Entropy, neutrino physics, and the lithium problem: why are there stars with essentially no lithium due to serious lithium deficiency in certain spatial regions in the early universe?

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abstract The consequences of abnormally low lithium abundance in a nearby population II star (which is almost as old as the supposed population III stars) as represented by HE0107-5240 are that standard BBN theory is out of sync with observations. Why such a low value for lithium problem in any stars as due to stellar formation and gravitational perturbation on DM will be discussed. Neutrino-gravitational wave interaction leads to a damping factor in the intensity of relic GW of $\left[1-5\cdot\left(\rho_{neutrino}/\rho\right)+\vartheta\left(\left[\rho_{neutrino}/\rho\right]^{2}\right)\right]$, as shown in CMBR data sets may be a solution.. Analysis the big bang nucleosynthesis may help explain the anomalously low value of lithium abundance in the star HE0107-5240 which by orthodox BBN should not exist, as explained by Shigeyama et al. 2003
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Introduction. The dimensional identification of energy given by p^{0} as well as variation in energy ΔE in a graviton , with $p^{0}\sim\overline{L}\cdot\mu$ and $\Delta E\sim\overline{L}\cdot\mu$ define how gravitons evolve in space time due to conditions which are related to the degree gravitons evolving in space time relate to the gravitational Lorenz violation. Note that $\overline{L}\neq 0$ extends the standard model, as given by Jenkens(2009) in which if gravitons travel with a speed of v , $\overline{L}\sim(v-c)/c$ when a dispersion relationship of $E=v|p|$ is assumed and μ is called the energy interaction scale for the energies involved. We will explain how Sergei Bashinsky's (2005) analysis fits into conditions for which $\overline{L}\rightarrow 0$, which is when variations from the standard model shrink to zero.. Bashinsky's analysis, with neutrino-graviton interaction uccur as $\overline{L}\neq 0$ becomes $\overline{L}\rightarrow 0$. We are seeking to understand if the regime where neutrino-graviton mixing may be taking place which would allow for stars like HE0107-5240 to have so little lithium in the first place.

1.Dispersion of neutrinos in early cosmology

M. Marklund, G. Brodin, and P.K. Shukla (1999) have estimated neutrino mass as $m_{\nu}^{2}=-g_{\alpha\ \beta}p^{\alpha}p^{\beta}$ where

m_{ν} is neutrino mass, $g_{\alpha\beta}$ is for a metric, and p^{α} is four momentum. If space becomes abruptly flat at the onset of inflation, for a neutrino mass, as $\overline{L}\neq 0$ approaches zero, $g_{\alpha\beta}$ approaches $g_{\alpha\alpha}$, i.e. leading to flat space, then by M. Marklund et al (1999) there exits, assuming k^{α} is for a four space wave number, the inequality

$$\omega_{F}^{2}>\left(g_{\alpha\alpha}/|g_{00}|\right)\cdot\left[k^{\alpha}\right]^{2}+2\omega_{F}\left(g_{00}/|g_{00}|\right)k^{0} \tag{1.1}$$

It is suggested that neutrino-graviton interactions would allow a researcher to input values of k^{α} , k^{0}, $g_{\alpha\alpha}$, and g_{00} when Eqn (1.1) is true, based on some of the arguments presented by Sergei Bashinsky (2005): that the neutrino has approximately $10^{28}-10^{29}$ the effective mass of a graviton.

$$m_{graviton}\leq 4.4\times 10^{-22}h^{-1}eV/c^{2}\Leftrightarrow\lambda_{graviton}\equiv\frac{\hbar}{m_{graviton}\cdot c}\sim 2.8\times 10^{15}\,meters \tag{1.2}$$

versus

$$m_{neutrino-relic-condt}\leq .5\times 10^{-1}h^{-1}eV/c^{2}\Leftrightarrow\lambda_{neutrino-relic-condt.}\equiv\frac{\hbar}{m_{n}\cdot c}\sim 2.8\times 10^{-8}\,meters \tag{1.3}$$

I.e., for non-relativistic conditions, the contribution of the neutrino is $10^{22}-10^{23}$ times larger than that from a graviton, and in certain models could be more than 10^{30} times larger than for a graviton. So for a non-relativistic graviton, $\mu/M_{Planck} \sim \overline{L} \propto \frac{c-v}{c} \Leftrightarrow \frac{p^0}{\mu} \leq 1$. Note that in gravitational Cherenkov radiation where there is relativitistic effects that instead of $\overline{L} \leq 1$, that as relativistic conditions are approached , $\frac{\mu}{M_{Planck}} \sim \overline{L} \leq 10^{-15}$ ..

Once we specify that it is likely that graviton-neutrino wave mixing took place as $\overline{L} \to 0$, we can consider entropy contributions in the time neutrinos interacted with gravitons to perturbations on DM which may also influence BBN.

