Emergent symmetries in nuclei: Probing physics beyond the standard model

K.D. Launey[1], **G.H. Sargsyan**[1], **A. Mercenne**[2], **M. Burrows**[1], **O.M. Molchanov**[1], **T. Dytrych**[1,3], **J.P. Draayer**[1]

[1]Department of Physics and Astronomy, Louisiana State University, USA
[2]Center for Theoretical Physics, Yale University, USA
[3]Nuclear Physics Institute of the Czech Academy of Sciences, Czech Republic

Abstract

Dominant shapes naturally emerge in atomic nuclei from first principles (Fig. 1), thereby establishing the shape-preserving symplectic Sp(3,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], *ab initio* modeling of α clustering and collectivity, as well as tests of beyond-the-standard-model physics [5]. I will report recent results, in the *ab initio* symmetry-adapted no-core shell model, that place unprecedented constraints on recoil corrections in the ^{8}Li$\rightarrow$^{8}Be β decay and help high-precision experiment establish the most stringent limit on tensor current contribution to the weak interaction to date, while explaining the Gamow-Teller β-decay discrepancy in the mass-8 systems [5]. [Supported by the U.S. NSF (PHY-1913728) and the Czech Science Foundation (22-14497S) & benefitted from HPC resources provided by LSU, NERSC, and Frontera.]

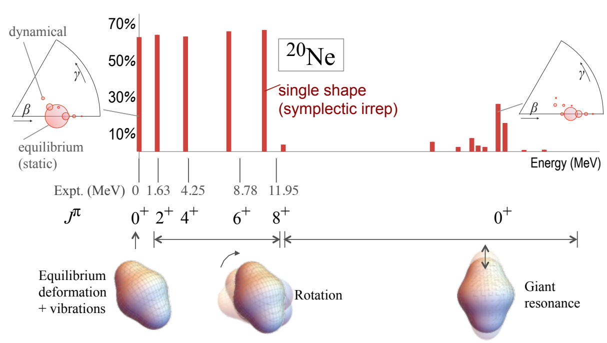

Figure 1. Emergence of almost perfect symplectic Sp(3,R) symmetry in nuclei from first principles, enabling *ab initio* descriptions of collectivity and clustering [1].

References

[1] T. Dytrych et al., *Phys. Rev. Lett.* **124** (2020) 042501.
[2] G. Rosensteel, D.J. Rowe, *Phys. Rev. Lett.* **38** (1977) 10.
[3] J.P. Draayer, K. Weeks, G. Rosensteel, *Nucl. Phys.* **A413** (1984) 215.
[4] O. M. Molchanov et al., *Phys. Rev. C* **105,** (2022) 034306.
[5] G.H. Sargsyan et al., *Phys. Rev. Lett.* **128** (2022) 202503; M.T. Burkey et al. *Phys. Rev. Lett.* **128** (2022) 202502.