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Optical Potentials Derived from Nucleon-Nucleon Chiral Potentials at N4LO: Comparison between Phenomenological and Microscopic Optical Potentials

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Proton elastic scattering is a very important process to understand nuclear interactions in finite nuclei. Even if this process has been extensively studied in the last years, a consistent microscopic description is still under development.
We want to study the domain of applicability of microscopic two-body chiral potentials in the construction of an optical potential, derived as the first-order term within the spectator expansion of the multiple scattering theory and adopting the impulse approximation and the optimum factorization approximation.
First, we derive a nonrelativistic theoretical optical potential
from nucleon-nucleon chiral potentials at fourth (N3LO) and fifth order (N4LO).
We check convergence patterns and establish theoretical error bands for
pp and np Wolfenstein amplitudes and the cross sections, analyzing powers,
and spin rotations of elastic proton scattering off some light nuclei at an incident proton energy of 200 MeV [1,2].
Second, the cross sections and analyzing powers for elastic
proton scattering off calcium, nickel, tin, and lead isotopes are presented for several incident proton energies, exploring the range $156 \leq E \leq 333$ MeV, where experimental data are available. In addition, we provide theoretical predictions for Ni56 at 400 MeV, which is of interest for the experiments at EXL [3].
In addition, we present some preliminary results for antiproton elastic scattering off nuclei at energies close to 200 MeV [4]
Our results indicate that microscopic optical
potentials derived from nucleon-nucleon chiral potentials at N4LO can provide reliable predictions for the cross section and the analyzing power both of stable and exotic nuclei.
Bibliography
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