Open question. Could a causal discontinuity lead to an explanation of fluctuations in the CMBR radiation spectrum ?

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Abstract Could a causal discontinuity lead to an explanation of fluctuations in the CMBR radiation spectrum? Is this argument valid if there is some third choice of set structure (for instance do self referential sets fall into one category or another?). The answer to this question may lie in (entangled?) vortex structure of space time, along the lines of structure similar to that generate in the laboratory by Ruutu [1] (1996). Self referential sets may be part of the generated vortex structure, and we will endeavor to find if this can be experimentally investigated. If the causal set argument and its violation via this procedure holds, we have the view that what we see a space time 'drum' effect with the causal discontinuity forming the head of a 'drum' for a region of about 10^{10} bits of 'information' before our present universe up to the instant of the big bang itself for a time region less than $t \sim 10^{-44}$ seconds in duration, with a region of increasing bits of 'information' going up to 10^{120} due to vortex filament condensed matter style forming through a symmetry breaking phase transition.

Introduction

The causal discontinuity condition is in [2] and is integral to the evolution of space time physics. The relevance this question as presented in the abstract has with CMBR is two fold. Conventional fluctuations leading to the CMBR angular separation of the particle-horizon distance of about $\Delta\theta \approx 1.4^0$, and this is in line with acoustic peaks in the WMAP power spectrum starting at about $l \sim 200$ for the multipole moment . Conventional treatment of the CMBR data makes generous use of error bars. Subir Shankar has raised the specific possibility in his talk ' Cosmology beyond the Standard Model' in ICGC-07, Pune, India, and also in print [3] that there is another explanation as to the error bars, namely that as reported in Subir Sarkar's BadHonnef07 talk [4] that there is a fluctuation in early universe structure, beyond the normal perturbations associated with the standard model which need to be investigated. In particular, JJ. Blanco-Pillado et al in 2004 [5] investigated race track models of inflation where there was investigation of a more complex version of a scalar field evolution equation of the form

$$\ddot{\phi}^i + 3H\dot{\phi}^i + \Gamma^i_{jk}\dot{\phi}^j\dot{\phi}^k + g^{ij}\frac{\partial V}{\partial \phi^j} = 0 \tag{1}$$

This has real and imaginary components to the scalar field which can be identified as of the form X_i for the real part to the scalar field ϕ^i , and Y_j for the imaginary part of the scalar field ϕ^j , as well as having

$$H^2 \equiv \left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\cdot\left[\frac{1}{2}\cdot g^{ij}\dot{\phi}^i\dot{\phi}^j + V\right] \tag{2}$$

JJ Blainco-Pillado et al. [5] use this methodology, using the physics of the Christoffel symbol as usually given by

$$\Gamma^{i}_{jk} = \frac{1}{2} \cdot g^{i,\sigma} \cdot \left(\partial_j g_{k,o} + \partial_k g_{\rho,j} - \partial_\rho g_{j,k} \right) \tag{3}$$

If one has no coupling of terms as in an expanding universe metric of the form [6]

$$dS^2 = -dt^2 + a^2(t) \cdot \delta^i_j dx^i dx^j \tag{4}$$

Then the Christoffel symbols take the form given by

$$\begin{aligned} \Gamma^{i}_{00} &= 0, \\ \Gamma^{i}_{j0} &= \Gamma^{i}_{0j} = \frac{\dot{a}}{a} \delta^i_j, \\ \Gamma^{i}_{jk} &= 0 \end{aligned} \tag{5}$$

The implications for the scalar evolution equation are that we have

$$\ddot{\phi}^i + 3H\dot{\phi}^i + (\dot{a}/a) \cdot \delta^i_j \dot{\phi}^j \dot{\phi}^0 + g^{ij} \frac{\partial V}{\partial \phi^j} = 0 \tag{6}$$

If we can write as follows, i.e. say that we have $\dot{\phi}^0 \sim 0$, as well as have $g^{ij} \equiv g^{ii} = \pm 1$,

$$g^{00} \equiv 1, g^{ii} = -1, \quad if \quad i = j \neq 0 \tag{7}$$

$$\ddot{\phi}^i + 3H\dot{\phi}^i + H \cdot \dot{\phi}^i \dot{\phi}^0 + g^{ii} \frac{\partial V}{\partial \phi^i} = 0 \tag{8}$$

$$\dot{\phi}^0 \sim 0 \Rightarrow \ddot{\phi}^i + 3H\dot{\phi}^i - \frac{\partial V}{\partial \phi^i} = 0 \tag{9}$$

On the other hand,

$$\dot{\phi}^0 \sim 1 \Rightarrow \ddot{\phi}^i + 4H\dot{\phi}^i - \frac{\partial V}{\partial \phi^i} = 0 \text{ provided } t \leq t_P \tag{10}$$

Otherwise, taking into account the causal discontinuity expression, we claim we will be working with

$$\ddot{\phi}^i + 3H\dot{\phi}^i - \frac{\partial V}{\partial \phi^i} = 0 \text{ provided } t > t_P \tag{11}$$

For very short time duration, and looking at the case for chaotic inflation, we would be working with, in this situation $\frac{\partial V}{\partial \phi^i} \cong M_P \phi_i$. Set an ansatz with regards to

$$\ddot{\phi}^i + 4H\dot{\phi}^i - M_P^2 \phi_i = 0 \text{ provided } t \le t_P \tag{12}$$

$$\text{If } \phi_i \sim e^{bt} \text{, Eqn. (62) } \Rightarrow b^2 + 4Hb - M_P^2 = 0 \Rightarrow b = -2H \pm \sqrt{4H^2 + 4M_P^2} \tag{12a}$$

This would lead to, if provided $t \le t_P$, and for a short period of time, H is a constant

$$\phi \approx c_1 \exp\left[(-2 \cdot H - \sqrt{4H^2 + 4M_P^2}) \cdot t\right] + c_2 \exp\left[(-2H + \sqrt{4H^2 + 4M_P^2}) \cdot t\right] \tag{13}$$

Similarly, for $t > t_P$, assuming for a short period of time that H is approximately a constant.

$$\phi \approx c_1 \exp\left[(-\frac{3}{2} \cdot H - \sqrt{\frac{9}{4}H^2 + 4M_P^2}) \cdot t\right] + c_2 \exp\left[(-\frac{3}{2}H + \sqrt{\frac{9}{4}H^2 + 4M_P^2}) \cdot t\right] \tag{14}$$

Ups shot is that for $t > t_P$, there is a greater rate of growth in the ϕ scalar field than is the case when $t \le t_P$

How to tie in the entropy with the growth of the scale function ?

