Contribution ID: **176**   Type: **Poster**

Quantifying uncertainties due to irreducible three-body forces on deuteron-nucleus reactions

Deuteron-induced nuclear reactions are typically described within a Faddeev three-body model consisting of a neutron, proton, and the nucleus interacting through pairwise forces. While Faddeev techniques enable the exact description of the three-body dynamics, their predictive power is limited in part by the omission of irreducible three-body nucleon-nucleon-nucleus forces. An alternative approach for describing deuteron-nucleus reactions is ab initio theory, where the system is described from first principles, starting from individual nucleons and the interactions amongst them. We adopt the ab initio no-core shell model (NCSM) coupled with the resonating group method (RGM) to compute microscopic nucleon-nucleus interactions and use them to describe deuteron-induced reactions by means of momentum space Faddeev calculations, beginning with 2H+4He scattering. Simultaneously, we also carry out ab initio calculations of the same deuteron-induced scattering process within the NCSM/RGM approach. I will show that the effects of the irreducible three-body force are not negligible and impact bound state energies as well as cross sections. I will also demonstrate that the irreducible three-body force arises from the complete antisymmetrization of the nucleon-nucleon-nucleus system. This finding paves the way for improved Faddeev calculations of deuteron-nucleus reactions.

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Session Classification: Poster Session

Track Classification: Poster Presentations