Quantum Monte Carlo calculations of nuclei with local chiral interactions

U.S. DEPARTMENT OF ENERGY | Office of Science

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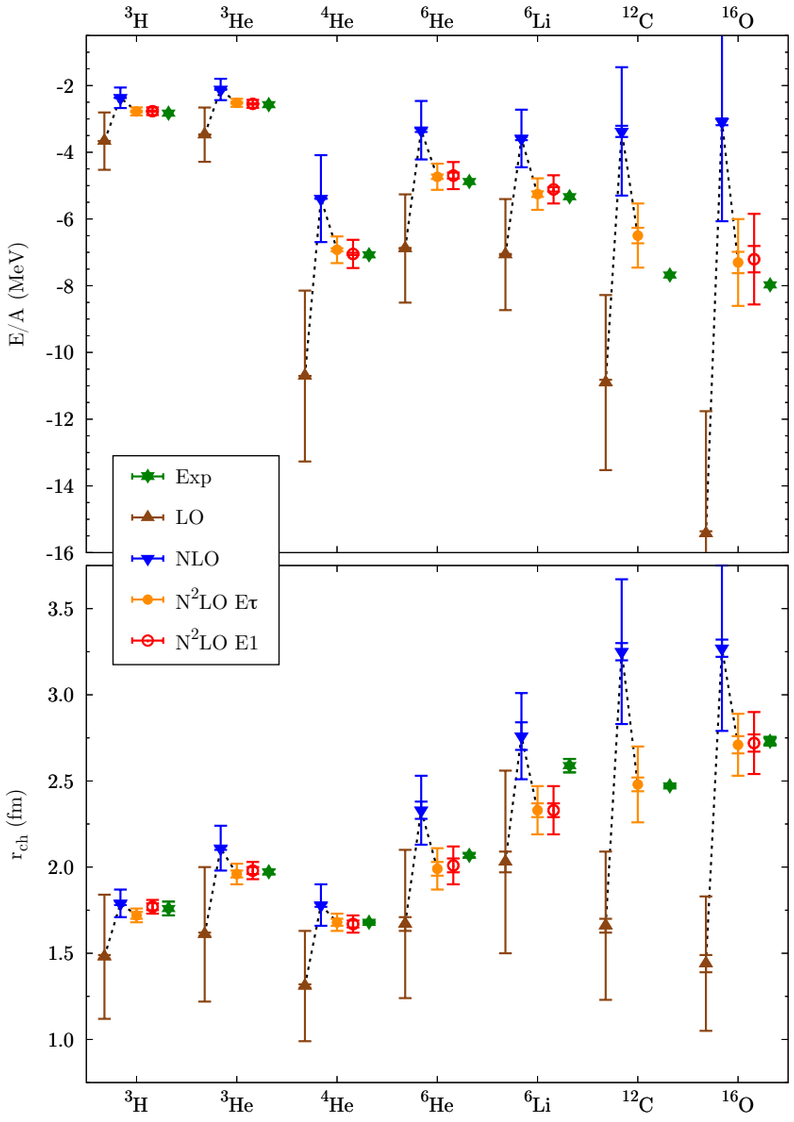
Objectives

- We use the Auxiliary Field Diffusion Monte Carlo (AFDMC) method to calculate ground state properties of nuclei up to *A*=16.
- We employ local chiral interactions up to next-to-next-to-leading order (N^2LO), including consistent three-nucleon forces, fit to few-body observables.



Energies and charge radii of nuclei with $3 \le A \le 16$ employing local chiral interactions up to N^2LO for different parametrizations of the three-body force ($E\tau$, $E1$) and coordinate-space cutoff R_0=1.0fm.

Impact

- The AFDMC method is successfully applied to the study of both closed- and open-shell nuclei employing the full two- plus three-body Hamiltonian in the imaginary time propagation.
- The employed local chiral interactions provide a good description of ground state properties (binding energies, charge radii, charge form factors) of nuclei up to oxygen, while simultaneously predicting properties of neutron matter compatible with neutron star observations.
- In addition to the Monte Carlo statistical uncertainties, we examine the theoretical uncertainties associated with the chiral expansion and the cutoff in the theory, as well as the associated operator choices in the three-nucleon forces. Harder interactions show independence of such a choice up to *A*=16.

Accomplishments

- Publications:

D. Lonardoni, J. Carlson, S. Gandolfi, J. E. Lynn, K. E. Schmidt, A. Schwenk, and X. B. Wang, Phys. Rev Lett. 120, 122502 (2018)

D. Lonardoni, S. Gandolfi, J. E. Lynn, C. Petrie, J. Carlson, K. E. Schmidt, and A. Schwenk, Phys. Rev. C 97, 044318 (2018)