by Glauber (1963) [19] with string theory replacing Glaubler's stated (1963) example. [19]. However, in string theory, the author, Beckwith observes a situation where a vacuum state as a template for graviton nucleation is built out of an initial vacuum state, $|0\rangle$. To do this though, as [25] Venkatartnam, and Suresh did, involved using a squeezing operator $Z[r, \vartheta]$ defining via use of a squeezing parameter r as a strength of squeezing interaction term, with $0 \le r \le \infty$, and also an angle of squeezing, $-\pi \le \vartheta \le \pi$ as used in $Z[r,\vartheta] = \exp\left[\frac{r}{2} \cdot \left(\left[\exp(-i\vartheta)\right] \cdot a^2 - \left[\exp(i\vartheta)\right] \cdot a^{+2}\right)\right]$, where combining the $Z[r,\vartheta]$ with

$$|\alpha\rangle = D(\alpha) \cdot |0\rangle \quad (37)$$

Equation (37) leads to a single mode squeezed coherent state, as they define it via

$$\left|\varsigma\right\rangle = Z\left[r,\vartheta\right]\left|\alpha\right\rangle = Z\left[r,\vartheta\right]D\left(\alpha\right)\cdot\left|0\right\rangle \xrightarrow[\alpha\to 0]{} Z\left[r,\vartheta\right]\cdot\left|0\right\rangle \tag{38}$$

The right hand side of Equation (38) given above becomes a highly non classical operator, *i.e.* in the limit that the superposition of states $\left|\varsigma\right\rangle \xrightarrow[\alpha\to 0]{} Z\left[r,\vartheta\right]\cdot\left|0\right\rangle$ occurs, there is a many particle version of a 'vacuum state' which has highly non classical properties. Squeezed states, for what it is worth, are thought to occur at the onset of vacuum nucleation, but what is noted for $\left|\varsigma\right\rangle \xrightarrow[\alpha\to 0]{} Z\left[r,\vartheta\right]\cdot\left|0\right\rangle$ being a super position of vacuum states, means that classical analog is extremely difficult to recover in the case of squeezing, and general non classical behavior of squeezed states. Can one, in any case, faced with $\left|\alpha\right\rangle = D\left(\alpha\right)\cdot\left|0\right\rangle \neq Z\left[r,\vartheta\right]\cdot\left|0\right\rangle$ do a better job of constructing coherent graviton states, in relic conditions, which may not involve squeezing?. Note L. Grishchuk [26] wrote in (1989) in "On the quantum state of relic gravitons", where he claimed in his abstract that 'It is shown that relic gravitons created from zero-point quantum fluctuations in the course of cosmological expansion should now exist in the squeezed quantum state. The authors have determined the parameters of the squeezed state generated in a simple cosmological model which includes a stage of inflationary expansion. It is pointed out that, in principle, these parameters can be measured experimentally'. Grishchuk, *et al.*, [26] (1989) reference their version of a cosmological perturbation h_{nlm} via the following argument. How the author works with the argument will affect what is said about the necessity, or lack of, of squeezed states in early universe cosmology. From [27] Class. Quantum Gravity: 6 (1989), page 161-165, where h_{nlm} has a component $\mu_{nlm}\left(\eta\right)$ obeying a parametric oscillator equation, where K is a measure of curvature which is $=\pm 1, 0$, $a\left(\eta\right)$ is a scale factor of a FRW metric, and $n = 2\pi\cdot\left[a\left(\eta\right)/\lambda\right]$ is a way to scale a wavelength, λ, with *n*, and with $a\left(\eta\right)$

$$h_{nlm} \equiv \frac{l_{\text{Planck}}}{a\left(\eta\right)}\cdot\mu_{nlm}\left(\eta\right)\cdot G_{nlm}\left(x\right) \tag{39}$$

$$\mu''_{nlm}\left(\eta\right) + \left(n^2 - K - \frac{a''}{a}\right)\cdot\mu_{nlm}\left(\eta\right) \equiv 0 \tag{40}$$

If $y\left(\eta\right) = \dfrac{\mu\left(\eta\right)}{a\left(\eta\right)}$ is picked, and a Schrodinger equation is made out of the Lagrangian used to formulate the above Equation (11) above, with $\hat{P}_y = \dfrac{-i}{\partial y}$, and $M = a^3\left(\eta\right)$, $\Omega = \dfrac{\sqrt{n^2 - K^2}}{a\left(\eta\right)}$, $\breve{a} = \left[a\left(\eta\right)/l_{\text{Planck}}\right]\cdot\sigma$, and $F\left(\eta\right)$ an arbitrary function. $y' = \partial y/\partial\eta$. Also, the author is working with an example which has a finite volume $V_{\text{finite}} = \int\sqrt{{}^{(3)}g}\,\mathrm{d}^3x$

Then the Lagrangian for deriving Equation (40) is (and leads to a Hamiltonian which can be **also** derived from the Wheeler De Witt equation), with $\varsigma = 1$ for zero point subtraction of energy

$$L=\frac{M\cdot y'^2}{2a(\eta)}-\frac{M^2\cdot\Omega^2 a\cdot y^2}{2}+a\cdot F(\eta) \tag{41}$$

$$\frac{-1}{i}\cdot\frac{\partial\psi}{a\cdot\partial\eta}\equiv\hat{H}\psi\equiv\left[\frac{\hat{P}_y^2}{2M}+\frac{1}{2}\cdot M\Omega^2\hat{y}^2-\frac{1}{2}\cdot\varsigma\cdot\Omega\right]\cdot\psi \tag{42}$$

Then there are two possible solutions to the S.E. Grishchuk [27] [28] created in 1989, one a non squeezed state, and another squeezed state. So in general the author works with [27]-[29]

$$y(\eta)=\frac{\mu(\eta)}{a(\eta)}\equiv C(\eta)\cdot\exp(-B\cdot y) \tag{43}$$

The **non squeezed state** has a parameter $B\big|_\eta \xrightarrow[\eta\to\eta_b]{} B(\eta_b)\equiv\omega_b/2$ where η_b is an initial time, for which the Hamiltonian given in (40) in terms of raising/lowering operators is "diagonal", and then the rest of the time for $\eta\neq\eta_b$, the **squeezed state** for $y(\eta)$ is given via a parameter B for squeezing which when looking at a squeeze parameter r, for which $0\le r\le\infty$, then Equation (43) has, instead of $B(\eta_b)\equiv\omega_b/2$

$$B\big|_\eta \xrightarrow[\eta\neq\eta_b]{} B(\omega,\eta\neq\eta_b)\equiv\frac{i}{2}\cdot\frac{(\mu/a(\eta))'}{(\mu/a(\eta))}\equiv\frac{\omega}{2}\cdot\frac{\cosh r+[\exp(2i\vartheta)]\cdot\sinh r}{\cosh r-[\exp(2i\vartheta)]\cdot\sinh r} \tag{44}$$

Taking Grishchuck's formalism literally, a state for a graviton/GW is not affected by squeezing when the author is looking at an initial frequency, so that $\omega\equiv\omega_b$ initially corresponds to a non squeezed state which may have coherence, but then right afterwards, if $\omega\neq\omega_b$ which appears to occur whenever the time evolution, $\eta\neq\eta_b\Rightarrow\omega\neq\omega_b\Rightarrow B(\omega,\eta\neq\eta_b)\equiv\frac{i}{2}\cdot\frac{(\mu/a(\eta))'}{(\mu/a(\eta))}\neq\frac{\omega_b}{2}$ A reasonable research task would be to determine, whether or not $B(\omega,\eta\neq\eta_b)\neq\frac{\omega_b}{2}$ would correspond to a vacuum state being initially formed right after the point of nucleation, with $\omega\equiv\omega_b$ at time $\eta\equiv\eta_b$ with an initial cosmological time some order of magnitude of a Planck interval of time $t\approx t_{\text{Planck}}\propto 10^{-44}$ seconds, we argue for reviewing the idea that coherent states are directly linked to the viability of applying **Table 1** to our physics problem.

10. Having Done an Argument as to Coherent States, of Gravitons, What About an Initial Wavefunction of the Universe?

If so, then we have that frequency is proportional to $1/t$, where t is time. *i.e.* hence if there is a value of $n=0$ and making use of the frequency, we then would be able to write as given by Kieffer, 2025 as a dust model of the universe, with [22]

$$\Psi_{1,\kappa=n=0}\approx\sqrt{\frac{\omega}{\pi}}\cdot\left[\frac{1}{\omega+i\cdot(t+r)}-\frac{1}{\omega+i\cdot(t-r)}\right] \tag{45}$$

Or,

$$\Psi_{2,\kappa=n=0} \approx \frac{1}{\sqrt{\pi}}\sqrt{\frac{\sqrt{8\pi}}{t}} \cdot \left[\frac{1}{\frac{\sqrt{8\pi}}{t} + i\cdot(t+r)} - \frac{1}{+\frac{\sqrt{8\pi}}{t} i\cdot(t-r)} \right] \tag{46}$$

With, say.

$$\omega \approx \frac{\sqrt{8\pi}}{t} \tag{47}$$

This is t the so called dust approximation as to the formation of the Universe, with the result that if r goes to zero, we avoid a singularity, which then also increases the likelihood of **Table 1** holding up.

Secondly is the open question of if or not we can form gravitational solitons [30] as well as [31] phenomenology being either proven or disproven.

Having given this formulation of a wavefunction of the Universe, what can we say about the before the Planckian regime of space time, to the post Planckian regime of space time implied by **Table 1**? *i.e.* we need to specify if we have h bar, leading to the possibility of quantum processes, in our analysis.

11. Order of Magnitude Estimate as to Necessary and Sufficient Conditions as to Calculation of H Bar in the Early Universe. Leading to Effective Initial Time Not Zero

We will now give a first order estimate as to calculation of h bar, *i.e.* isolate the actual spatial length, for the creation of a present day h bar Planck's constant. To do this look at

$$\Delta x \Delta p \geq \hbar + \frac{l_{\text{Planck}}^2}{\hbar} \cdot (\Delta p)^2 \tag{48}$$

Then THE FOLLOWING ARE EQUIVLENT

The idea would be that the Planck constant, h bar would be formulated as of the present day value,. Also, the modification for the string length, would have $\Delta x|_{\min} \sim 10^{\beta} l_{\text{Planck}}$, so then

$$\begin{aligned}
&\& \Delta x|_{\min} \Delta p \approx \hbar + \frac{l_{\text{Planck}}^2}{\hbar} \cdot (\Delta p)^2 \\
&\& \hbar^2 - \hbar \Delta x|_{\min} \Delta p + l_{\text{Planck}}^2 \cdot (\Delta p)^2 \approx 0 \\
&\hbar \approx \frac{\Delta x|_{\min} \Delta p}{2} \cdot \left(1 + \sqrt{1 - 4\frac{l_{\text{Planck}}^2}{\left(\Delta x|_{\min}\right)^2}} \right) \\
&\hbar \approx \frac{\Delta x|_{\min} \Delta p}{2} \cdot \left(1 + \sqrt{1 - 4\cdot 10^{-2\beta}} \right) \\
&\quad \approx \Delta x|_{\min} \Delta p \cdot \left(1 - \frac{2}{10^{2\beta}} \right)
\end{aligned} \tag{49}$$

Then,

$$\begin{aligned}&\text{if } \Delta p \sim N_{\text{graviton}} \cdot m_{\text{graviton}} \cdot c \\ &\hbar \approx \Delta x\big|_{\min} \cdot N_{\text{graviton}} \cdot m_{\text{graviton}} \cdot c \cdot \left(1 - \frac{2}{10^{2\beta}}\right) \\ &\Delta x\big|_{\min} \approx \frac{\hbar}{N_{\text{graviton}} \cdot m_{\text{graviton}} \cdot c \cdot \left(1 - \frac{2}{10^{2\beta}}\right)}\end{aligned} \tag{50}$$

This should be greater than a Plank length, mainly due to the situation of

$$\left(1 - \frac{2}{10^{2\beta}}\right)^{-1} \sim 1 + \frac{2}{10^{2\beta}} \tag{51}$$

We assume, here that this will be occurring in an interval of time approximately the value of Planck time given by

$$\begin{aligned}&t(\text{initial}) \sim \hbar / \rho(\text{initial}) \cdot V(\text{initial}) \\ &\sim \frac{\hbar}{\left(\frac{m_{\text{Planck}}}{l_{\text{Planck}}^3}\right)} \left(\frac{\hbar}{N_{\text{graviton}} \cdot m_{\text{graviton}} \cdot c \cdot \left(1 - \frac{2}{10^{2\beta}}\right)}\right)^{-3}\end{aligned} \tag{52}$$

Here, the number, N, is given as the number of gravitons, and the important factor is that Equation (6) is non zero.

12. Final Application of the Uncertainty Principle to Consider. Fwiw *i.e.* Information Transfer from a Prior to a Present Universe

How likely is $\delta g_{tt} \sim O(1)$? Not going to happen. Why? The homogeneity of the early universe will keep

$$\delta g_{tt} \neq g_{tt} = 1 \tag{53}$$

In fact, we have that from Giovannini [32], that if ϕ is a scalar function, and $a^2(t) \sim 10^{-110}$, then if

$$\delta g_{tt} \sim a^2(t) \cdot \phi \ll 1 \tag{54}$$

We see further confirmation of this in reference [33].

Then, there is no way that an early universe HUP is going to come close to $\delta t \Delta E \geq \frac{\hbar}{2}$. *i.e.* It depends assuming time is for all purposes fixed at about Planck time to isolate V_0.

i.e. for the sake of argument, in the near Planckian regime, we can figure that Equation (54) will have as far as evaluation of the argument the following configuration, *i.e.*

$$a(t) \approx a_{\text{initial}} \cdot (t/t_P)^{\nu} \tag{55}$$

Given this we will be looking at, if we do the set up [34]

$$\Delta x \Delta p \geq \frac{\hbar}{\delta g_{tt} = \left[a_{\text{initial}} \cdot (t/t_P)^{\nu}\right]^2 \left[\ln\left(\sqrt{\frac{8\pi G V_0}{\nu \cdot (3\nu - 1)}} \cdot t\right)^{\sqrt{\frac{\nu}{16\pi G}}}\right]} \tag{56}$$

Then eventually we obtain

$$V_0 \cong \left[\frac{\nu\cdot(3\nu-1)}{8\pi}\right]\cdot\left[\exp\left(\frac{16\sqrt{\pi}}{\sqrt{\nu}}\cdot\frac{1}{a_{\min}^2\cdot(t/t_p)^2}\right)\right]\cdot\left(\frac{1}{1+2\tilde{\gamma}\frac{\partial C}{\partial V}}\right)^2 \tag{57}$$

So then we are now doing an Evaluation of Equation (81) if we are near Planck time. Two limits

1st, what if we have expansion of the scale factor initially at greater than the speed of light?

Set $\nu \approx 10^{88}$ and then we can obtain if we are just starting off inflation say $a_{\min}^2 \approx 10^{-44}$. Then

$$V_0 \cong \left[10^{176}\right]\cdot\left[\exp\left(16\sqrt{\pi}\right)\right]\cdot\left(\frac{1}{1+2\tilde{\gamma}\frac{\partial C}{\partial V}}\right)^2, \tag{58}$$

If we wish to have a Planck energy magnitude of the V_0 term, we will then be observing

$$V_0 \cong \left[10^{176}\right]\cdot\left[\exp\left(16\sqrt{\pi}\right)\right]\cdot\left(\frac{1}{1+2\tilde{\gamma}\frac{\partial C}{\partial V}}\right)^2, \xrightarrow[2\tilde{\gamma}\frac{\partial C}{\partial V}\approx\left[10^{88}\right]]{} o(1) \tag{59}$$

i.e. the system complexity will become effectively almost infinite, and this will be explained in the conclusion by use of

$$2\tilde{\gamma}\frac{\partial C}{\partial V} \approx \left[10^{88}\right] \Rightarrow V_0 \cong o(1) \tag{60}$$

On the other hand, if there is a very small value for $2\tilde{\gamma}\frac{\partial C}{\partial V}$ we can see the following behavior for Equation (58), namely

$$2\tilde{\gamma}\frac{\partial C}{\partial V} \approx o(1) \Rightarrow V_0 \cong \left[10^{176}\right] \tag{61}$$

i.e. low complexity in the measurement process will then imply an enormous initial inflaton potential energy

2nd, now what if we have instead $\nu \approx 1$

$$V_0 \cong \left[\frac{1}{4\pi}\right]\cdot\left[\exp\left(\frac{16\sqrt{\pi}}{a_{\min}^2\cdot(t/t_p)^2}\right)\right]\cdot\left(\frac{1}{1+2\tilde{\gamma}\frac{\partial C}{\partial V}}\right)^2 \tag{62}$$

The threshold if $2\tilde{\gamma}\frac{\partial C}{\partial V} \approx \left[10^{88}\right]$ *i.e.* a huge value for initial complexity would be effectively made insignificant in cutting down the initial inflaton lead to

$$\exp\left(\frac{16\sqrt{\pi}}{\sqrt{\nu}}\cdot\frac{1}{a_{\min}^{2}\cdot\left(t/t_{p}\right)^{2}}\right)\xrightarrow[a_{\min}^{2}\approx 10^{-88}]{}V_{0}\cong\exp\left(10^{88}\right) \tag{63}$$

i.e. we come to the seemingly counter Intuitive expression that the initial inflaton potential would still be infinite if we used Equation (62) in Equation (58). We now get to our next important idea and result. Having said that does it make sense to ascertain the following as far as early universe geometry? *i.e.* we say its not so simple. *i.e.* here is an early idea which we do not follow.

[33] Abhay Ashtekar (2006) wrote a simple treatment of the Bounce causing Wheeler De Witt equation along the lines of, for $\rho_{*}\approx const\cdot\left(1/8\pi G\Delta\right)$ as a critical density, and Δ the eignvalue of a minimum area operator. Small values of Δ imply that gravity is a repulsive force, leading to a bounce effect.

$$\left(\frac{\dot{a}}{a}\right)^{2}\equiv\frac{8\pi G}{3}\cdot\rho\cdot\left(1-\left(\rho/\rho_{*}\right)\right)+H.O.T. \tag{64}$$

Furthermore, [31] Bojowald (2008) specified criteria as to how to use an updated version of Δ and $\rho_{*}\approx const\cdot\left(1/8\pi G\Delta\right)$ in his GRG manuscript on what could constitute grounds for the existence of generalized squeezed initial (graviton?) states. [31] Bojowald (2008) was referring to the existence of squeezed states, as either being necessarily, or NOT necessarily a consequence of the quantum bounce. As Bojowald (2008) wrote it up, in both his Equation (26) which has a quantum Hamiltonian $\langle\hat{V}\rangle\approx H$, with

$$\left.\frac{\mathrm{d}\langle\hat{V}\rangle}{\mathrm{d}\phi}\right|_{\phi\approx 0}\xrightarrow[\text{existence of un squeezed states}\Leftrightarrow\phi\approx 0]{}\to 0 \tag{65}$$

and $\hat{V}$ is a "volume" operator where the "volume" is set as V, Note also, that [31] Bojowald has, in his initial Friedman equation, density values $\rho\equiv\frac{H_{\text{matter}}(a)}{a^{3}}$, so that when the Friedman equation is quantized, with an initial internal time given by ϕ, with ϕ becoming a more general evolution of state variable than 'internal time'. If so, [31] Bojowald (2008) writes, when there are squeezed states

$$\left.\frac{\mathrm{d}\langle\hat{V}\rangle}{\mathrm{d}\phi}\right|_{\phi\neq 0}\xrightarrow[\text{existence of squeezed states}]{}N(\text{value})\neq 0 \tag{66}$$

We think that this is simply not realistic and we offer a different interpretation, which is heavily using the HUP in a different fashion

13. First Major Implication of This Use of the Hup Is to Investigate, *i.e.* Role of Complexity in Bridge from Black Hole Numbers as Given in Table 1

There are three regimes of black hole numbers given in Table 1. From Pre Planckian, to Planckian and then to post Planckian physics regimes. This is all assuming CCC cosmology. To start to make sense of this, we need to examine how one could achieve the complexity as indicated by **Figure 1** in the Planckian era. To do this at a start, we will pay attention to a datum in [34], namely a Horizon, like a Schwarzschild black hole construction with [14] [15] [34]

$$L_A = \sqrt{\frac{3}{\Lambda}} \tag{67}$$

In what one deems as a corpuscular gravity, one would have a "kinetic energy term" per graviton

$$\in_G \cong \frac{M_p}{\sqrt{\tilde{N}}} \tag{68}$$

And the mass of a black hole, scaling as [14] [15] [34]

$$M_{\text{black hole}} \cong \sqrt{\tilde{N}} M_p \approx \tilde{N} \in_G \tag{69}$$

so then we have $\tilde{N} = N$ and furthermore [14] [15] [34] also has

$$\in_G \cong \frac{M_p}{\sqrt{\tilde{N}}} \cong \frac{\hbar}{L_A} \approx \frac{M_p}{\sqrt{N}} \tag{70}$$

If so for Black holes, we have the following

$$\sqrt{\Lambda} \cong \frac{\sqrt{3} M_p}{\hbar \sqrt{N}} \tag{71}$$

Now as to what is given in [14] [15] [34] as to Torsion that we can do some relevant dimensional scaling.

First look at numbers provided by [14] [15] [34] as to inputs, *i.e.* these are very revealing, *i.e.* we go back to the arguments as to the beginning of the document, namely $\Lambda_{Pl} c^2 \approx 10^{87}$.

This is the number for the vacuum energy and this enormous value is 10^{122} times larger than the observed cosmological constant. Torsion physics, as given by [14] [15] [34] is solely to remove this giant number.

Our timing is to unleash a Planck time interval t about 10^{-43} seconds. Also the creation of the torsion term is due to a presumed "graviton" particle density of $n_{Pl} \approx 10^{98}\ \text{cm}^{-3}$.

This particle density is directly relevant to the basic assumption of how to have relevant Gravitons initially created as to obtain the huge increase in complexity alluded to, in order to obtain the number of micro black holes in the Planckian era [14] [15] [34].

i.e. assume that there are, then say initially up to 10^{98} gravitons, initially, and then from there, go to **Table 1** to assume what number of micro sized black holes are available, *i.e.* **Table 1** has say a figure of 10^{45} to at most 10^{50} micro sized black holes, presumably for 10^{98} gravitons being released, and this is meaning we have say 10^{50} black holes of say of Planck mass, to work with.

