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Ab initio folding potentials for proton-nucleus scattering based on NCSM nonlocal densities

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Constructing effective interactions ('optical potentials') between a proton or neutron and a nucleus for computing elastic scattering has a long tradition. A renewed interest in considering this challenging task stems from the possibility of combining today's *ab inito* structure work with elastic scattering from light up to medium-heavy nuclei using the framework of the spectator expansion of multiple scattering theory to compute its leading order term consistently. The calculation of the effective interaction in leading order in the spectator expansion relies on two basic input quantities, which are the fully off-shell nucleon-nucleon (NN) amplitudes in their Wolfenstein representation and the translationally invariant non-local scalar and spin-projected density matrices of the target nucleus.
For light nuclei (up to ^{16}O), the structure information can be obtained from the no-core shell model (NCSM). For heavier nuclei (up to ^{40}Ca), a systematic down-selection scheme was developed in the framework of the symmetry-adapted (SA) NCSM to reduce the full space of basis states to a subset that describes equilibrium and dynamical shapes. Within this selected model space, the spurious center-of-mass motion can be factored out exactly.
Calculations of elastic scattering observables, namely differential cross sections and spin observables, for proton scattering for nuclei with 0+ ground states from Carbon to Calcium in the energy range from 65 to 200 MeV will be presented and compared to experimental data.

Collaboration

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