Examination of sufficient conditions for inflation, e folds, density fluctuations, via our modified HUP, as a way to obtain HFGW quantum gravity traces from early universe

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Abstract

First, referring to an article by K. Freeze on "Natural Inflation", we review e folds data, and also the role of a modified Heisenberg Uncertainty principle as to what to expect from initial conditions as to satisfying the onset of inflation.. .. This leads to , combined with the authors work in delineating a 'perfect bounce' a minimum HFGW which may exist due to the early universe, possibly from the influence of a minimum nonsingular universe starting point forming the template of a minimum wave length for starting GW, which may lead to an initial quantum gravity influenced frequency which is subsequently e shifted down by inflation. The initial conditions for the generation of HFGW, may correspond to early universe quantum gravity. I.e. this last part is due to a question asked the author, Dr. Li Fangyu, in the first week of July 2016

Key words, Modified Heisenberg Uncertainty Principle, Sufficient condition for inflation, E folds, density fluctuations. Quantum gravity

1. What is important about the modified HUP and applying conditions brought up by Freeze, as to natural inflation in [1]?

We will first of all refer to two necessary and sufficient conditions for the onset of inflation, given in [1], and the modified HUP, given in [2], combined with Padmanablan's reference [3].

I.e. what we will be doing is to re do the reference calculations given in [1] with an eye toward initially using the potential V ~ Modified HUP Energy E, as the input into [1]s criteria into inflation generation. The given innovation in our procedure will be to have the following phase change, in terms of initial conditions

$$V_{\mathrm{Pr}e-Planckian} \sim \left(\Delta E \sim \frac{\hbar}{\delta t \cdot a_{\min}^{2} \phi_{\inf}} \right) \xrightarrow[Planckian-space-time]{} V \approx V_{0} \cdot \exp\left\{ -\sqrt{\frac{16\pi G}{\gamma}} \cdot \phi(t) \right\} \tag{1}$$

Here, we will be using in the Pre Planckian potential the inputs from the data usually associated with [3]

$$\begin{aligned} & a \approx a_{\min} t^{\gamma} \\ & \Leftrightarrow \phi \approx \sqrt{\frac{\gamma}{4\pi G}} \cdot \ln\left\{ \sqrt{\frac{8\pi G V_{0}}{\gamma \cdot (3\gamma - 1)}} \cdot t \right\} \\ & \Leftrightarrow V \approx V_{0} \cdot \exp\left\{ -\sqrt{\frac{16\pi G}{\gamma}} \cdot \phi(t) \right\} \end{aligned} \tag{2}$$

In other words, we will be using the inflation given by

$$\phi \approx \sqrt{\frac{\gamma}{4\pi G}} \cdot \ln\left\{ \sqrt{\frac{8\pi G V_{0}}{\gamma \cdot (3\gamma - 1)}} \cdot t \right\} \tag{3}$$

In

$$V_{\mathrm{Pr}e-Planckian} \sim \left(\Delta E \sim \frac{\hbar}{\delta t \cdot a_{\min}^{2} \phi_{\inf}} \right) \tag{4}$$

As far as applications to:[1]

a) Sufficient inflation: the 65 E fold limit

$$N_{e-foldings} = -\frac{8\pi}{m_{Planck}^{2}} \cdot \int_{\phi 1}^{\phi 2} \frac{V(\phi)}{\left(\frac{\partial V(\phi)}{\partial \phi} \right)} d\phi \geq 65 \tag{5}$$

b) Amplitude to density fluctuations, given by

$$\frac{\delta\rho}{\rho} \simeq \frac{H^2}{\dot{\phi}}\bigg|_{Horizon} \simeq \frac{\delta T}{T} \leq O\left(10^{-5}\right) \quad (6)$$

Eq. (5) and Eq. (6) will use Eq.(3) as the inflaton, while also using Eq. (4) as the Pre Planck Potential.

2. Filling in the details, and what it indicates as far as physics

What we are doing is a way to give more substance to the calculations given in [4], and we find that for Eq.(5) we have

$$N_{e-foldings} = \frac{8\pi}{m_{Planck}^2} \cdot \left(\ln\frac{t_2}{t_1}\right)^2 \sim \frac{8\pi}{m_{Planck}^2} \cdot \left(M_{\max-number}\right) \quad (7)$$

If we utilize the Planck Units, the above then changes to:

$$N_{e-foldings}\Big|_{Planck-units} = 8\pi \cdot \left(\ln\frac{t_2}{t_1}\right)^2 \sim 8\pi \cdot \left(M_{\max-number}\right) \quad (8)$$

For the Eq. (6) we would have

$$\frac{\delta\rho}{\rho} \simeq \frac{H^2}{\dot{\phi}}\bigg|_{Horizon} \sim \frac{\sqrt{\frac{8\pi G V_0}{\gamma\cdot(3\gamma-1)}}\cdot t\cdot H^2}{\sqrt{\frac{\gamma}{4\pi G}}\cdot\sqrt{\frac{8\pi G V_0}{\gamma\cdot(3\gamma-1)}}}\Bigg|_{Horizon} \sim \frac{t\cdot H^2}{\sqrt{\frac{\gamma}{4\pi G}}}\Bigg|_{Horizon}$$

$$\sim \frac{t\cdot H^2}{\sqrt{\frac{\gamma}{4\pi}}}\Bigg|_{Horizon-Planck-units} \leq O\left(10^{-5}\right) \quad (9)$$