14. Recap of Torsion in All of This, *i.e.* the Basics

Eventually, in the case of an unpolarized spinning fluid in the immediate aftermath of the big bang, we would see a Roberson Walker universe given as, if σ

is a torsion spin term added due to [14] [15] [34] as

$$\left(\frac{\dot{\tilde{R}}}{\tilde{R}}\right)^2 = \left(\frac{8\pi G}{3}\right)\cdot\left[\rho - \frac{2\pi G\sigma^2}{3c^4}\right] + \frac{\Lambda c^2}{3} - \frac{\tilde{k}c^2}{\tilde{R}^2} \tag{72}$$

Here the term $\tilde{k}$ is a measure of if one has positive, negative, or zero curvature. In all of this, the values of $\tilde{k}$ are usually linked to questions of if we have an open or closed universe. It has three possible values: 1 for a closed positive curvature universe (like a sphere), 0 for a flat Euclidian Universe, and 01 for an open negative-curvature universe. The question, which we need to address is as follows.

What [14] [15] [34] does as to Equation (72) versus what we would do and why? In the case of [14] [15] [34] we would see σ be identified as due to torsion so that we obtain

$$\left(\frac{\dot{\tilde{R}}}{\tilde{R}}\right)^2 = \left(\frac{8\pi G}{3}\right)\cdot[\rho] - \frac{\tilde{k}c^2}{\tilde{R}^2} \tag{73}$$

The claim is made in [14] [15] [34] that this is due to spinning particles which remain invariant so the cosmological vacuum energy, or cosmological constant is always cancelled. Our approach instead will yield

$$\left(\frac{\dot{\tilde{R}}}{\tilde{R}}\right)^2 = \left(\frac{8\pi G}{3}\right)\cdot[\rho] + \frac{\Lambda_{0\text{bserved}}c^2}{3} - \frac{\tilde{k}c^2}{\tilde{R}^2} \tag{74}$$

i.e. the observed cosmological constant $\Lambda_{0\text{bserved}}$ is 10^{-122} times smaller than the initial vacuum energy. The main reason for the difference in Equation (72) and Equation (74) is in the following observation.

Mainly that the reason for the existence of σ^2 is due to the dynamics of spinning black holes in the precursor to the big bang, to the Planckian regime, of space time, whereas in the aftermath of the big bang, we would have a vanishing of the torsion spin term. *i.e.* the **Table 1** dynamics in the aftermath of the Planckian regime of space time would largely eliminate the σ^2 term.

15. Filling in the Details of the Collapse of the Cosmological Term, versus the Situation given in Equation (72) via Numerical Values

First look at numbers provided by [14] [15] [34] as to inputs, *i.e.* these are very revealing

$$\Lambda_{Pl}c^2 \approx 10^{87} \tag{75}$$

This is the number for the vacuum energy and this enormous value is 10^{122} times larger than the observed cosmological constant. Torsion physics, as given by [14] [15] [34] is solely to remove this giant number. In order to remove it, the reference [14] [15] [34] proceeds to make the following identification, namely

$$\left(\frac{8\pi G}{3}\right)\cdot\left[-\frac{2\pi G\sigma^2}{3c^4}\right] + \frac{\Lambda c^2}{3} = 0 \tag{76}$$

What we are arguing is that instead, one is seeing, instead

$$\left(\frac{8\pi G}{3}\right)\cdot\left[-\frac{2\pi G\sigma^2}{3c^4}\right]+\frac{\Lambda_{Pl}c^2}{3}\approx 10^{-122}\times\left(\frac{\Lambda_{Pl}c^2}{3}\right) \tag{77}$$

Our timing as to Equation (77) is to unleash a Planck time interval t about 10^{-43} seconds. As to Equation (76) versus Equation (77) the creation of the torsion term is due to a presumed particle density of

$$n_{Pl}\approx 10^{98}\ \text{cm}^{-3} \tag{78}$$

Finally, we have a spin density term of $\sigma_{Pl}=n_{Pl}\hbar\approx 10^{71}$ which is due to innumerable black holes initially. This treatment of torsion and the spin density term, *i.e.* of black holes, with a particle density term of Equation (78) is due solely to the HUP employed, as to arguments given in the first part of the paper. And gives substance to Table 1 estimates about the number of black holes in the prior universe to the present universe.

Why I find this very interesting are the questions raised in [35] [36] *i.e.* what is special about the Plank mass as an example. We submit that a through examination of Torsion may allow an answer to this issue in terms of early universe cosmology.

16. As a Final Point to Consider, What Sort of Penrose Cyclic Argument Is Used for the Prior to Present Universe, as Employed by Table 1? We Argue It Allows for the Treatment of the Cosmological Problem, as Seen Here

Go first as to **Appendix A** as to the details as for Equation (79) in this document.

What this means in terms of phenomenology, is as follows, *i.e.* if we look at the section given by [34] as elaborated upon in the fifth force argument as given we can say the following.

First of all is the old standby namely in the onset of inflation, there would be a huge speed of inflationary expansion with the coefficient of scale factor given as [14] [15] [34]. *i.e.* this is looking at the coefficient showing up in $a(t)\approx a_0 t^{\nu}$ scale factor expansion, that if we go to Equation

$$\nu \xrightarrow{\text{Planck normalization}} 4\pi\times\left(\omega_{gw}\right)^{12}\times\frac{\varsigma^4}{\tilde{\beta}^2} \tag{79}$$

For mass greater than Planck mass, namely $M_{mass}\approx\zeta m_p$, with m_p for Planck Mass. We refer to [34], in that this is for the mass of a physical system, *i.e.* M_{mass} of an object which in its physical configuration is generating gravitational waves, ω_{gw} and we find that in the Planckian regime, $\tilde{\beta}$ is a coefficient connected to a fifth force argument due to reasoning from [34].

This leads to the following i.e. in [34] *which is reproduced here, In addition after approximating* $\left\langle r^2\right\rangle^2\approx\ell_p^4$, *i.e.* Planck length to the fourth power and $r\left\langle r^2\right\rangle^2\approx\ell_p^5$

We find then we have at the immediate beginning of inflation, an almost Planck frequency value of 1.855 times 10^{43} Hertz, we would need ν be 10^{502} which would be factored into Equation (1a) and the scale factor value for the term ν. This would mean for the fifth force argument that we would have an almost infinitely quick expansion in the neighborhood of Planck length for the start of inflation.

We find then we have at the immediate beginning of inflation, an almost Planck frequency value of 1.855 times 10^{43} Hertz, we would need ν be 10^{502} which would be factored into the coefficient of time which shows up in a scale factor argument and the scale factor value for the term ν. This would mean for the fifth force argument that we would have an almost infinitely quick expansion in the neighborhood of Planck length for the start of inflation.

We refer the reader to **Appendix A**, where two of the coefficients of Equation (76), ζ is connected to how many times a GW generating system has a mass greater than Planck mass, namely $M_{\text{mass}} \approx \zeta m_p$, with m_p for Planck Mass. We refer to **Appendix A**, in that this is for the mass of a physical system, *i.e.* M_{mass} of an object which in its physical configuration is generating gravitational waves, ω_{gw} and we find that in the Planckian regime, $\tilde{\beta}$ is a coefficient connected to a fifth force argument which is elaborated upon in **Appendix A**. We also state that the coefficient given as Equation (11) is such that in the Planckian regime, $\nu \longrightarrow \text{value} \approx \left(\omega_{gw}\right)^{12}$. The meaning of this is that at the start of inflation we have that Equation (79) will likely from Pre Planckian to Planckian space time be enormous corresponding to $\nu \longrightarrow \text{value} \approx \left(\omega_{gw}\right)^{12}$.

This is all defined in [4] in an article written by the author for Intech, for our convenience which is in **Appendix A**, in full

If so, by Novello [37] we then have a bridge to the cosmological constant as given by

$$m_g = \frac{\hbar \cdot \sqrt{\Lambda}}{c} \tag{80}$$

Consider first the relationship between vacuum energy and the cosmological constant. Namely $\rho_\Lambda \approx \hbar k_{\max}^4$ where we have that

$$\rho_\Lambda \approx \hbar k_{\max}^4 \approx \left(10^{18}\ \text{GeV}\right)^4 \xrightarrow[\text{reduced}]{} \left(10^{-12}\ \text{GeV}\right)^4 \tag{81}$$

where we define the mass of a graviton as in the numerator given by Equation (80), and then we can also use the following.

This is useful in terms of determining conditions for a cosmological constant [14] [15] [34] [38].

$$\begin{aligned} \rho_\Lambda c^2 &= \int_0^{E_{\text{Plank}}/c} \frac{4\pi p^2 \mathrm{d}p}{(2\pi\hbar)^3} \cdot \left(\frac{1}{2} \cdot \sqrt{p^2c^2 + m^2c^4}\right) \approx \frac{\left(3\times 10^{19}\ \text{GeV}\right)^4}{(2\pi\hbar)^3} \\ &\xrightarrow[E_{\text{Plank}}/c \to 10^{-30}]{} \frac{\left(2.5\times 10^{-11}\ \text{GeV}\right)^4}{(2\pi\hbar)^3} \end{aligned} \tag{82}$$

This means shifting the energy level of the Equation (81) downward by 10^{-30}, *i.e.* the top value energy becomes a down scale of Planck energy times 10^{-30}.

Gravitons are used as the back bone of how to reduce Equation (82) to the vacuum energy of today.

In addition there is one line of reasoning, which I believe bears mentioning.

What would be a way to determine necessary and sufficient conditions for a massive graviton to exist. To do so, we will look first at [39] Linde (Les Houches, 2013), whom wrote of the probability of creation of a closed universe as given by

$$\begin{aligned} &P(\text{probability}) \sim \exp\left(-24\pi^2 / V(\text{potential})\right) \\ &\Leftrightarrow V(\text{potential}) \sim \text{Energy}(\text{Planck}) \end{aligned} \tag{83}$$

The potential energy, so identified in Equation (83) is none other than the one used by Padmanbhan [3] in which the H so identified is the Hubble 'constant' parameter, which actually changes over time. In this case, the potential so identified in Equation (83) is given by

$$V \sim 3H^2 M_{\text{Planck}} \cdot \left(1 + \left(\dot{H}/3H^2\right)\right) \tag{84}$$

Here, if N is an integer number for dimensionality of space-time, and [3]

$$\begin{aligned} &H = \dot{a}(t)/a(t) \,\&\, a(t) \sim t^N \\ &\Leftrightarrow V \sim 2M_{\text{Planck}} \cdot N^2/t^N \end{aligned} \tag{85}$$

Applying the HUP uncertainty principle be looking at a minimum uncertainty principle situation of time.

If so, then if we have V as proportional to an energy E, then we can by the Heisenberg uncertainty principle

$$\Delta E \Delta t = \hbar \tag{86}$$

Then, if $\Delta t = t$ (minimum), and $\Delta E = E_{\text{initial}} \equiv \frac{c^4}{2G} \cdot r_{\text{critial}} \sim \frac{c^4 L_P}{2G}\sqrt{\frac{n_{\text{initial}}}{\pi}}$

$$\Delta t = \left(\hbar \Big/ \frac{c^4 L_P}{2G}\sqrt{\frac{n_{\text{initial}}}{\pi}}\right) = t_{\min} \tag{87}$$

Now, by Valev, [40] at the start of inflation, and this is before massive red shifting

$$\begin{aligned} &m_{\text{graviton}} \sim \frac{\hbar H}{c^2} \sim \frac{\hbar N}{c^2 t_{\min}} \sim \frac{2GN}{c^6 L_P^2 \sqrt{\frac{n_{\text{initial}}}{\pi}}} \sim 10^{-61} \text{ grams} \\ &\lambda_{\text{graviton}} \sim \frac{c}{H} \sim \frac{c \cdot t_{\min}}{N} \sim \frac{10}{N} \cdot L_p \sim \frac{1.61}{N} \times 10^{-34} \text{ meters} \\ &f(\text{frequency})_{\text{graviton}} \sim \frac{1.8 \times 10^{36}}{N} \text{Hertz} \end{aligned} \tag{88}$$

Inflation would reduce the frequency by 26 orders or so of magnitude (massive red shifting) [40]

$$f(\text{frequency})_{\text{graviton}} [\text{after inf}] \sim 10^{10} \text{ Hertz} \tag{89}$$

A clever argument but it clashes with the Mukhanov approach as to structural inhomogenity.

17. We Consider the Following Structure Formation Argument to Have Limited Utility and Here Is Why

We look at what Mukhanov [41] writes as far as structure formation. Mainly that there is a formulation of what is called self reproduction of inhomogeneity in terms of early universe conditions [27] [41]. In this, the starting point is if one used the meme of chaotic inflation, *i.e.* inflation generated by a potential of the form as given by Guth [26] as well as Mukhanov [41]

$$V(\text{potential}) \sim \phi^2 \tag{90}$$

In this, Mukhanov [41] write that one can look at a scalar field at the end of (chaotic) inflation, with an amplitude given by, with ϕ_i for the initial value of the inflaton such that (where m will be determined by inputs to be brought up later.)

$$\delta_{\phi}^{Max} \sim m \cdot \phi_i^2 \tag{91}$$

In terms of the initial inflaton, inhomogenities do not form if the initial inflaton is bounded [41]as given by

$$m^{-1} > \phi_i > m^{-1/2} \tag{92}$$

This leads to (low?) inhomogeneity in the space-time generated by inflation. Inflation is eternal [27] if. There is only the inequality. *i.e.* we think that this is dubious. *i.e.* this is suggesting that there is eternal inflation solely due to this inequality. *i.e.* I doubt it.

$$\phi_i > m^{-1/2} \tag{93}$$

This idea supports the **Figure 1** diagram given below.

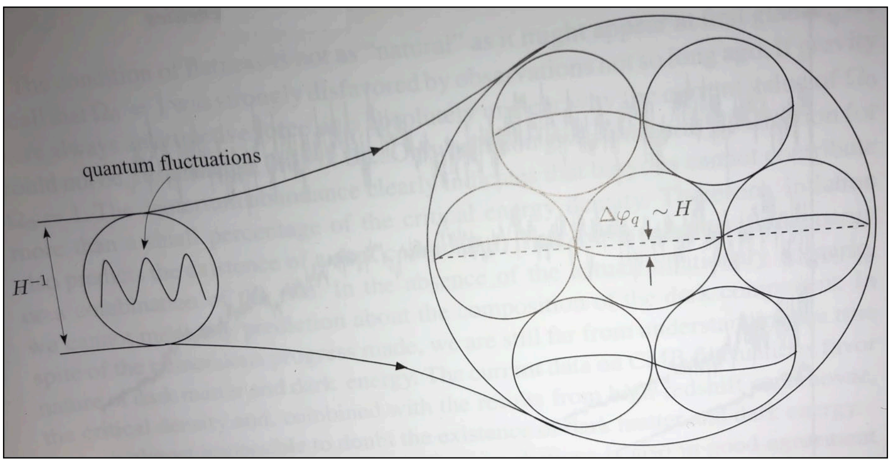

Figure 1. Which is from [41] for the onset of eternal inflation.

Clever but way too simple

We would like to have some connection to the reference [42]. So this leads to us looking at the Penrose treatment of Universe behavior and our modification of it.

18. 1st Part of Conclusion, *i.e.* First, How to Tie This into a Macro Picture of Multiverse Cosmology? First Consider How Black Holes from a Prior Universe May Impinge Upon Our Present Universe. A Great Idea as a Start

Next, let us view the Penrose suggestion as to Black holes from a prior universe.

In order to see this, consider a suggestion as to black holes, being the template for a start to the present universe given by [43], which has the Penrose suggestion of an imprint of a prior Universe black holes having an effect upon the CMBR spectrum. The CMBR spectrum is a real datum, but the worth of getting this information would be in terms of having what was said in [43] as to the "ghost" of prior universe black hole radiation.

Furthermore, this means accessing the material given in [44] [45] before we discuss developing the modified Penrose CCC material.

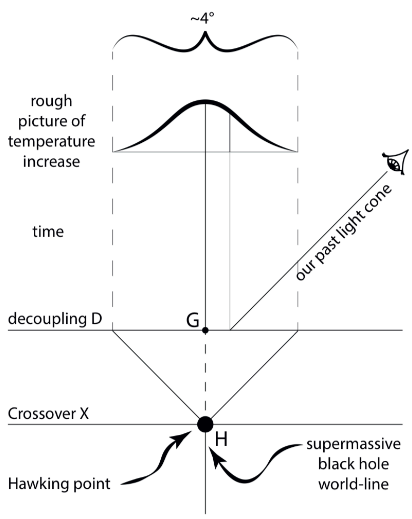

Figure 2. As given in [43] which has competing black hole radiation, and can we see this today in the CMBR?

From the 2nd page of reference [43] we have the following quote.

Quote (from page 2 of reference [43])

A conformal diagram representing the effect of a highly energetic event occurring at the space-time point H. In CCC, H is taken to be a Hawking point, where virtually the entire Hawking radiation of a previous-aeon supermassive black hole is concentrated at H by the conformal compression of the hole's radiating future. The horizontal line at the bottom stands for the crossover surface dividing the previous cosmic aeon from our own and describes our conformally stretched Big Bang. In conventional inflationary cosmology, X would represent the graceful exit turn-off of inflation. In each case, the future light cone of H represents the outer causal boundary of physical effects initiated at H, and such effects can reach D *only within the roughly* 0.08 *radian spread indicated at the top of the diagram.*

End of Quote

A) What can we expect from the transition from a Prior universe, to the Planckian regime of micro black holes? A transition from initially gigantic black holes to micro black holes.

B) In a word, we would likely have in the prior universe MASSIVE black hole, which would be broken up into millions (billions?) of Planck sized.

In a word the GW radiation and thermal/photonic input would have to fight through a thicket of pairs of micro black holes which would be in binary configuration generating their OWN GW background.

We first will discuss this "binary black holes" signal background which the Planckian early Universe stars would have to impinge upon, in order to come to our attention.

Now for the discussion of the millions (more than that) of micro sized black hole pairs which would create a generalized GW signature.

To evaluate the above in terms of our model, we need to refer to a formula given in [45], on a change in power from rotating Planck sized black holes separated say by a Planck length

$$\begin{aligned}\dot{E} &= \text{GW change in energy} = \frac{32\left(M_1 M_2\right)^2\left(M_1+M_2\right)}{5\cdot R^2 M_{Planck}^5} \\ &\xrightarrow[M_1=M_2=M_{\text{Planck}}]{} \frac{64}{5\cdot R^2\left(\text{Planck length}\right)} \\ &\equiv \text{Change in power from Rotating binary black holes}\end{aligned} \tag{94}$$

This then leads to the following question which we cite below *i.e.*

So, then what are the number of gravitons emitted via a spinning Planck sized black holes component binary in terms of gravitons [44] [45]?

Likely from the situation in [44] [45] for items as of about a Planck length, and involving Planck sized masses, we would see the Equation (94). Formula we are looking at is the formula which is for Luminosity from a black hole and the two black holes emit GW with a wave frequency 2 times the rotation frequency of the orbit of the two black holes to each other.

If we assume that we are still using this approximation above, from [46] we can see support for our choice of Planck length as the minimum separation distance between the two black holes via using Plank units normalized to 1 as yielding

$$\begin{aligned} R\left(\text{separation}\right) &\simeq r_g^{eff} = \frac{\left(M_1+M_2\right)}{\left(M_{\text{Planck}}\right)^2} \\ &\xrightarrow[M_1=M_2=M_{\text{Planck}}]{}\xrightarrow[M_{\text{Planck}}=1]{} 1 \equiv R\left(\text{Planck length}\right)\end{aligned} \tag{95}$$

Going to Clifford Will, [47] we see on page 252 a loss or shrinkage of the period for the rotating black hole pair defined by P

$$\dot{P}/P = \frac{\mathrm{d}P}{\mathrm{d}t}\cdot\frac{1}{P} = -\frac{3}{2}\frac{\dot{E}}{E} \tag{96}$$

Whereas, with the Mechanics version of P for a sphere to be defined by, where M is a mass of a star, and we assume a binary system with two masses of equal mass M, so that, if R is the separation between the two masses would be [48]

$$P = R\sqrt{\frac{2\pi^2 R}{G\cdot M}} \xrightarrow[M_{\text{Planck}}=1]{M_1=M_2=M_{\text{Planck}}} R(\text{Planck length})\sqrt{\frac{2\pi^2 R(\text{Planck length})}{G\cdot M(\text{Planck})}} \quad (97)$$

The frequency of rotation would be half that of the GW emitted by these two Planck mass black holes which would collapse into each other. So what we would see from the beginning of expansion of the Universe, to today is that the Primordial Black holes, of about Planck mass, all of say 10^{31} of them initially, which would due to turbulence, and ergodic mixing of space-time form binary pairs which would collapse into each other. This process would continue so that 10^{31} primordial black holes of Planck mass would re combine, via pairs collapsing into larger black holes to we having say 2 times 10^{11} super massive Black holes of mass about 10^9, times the mass of the Sun today, in the center of galaxies.

Not only this was going on, we also had dark stars forming, initially from Dark Matter, which would also form massive black holes. See Karen Freeze, in [49]-[51], whereas we also are assuming a non singular bounce, as to the start of the universe, as given in loop quantum gravity [31].

Our final concluding point to this chapter is to review the physics of **Figure 2**, and then to ask, can we ascertain the GW radiation of pre Universe stars getting into the present universe? *i.e.* keep in mind any suggestion as to cosmology will have to satisfy the following diagram.

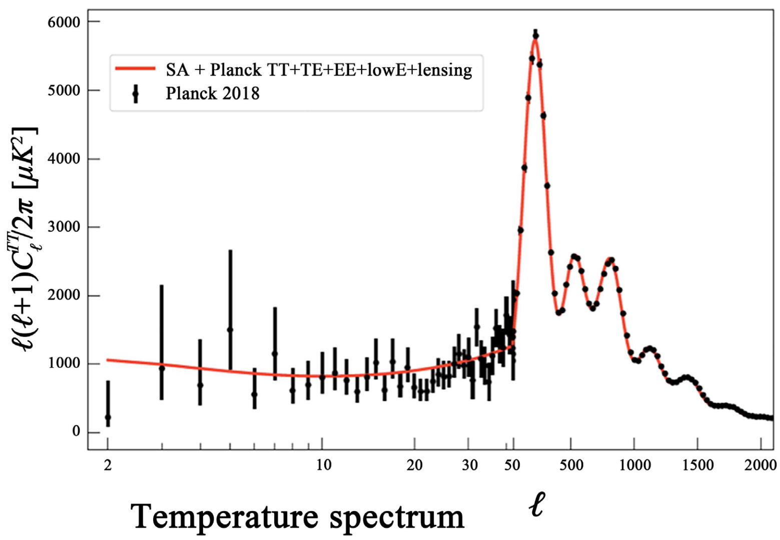

Figure 3. According to the physics of the CMB, as given in [49] Abhay Ashtekar in Zeldovich4. On September 7, 2020 [11].