Racetrack models of inflation, assuming far more detail than what is given in this simplistic treatment provide a power spectrum for the scalar field given by

$$P \sim \frac{1}{150\pi^2} \cdot \frac{V(\phi)}{\in} \tag{15}$$

This is assuming a slow roll parameter treatment with $\in << 1$, and for $t > t_P$. Eqn. (15) would be growing fairly rapidly in line with what is said about Eqn. (14) above. An increase in scalar power, is then proportional to an increase in entropy via

$$\left|\frac{\Delta E}{l_P^3}\right| \sim \left|\frac{\Delta P \in 150\pi^2}{l_P^3}\right| \approx |\Delta S| \tag{16}$$

Now, how does this tie in with the lumpiness seen in the CMBR spectra? In an e mail communication, `Subir Sarkar` summarized the situation up as follows [7] :

"*Quasi-DeSitter spacetime during inflation has no "lumpiness" - it is necessarily very smooth. Nevertheless one can generate structure in the spectrum of quantum fluctuations originating from inflation by disturbing* *the slow-roll of the inflaton - in our model this happens because other fields to which the inflaton couples through gravity undergo symmetry breaking phase transitions as the universe cools during inflation*"

If we use what is in **Appendix I**, namely the non flat space generalization of the flat space De Alembertian leading to, for a quartic potential as given in **Appendix I**

and generalizations of
$$\phi^2 = \frac{1}{\tilde{a}} \cdot \left\{ c_1^2 - \left[\alpha^2 + \frac{\kappa}{6a^2(t)} + \left(M(T) \approx \varepsilon^+ \right) \right] \right\} \xrightarrow[M(T\sim high)\to 0]{} \phi^2 \neq 0 \tag{17}$$

$$\phi^2 = \frac{1}{\tilde{a}} \cdot \left\{ c_1^2 - \left[\alpha^2 + \frac{\kappa}{6a^2(t)} + \left(M(T) \neq \varepsilon^+ \right) \right] \right\} \xrightarrow[M(T\sim Low)\neq 0]{} \phi^2 \approx 0 \tag{18}$$

The mass being referred to fades out if there is a temperature increase. So happens that there is one. And this due to the worm hole transfer of thermal heat and the like from a prior universe. This is done and can be made far more complex if the De Alembertian has off diagonal terms in it

i.e. if one does not insist upon simple Euclidian space, the Laplacian takes the form [6]

$$\Delta\phi \equiv \eta^{u,v}\partial_u\partial_v\phi \equiv \partial_i\partial^i\phi + \partial^i\phi \cdot \partial_i \ln\sqrt{|g|} \tag{19}$$

We claim that the generalization for Eqn. (17) and Eqn. (18) will lead in the case of cooling for a scalar field system in the aftermath of immediate rapid expansion of the scalar field a very different, and far more complicated dynamic than is given by Eqn. (18)

Recall what is given in modeling the pure Dilatonic potential, i.e. as given by Lalak, Ross, and Sakar [3] (2006). This potential has a minimum if B/A>1 where it can vanish, and it has a non zero minimum if we set 1 > B/A > N_2/N_1

$$\begin{aligned} V(s,\phi) &= \frac{1}{2s} \cdot \left(A \cdot (2s + N_1) \cdot e^{-s/N_1} + B \cdot (2s + N_2) \cdot e^{-s/N_2} \right)^2 \\ &+ \frac{1}{s} \cdot A \cdot B \cdot (2s + N_1) \cdot (2s + N_2) \cdot e^{-s/N_1} \cdot e^{-s/N_2} \cdot (1 - \cos(\phi \cdot \varepsilon)) \end{aligned} \tag{20}$$

This is assuming that we are having $s \to N_a \neq \infty$, leading to minima for $\phi_k = k\pi/\varepsilon$, with k being the positive and negative integers, i.e. this helps delineate between two condensates. If we have a complex scalar field $\phi_j = X_j + i \cdot Y_j$. we have moduli arguments which add far more structure, i.e. we are getting into Calabi-Yau compactification issues. **Appendix II** offers a simpler potential system. But that system plus Eqn. (20) must have spectral index behavior, i.e. reflecting inflation and the early universe, which matches WMAP data.

Point which is to be made here, is that the richer the structure with respect to Eqn. (20), and its race track version which has real and imaginary components to a scalar field, the less tenable the simple Eqn (17) and Eqn (68) pictures of simply rising and falling scalar potentials are. So the following claim is made.

CLAIM 1: In the initial phase of expansion in an inflationary sense, the period of time $t < t_P$ corresponds with a scalar field given by Eqn. (17) and Eqn. (18). As we have a rapidly increasing temperature , we have no complexity of the sort implied by Eqn. (20) above

CLAIM 2 : In the cool down period before the re heating period after inflation, we have additional structure put in, enough so , so that multiple minima and fluctuations exists which would give far more definition as to local scalar power spectra. I.e. we are looking at

$$\left|\frac{\Delta V(s,\phi)}{l_P^3}\right| \sim \left|\frac{\Delta P \in 150\pi^2}{l_P^3}\right| \approx |\Delta S| \Leftrightarrow |\Delta P| \sim \left|\frac{\Delta V(s,\phi)}{\in 150\pi^2}\right| \tag{21}$$

Provided that we have non zero minimum if we set 1 > B/A > N_2/N_1 for ΔV , we claim that then we are having the basis for non zero fluctuations seen as given in Sarkar's Bad Honnef 07 portrayal of CMBR.[7]

We can use the criteria of **Appendix III**, which gives realistic data input parameters as to the variance of the CMBR spectra. In particular, we can take Eqn. (3) of **Appendix III** and splicing that in on a new derivation as to C_l power spectra. I.e. C_l of **Appendix IV** is an incredibly crude model, which depends upon Eqn. (3) of that section for a power law , which then leads to how to re construct , assuming NO time dependence upon the Hubble Parameter ; i.e. $\dot{H} = 0$, to come up with a tensor type of expression for $C^{(T)}_l$ based upon what can be called very naïve assumptions.

Here we can make the following assertion. Especially with regards toGravitational waves. This is from Durrer, [8] and is a foundation for additional work which can be done

i.e.

$$C^{(T)}_l = \frac{2}{\pi} \cdot \int dk k^2 \left\langle \left| \int_{\eta\, dec}^{\eta_0} d\eta \cdot \dot{H}(\eta,k) \cdot \frac{j_l(k(\eta_0 - \eta))}{(k(\eta_0 - \eta))^2} \right|^2 \right\rangle \cdot \frac{(l+2)!}{(l-2)!} \tag{22}$$

We can appeal to simplified models as to how to come up with $\dot{H}$. First of all, consider the causal discontinuity equation argument. This is one phase as to implementation, i.e. look at $\dot{H} = \frac{d}{d\eta}\left(\frac{\dot{a}}{a}\right)$. This is where we are working directly with Eqn (12) in part, and at the regime of at least partial causal discontinuity [2], we are working with Eqn. (1) The interplay between these two equations in part can lead to an effective re construction of a potential system, which in part should in its structure, have some similarities with the race track potential. **Appendix V** also gives guidance as to re construction of the potential system we can work with, and also compare it with the different race track models so outlined.

