Shape mixing and clustering in nuclei: Probing physics beyond the standard model

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Abstract

Dominant shapes naturally emerge in atomic nuclei from first principles (Fig. 1), thereby establishing the shape-preserving symplectic $\text{Sp}(3,\mathbb{R})$ symmetry \([2,3]\) as remarkably ubiquitous and approximate symmetry in nuclei \([1]\). In this talk, I will discuss the critical role of this symmetry in enabling machine-learning descriptions of heavy nuclei \([4]\), \textit{ab initio} modeling of $\alpha$ clustering and collectivity, as well as tests of beyond-the-standard-model physics \([5]\). I will report recent results, in the \textit{ab initio} symmetry-adapted framework, that place unprecedented constraints on recoil corrections in the \(^{8}\text{Li}\) $\beta$ decay and help experiment establish the most stringent limit on tensor current contribution to the weak interaction to date, while explaining the Gamow-Teller $\beta$-decay discrepancy in the mass-8 systems \([5]\). [Supported by the U.S. NSF (PHY-1913728) and the Czech Science Foundation (16-16772S) & benefitted from HPC resources provided by LSU, NERSC, and Frontera.]

References


Figure 1. Emergence of almost perfect symplectic $\text{Sp}(3,\mathbb{R})$ symmetry in nuclei from first principles, enabling \textit{ab initio} descriptions of collectivity and clustering \([1]\).