Microscopic analysis of elastic scattering based on chiral two- and three-nucleon forces

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Recently, chiral effective field theory (Ch-EFT) made a theoretical breakthrough. The theory provides a systematic low momentum expansion based on chiral perturbation theory to interactions among nucleons. This allows us to define two-nucleon force (2NF) and three-nucleon force (3NF) definitely. Microscopic understanding of nuclear reaction and structure based on nuclear force from Ch-EFT is one of the main subjects in nuclear physics.

In the microscopic reaction analysis, the optical potentials between two colliding nuclei can be described by the folding model with an effective nucleon-nucleon interaction. As the first step, we construct new g-matrix effective interaction based on the 2NFs and 3NFs from Ch-EFT by using the framework of Brueckner-Hartree-Fock method. In this work, we aim to describe nucleon-nucleus (NA) and nucleus-nucleus (AA) elastic scattering with the new effective interaction based on Ch-EFT and investigate the effects of chiral 3NF on the scattering.

In the present analysis, g-matrix based on Ch-EFT reproduced the experimental cross sections and analyzing powers with no free parameters for each NA and AA system. Furthermore, we found that the chiral-3NF effects are small for NA scattering, but significantly important for AA scattering particularly backward angles of cross sections. Chiral 3NF makes the optical potentials less attractive and more absorptive, and reduces the cross sections.