THE NON-COPLANAR $^6Li(p,pd)^4He$ REACTION AT 120 and 200 MeV

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Knockout reactions, interpreted through the Distorted Wave Impulse Approximation (DWIA), provide information about cluster probabilities and momentum distributions. Non-coplanar knockout studies are particularly interesting since, for increasing angle ϕ between the participant (detected) cluster and the plane of the incident and scattered projectile, they sample monotonically increasing spectator cluster momenta. In the present experiments, scattering geometries are used in which the effective scattering angle and final-state relative energy of the two participants are insensitive to ϕ. Thus, the observed structure is attributable to the momentum wave function rather than final-state interactions, changes in the two-body cross section, or varying effects due to distortion.

The 120 MeV data are now published and an analysis of the 200 MeV data has been submitted for publication.[1] Measured energy-sharing spectra for eight non-coplanarity angles ϕ are shown in Fig. 1, for E_0=200 MeV and a particular quasi-elastic polar angle pair. Spectra predicted by the DWIA, using optical

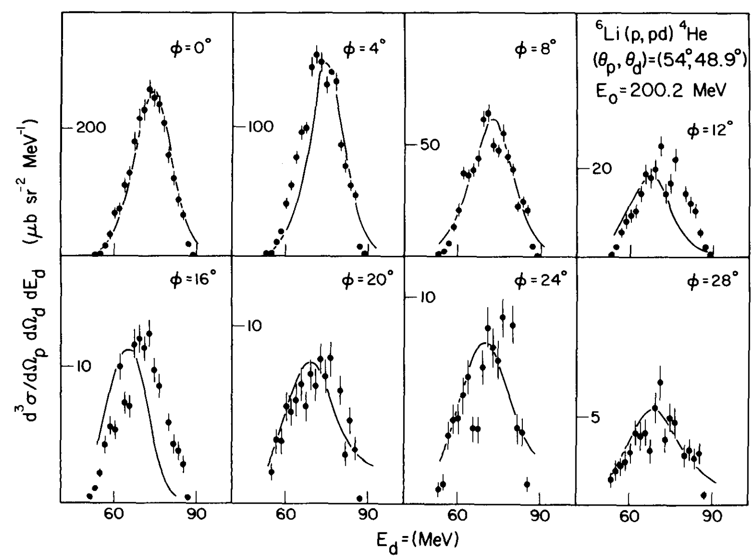

Figure 1. Cross sections vs. deuteron lab energy for the $^6Li(p,pd)^4He$ reaction at E_0=200.2 MeV and the quasifree angle pair Θ_p/Θ_d=54°/-48.9°, for eight values of the noncoplanarity angle ϕ. Curves are from DWIA calculations with different ground-state cluster wavefunctions, as described in the text.

potentials[2-4] for the p+Li, d+α, and p+α systems for the nearest available energies to those appropriate to our experiment are shown by solid lines. The ground-state cluster wavefunction was that of a Woods-Saxon potential of radius 1.85 fm. The dashed curves represent calculations with the optical potential parameters used for the 120 MeV analysis; they illustrate the insensitivity of the fits to the potential parameters.

The yields at 120 and 200 MeV, integrated over detected deuteron energy ranges of 11 and 20 MeV respectively, are plotted vs. ϕ in Fig. 2. Fits obtained with different ground-state cluster wavefunctions also are shown. All of them underpredict the large-angle yield, indicating either an abundance of high-momentum components in the ground-state wavefunction or the presence of reaction mechanisms (other than first-order quasielastic scattering) whose yield is more nearly isotropic. The soft-core wavefunction[5] comes closest to reproducing the large-angle yield but generates unphysically large (≈1.25) spectroscopic factors (C_d's). The Woods-Saxon potential predicts minima at both energies; one is observed at 120 MeV but not (with statistical significance) at 200 MeV. C_d's for this potential are 0.76 and 0.84, respectively, at these energies. Finally, calculations were done at 200 MeV for a recently-published[6] wavefunction obtained by solution of the Faddeev equations. The predicted yield vs. ϕ is nearly identical to that of the Woods-Saxon potential, and the deduced C_d (0.76) compares favorably with the values of 0.70 to 0.75 obtained by Kukulin et al.[6] for their six different models.

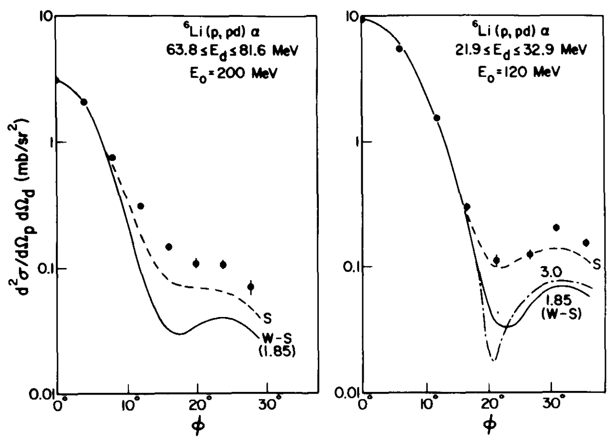

Figure 2. Cross sections, integrated over detected deuteron energy, vs. ϕ at 120 and 200 MeV bombarding energy. Curves are for DWIA calculations with different ground-state cluster wavefunctions, as described in the text.

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