In our **Figure 3**, we copy what was done by Ashtekar, in Zelsovich4 as to what was part of anisotropic fits to the E and B polarization, as given.

We argue that this realistically means quantum entanglement, and this leads to our multiverse generalization of the Penrose suggestion.

19. Looking Now at the Modification of the Penrose CCC (Cosmology)

We now outline the generalization for Penrose CCC (Cosmology) before inflation which we state we are extending Penrose's suggestion of cyclic universes, black hole evaporation, and the embedding structure our universe is contained within, This multiverse has BHs and may resolve what appears to be an impossible dichotomy. The following is largely from [52] [53] and has serious relevance to the final part of the conclusion. That there are N universes undergoing Penrose 'infinite expansion' (Penrose) [52] contained in a mega universe structure [53] Furthermore, each of the N universes has black hole evaporation, which is with Hawking radiation from decaying black holes. If each of the N universes is defined by a partition function, called $\{\Xi_i\}_{i\equiv1}^{i\equiv N}$, then there exist an information ensemble of mixed minimum information correlated about 10^7 - 10^8 bits of information per partition function in the set $\{\Xi_i\}_{i\equiv1}^{i\equiv N}\Big|_{\text{before}}$, so minimum information is conserved between a set of partition functions per universe [53]

$$\{\Xi_i\}_{i\equiv1}^{i\equiv N}\Big|_{\text{before}} \equiv \{\Xi_i\}_{i\equiv1}^{i\equiv N}\Big|_{\text{after}} \tag{98}$$

However, there is non-uniqueness of information put into individual partition function $\{\Xi_i\}_{i\equiv1}^{i\equiv N}$. Also Hawking radiation from black holes is collated via a strange attractor collection in the mega universe structure to form a new inflationary regime for each of the N universes represented.

Our idea is to use what is known as CCC cosmology [52], which can be thought of as the following [53]. First. Have a big bang (initial expansion) for the universe which is represented by $\{\Xi_i\}_{i\equiv1}^{i\equiv N}$. Verification of this mega structure compression and expansion of information with stated non-uniqueness of information placed in each of the N universes favors ergodic mixing of initial values for each of N universes expanding from a singularity beginning. The n_f stated value, will be using (Ng, 2008) $S_{\text{entropy}} \sim n_f$. [11]-[13]. How to tie in this energy expression, will be to look at the formation of a nontrivial gravitational measure as a new big bang for each of the N universes as by $n(E_i)$ the density of states at energy E_i for partition function [53].

$$\{\Xi_i\}_{i\equiv1}^{i\equiv N} \propto \left\{\int_0^\infty \mathrm{d}E_i \cdot n(E_i)\cdot \mathrm{e}^{-E_i}\right\}_{i\equiv1}^{i\equiv N}. \tag{99}$$

Each of E identified with Equation (108) above, are with the iteration for N universes [53], and [52]. Then the following holds, by asserting the following claim to the universe, as a mixed state, with black holes playing a major part, *i.e.*

CLAIM 1

See the below [53] representation of mixing for assorted N partition functions per CCC cycle

$$\frac{1}{N}\cdot\sum_{j=1}^{N}\Xi_j\Big|_{j\text{ before nucleation regime}}\xrightarrow{\text{vacuum nucleation tranfer}}\Xi_i\Big|_{i\text{ fixed after nucleation regime}} \quad (100)$$

For N number of universes, with each $\Xi_j\Big|_{j\text{ before nucleation regime}}$ for $j = 1$ to N being the partition function of each universe just before the blend into the RHS of Equation (100) above for our present universe. Also, each independent universe a s given by $\Xi_j\Big|_{j\text{ before nucleation regime}}$ is constructed *by the absorption of one to ten million black holes taking in energy. i.e.* (*Penrose*) [53]. Furthermore, the main point is done in [53] in terms of general ergodic mixing [54] [55].

Claim 2

$$\Xi_j\Big|_{j\text{ before nucleation regime}}\approx\sum_{k=1}^{Max}\Xi_k\Big|_{\text{black holes } j\text{th universe}} \quad (101)$$

What is done in Claims 1 and 2 [53] is to come up as to how a multi dimensional representation of black hole physics enables continual mixing of spacetime [53], largely as a way to avoid the Anthropic principle [56] [57], as to a preferred set of initial conditions. So then we come to the main point of all this.

Why we are Looking at the Modification of the Penrose CCC (Cosmology).

We argue this modification is mandated by having the initial DE wavefunction set as having a wave length as stated by

$$\lambda_{DE}\approx 10^{30}\ell_{\text{Planck}} \quad (102)$$

This will be used to make sense of the presentation given in [56] as well as rigorous data analysis of CMBR data. And in all of this, we will be making the scale factor approximation in macro scale *i.e.*

We have that for a scale factor expansion of the universe, that

$$a(t)=a_0\left\{\frac{1}{2\Omega_\Lambda}\cdot\left[\cosh\left(\sqrt{3\Lambda}t\right)-1\right]\right\}^{1/3}\xrightarrow{t\to\text{Large}}\exp\left(\sqrt{\frac{\Lambda}{3}}t\right) \quad (103)$$

The substitution of Equation (103) is in its large time t limit form relevant to **Figure 3**, whereas the earlier before time t is large value of the scale factor is more relevant to the Planckian physics, whereas we still can in very small be using the scale factor as proportional to t to the power of Equation (79), *i.e.* a very large number in the Planckian regime.

20. In This Set Up We Will Be Avoiding Some of the Problems Inherent in the Varying Cosmological Constant Models, *i.e.* See the Following, *i.e.* What If We Have This to Look at

Look at an argument provided by Thanu Padmanabhan [3], leading to the observed cosmological constant value suggested by Park as referenced by Beckwith in [58]. Assume that $l_P \sim 10^{-33}\,\text{cm} \xrightarrow{\text{Quantum Gravity threshold}} \tilde{N}^{\alpha} \cdot l_P$, but that when we make this substitution that $1 \le \tilde{N}^{\alpha} \le 10^{2}$ [59]

$$\begin{aligned} \rho_{VAC} &\sim \frac{\Lambda_{\text{observed}}}{8\pi G} \sim \sqrt{\rho_{UV} \cdot \rho_{IR}} \\ &\sim \sqrt{l_{\text{Planck}}^{-4} \cdot l_H^{-4}} \sim l_{\text{Planck}}^{-2} \cdot H_{\text{observed}}^{2} \end{aligned} \tag{104}$$

i.e. looking at if

$$\Delta\rho \approx \text{a dark energy density} \sim H_{\text{observed}}^{2} / G \tag{105}$$

Now to make it more interesting:

We can replace $\Lambda_{\text{observed}}, H_{\text{observed}}^{2}$ by $\Lambda_{\text{initial}}, H_{\text{initial}}^{2}$. In addition we may look at inputs from the initial value of the Hubble parameter to get the necessary e folding needed for inflation, according to

$$\begin{aligned} &\text{E foldings} = H_{\text{initial}} \cdot \left(t_{\text{End of inf}} - t_{\text{beginning of inf}} \right) \equiv N \ge 100 \\ &\Rightarrow H_{initial} \ge 10^{39} \text{ - } 10^{43} \end{aligned} \tag{106}$$

Leading to

$$a(\text{End of inf}) / a(\text{Beginning of inf}) \equiv \exp(N) \tag{107}$$

If we set $\Lambda_{\text{initial}} \sim c_1 \cdot \left[T \sim 10^{32}\ \text{Kelvin} \right]$ implying a very large initial cosmological constant value, we get in line with what Park suggested for times much less than the Planck interval of time at the instant of nucleation of a vacuum state

$$\Lambda_{\text{initial}} \sim \left[10^{156} \right] \cdot 8\pi G \approx \text{huge number} \tag{108}$$

21. Conclusion 2, *i.e.* We Find that Section XX as an Interpretation of Vacuum Energy is Problematic. Hence, We Stick with Our Constant Cosmological Constant Due to Its Easy Relevance to Table 1, and Figure 3

Furthermore, we wish to point out that Equation (108) is derived using classical arguments whereas the cosmological constant as used by our text initially is to be linked to black holes, and Torsion and has a direct tie into a quantum interpretation of black holes as given in our document, Note. in all this though we are still considering a Hubble parameter which is definable as given in [60]. Note H depends upon temperature T, and becomes enormous in the initial states of the Early Universe.

$$H = 1.66 \sqrt{g_*} \cdot \frac{T_{\text{temperature}}^{2}}{m_P} \tag{109}$$

An open question, is if the initial temperature, given in Equation (109) derivable by classical or quantum processes? Frankly this is extremely fundamental.

Further details of the coefficient of time used in the scale factor as given by

Equation (79) are in [61], whereas we assert that the Penrose Multiverse model, as given in section XIX is similar to the embedding program we asserted in the beginning for the initial HUP used for uncertainty principle. *i.e.* the multiverse in 5 dimensions may well be semi classical.

22. Now to Examine Two Other Approaches as to the De and Cosmological Problem. First the Klauder Enhanced Radiation Procedure Which Is a Way to Obtain De, *i.e.* the Cosmological Constant Before the Planckian Regime of Space-Time

Start with, here that [56] we have a term to the 4th power in Equation (109a) which is among other things linked to Horizon size, *i.e.* Horizon of the early universe in its expansion from early Planckian physics cconstraints

$$\begin{aligned}&\frac{1}{2}\cdot\sum_i \omega_i \equiv V(\text{volume})\cdot\int_0^{\hat{\lambda}}\sqrt{k^2+m^2}\,\frac{k^2\mathrm{d}k}{4\pi^2}\approx\frac{\hat{\lambda}^4}{16\pi^2}\\&\xrightarrow[\hat{\lambda}=M_{\text{Planck}}]{}\rho_{\text{boson}}\approx 2\times10^{71}\,\text{GeV}^4\approx10^{119}\cdot\left(\rho_{DE}=\frac{\Lambda}{8\pi G}\right)\end{aligned} \tag{109a}$$

We use the Padmanabhan 1st integral [3] of the form, with the third entry of Equation (109a) having a Ricci scalar defined via [62] [63] and usually the curvature $\aleph$ [64] set as extremely small, with the general relativity [63] [64] action of

$$\begin{aligned}&S_1=\frac{1}{2\kappa}\int\sqrt{-g}\cdot\mathrm{d}^4x\cdot(\Re-2\Lambda)\\&\&-g=-\det g_{uv}\\&\&\ \Re=6\cdot\left(\frac{\ddot{a}}{a}+\left(\frac{\dot{a}}{a}\right)^2+\frac{\aleph}{a^2}\right)\end{aligned} \tag{110}$$

Next for the idea from Klauder

We are going to go to page 78 by Klauder [64]-[66] of what he calls on page 78 a restricted Quantum action principle which he writes as: S_2 where we write a 1-1 equivalence as in [64]-[66], which is

$$S_2\equiv\int_0^T\mathrm{d}t\cdot\left[p(t)\dot{q}(t)-H_N\left(p(t),q(t)\right)\right]\approx S_1=\frac{1}{2\kappa}\int\sqrt{-g}\cdot\mathrm{d}^4x\cdot(\Re-2\Lambda) \tag{111}$$

Our assumption is that Λ is a constant [64]-[66], hence we assume then use the approximation, from [64]-[66]

$$\begin{aligned}&\frac{p_0^2}{2}=\frac{p_0^2(N)}{2}+N;\ \text{for } 0<N\le\infty \text{ and } q=q_0\pm p_0t\\&V_N(x)=0;\ \text{for } 0<x<1\\&V_N(x)=N;\ \text{otherwise}\\&H_N\left(p(t),q(t)\right)=\frac{p_0^2}{2}+\frac{(\hbar\cdot\pi)^2}{2}+N;\ \text{for } 0<N\le\infty\end{aligned} \tag{112}$$

Our innovation is to then equate $q=q_0\pm p_0t\sim\phi$ and to assume small time step values. Then [64]-[66]

$$\Lambda \approx \frac{-\left[\frac{V_0}{3\gamma-1}+2N+\frac{\gamma\cdot(3\gamma-1)}{8\pi G\cdot\tilde{t}^2}\right]}{\frac{1}{\kappa}\int\sqrt{-g}\cdot \mathrm{d}^3x}+\left(6\cdot\left(\frac{\ddot{a}}{a}+\left(\frac{\dot{a}}{a}\right)^2\right)\right)\Bigg|_{t=\tilde{t}} \tag{113}$$

If we assume that Equation (113) was formed within a cosmic bubble of space-time [50]

$$\left(\frac{\dot{a}}{a}\right)^2 = H^2_{\text{bounce cos}} = \frac{8\pi}{3M_P^2}\cdot\left(\rho-\frac{\rho^2}{2|\sigma|}\right) \tag{114}$$

Here, we have that ρ is a space-time density function, whereas σ is the tension of a space-time bubble presumably of the order of a Planck radius. Also, within the bubble of space-time $\left(\frac{\ddot{a}}{a}\right)\approx\varepsilon^+\simeq 0$ and $a(t)=a_{\min}t^{\gamma}$ at the surface of the space-time bubble. Hence

$$\Lambda \approx \frac{-\left[\frac{V_0}{3\gamma-1}+2\tilde{N}+\frac{\gamma(3\gamma-1)}{8\pi G t_{\text{Planck}}}\right]}{\frac{1}{\kappa}\int\sqrt{-g}\mathrm{d}^3x}+c_1\frac{16\pi}{M_P^2}\cdot\left(\rho-\frac{\rho^2}{2|\sigma|}\right) \tag{115}$$

c_1 is to be determined, whereas the inflaton [3]

$$\phi=\sqrt{\frac{\gamma}{4\pi G}}\ln\left\{\sqrt{\frac{8\pi G V_0}{\gamma(3\gamma-1)}}\cdot t\right\} \tag{116}$$

And what we will use the "inflaton potential" we write as [3]

$$V=V_0\cdot\left\{\sqrt{\frac{8\pi G V_0}{\gamma(3\gamma-1)}}\cdot t\right\}^{\sqrt{\frac{\gamma}{4\pi G}}-\sqrt{\frac{8\pi G}{\gamma}}} \tag{117}$$

Also [3]

$$\rho\approx\frac{\dot{\phi}^2}{2}+V(\phi)\equiv\frac{\gamma}{8\pi G}\cdot t^2+V_0\cdot\left\{\sqrt{\frac{8\pi G V_0}{\gamma(3\gamma-1)}}\cdot t\right\}^{\sqrt{\frac{\gamma}{4\pi G}}-\sqrt{\frac{8\pi G}{\gamma}}} \tag{118}$$

The significance of the procedure is that with tweaking we may be seeing the actual realization of classical gravity as an Eikonal Approximation to quantum theory [67] [68] as what was brought up by Horowitz and Oron in a highly non-standard way as seen in reference [68] which gives a different interpretation to Equation (118) above. The term we refer to as Eikonal approximation to a quantum state has the form of the following decomposition. From Powell and Crasemann, [69] we have the decomposition of Geometric style decomposition of the optical wave equation of

$$\nabla^2\psi-\frac{1}{v^2_{Velocity}}\cdot\frac{\mathrm{d}^2\psi}{\mathrm{d}t^2}=0 \tag{119}$$

Whereas we use the common $\lambda\cdot\omega=2\pi v_{\text{Velocity}}$, and if we substitute in an angular frequency dependence of $\mathrm{e}^{-i\cdot\omega\cdot t}$ in ψ, we get from (16) that if $\lambda=h/p$

and a momentum of value $p=\sqrt{2m\cdot\left(E-V\left(\text{potential}\right)\right)}$, Then we have a transformation of Equation (120) to Equation (121)

$$\nabla^2\psi+\frac{4\pi^2}{\lambda^2}\cdot\psi=0 \tag{120}$$

Leads to a Schrodinger equation of the form given by

$$\nabla^2\psi+\frac{8\pi^2}{h^2}\cdot\left(E-V\left(\text{potential}\right)\right)\cdot\psi=0 \tag{121}$$

Equation (120) has [70]

$$\psi=\sum_{\ell=0}^{\infty}\sum_{m=-\ell}^{\ell}\left(a_{\ell m}j_{\ell}\left(kr\right)+b_{\ell m}y_{\ell}\left(kr\right)\right)\cdot Y_{\ell}^{m}\left(\theta,\phi\right) \tag{122}$$

where we could get away with making a substitution of [69]

$$k=\frac{2\pi}{\lambda}=\frac{2\pi}{h}\cdot\left(E-V\left(\text{potential}\right)\right)^{1/2} \tag{123}$$

where the first and second Bessel Equation solutions [70] are of the form

$$j_{\ell}\left(kr=x\right)=\left(-x\right)^{\ell}\left(\frac{1}{x}\frac{\mathrm{d}}{\mathrm{d}x}\right)^{\ell}\frac{\sin x}{x} \tag{124}$$

$$y_{\ell}\left(kr=x\right)=-\left(-x\right)^{\ell}\left(\frac{1}{x}\frac{\mathrm{d}}{\mathrm{d}x}\right)^{\ell}\frac{\cos x}{x} \tag{125}$$

Then we have via making use of Kieffer's result of variance of the energy [71] is

$$\Delta E=\frac{\sqrt{2\tilde{n}+1}}{\lambda}\approx\frac{h\sqrt{2\tilde{n}+1}\cdot\left(E-V\left(\text{potential}\right)\right)^{1/2}}{2\pi}\equiv\hbar\sqrt{2\tilde{n}+1}\cdot\sqrt{\frac{V_{\text{volume}}}{8\pi G}}\cdot t \tag{126}$$

We get via [71] on page 239 of this reference. Equation (126). After we use Equation (126), then

$$\Delta E\Delta t\approx\sqrt{2\tilde{n}+1}\cdot\sqrt{\frac{V_{\text{volume}}}{8\pi G}}\cdot t\cdot\Delta t\cdot\hbar\approx\hbar \tag{127}$$

If so, then we have that if so by use of [72] since this is also applicable to black holes.

$$\begin{aligned}&t\propto t_{\text{Planck}}\propto\Delta t\Rightarrow\Delta E\Delta t\approx\sqrt{2\tilde{n}+1}\cdot\sqrt{\frac{V_{\text{volume}}}{8\pi G}}\cdot\left(\Delta t\right)^2\cdot\hbar\propto\hbar\\&\Rightarrow\left(\Delta t\right)^2\propto\frac{1}{\sqrt{2\tilde{n}+1}}\cdot\sqrt{\frac{8\pi G}{V_{\text{volume}}}}\end{aligned} \tag{128}$$

Using Planck units,

$$\left(\Delta t\right)^2\propto\frac{1}{\sqrt{2\tilde{n}+1}}\cdot\sqrt{\frac{8\pi G}{V_{\text{volume}}}}\equiv\sqrt{\frac{8\pi}{2\tilde{n}+1}}\cdot\left(t_{\text{Planck}}\right)^2 \tag{129}$$

If $\tilde{n}=\text{quantum number}$, then for Δt being proportional to $t_{\text{Planck}}\propto\Delta t$, we have definite restrictions on $\tilde{n}=\text{quantum number}$, *i.e.* of the type given by

$$\sqrt{\frac{8\pi}{2\tilde{n}+1}}\le 1 \tag{130}$$

Whereas the Kieffer Wavefunction commensurate as to Equation (126) for a quantum Dust universe initially is given as [72] on page 239 of this reference

$$\psi_{\tilde{n},\lambda}(t,r) \equiv \frac{1}{\sqrt{2\pi}} \cdot \frac{\tilde{n}! \cdot (2\lambda)^{\tilde{n}+1/2}}{\sqrt{(2\tilde{n})!}} \cdot \left[\frac{1}{(\lambda + i \cdot t + i \cdot r)^{\tilde{n}+1}} - \frac{1}{(\lambda + i \cdot t - i \cdot r)^{\tilde{n}+1}} \right] \quad (131)$$

This is approximately the same as the wave function of the Universe, as given by Kieffer in the case of torsion given earlier, but the difference lies in that the coefficient $\tilde{n}$ is greatly restricted.

Here the time t would be proportional to Planck time, and r would be proportional to Planck length, whereas we set

$$\lambda \approx \sqrt{\frac{8\pi G}{V_{\text{volume}} \hbar^2 t^2}} \xrightarrow{G=\hbar=\ell_{\text{Planck}}=k_B=1} \sqrt{\frac{8\pi}{t^2}} \equiv \frac{\sqrt{8\pi}}{t} \quad (132)$$

Then a preliminary emergent space-time wavefunction would take the form of

$$\psi_{\tilde{n},\lambda}(\Delta t,r) \equiv \frac{1}{\sqrt{2\pi}} \cdot \frac{\tilde{n}! \cdot \left(2 \cdot \sqrt{8\pi} \cdot (\Delta t)^{-1}\right)^{\tilde{n}+1/2}}{\sqrt{(2\tilde{n})!}} \cdot \left[\frac{1}{\left(\sqrt{8\pi} \cdot (\Delta t)^{-1} + i \cdot \Delta t + i \cdot r\right)^{\tilde{n}+1}} - \frac{1}{\left(\sqrt{8\pi} \cdot (\Delta t)^{-1} + i \cdot \Delta t - i \cdot r\right)^{\tilde{n}+1}} \right] \quad (133)$$

Just at the surface of the bubble of space-time, with $t_{\text{Planck}} \propto \Delta t$, and $r \propto \ell_{\text{Planck}}$

This is from a section, page 239 of the 3rd edition of Kieffer's book [67].

This is a very narrow set of conditions as to the wavefunction of the early Universe!!! Is this defensible? Note, we would need to have r in Equation (133) not zero in some sense to employ the presumed Equation (113). *i.e.* is this reasonable? Very much open to question. To put it mildly! Next, we have that we could have what is known as the NLED, *i.e.* Nonlinear Electromagnetic field approximation to the Cosmological constant.

23. Brane Theory Treatment of Entanglement Entropy and a Variable Cosmological Constant *i.e.* Muller and Lousto Early Universe Entanglement Entropy, and Its Implications. Solving the Spatial Length Issue, Provided a Minimum Time Step Is Preserved in the Cosmos, *i.e.* There Is Zero Observational Proof of This in Existence

We look at [10] again.

$$S_{\text{Entropy}} = 0.3 r_H^2 / a^2 \quad (134)$$

This is labeling an equation for entropy S as (134).

