STUDIES OF KNOCK-OUT REACTIONS

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We are continuing a program to study the approximations used in the analysis of nucleon-nucleus scattering. The proton-induced nucleon knock-out reaction is ideally suited for such studies because the kinematic conditions can be adjusted to isolate approximately the desired effects. Ioannides and Jackson[1)] suggested a reaction geometry in which nuclear structure effects could be minimized and distortion effects maximized. These ideas led us to examine this geometry in detail[2)] and to perform a preliminary measurement.

We used the $^{40}Ca(p,2p)^{39}K^*(2.52,1/2^+)$ reaction at 150 MeV with the momentum transfer fixed at $|\vec{q}|$=100 MeV/c and the energies of the outgoing protons (1,2) such that $\Lambda \equiv E_1/(E_1+E_2)$ = constant. By varying the proton angles θ_1, θ_2 under these conditions, the angle θ_3 of $\vec{q}$ with respect to the beam varies. Figure 1 is a plot of the ratio of the triple differential cross section for the $1/2^+$ state in ^{39}K at various values of θ_3 to that at θ_3 = 0. Because a ratio is plotted, bound state effects, already small because of the value of $\vec{q}$, are minimized, at least to first order. The three curves are calculations using the code WAVEPROG[3)] for three values of the real central well radius parameter (with the corresponding potential strength being adjusted to maintain a constant volume integral) of the optical potential for the outgoing protons.

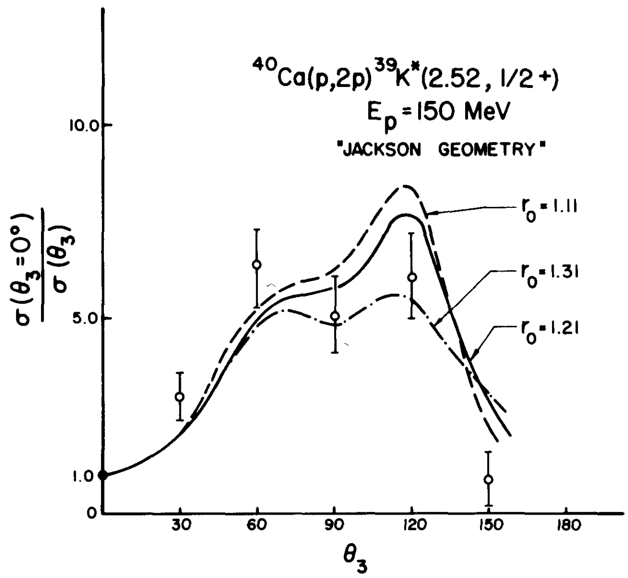

Figure 1. Cross-section ratio $\sigma(\theta_3)/\sigma(\theta_3=0°)$ in the Jackson geometry for different radii of the distorting potential.

A similar set of calculations for a standard energy-sharing (ES) geometry experiment[4)] in which the scattering angles are fixed and Λ varied to vary $\vec{q}$ is shown in Fig. 2. The difference to note between these two figures is that the "ES geometry" experiment does not select the best fit nearly as well as the "Jackson geometry," even with the rather low statistics for the latter which resulted from this preliminary run. This technique thus offers a means of choosing among sets of phase-equivalent optical model parameters* in a much more unambiguous fashion than has been available in the past by means of the (p,2p) reaction, and may provide an additional sensitive

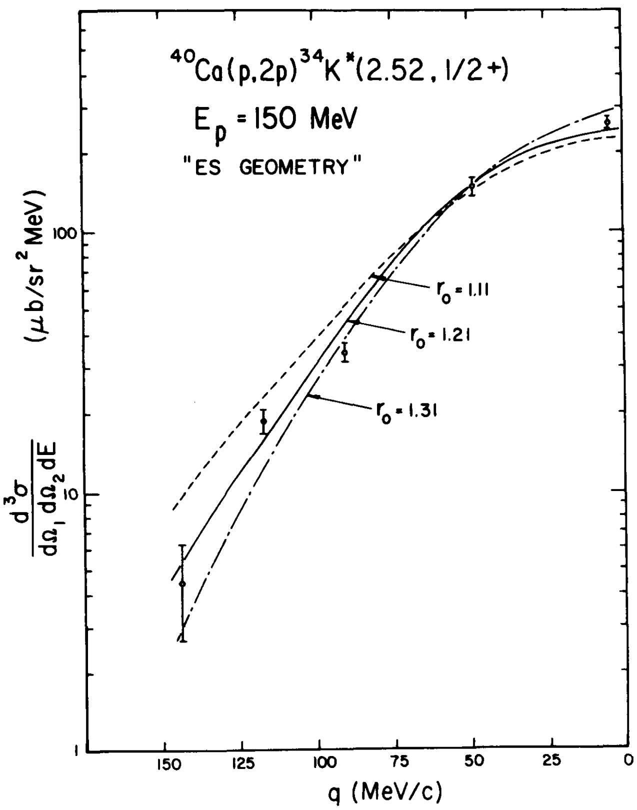

Figure 2. Cross section vs. momentum transfer in the energy-sharing geometry for different radii of the distorting potential.

testing ground (complementing elastic and inelastic proton scattering) for studying the distorting effects of the nuclear medium on the propagation of medium-energy protons. Additional analysis of this work is in progress.

*It should be noted that the optimum value for the radius parameter r_0 obtained here is in good agreement with that from a recent global optical-model analysis[5] of proton elastic scattering.

1) A.A. Ioannides and D.F. Jackson, Nucl. Phys. A308, 345 (1978).

2) D.W. Devins et al., "An Analysis of Fixed Condition Geometries for Knock-Out Reactions," Bull. Am. Phys. Soc. 23, 961 (1978).

3) N.S. Chant and P.G. Roos, Phys. Rev. C15, 57 (1977).

4) P.G. Roos et al., Phys. Rev. Lett. 40, 1439 (1978).

5) A. Nadasen et al., Phys. Rev. C23 (1981).