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P-A MEASUREMENTS IN THE ^{48}Ca(p,n)^{48}Sc REACTION AT 135 MeV

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We measured the polarization (P) and the analyzing-power (A_y) for the ^{48}Ca(p,n)^{48}Sc reaction at 135 MeV with the beam-swinger facility at the Indiana University Cyclotron Facility (IUCF). The experiment was performed using the improved transmission from the polarized ion source. The beam intensity was 400-600 nA of protons with a polarization of about 72%. The KSU neutron polarimeter[1] was located along the 0° swinger line at a flight path of 37 m; the energy resolution was about 1 MeV. This polarimeter uses three BC-517L liquid scintillator neutron analyzers together with six plastic scintillator "side" detectors and provides an analyzing power of about 0.35 for neutrons of about 120 MeV. These measurements extend our earlier cross section,[2] analyzing-power,[3] and spin-transfer[4] measurements for this reaction.

The target nucleus, ^{48}Ca, is understood to be a relatively good closed-shell nucleus and the transitions induced by the (p,n) reaction are to predominantly one particle, one-hole (1p1h) states. The 1^+ state at 2.52 MeV in ^{48}Sc is believed to be predominantly $(f_{7/2},f_{7/2}^{-1})$ and the 1^+ state at 16.8 MeV is believed to be predominately $(f_{5/2},f_{7/2}^{-1})$. The difference in the dominant 1p1h structures of these two 1^+ excitations is expected to affect the difference $P - A_y$ strongly. Love and Comfort[5] shows that for transitions with a single shell, one of the nonvanishing form factors for P = A is specified by the matrix element of the operator $< i\vec{L}\times\vec{\sigma} >$. They show that this matrix element will vanish for j(initial) = j(final); thus, P and A_y are expected to be the same for the low-lying 1^+ excitation, but we expect a significant difference for the state at 16.8 MeV. "Standard" nonrelativistic DWIA calculations support these expectations, in fact, the signs of P and A_y are predicted to be opposite over the entire angular range for the high-lying 1^+ excitation.

Results for σ, σP, and σA for the ^{48}Ca(p,n)^{48}Sc reaction at 5° are shown in Fig. 1. These results are qualitatively in agreement with the arguments presented above. The low-