For a time dependent horizon radius Hr which is in line with [10]

As a cosmology phenomenology as discussed in [10]

We can look at

$$S_{\text{Entropy}} = 0.3 r_H^2 / a^2 \sim \frac{0.3}{a^2} \exp\left[-t \cdot \sqrt{\frac{\Lambda}{3}} \right] \quad (135)$$

i.e.

$$\left[-t\sqrt{\frac{\Lambda}{3}}\right] \sim \ln_e\left(\frac{a^2}{0.3}\cdot S_{\text{entropy}}\right) \tag{136}$$

So, then one has

$$\Lambda \approx \frac{3}{t^2}\cdot\left[\ln_e\left(\frac{a^2}{0.3}\cdot S_{\text{entropy}}\right)\right]^2 \tag{137}$$

No matter how small the length gets, S_{entropy} if it is entanglement entropy, will not go to zero. The requirement is that the smallest length of time, *t*, re scaled does not go to zero. *This preserves a minimum non zero* Λ *vacuum energy, and in doing so keep the non zero initial bits, for computational bits contributions to evolving space time behavior even if* $R_{\text{initial}} \to 0$

24. Reviewing a Suggestion as to How to Quantify the Shrinkage of the Scale Factor and Its Connections with Entanglement Entropy

We are given by [73] if there is a nonsingular universe, a template as to how to evaluate scale factor *a* against time scaled over Planck time, with the following results.

$$\ln_e a + \frac{a^6}{6} + \frac{2\cdot a^3}{3} = \sqrt{\frac{8\pi}{3}}\cdot\frac{t}{t_{\text{Planck}}} \tag{138}$$

Two time and scale factor values in tandem particularly stand out. Namely,

$$a \sim \frac{a_{\text{scale}}}{\left[a_{\text{Planck}} \sim 10^{-25}\right]} \equiv 1.344 \Leftrightarrow t \propto t_{\text{Planck}} \sim 5.4\times10^{-44}\ \text{sec} \tag{139}$$

Also

$$a \sim \frac{a_{\text{scale}}}{\left[a_{\text{Planck}} \sim 10^{-25}\right]} \equiv 0.7414 \Leftrightarrow t \propto 0^+ \tag{140}$$

The main thing we can take from this, is to look at the inter-relationship of how to pin down an actual initial Hubble "constant" expansion parameter, where we look at:

$$1.813 = \exp\left(H_{\text{Planck}}\cdot t_{\text{Planck}}\right) \Leftrightarrow H_{\text{Planck}} = \frac{\ln_e(1.813)}{t_{\text{Planck}}} \tag{141}$$

Recall that $\Lambda \approx \frac{3}{t^2}\cdot\left[\ln_e\left(\frac{a^2}{0.3}\cdot S_{\text{entropy}}\right)\right]^2$, which is predicated upon, if the time is close to Planck time the initial maximal density of

$$\rho_{\text{Planck}} \sim 5.2\times10^{96}\ \text{kg/m}^3 \tag{142}$$

And length given by

$$\text{Length}(\text{Planck}) = l_{\text{Planck}} \sim 1.6\times10^{-35}\ \text{meters} \tag{143}$$

So (142) is implying that the amount of matter in a region of space $(l_{\text{Planck}})^3$ is initially about

$$\rho_{\text{initial}} \sim 2\times10^{-10}\ \text{kg} \sim 2\times10^{-7}\ \text{grams} \quad (144)$$

Using 1 GeV/c² = 1.783 × 10⁻²⁷ kg means that (141) above is

$$\rho_{\text{initial}} \sim 2\times10^{-10}\ \text{kg} \sim 2\times10^{-7}\ \text{grams} \sim 10^{+17}\ \text{GeV} \quad (145)$$

Then if

$$10^{+17}\ \text{GeV} \sim \Lambda \approx \frac{3}{t^2}\cdot\left[\ln_e\left(\frac{a^2}{0.3}\cdot S_{\text{entropy}}\right)\right]^2 \quad (146)$$

It will lead to

$$10^{+17}\ \text{GeV}\times10^{-70}\ \text{sec}^2 \sim \left[\ln_e\left(\frac{a^2}{0.3}\cdot S_{\text{entropy}}\right)\right] \quad (147)$$

Then, to first order, one is looking at Initial entropy to get a non zero but definite vacuum energy as leading to an entanglement entropy of about (just before the electro weak regime)

$$S_{\text{entropy}} \sim 1/a^2 \sim 10^{20}\text{ - }10^{40} \quad (148)$$

25. Reviewing the Geometry for Embedding Equation (148) above

In line with Stoica [7] shrinking the minimum length and referring to both (146) and (143), the idea is to use a surface area treatment as to getting the initial entropy values as given in (149). To do so, the author looks at the following diagram (**Figure 4**):

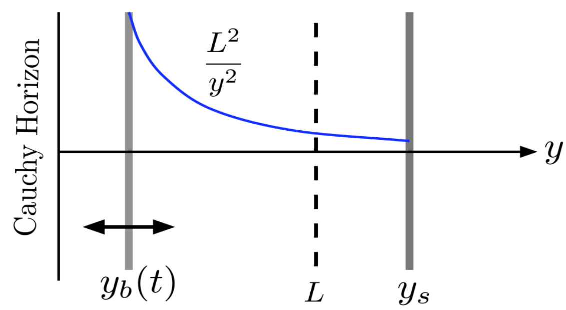

Figure 4. From [73], this is an early universe model of Brane physics as a higher dimensional cosmology.

The two branes given at y_b and y_s refer to the two Brane world states, especially in line with [74] [75]. The first one, namely y_b is the brane where our physical universe lives in, and is embedded in. If one uses this construction, with higher dimensions than just 4 dimensions, then it is possible to have a single point in 4 dimensional space as a starting point to a tangential sheet which is part of an embedding in more than 4 dimensions. Along the lines of having a 4 dimensional cusp with its valley (lowest) point in a more than 4 dimensional tangential surface. The second brane is about 10^{-30} centimeters away from the brane our physical world lives in, and moves closer to our own brane in the future, leading to a slapping of the two branes together about a trillion years ahead in our future [74] [75]. The geometry we are referring to with regards to embedding is in the first brane y_b. [73] uses this geometry to have graviton production which the author has used to model Dark Energy [76].

26. Conclusion. Making Computational Bits

As stated by Ng. the idea would be to have *i.e.* [11]-[13], *i.e.* the coefficient of 3/4th is due to factoring in curvature in the very early universe whereas we would intuitively expect it to be 1.

$$\#\text{bits} \sim \left[\frac{E}{\hbar}\cdot\frac{l}{c}\right]^{3/4} \approx \left[\frac{Mc^2}{\hbar}\cdot\frac{l}{c}\right]^{3/4} \tag{149}$$

Here in this case, even if the spatial contribution, due to [10] goes to zero, the idea would be to have the time length non zero so as to have a space-time version of l non zero. This would also be in tandem with calling *E*, in (149) as proportional to $\Lambda \approx \frac{3}{t^2}\cdot\left[\ln_e\left(\frac{a^2}{0.3}\cdot S_{\text{entropy}}\right)\right]^2$, where if the time is Planck time, in minimum value, and $S_{\text{entropy}} \sim 1/a^2 \sim 10^{20}$ - 10^{40} in value, one would have before the electro-weak an input into energy *E*, which would require an entropy (entanglement).

What remains to be seen is, if there is a geometric sheet in more than 4 dimensions, allowing for non zero time, as argued for $\Lambda \approx \frac{3}{t^2}\cdot\left[\ln_e\left(\frac{a^2}{0.3}\cdot S_{\text{entropy}}\right)\right]^2$, even if the spatial component goes to zero, according to [10]. We suggest an update as to what was written by Seth Lloyd [77] with

$$I = S_{\text{total}}/k_B \ln 2 = [\#\text{operations}]^{3/4} = \left[\rho\cdot c^5\cdot t^4/\hbar\right]^{3/4} \tag{150}$$

when [23]

$$\rho \equiv T^{00} \sim \Lambda_{\text{vacuum energy}} \tag{151}$$

While doing this, a good thing to do, would be to keep in mind the four dimensional version of vacuum energy as given by Park, [78] namely

$$\Lambda_{4\text{-dim}} \approx c_2\cdot T^{\beta} \tag{152}$$

As well as the transition given by a combination of [78], with [79], Barvinskey *et al.*

$$\Lambda_{4\text{-dim}} \propto c_2\cdot T \xrightarrow[\text{gravtion production}]{} 360\cdot m_P^2 \ll c_2\cdot\left\lfloor T \approx 10^{32}\,\text{K}\right\rfloor \tag{153}$$

i.e. here is the problem. There is zero, and I repeat zero evidence, as to Equation (153), *i.e.* but it does open up the question of linkage, between prior to present universes as given in **Table 1**. *i.e.* between a black hole to white hole linkage between earlier universe (or universes) and the present universe.

27. Future Project as to Explicitly Working in Prior Universe White Hole Linked to Present Universe Black Hole, via a Special Wormhole, for Each Wormhole Linking Prior to Present Universes

What we are doing is using the following wormhole connection, *i.e.*

In doing this we should note that we are assuming as a future work that there would be black holes, in our initial configuration, plus a white hole in the immediate pre inflationary regime. Likely in a recycled universe. Reference [80] [81] is what we will start off with [80] [81] and its given metric as far as a black hole to white hole solution. *i.e.*

$$\mathrm{d}S^2 = -A(r,a)\mathrm{d}t^2 + B(r,a)^{-1}\mathrm{d}r^2 + g^2(r,a)\mathrm{d}\Omega^2 \tag{154}$$

We can perform a major simplification by setting, then

$$A(r,a) = B(r,a) = f(r,a) \tag{155}$$

In doing so, [80] gives us the following stress energy tensor values as give

$$\begin{aligned} T_t^t &= \frac{1}{8\pi}\cdot\left(\frac{1}{g}\cdot\left(f'g' + 2fg''\right) - \frac{1}{g^2}\cdot\left(1 - fg'^2\right)\right) \\ T_r^r &= \frac{1}{8\pi}\cdot\left(\frac{1}{g}\cdot\left(f'g'\right) - \frac{1}{g^2}\cdot\left(1 - fg'^2\right)\right) \\ T_\theta^\theta = T_\phi^\phi &= \frac{1}{8\pi}\cdot\left(\frac{1}{g}\cdot\left(f'g' + fg''\right) + \frac{1}{2}\cdot\left(f''\right)\right) \end{aligned} \tag{156}$$

In doing this, we will chose the primed coordinate as representing a derivative with respect to *r*. Also in the case of black hole to white hole joining, we will be looking at a gluing surface as to the worm hole joining a black hole to white hole given as with regards to a gluing surface connecting a black hole to a white hole which we give as ξ. And $\tilde{\tilde{n}}$ is a quantum gravity index. Note that in [80] [81] the authors often set it at 3, if so then for a black hole, to white hole to worm hole configuration they give

$$g(r,a) = \begin{cases} r^2 + a^2\left(1 - \dfrac{r^2}{\xi^2}\right)^{\tilde{\tilde{n}}}, & \text{when } (r \le \xi) \\ r^2, & \text{when } (r > \rho) \end{cases} \tag{157}$$

We then make the following connection to energy density in a black hole to white hole system, *i.e.*

$$\begin{aligned} &\rho_{\text{black hole white hole wormhole}} \equiv -T_r^r \\ &\approx \hbar\omega_{\text{black hole white hole wormhole}}\tilde{n}_{\text{black hole white hole wormhole}} \end{aligned} \tag{158}$$

This will lead to, if we use Planck units where we normalize *h* bar to being 1, of

$$\begin{aligned} &\tilde{n}_{\text{black hole white hole wormhole}} \\ &= \frac{1}{8\pi}\cdot\left(\frac{1}{g}\cdot\left(f'g'\right) - \frac{1}{g^2}\cdot\left(1 - fg'^2\right)\right)\cdot\frac{1}{\omega_{\text{black hole white hole wormhole}}} \end{aligned} \tag{159}$$

If we are restricting ourselves to quantum geometry at the start of expansion of the universe, it means that say we can set these values to be compared to the inputs of quantum number n used to specify a quantum number *n*.

28. Final Conclusion, *i.e.* a White Hole to a Black Hole Tunnel from a Prior Universe, to a Present Universe, as Given by Section XXVII May Be the Way to Go. How to Tie That into the Detail Provided as of Equation (132)?

That is the final question and it is allowing for if we can still write $\lambda \approx \sqrt{\frac{8\pi G}{V_{\text{volume}}\hbar^2 t^2}} \xrightarrow{G=\hbar=\ell_{\text{Planck}}=k_B=1} \sqrt{\frac{8\pi}{t^2}} \equiv \frac{\sqrt{8\pi}}{t}$ in a wave function of the universe as given by Kieffer in Equation (133).

Now for a note as to Appendix B *i.e.* this assumes a model of a time VARYING cosmological constant, *i.e.* one which is an outgrowth of the additional energy dumped into the universe by early UNIVERSE E and B fields. This is similar to GR, but my doubts as to its veracity are in that it is fiendishly easy in NLED cosmology to have an infinitely expanding Universe, *i.e.* eternal inflation. If one supposes that the Penrose situation of prior to our present universe super massive black holes from an earlier cycle of creations makes an appearance in the CMBR, we are NOT going to have eternal inflation.

If the Penrose supposition of super massive black holes making an impingement upon the CMBR, is in a sense proved, I do not see how we can have NLED cosmology in our falsifiable cosmology models. *i.e.* if one has CMBR with NO impingement of super massive black holes, upon the CMBR as speculated by Penrose, in his CCC cosmology, then the NLED program and the possibility of its time varying cosmological "constant" parameter cannot be dismissed. In addition, NLED may due to what I put in IA sub section in **Appendix B** be very useful for some of the anomalies showing up in CMBR as far as structure formation.

Furthermore is its possible tie in with [82] which is a very important summing up of generalized entropy research and gravitation. Also, there is also considerable evidence which cannot be dismissed as to E and B fields attached to black holes. This is something which has been speculated as to the Membrane model of black holes, for decades [83].

Final concluding remarks. If **Appendix B** is the way to go, NLED MAY offer a way to fix Planck's constant. See **Appendix C**. This is viable if **Appendix B** is not ruled out. See also **Appendix D**, as far as the idea of a partition function of the Universe. We have an outstanding question about the term E which shows up. Can we improve on it?

The game changer is seen in **Appendix E**, *i.e.* a way to calculate 10^{122} entropy in the universe using a horizon argument for the universe. Can we match this argument with our modification of the Penrose hypothesis, as given? Extremely interesting if possible. And it also puts a different spin as to what a universe really means.

The probable results of not allowing the Penrose Singularity are collected **in Appendix F**, which is of educational value for the reader.

A future project is as follows. If **Appendix E** is analyzed, it is effectively Hamiltonian General relativity. *i.e.* Mostly a classical theory. Classical Hamiltonians generate what are called Poisson brackets. See **Appendix G**, where we summarize a reference list comparison of Poisson brackets, and Hamiltonian systems with their linkage to Quantum commutation relations. *i.e.* if we can make a linkage to **Appendix E**, and the results of Table 1 via torsion physics, we can possibly use a cross over to quantum commutation relationships which would aid in the development of a purely quantum analysis of early universe cosmology.

Appendix H, summarizes two first integrals being compared as how to isolate a cosmological constant at the start of our universe as well as the datum of negative pressure. The 1st first integral is w.r.t. General Relativity. The 2nd first is a quantum system.

Finally, **Appendix I**, is a handy reference as to the issue of Strange attractors which is the smoking gun in terms of the modification of the CCC Penrose cosmology so pursued.

Origin of using the term strange attractor, with respect to CCC cosmology, is as follows. *i.e.* this paper is a really good visual source.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix A. A Redo of the Fifth Force Argument as of Reference [34]

$$
\begin{aligned}
& a(t) = a_{\text{initial}} t^{\nu} \\
& \Rightarrow \phi = \ln\left(\sqrt{\frac{8\pi G V_0}{\nu \cdot (3\nu - 1)}} \cdot t\right)^{\sqrt{\frac{\nu}{16\pi G}}} \\
& \Rightarrow \dot{\phi} = \sqrt{\frac{\nu}{4\pi G}} \cdot t^{-1} \\
& \Rightarrow \frac{H^2}{\dot{\phi}} \approx \sqrt{\frac{4\pi G}{\nu}} \cdot t \cdot T^4 \cdot \frac{1.66^2 \cdot g_*}{m_P^2} \approx 10^{-5}
\end{aligned}
\tag{1a}
$$

This would lead to an expansion parameter, a Hubble constant as given in [4]

This of course makes uses of [4] as this value, *i.e.* we write H in terms of temperature T initially to specify how fast the expansion was in high temperature regimes

$$
H = 1.66\sqrt{g_*} \cdot \frac{T_{\text{temperature}}^2}{m_P} \tag{2a}
$$

If so then

We will be using the ideas given in when we have the Gravitational wave frequency specified by [5] with r in the following equation of the order of Planck length, more or less [4]

$$
\begin{aligned}
& \omega_{gw}^6 \approx c^7 \times \frac{\tilde{\beta}}{2 m_P r} \cdot \sqrt{\frac{\nu}{\pi G}} \times \frac{1}{Gc \cdot (M_{\text{mass}})^2 \langle r^2 \rangle^2} \\
& \Rightarrow \omega_{gw} \approx \left(\sqrt{\frac{\nu}{4\pi G}} \times \frac{\tilde{\beta} \cdot c^6}{G \cdot (M_{\text{mass}})^2 m_P r \cdot \langle r^2 \rangle^2}\right)^{1/6}
\end{aligned}
\tag{3a}
$$

The idea of a fifth force contribution makes its way via the argument given in [1] to the effect that the power of a signal of GW generation in the primordial GW sense would be given by [4]

$$
\begin{aligned}
P_{GW} & \approx \frac{Gc \cdot (M_{\text{mass}})^2 \omega_{gw}^6 \langle r^2 \rangle^2}{c^6} \approx c \times \left|F_{\text{5th force}}\right| \\
& = \left| -c \times \frac{\tilde{\beta} \cdot (\vec{\nabla} \phi)}{m_P} \right| \approx c \times \frac{\tilde{\beta}}{2 m_P r} \cdot \sqrt{\frac{\nu}{\pi G}}
\end{aligned}
\tag{4a}
$$

Having said that I am now ready to discuss the role of individual black holes. In order to do this we use [4] namely

$$
t = \frac{r}{\varpi c} \tag{5a}
$$

The term of ϖ is a dimensionless value less than or at most equal to the value 1, and never negative. If so, then Equation (5a) will yield a radial force component which we will write as [4]

$$F_{\text{5th force}} = -\frac{\tilde{\beta}\cdot\left(\vec{\nabla}\phi\right)}{m_P} \approx -\frac{\tilde{\beta}}{2m_P r}\cdot\sqrt{\frac{\nu}{\pi G}} \tag{6a}$$

In this, with respect to this document we have that $\tilde{\beta}$ is due to a Chamenon particle, as seen in [4] in *Chameleon cosmology*. *Also f*or mass greater than Planck mass, namely $M_{\text{mass}} \approx \zeta m_p$, with m_p for Planck Mass. We refer to [4], in that this is for the mass of a physical system, *i.e.* M_{mass} of an object which in its physical configuration is generating gravitational waves, ω_{gw} and we find that in the Planckian regime, $\tilde{\beta}$ is a coefficient connected to a fifth force argument due to reasoning from [4].

This leads to the following i.e. in [34] *which is reproduced here, In addition after approximating* $\left\langle r^2 \right\rangle^2 \approx \ell_p^4$, *i.e.* Planck length to the fourth power and $r\left\langle r^2 \right\rangle^2 \approx \ell_p^5$.

We find then we have at the immediate beginning of inflation, an almost Planck frequency value of 1.855 times 10^{43} Hertz, we would need ν be 10^{502} which would be factored into Equation (1a) and the scale factor value for the term ν. This would mean for the fifth force argument that we would have an almost infinitely quick expansion in the neighborhood of Planck length for the start of inflation.

Appendix B. How to Use NLED Cosmology in Order to Come Up with a Cosmological Constant? Formation of Structure Due to NLED Formalism?

We will treat in notation **Appendix B** as a mini paper in its own right. Hence the set up as follows.

We repeat an earlier introductory, in the main text section of Mukanov [41] for consistency in the appendix, **Appendix B**, so it can be read as independent of the rest of the paper. Having said that….

This appendix A has several routes as to identifying NLED phenomenon pertinent to cosmology structure formation. First we look at what Mukhanov [41] writes as far as structure formation. Mainly that there is a formulation of what is called self reproduction of inhomogeneity in terms of early universe conditions [41]. In this, the starting point is if one used the meme of chaotic inflation, *i.e.* inflation generated by a potential of the form as given by Mukhanov [41]

$$V(\text{potential}) \sim \phi^2 \tag{1b}$$

In this, Mukhanov [41] write that one can look at a scalar field at the end of (chaotic) inflation, with an amplitude given by, with ϕ_i for the initial value of the inflaton such that (where m will be determined by NLED inputs to be brought up later)

$$\delta_{\phi}^{Max} \sim m \cdot \phi_i^2 \tag{2b}$$

In terms of the initial inflaton, inhomogenities do not form if the initial inflaton is bounded [41] as given by

$$m^{-1} > \phi_i > m^{-1/2} \tag{3b}$$

This leads to (low?) inhomogeneity in the space-time generated by inflation. Inflation is eternal [41] if. there is only the inequality

$$\phi_i > m^{-1/2} \tag{4b}$$

Our analysis of NLED is concerned with the application of Equation (4b), and its consequences.

