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Deuteron-Alpha Scattering in a Three-Body Approach

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Single particle transfer reactions (d,p) involving rare isotopes continue to be an important tool for extracting nuclear structure information such as asymptotic normalizations coefficients, and contribute to the understanding of the dynamics of the reactions. The (d,p) reaction may be viewed as a three-body $n+p+A$ problem in which the deuteron and the nucleus A act as participants in the reaction. It is advantageous to consider this reaction within a momentum space Faddeev framework, which allows treating all channels on the same footing, independent if the nucleus is heavy or light.

As first application we concentrate on the deuteron-alpha system, for which we calculate d+alpha elastic scattering below and above the three-body breakup threshold, as well as exclusive break-up cross section in several configurations. The interactions in the respective two-body subsystems are given by multi-rank separable representations of realistic interactions based on the Ernst-Shakin-Thaler formulation, which have also been successfully applied in calculating the ground state of Lithium-6 as three-body system. We benchmark the calculations employing separable representations of the forces in the subsystems against calculations in which those forces are used directly and find excellent agreement for relatively moderate basis sizes in the separable expansion.

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