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Ab initio intruder states, electric monopole transitions, and shape mixing

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Abstract

Shape coexistence plays an essential role in the structure of light nuclei, including in the p shell, where excitations across the $N = 8$ or $Z = 8$ shell closures give rise to low-lying intruder states. Furthermore, electric monopole ($E0$) transitions are traditionally interpreted as providing a signature of shape coexistence, although only a handful of $E0$ strengths have been measured in p-shell nuclei. To the extent that *ab initio* calculations provide an accurate description of the wave functions for these light nuclei, we can use such calculations to gain insight into aspects of nuclear structure about which we could otherwise only speculate based on phenomenological arguments and limited data. In this talk we will explore: (1) the appearance of intruder states in *ab initio* no core-configuration interaction, or no-core shell model, calculations, (2) the use of $E0$ transitions to diagnose shape mixing in the calculated wave functions, and (3) the importance of quantatively understanding this shape mixing (in particular, the mixing matrix element) in order to extract *ab initio* predictions for $E0$ transitions.