Modern optical potentials and the role of nuclear structure

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Interest in low- and intermediate-energy nucleon-nucleus optical potentials has increased recently due to advances in the construction of the so-called folding models. At low energies, the optical potential plays a pivotal role in the calculation of nucleon-induced reactions, which are important in the understanding of nucleosynthesis. Central to that is the underlying nuclear structure, especially of nuclei beyond the valley of stability. Understanding the structures of those exotic nuclei has been one of the aims of radioactive beam experiments, where the scattering of exotic nuclei from hydrogen at intermediate energies translates to proton scattering from those systems. One may gain much nuclear structure information from those data with analyses based on modern microscopic optical potentials. I shall review the current state of play of the g-folding optical potentials, based on coordinate space representations of the NN g matrices, and how one may gain insight into the structures of light exotic nuclei. As examples, I will mention scattering from ^{6,8}He, and ^{9,11}Li . I shall also review calculations of elastic and inelastic scattering that have been made for ^{208}Pb, which shows promise for the study of heavy exotic nuclei using these methods.

At low energies, a new scattering theory, the Multi-Channel Algebraic Scattering [1, 2], has been developed. This new approach allows for the finding of both resonant (positive energy) and bound (negative energy) states of the compound nuclei as solutions of the coupled Lippmann-Schwinger equations. The constraint imposed by the specification of bound states determines the degree of nonlocality as coming from Pauli exclusion. I will discuss this in terms of low-energy nucleon scattering from ^{12}C and ^{6}He. Astrophysics applications will also be discussed.

References

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