

Status of nuclear optical potentials and future prospects

A. J. Tropicano

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], Thompson/Nunes textbook (73, 126).

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: [3] section 3, [4].

IV. MICROSCOPIC OPTICAL POTENTIALS

Things to include:

- Successes and limitations.
- Motivation: predictions for exotic region of the nuclear chart.
- Coupled cluster Green’s function [5].
- References: [3] section 4, [6] G-matrix interaction, [7] self-consistent Green’s function, [5].

V. THEORETICAL ISSUES

Things to include:

- Fitting ambiguities for phenomenological potential.
- Uncertainty quantification.
- Add this to outlook in conclusion?
- References: [8].

VI. CONCLUSION

Summary and outlook.

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 - [3] W. H. Dickhoff and R. J. Charity, *Prog. Part. Nucl. Phys.* **105**, 252 (2019), arXiv:1811.03111 [nucl-th].
 - [4] A. J. Koning and J. P. Delaroche, *Nucl. Phys. A* **713**, 231 (2003).
 - [5] J. Rotureau, P. Danielewicz, G. Hagen, F. Nunes, and T. Papenbrock, *Phys. Rev. C* **95**, 024315 (2017), arXiv:1611.04554 [nucl-th].
 - [6] T. Furumoto, K. Tsubakihara, S. Ebata, and W. Horiuchi, *Phys. Rev. C* **99**, 034605 (2019).
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 - [8] G. B. King, A. E. Lovell, and F. M. Nunes, *Phys. Rev. C* **98**, 044623 (2018), arXiv:1810.06129 [nucl-th].