Using Interplay between Release of Gravitons due to Physical Processes and Numerical Count of Gravitons and the Interplay with BraneworldPhysics

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Abstract

The article begins with a description of inflation physics, with an eye toward a mechanism of GW release from early universe conditions to begin construction of an analysis of the similarities and differences between GW and Gravitons in terms of data sets. We also look at a way to quantify the production of gravitons from early universe conditions and to go as far as to quantify the probability of production of gravitons from very early universe conditions and to compare that analysis with Braneworld predictions, given at the very end.

I. Start off with the following from [1] [2] [3] with an assumed value as stated by[1]

$$
\begin{aligned}
& a(t) = a_{initial} t^{\nu} \\
& \Rightarrow \phi = \ln\left(\sqrt{\frac{8\pi G V_0}{\nu \cdot (3\nu - 1)}} \cdot t \right)^{\sqrt{\frac{\nu}{16\pi G}}} \\
& \Rightarrow \dot{\phi} = \sqrt{\frac{\nu}{4\pi G}} \cdot t^{-1} \\
& \Rightarrow \frac{H^2}{\dot{\phi}} \approx \sqrt{\frac{4\pi G}{\nu}} \cdot t \;\; \cdot T^4 \cdot \frac{(1.66)^2 \cdot g_*}{m_P^2} \approx 10^{-5}
\end{aligned}
\qquad (I)
$$

This of course makes uses of

$$
H = 1.66 \sqrt{g_*} \cdot \frac{T_{temperature}{}^2}{m_P} \qquad (2)
$$

We will make the following calculation [4][5] where we start off with [4] , page 19 thatWhereas

$$
V_0 = \left(\frac{.022}{\sqrt{q N_{efolds}}} \right)^4 = \frac{\nu(\nu - 1)\lambda^2}{8\pi G m_P^2} \; (3)
$$

Whereas we will look at from [5]

$$V(\phi) = V_0 \exp\left(-\sqrt{\frac{16\pi G}{\nu}}\phi\right) = V_0 \exp\left(-2\ln\left(\sqrt{\frac{8\pi G V_0}{\nu(3\nu-1)}}t\right)\right) \equiv \frac{\nu(3\nu-1)}{8\pi G \cdot t^2} \quad (5)$$

Whereas from [5] and its page 125 there is a number, per unit volume a production of χ particles

$$n_\chi \approx \left(g|\dot{\phi}|\right)^2 \equiv g^2 \cdot \frac{\nu}{4\pi G} \cdot \frac{1}{t^2} \quad (6)$$

II. Obtaining a value of number of particles if χ refers to Gravitons

To do this look at first the value of g^2 we set the term in the bracket of the logarithm in Eq (1) to go to 1

We obtain

$$\sqrt{\frac{4\pi G V_0}{\nu \cdot (3\nu - 1)}} \cdot t \equiv e^1 \quad (7)$$

Then upon going from (7) to Eq. 1, we can write

$$\phi \to \sqrt{\frac{\nu}{16\pi G}} \quad (8)$$

Having done this, we look at Eq (6) and obtain

$$n_\chi \approx \left(g|\dot{\phi}|\right)^2 \equiv g^2 \cdot \frac{\nu}{4\pi G} \cdot \frac{1}{t^2} \equiv g^2 \cdot \frac{\nu^2 \cdot (3\nu-1) \cdot e^{-2}}{4\pi G V_0} \quad (9)$$

In this case we go to the value of Eq. (3) and obtain

$$\begin{aligned} n_\chi &\approx \left(g|\dot{\phi}|\right)^2 \equiv g^2 \cdot \frac{\nu}{4\pi G} \cdot \frac{1}{t^2} \equiv g^2 \cdot \frac{\nu^2 \cdot (3\nu-1) \cdot e^{-2}}{4\pi G V_0} \\ &\xrightarrow[See-eq.(3)]{} g^2 \cdot \frac{\nu^2 \cdot (3\nu-1) \cdot q^2 \cdot (N_{efolds})^2}{4\pi G \cdot [.022]^2 \cdot e^2} \end{aligned} \quad (10)$$

Our approximation to get a value of g is then to go to the following, assuming initial graviton production in the neighborhood of the early universe of about 10^6 and use this form for the Graviton condensate of black holes [6]

$$
\begin{aligned}
& m \approx \frac{M_P}{\sqrt{N_{gravitons}}} \\
& M_{BH} \approx \sqrt{N_{gravitons}} \cdot M_P \\
& R_{BH} \approx \sqrt{N_{gravitons}} \cdot l_P \\
& S_{BH} \approx k_B \cdot N_{gravitons} \\
& T_{BH} \approx \frac{T_P}{\sqrt{N_{gravitons}}}
\end{aligned}
\qquad (11)
$$

In the early universe our approximation is to assume that the initial value of entropy is about 10^20 instead of the value of 10^120 associated with it today, meaning that there was per black hole about 10^14 in generated entropy, namely setting

$$S_{Universe-initial-entropy} \approx 10^6 \times S_{black-holes} \approx 10^{20} \qquad (12)$$

Meaning per black hole a mass of the neighborhood of about

$M_{black-hole} \approx 10^7 M_P$ or about 100 grams (13)

