Gedankerexperiment, assuming density is proportional to change in energy from HUP(modified) and nonsingular quantum bounce Friedman Equations

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This paper is to address using what a fluctuation of a metric tensor leads to, in pre Planckian physics, namely. If so then, we pick the conditions for an equality, with a small δg_{tt} , to come up with restraints which are in line with modifications of the Friedman equation in a quantum bounce, with removal of the Penrose theorem initial singularity. In line with super negative pressure being applied, so as to understand what we can present as far as H = 0 (quantum bounce) in terms of density of the Universe. And also considering what to expect when $P = w\Delta\rho \sim (-1+\varepsilon^{+})\Delta\rho$. I.e. we have a negative energy density in Pre Planckian space-time.

Keywords: Emergent time , metric tensor perturbations, HUP , negative energy density

1. Introduction .

We use Freeze et.al. Phantom bounce [1] plus Padmahan's inflaton value [2] in the case of $a(t) \sim a_{starting-point} \cdot t^{\alpha}$ in order to come up with a criteria as to initial mass. As given by [1] we have at a non singular bounce model of Cosmology a modified Friedman Equation of the form

$$H^2 = \frac{8\pi}{3M_{Planck}^2} \cdot \left(\rho - \frac{\rho^2}{2|\sigma|} \right) \tag{1}$$

Which when this is set equal to zero, at the time of a quantum bounce for a non singular universe, with

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$$3\cdot\left(1+\frac{p}{\rho}\right)\cdot\frac{\rho^2}{|\sigma|}-\frac{\rho^2}{|\sigma|}-\left(1+\frac{3p}{\rho}\right)\cdot\rho=3\cdot\left(1+\frac{p}{\rho}\right)\cdot\rho \qquad (2)$$

This Eq.(2) will have a modification of the density along the lines of $\rho\to\Delta\rho$

We also will be examining the influence of [3]

$$\frac{\Delta\rho}{\Delta t}\sim(visc)\times\left(H_{\text{int}}{}^{2}\right)\times a^4 \qquad (3)$$

With here as given by [4]

$$\begin{aligned}\Delta\rho &\sim (visc)\times\left(H_{\text{int}}{}^{2}\right)\times a^4\times\frac{2\hbar}{\delta g_{tt}k_B T_{initial}}\\ &\sim (visc)\times\left(H_{\text{int}}{}^{2}\right)\times a^2_{init}\times\frac{2\hbar}{\phi_{\text{inf}}k_B T_{initial}}\end{aligned} \qquad (4)$$

Our task will be to be looking at what this becomes with Eq. (4) put into Eq. (2) when $\rho\to\Delta\rho$

The term for pressure we will be using is, then from [5]

$$P=w\Delta\rho\sim(-1+\varepsilon^{+})\Delta\rho \qquad (5)$$

Then, we will be looking at Eq. (2) written as

$$3\cdot\left(1+(-1+\varepsilon^{+})\right)\cdot\frac{\Delta\rho^2}{|\sigma|}-\frac{\Delta\rho^2}{|\sigma|}-\left(1+3(-1+\varepsilon^{+})\right)\cdot\Delta\rho=3\cdot\left(1+(-1+\varepsilon^{+})\right)\cdot\Delta\rho \qquad (6)$$

Leading to

$$\Delta\rho\cdot\left(1-\frac{1}{3\cdot\varepsilon^{+}}\right)=|\sigma|\cdot\left(1+\frac{\left(2-3\cdot\varepsilon^{+}\right)}{\left(3\cdot\varepsilon^{+}\right)}\right) \qquad (7)$$

Or then, if we use [2]

$$a \approx a_{\min} t^{\gamma}$$
$$\Leftrightarrow \phi \approx \sqrt{\frac{\gamma}{4\pi G}} \cdot \ln\left\{ \sqrt{\frac{8\pi G V_0}{\gamma \cdot (3\gamma - 1)}} \cdot t \right\} \tag{8}$$

