Abstract

Although several global optical model potentials for $A=3$ nuclei with heavy targets have been produced, often these global potentials have difficulty reproducing experimental measurements of $3^-$ elastic scattering from lighter nuclei, such as Lithium-6 and Carbon-12. Recently urgent experimental needs arose for a $3^-$ optical potential with light targets. In this work, we extract a systematic potential of 3He with 1$p$-shell nuclei. Angular distributions of elastic scattering cross sections for 3He from 6Li, 10B, 12C, 14C, 14N, 16O, and 72Kr are measured using a target thickness of 8.7 mg/cm². The excitation energy of this work was about 7.2 MeV. Using MINOPT to vary all parameters that were well determined, 3He elastic data with 14 correlated parameters. MINOPT consists of two parts. OPTICS solves the Schrödinger equation for a given potential and provides the theoretical cross sections. MINUIT, the statistical optimization program, varies parameters to search for a minimumization of chi-squares.

Utilizing MINOPT

The program MINOPT was used to simultaneously fit the 3He elastic data with 14 correlated parameters. MINOPT consists of two parts. OPTICS solves the Schrödinger equation for a given potential and provides the theoretical cross sections. MINUIT, the statistical optimization program, varies parameters to search for a minimization of chi-squares.

Tasks

- To find the best fit potential, many different initial parameters must be tested. During calculation MINOPT may halt at local minimum of chi-square, rather than the desired smallest chi-square.
- Similarly, MINOPT may also produce un-physical results. These results must be discarded.
- To make sure the final result is stable against variation of initial values.

Results: Experimental Cross Sections vs. Predicted Cross Sections

- Fitting Strategies
- Using MINOPT to vary all parameters that were well constrained by the data, and using the parameters of the previous GDP08 fit to fix parameters that were unconstrained.
- Once a set of good candidate fits are found, varying starting parameter values by 10% to verify convergence and stability of the parameters.

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