STRETCHED NEUTRINOS AND THE SUPPOSED LINK OF NEUTRINOS TO GRAVITONS/GRAVITY WAVE DATA SETS

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The issue of whether or not a correlation exists between neutrino physics and gravitational wave data sets/gravitons is raised anew. Particular emphasis is placed on analysis of the Fuller and Kishimoto scenario, suggesting that the wave function of a relic neutrino may span up to billions of light years across galaxies because of its low energy and particles traveling at different speeds. There is an initial close relationship between gravitational waves/gravitons and relic neutrinos in early-universe nucleation, so is there is a corresponding "stretch-out" of gravitons? If so, what would this imply for improved graviton/gravity wave detectors?

1 Introduction

1.1 What can be said about gravitational wave density value detection?

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

$$\Omega_{gw} \equiv \frac{\rho_{gw}}{\rho_c} \equiv \int_{f=0}^{f=\infty} d(\log f)\cdot \Omega_{gw}(f) \Rightarrow h_0^2 \Omega_{gw}(f) \cong 3.6 \cdot \left[\frac{n_f}{10^{37}}\right]\cdot\left(\frac{f}{1kHz}\right)^4 \quad (1)$$

where n_f is the frequency-based numerical count of gravitons per unit phase space. The author suggests that n_f may also depend upon the interaction of gravitons with neutrinos in plasma during early-universe nucleation, as modeled by M. Marklund *et al* [2]. Also, Fuller and Kishimoto [3] state. that the wave function of a relic neutrino may span up to billions of light years across galaxies because of its low energy, comprising particles traveling at different speeds.

The author suggests that relic interstellar neutrinos and gravitons interact with each other in addition to plasmas. If so, and if Eq. (1) is modified by a change in phase space counting and a weighted average $\langle f \rangle$ of the frequencies of neutrinos and gravitons,[1,4]

$$n_f \propto n_f[graviton] + n_f[neutrinos] \quad (2)$$

$$h_0^2 \Omega_{gw}(f) \cong \frac{3.6}{2}\cdot\left[\frac{n_f[graviton]+n_f[neutrino]}{10^{37}}\right]\cdot\left(\frac{\langle f \rangle}{1kHz}\right)^4 \quad (3)$$

2 Consequences of small graviton mass for reacceleration of the universe

In a revision of Alves *et. al,* [5] A. W. Beckwith[4] 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. a.l*[5] is use by Beckwith[4] for a non-zero graviton

$$\rho \equiv \rho_0 \cdot \left(\frac{a_0}{a}\right)^3 - \left[\frac{m_g c^6}{8\pi G\hbar^2}\right] \cdot \left(\frac{a^4}{14} + \frac{2a^2}{5} - \frac{1}{2}\right) \tag{5}$$

I.e. Eq. (6) below is making a joint DM and DE model., with all of Eq. (6) being for KK gravitons and DM, and 10^{-65} grams being a 4 dimensional DE . Eq (5) is part of a 4 dimensional imprint of gravitons as represented by Eq. (6) below , showing up in Eq. (7) due to Eq. (5) being part of the Friedmann equations influencing scale factor a

$$m_n(Graviton) = \frac{n}{L} + 10^{-65} \text{ grams} \tag{6}$$

And graviton mass affects q (since scale factor, a is affected by density ρ),

$$q = -\frac{\ddot{a}a}{\dot{a}^2} \tag{7}$$

Beckwith[4] also found that the red shift was z ~ .4 , a billion years ago, when the acceleration of the universe increased, instead of slowing down, as shown in Fig. 1.

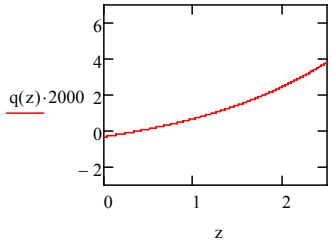

Fig. 1: Reacceleration of the universe based on [3] **(note that q < 0 if z <.4)**

3 Connecting neutrinos with gravitons by looking at their wavelengths

Assuming $m_0(Graviton) \approx 10^{-65}$ grams for gravitons in 4 dimensions, the supposition by Bashinsky[8] and Beckwith[7] is that density fluctuations are influenced by a modification of overall cosmological density ρ in the Friedmann equations by the proportionality factor given by Bashinsky,[8] $\left[1 - 5 \cdot (\rho_{neutrino}/\rho) + \vartheta\left([\rho_{neutrino}/\rho]^2\right)\right]$ This proportionality factor for ρ as showing up in the Friedmann equations should be taken as an extension of Marklund *et. al* [2] , due to graviton-neutrino interactions along the

lines initially proposed by Marklund *et al*[2] , where neutrinos interact with plasmons and plasmons interact with gravitons. Thereby implying neutrino- graviton interactions Also, here graviton wavelengths have the same order of magnitude of neutrinos. Note, from Valev, [9]

$$m_{graviton}\Big|_{RELATIVISTIC} < 4.4\times 10^{-22} h^{-1} eV/c^2$$
$$\Leftrightarrow \lambda_{graviton} \equiv \frac{\hbar}{m_{graviton}\cdot c} < 2.8\times 10^{-8}\, meters \qquad (8)$$

Extending the M. Marklund *et al.*[2] and Valev[9] results, some gravitons may become larger,

$$\lambda_{graviton} \equiv \frac{\hbar}{m_{graviton}\cdot c} < 10^{4}\, meters \text{ or larger} \qquad (9)$$

4 Conclusions

If a joint DM and DE model as given by Eq. 6 is consistent with known astrophysical observations, the author suggests interconnections of Eq. (8) with Eq. (3) should be proven, along with further work on Eq. (6) to get better results than what has been as given by chaplygin-gas style[10] joint DM-DE models. We means getting about the total dependence upon baryon acoustic oscillations data and supernovas as a benchmark and proof for the existence of DE, especially when the current value of the equation of state for dark energy is $w_{0de}=-1.08 <-1$. Answering these questions requires new developments to improve sensitivity of GW detectors.[1] Eq. (6) appears to be a leap forward which if backed by observations would delineate a role for the emergency of DE on more than an ad hoc basis. Note that DE does not appear in the beginning of inflation, and Eq. (6) would tie in the increase in DE from the beginning of inflation with emergence and nucleation of gravitons. Details pending improvements in $h \sim 10^{-33}$ GW sensitivity.[11]

References

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