Geddankerexperiment for initial temperature, particle count and entropy affected by initial D.O.F and fluctuations of metric tensor and the Riemannian Penrose inequality, with Applications

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This paper is to address using what a fluctuation of a metric tensor leads to, in pre Planckian physics, namely $\delta t \Delta E \geq \frac{\hbar}{\delta g_{tt}} \neq \frac{\hbar}{2}$. If so then, we pick the conditions for an equality, with a small δg_{tt}, to come up with restraints initial temperature, particle count and entropy affected by initial degrees of freedom in early Universe cosmology. This leads to an open question as to the applicability of the Riemannian Penrose inequality, in early universe conditions , if the mass m, is a sum of prior universe gravitons, and if the area A is due to either a quantum bounce, or due to Non Linear Electrodynamics scale factor a not being zero.

Keywords: Emergent time, heavy gravity, metric tensor perturbations, HUP, Riemannian Penrose inequality

1. Introduction . Finding

This article starts with updating what was done in [1] , which is symbolized by, if the scale factor is very small, metric variance [2,3]

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$$\left\langle \left(\delta g_{uv}\right)^2 \left(\hat{T}_{uv}\right)^2 \right\rangle \geq \frac{\hbar^2}{V_{Volume}^2}$$
$$\xrightarrow[uv \to tt]{} \left\langle \left(\delta g_{tt}\right)^2 \left(\hat{T}_{tt}\right)^2 \right\rangle \geq \frac{\hbar^2}{V_{Volume}^2} \qquad (1)$$
$$\& \quad \delta g_{rr} \sim \delta g_{\theta\theta} \sim \delta g_{\phi\phi} \sim 0^+$$

In [4] this lead to

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

We assume δg_{tt} is a small perturbation and look at $\delta t \Delta E = \frac{\hbar}{\delta g_{tt}}$ with

$$\Delta t_{time}(initial) = \hbar / \left(\delta g_{tt} E_{initial}\right) = \frac{2\hbar}{\delta g_{tt} \cdot g_{*s}(initial) \cdot T_{initial}} \qquad (3)$$

This would put a requirement upon a very large initial temperature $T_{initial}$ and so then, if $S(initial) \sim n(particle - count) \approx g_{*s}(initial) \cdot V_{volume} \cdot \left(\frac{2\pi^2}{45}\right) \cdot \left(T_{initial}\right)^3$ [5]

$$S(initial) \sim n(particle - count) \approx \frac{V_{volume}}{g_{*s}{}^2(initial)} \cdot \left(\frac{2\pi^2}{45}\right) \cdot \left(\frac{\hbar}{\Delta t_{initial} \cdot \delta g_{tt}}\right)^3 \qquad (4)$$

And if we can write as given in [2,3]

$$V_{volume(initial)} \sim V^{(4)} = \delta t \cdot \Delta A_{surface-area} \cdot \left(r \leq l_{Planck}\right) \qquad (5)$$

The volume in the pre Planckian regime would be extremely small, i.e. if we are using the convention that Eq. (4) holds, then it argues for a very large g_s^* beyond the value of 102, as given in [5] . In any case, our boundary between the Pre Planckian regime and Planckian, as far as the use of Eq. (4) yields a preliminary value of , for a radii less than or equal to Planck Length , of non zero value, with

$$10^{20} \leq S(initial) \sim n(particle-count)\Big|_{r \leq l_P} \leq 10^{37} \quad (6)$$

This is also assuming a $\delta t_{initial} \approx \Delta t_{initial} \propto Plank-time$, i.e. at or smaller than the usual Planck time interval.

2. Counter pose hypothesis, by String Theory, for Eq. (6)

The author is aware of the String theory minimum length and minimum time which is different from the usual Planck lengths, but are avoiding these, mainly due to a change in the assumed entropy formulae to read as the square root of the above results, namely [6,7,8]

$$10^{10} \leq S(initial)\Big|_{String-Theory} \sim \sqrt{n(particle-count)}\Big|_{r \leq l_P} \leq 10^{16} \quad (7)$$

The above is still non zero, but it cannot be exactly posited as in the Pre Planckian regime of Space-time, since the minimum length may be larger than Planck Length, i.e. as of the sort given in [8]

3. Conclusions : Questions as to refining both Eq. (6) and Eq. (7) for more precise Entropy bounds , and does the Riemannian Penrose inequality hold ?