In addition to this treatment of how to get a CMBR reconstruction of gravitational tensor fluctuations, we can also look at observational efforts to confirm, or falsify different models of $\left|\frac{\Delta P \in 150\pi^2}{l_P^3}\right| \approx |\Delta S|$, i.e. how the entropy varies will be in its own way will affect the power spectra, which in turn affects confirming or falsifying the spectral index $n_s = 1 - \frac{d \ln P}{dN} \approx .95 \pm .02$. Here, N is the number of e folding in inflation and we can follow through on elementary calculations of how P varies due to choices of potential system we are examining. I.e. recall Subir Sarkar's 2001 investigation of a simple choice of variant of the standard chaotic inflationary potential given by [9]

$$V \equiv V_0 - c_3\phi^3 + \frac{1}{2}\lambda \cdot \phi^2 \cdot \rho^2 + \ldots \tag{23}$$

Sarkar treated the inflaton as having a varying effective mass, with an initial value of effective mass of $m_\phi{}^2 = \frac{d^2V}{d\phi^2}$ given a before and after phase transition value of

$$m_\phi{}^2 = -6c_3 \cdot \langle\phi\rangle\Big|_{Before-phase-transition} \xrightarrow[phase-transition]{} -6c_3 \cdot \langle\phi\rangle + \lambda \cdot \Sigma^2\Big|_{after-phase-transition} \tag{24}$$

This is, when Sarkar did it, with $\lambda = \kappa \cdot m^2 / M_P^2$ as a coupling term . This would also affect the spectral index value, and it also would be a way to consider an increase in inflation based entropy. The only draw back to this phenomenological treatment is that it in itself does not address the formation of an instanton in the very beginning of inflation, a serious draw back since this does not also give an entry into the formation of the layers of complexity which we think is more accurately reflected in the transferal of state from a growing value of the magnitude of the scalar field as given by Eqn. (17) and Eqn. (18) as temperature flux flows in from a prior universe, to the cooling off period we think is necessary for the formation of a complex scalar field and its analogies in the race track style models , as in Eqn (20), and **Appendix I** below. Eqn (72) with its treatment of tensorial contributions to the CMBR has its counter part, an implied release in relic gravitons which may , or may not be amendable to observational techniques . We would most likely imply their existence indirectly via use of Eqn. (22) and seeing if they can be linked to the behavior of the inflaton generating a new burst of entropy at the onset of inflation. **Appendix VI** shows what we may wish to consider as to relic graviton production which is linkable to the worm hole, and causal discontinuity discussion we have brought up, with regards to early universe entropy generation. We also will make reference that this has been linked to brane theory via **Appendix VII** material.

Conclusion. Match up with Smoot's table

In a colloquium presentation done by Dr. Smoot in Paris [10] (2007); he alluded to the following information theory constructions which bear consideration as to how much is transferred between a prior to the present universe in terms of information 'bits'.

0) Physically observable bits of information possibly in present Universe - 10^{180}
1) Holographic principle allowed states in the evolution / development of the Universe - 10^{120}
2) Initially available states given to us to work with at the onset of the inflationary era- 10^{10}
3) Observable bits of information present due to quantum / statistical fluctuations -10^8

Our guess is as follows. That the thermal flux so implied by the existence of a worm hole accounts for perhaps 10^{10} bits of information. These could be transferred via a worm hole solution from a prior universe to our present , and that there could be , perhaps 10^{120} minus 10^{10} bytes of information temporarily suppressed during the initial bozonification phase of matter right at the onset of the big bang itself .

‘Then after the degrees of freedom dramatically drops during the beginning of the descent of temperature from about $T \approx 10^{32}\, Kelvin$ to at least three orders of magnitude less, as we move out from an initial red shift

$$z \approx 10^{25}$$

to [11]

$$T \approx \sqrt{\varepsilon_V} \times 10^{28}\, Kelvin \sim T_{Hawkings} \cong \frac{\hbar \cdot H_{initial}}{2\pi \cdot k_B} \qquad (25)$$

Whichever model we can come up with that does this is the one we need to follow, experimentally. And it gives us hope in confirming if or not we can eventually analyze the growth of structure in the initial phases of quantum nucleation of emergent space time [12]. We also need to consider the datum so referenced as to the irregularities as to the cooling down phase of inflation, as mentioned by Sakar, [7]

The race track models, after the inflaton begins to decline would be ideal in getting the couplings, and the symmetry breaking. We will refer to this topic in a future publication. We can make a few observations though about the coupling so assumed. First, there is a question of if or not there is a finite or infinite fifth dimension. String theorists have argued for a brane-world with a warped, infinite extra dimension allowing for the inflaton to decay into the bulk so that after inflation, the effective dark energy disappears from our brane. This is achieved by shifting away the decay products into the infinity of the 5th dimension. [13] Nice hypothesis, but it presumes CMB density perturbations could have their origin in the decay of a MSSM flat direction. It would reduce the dynamics of the inflaton to be separation between a Dp brane and $\overline{D}p$ anti brane via a moduli argument.

What if we do not have an infinite fifth dimension ? What if it is compactified only ? We then have to change our analysis.

Another thing. We place limits on inflationary models; for example, a minimally coupled $\lambda\phi^4$ is disfavored at more than 3 σ. Result? Forget quartic inflationary fields , as has been show by H. V. Peiris, G. Hingshaw et al [14] . We can realistically hope that WMAP will be able to parse through the race track models to distinguish between the different candidates. So far “First-Year Wilkinson Microwave Anisotropy Probe (WMAP)1 Observations: Implications For Inflation” , is giving chaotic inflation a run for its money. We shall endeavor for numerical work using some of the tools brought up in this present discussion for falsifying or confirming the figures 1 and 2 of this text which show variance in the CMBR spectrum.

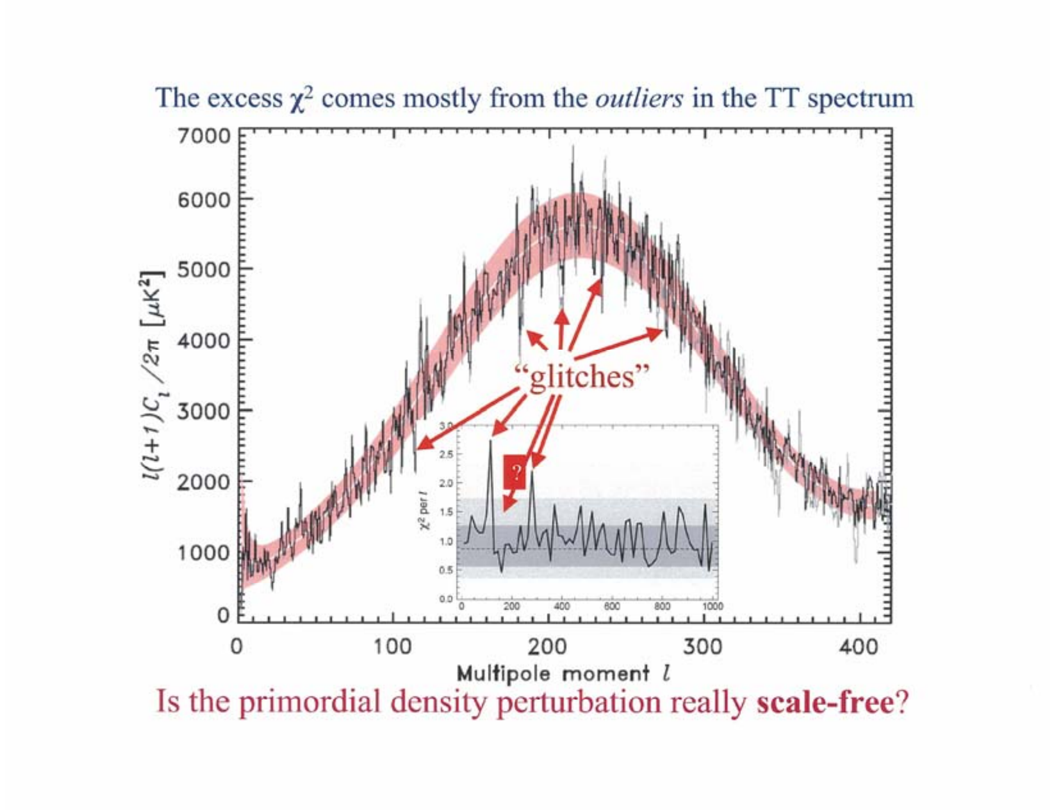

Figure 1 as given by Subir Sarkar, from his web site. Copied from Dr. Sarkar's Bad Honnif 07 talk and re produced here with explicit permission of the original presenter .Shows the glitches which need to be addressed in order to make a CMBR data set congruent with an extension of the standard model of cosmology.

