Calculating δg_{tt} at Boundary of Start of Planckian Physics Due to 1 Million Relic Black Holes

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Abstract

We use the ideas of a million black holes, at the boundary of δg_{tt} contribution to the shift from Pre Planckian to Planckian physics, as a summed up contribution from one million primoridial black holes. I.e. this is assuming a quantum bounce This is an extension of work done by the author as to explain the nature of a transition from δg_{tt} being tiny to when δg_{tt} becomes 1 in value. Taking this into account, this article is a way to delineate the physics, inherent in the transition from $\Delta E \Delta t \geq \frac{\hbar}{\delta g_{tt}}$ to $\Delta E \Delta t \geq \hbar$ which puts a premium upon the growth of the inflaton, due to $\delta g_{tt} \sim (a_{\min})^2 \cdot \phi$, with $a_{\min} \sim 10^{-55}$ but with ϕ changing from $\phi|_{\text{Pre-Planckian}} \approx 10^{-137} \xrightarrow{2nd-order-phase-transtion} \phi|_{Planckian} \approx 10^{114}$, an 10^{255} increase in magnitude. This increase in magnitude may be the driver of subsequent inflation. When $\Delta E \Delta t \geq \frac{\hbar}{\delta g_{tt}}$ we have a pre quantum, especially if the inequality becomes an equality, and then the transition to $\Delta E \Delta t \geq \hbar$ marks the start of quantum gravity, whereas our black hole entropy model used to obtain a non zero entropy contribution from 1 million primordial relic black holes, as referenced, comes from Dr. Sen in an October 10 Run Run Shaw lecture in Stonybrook University.

Key words, massive gravity, inflaton physics, Infinite quantum statistics,(usual) Black hole entropy.

1. Introduction

Dr. Sen, in 2016 [1] give a simple black hole generation of entropy analogy which we write as, using Planck units for 3+1 dimensional geometry

$$S(Entropy) = \frac{k_B c^3 A_{surface-area}}{4\pi G\hbar} \equiv \frac{A_{surface-area}}{4\pi}\bigg|_{Planck-units} \xrightarrow{3+1Dimensions} r^2 \approx LogN \tag{1}$$

N, in this case, is a counting mechanism, for 'particles' leaving the event horizon of a black hole and we will have more to say about an alleged counting mechanism later, while r, in this case, is a radial "distance" which is assuming a nonsingular treatment with r, in this case equivalent to an event horizon[2, 3]. We will though for the sake of a model, state that we are fixing say 10^6 (a million) relic black holes, at the boundary of Pre Planckian to Planckian physics. And that we are when doing that, making the following transformation, as given by [4]

$$\Delta E \Delta t \geq \frac{\hbar}{\delta g_{tt}}\bigg|_{\Pr e-Planckian} \xrightarrow{2nd-order-phase-transtion} \Delta E \Delta t \geq \hbar\big|_{Planckian} \tag{2}$$

The idea of a 2nd order transition in cosmology can be looked up in [5,6, 7] but in fact what we are examining is due to [3], namely if we are looking at the generation of gravitational waves/ gravitons from decay of the following mass via

$$M(black-hole) \sim 10^{15} \cdot \left(\frac{t}{10^{-23}\sec}\right) g \xrightarrow{\text{Re}lic-conditions} M < 10^{15} g$$

$$\&$$

$$\tau\left(Black-hole-life-time\right) \sim 10^{64} \cdot \left(\frac{M}{M_{Sun}}\right)^3 yr \xrightarrow{M<10^{15} g} \tau < 10^{-23}\sec \tag{3}$$

Take about 1 million black holes behaving as given in Eq. (3) And also assume, [8], i.e. a quantum bounce, with[8]

$$a_{\min} \sim 10^{-55} \tag{4}$$

And we will be using in Eq. (2)

$$\delta g_{tt} \sim \left(a_{\min}\right)^2 \cdot \phi \tag{5}$$

In addition, from [9] we will be using the following for the inflaton, if $a(t) = a_0 t^\gamma$, then

$$V(t) = V_0 \left(\frac{\gamma(3\gamma-1)}{8\pi G V_0}\right)^{1/\sqrt{2}} \frac{c^{\sqrt{2}}}{t^{\sqrt{2}}} = V_0 \left(\frac{\gamma(3\gamma-1)}{8\pi G V_0}\right)^{1/\sqrt{2}} \frac{c^2}{r^{\sqrt{2}}} \tag{6}$$

$$\phi \approx \sqrt{\frac{\gamma}{4\pi G}} \cdot \ln\left\{\sqrt{\frac{8\pi G V_0}{\gamma \cdot (3\gamma-1)}} \cdot t\right\} \tag{7}$$

Furthermore, Sciama, in 1982 [10] allows us to write the following, namely

Sciama [10] in 1982 argued for the lifetime of a black hole, of mass M, that the following holds

$$t(black-hole-lifetime) \sim 10^{10} \cdot \left(M / 10^{15} grams\right)^3 years \sim 3.154 \times 10^{17} \cdot \left(M / 10^{15} grams\right)^3 \sec \qquad (8)$$

Here, if the time is about 10^-44 seconds (Planck time), then $M \sim 10^{-7} grams$. If so, then, according to [2] , Calmert, et. al. about .1% of the energy emitted, in the traditional 4 dimensional black hole (3+1 dimensions) would be gravitons. Then, $M \sim 10^{-7} grams$ becomes linked to Gravitons according to

$$M(primoridial - B.H.) \sim 10^{-7} grams \Rightarrow M(gravitons) \sim 10^{-10} grams \qquad (9)$$

