New Developments in Few-Cluster Nuclear Reactions

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A rigorous few-body scattering theory as proposed by Faddeev and extended by Yakubovsky and Alt, Grassberger and Sandhas is implemented in the momentum-space framework. Past applications include the nucleon-deuteron scattering, three-cluster nuclear reactions, and four-nucleon scattering. Recent and ongoing extensions of this framework will be presented. First, we made a two-fold extension of the standard dynamics by developing a new nonlocal form of optical potentials and simultaneously including the excitation of the nuclear core. Example results for nucleon transfer reactions (d,p) and (p,d) and deuteron inelastic scattering (d,d′) ^{10}Be and ^{24}Mg nuclei demonstrate a good reproduction of the experimental data and an improved consistency between the two-body (elastic and inelastic nucleon-nucleus scattering) and three-body description [1, 2]. Second, the four-nucleon scattering is extended to higher energies. Exact four-body calculations are compared with those based on microscopic optical potential with no-core shell model densities, allowing to evaluate the the reliability of the optical potential method. Third, reactions in hypernuclear three-body systems are described fully including the coupling between the nucleon-Lambda and nucleon-Sigma(+,0,-) states, which a highly complicated problem with many thresholds. The impact of the resonant states on various elastic and inelastic cross sections is studied.

References

[1] A. Deltuva, D. Jurčiukonis, *Phys. Let. B* **840** (2023) 137867.

[2] A. Deltuva, D. Jurčiukonis, *Phys. Rev. C* **107** (2023) 064602.