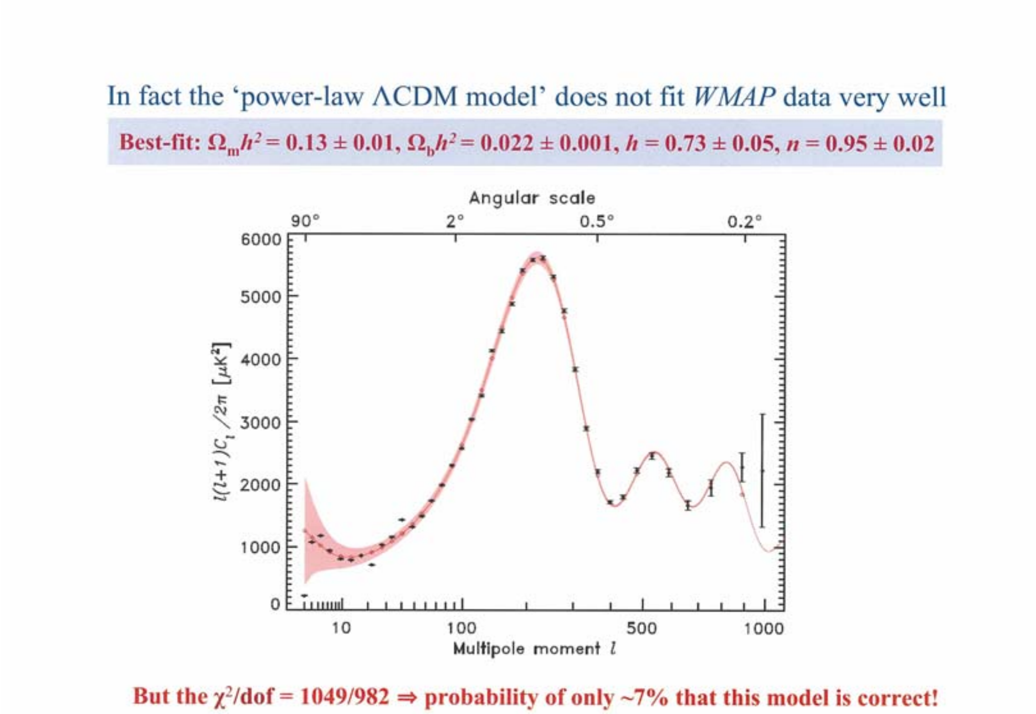

Figure 2, Sakar figure about CMBR , from Bad Honnif

Appendix I: The D'Albembertain operation in an equation of motion for emergent scalar fields

We begin with the D'Albertain operator as part of an equation of motion for an emergent scalar field. We refer to the Penrose potential (with an initial assumption of Euclidian flat space for computational simplicity) to account for, in a high temperature regime an emergent non zero value for the scalar field ϕ due to a zero effective mass, at high temperatures. [14]

When the mass approaches far lower values, it, a non zero scalar field re appears.

Leading to $\phi \xrightarrow[T \to 2.7^0 \, Kelvin]{} \varepsilon^+ \approx 0^+$ as a vanishingly small contribution to cosmological evolution

Let us now begin to initiate how to model the Penrose quintessence scalar field evolution equation. To begin, look at the flat space version of the evolution equation

$$\ddot{\phi} - \nabla^2 \phi + \frac{\partial V}{\partial \phi} = 0 \qquad (1)$$

This is, in the Friedman – Walker metric using the following as a potential system to work with, namely:

$$V(\phi) \sim -\left[\frac{1}{2}\cdot\left(M(T)+\frac{\Re}{6}\right)\phi^2 + \frac{\tilde{a}}{4}\phi^4\right] \equiv$$
$$-\left[\frac{1}{2}\cdot\left(M(T)+\frac{\kappa}{6a^2(t)}\right)\phi^2 + \frac{\tilde{a}}{4}\phi^4\right] \tag{2}$$

This is pre supposing $\kappa \equiv \pm 1,0$, that one is picking a curvature signature which is compatible with an open universe.

That means $\kappa = -1,0$ as possibilities. So we will look at the $\kappa = -1,0$ values . We begin with.

$$\ddot{\phi} - \nabla^2\phi + \frac{\partial V}{\partial \phi} = 0 \Rightarrow$$
$$\phi^2 = \frac{1}{\tilde{a}}\cdot\left\{c_1^2 - \left[\alpha^2 + \frac{\kappa}{6a^2(t)} + M(T)\right]\right\} \tag{3}$$
$$\Leftrightarrow \phi \equiv e^{-\alpha\cdot r}\exp(c_1 t)$$

We find the following as far as basic phenomenology, namely

$$\phi^2 = \frac{1}{\tilde{a}}\cdot\left\{c_1^2 - \left[\alpha^2 + \frac{\kappa}{6a^2(t)} + \left(M(T) \approx \varepsilon^+\right)\right]\right\} \tag{4}$$
$$\xrightarrow[M(T\sim high)\to 0]{} \phi^2 \neq 0$$

$$\phi^2 = \frac{1}{\tilde{a}}\cdot\left\{c_1^2 - \left[\alpha^2 + \frac{\kappa}{6a^2(t)} + \left(M(T) \neq \varepsilon^+\right)\right]\right\} \tag{5}$$
$$\xrightarrow[M(T\sim Low)\neq 0]{} \phi^2 \approx 0$$

The difference is due to the behavior of $M(T)$. We use $M(T) \sim$ axion mass $m_a(T)$ in asymptotic limits with

$$m_a(T) \cong 0.1 \cdot m_a(T=0)\cdot(\Lambda_{QCD}/T)^{3.7} \qquad (6).$$

Appendix II: Managing what to do with racetrack inflation, as cool down from initial expansion commences

P. Brax, A. Davis et al [15] devised a way to describe racetrack inflation as a way to look at how super gravity directly simplifies implementing how one can have inflation with only three T (scalar) fields . The benefit to what we work with is that we may obtain two gaugino condensates and look at inflation with a potential given by [15]

$$V = V_0 + V_1 \cos(aY) + V_2 \cos(bY) + V_3 \cos(|a-b| \cdot Y) \tag{1}$$

This has scalar fields X, ϕ as relatively constant and we can look at an effective kinetic energy term along the lines of

$$\Im_{Kinetic} = 3 \cdot (\partial Y)^2 / 4(\partial X)^2 \tag{2}$$

This ultra simple version of the race track potential is chosen so that the following conditions may be applied

(1) Exist a minimum at $Y = Y_0$; i.e. we have $V^{'}(Y_0) = 0,$ and $V^{"}(Y_0) > 0,$ when we are not considering scalar fields X, ϕ

(2) We set a cosmological constant equal to zero with $V(Y_0) = 0$

(3) We have a flat saddle at $Y \approx 0$; i.e. $V^{"}(0) = 0$

(4) We re - scale the potential via $V \to \lambda V$ so as to get the observed power spectra $P = 4 \times 10^{-10}$

Doing all this though frequently leads to the odd situation that $|a-b|$ must be small so that $X >> 1$ in a race track potential system when we analyze how to fit Eqn. (1) for flat potential behavior modeling inflation. This assumes that we are working with a spectra index of the form so that if the scalar field power spectrum is

$$P = \frac{V}{150\pi^2 \varepsilon} \tag{3}$$

Then the spectral index of the inflaton is consistent with WMAP data. I.e. if we have the number of e foldings $N > N_* \approx .55$

$$n_s = 1 - \frac{d \ln P}{dN} \approx .95 \pm .02 \tag{4}$$

These sort of restrictions on the spectral index will start to help us retrieve information as to possible inflation models which may be congruent with at least one layer of WMAP data. This model says nothing about if or not the model starts to fit in the data issues Subir Sarkar identified in is Pune, India lecture in 2007.

