ANALYZING POWERS FOR DEUTERON-INDUCED REACTIONS LEADING TO CONTINUUM FINAL STATES

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Measurements have been made of the cross section, vector (A_y), and tensor (A_{yy}) analyzing power for various inclusive reactions initiated by 80-MeV polarized deuterons incident on a ^{58}Ni target. Solid-state telescopes using both Silicon and high-purity Germanium detectors were used to observe outgoing p, d, t, ^{3}He, and ^{4}He over a broad range of energies. The experimental details were reported in the 1980 IUCF Scientific and Technical Report.[1]

Analysis of the spectra is now complete and samples of the analyzing powers are shown in Figs. 1-3. For the outgoing deuterons (Fig. 1), both A_y and A_{yy} rise with increasing angle and with outgoing deuteron energy, and match smoothly onto the elastic scattering angular distribution. Thus, the analyzing power of the continuum reflects the spin-orbit distortions present in the entrance channel. Figures 2 and 3 show that this observation is true even when there is mass transfer. In all cases, the vector analyzing power departs from zero at the smallest angles and outgoing energies. Thus reactions initiated by spin-down deuterons disappear first as the scattering

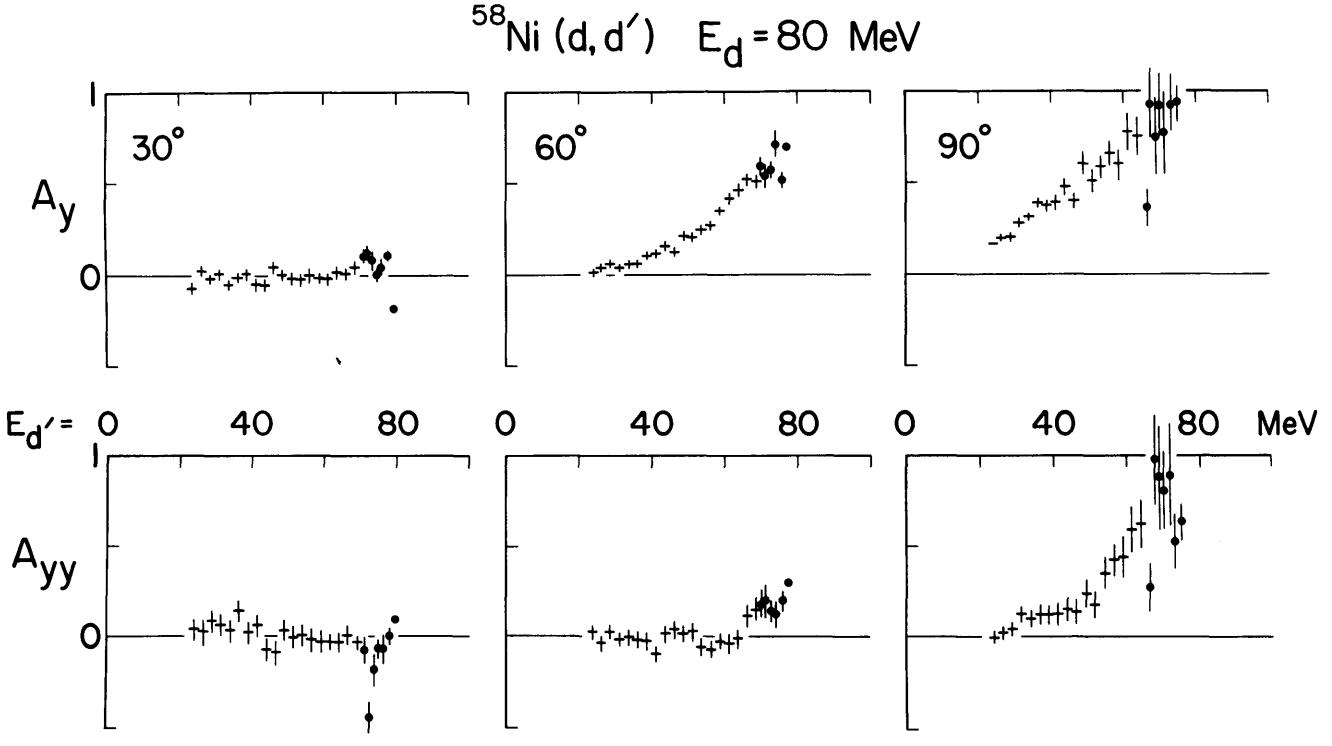

Figure 1. Analyzing powers (A_y and A_{yy}) for deuterons emerging from d + ^{58}Ni inelastic scattering as a function of outgoing deuteron energy. The continuum is divided into 2.5 MeV bins (crosses); discrete states are shown by points.