This would mean then 1 primordial black hole would produce, if the mass of a graviton is 10^-62 grams [11]

$$total - M(gravitons) \sim 10^{-10} grams \Rightarrow 10^{52} gravitons \qquad (10)$$

Or, for a million black holes about 10^58 gravitons And we would, do the following for change in energy, namely write, from [2], and using [4]

$$\begin{aligned} &\frac{dE}{dt} \doteq \frac{\Delta E}{\Delta t} \approx \left(\# Black - Holes\right) \cdot M\left(Black - Holes\right) \cdot \omega^2_{gravitons} \cdot r_H^2 \\ &\Leftrightarrow \Delta E \Delta t \approx \left(\Delta t\right)^2 \cdot \left(\# Black - Holes\right) \cdot M\left(Black - Holes\right) \cdot \omega^2_{gravitons} \cdot r_H^2 \sim \frac{\hbar}{\delta g_{tt}} \end{aligned} \qquad (11)$$

Furthermore, we will be assuming, using for Graviton production, that $r_H^2 \sim r^2 \propto l^2_{Planck}$, i.e. the Planck length is approximately the same as the event Horizon of the Black hole, that then we will use Eq. (1) directly with the result that for 3+1 dimensions, we are using if we use Planck length, that

$$r_H^2 \sim r^2 \propto l^2_{Planck} \propto S_{Black-Hole} \qquad (12)$$

For the remainder of this document we will be working with

$$\delta g_{tt} \sim 1/\left(\Delta t\right)^2 \cdot \left[\left(\# Black - Holes\right) \cdot M\left(Black - Holes\right) \cdot \omega^2_{gravitons} \cdot S_{Black-Hole}\right] \qquad (13)$$

We will be working with Eq. (13) to isolate out what we can extract from this, in terms of early universe conditions. The approximation for Gravitons and entropy is based upon, Ng, namely we will, as a start, incorporate Ng's infinite quantum statistics idea, of entropy being equivalent to a count of particles, i.e. by [12]

$$S(entropy) \sim \# gravitons \qquad (14)$$

All this will be elaborated upon in the main analysis leading to the change in inflaton values, next.

2. Isolation of the value of the inflaton, using Eq. (13) , Eq. (14)

Given the above, we can write, if we do the math, that we need to do a basic re normalization via Planck units of the above in terms of $k_B = t_{Planck} = \hbar = c = m_{Planck} = 1$, if so then we have that we rewrite Eq. (13) via

$$\begin{aligned} &\left(\Delta t\right)^2 \sim t_{Planck}{}^2 = 1 \\ &\& \\ &M\left(Black - Holes\right) \sim 10^{-7} g \approx 10^{-2} m_{Planck} \approx 10^{-2} \end{aligned} \qquad (15)$$

Then if $(a_{\min})^2 \sim 10^{-110}$ we can rewrite the equation 13. To read as follows. If the mass of a graviton is $10^{-62} g$, and the value of Planck mass is about $10^{-5} g$ with Planck mass renormalized by Planck scaling to be 1, then in the Planck rescaling we have

$$m_{graviton} \sim 10^{-57} \tag{16}$$

Now if the frequency, initially was of the order of

$$\omega_{gravitons}\Big|_{initially} \sim 10^{40} Hz \tag{17}$$

We get, then that

$$\begin{aligned} \delta g_{tt}\Big|_{Boundary(\Pr e-Planck,Planck)} &\sim 10^{-251} \xrightarrow[2nd-order-phase-transition]{} 1 \\ \phi\Big|_{Boundary(\Pr e-Planck,Planck)} &\sim 10^{-141} \xrightarrow[2nd-order-phase-transition]{} 10^{114} \end{aligned} \tag{18}$$

I.e. the inflaton, nearly zero, in the Pre-Planckian regime, becomes enormously large, right after the phase transition, and we are assuming that the scale factor, $(a_{\min})^2 \sim 10^{-110}$ is invariant, in Eq. (18). If so then there is a 10^{255} increase in the inflaton, according to Eq. (18).

3. Conclusion. Is the Increase of 10^{255} for the Inflaton, a Driver of Inflation?

No one knows. It is a seminal question, but Eq.(2) is a good imbedding of inflation. I.e. if one uses the Penrose Cyclic conformal cosmology as given in [4] in that references page 111 to page 112, we may be able to ascertain a description of our problem as one where the dramatic 10^{255} increase in the inflaton, according to Eq. (17), maybe due to the influx of new matter-energy as given in [4] . Further details are to be checked as to [13,14,15,16,17,18]. In particular, does this help us find relic gravitational waves ? . Check Corda's choices as to gravity, and its foundations in [17]. We can examine if [13] is satisfied, by considering the initial conditions given in Freeze's article which leads to the 63 orders of e fold expansion, in inflation. References [14,15,16] give experimental constraints as to gravitation by LIGO which we need to consider, and of course [18] is a way of reformulating the issue of if there is a vacuum energy involved which can be mathematically calculated.

The final question to ask, is about the N in the right hand side of Eq.(1). It can be viewed, as say the number of operations, for the Universe. I.e. in this sense is a counter point to the [19] of Seth Lloyd which has a power relationship of the entropy being 3/4th the power of the computational bits. I.e. our suggestion is that perhaps there are many more N computations than was supposed in Seth Lloyds [19] reference.

6.. Acknowledgements

This work is supported in part by National Nature Science Foundation of China grant No. 11375279

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