Theory of deuteron stripping: From surface integrals to a generalized R-matrix approach

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There are two main reasons for the absence of a practical theory of stripping to resonance states that could be used by experimental groups: The numerical problem of the convergence of the distorted-wave Born approximation (DWBA) matrix element when the full transition operator is included and the ambiguity over what spectroscopic information can be extracted from the analysis of transfer reactions populating the resonance states. To address both questions in this paper a new theory of the deuteron stripping based on the surface integral formalism [1] and generalized R-matrix approach is developed. The theory uses post continuum discretized coupled channels (CDCCs) formalism going beyond of the DWBA. First, the formalism is developed for the DWBA and then it is extended to the CDCC formalism, which is the ultimate goal of this work. The CDCC wave function takes into account not only the initial elastic d + A channel but also its coupling to the deuteron breakup channel p + n + A missing in the DWBA. Stripping to both bound states and resonances is included. The convergence problem for stripping to resonance states is solved in the post CDCC formalism. The reaction amplitude is parametrized in terms of the reduced width amplitudes (asymptotic normalization coefficients), inverse level matrix, boundary condition, and channel radius, which are the same parameters used in the conventional R-matrix method. For stripping to resonance states, many-level and one- and two-channel cases are considered. The theory provides a consistent tool to analyze both binary resonant reactions and deuteron stripping in terms of the same parameters. The paper was published in Phys. Rev. C **84**, 044616 (2011).

[1] A.S. Kadyrov *et al.*, Ann. Phys. **324**, 1516 (2009).