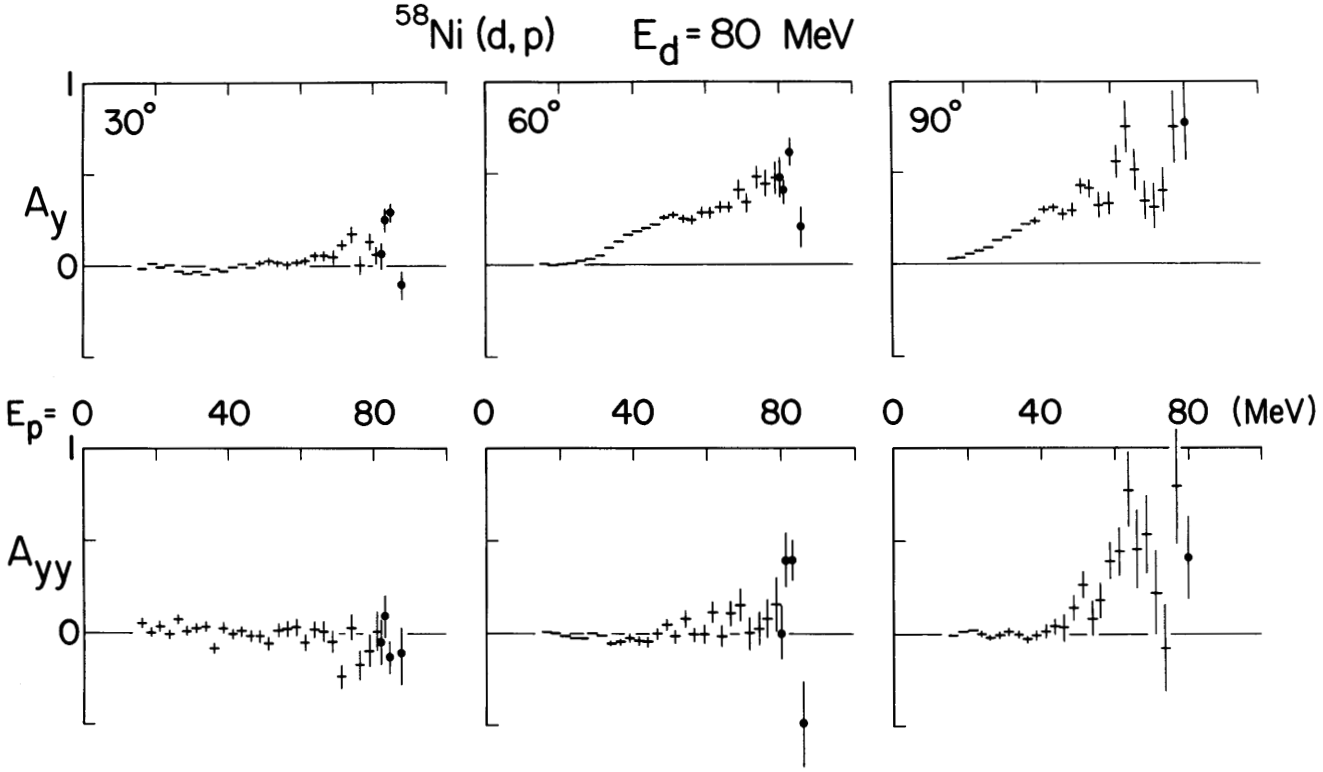

Figure 2. Analyzing powers (A_y and A_{yy}) for protons emerging from the ^{58}Ni(d,p) reaction as a function of outgoing proton energy. The continuum is divided into 2.5 MeV bins (crosses); discrete states are shown by points.

angle and outgoing energy increase. Later, reactions initiated from the m=0 projection disappear, causing A_{yy} to rise. This observation is consistent with the classical picture of the spin-dependence in rainbow scattering.[2]

In Figs. 1-3, the points at large outgoing energy are the results of an analysis of the prominent discrete states in the spectrum. The similarity between their analyzing powers and the trend of the continuum shows that the spin-orbit distortions are more important than spin or mass transfer in determining the features of the analyzing power. Nevertheless, some influence of the structure of the final state can be found in this data.

Outgoing deuterons at 90° and 66 MeV (see Fig. 1) show a marked reduction in the vector and tensor analyzing power. This excitation marks the location of 4^+ strength in ^{58}Ni. A detailed analysis of other low-lying 4^+ states (not shown in Fig. 1) gives similar results. The analyzing power for outgoing protons at 60° does not rise monotonically (see Fig. 2). The apparently larger analyzing power near 40 MeV may come from breakup protons. Especially at 90°, fluctuations in A_y and A_{yy} for outgoing protons seem correlated, and may be tied to the excitation energies of various single-particle states. For two-nucleon transfer (see Fig. 3), the vector analyzing power is smaller in magnitude, and structure effects seem more important. The negative point at 60° is the excitation of a strong 7^+ state in ^{56}Co. Here, the analyzing power is dominated by spin transfer ($j = \ell + 1$ in this case) and not rainbow scattering.

