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Understanding the Effect of the Chiral EFT Interaction on Nuclear Collectivity From an Ab Initio Symmetry-Adapted Perspective

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In this talk, I will discuss an *ab initio* approach which exploits symplectic symmetry in order to provide a physically informed basis that successfully describes collective and clustering features, including quadrupole moments, electromagnetic transitions, as well as alpha widths, in light to intermediate-mass nuclei [1, 2, 3]. Looking towards the high-precision physics era, we study uncertainties on collective observables computed with chiral effective field theory interactions by coupling the framework of the symmetry-adapted no-core shell model with the method of global sensitivity analysis [4]. Specifically, we generate large samples of the low-energy constants (LECs) that parametrize chiral potentials, in order to obtain distributions of observables such as the quadrupole moment in 6Li and 12C. We then compute Sobol sensitivity indices to determine the contribution of the variance in each LEC to the overall variance observed in these distributions. For the first time we determine the underlying forces to which collective observables are most sensitive. This study is a first step in the construction of high-precision nuclear interactions, which coupled with Bayesian analysis will aim to provide rigorous uncertainty quantifications on collective nuclear observables.

[1] "Physics of Nuclei: Key Role of an Emergent Symmetry"; T. Dytrych, K. D. Launey, J. P. Draayer, D. J. Rowe, J. L. Wood, G. Rosensteel, C. Bahri, D. Langr, R. B. Baker; Phys. Rev. Lett. 124, 042501 (2020)

"Clustering and Alpha-Capture Reaction Rate from Ab Initio Symmetry-Adapted Description of 20Ne"; A. C. Dreyfuss, K. D. Launey, J. E. Escher, G. H. Sargsyan, R. B. Baker, T. Dytrych, J. P. Draayer; Phys. Rev. C 102, 044608 (2020)

"Nuclear Dynamics and Reactions in the Ab Initio Symmetry-Adapted Framework"; K. D. Launey, A. Mercenne, T. Dytrych; Annu. Rev. Nucl. Part. Sci. 71, 253–277 (2021)

"Global Sensitivity Analysis of Bulk Properties of an Atomic Nucleus"; A. Ekström, G. Hagen; Phys. Rev. Lett. 123, 252501 (2019)

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