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From ab initio structure predictions to reaction calculations via effective field theory

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Halo nuclei exhibit an uncommon nuclear structure with a larger matter radius compared to stable nuclei [1]. This large size is qualitatively understood as due to the loose binding of one or two valence neutrons, which have then a high probability of presence at a large distance from the other nucleons. They thus form a sort of halo around the compact core of the nucleus. The best known examples are 11Be, with a one-neutron halo, and 11Li, with a two-neutron halo. Due to their short lifetime, these nuclei are mostly studied through reactions like breakup [2]. In order to extract valuable structure information from measured cross sections, a precise model of the reaction coupled to a reliable description of the projectile is needed. Many such models have been developed (see Ref. [3] for a recent review). However, they mostly rely on a simple two- or three-body description of the nucleus. Recently, some of these exotic nuclei have become accessible to ab initio calculations [4]. Unfortunately, such A-body descriptions are too computationally demanding to be directly included within existing reaction models. In the present work, we use the outputs of an ab initio calculations of 11Be as inputs to the description
of that nucleus within a reliable breakup model [5]. That description is inspired by an effective field theory treatment of 11Be [6] (see Ref. [7] for a recent review). Our calculations of the breakup of 11Be on Pb and C at about 70AMeV are in very good agreement with experimental measurements [2]. These excellent results prove the feasibility of incorporating results from ab initio calculations in reaction theory in this way. More importantly, they confirm the results for important aspects of 11Be obtained by the calculations of Calci et al. [4], hence improving our understanding of the nuclear structure far from stability.

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Summary

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