Separable Nucleon-Nucleus Optical Potentials

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MOTIVATION

- Directly stripping (d, p) reactions are a tool to investigate the structure of exotic nuclei.
- (d, p) reactions can be treated as a three-body problem with effective two-body interactions:
  - neutron-proton
  - neutron-nucleus
  - proton-nucleus
- Three-body problem: Faddels techniques in momentum space with separable two-body interactions.
- Current calculations are limited up to calcium isotopes (Z=38) due to numerical complications in treating the Coulomb force via screening techniques.

RESULTS

- Develop separable effective interactions
- Show that they reproduce two-body observables
- No screening of the Coulomb force

SUMMARY

- Starting from a Woods-Saxon type phenomenological optical (cross-optical) potentials:
  - analytic and numeric Fourier transform to momentum space
  - generalized Ernst-Shakin-Thaler (EST) to
    - charged particles (L. Hlopete, V. Eremenko, et al., eprint:1409.6912)
  - succeeded in calculating Coulomb distorted form factors in momentum space
- Ingredients are ready for implementation in three-body calculations.

METHODS

- The starting point for developing separable interactions is the EST scheme:
  - requires that at fixed energies $E$, the scattering wavefunctions from the original potential and separable representation are identical
  - complex potentials: generalize EST scheme to use "all" and "off" scattering states to preserve reciprocity
  - charged particles: EST scheme is generalized to use Coulomb scattering states instead of plane waves
- Coulomb distorted form factors in momentum space

Off-shell transition matrix

- Cross sections calculated from the momentum space separable representation of the CH89 global optical potential, while the black dotted line (iv) depicts the corresponding coordinate space calculation. The blue dashed-dotted line shows the calculation in which the short-range Coulomb potential is omitted.
- Geel-van-Shilov regularization of oscillatory singularity in folding integrals of form factors with Coulomb wavefunctions.