1B. NLED Applied to Equation (4a) Plus Details of Structure Formation Added

What we will do is to look at the following treatment of mass, and this will be our starting point. *i.e.* we will be looking at, if l_P is Planck length, and $\alpha > 0$, then

$$m \sim 10^{\alpha} \cdot l_p^3 \cdot \rho(\text{density}) \tag{5b}$$

Then we can consider the following formulation of density given below. If we do not wish to consider a singular universe, then Camara *et al.*, [84] has an expression as to density, with a B field contribution to density, and we also can used the Weinberg result [4] [85] [86] of scaling density with one over the fourth power of a scale factor, which we will remark upon in the general section, as well the Corda and Questa result of [12] [23] [87] for density of (note reference [86] is for a star, whereas [84] is for a universe).In addition, Corda, and others in [87] use quintessential density to falsify the null energy condition of a Penrose theorem cited in [88], Further details of what Penrose was trying to do as to this issue of GR, can be seen in [88] [89], and to answer how to violate the null energy condition, one should go to [88] [89] for quintessential density defined, Then in both the massive star and the early universe, the density result below is applicable [87].

$$\rho_\gamma = \frac{16}{3} \cdot c_1 \cdot B^4 \tag{6b}$$

Keeping in mind what was said as to choices of what to do about density, and its relationship to Equation (5b) above, we then can reference what Mukhanov [41] says about structure formation as follows, namely look at how a Hubble parameter changes with respect to cosmic evolution. It changes with respect to H_{today} being the Hubble parameter in the recent era, and the scale factor a, with this scale factor being directly responsive to changes in density according to [84], *i.e.*

$$\rho \sim a^{-4} \tag{7b}$$

In the next section, we will examine how [84] [87] suggests how to vary the scale factor cited in Equation (7b), and we will in this section take note of what the scale factor does to the Hubble parameter given in Equation (8b) below, and then in the section afterwards review a possible reconciliation of what Equation (4b) and Equation (7b) say about defining early universe parameters. But to know why we are doing it, we should take into consideration what happens to the Hubble parameter, as given below [41].

$$H \sim H_{\text{today}} / a^{3/2} \tag{8b}$$

According to [41] inhomogeneous patches of space time appear in a causal region of space time for which [41]

$$\text{Causal domain} \sim H^{-1} \sim 1 / \left(H_{\text{today}} / a^{3/2} \right) \tag{9b}$$

Furthermore, [41] states that about 20 such domains are created in a Hubble time interval $\Delta t_H \propto H^{-1}$ *i.e.* As a function of say 10^α times Planck time, for a domain size given by Equation (9a) above and that this requires then a clear statement as to how the scale factor changes, due to considerations given by [85] [86] and reconciling the density expression given in Equation (6b) and Equation (7b) above.

2B. Showing a Non Zero Initial Radius of the Universe due to Non Linear Space-Time E&M

What we are asserting is. in [84] there exists a scaled parameter λ, and a parameter a_0 which is paired with α_0. For the sake of argument, we will set the $a_0 \propto \sqrt{t_{\text{Planck}}}$, with $t_{\text{Planck}} \sim 10^{-44}$ seconds. Also, Λ is a cosmological 'constant' parameter which is described later, as in quintessence, via reference [85], and is in [84] [87] via:

$$\alpha_0 = \sqrt{\frac{4\pi G}{3\mu_0 c}} B_0 \tag{10b}$$

$$\lambda = \Lambda c^2 / 3 \tag{11b}$$

Then if, initially, Equation (11b) is large, due to a very large Λ the time, given in Equation (6b) of [86] is such that we can write, most likely, that even though there is an expanding and contracting universe, that the key time parameter may be set, due to very large Λ as

$$t_{\min} \approx t_0 \equiv t_{\text{Planck}} \sim 10^{-44}\ \text{s} \tag{12b}$$

Whenever one sees the coefficient like the magnetic field, with the small 0 coefficient, for large values of Λ, this should be the initial coefficient at the beginning of space-time which helps us make sense of the nonzero but tiny minimum scale factor [84]

$$a_{\min} = a_0 \cdot \left[\frac{\alpha_0}{2\lambda} \left(\sqrt{\alpha_0^2 + 32\lambda\mu_0\omega B_0^2} - \alpha_0 \right) \right]^{1/4} \tag{13b}$$

The minimum time, as referenced in Equation (7b) most likely means, due to large Λ that Equation (13b) is of the order of about 10^{-55}, *i.e.* 33 orders of magnitude smaller than the square root of Planck time, in magnitude. We next will be justifying the relative size of the Λ.

3B. Showing How to Obtain a Varying Λ with a Large Initial Value and Its Relationship to Obtaining a Scale Factor Value for the Early Universe via NLED Methods

Non withstanding the temperature variation in reference [85] for the cosmological Hubble parameter, we also can reference what is done in reference [84] namely due to

$$\Lambda(t) \sim \left(H_{\text{inflation}} \right)^2 \tag{14b}$$

In short, what we obtain, via looking at due to [78], that Equation (14b) is also equivalent to

$$\Lambda_{Max} \sim c_2 \cdot T_{\text{temperature}}^{\tilde{\beta}} \tag{15b}$$

Comparing Equation (14b) and Equation (15b) above, leads to the following constraints, *i.e.* [84]

$$\left(\rho \sim a^{-4} \right)^{-1} \sim a^4 \sim \frac{16}{3} \cdot c_1^{-1} \cdot B^{-4} \sim a_0^4 \left[\frac{\alpha_0}{2\lambda} \left(\sqrt{\alpha_0^2 + 32\lambda\mu_0\omega B_0^2} - \alpha_0 \right) \right] \tag{16b}$$

The above relationship will argue in favor of a large value for Equation (15b) and Equation (16b) B field and also the cosmological 'constant' parameterized in Equation (14b) and Equation (15b), *i.e.* once fully worked out, the allowed values of B, for initial conditions will be large but tightly constrained, and this in turn will allow for Equation (16b) having initially extremely small inhomogeneity behavior, in line with being proportional to the inverse of an allowed Hubble parameter based upon Equation (18b) later on. Note that from [90] we have

$$\frac{\Delta H}{H} \sim \Omega_m^2 h^2 \Delta_{\Re} \sim 10^{-5} \tag{17b}$$

Here, we have that if there is a flat universe, that according to Guth [91] and taking note of

$$H^2 = \frac{8\pi}{3} \cdot \rho \tag{18b}$$

Roughly put, what we are predicting is, that if we use what Lloyd wrote, namely [77] as well as use the magnetic field relations to density brought up in Equation (6b). This is also in part related to the number of gravitons which could be expected as given by Peebles [92] [93] *i.e.* if one has a density related to energy via $\rho \propto \hbar \cdot \omega_{\text{Graviton}} \cdot V^{-1}(\text{Volume}) \Leftrightarrow \hbar \cdot \omega_{\text{Graviton}} \sim \rho \cdot V^{+1}(\text{Volume})$. Then one can write, say by using the approximation given by Peebles [92] [93]

$$\begin{aligned} \mathbb{N}_{\text{graviton}} &= \text{graviton}\,\# \sim \left(\left(\exp\left[\hbar \cdot \omega_{\text{graviton}} / k_B T\right]\right) - 1\right)^{-1} \\ &\propto \left(\left(\exp\left[\rho \cdot V_{\text{Volume}} \cdot a_{\text{initial}}(t) / k_B\right]\right) - 1\right)^{-1} \end{aligned} \tag{19b}$$

If we have such a treatment of information as given by Lloyd [77], plus the above, we can estimate that there is a fluctuation due to early universe cosmology along the lines of, if we have a base line number for initial (expansion) value of the Hubble parameter, we call $H_{\text{base line}}$ as a starting point for an expanding universe, and with $\#\text{operations}$, as given by Lloyd [77] as a function of entropy, initially. So then, in terms of what may be generated and show up in the CMBR we may see

$$\Delta H(\text{thermal}) \sim H_{\text{base line}} \cdot (\#\text{operations})^{1/4} \cdot 10^{-5} \cdot \sqrt{t/t_{\text{Planck}}} \tag{20b}$$

The number of gravitons, as given by Equation (19b) is significant, since we have, if we look at say what constitutes a contribution from $\rho \cdot V_{\text{Volume}}$, and from there, given a value of $H_{\text{base line}}$ according to the following procedure

$$H_{\text{initial}} \sim \sqrt{\frac{8\pi k_B}{12 \cdot V_{\text{Volume}} \cdot a_{\text{initial}}}} \cdot \left(\log\left[1 + \frac{1}{\mathbb{N}_{\text{graviton}}(\text{initial})}\right]\right) \tag{21b}$$

We state that also, indeed, some of this is apparent in [94] as well.

For the sake of simplicity, we will have, then

$$\begin{aligned} & H_{\text{initial}} \approx H_{\text{base line}} \Rightarrow H_{\text{base line}} \sim \sqrt{\frac{8\pi k_B}{12 \cdot V_{\text{Volume}} \cdot a_{\text{initial}}}} \cdot \left(\log\left[1 + \frac{1}{\mathbb{N}_{\text{graviton}}(\text{initial})}\right]\right) \\ & \& \ \Delta H(\text{thermal}) \sim \sqrt{\frac{8\pi k_B}{12 \cdot V_{\text{Volume}} \cdot a_{\text{initial}}}} \cdot \left(\log\left[1 + \frac{1}{\mathbb{N}_{\text{graviton}}(\text{initial})}\right]\right) \\ & \qquad \cdot (\#\text{operations})^{1/4} \cdot 10^{-5} \cdot \sqrt{t/t_{\text{Planck}}} \\ & \& \ \#\text{operations} \sim \left(\mathbb{N}_{\text{graviton}}(\text{initial})\right)^{4/3} \Rightarrow \\ & \Delta H(\text{thermal}) \sim \sqrt{\frac{8\pi k_B}{12 \cdot V_{\text{Volume}} \cdot a_{\text{initial}}}} \cdot \left(\log\left[1 + \frac{1}{\mathbb{N}_{\text{graviton}}(\text{initial})}\right]\right) \\ & \qquad \cdot \left(\mathbb{N}_{\text{graviton}}(\text{initial})\right)^{1/3} \cdot 10^{-5} \cdot \sqrt{t/t_{\text{Planck}}} \end{aligned} \tag{22b}$$

The upshot of Equation (21b) is that if Equation (16b) is commensurate with a minimum value of the scale factor, *i.e.* so long as $a_{\text{initial}} \neq 0$ due to [84] [94]

$$\begin{aligned} a_{\text{initial}} \approx a_{\min} &\sim a_0 \cdot \left[\frac{\alpha_0}{2\lambda}\left(\sqrt{\alpha_0^2 + 32\lambda\mu_0\omega B_0^2} - \alpha_0\right)\right]^{1/4} \\ &\propto \left[\frac{\alpha_0}{2\lambda}\left(\sqrt{\alpha_0^2 + 32\lambda\mu_0\omega B_0^2} - \alpha_0\right)\right]^{1/4} \end{aligned} \tag{23b}$$

Then the shift in the change in the Hubble parameter, in expansion to first order can be set as

$$\begin{aligned} \Delta H(\text{thermal}) &\sim \sqrt{\frac{8\pi k_B}{12 \cdot V_{\text{Volume}}}} \cdot \frac{\left(\log\left[1 + \frac{1}{\mathbb{N}_{\text{graviton}}(\text{initial})}\right]\right)}{\left[\frac{\alpha_0}{2\lambda}\left(\sqrt{\alpha_0^2 + 32\lambda\mu_0\omega B_0^2} - \alpha_0\right)\right]^{1/8}} \\ &\cdot \left(\mathbb{N}_{\text{graviton}}(\text{initial})\right)^{1/3} \cdot 10^{-5} \cdot \sqrt{t/t_{\text{Planck}}} \end{aligned} \tag{24b}$$

By necessity to get non pathological values of the change in $\Delta H(\text{thermal})$, we need to have

$$\begin{aligned} &\mathbb{N}_{\text{graviton}}(\text{initial}) \neq 0 \\ &\mathbb{N}_{\text{graviton}}(\text{initial}) \neq \infty \\ &B_0 \equiv B_{\text{initial}} \neq 0 \\ &B_0 \equiv B_{\text{initial}} \neq \infty \\ &\lambda \neq 0 \\ &\lambda \neq \infty \end{aligned} \tag{25b}$$

The initial volume would be at a minimum the cube of Planck's length, say 10^{-33} centimeters, cubed, leading to an enormous value for Equation (23b), whereas we would be considering if we had an initial time step close to Planck time, and $0 < \mathbb{N}_{\text{graviton}}(\text{initial}) < 10^5$, and

$$\begin{aligned} \Delta H(\text{thermal}) &\sim \sqrt{\frac{8\pi k_B}{12 \cdot V_{\text{Volume}}}} \cdot \frac{\left[\frac{1}{\mathbb{N}_{\text{graviton}}(\text{initial})} - \frac{1}{2\mathbb{N}_{\text{graviton}}^2(\text{initial})}\right]}{\left[8\mu_0\omega B_0^2\right]^{1/8}} \\ &\cdot \left(\mathbb{N}_{\text{graviton}}(\text{initial})\right)^{1/3} \cdot 10^{-5} + H.O.T \end{aligned} \tag{26b}$$

This places an absolute requirement upon having the initial magnetic field not equal to zero,

As well as having a nonzero initial graviton production number, and also non zero initial volume.

With both these requirements in place, if $m_{\text{graviton}} \sim \frac{\hbar H}{c^2} \sim 10^{-61}\,\text{grams}$, and we set in a Planck time interval

$$m_{\text{graviton}} \sim \frac{\hbar H}{c^2} \sim 10^{-61} \text{ grams}$$
$$\sim \frac{\hbar}{c^2} \cdot \sqrt{\frac{8\pi k_B}{12 \cdot V_{\text{Volume}}}} \cdot \frac{\left[\frac{1}{\mathbb{N}_{\text{graviton}}(\text{initial})} - \frac{1}{2\mathbb{N}^2_{\text{graviton}}(\text{initial})}\right]}{\left[8\mu_0 \omega B_0^2\right]^{1/8}} \cdot \left(\mathbb{N}_{\text{graviton}}(\text{initial})\right)^{1/3} \cdot 10^{-5} \tag{27b}$$

And that Equation (26b) may give some insight as to the fluctuations which show up in **Figure 2**, of reference [10] [95].

4B. Does the Existence of Tightly Constrained but Very Large Magnetic Fields Allow for Inhomogeneous Patches Due to NLED Showing Up in CMBR

We then get an inter relationship between $\mathbb{N}_{\text{graviton}}(\text{initial})$, the initial Volume, and the initial magnetic field to consider. Moreover, what we have also shown, is that NLED. Appearing initially, that it is very probable that if one uses infinite quantum statistics as given by Ng [11]-[13].

$$\mathbb{N}_{\text{graviton}}(\text{initial}) \approx S(\text{initial entropy}) \neq 0 \tag{28b}$$

Note that in usual treatment of entropy, and entropy density we usually assume a fourth order dependence upon temperature for entropy density. Here we say that this entropy is most likely independent of Temperature, by Infinite quantum statistics, as given by Ng [11]-[13]. But we also will be talking about a necessary bound of quantum fluctuations which will be given below. *i.e.* consider if we have the following restrictions in fluctuations due to quantum effects which we give as follows.

What we will mention, is that co current with Equation (26b), Equation (27b) and Equation (28b) that there is a situation for which, as given by Mukhanov [41] there are conditions in which a quantum fluctuation would spoil initial homogeneity if there exist quantum fluctuations exceeding

$$\lambda_{\text{Critical value}} \sim (\Delta H)^{-1} \exp\left(m^{-1}_{\text{graviton}}\right)$$
$$\sim \sqrt{\frac{12 \cdot V_{Volume}}{8\pi k_B}} \cdot \frac{\left[8\mu_0 \omega B_0^2\right]^{1/8} \left(\mathbb{N}_{\text{graviton}}(\text{initial})\right)^{-1/3} \cdot 10^5}{\left[\frac{1}{\mathbb{N}_{\text{graviton}}(\text{initial})} - \frac{1}{2\mathbb{N}^2_{\text{graviton}}(\text{initial})}\right]} \cdot \exp\left(\frac{c^2}{\hbar} \cdot \sqrt{\frac{12 \cdot V_{Volume}}{8\pi k_B}} \cdot \frac{\left[8\mu_0 \omega B_0^2\right]^{1/8} \left(\mathbb{N}_{\text{graviton}}(\text{initial})\right)^{-1/3} \cdot 10^5}{\left[\frac{1}{\mathbb{N}_{\text{graviton}}(\text{initial})} - \frac{1}{2\mathbb{N}^2_{\text{graviton}}(\text{initial})}\right]}\right) \tag{29b}$$

The quantum uncertainty in position which will be referred to is of the form $\Delta x \Delta p \equiv \lambda_{QM} \cdot m \cdot c \approx \hbar \Leftrightarrow$

$$\lambda_{\text{QM graviton}} \approx \frac{\hbar}{m_{\text{graviton}} \cdot c} \sim c \cdot \sqrt{\frac{12 \cdot V_{\text{Volume}}}{8\pi k_B}} \cdot \frac{\left[8\mu_0 \omega B_0^2\right]^{1/8} \left(\mathbb{N}_{\text{graviton}}(\text{initial})\right)^{-1/3} \cdot 10^5}{\left[\frac{1}{\mathbb{N}_{\text{graviton}}(\text{initial})} - \frac{1}{2\mathbb{N}^2_{\text{graviton}}(\text{initial})}\right]} \tag{30b}$$

When the wavelength function of Equation (29b) and Equation (30b) are about the same value, one has the destruction of inhomogeneity, in early universe conditions, which puts restrictions on the value of graviton mass, of presumed entropy, as given by Ng's infinite quantum statistics, and more. The details of such will be elaborated upon in further publications. Furthermore, it also puts constraints upon the magnetic fields which may be present in early universe conditions. In any case the expected mass of the graviton would be of the order of about 10^{-62} grams, and the entropy would be here about [11]-[13]

$$1 < \mathbb{N}_{\text{graviton}}(\text{initial}) \sim S_{\text{initial}} < 10^{5} \tag{31b}$$

This also refers to [34] [35] [77].

The implications of Equation (28b) to Equation (30b) need to be considered and evaluated fully. As well as making sense of the Mukhanov based [41] criteria as to the formation of structure during the Dark ages, just before the turn on of the CMBR at z(redshift) ~1100

$$\text{Structure} \propto 1 \Bigg/ \sqrt{\frac{8\pi k_B}{12 \cdot V_{\text{Volume}}}} \cdot \frac{\left[\dfrac{1}{\mathbb{N}_{\text{graviton}}(\text{initial})} - \dfrac{1}{2\mathbb{N}^2_{\text{graviton}}(\text{initial})}\right]}{\left[8\mu_0 \omega B_0^2\right]^{1/8}} \cdot \left(\mathbb{N}_{\text{graviton}}(\text{initial})\right)^{1/3} \cdot 10^{-5} \tag{32b}$$

Equation (32b) has to be commensurate with Equation (28b) and Equation (29b) which will take some serious work.

Appendix C. Gedankenexperiment for Modified ZPE and Planck's "Constant", *h*, in the Beginning of Cosmological Expansion, Partly Due to NLED

We have formatted this as a self-contained document for the sake of referencing it independently.

Abstract. We initially look at a nonsingular universe representation of entropy, based in part on what was brought up by Muller and Lousto. This is a gateway to bringing up information and computational steps (as defined by Seth Lloyd) as to what would be available initially due to a modified ZPE formalism. The ZPE formalism is modified as due to Matt Visser's alternation of k (maximum) ~1/(Planck length), with a specific initial density giving rise to initial information content which may permit fixing the initial Planck's constant, h, which is pivotal to the setting of physical law. The settings of these parameters depend upon NLED.

1C. Introduction

For the record this is a synopsis of the following document as given in [96].

We can ascertain where this is going looking at [97]-[106] before reading this abbreviated summary as extracted from [96].

First of all we wish to ascertain if there is a way to treat entropy in the universe, initially, by the usual black hole formulas. Our derivation takes advantage of work done by-Muller, and Lousto [10] which have a different formulation of entropy cosmology, based upon a modified event horizon, which they call the Cosmological Event Horizon. *i.e.* it represents the distance a photon emitted at time t can travel. Afterwards, we give an argument, as an extension of what is presented by Muller and Lousto [10], which we claim ties in with Cai [97], as to a bound to entropy, which is stated to be S (entropy) less than or equal to N, with N, in this case, a micro state numerical factor. Then, a connection as to Ng's infinite quantum statistics [11]-[13] is raised. *i.e.* afterwards, we are then referencing C.S. Camara a way to ascertain a non zero finite, but extremely small bounce and then we use the scaling, as given by Camara [84], that a resulting density, is scaled as by $\rho \sim a^{-4}$. In addition we will set this scaling as a way to set minimum magnetic field values, commensurate to the modified ZPE density value, as given by Visser [98], with $\rho \sim a^{-4}$ paired off with [98]'s $\rho \sim \text{mass}(\text{planck}) \Big/ \left(\text{length}[\text{Planck}]\right)^3$, so then the magnetic fields as given by [84] can in certain cases be estimate. In addition, comparing the results of [84] and [98] permit us to use Waleka's [99] result of a time step ~ 1/square root of $\rho \sim \text{mass}(\text{planck}) \Big/ \left(\text{length}[\text{Planck}]\right)^3$ versus a time step ~ 1/square root of $\rho \sim a^{-4}$, with equality giving further constraints upon magnetic fields and a cosmological "constant" Λ. Doing so, will then permit us to make further use of [100] and its relationship between and a cosmological "constant" Λ and an upper bound to the number of produced gravitons. Isolating N (the number of gravitons) and if this is commensurate with entropy due to [97] and [11]-[13] will allow us to use Seth Lloyd supposition of [77] as to the number of permitted operations in quantum physics may be permitted. This final step will allow us to go to the final supposition, as to what number of operations/information may be needed to set a value of h (Planck's constant) in the beginning of the universe, Ford given in [101] with value, $\hbar$ invariant over time.

$$\hbar(\text{initial}) = E(\text{initial}) \cdot t(\text{initial}) = \rho(\text{initial}) \cdot V(\text{initial}) \cdot t(\text{initial}) \tag{1c}$$

Please see the rest of the document as given in reference [96]. We have jumped to the conclusion,

<SNIP> with a drop down to the last part of this presentation.

2C. Conclusion. Order of Magnitude Estimate as to Necessary and Sufficient Conditions as to Calculation of H Bar in the Early Universe. Leading to Effective Initial Time Not Zero

We will now give a first order estimate as to calculation of h bar, *i.e.* Equation (1c). *i.e.* isolate the actual spatial length, for the creation of a present day *h* bar Planck's constant. To do this look at [35] [106]

$$\Delta x \Delta p \geq \hbar + \frac{l_{\text{Planck}}^2}{\hbar} \cdot (\Delta p)^2 \tag{2c}$$

Then the following are Equivalent.