Appendix III. Basic physics of achieving minimum precision in CMBR power spectra measurements

Begin first of all looking at

$$\frac{\Delta T}{T} \equiv \sum_{l,m} a_{lm} Y_{l,m}(\theta,\phi) \tag{1}$$

This leads to consider what to do with

$$C_l = \left\langle \left| a_{l,m} \right|^2 \right\rangle \tag{2}$$

Samtleben et al [16] consider then what the experimental variance in this power spectrum, to the tune of an achievable precision given by

$$\frac{\Delta C_l}{C_l} = \sqrt{\frac{2}{2l+1}} \cdot \left(\frac{1}{\sqrt{f_{sky}}} + \frac{4\pi \cdot (\Delta T_{\exp})^2}{C_l} \cdot \sqrt{f_{sky}} \cdot e^{l^2 \sigma_b^2} \right) \tag{3}$$

f_{sky} is the fraction of the sky covered in the measurement , and $\Delta T_{\exp}$ is a measurement of the total experimental sensitivity of the apparatus used. Also σ_b is the width of a beam , while we have a minimum value of $l_{\min} \approx (1/\Delta\Theta)$ which is one over the fluctuation of the angular extent of the experimental survey.

I.e. contributions to C_l uncertainty from sample variance is equal to contributions to C_l uncertainty from noise. The end result is

$$4\pi \cdot f_{sky} = C_l \cdot \left(\exp\left[-l^2\sigma^2\right]\right) / (\Delta T)^2 \tag{4}$$

Appendix IV : Cosmological perturbation theory and tensor fluctuations (Gravity waves)

Durrer [8] reviews how to interpret C_l in the region where we have $2 < l < 100$, roughly in the region of the Sachs-Wolf contributions due to gravity waves. We begin first of all by looking at an initial perturbation , using a scalar field treatment of the ‘ Bardeen potential’ Ψ This can lead us to put up, if H_i is the initial value of the Hubble expansion parameter

$$k^3 |\Psi|^2 \cong \left(\frac{H_i}{M_P} \right)^2 \tag{1}$$

And

$$\left\langle |\Psi|^2 \right\rangle \cdot k^3 = A^2 k^{n-1} \cdot \eta_0^{n-1} \tag{2}$$

Here we are interpreting $A =$ amplitude of metric perturbations at horizon scale, and we set $k = 1/\eta_0$, where η is the conformal time, according to $dt \equiv a d\eta =$ physical time, where we have a as the scale factor.

Then for $2 < l < 100$, and $-3 < n < 3$, and a pure power law given by

$$\left\langle |H(k, \eta = 1/k)|^2 \right\rangle \cdot k^3 = A_T^2 k^{n_T} \cdot \eta_0^{-n_T} \tag{3}$$

We get for tensor fluctuation, i.e. gravity waves,, and a scale invariant spectrum with $n_T = 0$

$$C_l^{(T)} \approx \frac{A_T^2}{(l+3)\cdot(l-2)} \cdot \frac{1}{15\pi} \tag{4}$$

Appendix V .FORMATION OF THE SCALAR FIELD, BIFURCATION RESULTS

Start with Padamadans's formulas [17]

$$V(t) \equiv V(\phi) \sim \frac{3H^2}{8\pi G} \cdot \left(1 + \frac{\dot{H}}{3H^2}\right) \tag{1}$$

$$\phi(t) \sim \int dt \cdot \sqrt{\frac{-\dot{H}}{4\pi G}} \tag{2}$$

If $H = \dot{a}/a$ is a constant, Eqn. (2) gives us zero scalar field values at the beginning of quantum nucleation of a universe. At the point of accelerated expansion (due to the final value of the cosmological constant), it also gives an accelerating value of the cosmological scale-factor expansion rate. We justify this statement by using early-universe expansion models, which have $a(t_{INITIAL}) \sim e^{H \cdot t}$. This leads to the derivative of $H = \dot{a}/a$ going to zero. This is similar to present-time development of the scalar factor along the lines of $a(t_{later}) \sim e^{(\Lambda[present-day] \cdot t)}$, also leading to the derivative of $H = \dot{a}/a$ going to zero.

When both situations occur, we have the scale factor $\phi = 0$. Between initial and later times, the scale factor no longer has exponential time dependence, due to it growing far more slowly, leading to $\phi \neq 0$.

Both regimes as specified by Eqn. (2) above lead to zero values for a quintessence scalar field. But it does not stop there. We will show later that in actuality, the scalar field likely damps out far before the CMBR barrier value of expansion when Z = 1100, about 380,000 to 400,000 years after the big bang.

Claim 1: We Observe That The Scalar Field $\phi(t)$ Is Zero At The Onset Of the Big Bang, And Also Is Zero During the Present Cosmological Era.

This scalar "quintessence" field is non zero in a brief period of time right after the inflationary era."

We show this by noting that in Eqn (2), the time derivative of $H = \dot{a}/a$ goes to zero when both the scale factors $a(t_{INITIAL}) \sim e^{H \cdot t(initial)}$, and $a(t_{later}) \sim e^{\Lambda[present-day] \cdot t(later)}$. The exponential scale factors in both cases (the initial inflationary environment and the present era) lead to the time derivative of the $H = \dot{a}/a$ expression in Eqn. (2) going to zero.

Sub point to claim 1: The existence of two zero values of the scalar field $\phi(t)$ at both the onset and at a later time implies a bifurcation behavior for modeling quintessence scalar fields. This is due to the non-zero $\phi(t)$ values right after the initiation of inflation.

Appendix VI : Open questions as to what the large vacuum energy implies for initial conditions for graviton production, plus graviton production in a relic setting

If we have a non infinite but huge negative value of the cosmological vacuum energy in the wormhole, then we have 10^{10} bits of computing information. When we leave the wormhole, we have 10^{120} bits of computing information We specify a transition between the two regions in terms of a causal discontinuity regime created by a(t) chaotic behavior due initially to the initially very large value of thermal vacuum energy transmitted.

Details, and many more of them are needed to bridge this transition to the problem of structure formation and a drop of temperature. If we look at Ruutu's [1] (1996) ground breaking experiment we see vortex line filaments rapidly forming. Here are a few open questions which should be asked.

