DECELERATION PARAMETER Q(Z) IN FIVE DIMENSIONAL GEOMETRIES, AND DOES A RE APPEARANCE OF QUINESSENCE $\phi(t)$ PLAY A ROLE IN AN INCREASE IN COSMOLOGICAL ACCELERATION AT Z ~. 423?

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The case for a four dimensional graviton mass (non zero) influencing reacceleration of the universe in five dimensions is stated, with particular emphasis upon if five dimensional geometries as given below give us new physical insight as to cosmological evolution. A calculated inflaton $\phi(t)$ may partly re-emerge after fading out in the aftermath of inflation. The inflaton may contribute to, with non zero graviton mass, in re acceleration of the universe a billion years ago. The inflaton also may be the source of re acceleration of the universe, especially if the effects of a re emergent inflaton are in tandem with the appearance of macro effects of a small graviton mass, leading to a speed up of the rate of expansion of the universe at red shit value of Z ~ .423

1 Introduction : What can be said about DM and DE ?

We will start with a first-principle introduction to detection of gravitational wave density using the definition given by Maggiore [1]

$$h_0^2\Omega_{gw}(f) \cong 3.6 \cdot \left[\frac{n_f}{10^{37}}\right] \cdot \left(\frac{f}{1kHz}\right) \tag{1}$$

where n_f is the frequency-based numerical count of gravitons per unit phase space. The author suggests that n_f may depend upon the interaction of gravitons with neutrinos in plasma during early-universe nucleation, as modeled by M. Marklund *et al* [2], which is a supposition the author[3] is investigating for a modification of a joint KK tower of gravitons, as given by Maartens[4] for DM. Assume the stretching of early relic neutrinos that would lead to the KK tower of gravitons--for when $\alpha < 0$, is[3],

$$m_n(Graviton) = \frac{n}{L} + 10^{-65} \text{ grams} \tag{2}$$

. Also Eq. (3) will be the starting point used for a KK tower version of Eq. (4) below. So from Maarten's [5] 2005 paper,

$$\dot{a}^2 = \left[\left(\frac{\tilde{\kappa}^2}{3}\left[\rho + \frac{\rho^2}{2\lambda}\right]\right)a^2 + \frac{\Lambda \cdot a^2}{3} + \frac{m}{a^2} - K\right] \quad (3)$$

Maartens [4]also writes $\dot{H}^2 = \left[-\left(\frac{\tilde{\kappa}^2}{2}\cdot[p+\rho]\cdot\left[1+\frac{\rho^2}{\lambda}\right]\right) + \frac{\Lambda \cdot a^2}{3} - 2\frac{m}{a^4} + \frac{K}{a^2}\right]$.

Also, if $\rho \cong -P$, for red shift values z between zero to 1.0-1.5 with equality, $\rho = -P$, for z between zero to **.5.** $a \equiv [a_0 = 1]/(1+z)$. As given by Beckwith[3]

$$q = -\frac{\ddot{a}a}{\dot{a}^2} \equiv -1 - \frac{\dot{H}}{H^2} = -1 + \frac{2}{1+\tilde{\kappa}^2[\rho/m]\cdot(1+z)^4\cdot(1+\rho \ \ /2\lambda)} \approx -1 + \frac{2}{2+\delta(z)} \quad (4)$$

Eq. (4) assumes $\Lambda = 0 = K$, and the net effect is to obtain, a substitute for DE, by presenting how gravitons with a small mass done with $\Lambda \neq 0$, even if curvature **K** =0

2 Consequences of small graviton mass for reacceleration of the universe

In a revision of Alves *et. al,* [6] Beckwith[3] used a higher-dimensional model of the brane world and Marsden[6] KK graviton towers. The density ρ of the brane world in the Friedman equation as used by Alves *et. al*[9] is use by Beckwith[3] for a non-zero graviton

$$\rho \equiv \rho_0 \cdot (1+z)^3 - \left[\frac{m_g \cdot (c=1)^6}{8\pi G(\hbar = 1)^2}\right]\cdot\left(\frac{1}{14\cdot(1+z)^3} + \frac{2}{5\cdot(1+z)^2} - \frac{1}{2}\right) \quad (5)$$

I.e. Eq. (3) above is making a joint DM and DE model, with all of Eq. (4) being for KK gravitons and DM, and 10^{-65} grams being a 4 dimensional DE. Eq. (4) is part of a KK graviton presentation of DM/ DE dynamics. Beckwith[11] found at z ~ **. 4**, a billion years ago, that acceleration of the universe increased, as shown in Fig. 1.

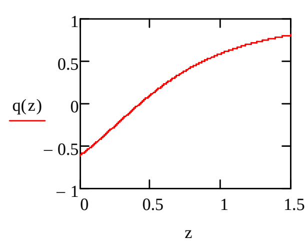

Fig. 1: Reacceleration of the universe based on Beckwith [3] **(note that q < 0 if z <.423)**

3. Conclusion: What if an inflaton re-emerges in space-time ? At z ~ . 423?

Padmanabhan[18] has written up how the 2[nd] Friedman equation as of Eq. (5), which for **z ~ . 423** may be simplified to read as $\dot{H}^2 \cong \left[-2\frac{m}{a^4}\right]$ would lead to an inflaton value of , when put in, for scale factor behavior as given by $a(t) \propto t^{\lambda}, \lambda = (1/2) - \varepsilon^{+}, 0 \le \varepsilon^{+} << 1$, of, for the inflaton[7] and inflation of

$$\phi(t) = \int dt \cdot \sqrt{-\frac{\dot{H}}{4\pi G}} \sim \sqrt{\frac{2m}{4\pi G}} \cdot [2\varepsilon^{+}] \cdot t^{2\cdot\varepsilon^{+}} \qquad (6)$$

Which is assuming Assuming a decline of $a(t) \propto t^{\lambda}, \lambda = (1/2) - \varepsilon^{+}, 0 \le \varepsilon^{+} << 1$, As the scale factor of $a(t) \propto t^{\lambda}, \lambda = (1/2) - \varepsilon^{+}, 0 \le \varepsilon^{+} << 1$ had time of the value of roughly $a(t) \propto t^{\lambda}, \lambda = (1/2) - \varepsilon^{+}, 0 \le \varepsilon^{+} << 1$ have a power law relationship drop below $a(t) \propto t^{1/2}$, the inflaton took Eq. (7) 's value which may affect the increase in the rate of acceleration We relate an energy state to the inflaton if $a(t) = a_0 t^{\lambda}$, then there is a potential of [7]

$$V(\phi) = V_0 \cdot \exp\left[-\sqrt{\frac{16\pi G}{\lambda}} \cdot \phi(t) \right] \qquad (7)$$

A situation where both $\lambda = (1/2) - \varepsilon^{+}$ grows smaller, and, temporarily, $\phi(t)$ takes on Eq. (7)'s value, even if the time value gets large, then there is infusion of energy by an amount dV. The entropy dS ≃dV/T, will lead, if there is an increase in V, as given by Eq. (6) a situation where there is an increase in entropy. If $S \approx N =$ number of graviton states[3,8] then we have an argument that the re emergence of an inflaton, with a reduction of Eq. (7 in magnitude may be part of gravitons playing a role in the re acceleration of the universe. Finally, Eq. (6) to Eq. (7) as combined with $S \approx N$ as referenced on pages 2 and 3 as a way to link graviton count with entropy may make inter connections between the inflaton picture of entropy generation and entropy connected/ generated with a numerical count of gravitons. What is needed is experimental verification of Eq. (6)

References

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