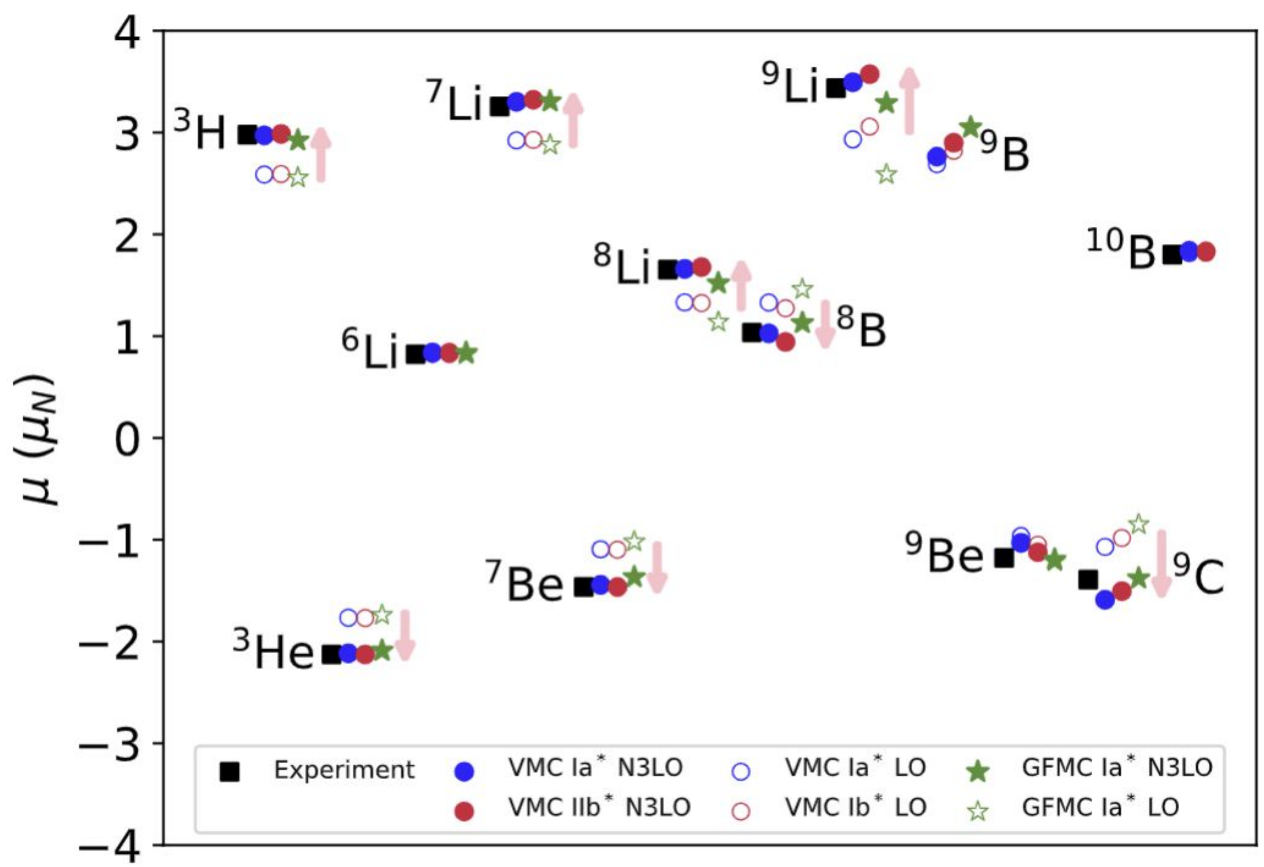
Magnetic structure of light nuclei

U.S. DEPARTMENT OF ENERGY | Office of Science

NUCLEI Nuclear Computational Low-Energy Initiative

Objectives

In this work, we computed magnetic moments, two-body densities, and form factors in light nuclei using quantum Monte Carlo (QMC) methods. We compared our results to measured data, where available, to validate the nuclear model derived in chiral effective field theory (χEFT). Generally, good qualitative agreement was found between QMC and experimental data.



Magnetic moments computed with QMC techniques (red, blue, and green symbols) compared with data (black squares). Good qualitative data is shown for the most sophisticated calculations in the χEFT approach (filled symbols). Pink arrows indicate the major shift from going from the least sophisticated approximation to the most sophisticated calculation.

Impact

This work provided a systematic evaluation of choices to fitting χEFT models on nuclear magnetic data. We demonstrated that χEFT provides good agreement with the data, and our systematic evaluation clarified an apparent lack of convergence in χEFT models. We also provided the first-ever calculations of magnetic form factors in the $7 \leq A \leq 10$ mass range, as well as novel computations of two-body magnetic densities. The former demonstrated never-before-studied phenomena when comparing mirror pairs of stable and radioactive nuclei that may be probed with rare isotope facilities in the future, while the later allowed for an interpretation of the physics underpinning a previously observed lack of convergence in magnetic moment calculations.

Accomplishments

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