1) Do the filaments in any shape or form have an analogy to the cosmic strings so hypothesized by String theorists ? My guess is a flat MAYBE but one cannot be certain of this. This deserves to be analyzed fully. If they have an analogy to cosmic strings, then what is the phase transition from a maximally entangled space time continuum, with a soliton type behavior for temperatures of the order of $T \sim 10^{32}\,Kelvin$ to the formation of these stringy structures.
2) What is the mechanism for the actual transition from the initial 'soliton' at high temperatures to the symmetry breaking phase transition? This is trickier than people think. Many theorists consider that, in tandem with Ruutu's [1] (1996) experiment that Axion super partners, Saxions, actually are heated up and decay to release entropy. Do we have structures in initial space time analogous to super fluids allowing us to come up with such a transformation. Do axions/ Saxion super partner pairs exist in the onset of thermal transition from a prior universe to our present universe? How could this be experimentally determined with rigorous falsifiable experimental analysis?

3) One of the models considered as a super fluid candidate for this model has been the di quark one. This however was advanced by Zhitinisky[18] (2002) in terms of 'cold dark matter'. Could some analogy to di quarks be used for initial states of matter thermally impacted by a transfer of thermal energy via a wormhole to form a cosmic 'bubble' in line with the initial plasma state given in Ruutu's [1] (1996) experiment?
4) Do the formation of such initial conditions permit us to allow optimal conditions for graviton production? If so, can this be transferred to engineering prototypes ? How can this be modeled appropriately ?

Here is a very simplified model as to what we may be able to expect if there is actual relic graviton production . I.e. Detecting gravitons as spin 2 objects with available technology .To briefly review what we can say now about standard graviton detection schemes, Rothman [19] states that the Dyson seriously doubts we will be able to detect gravitons via present detector technology. The conundrum is that if one defines the criterion for observing a graviton as

$$\frac{f_\gamma \cdot \sigma}{4 \cdot \pi} \cdot \left(\frac{\alpha}{\alpha_g} \right)^{3/2} \cdot \frac{M_s}{R^2} \cdot \frac{1}{\varepsilon_\gamma} \geq 1 \tag{1}$$

Here,

$$f_\gamma = \frac{L_\gamma}{L} \tag{2}$$

This has $\frac{L_\gamma}{L}$ a graviton sources luminosity divided by total luminosity and R as the distance from the graviton source, to a detector. Furthermore, $\alpha = e^2 / \hbar$ and $\alpha_g = G m_p^2 / \hbar$ a constants r, while ε_γ is the graviton P.E. As stated in the manuscript, the problem then becomes determining a cross section σ for a graviton production process and $f_\gamma = \frac{L_\gamma}{L}$.

If this is the case, then what can we do to see how relic gravitons may emerge if we have a worm hole transferred burst of thermal/ vacuum energy ? [20]

TABLE 1. With respect to phenomenology.

Time	Thermal inputs	Dynamics of axion	Graviton Eqn.
Time $0 \leq t << t_P$	Use of quantum gravity to give thermal input via quantum bounce from prior universe collapse to singularity. Brane theory predicts beginning of graviton production.	Axion wall dominant feature of pre inflation conditions, due to Jeans inequality with enhanced gravitational field, Quintessence scalar equation of motion valid for short time interval	Wheeler formula for relic graviton production beginning to produce gravitons due to sharp rise in temperatures.
Time $0 \leq t < t_P$	End of thermal input from quantum gravity due to prior universe quantum bounce. Brane theory predicts massive relic graviton production	Axion wall is in process of disappearing due to mark rise in temperatures. Quintessence valid for short time interval	Wheeler formula for relic graviton production produces massive spike gravitons due to sharp rise in temperatures

Time $0 < t \approx t_P$	Relic graviton production largely tapering off, due to thermal input rising above a preferred level, via brane theory calculations. Beginning of regime where the Λ_{4-Dim} is associated with Guth style inflation.	Axion wall disappears, and beginning of Guth style inflation. Quintessence scalar equations are valid . Beginning of regime for $\frac{\Lambda_{4-\dim}}{\lvert\Lambda_{5-\dim}\rvert} - 1 \approx \frac{1}{n}$ 5 dim $\rightarrow$ 4 dim	Wheeler formula for relic graviton production leading to few relic gravitons being produced.

Also, one can expect a difference in the upper limit of Park's four dimensional inflation [25] value for high temperatures, onn the order of 10 to the 32 Kelvin, and the upper bound, as Barvinsky (2006) [24] predicts. If put into the Harkle-Hawking's wave function, this diffenence is equivalent to a nucleation-quantization condition, which, it is claimed, is a way to delineate a solution to the cosmic landscape problem that Guth (1981,2000,2003) [21,22,23] discussed. In order to reference this argument, it is useful to note that Barvinsky in (2006) [24] came up with

$$\Lambda_{\max}\Big|_{Barvinsky} \cong 360 \cdot m_P^2 \tag{3}$$

A minimum value of

$$\Lambda_{\min}\Big|_{Barvinsky} \cong 8.99 \cdot m_P^2 \tag{4}$$

This is in contrast to the nearly infinite value of the Planck's constant as given by Park (2003) [25]

$\cdot\Lambda_{4-\dim}$ is defined by Park (2003).with $\varepsilon * = \frac{U_T^4}{k^*}$ and $U_T \propto (external \quad temperature)$, and $k^* = \left(\frac{1}{'AdS\, curvature} \right)$ so that

$$\Lambda_{4-\dim, Max}\Big|_{Park} \xrightarrow[T \mapsto 10^{32}\, Kelvin]{} \infty \tag{5}$$

As opposed to a minimum value as given by Park (2003) [25]

$$\cdot\Lambda_{4-\dim} = 8 \cdot M_5^3 \cdot k^* \cdot \varepsilon^* \xrightarrow[external \quad temperature \to 3\, Kelvin]{} \left(.0004eV\right)^4 \tag{6}$$

TABLE 2.What can be said about cosmological Λ in 5 and 4 dimensions.

Time $0 \le t << t_P$	**Time** $0 \le t < t_P$	**Time** $0 < t \approx t_P$	**Time** $t > t_P$ $\rightarrow$ **today**
$\lvert\Lambda_5\rvert$ undefined, $T \approx \varepsilon^+ \rightarrow T \approx 10^{32} K$ $\Lambda_{4-\dim} \approx$ almost ∞	$\lvert\Lambda_5\rvert \approx \varepsilon^+$, $\Lambda_{4-\dim} \approx$ extremely large $T \approx 10^{12} K$	$\lvert\Lambda_5\rvert \approx \Lambda_{4-\dim}$, T smaller than $T \approx 10^{12} K$	$\lvert\Lambda_5\rvert \approx$ huge, $\Lambda_{4-\dim} \approx$ small, $T \approx 3.2K$

This leads to presenting the Wheeler graviton production formula for relic gravitons

As is well known, a good statement about the number of gravitons per unit volume with frequencies between ω and $\omega + d\omega$ may be given by (assuming here, that $\bar{k}$ = $1.38 \times 10^{-16} erg/{}^0K$, and ${}^0K$ is denoting Kelvin temperatures, wherewhere Gravitons have two independent polarization states), as given by Weinberg (1972).[26]

$$n(\omega)d\omega = \frac{\omega^2 d\omega}{\pi^2} \cdot \left[\exp\left(\frac{2 \cdot \pi \cdot \hbar \cdot \omega}{\bar{k}T} \right) - 1 \right]^{-1} \tag{7}$$

Thee hypothesis presented here is that input thermal energy (given by the prior universe) inputted into an initial cavity/region (dominated by an initially configured low temperature axion domain wall) would be thermally excited to reach the regime of temperature excitation. This would permit an order-of-magnitude drop of axion density ρ_a from an initial temperature $T_{dS}\big|_{t \le t_P} \sim H_0 \approx 10^{-33} eV$.

