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Deformation effects on a double-folding optical potential

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The nuclear optical model simplifies the complex many-body problem of nuclear scattering by reducing it to a single-particle scattering problem with a complex effective central potential. It has been widely used to describe the scattering of a nuclear particle by a nucleus. With the advancement of rare isotope beam facilities, it is feasible to use exotic deformed nuclei as projectiles. In this study, we investigate the impact of nuclear deformation on double-folding optical potentials. The nucleon density profiles of the projectile and target nuclei are calculated using two modern nuclear mass models that differ primarily in their treatment of deformation. The first model is the relativistic continuum Hartree-Bogoliubov (RCHB) theory, which assumes spherical symmetry, while the second is the deformed relativistic Hartree-Bogoliubov theory in continuum (DRHBc), which incorporates axial symmetry. We examine several sodium (Na) isotopes to investigate how nuclear deformation affects the optical potentials. We observe that as the orientation angle of the deformed isotope decreases, the optical potential becomes deeper. Next, we consider the elastic scattering of protons on Na to explore how nuclear deformation influences the corresponding differential cross section. We find that the position of the dip in the differential cross section shifts with changes in the orientation angle.

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