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Neutrinos, BBN and Nuclear Astrophysics

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Big Bang Nucleosynthesis (BBN) theory describes the formation of light isotopes such as D, ^3He , ^4He , ^6Li and ^7Li in the first minutes of cosmic time. Their abundance only depends on the baryonic density, on particle physics and on nuclear astrophysics, through the competition between the universal expansion rate and the yields of relevant nuclear reactions. As the expansion rate depends on the number of active neutrino families (and any other relativistic species), the comparison between computed and observed abundances of light isotopes allows to constrain the number of neutrinos species, provided that the knowledge of the relevant nuclear processes is accurate enough.

Starting from the present uncertainty of the relevant parameters (i.e. baryonic density [1,2], observed abundance of isotopes [3,4] and BBN nuclear cross sections [5]), it will be shown that a renewed study of several nuclear reactions, possibly with existing or proposed underground accelerator facilities [6], is essential to improve the accuracy of computed abundances of light isotopes, providing the BBN theory a powerful probe of particle physics beyond the standard model [7]. In particular, it will be shown that the accurate measurement of the $\text{D}(p,\gamma)^3\text{He}$ reaction at BBN energies (50-500 keV), is of primary importance to constrain the number of active neutrinos and/or the lepton degeneracy in the neutrino sector [7,8].

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