Graviton power burst/ where did the missing contributions to the cosmological ‘constant‘ parameter go?

To do this, one needs to refer to a power spectrum value that can be associated with the emission of a graviton. Fortunately, the literature contains a working expression of power generation for a graviton produced for a rod spinning at a frequency per second ω , per Fontana [27] (2005), for a rod of length $\hat{L}$ and of mass m a formula for graviton production power. This is a variant of a formula given by Park [28] (1955), with mass $m_{graviton} \propto 10^{-60} kg$

$$P(power) = 2 \cdot \frac{{m_{graviton}}^2 \cdot \hat{L}^4 \cdot {\omega_{net}}^6}{45 \cdot \left(c^5 \cdot G\right)} \tag{8}$$

The contribution of frequency here needs to be understood as a mechanical analogue to the brute mechanics of graviton production. The frequency ω_{net} is set as an input from an energy value, with graviton production number (in terms of energy) derived via an integration of Eqn. (7) above, $\widehat{L} \propto l_P$. This value assumes a huge number of relic gravitons are being produced, due to the temperature variation.

$$\langle n(\omega) \rangle = \frac{1}{\omega\left(net \quad value\right)} \int_{\omega 1}^{\omega 2} \frac{\omega^2 d\omega}{\pi^2} \cdot \left[\exp\left(\frac{2 \cdot \pi \cdot \hbar \cdot \omega}{\bar{k}T} \right) - 1 \right]^{-1} \tag{9}$$

And then one can set a normalized "energy input "as $E_{eff} \equiv \langle n(\omega) \rangle \cdot \omega \equiv \omega_{eff}$; with $\hbar\omega \xrightarrow[\hbar \equiv 1]{} \omega \equiv \left| E_{critical} \right|$, which leads to the following table of results, where T^* is an initial temperature of the pre- inflationary universe condition [29].

TABLE 3. Graviton burst.

Numerical values of graviton production	Scaled Power values
N1= 1.794×10^{-6} for $Temp = T^*$	Power = 0
N2= 1.133×10^{-4} for $Temp = 2T^*$	Power = 0
N3= $7.872 \times 10^{+21}$ for $Temp = 3T^*$	Power = $1.058 \times 10^{+16}$
N4= $3.612 \times 10^{+16}$ for $Temp = 4T^*$	Power $\cong$ very small value
N5= 4.205×10^{-3} for $Temp = 5T^*$	Power= 0

Here, N1 refers to a net graviton numerical production value as given by Eqn. (9). There.T is a distinct power spike of thermal energy that is congruent with a relic graviton burst.

Appendix VII : Using our bound to the cosmological constant to link relic graviton production to branes

We use our bound to the cosmological constant to obtain a conditional escape of gravitons from an early universe brane. To begin, we present using the paper written by J.Leach et al on conditions for graviton production [30]

$$B^2(R) = \frac{f_k(R)}{R^2} \tag{1}$$

Also there exists an 'impact parameter'

$$b^2 = \frac{E^2}{P^2} \tag{2}$$

This leads to, practically, a condition of 'accessibility' via. R so defined is with respect to 'bulk dimensions'

$$b \geq B(R) \tag{3}$$

$$f_k(R) = k + \frac{R^2}{l^2} - \frac{\mu}{R^2} \tag{4}$$

Here, k = 0 for flat space, k = -1 for hyperbolic three space, and k = 1 for a three sphere, while an radius of curvature

$$l \equiv \sqrt{\frac{-6}{\Lambda_{5-\dim}}} \tag{5}$$

Here, we have that we are given

$$k^* = \left(\frac{1}{'AdS\,curvature} \right) \tag{6}$$

Park et al note that if we have a 'horizon' temperature term

$$U_T \propto (external \quad temperature) \tag{7}$$

We can define a quantity

$$\varepsilon * = \frac{U_T^4}{k^*} \tag{8}$$

Then there exists a relationship between a four-dimensional version of the Λ_{eff} , which may be defined by noting

$$\Lambda_{5-\dim} \equiv -3 \cdot \Lambda_{4-\dim} \cdot \left(\frac{U_T}{k^{*3}} \right)^{-1} \propto -3 \cdot \Lambda_{4-\dim} \cdot \left(\frac{external \quad temperature}{k^{*3}} \right)^{-1} \tag{9}$$

So

$$\Lambda_{5-\dim} \xrightarrow[external \quad temperature \to small]{} \text{very large value} \tag{10}$$

In working with these values, one should pay attention to how $\cdot \Lambda_{4-\dim}$ is defined by Park, et al. [25]

$$\cdot \Lambda_{4-\dim} = 8 \cdot M_5^3 \cdot k^* \cdot \varepsilon^* \xrightarrow[external \quad temperature \to 3\,Kelvin]{} (.0004eV)^4 \tag{11}$$

Here, I am defining $\Lambda_{5-\dim}$ as being an input from changes in the actual potential system due to

$$\Lambda_{5-\dim} \equiv -3 \cdot \Lambda_{4-\dim}(\Delta V) \cdot \left(\frac{U_T}{k^{*3}} \right)^{-1} \tag{12}$$

Here we are looking at how the initial vacuum energy 'cosmological constant' parameter may be effected by a change in the potential system with the $\Lambda_{4-\dim}(\Delta V)$ tern with different temperature values implied for input into the four dimensional vacuum energy. I.e. $\Lambda_{4-\dim}(\Delta V)$ starts off with a given temperature value input as we look at (ΔV) for a maximized potential value, and subsequently dropping as the potential system evolves to a different value as inflation proceeds..

This, for potential, $(\Delta V)$is defined via transition between the first and the second potentials of the form given by

$$V \equiv V_0 - c_3\phi^3 + \frac{1}{2}\lambda \cdot \phi^2 \cdot \rho^2 + \ldots \tag{13}$$

Sarkar treated the inflaton as having a varying effective mass, with an initial value of effective mass of $m_\phi{}^2 = \frac{d^2V}{d\phi^2}$ given a before and after phase transition value of

$$m_\phi{}^2 = -6c_3 \cdot \langle\phi\rangle\Big|_{Before-phase-transition} \xrightarrow[phase-transition]{} -6c_3 \cdot \langle\phi\rangle + \lambda \cdot \Sigma^2\Big|_{after-phase-transition} \tag{14}$$

Either this potential can be used, or we just use a variant of a transition to the Race track potential given by

$$\begin{aligned} V(s,\phi) &= \frac{1}{2s} \cdot \left(A \cdot (2s + N_1) \cdot e^{-s/N_1} + B \cdot (2s + N_2) \cdot e^{-s/N_2} \right)^2 \\ &+ \frac{1}{s} \cdot A \cdot B \cdot (2s + N_1) \cdot (2s + N_2) \cdot e^{-s/N_1} \cdot e^{-s/N_2} \cdot (1 - \cos(\phi \cdot \varepsilon)) \end{aligned} \tag{15}$$

This with a version of the scalar field in part be minimized. This is assuming that we are having $s \to N_a \neq \infty$, leading to minima for $\phi_k = k\pi/\varepsilon$, with k being the positive and negative integers, i.e. this helps delineate between two condensates. If we have a complex scalar field $\phi_j = X_j + i \cdot Y_j$. we have moduli arguments which add far more structure . Either type of structure can be used and put in so we come up with an effective value for a potential system. I.e. at a given

$$B_{eff}{}^2(R_t) = \frac{1}{l_{eff}{}^2} + \frac{1}{4 \cdot \mu} \tag{16}$$

Claim : $R_b(t) = a(t)$ ceases to be definable for times $t \leq t_P$ where the upper bound to the time limit is in terms of Planck time and in fact the entire idea of a de Sitter metric is not definable in such a physical regime.

