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THE REACTION $\vec{p}$ + d → t + π^+ AT INTERMEDIATE ENERGIES*

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We have measured angular distributions of the cross sections and analyzing
powers at 500, 475, 450 and 425 MeV incident proton energy of the reaction
$\vec{p}$ + d → t + π^+. The angular distributions cover the angular range
110° < $\theta_{\pi c.m.}$ < 160°. The angular distributions of the cross sections are
flat, while the angular distributions of the analyzing powers indicate an
unexpectedly rapid variation with energy.

1. EXPERIMENTAL PROCEDURE

Polarized protons from the TRIUMF cyclotron were incident onto a solid 212
mg/cm^2 thick CD_2 target. The reaction products t and π^+ were detected in the
1.6 GeV/c magnetic spectrometer MRS and NE 110 plastic scintillators,
respectively. The beam intensity and polarization were monitored continuously
by an in-beam polarimeter. A secondary electron emission monitor served as
additional beam intensity monitor. For calibration purposes the differential
cross sections of elastically scattered protons from hydrogen (CH_2 target) and
deuterium (CD_2 target) were measured at a limited number of angles and compared
with published values.

2. RESULTS AND DISCUSSION

The differential cross section angular distributions within the range 110° <
$\theta_{\pi c.m.}$ < 160° are nearly flat, and over the four energies measured vary within a
narrow band from 0.90 to 1.25 µb/sr. There is no significant backward peaking.

Previous measurements of analyzing powers for the $\vec{p}$ + d → π^+ + t reaction had
indicated apparent rapid variation with energy in the back angle extrema, which
occur at $\theta_{\pi c.m.}$ ≈ 140°. Mathie et al.[1] measured A_π at 305, 330 and 400 MeV,
finding A_π (125°-135°) = -0.27 ± 0.03 at 400 MeV. Auld et al.[2] extended the
energy range from 400 MeV to include 425, 445, and 470 MeV, but limited
themselves to angles $\theta_{\pi c.m.}$ ≈ 135° or larger. Their 400 MeV data, are A_π (135°)=

-0.50 ± 0.07, are inconsistent with results of ref. 1; at 470 MeV an extremum of $A_\pi = -1.06 \pm 0.22$ was observed at $\theta_{\pi c.m.} = 150°$. However, at 500 MeV Cameron et al.[3] found a back angle maximum of $A_\pi = -0.21 \pm 0.02$ only.

Our present measurements of A_π (fig. 1) show at 425 and 450 MeV minima markedly lower than those at 400 MeV (ref. 1) or at 500 MeV (ref. 3), but the extremum at 475 MeV of $A_\pi = -0.45 \pm 0.08$ disagrees with $A_\pi = -1.06 \pm 0.22$ $(\theta_{\pi c.m.} = 150°)$ given in reference 1 at 470 MeV. At present no theoretical predictions are available.
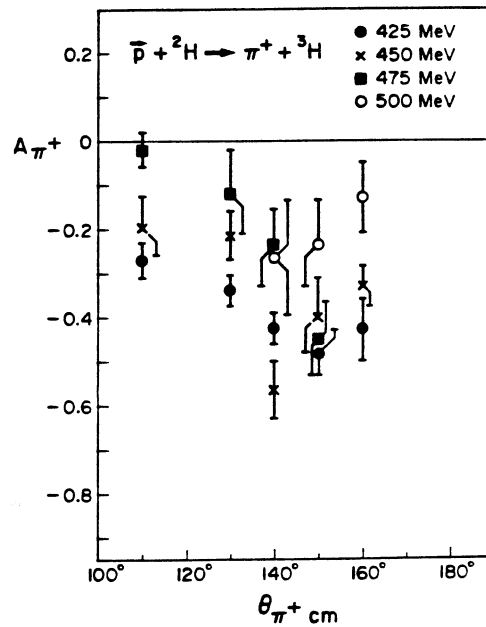

FIGURE 1
Angular distributions of the analyzing
powers as a function of the center of
mass scattering angle of the pion.

REFERENCES

1) E.L. Mathie, Ph.D. thesis, Univ. of British Columbia (1980).

2) E.G. Auld et al., Phys. Lett. 93B (1980) 258.

3) J.M. Cameron et al., Phys. Lett. 103B (1981) 317.