

PHY982: Nuclear Dynamics

Homework 5: elastic fitting

Deadline: 1st April 2008

Optical potentials are widely used in reaction calculations. A typical way to pin down the optical parameters is by performing a fit to the elastic scattering at the corresponding energy. Also very common, is the use of global potentials such as those in Perey and Perey. In this homework you will perform a fit to the elastic and compare with global optical potentials.

SFRESKO does data fitting using the MINUIT subroutine and calling FRESKO in each iteration. A typical input for sfresco (search.in) can be found in `'/projects/proj6/phy982/inputs/example-fit.tar'`.

You will also need an initial input for fresco, which you should prepare in the same lines of your example-el.in (the corresponding file in example-fit.tar is elastic.in). You can also use the script 'sfresco.in' if you do not want to run SFRESKO interactively. A short description of how SFRESKO works can be found in the fresco manual.

1. For a couple of targets (they can be the nuclei you used in hw2 or hw3) find proton (or neutron) elastic data at three different energies. The NNCD database provides an easy access, compilation of reaction data (<http://www.nndc.bnl.gov/exfor3/cinda.htm>).
2. Use SFRESKO to fit the elastic for the two targets and for each energy. In every case, take as initial parameters for the Woods-Saxon interactions: $V_R = 40$ MeV; $r_R = 1.2$ fm; $a_R = 0.6$ fm and a volume imaginary part as $V_I = 40$ MeV; $r_I = 1.2$ fm; $a_I = 0.6$ fm. To begin with, neglect the spin-orbit interaction. Do not start with a six-parameters fit but rather gradually allow for parameter variations. Compare the quality of the optical potentials obtained in this way. Are they energy dependent? Do they scale with the radius of the target?
3. Try also an optical potential fit to the three energies simultaneously and comment on your results.
4. Study the sensitivity of your final optical parameters to the initialization. In particular, analyse the correlation between parameters.
5. Repeat the procedure of 2. assuming a surface imaginary component instead. Determine which of the parameter sets (volume versus surface) is best pinned down.
6. Add onto your best description so far, the spin-orbit term and perform a new fit. Can you improve the description of the data with this term?
7. Determine the Perey and Perey global optical potentials $U_{opt}(R)$ and compare with those you have obtained. Which is the best?
8. Prepare a report with your results and conclusions. It should not exceed 10 pages.