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Constraining Big Bang lithium production with recent solar neutrino data

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The $^{3}\mathrm{He}(\alpha,\gamma)\,^{7}\mathrm{Be}$ reaction affects not only the production of $^{7}\mathrm{Li}$ in Big Bang nucleosynthesis, but also the fluxes of $^{7}\mathrm{Be}$ and $^{8}\mathrm{B}$ neutrinos from the Sun. This double role is exploited here to constrain the former by the latter. A number of recent experiments on $^{3}\mathrm{He}(\alpha,\gamma)\,^{7}\mathrm{Be}$ provide precise cross section data at E = 0.5-1.0 MeV center-of-mass energy. However, there is a scarcity of precise data at Big Bang energies, 0.1-0.5 MeV, and below. This problem can be alleviated, based on precisely calibrated $^{7}\mathrm{Be}$ and $^{8}\mathrm{B}$ neutrino fluxes from the Sun that are now available, assuming the neutrino flavour oscillation framework to be correct. These fluxes and the standard solar model are used here to determine the $^{3}\mathrm{He}(\alpha,\gamma)\,^{7}\mathrm{Be}$ astrophysical S-factor at the solar Gamow peak, $S^{\nu}_{34}(23^{+6}_{-5}) = 0.548 \pm 0.054$ keV b. This new data point is then included in a re-evaluation of the $^{3}\mathrm{He}(\alpha,\gamma)\,^{7}\mathrm{Be}$ S-factor at Big Bang energies, following an approach recently developed for this reaction in the context of solar fusion studies. The re-evaluated S-factor curve is then used to re-determine the $^{3}\mathrm{He}(\alpha,\gamma)\,^{7}\mathrm{Be}$ thermonuclear reaction rate at Big Bang energies. The predicted primordial lithium abundance is $^{7}\mathrm{Li/H} = 5.0 \times 10^{-10}$, far higher than the Spite plateau.

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