2. *Entropy generation via Ng's infinite quantum statistics*

To understand the link between dark matter and gravitons, note that the "size" V of the nucleation space for dark matter is large, whereas graviton space V for nucleation is tiny, well inside inflation. Therefore, the log factor drops out of entropy S if V chosen properly for both eqn 1 and eqn 2. Ng's result begins with a modification of the entropy/ partition function, using the following approximation of temperature and its variation with respect to a spatial parameter; $T \approx R_H^{-1}$ (R_H can be thought of as a representation of the region of space where we take statistics of the particles in question). According to Ng, removing the N from the denominator of $[V/N\lambda^3]$ leads to entropy of the value of $S = (\log[Z_N])$

$$S \approx N \cdot \left(\log\left[V/N\lambda^3\right] + 5/2\right) \quad which \quad becomes \quad N \cdot \left(\log\left[V/\lambda^3\right] + 5/2\right) \approx N \tag{2.1}$$

But $V \approx R_H^3 \approx \lambda^3$, so unless N in Eqn (2.1) is about 1, S (entropy) would be < 0, which is a contradiction. Now this is where Jack Ng introduces removing the N! term in Eqn (2.1) where $g_{today} \approx 2-3$ today. We assert that Eqn (2.1) occurs in a region of spacetime before $g_{re-heat} \approx 1000$, so after reheating, Eqn (2.1) no longer holds, and we instead can look at

$$S_{total} \equiv s_{Density} \cdot V_4 = \frac{2\pi^2}{45} \cdot g_{\bullet} \cdot T^3 \cdot V_4 \tag{2.2}$$

Where $T < 10^{32} K$. We can compare Eqn (2.1) to Glinka's (2007) quantum gas, if we identify $\Omega = \frac{1}{2|u|^2 - 1}$ as a partition function (with u part of a Bogoliubov transformation) due to a graviton-quintessence gas, to get an information theory based entropy value of

$$S \equiv \ln \Omega \tag{2.3}$$

Such a linkage would open up the possibility that primordial gravitational waves could be interfering , mixing with neutrino matter waves, especially if $m_{graviton}\big|_{NON-RELATIVISTIC}$ Eventually the contributing graviton wave functional becomes, instead, the same order of magnitude as the matter wave values of neutrinos.

$$m_{graviton}\Big|_{RELATIVISTIC} < 4.4 \times 10^{-22} h^{-1} eV / c^2 \Leftrightarrow \lambda_{graviton} \equiv \frac{\hbar}{m_{graviton} \cdot c} < 2.8 \times 10^{-8} meters \tag{2.4}$$

Also, the graviton wavelength, could be within the initial sphere space time at of the onset of inflation

3. *How DM would be influenced by gravitons*

The interrelationship of structure of the profile of a DM cluster , with perturbations to DM density profile

$$\delta \equiv -\left[\frac{3}{2} \cdot \Omega_m \cdot H^2\right]^{-1} \cdot \nabla^2 \Phi \tag{3.1}$$

As told to the author by Sabino Matarre , in July , 2009, in Como Italy, the gravitational potential has , perturbatively spaking an additional term f_{NL} added to variations in the gravitational potential term which Matarre gave as

$$\Phi \equiv \Phi_L + f_{NL} \cdot \left[\Phi_L^2 - \left\langle \Phi_L^2 \right\rangle\right] + g_{NL} \cdot \Phi_L^3 \tag{3.2}$$

It is suggested that the function f_{NL} is largely due to entropy variations, some of which occurred during relic GW/graviton production. Here the expression $f_{NL} =$ variations from gaussianity. Furthermore, Φ_L is a linear Gaussian potential, and the overall gravitational potential is altered by inputs from f_{NL} . Note that neutrinos flavor physics oscillations are not very important in terms of f_{NL} , as has been specified in conversations Dr. Beckwith had in September 23, 2009 in Erice with Dr. Georg Raffert. Which leads to emphasizing the role of entropy processes due to gravition, and graviton-neutrino physics, as $\overline{L} \to 0$

4.Conclusion This paper concentrates on recent suggestions for how to look for improvements in the measurement of the primordial abundances of these nuclei after Big Bang Nucleosynthesis The start to this investigation is to explain how, and why the star HE0107-5240 could form with so little lithium in the first place. It is suggested that to explain the existence of lithium--deficient stars, the interaction of grativational waves/gravitons with neutrinos, as suggested by Sergei Bashinsky (2005) needs to be reinvestigated. As stated by Fuller et al, (2009) neutrinos could interact with DM potential wells in ways the author, Beckwith thinks could influence galaxy hierarchy formation as given by P Rosati et al (2009) will also have a counter part in deviations in the BBN nucleo synthesis of light elements, partly due to examining the role of temperature fluctuations partly modeled on Eqn (4.1) below ,leading to fluctuations affecting BBN element rarity.

$$(\delta T/T) \cong (1/3) \cdot \left[\Phi_L + \tilde{f}_{NL} \cdot \left(\Phi_L^2 - \left\langle \Phi_L \right\rangle^2\right)\right] \tag{4.1}$$

While Eqn (3.2) above would have its maximum impact for regions as of about red shift $Z \sim 1.5 - 2.0$, the impact of Eqn (4.1) would be as of red shifts $Z \sim 1000 - 1100$, with the corresponding $\tilde{f}_{NL}$ very heavily influenced by Bashinsky's (2005) neutrino – gravition damping as stated by the coefficient of density fluctuation modeifed by $\left[1 - 5 \cdot (\rho_{neutrino}/\rho) + \vartheta\left([\rho_{neutrino}/\rho]^2\right)\right]$. Note that $\tilde{f}_{NL}$ would be larger than f_{NL} of Eqn. (3.2) and would be dominated by neutrino-gravition interactions, whereas f_{NL} would likely be dominated by graviton generated entropy, with neutrinos at $Z \sim 1.5 - 2.0$ hitting DM directly.

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