ORCHID: A TWO-NUCLEON MODEL CODE FOR (p,π) CALCULATIONS

J.S. Conte[+] and R.D. Bent
Indiana University Cyclotron Facility, Bloomington, Indiana 47405

M. Dillig
Institute for Theoretical Physics, University of Erlangen-Nurnberg Erlangen, West Germany

Work on the Indiana-Erlangen two-nucleon model code for calculating (p,π) cross sections and analyzing powers was brought to a stage of completion during 1984. The model includes all of the resonant p-wave part of the interaction, which is thought to be dominant at IUCF energies except very close to threshold. The Non-resonant p-wave and s-wave parts of the interaction are not included. Initial state interactions and higher order corrections for rescattering of the outgoing pion are treated as distortions via proton-nucleus and pion-nucleus optical potentials. The ideas of this model and previous progress in developing the computer program have been reported previously.[1-6]

The proton distorted waves are calculated using the optical model code SNOOPY.[7] The pion distorted waves are calculated using the relativistic optical model code DWPIES,[8] which is a modified version of the code PIRK.[9] For both protons and pions, plane wave expansions of the distorted waves are made using the technique of Charlton,[10] so that the distorted-wave (p,π) calculation is a sum over plane wave states.

Figure 1 shows the results of calculations for the $^3He(p,\pi^+)^4He$ reaction and recent IUCF data.[11] The proton optical potential parameters were taken from van Oers et al.[12] The pion optical potential parameters chosen reproduce qualitatively π^--^{4}He elastic data.[13] The proton distortions produce the expected effect of lowering the (p,π^+) cross section by about a factor of three, without changing the angular distribution very much. This is consistent with previous two-nucleon model calculations[14,15] for the reaction $^{12}C(p,\pi^+)^{13}C$. The pion distortions, on the other hand, produce a surprisingly large effect, in view of the fact that most of the momentum sharing is believed to be incorporated microscopically in the two-nucleon reaction mechanism. Even with this large enhancement, the calculated cross section is below the data by a factor of about 10. The calculated analyzing powers agree with the data only at forward angles.

Fig. 2 shows a comparison between calculation and data[16] for the reaction $^{14}C(p,\pi^-)^{15}O^*$ leading to the stretched 2p-1h state at 7.3 MeV. For these

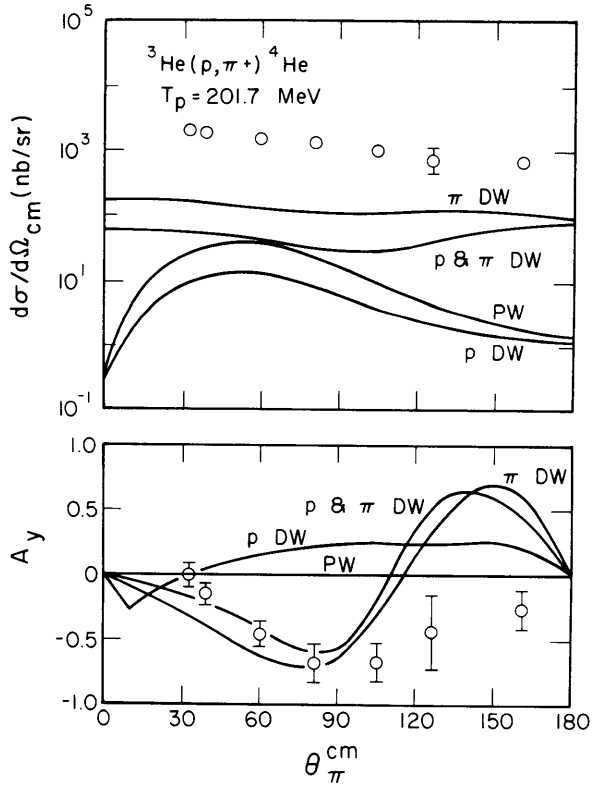

Figure 1. Calculated and experimental differential cross sections and analyzing powers for the reaction $^3He(p,\pi^+)^4He_{g.s.}$

calculations the proton distorted waves were calculated using proton-^{12}C optical potential parameters from Meyer et al.[17] The pion optical potential parameters used reproduce qualitatively pion elastic data. Here the effects of the proton and pion distortions are reasonable, and the agreement between theory and experiment is better than for $^{3}He(p,\pi^{+})^{4}He$.

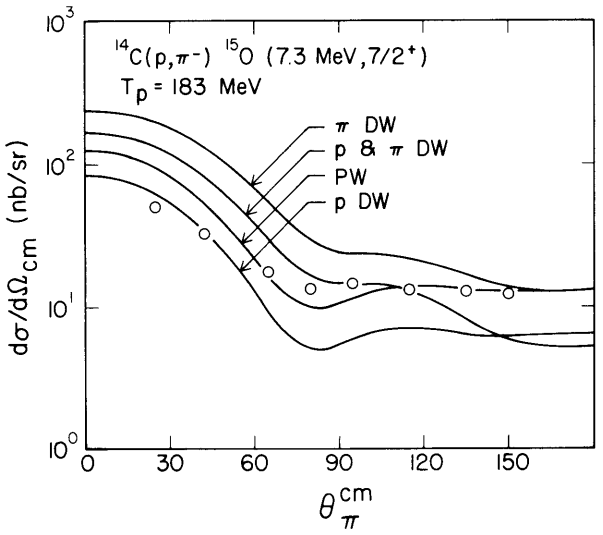

Figure 2. Calculated and experimental differential cross sections for the reaction $^{14}C(p,\pi^{-})^{15}O$(7.3 MeV, 7/2+).

+Present Address: Purdue University Computing Center, West Lafayette, Indiana 47907.

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