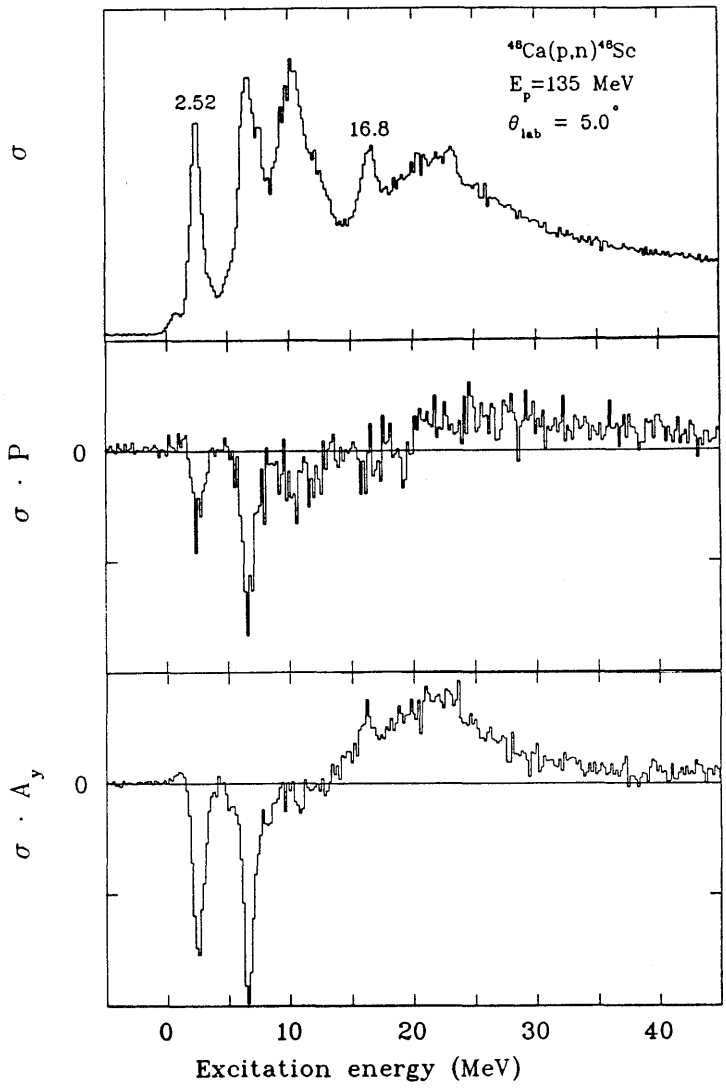


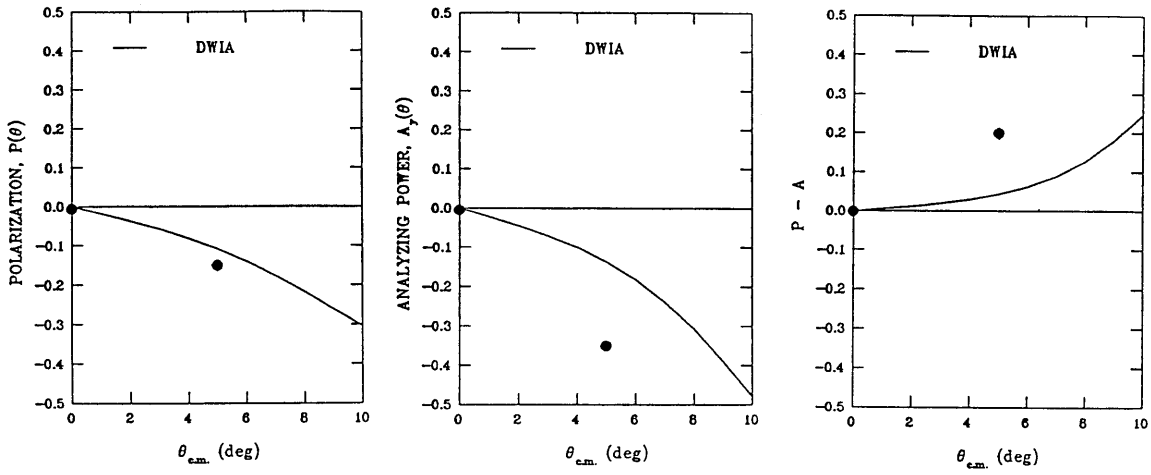
Figure 1. Results for σ, σP, and σA for the ^{48}Ca(p,n)^{48}Sc reaction at 135 MeV and 5.0°. The ordinate scales are in arbitrary units.

excitation part of the spectrum is dominated by $(f_{7/2},f_{7/2}^{-1})$ 1^+ strength, which is expected to show little difference between P and A_y. Because the spectrum near the 16.8 MeV state is dominated by $(f_{5/2},f_{7/2}^{-1})$ 1^+ strength, it is expected to show significant differences between P and A_y. At higher energies, the spectrum is dominated by quasi-free scattering, for which P and A_y are expected to be nearly identical.

Figure 2 shows the extracted results for P, A_y, and P−A for the transitions to the 2.52 and 16.8 MeV states at 0° and 5°. The solid lines show the DWIA predictions. Both P and A are seen to be zero at 0°, as expected. At 5°, it is seen that A_y has opposite signs for these two transitions. The DWIA calculations correctly predict the signs of both P and A in each case, but consistently underestimate the magnitudes. Analysis at larger angles is in progress.

^{48}Ca(p,n)^{48}Sc (1^+, 2.52 MeV)

135 MeV



^{48}Ca(p,n)^{48}Sc (1^+, 16.8 MeV)

135 MeV

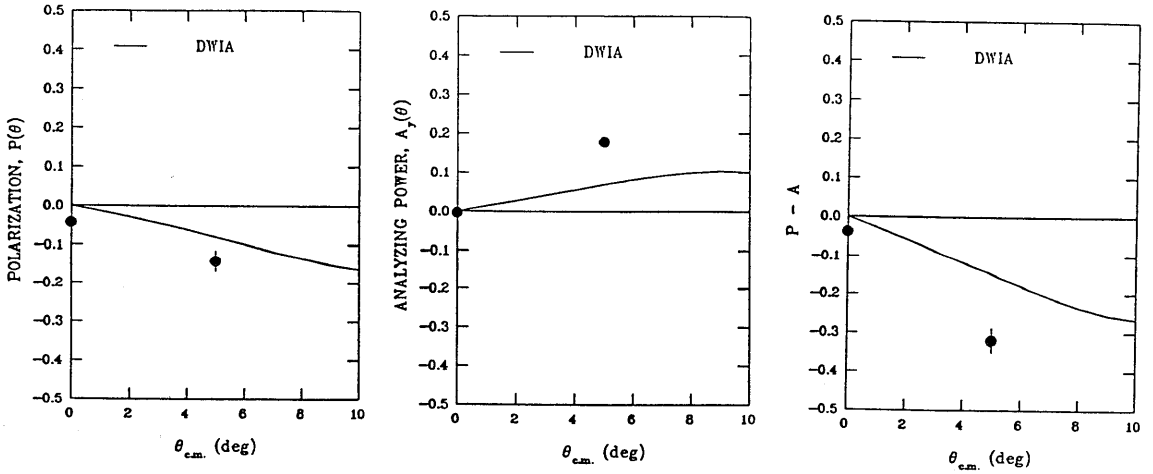


Figure 2. P, A_y and P−A angular distributions for the ^{48}Ca(p,n)^{48}Sc reaction at 135 MeV to the 1^+ states at 2.52 and 16.8 MeV.

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