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Systematics of Elastic and Inelastic Deuteron Breakup

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Deuteron-induced reactions are being used to produce medical radioisotopes [1] and as surrogates to other reactions (see review [2] and references therein), among their recent applications. Although they have been studied for decades [3-6], the complexity of these reactions 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 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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