Contribution ID: **5** Type: **not specified**

Measurement and DWBA analysis of the 7Li(3He,d)8Be reaction cross sections at E(3He) = 20 MeV

The elucidation of production and destruction processes of Lithium, Beryllium and Boron light elements both in stellar and interstellar media is of crucial interest in connection with several astrophysical problems. In addition to the rarity of Li, Be and B elements in the solar-system (the Li-Be-B problem), some of these problems are, e. g., the origin and interactions of cosmic rays, galactic chemical evolution and gamma-ray astronomy. Important efforts have been made previously in order to improve our knowledge of these problems, and the current work dealing with the7Li (p, α) α nuclear reaction enters in this framework. This reaction indubitably contributes to the depletion of lithium in stellar interiors and, consequently, the corresponding rate needs to be determined with the highest possible precision at stellar temperatures. Several experiments have been carried out to perform direct measurements of the astrophysical S (E)-factor for this reaction [1-3]. This method would yield more accurate results if the partial (reduced) widths involved in theoretical expressions to be fitted to experimental data were known with limited uncertainties. Alternatively, this goal may be more easily attained, for instance, via a DWBA theoretical analysis of angular distribution experimental data for the7Li (3He, d) 8Be proton-transfer reaction where the 2+ excited states of 8Be of astrophysical interest at Ex = 16.626 MeV and 16.922 MeV are formed with high cross sections. In this work, the angular distributions for these states and the 1+ state at 17.640 MeV produced in the later reaction have been measured at the Orsay –Institut de Physique Nucléaire tandem accelerator for E_(3_He)=20 MeV, using a high energy resolution position sensitive detection system on the line of the split-pole electromagnetic spectrometer. Then, the measured cross section data have been carefully analyzed within the DWBA theory, extracting relevant values of the nuclear level spectroscopic and asymptotic normalization factors that are reported and discussed here in comparison to previous ones from the literature [4, 5].

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