We get

$$\Delta\rho \approx -2|\sigma| \approx (visc) \times \left(H_{\text{int}}{}^{2}\right) \times a_{init}^{2} \times \frac{2\hbar}{\phi_{\text{inf}} k_B T_{initial}}$$
$$\approx (visc) \times \left(H_{\text{int}}{}^{2}\right) \times a_{init}^{2} \times \frac{2\hbar}{\phi_{\text{inf}} k_B T_{initial}} \tag{9}$$
$$\approx -(visc) \times \left(H_{\text{int}}{}^{2}\right) \times a_{init}^{2} \times \frac{2\hbar}{\left| \sqrt{\frac{\gamma}{4\pi G}} \cdot \ln\left\{ \sqrt{\frac{8\pi G V_0}{\gamma \cdot (3\gamma - 1)}} \cdot t_{\min} \right\} \right| k_B T_{initial}}$$

With the initial Hubble parameter, in this situation a constant value in the Pre Planckian regime of space-time, instead of the usual

$$H_{Hubble} = \dot{a}/a \tag{10}$$

Also, $visc$ in Eq. (1) is for a viscous "fluid" approximation in a non-singular regime of space-time namely, that we have initially due to[4] and the proportionality of energy to Boltzman's constant times temperature [4]

$$\Delta t_{initial} \sim \frac{\hbar}{\delta g_{tt} E_{initial}} \sim \frac{2\hbar}{\delta g_{tt} k_B T_{initial}} \tag{11}$$

2. What the Emergent Energy density parameter, in the Pre Planckian to Planckian Space-time Regime means

Start off with a definition of negative energy density, as given in Eq.(9). Our supposition is that this initial negative energy density, would be due to a change in causal structure flipped to Positive energy, which could then lead to a release of energy for inflation given the evolution of the inflaton. With volume defined in four space by

$$V_{volume(initial)} \sim V^{(4)} = \delta t \cdot \Delta A_{surface-area} \cdot \left(r \le l_{Planck} \right) \qquad (12)$$

And with the 'three volume' defined above, with the time factored out. And initial scale factor given as [4,6]

$$\alpha_0 = \sqrt{\frac{4\pi G}{3\mu_0 c}} B_0$$
$$\hat{\lambda}(defined) = \Lambda c^2 / 3 \qquad (13)$$

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

Here, the minimum scale factor has a factor of Λ which we interpret as todays value of the cosmological constant. B is the early cosmological B field , the Frequency of the order of 10 ^ 40 Hz, and $a_{\min} \sim a_{initial} \sim 10^{-55}$

We found that we observe having

$$a \approx a_{\min} t^{\gamma}$$
$$\Leftrightarrow \phi \approx \sqrt{\frac{\gamma}{4\pi G}} \cdot \ln \left\{ \sqrt{\frac{8\pi G V_0}{\gamma \cdot (3\gamma - 1)}} \cdot t \right\} \qquad (14)$$
$$\& \phi > 0 \quad iff \sqrt{\frac{8\pi G V_0}{\gamma \cdot (3\gamma - 1)}} \cdot \delta t > 1$$

This puts a major restriction upon admissible V_0 and δt terms, for our problem and Eq. (14) is incommensurate with negative energy in Pre Plankian spacetime. i.e. Eq. (14) is the causal condition in which we would have a change from Negative to Positive energy.

3. CONCLUSION: And now for the Use of the Idea of Negative energy Density In Pre Plankian Space-time

In order to have a positive inflaton, we would need to satisfy [4] having

$$\phi > 0 \quad iff \sqrt{\frac{8\pi G V_0}{\gamma \cdot (3\gamma - 1)}} \cdot \delta t > 1 \tag{15}$$

This also is the same condition for which we would have to have visc, i.e. the viscosity of the initial spherical starting point for expansion, nonzero as well as reviewing the issues as of [7,8,9,10,11,12,13]

Whereas how we do it may allow for the Corda references, [9, 11] to be experimentally investigated. Finally the Abbot articles of [10,12] must be adhered to

Let us say categorically that the negative density value, is before the conditions of Eq. (15) are satisfied, in Planckian space-time, and that the resumption of Eq. (15) boundary conditions are equivalent to a causal barrier being breached in early space time, which may have consequences as to the information consistency as between our present universe and prior universes.

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