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Optical potentials and Uncertainties

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Optical potentials are an essential ingredient in theories for nuclear reactions [1]. They characterize initial and final states, determine transmission coefficients and often provide the terms needed for transition operators responsible for the reaction. Over the last decade, significant progress has been made in obtaining optical potentials from ab-initio many-body calculations (e.g. [2,3]). Depending on the method used, these optical potentials have different properties and, in most cases, still fall short compared to phenomenological potentials in describing elastic scattering.

Concurrently to the ab-initio developments, we have also developed state-of-the-art methodology, using Bayesian Statistics, to understand the uncertainties these potentials carry and how these propagate to reaction observables [4,5,6,7,8]. It is now possible to make predictions of confidence intervals for reaction observables and use a variety of statistical tools to determine which observables are best to constrain specific optical potential parameters and determine the data that provides maximum information [9]. It is also possible to emulate large-scale breakup calculations to enable uncertainty quantification in complex reactions [10].

In this presentation, we will provide an overview of these recent developments and provide an outlook on promising future applications.

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