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Insights into the reactions and structure of light nuclei from Effective Field Theory.

In this talk I will show how an Effective Field Theory for weakly-bound few-body systems ("Halo EFT") aids the modeling and understanding of light nuclei in the p-shell. After introducing Halo EFT I will discuss two examples of its use. First, I will describe our recent analysis of the reaction ^{3}He(α, γ) [1]. In this case we take ^{3}He and ^{4}He as the effective degrees of freedom and work to next-to-leading order in the EFT. We use a Bayesian analysis to perform the extrapolation of higher-energy data to solar energies and find a markedly smaller uncertainty to previous evaluations, as well as significant constraints on ^{3}He-^{4}He scattering parameters. Second, I will demonstrate that a three-body (α-neutron-proton) model of ^{6}Li exhibits a correlation between the deuteron-α scattering length and the ^{6}Li binding energy [2]. Such correlations appear generically in three-body systems with weak binding (cf. the Phillips line in the $A = 3$ system) and can be understood as a consequence of the requirement that the EFT be renormalized. The emergence of such a correlation in the presence of p-wave nucleon-α interactions is particularly striking, as is the fact that it is rather insensitive to the actual values of the p-wave phase shifts. I will close by discussing the implications of this finding for model and EFT treatments of ^{6}He and ^{6}Li.

[1] S-factor and scattering parameter from ^{3}He + ^{4}He $\rightarrow$ ^{7}Be + γ data, X. Zhang, K. M. Nollett, and D. R. Phillips, arXiv:1811.07611, to appear in the proceedings of the 22nd International Conference on Few-body Problems in Physics.
[2] Few-body universality in the deuteron-α system, J. Lei, L. Hlophe, Ch. Elster, A. Nogga, F. M. Nunes, and D. R. Phillips, Phys. Rev. C **98**, 051001 (2018).

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