Light Nuclei with Novel Chiral NN Interaction

Objectives

- Predict properties of stable and unstable light nuclei and quantify their uncertainties
- Verify order-by-order convergence of chiral effective field theory using novel semi-local NN interaction
- Produce accurate predictions of nuclear properties with the *ab initio* no-core shell model appropriate for experimental tests

Impact

- Guides experimental programs at FRIB and other rare isotope beams facilities
- Demonstrates the predictive power of *ab initio* nuclear theory for nuclear properties
- Establishes foundation for precision determination of theoretical many-nucleon interactions

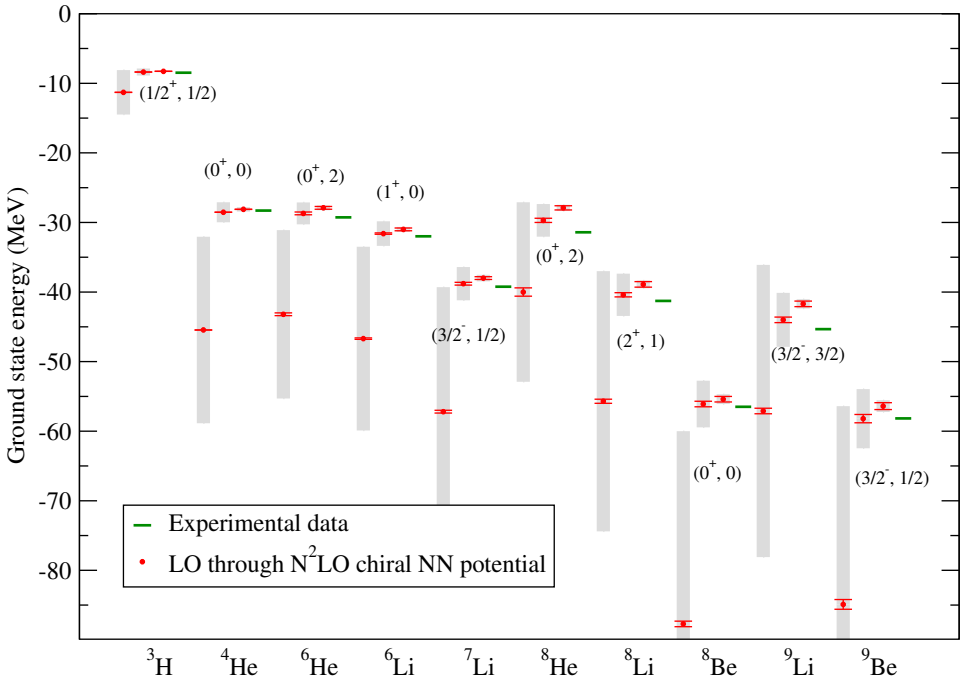

Figure: Ground state energies at Leading Order (LO), shown as the leftmost red point for each nucleus; at Next-to-Leading Order (NLO) shown as the adjoining red point; and at Next-to-Next-to-Leading Order (N^2LO) shown as the rightmost red point for each nucleus. Experimental data are indicated in green. For each calculated result, extrapolation uncertainties are indicated by red vertical bars. Uncertainty estimates due to truncating the chiral expansion at each order are indicated by the grey bars.

Accomplishments

1. Demonstrated the need for three-nucleon interactions at N^2LO at mass number 6 and higher
2. Confirmed that theory predicts the correct ground state spins and parities for these nuclei
3. Established a theoretical pathway for predicting properties of rare and unstable isotopes of light nuclei with quantified uncertainties
4. Achieved understanding of theoretical uncertainties in light nuclei due to truncating the chiral expansion at the level of N^2LO

U.S. DEPARTMENT OF ENERGY | Office of Science

NUCLEI Nuclear Computational Low-Energy Initiative

References: S. Binder, et al., LENPIC Collaboration, Phys. Rev. C 93, 044002 (2016); S. Binder, et al., in preparation

Contacts: pmaris@iastate.edu; jvary@iastate.edu; furnstah@mps.ohio-state.edu