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Extending the Dispersive Optical Model to β-unstable systems

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Optical potentials remain an indispensable ingredient for modeling many types of nuclear reaction, such as in statistical (Hauser-Feshbach) calculations of radiative capture. As with level densities and γ-ray strength functions, optical potentials for systems near the neutron dripline remain poorly known but are important for characterizing key astrophysical nucleosynthesis pathways. Recent work with dispersive optical potentials on β-stable Ca, Ni, Sn, and Pb isotopes suggests that even in the absence of scattering data to train against, bound-state observables –such as the charge radius, binding energy, particle number, and single-particle energies – can provide powerful constraints on the potential, improving the fidelity of extrapolation toward the dripline. Using a simplified dispersive optical potential equipped with uncertainty quantification, we show how single-nucleon scattering data on 40-48Ca systems can be augmented with bound-state information from 36-60Ca to provide improved neutron capture cross sections relevant for the weak r-process.

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