Towards a more complete description deuteron-induced reactions

Deuteron-induced reactions are being used to produce medical radioisotopes [1] and as surrogates to other reactions (see review [2] and references therein), among recent applications. Although they have been studied for decades [3-6], their complexity continues to make their theoretical description challenging. The direct reaction mechanism is a major contributor to the reaction cross section due to the low binding energy of the deuteron. Competition between elastic breakup, absorption of only a neutron or a proton (stripping and inelastic breakup) and absorption of the deuteron must be taken into account to determine the formation or not of a compound nucleus and its subsequent decay. The inelastic breakup reactions – those in which either only a neutron or a proton is absorbed – are particularly complex, as they form compound nuclei with a wide range of excitation energies and angular momenta. We present the results of a theoretical study of elastic and inelastic deuteron breakup for a large selection of targets at incident deuteron energies below 100 MeV. We use the zero-range post-form DWBA approximation to calculate the elastic breakup cross section [3,4] and its extension to absorption channels to calculate the inelastic breakup cross sections [5,6]. We look in detail at the extent to which our DWBA is capable of describing the inclusive breakup cross sections. We also discuss the regularities and ambiguities in our results, as well as the irregularities in the inelastic breakup energy and angular momentum distributions that complicate their substitution by a smooth distribution obtained from systematics.

References

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