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Halo and unbound light nuclei from ab initio theory

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In recent years, significant progress has been made in ab initio nuclear structure and reaction calculations based on input from QCD employing Hamiltonians constructed within chiral effective field theory. One of the modern approaches is the No-Core Shell Model with Continuum (NCSMC) [1,2], capable of describing both bound and scattering states in light nuclei simultaneously. We will present latest NCSMC calculations of weakly bound states and resonances of exotic halo nuclei 11Be and 15C and discuss the photo-dissociation of 11Be and 14C(n,γ)15C capture. We will also present our results for their unbound mirror nuclei 11N and 15F, respectively. We will point out the effects of continuum on the structure of mirror resonances and highlight the role of chiral NN and 3N interactions. Finally, we will discuss polarization effects in the 3H(d,n)4He fusion [3]. This transfer reaction is relevant for primordial nucleosynthesis and is being explored in large-scale experiments such as NIF and ITER as a possible future energy source.

[1] S. Baroni, P. Navratil, and S. Quaglioni, Phys. Rev. Lett. 110, 022505 (2013); Phys. Rev. C 87, 034326 (2013).
[2] P. Navratil, S. Quaglioni, G. Hupin, C. Romero-Redondo, A. Calci, Physica Scripta 91, 053002 (2016).
[3] G. Hupin, S. Quaglioni, and P. Navratil, Nature Communications (2019) 10:351; https://doi.org/10.1038/s41467-018-08052-6

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