Bibliography

[1] Ruutu, V. , Eltsov, V, Gill, A., Kibble, T., Krusius, M., Makhlin, Y.G., Placais, B., Volvik, G, and Wen, Z., "Vortex Formation in neutron – irradiated ^{3}He as an analog of cosmological defect formation," *Nature* **382**, 334-336 (25 July 1996)

[2] Beckwth, et.al. "Is Octonionic Quantum Gravity Relevant Near the Planck Scale? if Gravity Waves Are Generated by Changes in the Geometry of the Early Universe, How Can We Measure Them?", http://vixra.org/abs/1101.0017

[3] Lalak, Z., Ross, G., and Sakar, S., "Racetrack Inflation and assisted Moduli Stabilization", arXIV hep-th / 0503178 v 2, 12 June, 2006

[4] http://www-thphys.physics.ox.ac.uk/user/SubirSarkar/

[5] Blanco-Pillado, J., Burgess, C., Cline, J., Escoda, C., Gomez - Reino , M., Kallosh, R., Line, A., Quevedo, F., " Racetrack Inflation", JHEP 0411 (2004) 076, arXIV hep-th / 0411011

[6] Carroll, S., *Spacetime and Geometry:: An Introduction to General Relativity*, Addison Wesley Co., San Francisco, 2005

[7] Private communications with Subir Sarkar received as of January 2998

[8] Durrer, R., " Cosmological Pertubation theory", From the book "Physics of the Early Universe", in Lecture Notes in Physics, **653**", with Papantonopoulos, E., as editor and printed by Springer- Verlag 2004

[27][9] Hunt, P. and Sakar, S., " Multiple Inflation and the WMAP "glitches" ", **Phys Rev D** Volume 70**, 103518**

[10] Smoot, G, 11th Paris Cosmology Colloquium, August 18th , 2007 with respect to Smoot, G, " CMB Observations and the Standard Model of the Universe" 'D.Chalonge' school, http://chalonge.obspm.fr/Programme2007.html

[11] Sanchez, N. 11th Paris Cosmology Colloquium, August 18th, 2007 with respect to Sanchez, N., "Understanding Inflation and Dark Energy in the Standard Model of the Universe", 'D.Chalonge' school http://chalonge.obspm.fr/Programme2007.html

[12] Enqvist, K., Mazumdar, A., Perez--Lorenzana, A., " Dumping inflaton energy out of this world",**Phys Rev D**, Volume 70, 103508

[13] H. V. Peiris, H., Komatsu, E., Verde, L., Spergel, D., Bennett, C., Halpern, M., Hinshaw, G., Jarosik, N., Kogut, A., Limon, M., Meyer, S., Page, L., Tucker, G., Wollack, E., and Wright, E.," First-Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Implications For Inflation", The Astrophysical Journal Supplement Series, 148:213–231, 2003 September

[14] Lecture notes taken at IGC conference, http://www.gravity.psu.edu/igc/conf_files/program_complete.pdf with respect to the Penrose presentation, " Conformal Cyclic cosmology, Dark Matter, and Black Hole Evaporation", plus questions asked of the lecturer in the aftermath of that presentation

[15] Brax, Ph., Davis, A., Davis, S., Jeannerot, R., Postman, M., " D-term Uplifted Racetrack Inflation", Journal of Cosmology and Astroparticle Physics, JCAP01(2008) 08

[16] Samtleben, D., Staggs, S., Winstein, B., "The Cosmic Microwave Background for Pedestrians: A Review for Particle and Nuclear Physicists", Annu..Rev . Nucl. Part. Sci. 2007, 57, : 245-83

[17] Padmanabhan, T, " Theoretical Astro physics , Volume 1 : Astrophysical processes " , Cambridge University Press, Cambridge, UK, 2000

[18]Zhitinisky, A., "Dark Matter as Dense Color Superconductor' arXIV: astro-ph/0204218 v1 12 April 2002. ***Refer to the last version of this document***

[19] Rothman, T. and Boughn, S., " *Can Gravitons be Detected ?*", *Foundations of Physics*, **36**, No. 12,, 1801-1825 (December 2006), arXIV gr-qc/0601043 v 2 02 Jan 2006

[20]Beckwith, A.W, "How can Brane World physics influences the formation of a cosmological constant relevant to graviton production?" *arXIV physics/0612010*, accessible as http://arxiv.org/abs/physics/0612010, *E.J T.P.,* ***4****, No. 15, 105-142* (July 2007a).

[21] Guth, A.H "Inflationary Universe: A Possible Solution to the Horizon and Flatness Problems," *Phys. Rev.* D 23, 347-356 (1981)

[22] Guth. A.H., "Inflation and Eternal Inflation," http://www.citebase.org/cgi-bin/citations?id=oai:arXiv.org:astro-ph/0002156 (2000).

[23] Guth. A.H., "Eternal Inflation," http://online.itp.ucsb.edu/online/strings_c03/guth/pdf/KITPGuth_2.pdf (2003)

[24] Barvinsky,A., Kamenschick,A., Yu, A. , " Thermodynamics from Nothing: Limiting the Cosmological Constant Landscape, Phy Rev D **74** 121502 (Rapid communications)

[25] Park, D.K., Kim, H., and Tamarayan, S., "Nonvanishing Cosmological Constant of Flat Universe in Brane world Senarios," *Phys.Lett.* **B**535 (2002) pp. 5-10

[26] Weinberg , S., *Gravitation and Cosmology: Principles and Applications of the General theory of Relativity*, John Wiley & Sons, Inc. New York, 1972
[27] Fontana, G., "*Gravitational Wave Propulsion,*" in *CP746, Space Technology and Applications International Forum*-STAIF 2005, editede by M. S. El-Genk, American Institute of Physics, Melville, NY, 2005
[28] Park, D, "Radiations from a Spinning Rod,"*Physical Review*, **99**, No. 4, 1324-1325 (1955).
[29] Beckwith, A.W., **"**Does A Randall-Sundrum Brane World Effective Potential Influence Axion Walls Helping to Form a Cosmological Constant Affecting Inflation?" http://www.citebase.org/cgi-bin/citations?id=oai:arXiv.org:gr-qc/0603021 **(**2006**),** in *AIP Conf.Proc*.880:1170-1180 (2007).
[30] Leach, J.A. and Lesame, W.M ," Conditional escape of gravitons from the brane" arXIV gr-qc/0502109 v3 26 Apr 2005