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Exploring Neutron Channel Solutions for the Cosmological Lithium Problem at CERN/n_TOF

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Nuclear reactions responsible for the creation and destruction of Be-7 (the progenitor of Li-7), during Big Bang Nucleosynthesis (BBN), play the key role in the determination of the resulting primordial abundance of Li-7, the third chemical element formed during the very early phase of evolution of the Universe. Current standard BBN models predict a Li-7 abundance which is a factor of 2-3 larger than what is determined by astronomical observations. A neutron channel which could enhance the destruction rate of Be-7 during BBN has been recently investigated, amongst others, at the neutron time-of-flight facility, n_TOF a CERN, Geneva.

n_TOF (neutron time-of-flight) is the pulsed neutron source based on the spallation process induced by the 20 GeV/c proton beam of the CERN accelerator complex injected on a lead target. The source is coupled to two flight paths, one of 185 m and the other of 20 m length. The facility has been designed to study neutron-nucleus interactions for kinetic neutron energies ranging from a few meV to several GeV. The kinetic energy of the neutrons is determined by measuring the time of flight, hence the name n_TOF (www.cern.ch/ntof).

At n_TOF, the 7Be(n,a)4He reaction has been recently measured for the first time in a wide incident neutron energy range(*), allowing to put severe constrains on one of the Be-7 destruction mechanisms during BBN. A second reaction channel, the 7Be(n,p)7Li has been explored, again extending the reaction cross section data to a wider range and, therefore, allowing for an update of the related reaction rate to be used in standard BBN network calculations.

The new experimental results, theoretical interpretations and implications of these two reaction channels on the Cosmological Lithium Problem will be presented.

(*) M Barbagallo et al. (The n_TOF Collaboration), Phys. Rev. Lett. 117, 152701 (2016).

Selected session

Nuclear Astrophysics

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