Recent Developments in Microscopic Optical Potentials

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The optical potential is a well-known and successful tool that is widely used to describe nucleon-nucleus scattering processes across wide regions of the nuclear landscape. With the upcoming facilities for exotic nuclei, such as FRIB, we strongly believe that a microscopic approach, completely free from phenomenology, will be the preferred tool to make reliable predictions, assess the unavoidable approximations, and provide a clear physical interpretation of the process under consideration. The Watson multiple scattering theory provides a successful framework to derive such optical potential for energies around 200 MeV and above. In its simplest formulation, derived at the first order, the optical potential is obtained as the folding integral of the nucleon-nucleon scattering t matrix and the target density, representing the two fundamental ingredients of the model. After many years of advances in theoretical nuclear physics it is now possible to calculate these two quantities using the same inter-nucleon interaction that is the only input of our calculations. Results obtained within this framework will be presented for nucleon elastic scattering off light- and medium-mass nuclei, adopting different ab initio approaches to calculate the target densities, such as No-Core Shell Model and Self-Consistent Greens Function. Future extensions of the model, such as the inclusion of medium effects and the calculation of inelastic scattering will be also discussed along with the extension of the formalism to compute a nucleus-nucleus optical potential for elastic scattering calculations.