This, especially, Eq. (9) puts severe restraints upon H

Here we will be referencing a model for $a \approx a_{\min} t^{\gamma}$ meaning that the constraint Eq. (9) , bottom part, becomes affected by

$$H \sim \left(\dot{a}/a\right) \sim \gamma/t \quad (10)$$

Then

$$\frac{\delta\rho}{\rho} \sim \frac{t \cdot H^2}{\sqrt{\frac{\gamma}{4\pi}}}\Bigg|_{Horizon-Planck-units} \sim \frac{\gamma^{3/2}\sqrt{4\pi}}{\left(t/t_{Planck}\right)}\Bigg|_{Horizon-Planck-units} \leq O\left(10^{-5}\right) \quad (11)$$

3. Does this lead to HFGW traces of the quantum gravity effects from the early universe ?

There is nothing too surprising about Eq. (11) above. However, Eq. (8) states that we really DO need to, if we assume the HUP modified, as given in our derivations, that the fine details of the E folding depend upon our choice of time t1 and time t2, in crucial ways. If t1 is say in the Pre Planckian era, before Planck time, and t2 is say in the electro weak, the implications are profound.

Secondly, and more importantly is the following consideration: As asked the author by Dr. Li Fangyu in the first week of July

I.e. it is easy with our formalism, to come up with convincing arguments as to Eq. (8) having the value of say 60-65 based on trivial use of time intervals, especially if we start at 10^-33 seconds, meaning that we can expect that if the wave length, corresponding to [5] is 10^-35 meters, as an initial wave length, that 1 meter wave leading to .3 GHz will lead to

$$\begin{aligned} &10^{-35} meters = \lambda\left(initial\right) \Rightarrow \omega\left(initial\right) \sim .3\times 10^{35}\,GHz = .3\times 10^{44}\,Hz \\ &\& Efold = 65 \Rightarrow \omega\left(after - Efold\right) \sim \frac{.3\times 10^{35}\,GHz}{e^{65}} = .\frac{3\times 10^{44}\,Hz}{e^{65}} \end{aligned} \quad (12)$$

In addition this may also affect [5] and [6] in terms of phenomenology, all of which needs to be vetted in careful data set analysis.

The question to ask, though, if [5] indicates a spatial regime for the onset of quantum gravity, in terms of a quantum bounce, does Eq. (12) indicate necessary and sufficient conditions for High frequency gravitational waves to perhaps pick up telic conditions allowing for quantum gravity ?

4. Conclusion. Several lessons imparted; plus future questions

a. First of all, we argue that the existence of a modified Heisenberg uncertainty principle, as given by [2] will be the pre Planckian space-time contribution to a modified vacuum state which is necessary for the subsequent evolution of quantum gravity, at the onset of space-time.

b. Secondly, the modified HUP used, is integral to forming a suitable Potential system which is then incorporated into the standard e folds calculation. I.e. this in terms of [1, 2. 3]

c. The choices so used allow e folds then, in this formulation to be proportional to the Log of the ratio of final to initial evaluative times, with initial times as of the onset of quantum gravity, in the evolution of the universe. This is hardly an accident, and it also depends upon the choice of the inflaton chosen from [3]

d. The contributions given , as we discuss in a,b,c,allow for an Ergodic mixing type treatment of multi verse contributions to initial conditions, along the lines if [4]

e. Reference [5] is particularly important, as to establish initial conditions which we state, as follows which are commensurate to the quantum gravity conditions which Dr. Li Fangyu asked the author, explicitly

$$10^{-35}\,meters = \lambda\left(initial\right) \Rightarrow \omega\left(initial\right) \sim .3\times 10^{35}\,GHz = .3\times 10^{44}\,Hz \qquad (13)$$

f. The choice of Eq.(5) and Eq.(8) with an e fold value of about 65 places specific initial conditions which are for initial times about 10^-44 seconds, i.e. at or about Planck time

g. The Planck time initial condition so specified, plus Eq. (8) about 65 in value, allows for Eq. (12) to be stated as it is

Our question which we need to ask, is this strictly dependent upon an infaton as modeled by Eq. (3) above? Secondly, is this choice of inflaton, unique? Third, is our choice of inflaton commensurate with all of the specifications in Dr. Corda's article about 'gravity's primordial breath?" Given in [6]

If we can answer the above questions, about inflatons, as mentioned above, our final to do list is to determine if gravitons are in themselves, information carriers from a prior to the present universe?

We argue that if this is, indeed the case, i.e. gravitons as information carriers, that this re enforces a dynamical systems treatment of the following mapping For the sake of the iterative mapping, we will be looking at if we set $\hbar = 1$

$$\begin{aligned} &\delta g_{tt} \sim \left[\left(\Delta n_{gravitons}\right)\cdot \Delta t\right]^{-1} \\ &\Leftrightarrow \delta g_{j} \sim \left(1/n_{gravitons}\right)_{j} \cdot \left(1/\Delta t\right)_{j} \end{aligned} \qquad (14)$$

This last equation is part of an accepted article by the author, in [7], and is integral to an information theory treatment about the evolution of space-time initial vacuum states, which the author hopes to elucidate fully in the future.

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