This is leading to a value of about a radius per black hole about 10^7 Planck length

We will to first approximation then state that we would have for about a 10^10 Plank sized length box, per side specify about what the numerical density should be. i.e.

$$
\begin{aligned}
& n_\chi \approx \left(g \left| \dot{\phi} \right| \right)^2 \equiv g^2 \cdot \frac{\nu}{4\pi G} \cdot \frac{1}{t^2} \equiv g^2 \cdot \frac{\nu^2 \cdot (3\nu - 1) \cdot e^{-2}}{4\pi G V_0} \\
& \xrightarrow[See-eq.(3)]{} g^2 \cdot \frac{\nu^2 \cdot (3\nu - 1) \cdot q^2 \cdot (N_{efolds})^2}{4\pi G \cdot [.022]^2 \cdot e^2} \\
& \xrightarrow[10^{10} l_P \times 10^{10} l_P \times 10^{10} l_P volume]{} 10^{14}\, gravitons / black - hole \\
& \approx 10^{20}\, gravitons - total
\end{aligned}
\qquad (14)
$$

This means if we have the value of particles restricted to gravitons, per (10^10 times Planck length) cubed volume of space where we specify q to about being of order 1 we have, if the N in Eq. (14) is for e-folds of inflation, set to about 60, then

$$g^2 \approx \left(\frac{\nu^2 \cdot (3\nu - 1) \cdot q^2 \cdot (N_{efolds})^2}{4\pi G \cdot [.022]^2 \cdot e^2} \right)^{-1} \times 10^{20}\, gravitons \qquad (15)$$

This value of Eq. (15) is assuming a (10^ times Planck length)^3 “box” for containment of a lot of small black holes!

III. About that mass per graviton. we have a problem, here is my presumed fix.

If we look at m in Eq. (10) and presume that is for gravitons, we have a problem.
The mass m, in Eq. (10) would be of about

$$m \approx 10^{-7} M_P \approx 10^{-12}\, grams \qquad (16)$$

However, the rest mass of a massive graviton is about

$$m(rest - mass - graviton) \approx 10^{-65}\, grams \qquad (17)$$

We would be assuming special relativity, with a TOP mass of about

$$m \approx \frac{m_g}{\sqrt{1-\left(\frac{v_g}{c}\right)^2}} \approx \frac{M_P}{\sqrt{N_{gravitons}}} \approx 10^{-10}\, grams \qquad (18)$$

Say between 10^-10 to 10^-12 grams. Of course this has to be experimentally confirmed

IV. Does this all mesh in with more classical relativity assumptions?

First of all, if this is related to the following

If so, by Novello [7] we then have a bridge to the cosmological constant as given by

$$m_g = \frac{h \cdot \sqrt{\Lambda}}{c} \quad (19)$$

What we are referring to is in our model what would be in the near the beginning of inflation and we would be trying to reconcile if our use of mini black holes could be made commensurate as to the existence of setting our value of rest massive gravity to about the square root of the Cosmological constant. Bear in mind that if we do so that the present value of the cosmological constant in Eq. (19) is , if we assume Planck units, [8]

$$\rho_\Lambda c^2 = \frac{E_\Lambda}{V} \approx \frac{1}{2} \cdot \int_0^{E/c} \sqrt{p^2 c^2 + m^2} \cdot \frac{4\pi p dp}{(2\pi h)^3} \approx \frac{E^4}{16\pi^2 \cdot (hc)^3}$$

$$\xrightarrow[E=E_P]{} \frac{\left(3\times 10^{27} eV\right)^4}{(hc)^3}$$

$$\rho_\Lambda c^2 \approx \frac{\left(3\times 10^{27} eV\right)^4}{(hc)^3} \xrightarrow[Critical-density]{} \frac{\left(2.5\times 10^{-3} eV\right)^4}{(hc)^3}$$

$$E(field - theory) \approx m_p \approx 10^{-5} g \approx 10^{27} eV$$

$$E(vacuum - meas) \approx 10^{-35} g \approx 10^{-5} g \approx 10^{-3} eV \qquad (20)$$

$$E(gravion - rest) \approx 10^{-65} g \approx 10^{-33} eV$$

$$\rho_{de} \equiv 3c^2 m_p^2 L^{-2}$$

$$L = 1/R_b$$

$$R_b = a \cdot \int_a^\infty \frac{da}{Ha^2}$$

This is a remaining datum to be investigated thoroughly . If the above, in Eq. (20) groupings can be reconciled we have something to work with, and furthermore is there a connection to this idea of initial mass creation in braneworld. [8] And this would be for a black hole with mass as in Eq,. (11)

$$\delta M \approx \frac{6k}{8\pi G_5} \cdot \frac{4\pi r_h^3}{3} \qquad (21)$$

That value of mass, assuming a volume of $\frac{4\pi r_h^3}{3}$ has been taken from a brane world, according to [8] , with a re scaled gravitational value in 5 dimensions set as G_5 , is allegedly commensurate with the creating of a black hole mass as given in Eq. (11)

Do we believe it in terms of early universe creation of black holes and setting of a cosmological constant ? That would take a lot of work according to my standards.

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