If from Giovannini [9] we can write

$$\delta g_{tt} \sim a^2(t) \cdot \phi << 1 \quad (8)$$

Refining the inputs from Eq.(8) means more study as to the possibility of a non zero minimum scale factor [10] , as well as the nature of ϕ as specified by Giovannini [9] . We hope that this can be done as to give quantifiable estimates and may link the non zero initial entropy to either Loop quantum gravity “quantum bounce” considerations [11] and/or other models which may presage modification of the sort of initial singularities of the sort given in [12]. Furthermore if the non zero scale factor is correct, it may give us opportunities as to fine tune the parameters given in [10] below.

$$\alpha_0 = \sqrt{\frac{4\pi G}{3\mu_0 c}} B_0$$
$$\hat{\lambda}(defined) = \Lambda c^2 / 3 \qquad (9)$$

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

Where the following is possibly linkable to minimum frequencies linked to E and M fields [10] , and possibly relic Gravitons

$$B > \frac{1}{2 \cdot \sqrt{10\mu_0 \cdot \omega}} \qquad (10)$$

Finally is the question of applicability of the Riemann Penrose inequality which is [13] , p431, which is stated as

Riemann Penrose Inequality: Let (**M, g**) be a complete , asymptotically flat 3-manifold with Non negative-scalar curvature, and total mass m, whose outermost horizon Σ has total surface area A. Then

$$m_{total-mass} \geq \sqrt{\frac{A_{surface-Area}}{16\pi}} \qquad (11)$$

And the equality holds, iff (**M, g**) is isometric to the spatial isometric spatial Schwartzshield manifold **M** of mass **m** outside their respective horizons.

Assume that the frequency, say using the frequency of Eq.(10), and $A \approx A_{\min}$ of Eq.(11) is employed. So then say we have

$$\omega \approx \omega_{initial} \sim \frac{1}{d_{\min}}$$
$$d_{\min} \sim A^{1/3} \propto a_{\min} \qquad (12)$$

Assume that we also set the input frequency as to Eq. (10) as according to $10 < \zeta \leq 37$ i.e. does

$$\left(m_{total-mass} \sim 10^{\zeta} \cdot m_{graviton}\right)^2 \propto a_{\min}^3 / 16\pi$$
$$\Leftrightarrow \omega \approx \omega_{initial} \sim \frac{1}{d_{\min}} \sim \left(16\pi \times 10^{\zeta} \cdot m_{graviton}\right)^{-2/3} \quad (13)$$

In doing this, this is a frequency input into Eq. (10) above where we are safely assuming a graviton mass of about [14]

$$m_{total-mass} \sim 10^{37} \cdot m_{graviton}$$
$$m_{graviton} \sim 10^{-62}\, grams \quad (13)$$

Does the following make sense ? I.e. look at , when $10 < \zeta \leq 37$

$$\left(m_{total-mass} \sim 10^{\zeta} \cdot m_{graviton}\right)^2 \propto a_{\min}^3 / 16\pi$$
$$\Leftrightarrow \omega \approx \omega_{initial} \sim \frac{1}{d_{\min}} \sim \left(16\pi \times 10^{\zeta} \cdot m_{graviton}\right)^{-2/3} \quad (14)$$

We claim that if this is an initial frequency and that it is connected with relic graviton production, that the minimum frequency would be relevant to Eq. (10), and may play a part as to admissible B fields. Furthermore, , if $N = N_{graviton} \approx 10^{\zeta} \quad ; 10 < \zeta \leq 37$, then [15] with

$$N = N_{graviton}\Big|_{r_H} = \frac{c^3}{G \cdot \hbar} \cdot \frac{1}{\Lambda} \approx \frac{1}{\Lambda} \quad (15)$$

Which in turn would lead to [16]

$$m_{graviton} = \frac{\hbar}{c} \cdot \sqrt{\frac{(2\Lambda)}{3}} \approx \sqrt{\frac{(2\Lambda)}{3}} \quad (16)$$

Doing so would put a different mass of a graviton into Eq. (13) with attendant consequences we may refer to at a later publication. See [17] for details.

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