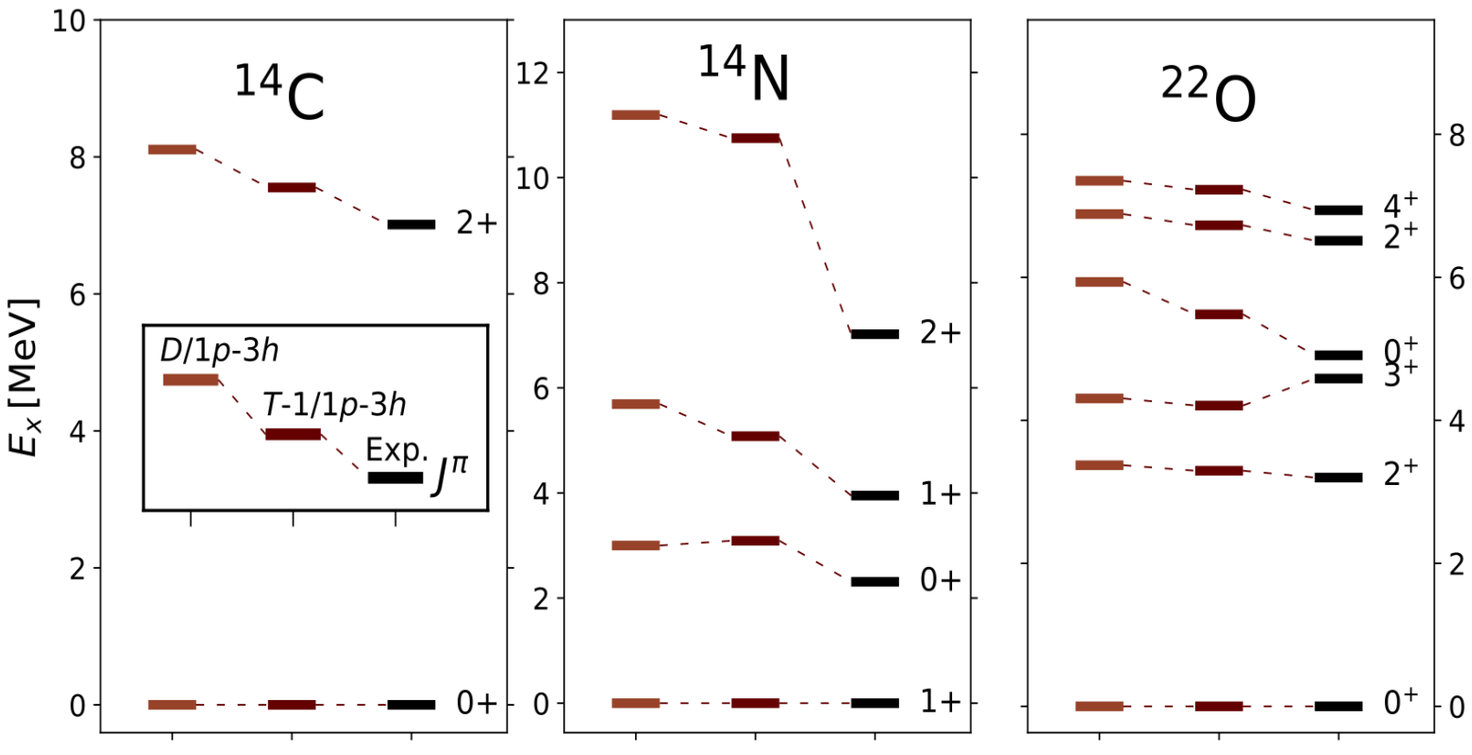
Structure and dynamics of open-shell nuclei from spherical coupled-cluster theory

U.S. DEPARTMENT OF ENERGY | Office of Science

NUCLEI Nuclear Computational Low-Energy Initiative

Objectives

- Extend the coupled-cluster method to selected open-shell nuclei characterized by having two nucleons removed from a shell closure, dubbed as two-particle-removed (2PR) systems.
- Validate the new approach on ground-state energies, excited states, and electric dipole polarizabilities in the oxygen and calcium isotopic chains.



Excitation energies of low-lying states in ^{14}C, ^{14}N and ^{22}O, obtained using the 2PR approach with the chiral interaction ΔNNLO$_{GO}$(394), in comparison to experimental data. Results shown in dark brown were obtained with the most accurate approximation scheme currently available for 2PR nuclei.

Impact (as of now)

- Achieved an accuracy for binding energies and selected low-lying excited states comparable to established closed-shell coupled-cluster theory.
- Found consistency between experimental data and predictions of binding energies and positive-parity low-lying excited states.
- 2PR predictions for the electric dipole polarizability underestimate experiment, pointing toward the need of including higher order correlations in the many-body expansion.

Accomplishments (as of now)

- Pre-print: F. Marino, F. Bonaiti, S. Bacca, G. Hagen, G. R. Jansen, arXiv:2504.11012 [nucl-th].