Microscopic Proton Optical Potential from p-^{58}Ni at 30-400MeV in BHF Using Two and Two plus Three-Body Forces

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In the present work, we have analyzed proton elastic scattering data at 30.3, 40.0, 65.0, 192.0, 200.0, 295.0, 300.0 and 400.0 MeV from p-^{58}Ni using calculated microscopic optical potential obtained from first order Brueckner theory. We have used Argonne V14 (AV14) [1] two body nuclear force plus the two models for three-body force (TBF) namely; the Urbana VII model (AV14 plus UVII) [2,3] and the phenomenological density dependent three nucleon interaction model (AV14 plus TNI) [4,5] of Lagris, Friedman and Pandharipande.

The numerical g-matrices (effective interaction) calculated at specific energies are folded over the point proton and neutron densities of the target nucleus to calculate different components of nucleon-nucleus optical potential using folding procedure. The calculated potential consists of central, real V (E, r) and imaginary parts W (E, r), spin orbit real V_{so} (E, r) and spin orbit imaginary W_{so} (E, r) parts. The calculation of the differential elastic scattering and the reaction cross sections are done by using the calculated potential U (E, r) in a spherical optical model code. Comparison with experimental data is done by minimizing χ^2 per degree of freedom by adjusting four normalization parameters λ_v, λ_w, λ^R_{so}, λ^I_{so}. The ideal values of λ must be unity indicating that the calculated potential are in 100% agreement with the ones required for fitting the experimental data. λ >1 (λ <1) implies that the calculated potentials are smaller (larger) than that required by the experimental data.

For the data considered in this work in energy region 30-65 MeV, we find that λ^I_{SO} is in all cases nearly zero and hence in the final analysis it was kept zero. For analyzing the proton scattering data we have thus only three free parameters: λ_V , λ_W and λ^R_{SO} .

Figure 1 show that proton differential elastic cross sections data are nicely reproduced with experimental data at all energies observed for the entire range of scattering angle.

In this paper we also describe our results for the calculated optical potential at 30.3 MeV and 400 MeV We note the following features of our results:

1. The strength of real and imaginary central optical potential obtained after the inclusion of three body forces decreases at both energies (30.3 and 400 MeV) than the one obtained from AV14 (only two-body force).
2. The real central potential obtained from AV14 plus UVII model of three body force is slightly more repulsive than that obtained from AV14 + TNI in both targets.

The real and imaginary part of spin-orbit optical potential at both incident energies exhibit only marginal changes due to the inclusion of three-body forces in the Hamiltonians.

Figure 2 and 3 shows our results for the calculated optical potential for p- ^{58}Ni at 30.3 MeV and 400 MeV.

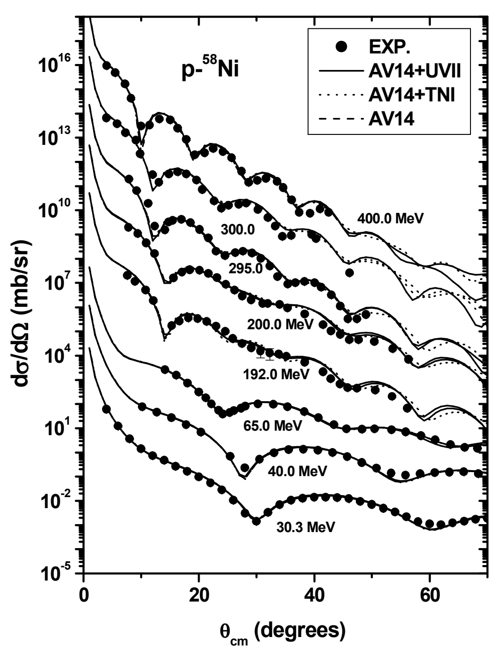

Fig. 1 Differential elastic cross-section and analyzing power for the scattering of protons from p- ^{58}Ni at 30.3-400 MeV using AV14 (dashed line), AV14 plus UVII (solid line) and AV14 plus TNI (dotted line) in BHF.

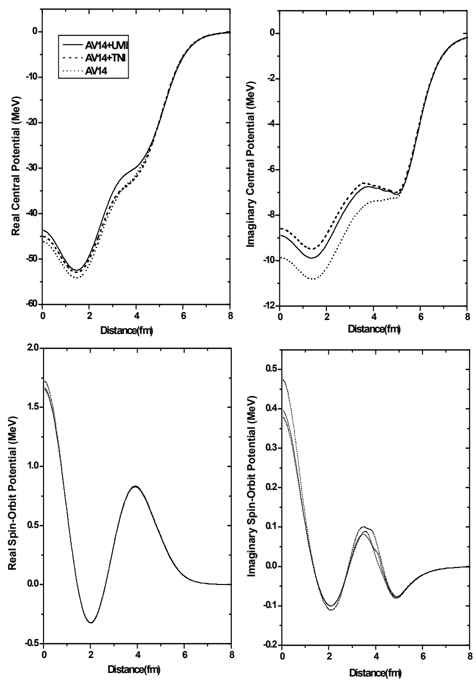

Fig. 2 Calculated real and imaginary central and spin-orbit parts of optical potential for p- ^{58}Ni at 30.3 MeV.

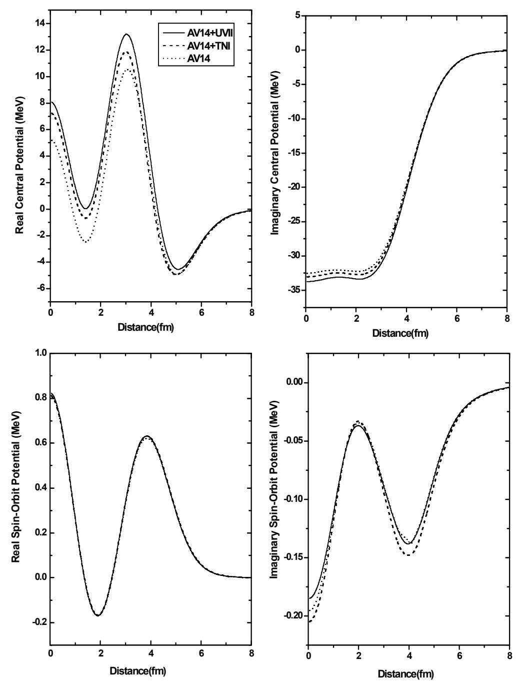

Fig. 3 Calculated real and imaginary central and spin-orbit parts of optical potential for p- ^{58}Ni at 400 MeV.

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