

## **New Horizons in *Ab Initio* Nuclear Structure Theory**

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Low-energy nuclear theory has entered an era of *ab initio* nuclear structure and reaction calculations based on input from QCD. One of the most promising paths from QCD to nuclear observables employs Hamiltonians constructed within chiral effective field theory as starting point for precise *ab initio* many-body approaches. However, the full inclusion of chiral two- plus three- plus multi-nucleon interactions in exact or approximate many-body calculations poses a formidable challenge. I discuss recent breakthroughs that allow for *ab initio* calculations for ground states and spectra of nuclei throughout the p- and the lower sd-shell with full 3N interactions using consistent Similarity Renormalization Group (SRG) transformations and the Importance-Truncated No-Core Shell Model (IT-NCSM). This framework allows for predictions of nuclear structure phenomena of experimental relevance starting from chiral Hamiltonians rooted in QCD (bottom-up approach) as well as for a validation of the fundamental theoretical ingredients by confrontation with experimental nuclear structure data (top-down approach). I present recent highlights illustrating this two-way link between QCD and nuclear structure. Moreover, I discuss extensions of these *ab initio* calculations to heavy nuclei within coupled-cluster theory and the in-medium SRG, to low-energy reactions of astrophysical relevance, and to p-shell hypernuclei.

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