The idea would be that the Planck constant, h bar would be formulated as of the present day value. Also, the modification for the string length, would have $\Delta x|_{\min} \sim 10^{\beta} l_{\text{Planck}}$, so then

$$\begin{aligned}
&\& \ \Delta x|_{\min} \Delta p \approx \hbar + \frac{l_{\text{Planck}}^2}{\hbar} \cdot (\Delta p)^2 \\
&\& \ \hbar^2 - \hbar \Delta x|_{\min} \Delta p + l_{\text{Planck}}^2 \cdot (\Delta p)^2 \approx 0 \\
&\hbar \approx \frac{\Delta x|_{\min} \Delta p}{2} \cdot \left(1 + \sqrt{1 - 4\frac{l_{\text{Planck}}^2}{\left(\Delta x|_{\min}\right)^2}}\right) \\
&\hbar \approx \frac{\Delta x|_{\min} \Delta p}{2} \cdot \left(1 + \sqrt{1 - 4 \cdot 10^{-2\beta}}\right) \\
&\approx \Delta x|_{\min} \Delta p \cdot \left(1 - \frac{2}{10^{2\beta}}\right)
\end{aligned} \tag{3c}$$

Then,

$$\begin{aligned}
&\text{if } \Delta p \sim N_{\text{graviton}} \cdot m_{\text{graviton}} \cdot c \\
&\hbar \approx \Delta x|_{\min} \cdot N_{\text{graviton}} \cdot m_{\text{graviton}} \cdot c \cdot \left(1 - \frac{2}{10^{2\beta}}\right) \\
&\Delta x|_{\min} \approx \frac{\hbar}{N_{\text{graviton}} \cdot m_{\text{graviton}} \cdot c \cdot \left(1 - \frac{2}{10^{2\beta}}\right)}
\end{aligned} \tag{4c}$$

This should be greater than a Plank length, mainly due to the situation of

$$\left(1 - \frac{2}{10^{2\beta}}\right)^{-1} \sim 1 + \frac{2}{10^{2\beta}} \tag{5c}$$

We assume, here that this will be occurring in an interval of time approximately the value of Planck time given by

$$t(\text{initial}) \sim \hbar/\rho(\text{initial})\cdot V(\text{initial}) \\ \sim \frac{\hbar}{\left(\frac{m_{\text{Planck}}}{l_{\text{Planck}}^{3}}\right)}\left(\frac{\hbar}{N_{\text{graviton}}\cdot m_{\text{graviton}}\cdot c\cdot\left(1-\frac{2}{10^{2\beta}}\right)}\right)^{-3} \tag{6c}$$

Here, the number, N, is given as the number of gravitons, and the important factor is that Equation (6c) is non zero. Whereas this will then lead to a fixed magnetic field behavior as to N being defined above, by Equation (6c) and the N so being defined, leading to a bound on Λ.

We will, from now on give definite cases as to what these parameters should be in future work.

The upshot is that the entropy, at the close of the Inflationary era, would be dominated by Graviton production.

We will consider what happens as of about the electroweak era, and this would have consequences as far as information, as can be seen by the approximation given by Seth Lloyd [77] on page 14 of the article, as to the number of operations # being roughly about

$$\# \leq (1/2\pi)\cdot(r/l_P)\cdot(t/t_P) \tag{7c}$$

In the electro-weak era, we would be having Equation (7c) as giving a number of 'computational steps' many times larger (10 orders of magnitude) than the entropy of the Electro-weak,

$$\#(\text{Electro-weak}) \sim 10^{49} \tag{8c}$$

In the immediate aftermath of inflation, this number would be, instead about 10^5 - 10^7.

Some work so required will lead to an understanding of the number of steps needed, computationally for forming h bar will be done in the next rendition of this project. Whereas we would hope that the magnetic fields, would be shown to be commensurate with the E and M calculations as given in [107], while keeping in mind what was brought up by [108] about Graviton mass and other parameters.

Appendix D. Partition Function of the Universe with Respect to Our Modification of Penrose CCC Cosmology, with a Final Question to Ask

Our idea is to initially reference [109] then use what is known as CCC cosmology [110] which can be thought of as the following. First. Have a big bang (initial expansion) for the universe which is represented by $\{\Xi_i\}_{i\equiv 1}^{i\equiv N}$. Verification of this mega structure compression and expansion of information with stated non-uniqueness of information placed in each of the N universes favors ergodic mixing of initial values for each of N universes expanding from a singularity beginning. The n_f stated value, will be using (Ng, 2008) $S_{\text{entropy}} \sim n_f$. [11]-[13]. How to tie in this energy expression, as in Equation (1d) will be to look at the formation of a nontrivial gravitational measure as a new big bang for each of the N universes as by $n(E_i)$ the density of states at energy E_i for partition function [111].

$$\{\Xi_i\}_{i\equiv 1}^{i\equiv N} \propto \left\{ \int_0^\infty \mathrm{d}E_i \cdot n(E_i) \cdot \mathrm{e}^{-E_i} \right\}_{i\equiv 1}^{i\equiv N}. \tag{1d}$$

We need to considerably elaborate this idea in terms of the arguments as given in [110].

Each of E identified with Equation (1d) above, are with the iteration for N universes. Can we add more specificity as to the value of E as given in Equation (1d)?

Appendix E. How to Get a Maximized Entropy Proportional to 10^{122} If the Universe Is initially Set Up as a Black Hole, *i.e.* a Horizon Argument

1E. Introduction, Consider Using a Reduced Hamiltonian in the Setup of a Schrodinger Equation for Inside a Singular "Bubble" of Space-Time

We are looking at applying the following "reduced Hamiltonian" with the Reduced Hamiltonian described via first looking at the Line Element as given by

$$\mathrm{d}s^2 = -\left(\frac{n}{\tau}\right)^2 \mathrm{d}\tau^2 + \frac{n}{(n-1)} \cdot \frac{1}{\tau^2} \cdot \gamma_{ij} \cdot \mathrm{d}x^i \mathrm{d}x^j \tag{1e}$$

Here, n is the spatial dimension, and the idea is to form a so called "reduced Hamiltonian" commensurate with choosing space-time values which may be entertaining a constant value for an expanding cosmology. In our case what we will be assuming, roughly, in a departure from ADM theory and other constructions is that H (Hamiltonian) = E (energy) and that we are NOT assuming as was done in ADM theory a zero overall Hamiltonian or energy construction.

Using the construction given on page 154 of [111] we will be defining the reduced Hamiltonian commensurate with General Relativity via

$$H_{\text{reduced}}\left(\tau, \gamma, p_{TT}\right) \geq H_{\text{reduced}}\left(\tau, \gamma, 0\right) = \left(\frac{n}{n-1}\right)^{n/2} vol\left(M, \gamma\right) \tag{2e}$$

Whereas we define $vol(M,\gamma)$ via a Riemanian manifold and we will for the sake of simplicity write [112]

$$vol\left(M, \gamma\right) = V_n = \frac{\pi^{n/2}}{\Gamma\left(\frac{n}{2}+1\right)} \cdot r^n \tag{3e}$$

where we have $\Gamma\left(\frac{n}{2}+1\right)$ is a gamma function [112]-[114] and so then we get by our procedure we will be making our identification of a starting point Hamiltonian for our evaluation via Planck era inflation is to have a magnitude to the given Hamiltonian as in

$$H_{\text{reduced}}\left(\tau, \gamma, 0\right) = \left(\frac{n}{n-1}\right)^{n/2} \cdot \frac{\pi^{n/2}}{\Gamma\left(\frac{n}{2}+1\right)} \cdot r^n \tag{4e}$$

In doing this we will be postulating making our starting point using Planck units, as seen in [115] [116], and so with that we will introduce our treatment of the expansion of the Universe via the ideas given in [117], for a nonsingular start to expansion of the Universe, and our next stop is to review in part the ideas of a Spherical infinite well as a starting point for defining the quantum number, which will be relevant to expansion of the universe which will commence and affect GW polarization states. We will in doing so, re scale the equation given in (4) in terms of Planck energy, but the point of the above equation, as stated, is that the Hamiltonian will be affected by dimensionality considerations.

Using [117] with an interior region affected by a Schrodinger equation in the bubble modeled after a spherical infinite well, we first look at [118] to ascertain giving a free particle wave function in spherical co-ordinates as, if $\rho = kr$

$$\left(\frac{1}{\rho^2}\cdot\frac{\mathrm{d}}{\mathrm{d}\rho}\cdot\rho^2\cdot\frac{\mathrm{d}}{\mathrm{d}\rho}-\frac{\ell\cdot(\ell+1)}{\rho^2}+1\right)\Psi = 0 \quad (5e)$$

As given by Gottfried, [118], we can have a regular solution to Equation (5e) as given by a Spherical Bessel function J, so that

$$\Psi \propto \sqrt{\frac{\pi}{2\rho}}\cdot J_{\ell+\frac{1}{2}}(\rho) \quad (6e)$$

In the case of a spherical infinite well, we will look at solutions which vanish at the wall which by [119] Leads to the following We have an energy level defined, if $r = a$, the maximum radius of the interior region of space-time

$$E(\text{energy}) = \frac{\hbar^2 K^2}{2m} = \frac{\hbar^2(\mathbb{N}+1)^2\pi^2}{2ma^2} \quad (7e)$$

In this we are assuming that the wavefunction would vanish at the walls of the spherical region, with most likely

$r = \imath(\text{planck}) = \text{Planck length} = a$ meaning that

$$\begin{aligned}&\left(\frac{\mathrm{d}^2}{\mathrm{d}r^2}+\frac{2}{r}\frac{\mathrm{d}^2}{\mathrm{d}r}-\frac{\ell\cdot(\ell+1)}{r^2}+K^2\right)\cdot\Re = 0\\ &K^2 = \frac{2mE(\text{energy})}{\hbar^2}\\ &\Re = \sqrt{\frac{2}{a(\text{radius well})}}\cdot\frac{\sin(Kr)}{r}\end{aligned} \quad (8e)$$

Our idea is to use this idea of the Spherical square well, which is in 3 space, and then to make the following scaling available if we look at the arbitrary dimensional value, *i.e.* to look at, $\mathbb{N}$ as a quantum excitation number greater than or equal to zero

$$[\text{Interior energy}, n\ \text{dim}] \propto \frac{\hbar^2(\mathbb{N}+1)^2\pi^2}{2ma^2}\cdot\frac{\left[\left(\frac{n}{n-1}\right)^{n/2}\cdot\frac{\pi^{n/2}}{\Gamma\left(\frac{n}{2}+1\right)}\cdot a^n\right]}{\left[\left(\frac{3}{2}\right)^{3/2}\cdot\frac{\pi^{3/2}}{\Gamma\left(\frac{5}{2}\right)^{3/2}}a^3\right]} \quad (9e)$$

And that for 3 dimensions we would have

$$\Re(a) = \sqrt{\frac{2}{a(\text{radius well})}}\cdot\frac{\sin(Ka)}{a} = \sqrt{\frac{2}{\imath(\text{planck})}}\cdot\frac{\sin(K\imath(\text{planck}))}{\imath(\text{planck})} = 0 \quad (10e)$$

Note that the value of the following

$$\Gamma\left(\frac{5}{2}\right)=\frac{3}{4}\cdot\sqrt{\pi}\approx 1.329340388179 \tag{11e}$$

In n dimensions we have then that\ if we apply a double factorial, we have [120]

$$\Gamma\left(\frac{n}{2}\right)=\frac{(2n)!!}{4^{n}\cdot n!!}\cdot\sqrt{\pi} \tag{12e}$$

And

$$n!=\prod_{i=1}^{n} i \tag{13e}$$

In the case where we make the following normalization, *i.e.* that if we set the Plank units equal to 1, *i.e.* that

$$\hbar = \imath(\text{planck length}) = M_P(\text{Planck mass}) = t_P(\text{Planck time}) = 1 \tag{14e}$$

We then will have an interior space-time bubble energy of the value of, while also assuming $c = 1$

$$\begin{aligned}&[\text{Interior energy}, n \text{ dim}]\xrightarrow[n=3]{}\frac{(\mathbb{N}+1)^{2}\pi^{2}}{2\Theta}\\&\Theta=\Theta\cdot M_P(\text{Planck mass})\end{aligned} \tag{15e}$$

Input values into Θ will be the subject of the next section of this document

2E. E Input Values for Θ in the Different Scenarios *i.e.* for the Sake of Making Sense of Entropy Values Generated in the Event Horizon of the Universe Which Has a Value of 10^{122}, When *n* = 3 (3 Spatial, 1 Time Dimension)

We will first ascertain how this Θ refers to the case when $n = 3$, *i.e.* the usual 3 + 1 space-time metric of GR.

What we are referencing in this part of the manuscript is what values of the universe are obtained in the Event Horizon of the universe. Looking at [121] we have that what is specified is an enormous entropy value so generated. In cosmology, the event horizon of the observable universe is the largest comoving distance from which light emitted now can ever reach the observer in the future, so what we are doing is to ascertain how to come up with a commensurate way we can have 10^{122} in entropy created by conditions within the space-time bubble. To do this what we will do is as follows.

First, we go to the interior energy, n dimensions. *i.e.* Equation (15e). In [121] due to an argument there is a stated version of entropy due to super massive black holes. That value is given as follows. The contribution is for super massive black holes at the center of galaxies, each with a mass 10^9 times that of the solar system sun, with a value on page 6 of [121] giving

$$S_{SMBH} = 3.1\times10^{104}k \tag{16e}$$

Whereas the volume and the entropy of the Event Horizon of the Universe is given by

$$V_{CEH} \approx 1.37 \times 10^{79}\ \mathrm{m}(\text{meters})$$
$$S_{CEH} = \frac{kc^3 \pi R_{CEH}^2}{G\hbar} = \frac{kc^3 A}{4G\hbar} \approx 2.6 \times 10^{122} k \tag{17e}$$

Roughly speaking, we have that the entropy of the Event Horizon of the universe, so defined above, is 10^{18} times that of the mass of supermassive black holes in the center of spiral galaxies today.

Our claim, is that we then have a direct equivalence of mass and energy, *i.e.* dark matter and dark energy directly equivalent to Equation (15e) above, and that if $\mathbb{N} = 0$, in Equation (15e) we can state the following, namely that for 2 times 10^{11} supermassive black holes

$$\left[\text{Interior energy}, n\ \text{dim} = 3\right] \propto \left.\frac{(\mathbb{N}+1)^2 \pi^2}{2\Theta}\right|_{\mathbb{N}=0}$$
$$\Rightarrow S_{SMBH} = 3.1 \times 10^{104} k(\text{total entropy}) \tag{18e}$$

And that for the Entropy due to the event horizon of the Universe, we have $\mathbb{N} \approx 10^9$ in Equation (15e) we can state the following, namely that

$$\left[\text{Interior energy}, n\ \text{dim} = 3\right] \propto \left.\frac{(\mathbb{N}+1)^2 \pi^2}{2\Theta}\right|_{\mathbb{N}=10^9}$$
$$\Rightarrow S_{CEH} \approx 2.6 \times 10^{122} k(\text{total entropy}) \tag{19e}$$

Having done this, I invite the readers to review on their own [122]-[130] in order to self explore extensions of this entropy of a black hole horizon for future geometrical interpretations of the early universe.

3E. Examining How, If $\mathbb{N} = 0$ We Get the Entropy of Equation (18), When $n = 3$

This will require making assumptions as to the number of Super massive black holes. Our best guess is that they are on the order of 2 × 10^{11} spiral galaxies, and of so this means roughly there is an average value of, today

$$S_{\text{ONE giant black hole}} \approx 10^{91}\text{ - }10^{93} k \tag{20e}$$

This for about 2 × 10^{11} center of galaxy main black holes in 2 × 10^{11} spiral galaxies. Figure then that we would be assuming about 2 × 10^{11} black holes, maybe of the order of Planck size initially which grew tremendously from the Planck era. Assuming so, then we can make the following estimate, mainly what would be required so that we would have 2 × 10^{11} seeds in the interior of the pre Planckian bubble for the creation of 2 × 10^{11} black holes?

Konstantinos Dimopoulos, Tommi Markkanen, Antonio Racioppic and Ville Vaskonen, S. Hawkings, and others have postulated that mini black holes, created after the onset of the big bang [122] [123] and indeed, [123] has proposed.

Quote

The mechanism is based on a period of thermal inflation followed by fast-roll inflation due to tachyonic mass of order the Hubble scale. Large perturbations are generated at the end of the thermal inflation as the thermal inflaton potential turns from convex to concave. These perturbations can lead to copious production of PBHs when the relevant scales re-enter horizon. We show that such PBHs can naturally account for the observed dark matter in the Universe when the mass of the thermal inflaton is about 10^6 GeV.

End of Quote

In other words, we would be looking at an "inflaton" of the order of 10^6 GeV, as a preliminary mass-energy contribution giving value to the creation of 2 times 10^{11} black holes which if accretion to these black holes occurred, would lead to 10^{104} as the value of entropy today.

In fact, [123] has in it a way which mini black holes could grow far larger today, *i.e.* see this formula [124]

$$M(t) \approx M_0 \exp\left(\frac{0.1}{\varepsilon} \cdot \frac{t}{45\text{ Myr}}\right) \tag{21e}$$

The variable ε is specified by [124] as about.1 but it could actually be far smaller, but what is worthy of note is that we could look at an inflaton energy of 10^6 GeV, and from there note that the Plank mass is about 2.45 times 10^{18} GeV, or about 2.1745 times 10^{-5} grams. Whereas the sun weighs 1.9 times 10^{33} grams. Hence, at a minimum, we would be looking for an increase of the following magnitude mass increase for one primordial black hole

$$\begin{aligned} &\exp\left(\frac{0.1}{\varepsilon} \cdot \frac{t}{45\text{ Myr}}\right) \approx 10^9 \times 10^{33} \times 10^5 \approx 10^{47} \\ &\Rightarrow \left(\frac{0.1}{\varepsilon} \cdot \frac{t}{45\text{ Myr}}\right) \approx 108.221499371 \end{aligned} \tag{22e}$$

This would be for a Planck size black hole growing to become 10^{47} times larger in mass, to be a supermassive black hole at the center of a galaxy, about 10^9 or more times the mass of the sun.

Our supposition is that the majority of these mini black holes, if they did not evaporate, could have formed the nucleus of later massive black holes, if they attracted dark matter, and this is actually what Karen Freeze supposed in [125].

This then leaves us with setting say what we could ascertain via 2 times 10^{11}, times Plank Mass, as a starting point for energy, in the expression for stored energy in the beginning of the space time bubble, whereas Equation (22e) leaves us with looking at starting effective matter-energy "packets" of about

$$\begin{aligned} &\frac{\pi^2}{2\Theta} \xrightarrow[\text{Plank units set=1,go to Planck era}]{} 10^{-47} \text{ todays mass energy} \\ &\Rightarrow \Theta \xrightarrow[\text{Plank units set=1,go to Planck era}]{} \frac{2}{\pi^2} \times 10^{47} \end{aligned} \tag{23e}$$

We then take into consideration $(\mathbb{N}+1)^2 \approx 10^{18}$ so we can approach $10^{122} k$ entropy units due to the cosmic event Horizon, so then that if the universe had a weight of about 10^{56} grams, in ordinary matter, and about 10^{58} grams in ordinary matter plus dark matter and dark energy, we would have then

$$\frac{\pi^2}{2\Theta}\xrightarrow[\text{Plank units set=1,go to Planck era}]{}10^{-47}\times 10^{58}\text{ g}\approx 10^{9}\text{ g} \tag{24e}$$

This would be about the matter-energy of the bubble, w.r.t matter (which is usually in GeV/c^2).

If we add in that we are expecting, say ≈ 10^{11} black holes, which will be in the center of ≈10^{11} galaxies (spiral), this comes out to obtaining black holes, with say a conversion factor of

$$10^{-2}\text{ g}\approx 1.78266\times 10^{28}\text{ GeV}\approx 459.48\times M_P\left(\text{Planck mass}\right) \tag{25e}$$

Whereas Equation (24e) would yield

$$\begin{aligned}&\frac{\pi^2}{2\Theta}\xrightarrow[\text{Plank units set=1,go to Planck era}]{}10^{-47}\times 10^{58}\text{ g}\approx 10^{9}\text{ g}\\&\approx 459.48\times 10^{11}M_P\left(\text{Planck mass}\right)\end{aligned} \tag{26e}$$

If one included, say $\left(\mathbb{N}+1\right)^2\approx 10^{18}$, in terms of a quantized energy, this would then read

$$\begin{aligned}&\frac{\pi^2\left(\mathbb{N}+1\right)^2}{2\Theta}\xrightarrow[\text{Plank units set=1,go to Planck era}]{}10^{-47}\times 10^{58}\times 10^{18}\text{ g}\approx 10^{27}\text{ g}\\&\approx 459.48\times 10^{29}M_P\left(\text{Planck mass}\right)\approx 4.5948\times 10^{31}M_P\left(\text{Planck mass}\right)\end{aligned} \tag{27e}$$

We are then dealing with, at the beginning of the Planck era, $\approx 5\times 10^{31}M_P\left(\text{Planck mass}\right)$ Planck black holes, which would massively accrete by size, if fed by dark matter, into at a minimum of 2 × 10^{11} super massive black holes in the center of 2 × 10^{11} spiral galaxies in the universe. Note, that a black hole of Plank mass would have

$$T_{\text{Hawking temperature}}\left(\text{of }M_P\text{ black hole}\right)\equiv\frac{M_Pc^2}{k}\approx 1.42\times 10^{32}\text{ Kelvin} \tag{28e}$$

We submit that this would vaporize any so called infinitely deep spherical well "wall", which in fact would be a domain wall, similar to what is brought up in [126].

Appendix F. What are Some of the Consequences of Not Heeding the Penrose Singularity Theorem

1F. The Basic Facts of the Penrose Singularity Theorem and Why We Do Not Assume a Point Scale Factor, as an Initial Starting Point

[131] has this foundational structure which is relevant to out inquiry fand we get the following.

From their section 8.2 as to Quantum effects

Quote

A very important line of research arises from the tension between the singularity theorems and the (yet unfound) theory of quantum gravity. It is widely accepted that the existence of classical singularities signal a breakdown of the classical theory at extreme conditions, which is precisely when gravitational quantum effects will become relevant. Thus, there is a need to clarify if the singularity theorems, or part of them, can survive when entering into a quantum regime, or if they then simply vanish altogether. For a general discussion, see [132]. A first step towards the analysis of singularity theorems in this respect is the weakening of the "energy conditions"—also relevant in the classical Singularity theorems 38 regime—that is to say, finding an appropriate version of the curvature condition in the theorems. Early results in this direction include the theorems based on averaged energy conditions [133] as discussed in subsection 5.1, which were used to deal with the quantum violations of the energy conditions in [134], later improved in [135]. A larger discussion can be found in [136] (and references therein) and has been recently newly considered in [109], where an analysis of Raychadhuri-like equations is performed proving that it is viable to have energy-momentum tensors which fail to satisfy even averaged energy conditions as long as an appropriate version of them—with an exponential damping factor—are in place. This leads to a proof of a version of the Penrose singularity theorem allowing for global violations of the energy conditions.

