Consistent analysis of deuteron interactions at low and medium energies

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Abstract

A detailed analysis of the deuteron induced reactions starting from the full parametrization procedure [1] towards the consideration of the theoretical models associated to the reaction mechanisms involved in the deuteron interaction process is carried out.

Specific non-compound processes as breakup (BU) and direct reactions (DR) make the deuteron-induced reactions substantially different from reactions with other incident particles. The deuteron interaction with low and medium mass target nuclei and incident energies below and around the Coulomb barrier proceeds largely through stripping and pick-up DR mechanisms, while pre-equilibrium emission (PE) and evaporation from fully equilibrated compound nucleus (CN) become important at higher energies (e.g., [2] and Refs. therein). Moreover, the deuteron breakup mechanism is quite important along the whole incident-energy range [3]. Thus, significant discrepancies with measured cross sections follow the scarce consideration of only PE and CN mechanisms while microscopic calculation of inclusive BU and DR cross sections are yet numerically tested (e.g., [4] and Refs. therein).

However, whereas the associated models for DR, PE, and CN mechanisms are already settled, an increased attention should be paid to the theoretical description of the BU two components, namely the elastic BU, with no interaction target nucleus-–breakup nucleons, and inelastic BU or breakup fusion (BF), where one of the deuteron constituents interacts non-elastically with the target nucleus. This is why a comparative assessment of measured data and results of BU microscopic description [5,6], as well as current parametrization [7] already involved within recent systematic studies [3] is equally useful to basic studies and improved nuclear data calculations. Actually, missing of the suitable BU+DR analysis leads to still large disagreement between the experimental and evaluated deuteron-activation excitation functions [8]

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