Status of nuclear optical potentials and future prospects

A. J. Tropiano

Department of Physics, The Ohio State University, Columbus, OH 43210, USA

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I. INTRODUCTION

Things to include:

– Why are nuclear reactions important? (Processes that help us understand nuclear structure amongst other things.) List examples.

– r-process for motivation.

– How do optical potentials help us understand nuclear reactions?

– References: ...

II. FORMALISM

Things to include:

– More general things from Thompson/Nunes: define optical potentials as complex potentials and consequences of this. Reaction cross section derivation.

– Derivation of the general optical potential (equation (2.15) in Feshbach).

– Properties of the potential: complex (meaning), non-local (derivation), dispersion relation.

– Relation to observables (basic quantum stuff?)

– References: [1], [2], [3].

III. PHENOMENOLOGY

Things to include:

– Form of the potential: Woods-Saxon shape, coulomb component, spin-orbit force. (Basic example in Thompson/Nunes.). Can start with discussion similar to Thompson/Nunes.

– Fit strength, radii, and diffuseness of complex potential.

– Issue: fitting ambiguities, extractions to exotic regions of the nuclear chart.

– Make sure to touch on phenomenology of optical potentials in modern experimental analyses (key word is modern!)

– References: [4] section 3, [5].

IV. MICROSCOPIC OPTICAL POTENTIALS

Things to include:

– Successes and limitations.

– Motivation: predictions for exotic region of the nuclear chart.

– Coupled cluster Green's function [6].

– References: [4] section 4, [7] G-matrix interaction, [8] self-consistent Green's function, [6].

V. THEORETICAL ISSUES

Things to include:

– Fitting ambiguities for phenomenological potential.

– Uncertainty quantification.

– Add this to outlook in conclusion?

– References: [9].

VI. CONCLUSION

Summary and outlook.

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[2] H. Feshbach, Annals Phys. **19**, 287 (1962).

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[4] W. H. Dickhoff and R. J. Charity, Prog. Part. Nucl. Phys. **105**, 252 (2019), arXiv:1811.03111 [nucl-th].

[5] A. J. Koning and J. P. Delaroche, Nucl. Phys. A **713**, 231 (2003).

[6] J. Rotureau, P. Danielewicz, G. Hagen, F. Nunes, and T. Papenbrock, Phys. Rev. C **95**, 024315 (2017), arXiv:1611.04554 [nucl-th].

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[9] G. B. King, A. E. Lovell, and F. M. Nunes, Phys. Rev. C **98**, 044623 (2018), arXiv:1810.06129 [nucl-th].