End of Quote

We get similar cautions of what can be consequences from [137] [138] of violation of global violations of the energy condition as from [131]. In addition, [139] has some of the basic facts to consider with a statement of the Euclidian Universe which is very pertinent to our situation.

Quote

Unlike the black hole pair creation, one couldn't say that the de Sitter universe was created out of field energy in a pre-existing space. Instead, it would quite literally be created out of nothing: not just out of the vacuum but out of absolutely nothing at all because there is nothing outside the universe. In the Euclidean regime, the de Sitter universe is just a closed space like the surface of the Earth but with two more dimensions. If the cosmological constant is small compared to the Planck value, the curvature of the Euclidean four sphere should be small. This will mean that the saddle point approximation to the path integral should be good, and that the calculation of the wave function of the universe won't be affected by our ignorance of what happens in very high curvatures.

End of Quote

Our point of divergence from this statement is:

1st we do NOT assume that the Universe is made out of "nothing" because we assume via a version of CCC cosmology [134] which involves phase transtions that there has been regular inputs into this present universe.

2nd we do assume that we may have a wavefunction of the Universe which does not take into accord high curvature regimes.

2F. Having Said This Divergence from the Hawking Treatment of a De Sitter Universe and Its Creation from "Nothing" We Will Commence Upon Stating the Wave Function Treatment of Acceleration from the Initial Phase Transition We Outline in the Rest of this Document

In a word, we are assuming that there is a marked phase transition between early time pre expansion physics, and then the expansion physics. To do so we are looking at [140] [141]. *i.e.* what we are doing is akin to the following description which was pitched to be relevant to the electroweak regime. With certain caveats, we hold that it is similar to what we would have at the very start of expansion of the universe. *i.e.* change the description from the electroweak to the initial nonsingular starting point of the universe in line with [131] and we are set to go for our cosmological evolution.

See [142]

Quote

Phase transitions are a generic, but not universal, feature of gauge field theories, like the Standard Model, which are based on elementary particle mass generation by spontaneous symmetry-breaking [1] [2]. When there is a phase transition in a gauge theory it is (except for special parameter choices) first-order, which means that just below the critical temperature, the universe transitions from a metastable quasi-equilibrium state into a stable equilibrium state, through a process of bubble nucleation, growth, and merger [3]-[6]. Such a first-order phase transition in the early universe naturally leads to the production of gravitational waves [7] [8]. If it took place around the electroweak scale, by which we mean temperatures in the range 100 - 1000 GeV, the gravitational wave signal could lie in the frequency range of the upcoming space-based gravitational wave detector LISA (Laser Interferometer Space Antenna) [9]. The approval of the mission, and the detection of gravitational waves [10], has generated enormous interest in phase transitions in the early universe.

End of Quote

The evolution of energy section, in [134], about pp 34-39 of reference [134] will be obeyed once we commence once we get through the initial phase transitions. In the meantime once we get to the initial phase transitions, [135] we have that [136] describes well the initial gravitational wave generation well. Which may be a starting point for a Pre Planckian spacetime

Also,

[143] Hee-Boon Low and Chi Xiong, outline on page 60, of reference [143] their Equation (13) which has an additional term, this involves use of Vinens equation for a vortex tangle to be added to the usual cosmological evolution equations, which may account for what was brought up in [144], namely a reconciliation of the Higgs hypothesis given in pp35 to 44, but that would be a bridge for the creation of matter-energy after a first order phase transition. What we will be concerned with next will be the bridge from CCP inputs into the generation of the present cosmos, to our present universe. From between a CCC cosmology construction, with an additional modification put in, to the physics of the question we put in initially which will be of with regards to signatures of Black Holes, from a prior universe to our present cosmos.

What we will be analyzing is a definite quantum violation of the energy condition.

3F. Begin First with a Description of the Emergent Tunneling Wave Space-Time Equation Used to Compare the Start of Expansion, of That Wave Equation, with Planckian-Era Quantum Conditions

We use the construction from [145] is to, if the initial 'potential' $V(\phi)$ is very large, how to isolate the form of the wavefunction, especially if $a^2 V(\phi) > 1$, even if a is the initial value, *i.e.* very, very small, even if $a_{\min} \propto 5.13 \times 10^{-62}$, and then by page 269 of [145] go to the following formulation. Namely that we look at

$$\Psi_T \propto \frac{\exp\left(-1/3V(\phi)\right)}{\left(a^2 V(\phi)-1\right)^{1/4}} \cdot \exp\left(-i \cdot \frac{\left(a^2 V(\phi)-1\right)^{3/2}}{3V(\phi)}\right) \tag{1f}$$

Our entries into all the above will be the subject of the next several sessions of our document and we will endeavor to explain how this all fits into the early universe modeling we will be working with as far as foundational research into Quantum gravity.

In terms of a contribution from the modified Einstein Equations, we will be considering the time components of the Einstein equation with the stress and strain component in quantum expectation language, written as, due to emergent space-time from pre Planckian to Planckian regimes. *i.e.* look at the time related transitions, and this is what we get. *i.e.* the basic equations are related as follow

$$\begin{gathered}\left(\frac{R_{\mu\nu} - \frac{R}{2} \cdot g_{\mu\nu} + \Lambda g_{\mu\nu}}{8\pi G_N} + \left\langle \Psi \middle| T_{\mu\nu} \middle| \Psi \right\rangle = 0\right) \\ \xrightarrow[\mu,\nu \to 0,0]{} \frac{R_{00} - \frac{R}{2} \cdot g_{00} + \Lambda g_{00}}{8\pi G_N} + \left\langle \Psi \middle| T_{00} \middle| \Psi \right\rangle = 0\end{gathered} \tag{2f}$$

Here we will have the following approximations, used,. Namely look at inflation physics from [3]

$$\rho \approx \frac{\dot{\phi}^2}{2} + V(\phi) \equiv \frac{\gamma}{8\pi G} \cdot t^2 + V_0 \cdot \left\{ \sqrt{\frac{8\pi G V_0}{\gamma(3\gamma-1)}} \cdot t \right\}^{\sqrt{\frac{\gamma}{4\pi G}} - \sqrt{\frac{8\pi G}{\gamma}}} \tag{3f}$$

Which are a result of the following equations used. *i.e.*

Using this above is using Padmabhan's inputs [3] into the inflaton potential and also into the inflaton itself, which uses at the surface of a presumed nonsingular start to the expansion of the universe [3]

$$a(t) = a_{\min} t^{\gamma} \tag{4f}$$

Leading to using the inflaton [3]

$$\phi \approx \sqrt{\frac{\gamma}{4\pi G}} \cdot \ln \left\{ \sqrt{\frac{8\pi G \cdot V_0}{\gamma \cdot (3\gamma-1)}} \cdot t \right\} \tag{5f}$$

And what we will use later the "inflaton potential" we write as [3]

$$V = V_0 \cdot \left\{ \sqrt{\frac{8\pi G V_0}{\gamma(3\gamma-1)}} \cdot t \right\}^{\sqrt{\frac{\gamma}{4\pi G}} - \sqrt{\frac{8\pi G}{\gamma}}} \tag{6f}$$

Furthermore, we have from [140] pages 212-3, and [141]

$$m \cdot \partial_t \left(a^2 - a^3 \right) = 0 \tag{7f}$$

And then, a minimum time step we define via a minimum time step of

$$t = \left(\frac{2}{3 a_{\min}} \right)^{1/\gamma} \tag{8f}$$

Note that if the time as defined by Equation (8f) is on the order of Planck time, *i.e.* 10^{-44} seconds, we have then that $\gamma \approx 61\text{-}62$. We then close with a statement, if

$$\frac{3\left(\left(\frac{\ddot{a}}{a} \right) \cdot (g_{00} - 1) + \left(\frac{\dot{a}}{a} \right)^2 g_{00} + \frac{\kappa}{a^2} g_{00} \right) + \Lambda g_{00}}{8\pi G_N} = -\left\langle \Psi \left| \frac{c\dot{\phi}^2}{2} + cV(\phi) \equiv \frac{c\gamma}{8\pi G} \cdot t^2 + cV_0 \cdot \left\{ \sqrt{\frac{8\pi G V_0}{\gamma(3\gamma-1)}} \cdot t \right\}^{\sqrt{\frac{\gamma}{4\pi G}} - \sqrt{\frac{8\pi G}{\gamma}}} \right| \Psi \right\rangle \tag{9f}$$

If the wave function is taken via Equation (1f) put in, we have that the effective wave function for the "Quantum" part in the RHS of Equation (9f) is then

$$\Psi_T \propto \frac{\exp\left(-1/3V(\phi)\right)}{\left(a^2 V(\phi) - 1\right)^{1/4}} \tag{10f}$$

Still though this is going to be constrained by this graviton production rate, per early universe micro black holes, starting off with that we make the following assumption, *i.e.* We use the construction from [145] as to, if the initial 'potential' $V(\phi)$ is very large, how to isolate the form of the wavefunction, especially if $a^2 V(\phi) > 1$, even if a is the initial value, *i.e.* very, very small, even if $a_{\min} \propto 5.13 \times 10^{-62}$. This means that we have a lot of energy involved so that relic gravitational production from micro sized primordial black holes will be enormous.

This is a probable result of not having employment of the Penrose singularity theorem.

Appendix G *i.e.* Poisson Brackets and Their Equivalence to Quantum Commutation Relations

First of all, we can reference this handy reference from the U of Texas [146]-[148]

In a word, if we can do the following, *i.e.* Poisson Brackets and Commutator Brackets, go to their Equation (10) to Equation (13) come up with an array of inter relationships of the Hamiltonian system as in **Appendix E**, and see if we have Poisson brackets from physical situations arising from **Appendix E**, and use reference [148] as to how to ascertain equivalent quantum commutation relationships.

This is also possibly linkable as to the utility of the Ehrenfest theorem [149]-[151] which may prove useful in terms of future work, *i.e.* if we manage to link **Appendix E** with the first part of this manuscript, w.r.t. torsion, mini black holes.

Appendix H. Klauder Quantization and the Appearance of a Cosmological Constant Due to Comparing Two First Integrals, *i.e.* Leading to How to Obtain a Mass of a Graviton, and Does This Methodology Lead to Voids?

Using the Klauder enhanced quantization as a way to specify the cosmological constant as a baseline for the mass of a graviton, we eventually come up and then we will go to the relationship of a Planck Length to a De Broglie length in order to link how we construct a massive graviton mass, with cosmological constant and to interface that with entropy in the early universe. We then close with a reference to the possible quantum origins of e folding and inflation. This objective once achieved is connected with a possible mechanism for the creation of voids, in the later universe, using a construction of shock fronts from J. P. Onstriker, 1991 and followed up afterwards with Mukhanov's physical foundations to Cosmology book section as to indicate how variable input into self reproduction of the Universe structures may lead to void formation in the present era. A connection with Wesson's 5 dimensional cosmology is brought up in terms of a generalized uncertainty principle which may lead to variations of varying energy input into self reproducing cosmological structures which could enable non uniform structure formation and hence voids. One of the stunning results is that the figure of number of gravitons, about 10^{58}, early on, is commensurate with a need for negative pressure, (middle of manuscript) which is a stunning result, partly based on Volovik and weakly interacting Bose gas model for pressure, which is completely unexpected. Note that in quantum physics, the idea statistically is that at large quantum numbers, we have an approach to classical physics results. We will do the same as to our cosmological work. This means that the $n^2_{\text{quantum number}} \gg 1$, in our last set of equations, which as we indicate has the surprise condition that for PrePlanckian space-time that a very large value for initial Pre Planckian dimensions $d_{\dim}$ which is the dimensional input into the Pre Planckian state, prior to emergence into Planckian cosmology conditions. We conclude by stating the following question. Can extra dimensions come from a Multiverse feed into Pre-Planckian space-time? See Theorem at the end of this publication. Our answer is in the affirmative, and it has intellectual similarities to George Chapline's work with Black hole physics.

1H. Start with the General Relativity First Integral

We use the Padmanabhan 1st integral [3], of the form, with the third entry of Equation (1h) having a Ricci scalar defined via [66] [152] and usually the curvature $\aleph$ is set as extremely small, with the general relativity [66] [152]

$$S_1 = \frac{1}{2\kappa} \cdot \int \sqrt{-g} \cdot \mathrm{d}^4 x \left(\Re - 2\Lambda \right) \tag{1h}$$

$$g = -\det g_{uv} \tag{2h}$$

$$\Re = 6 \cdot \left(\frac{\ddot{a}}{a} + \left(\frac{\dot{a}}{a} \right)^2 + \frac{\aleph}{a^2} \right) \tag{3h}$$

Also, the variation $\delta g_{tt} \approx a_{\min}^2 \phi$ by [1] [105] will have an inflaton, ϕ given by [64]. Leading to the inflaton which is combined into other procedures for a solution to the cosmological constant problem. Here $a_{\min}$ is a minimum value of the scale factor and is not zero, but close to it.

2H. Next for the Idea from Klauder

We are going to go to page 78 by Klauder [66] of what he calls on page 78 a restricted Quantum action principle which he writes as S_2 and we write a 1-1 equivalence as in [66], which is also seen in [152] restricted Quantum action principle which he writes as S_2. This also has some overlap with the formalism of [153]

$$S_1 = \frac{1}{2\kappa} \cdot \int \sqrt{-g} \cdot \mathrm{d}^4 x \left(\Re - 2\Lambda \right) \approx S_2 \equiv \int_0^T \mathrm{d}t \cdot \left(p(t) \cdot \dot{q}(t) - H_{\tilde{N}}(p, \dot{q}) \right) \tag{4h}$$

where we use in our comparison of the two first integrals, the following value

$$\Re = 6 \cdot \left(\frac{\ddot{a}}{a} + \left(\frac{\dot{a}}{a} \right)^2 + \frac{\aleph}{a^2} \right) \tag{5h}$$

Our assumption is that Λ is a constant, hence we assume then the following approximation, from [146] which is the precursor of activity as given in [1] [3] [64] [105] we have

$$\frac{p_0^2}{2} = \frac{p_0^2(\tilde{N})}{2} + \tilde{N} \quad \text{for } 0 \le \tilde{N} \le \infty \text{ and } q = q_0 \pm p_0 \cdot t \tag{6h}$$

$$\begin{aligned} V_{\tilde{N}}(x) &= 0, \quad \text{for } 0 < x < 1 \\ V_{\tilde{N}}(x) &= \tilde{N}, \quad \text{otherwise} \end{aligned} \tag{7h}$$

$$H_{\tilde{N}}\left(p(t), q(t) \right) = \frac{p_0^2(\tilde{N})}{2} + \frac{(\hbar \cdot \pi)^2}{2} + \tilde{N} \quad \text{for } 0 \le \tilde{N} \le \infty \tag{8h}$$

Our innovation is to then set $q = q_0 \pm p_0 t \approx \phi$ and assume small time step values. Then as in [64]

$$\Lambda \approx -\kappa \cdot \frac{\left[\frac{V_0}{3\gamma - 1} + 2\tilde{N} + \frac{\gamma \cdot (3\gamma - 1)}{8\pi G \tilde{t}^2} \right]}{\int \sqrt{-g} \mathrm{d}^3 x} + 6 \cdot \left(\frac{\ddot{a}}{a} + \left(\frac{\dot{a}}{a} \right)^2 \right) \tag{9h}$$

These are terms within the bubble of space-time given in [1] using the same inflaton potential. The scale factor is presumed here to obey the value of the scale factor in [84].

3H. Why This Is Linked to Gravity/Massive Gravitons, and Possibly Early Universe Entropy

Klauder's program [66] is to embed via Equation (7h) as a quantum mechanical well for a Pre Planckian-system for inflaton physics as given by Equation (7h). And Equation (8h) and Equation (9h) as given in Klauder's treatment of the action integral as of page 87 of [66] where Klauder talks of the weak correspondence principle, where an enhanced classical Hamiltonian, is given 1-1 correspondence with quantum effects, in a non-vanishing fashion. If so, by Novello [34] and Equation (6h) and Equation (7h) and Equation (8h) we have then for early universe conditions, that we will be leading up to using an algorithm for massive gravitons, as in [64], and [37]. If so use the mass of a graviton via Equation (9h) in the following representation *i.e.* from Novello, we use

$$m_g = \frac{\hbar \cdot \sqrt{\Lambda}}{c} \tag{10h}$$

The long and short of it is, to tie this value of the cosmological constant, and the production of gravitons due to early universe conditions, to a relationship between De Broglie wavelength, Planck length, and if the velocity v gets to a partial value close to the speed of light, that, we have, say by using [154] as given by Diosi, in Dice (2018) for quantum systems, if we have instead of a velocity much smaller than the speed of light, a situation where the particle moves very quickly (a fraction of the speed of light) that instead of the slow massive particle postulated in [154]

$$\lambda_{\text{De Broglie}} \approx \frac{2 \cdot \pi \cdot \hbar}{m_g v(\text{velocity})} \cdot \sqrt{1 - \left(\frac{v(\text{velocity})}{c}\right)^2} \simeq \ell_{\text{Planck}} \tag{11h}$$

$$\ell_{\text{Planck}} = \sqrt{\frac{\hbar G}{c^3}} \tag{12h}$$

If the velocity of particle is just under the speed of light, *i.e.*
$v(\text{velocity}) \to c - \delta^+$ one then would have

$$\varepsilon(\text{Particle energy}) \approx E_{\text{Planck}}(\text{Planck energy}) \tag{13h}$$

If so then, we will be looking at using Ng version of entropy via use of infinite quantum Statistics, [155] we have for a clearly specified value of mass of the graviton, as in [5], then we have for the negative components. Set here, $c = 1$, $m_g \approx 10^{-62}$ grams , as in [5] for the mass of a massive graviton and

$$E_{\text{Planck}}(\text{Planck energy}) \simeq 2.18 \times 10^{-5} \text{ grams}$$

$$E_{\text{Planck}}(\text{Planck energy}) \simeq 2.18 \times 10^{-5} \text{ grams} \approx m_g \times N(\text{Entropy count}) \tag{14h}$$

Tben we have a superscript $\mathbb{N}$ which has about the numerical number of the e folds as given next, due to

$$N(\text{Entropy count}) \simeq 10^{58} \equiv 10^{\mathbb{N}} \tag{15h}$$

4H. Can This Tie in with Early Universe E Folds? *i.e.* from [156] E Folds Are between 55 to 60

E folds in cosmology are a way of delineating if we have enough expansion of the universe is in line with inflation.in order to solve the most important cosmological problems. As seen in [11] we can have inflation.in order to solve the most important cosmological problems. As seen in [154] we can have

$$\mathbb{N}(\text{e folding}) = -\int \mathrm{d}t H(\cos m) \tag{16h}$$

Here, $H(\cos m)$ a value of the Friedman equation, and if we use [5] be defined via that the potential energy, V, of initial inflation is initially over shadowed by the contributions of the Friedman equation, H, at the onset of inflation. Then

$$\mathbb{N}(\text{e folding}) = 55 - 60 \tag{17h}$$

What we wish to explore will be if Equation (17h) above is consistent with

$$N(\text{Entropy}) \approx 10^{58} \equiv 10^{\mathbb{N}} \Leftrightarrow \mathbb{N} \approx 58 \tag{18h}$$

Doing so may involve use of the Corda article, as given in [155].

5H. Now for Foundational Treatment as to If We May Have an Influence of the 5th Dimension in Our Problem

Wesson, [5] has a procedure as far as a five-dimensional uncertainty principle which is written as, if $n \sim L/l$. Where L is for 4th dimensions, and l is a five dimensional representation, so we have

$$\mathrm{d}S_5^2 = n^2 \mathrm{d}s_4^2 - n^4 \mathrm{d}l^2 = \left[\frac{L}{l}\right]^2 \mathrm{d}s_4^2 - \left[\frac{L}{l}\right]^4 \mathrm{d}l^2 \tag{19h}$$

Then we have an uncertainty principle in 5 dimensions as by Wessson [5] for which we can do if we look at the zeroth contribution as given in the deterministic structure

$$\left|\mathrm{d}p_\alpha \mathrm{d}x^\alpha\right| \equiv \frac{\mathrm{d}n^2}{n} \xrightarrow[\alpha \to 0]{} \left|\mathrm{d}E\mathrm{d}t\right| \approx \left|\Delta E \Delta t\right| \equiv \int \frac{\mathrm{d}n^2}{n} \equiv n \cdot \ln n \tag{20h}$$

Using a numerical expansion of the form from CRC tables [156]

$$n \ln n = n \cdot (n-1) - \frac{n}{2} \cdot (n-1)^2 + \frac{n}{3} \cdot (n-1)^3 + \cdots \tag{21h}$$

Up to cubic roots we obtain one real root and 2 conjugate complex roots of, if we use minimum uncertainty of $\Delta E \Delta t = \hbar = 1$ and set $c = 1$, we have then one real root, and two conjugate complex roots, so that

$$n_1 \simeq 1.54715 \quad \text{(as real root for a cubic equation for } n) \tag{22h}$$

$$n_{2,3} \simeq 0.426413 \pm 1.2242i \quad \text{(as two complex conjugate roots for } n) \tag{23h}$$

If so for the real case, of n, we have about the Planckian regime we look at

$$l = \frac{l_{\text{Planck}}}{1.54715} \tag{24h}$$

We will then look at the consequences of the real root, first, in terms of variation of minimum time step before going to other cases, but for the record, we have then the weird case of, for real root n in Equation (22h) that to other cases, but for the record, we have then the weird case of, for real root n in Equation (22h) that

$$\Delta t \approx -\frac{0.845184}{\Delta E} \tag{25h}$$

Equation (25h) is positive and real valued only if $\Delta E < 0$

6H. Under What Conditions Is $\Delta E \le 0$ How Would Negative Energy Tie into Negative Pressure Which Is Normally Expected in the Onset of Inflation?

