Geddankerexperiment for initial temperature, particle count and entropy affected by initial D.O.F and fluctuations of metric tensor

A. B. Beckwith†
Physics Department, Chongqing University,
Chongqing 40014, PRC
†*E-mail: abeckwith@uh.edu*

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.

Keywords: Emergent time, heavy gravity, metric tensor perturbations, HUP

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]

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

In [4] this lead to

† Work partially supported by National Nature Science Foundation of China grant No. 11375279
.

$$\delta t \Delta E \geq \frac{\hbar}{\delta g_{tt}} \neq \frac{\hbar}{2} \qquad (2)$$

$$Unless \quad \delta g_{tt} \sim O(1)$$

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

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

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]

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

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

If from Giovannini [9] we can write

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

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.

$$\begin{aligned} \alpha_0 &= \sqrt{\frac{4\pi G}{3\mu_0 c}} B_0 \\ \widehat{\lambda}(defined) &= \Lambda c^2 / 3 \end{aligned} \tag{9}$$

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

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

$$B > \frac{1}{2 \cdot \sqrt{10\mu_0 \cdot \omega}} \tag{10}$$

References

1.T. G. Downes, G. J. Milburn, "Optimal Quantum Estimation for Gravitation ", gr-qc arXiv:1108.5220
2. W. G. Unruh; "Why study quantum theory?", **Canadian Journal of Physics,** 1986, Vol. 64, No. 2 : pp. 128-130; (doi: 10.1139/p86-019)
3. W. G. Unruh; "Erratum: Why study quantum gravity?", Can. J. Phys. 64, 128 (1986)

4. A. W. Beckwith, "Gedankenexperiment for Refining the Unruh Metric Tensor Uncertainty Principle Via Schwartzshield Geometry and Planckian Space-Time with Initial Non Zero Entropy"; will be an article published, with corrections in Ukranian journal of physics, and can be read in http://vixra.org/pdf/1509.0173v6.pdf

5. E. Kolb, M. Turner, *The Early Universe* ,Addison-Wesley Publishing Company, Redwood City, California, USA, 1990
6.J. Louis, T. Mohaupt, and S. Theisen , "String Theory: An Overview" http://www.aei.mpg.de/~theisen/LMT.pdf
7. M. Ammon, J. Ergmenger, *Gauge/ Gravity Duality, Foundations and Applications*, Cambridge University Press, Cambridge UK, 2015
8. K. Becker , M. Becker, J. H. Schwarz**,** *String Theory and M-Theory: A Modern Introduction 1st Edition* Cambridge University Press, Cambridge, UK, 2007

9. M. Giovannini, *A Primer on the Physics of the Cosmic Microwave Background* World Press Scientific, Hackensack, New Jersey, USA, 2008
10. C.S. Camara, M.R. de Garcia Maia, J.C. Carvalho, and J.A.S. Lima, " Nonsingular FRW cosmology and Non Linear dynamics", Arxiv astro-ph/0402311 version 1, Feb 12, 2004
11.C. Rovelli, and F. Vidotto, *Covariant Loop Quantum Gravity, An Elementary Introduction to Quantu Gravity and Spinfoam Theory* Cambridge University Press, Cambridge, UK, 2015
12. A. Ashtekar, B. Berger, J. Isenberg and M. Mac Callum *General Relativity and Gravitation, a Centennial Perspective,* Cambridge University Press, Cambridge, UK, 2015