Modeling of reactions with exotic nuclei

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Probing the structure of exotic nuclei necessarily requires some kind of reaction, and so the accurate determination of exotic structures almost always depends on a precise theory of nuclear reactions.

For exotic halo nuclei, their loosely bound structure allows simple few-body or cluster models to largely account for the most general properties of the halo states. The cluster structure allows transparent reaction models to be formulated, but, because of the soft nature of halo configurations, these same models must be solved with fewer approximations.

Traditionally, the experimental examination of halo states has been gained from measuring either total reaction cross sections, momentum distributions of the breakup fragments, or beta decays to or from halo states. Recent information has been obtained from more precise breakup and particle transfer reactions, and these have provided new details that challenge both halo structure models and theories of reaction dynamics. New developments in the precision of breakup and transfer theories have lead to continuing revisions of our views of halo structures, and such theories will soon contribute to the most reliable probes of halo nuclei.

I will review the state of the art for the modeling of breakup reactions [1], transfers to bound states [2], fusion calculations at low energy [3], and stripping reactions at high energy [4]. In each case we will find that we use reaction theory, and comparison of predictions with experiment, to learn about the details of *both* the exotic nuclear structure *and* the detailed reaction mechanisms. It is only by the accurate modeling of reactions with both known and unknown (stable and exotic) nuclei that we can systematically extend our knowledge of nuclear states.

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