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The Primordial Lithium Problem : Can We Avoid New Physics ?

The primordial abundances of light elements form an important evidence of the Big Bang Model of the universe. With precise measurements of the baryon-to-photon ratio, \eta from WMAP, these final abundances, which are functions of \eta alone in general, are fixed and must be consistent. As a result, any discrepancy between the theoretical and observational abundances of these elements, as exists for lithium, may be due to inadequacies in the Big Bang Nucleosynthesis (BBN) Model which is based on the Standard Model of particle physics and cosmology. In fact, the theoretical Li-7 abundance is 3-4 times more than the observational value inferred from \eta_{WMAP} ; this is known as the "Lithium Problem". This could potentially point to new physics beyond the Standard Model. However, one must first exhaust standard alternatives / solutions before resorting to new physics. Here we examine solutions within standard nuclear physics that lead to additional destruction of A=7 isotopes due to new nuclear reaction channels or upward corrections to existing channels, as the production channels are more constrained. This could be achieved within the Standard Model via missed resonant nuclear reactions, which is the possibility explored here. We find some potential candidate resonances that can solve the lithium problem and specify required resonance energies and widths. For all of these states, a large channel radius (a > 10 fm) is needed to give sufficiently large widths. These resonance properties need experimental verification. If experiment rules them out, then we may be compelled to invoke new physics to solve the lithium problem and potentially constrain new physics models.

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