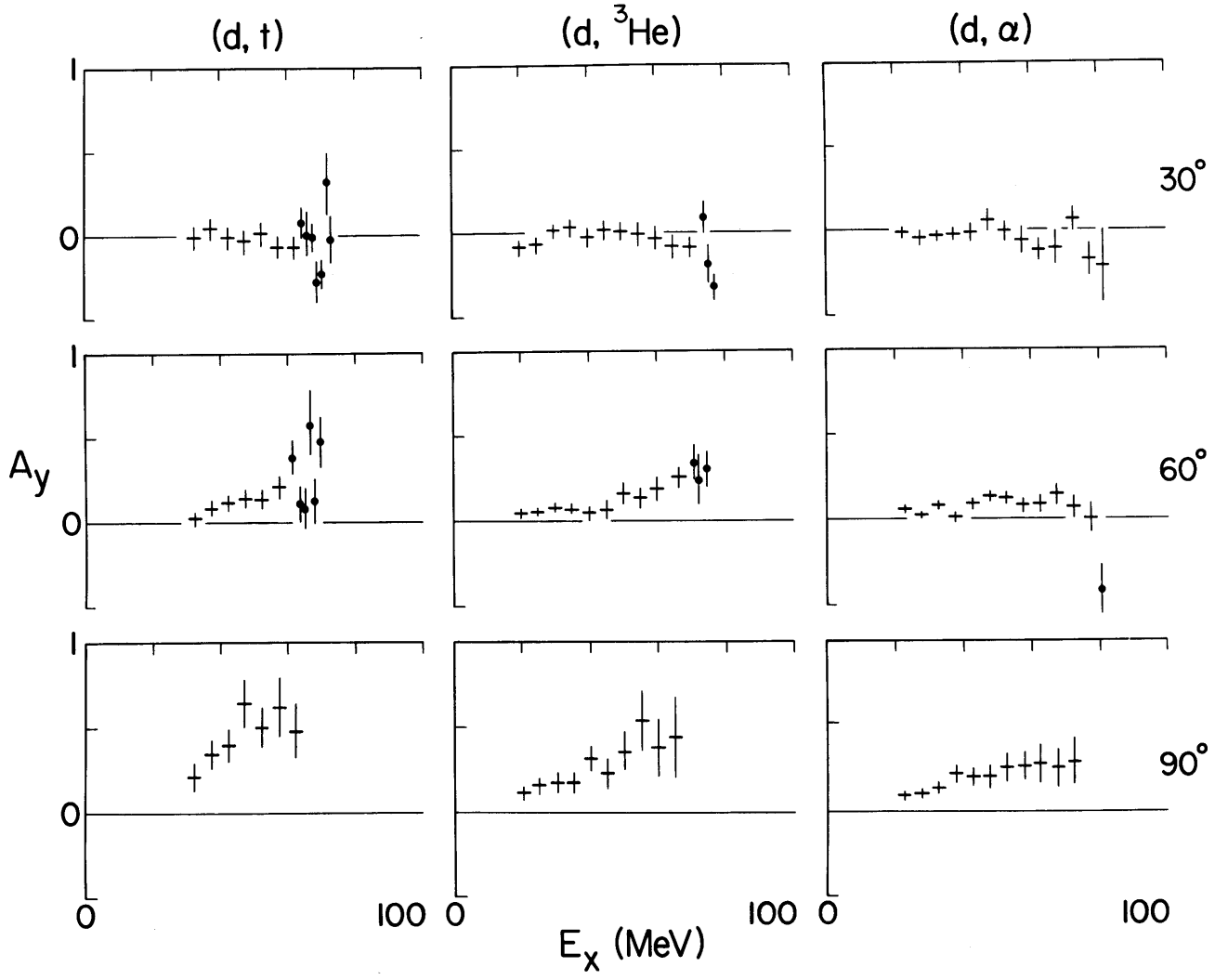

Figure 3. Vector analyzing power (A_y) for t, ^{3}He, and ^{4}He emerging from d + ^{58}Ni reactions as a function of outgoing particle energy. The continuum is divided into 5 MeV bins (crosses); discrete states are shown by points.

Similar trends in the analyzing power have been observed at similar energies/nucleon with both polarized proton and deuteron projectiles.[3,4] These trends are consistent with calculations using the DWBA and appropriate distributions of final-state spin and strength.[3,4]

1) E.J. Stephenson, J.C. Collins, C.C. Foster, D.L. Friesel, J.R. Hall, W.W. Jacobs, W.P. Jones, M.D. Kaitchuck, and P. Schwandt, IUCF Scientific and Technical Report 1980, p. 100.

2) E.J. Stephenson, C.C. Foster, P. Schwandt, and D.A. Goldberg, Nucl. Phys. A359, 316 (1981).

3) H. Sakai, K. Hosono, N. Matsuoka, S. Nagamachi, K. Okada, K. Naeda, and H. Shimizu, Phys. Rev. Lett. 44, 1193 (1980).

4) H. Sakai, N. Matsuoka, K. Hatanaka, K. Okada, and H. Shimizu, Phys. Rev. C 24, 2766 (1981).