

Recent developments for microscopic optical potentials for nucleon-nucleus elastic scattering

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The optical potential (OP) is a fundamental ingredient that is widely used in nuclear reactions. Broadly speaking, there are two types of approaches to determine OPs, phenomenological and microscopic. Phenomenological OPs are based on some free parameters that are fixed to reproduce the existing experimental data, while microscopic OPs are obtained from fundamental theory. Although phenomenological OPs can give a better description of the data, they lack predictive power due to the presence of free parameters.

In contrast, microscopic OPs are obtained from the fundamental theory and they do not rely on any free parameter. Thus, they provide a greater predictive power that makes them suitable for situations where no experimental data is available. A successful approach used to calculate a microscopic OP, in the energy range of 100-300 MeV, is based on the folding integral of the nucleon-nucleon t matrix and the nonlocal target density, obtained by adopting the ab initio No-Core Shell Model method. However, the numerical calculation of this integral is computationally expensive and makes the OP difficult to use in complicated scattering processes.

To address this, we developed an approach to compute the OP faster than the standard method. In our approach, the t matrix and density are both expanded in the harmonic oscillator basis and this allows us to use analytic results for a faster calculation of the folding integral. We will give an overview of this approach and present preliminary results for elastic nucleon scattering off ^{12}C , ^{16}O , and for some non-zero spin targets.