First of all, look at conditions for rapid acceleration of the Universe, *i.e.* to have this according to the GR theory we have by [157] if $a(t)$ is a scale factor, then the Friedman equations read as

$$\frac{\ddot{a}}{a} = -\frac{4\pi G}{3}\sum_{j=1}\left(\rho_j + 3p_j\right) + \frac{\Lambda_b}{3} \tag{26h}$$

Then if we go to Gravitons again, and $j = 1$ we can stated

$$\xrightarrow[j=1,a(t)=a_{MN}t^{\alpha}]{} \Lambda_b = 3\alpha^2 - 3\alpha + 4\pi G\left(\rho_{j=1} + 3p_{j=1}\right) \tag{27h}$$

Now, look at a concept of pressure. Here. If the first expression is tabulated about Planck time (or just before).

We can then make the identification that we have negative pressure, we then have if we have both pressure and energy negative then we can make the following pairing of terms, *i.e.* first for the negative terms in Equation (27h) and also looking at Equation (9h), for $j = 1$, with the value of the cosmological constant in Equation (9h) used, with $\Lambda = \Lambda_b$ and with negative terms of Equation (9h) and Equation (27h) used, we have

$$-\frac{3p_{\text{momentum}}\kappa}{\int\sqrt{-g}\,\mathrm{d}^4x} = -3\alpha + 12\pi G\cdot\left(p_{j=1}\left(\text{pressure}\right)\right) \tag{28h}$$

Usually, the α is small so then the momentum term is such that the pressure is negative. As seen in Equation (28h), and we furthermore elaborate upon this in the next section, via what is brought up by [157] from Volovok. But before doing this:

We will after this is described go to the positive terms in Equation (27h). We get then for density, in terms of looking at positive terms in Equation (27h) and comparing what we have with Equation (9h) if we make the following positive term identification. With $\Lambda = \Lambda_b$

$$\frac{H_{\text{Potential well hamiltonian}}\left(p(t),q(t)\right)\kappa}{2\int\sqrt{-g}\,\mathrm{d}^4x} + 6\cdot\left(\alpha^2 + \frac{\aleph}{a_{\min}^2 t^{2\alpha}}\right)_{t=t_{\text{Planck}}} = 6\alpha + 4\pi G\cdot\left(\rho_{j=1}\right) \tag{29h}$$

We will then be looking at how we can then equate out a negative energy and a negative pressure for this Pre Planckian to Planckian physics transition.

7H. Explicit Calculation for a Negative Pressure in This Pre Planckian to Planckian Physics Transition

We will transition to Reference [157] by Volovik, 2003 which has the following expression for pressure in a vacuum state of weakly interacting Bose Gases. *i.e.* We use then Equation (30h) below for pressure, if we use the following approximations $E_{\text{Planck}1} = mc^2$, $E_{\text{Planck}2} = \hbar c \big/ \left(\Theta = \sqrt[3]{n\left(\text{particle density}\right)}\right)$, and so then we have a pressure for Bose pressure

$$^{+}p_{\text{Bose fluid}}\left(\text{pressure}\right)=\frac{1}{2\hbar^{3}}\cdot\left(E_{\text{Planck2}}^{3}E_{\text{Planck1}}-\frac{16}{15\pi^{2}}E_{\text{Planck1}}^{4}\right) \tag{30h}$$

This expression becomes negative if $E_{\text{Planck2}}^{3}E_{\text{Planck1}}<\frac{16}{15\pi^{2}}E_{\text{Planck1}}^{4}$ and if so we have negative pressure. *i.e.* For our problem if we configure the initial contents of the "well" we assume for having a near singularity, for space-time expansion start we can have $n\left(\text{Particle density}\right)=N/V\left(\text{volume}\right)$, with N as the number of would be "gravitons, and $V\left(\text{volume}\right)$ being the "Volume of space-time for our evaluation". Whereas $m=m\left(\text{mass}\right)=N\left(\text{number gravitions}\right)\times m_{g}$ with the use of the massive graviton value $m_{g}=\text{mass}\left(\text{heavy gravity gravition}\right)$. If so a simple calculation for this problem would have, then a negative value for pressure if we have the following, namely

$$\frac{\hbar c\cdot\sqrt[3]{V_{\text{Volume}<}}}{\left(N_{\text{graviton number}}m_{g}\right)^{1/3}}\leq\sqrt[3]{\frac{16}{15\pi^{2}}}\times N_{\text{graviton number}}m_{g}c^{2} \tag{31h}$$

Here, set $m_{\text{graviton}}\leq 10^{-65}$ to 10^{-62} grams, from [47], and Planck $m_{\text{Planck}}=2.176\times10^{-5}$ grams [158] And then also use a very specialized $V\left(\text{volume}\right)=\text{cube of planck length}\times 0.27002422918$ Therefore, if we write in the following units $\text{Planck length}=L_{\text{Planck}}=1=\hbar=m_{g}$, we have Equation (31h) re written as

$$\left(\frac{15\pi^{2}}{16}\right)^{1/3}\times 0.270024\leq\left(0.5\times10^{-58}m_{Pl}\right)^{4/3}N_{\text{graviton}}^{4/3} \tag{32h}$$

Or roughly

$$\left(\frac{15\pi^{2}}{16}\right)^{1/3}\times 0.270024\leq 10^{-77}N_{\text{graviton}}^{4/3} \tag{33h}$$

Leading to

$$10^{77}\leq N_{\text{graviton}}^{4/3} \tag{34h}$$

Or an upper bound of say for graviton mass of 10^{-62} grams, we have that we have negative pressure in our system for the number of gravitons being less than 10^{58}, in a volume about 27 times the cube of Planck length. This is stunning because in Equation (14h) we have an entropy number 10^{57} to 10^{58}, which is amazing because it suggests that the entropy generation we pick is tied in explicitly for the generation of negative pressure which is essential for inflation.

8H. Now for How We Could Consider Having ΔE Drop as Negative Energy, in Our Problem of Pre-Planckian Physics Right before the Onset of Inflation. With a Flip over to Ultra High Temperature-Energy Conditions

From [18] we have the following relationship, *i.e.* see referenced [159] have in its Equation (8) the following value *i.e.* if d = Dimensions, P = Pressure, V = Volume, then the basic energy expression is given as

$$E = \frac{d}{2} PV \tag{35h}$$

The discussion as to implementation of Equation (35h) has that if the conditions in Section 6 above are obtained for negative pressure, that in the Pre Planckian state we have at a chance, a quadratic dispersion relationship. In addition, Reference [159] claims that this is a result of a derivation from the Virial theorem as given in [160], so then that we may look at

$$\begin{aligned} &(\text{Heisenberg}) \frac{\mathrm{d}P(\text{momentum})}{\mathrm{d}t} = \frac{i}{\hbar} \cdot [H, P] \\ &\xrightarrow[{[P,X]=\frac{\hbar}{i} I_{\text{unit matrix}}}]{} \frac{\mathrm{d}P(\text{momentum})}{\mathrm{d}t} = -V'(x) \end{aligned} \tag{36h}$$

This is in turn directly related to the Schrodinger-Ehrenfest theorem, we can write as

$$\frac{\mathrm{d}\langle P(\text{momentum})\rangle}{\mathrm{d}t} = -\langle V'(x)\rangle \tag{37h}$$

This is in a way of referring to [18] and [19] a way to ascertain the correctness of using Equation (35h) in the Pre-Planckian to Planckian transition in space-time.

Having said that. We will then state that what we believe is that V as volume, as given in Equation (35h) would be roughly about 27 times the cube of Planck length, as a starting point, for investigation and that we would then have a transition up to the Planck length. Prior to nucleation of space-time.

Our hypothesis, is that breaching the barrier to full emergence would entail a simultaneous flip from negative (bound energy states) to Positive energy, whereas we would be using a variant of positive energy given as a restatement of Equation (34h)

$$E(\text{inf}) = \frac{d}{2} k_B T_{\text{inf}} \tag{38h}$$

i.e. a release of bound state to unrestrained positive energy would be commenced from the Pre Planckian to Planckian transition. *i.e.* eventually, if there is a barrier, of space-time at the surface of a sphere of about.27 times the cube of Plank length, in "volume" that when the barrier was breached, there would be a switch from negative energy, to positive energy, but that the pressure would still be negative, hence "inside" the initial near singularity sphere we would have a negative value of Equation (38h) signifying a BOUND state. Once the barrier collapsed, Equation (38h) would switch to positive, but that in lieu of inflation that the pressure of our system would still follow Equation (30h) and Equation (31h).

All this may be tied into an issue of semi classical reasoning as given below. We include this in to motivate readers to consider how a semi classical set of approximations may lead to bridging the gap between General Relativity and Quantum mechanics. We argue that the challenge in our present problem is to re duplicate the same methodology, but to also find a suitable potential system, instead of just a hierarchy of kinetic energy expressions. This however mandates the existence of higher dimensions. *i.e.* so our document is commensurate with the following, *i.e.* Ergodic mixing.

9H. Space-Time Dimensional Theorem (Involving Ergodic Mixing)

More on a linkage to Pre-Planckian to Planckian physics.

One of the striking results in [39] is their treatment of entropy, as given in their Equation (40h), which is brought up to take into consideration the possibility of tunneling. *i.e.* the variation in entropy, ΔS, is given as

$$i\Delta S = \frac{ikEt}{\hbar} - \frac{E}{t} \tag{39h}$$

My first conclusion is that if there is a tie into the formula 37 of this appendix H manuscript that in fact what was done in [39] may be a way to tie in energy, E, with entropy, and make the analogy to Tunneling from the interior to the exterior of a boundary between pre Planckian to Planckian space time more exact.

In addition, we wish the reader to review the issues given in references [161]-[177] before we go to the issues in the next page, 86.

I would be inclined to take the absolute magnitude of this above entropy expression and to assume the following, *i.e.* in the aftermath of tunneling right at the nexus of a boundary we would see approximately have for entropy generation, using the absolute magnitude of [39] as well as delta $S \sim n$ (particle counting) by infinite quantum statistics as given by Ng. [11]. An advantage of Equation (39h) if confirmed would be a way to examine the Weak correspondence principle more exactly. We shall comment upon this in our conclusion. Here, we take the absolute value of Equation (52h) and we will use that in our conclusion.

$$|\Delta S| = \sqrt{\left|\frac{kEt}{\hbar}\right|^2 + \left|\frac{E}{t}\right|^2} = \text{particle count} \tag{40h}$$

10H. Conclusion: Can We Use Equation (39h) and Equation (40h) to Quantify a Correspondence Principle in Cosmology Precisely?

I wish to thank Christian Corda for bringing this question to my attention. The answer is maybe, but if we do that we can assume that the modeling of E, used in Equation (40h) may be commensurate for the energy levels of a spherical infinite square well, *i.e.* see this, [178] We will assume the spherical, zero angular momentum case if we do this, so then we have if the radius of the well has zero inside the well and an infinite potential barrier value just outside, that to first approximation we have that. By [178]

$$E_{n,0} = \frac{n_{\text{quantum}}^2 \pi^2 \hbar^2}{2m \cdot r_{\text{spherical well}}^2} \tag{41h}$$

Making the approximation that m, in this last set of calculation is the same as the mass of a graviton, and that the term a, as given above is less than or equal to

Planck length, if the resulting *n*, as used in Equation (41h) is large, and ties in with Equation (38h), with that temperature dependence, we may see the start of classical to quantum correspondence, for large *n*, and a tie in that way to the Weak correspondence principle. What we can do is to look also at a relation given by Kerson Huang, in [179], as well as page 481 of the Hubble parameter given in [180] where we have normalized the Planck mass to have a value of 1. If so then

$$\frac{8\pi G\rho}{3\tilde{H}\left(\text{Hubble parameter}\right)^2}-\frac{\kappa_{\text{Flatness parameter}}}{\tilde{H}\left(\text{Hubble parameter}\right)^2\cdot a\left(t\right)^2}=1 \tag{42h}$$

If so, then we can look at

$$\kappa_{\text{Flatness parameter}}=-\left(1.66\times\sqrt{g_*}\cdot T^2_{\text{max temperature}}\right)^2\cdot a\left(t\right)^2+8\pi G\rho\times a\left(t\right)^2 \tag{43h}$$

If we use the value of $a\left(t\right)=a_{\min}t^{\gamma}$, and then we have

$$\kappa_{\text{Flatness parameter}}=\left[-\left(1.66\times\sqrt{g_*}\cdot T^2_{\text{max temperature}}\right)^2+8\pi G\rho\right]\times a^2_{\min}t^{2\gamma} \tag{44h}$$

In order for this Equation (44h) to be greater than equal to zero, we would need to have

$$8\pi G\rho\geq 1.66^2 g_* T^4_{Temp} \tag{45h}$$

How to tie this into the matter of energy. *i.e.* use for Pre Planckian to Planckian transitions showing large quantum number values so that the correspondence principle in cosmology would hold would be to have using energy as given in Equation (41h)

$$n^2\left(\text{quantum number}\right)=\frac{2\cdot V_{\text{space volume}}\cdot m_g\left(1.66\times\sqrt{g_*}\cdot T^2_{\text{max temperature}}\right)^2}{\pi^2\hbar^2} \tag{46h}$$

We should before proceeding also note that we would also be utilizing having $\Delta E\equiv\frac{d\left(\dim\right)}{2}\cdot k_B\cdot T_{\text{universe}}$ so that we have,

$$n^2\left(\text{quantum number}\right)\approx\frac{2d\left(\dim\right)\cdot V_{\text{space volume}}m_g\cdot\left(R_{\text{radius well}}\right)^2}{\pi^2\hbar^2} \tag{47h}$$

where we are assuming having an almost one to one connection between g_* and $d\left(\dim\right)$

$$\rho=\frac{E\left(\text{cylindrical well energy}\right)}{V_{\text{Volume}}}=\frac{n^2\left(\text{quantum number}\right)\cdot\pi^2\hbar^2}{V_{\text{Volume}}\cdot m_g\cdot\left(r_{\text{radius well}}\right)^2} \tag{48h}$$

For there to be an equality, which would be a necessary condition for having a correspondence principle in Cosmology, *i.e.* to have quantum effects for high numbers, *i.e.* $n^2_{\text{quantum number}}\gg 1$, one would likely have, even if we state g_* is a degree of freedom, would be that the stated dimensional values of inputs into a very large value for $d_{\dim}$ for inputs into the Pre Planckian state, prior to emergence into Planckian cosmology conditions would have to be an extremely large number. *i.e.* we would be looking for conditions in the pre Planckian space time for which $n^2_{\text{quantum number}}\gg 1$ due to an enormous value for $d_{\dim}$.

In saying this, we have to be more precise than we have been wont to be in geometry of pre Planckian space time. And if $n^2_{\text{quantum number}}$ approached 1, for whatever the reason, the chances that we could evaluate Eqation (40h) in terms of the Correspondence principle would evaporate. So, we ask:

Can extra dimensions come from a Multiverse feed in to Pre-Planckian space-time?

To do this what we do is to state the multiverse done in [181] and [182] and cite the number, N so brought up with changes in g_*, which is, the degree of freedom so assumed.

This idea is extremely speculative, but it embodies using this version of an idea which is in a recent conference proceedings in Spain used these two references, [181] [182] *i.e.* the idea was to refer to a Multiverse version of what is known as the Penrose Cyclic Conformal cosmology conjecture, *i.e.* [183] use this construction.

We are extending Penrose's suggestion of cyclic universes, black hole evaporation, and the embedding structure our universe is contained within, This multiverse embeds BHs and may resolve what appears to be an impossible dichotomy. The following is largely taken from [43]and [44] and has serious relevance to the final part of the conclusion. That there are no fewer than N universes undergoing Penrose 'infinite expansion' (Penrose) [183] contained in a mega universe structure. Furthermore, each of the N universes has black hole evaporation, with the Hawking radiation from decaying black holes. If each of the N universes is defined by a partition function, called $\{Z_i\}_{i=1}^{n}$ then there exist an information ensemble of mixed minimum information correlated as about 10^7 - 10^8 bits of information per partition function in the set $\{Z_i\}_{i=1}^{n}\Big|_{\text{Before}}$, so minimum information is conserved between a set of partition functions per universe

$$\{Z_i\}_{i=1}^{n}\Big|_{\text{Before}} \equiv \{Z_i\}_{i=1}^{n}\Big|_{\text{After}} \tag{49h}$$

However, there is non-uniqueness of information put into each partition function. $\{Z_i\}_{i=1}^{n}$ Furthermore Hawking radiation from the black holes is collated via a strange attractor collection in the mega universe structure to form a new big bang for each of the N universes represented by $\{Z_i\}_{i=1}^{n}$. Verification of this mega structure compression and expansion of information with a non-uniqueness of information placed in each of the N universes favors ergodic mixing treatments of initial values for each of N universes expanding from a singularity beginning. The n_f value, will be using (Ng, 2008) $S(\text{entropy}) \sim n_f$ [11]. How to tie in this energy expression, will be to look at the formation of a nontrivial gravitational measure as a new big bang for each of the N universes as by $n(E_i)$ the density of states at a given energy E_i for a partition function. [184]

$$\{Z_i\}_{i=1}^{n} \propto \left\{ \int_0^\infty \mathrm{d}E_i\, n(E_i) \cdot \exp(-E_i) \right\}_{i=1}^{N} \tag{50h}$$

Each of E_i identified with Equation (50h) above, are with the iteration for N

universes [177]. Then the following holds, by asserting the following claim to the universe, as a mixed state, with black holes playing a major part, due to the CCC cosmological picture, by starting off with

Claim 1

$$\frac{1}{N}\cdot\sum_{i=1}^{N}\left\{Z_i\right\}\Big|_{i\text{ Before nucleation regime}}\xrightarrow{\text{After Planck era}}\left\{Z_i\right\}\Big|_{i\text{ fixed After nucleation regime}} \tag{51h}$$

For N number of universes, with each $\left\{Z_i\right\}\Big|_{i\text{ Before nucleation regime}}$ for i = 1 to N being the partition function of each universe just before the blend into the RHS of Equation (51h) above for our present universe. Also, each of the independent universes given by are constructed by the absorption of one to ten million black holes taking in energy. *i.e.* (Penrose) [183].

Keep in mind what is brought up in [184] Furthermore, the main point is similar to what was done in [185] in terms of general ergodic mixing The second Claim is that the dynamics of black holes, in a particular universe, call it, the ith, one, are of critical importance.

Claim 2

$$\left\{Z_i\right\}\Big|_{i\text{ Before nucleation regime}}\approx\sum_{k=1}^{\text{Maximum}}\left\{Z_k\right\}\Big|_{k\text{ Black-Hole nucleation regime}} \tag{52h}$$

What is done in **Claim 1** and **Claim 2** is to come up with a protocol as to how a multi-dimensional representation of black hole physics enables continual mixing of spacetime [47] largely as a way to avoid the Anthropic principle, as to a preferred set of initial conditions.

What this Ergodic condition of mixing of different contributions in the Pre Planckian space-time would do is to add, via using up to N (almost infinite, say) multiverse contributions to a CCC version of space time is to add a statistical averaging of an initial start from a Pre Planckian to Planckian transition.

Prior to working with the theorem, we wish to bring up the following, *i.e.* that we would write the number, N of different multiverse contributions to a pre Planckian space-time would then lead to the following theorem.

Space-time dimensional Theorem (involving ergodic mixing)

The number of multiverse contributions, call it N (number of multiverse contributions) has a 1-1 relationship to the coefficient, d(dim) as of an equality in Equation (58) and Equation (59) so that the quantum number obtained in the left hand side of Equation (58) and also Equation (59) will be sufficiently large to permit values $\gg 1$ such that the quantum version of quantum gravity linked to classical GR holds after the transition to from Pre Planckian to Planckian physics commences

Proof

First of all write

$$g_* = N\left(\text{multiverse number}\right)\times g_*\left(\text{individual universe}\right) \tag{53h}$$

Here, we will define, $g_*\left(\text{individual universe}\right)$ in terms of what is given in Kolb and Turner [2], see that usually [2] has a value of, in the very early universe, of $g_* \approx 102$ d.o.f. *i.e.* 102 degrees of freedom (for each individual universe), *i.e.*, if one is using Equation (53h) we then conclude with writing

$$n^2_{\text{quantum number}} \equiv \frac{2 \cdot V_{\text{space volume}} m_g \cdot \left(R_{\text{radius well}}\right)^2 \cdot 1.66^2}{\pi^2 \hbar^2} \cdot N_{\text{Contributing universes}} \cdot g_{*\,\text{individual universe}} \cdot T^4_{\text{universe}} \quad (54\text{h})$$

Concluding that we can state directly that:

$d_{\dim}$ varies directly with *N*, where *N* is the number of individual multiverse components (55h).

We furthermore state that this procedure, as similar to a black hole (not identical) and, has much overlap with Dr. George Chapline's *et al.* [186].

If this theorem is upheld as far as being proven, a road to quantum, gravity exists. This idea will be significantly developed in future publications.

Chapline *et al.*, state as follows on page 1 of their article [186].

Quote

The black hole event horizon is a continuous quantum phase transition of the vacuum of space-time roughly analogous to the quantum liquid-vapor critical point of an interacting bose fluid.

End of Quote

We are doing much the same sort of thing, in the Pre Planckian to Planckian transition, and we will add far more detail relevant to experimental confirmation in a future article follow up which conceivably could be tested via experimental work.

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Concluding that we can state directly that $d_{\dim}$ varies directly with *N*, where

N is the number of individual multiverse components.

We furthermore state that this procedure, as similar to a black hole (not identical) and has much overlap with Dr. George Chapline's *et al.* [186].

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Appendix I. A Brief Set of References with Respect to Strange Attractors

A strange attractor in cosmology is a concept from dynamical systems theory where the universe's evolution is chaotic but follows an underlying, complex, fractal-like pattern. The rationale is that certain cosmological models, particularly those with multiple interacting fields, exhibit chaotic behavior that doesn't settle into a simple state but instead traces a complex, non-repeating trajectory in phase space. This suggests the universe may not be perfectly predictable, yet its long-term evolution is governed by these strange attractors, leading to phenomena like fluctuating periods of expansion and contraction.

Chaos and fractals: new frontiers of science	Deviase & Briggs	An accessible, yet mathematically detailed, overview of chaos theory and fractals.
Turbulence, strange attractors and chaos	David Ruelle	A collection of classic papers by Ruelle and co-authors on the theory of chaos and its applications.
Chaotic evolution and strange attractors	David Ruelle	A non-mathematical, yet authoritative, introduction to chaotic systems for scientists in various fields.
Strange attractors: creating patterns in chaos	Julien Clinton Sprott	Provides a hands-on, computational approach with programs, disk, and illustrations for creating patterns from chaos.

FTR I will in the next paper supply a detailed proof as to how strange attractors are the right tool for the Ergodic theorem referenced as for the modification of Penrose CCC cosmology.