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ANALYZING POWER MEASUREMENTS FOR THE EXCITATION OF STATES IN ^{28}Si and ^{24}Mg BY INELASTIC SCATTERING OF POLARIZED PROTONS

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Analyzing powers $A_y(\theta)$ for the excitation of states in ^{28}Si and ^{24}Mg with excitation energies up to 16 MeV have been measured with a 135-MeV polarized proton beam. The scattered protons were detected with the QDDM magnetic spectrograph at angles between 25^o and 65^o with an overall resolution of about 70 keV. Results for the 6^-, T=1 (14.35 MeV), 6^-, T=0 (11.58 MeV), and 5^-, T=0 (9.70 MeV) states in ^{28}Si,[1] whose predominant configurations are all $(d_{5/2})^{-1}(f_{7/2})$, are shown in Fig. 1, where they are compared with the results of DWIA calculations using the t-matrix effective interaction derived by Love from the free nucleon-nucleon scattering data.[2] The cross section for the 6^-, T=1, state is due mainly to the tensor direct term in the interaction, while that for the 6^-, T=0, state is due mainly to tensor and spin-orbit exchange terms, and that for the 5^-, T=0, state is due mainly to spin-orbit and central interaction terms. The $A_y(\theta)$ results for the 6^- states are sensitive to interference both between the central and spin-orbit parts and between the spin-orbit and tensor parts of

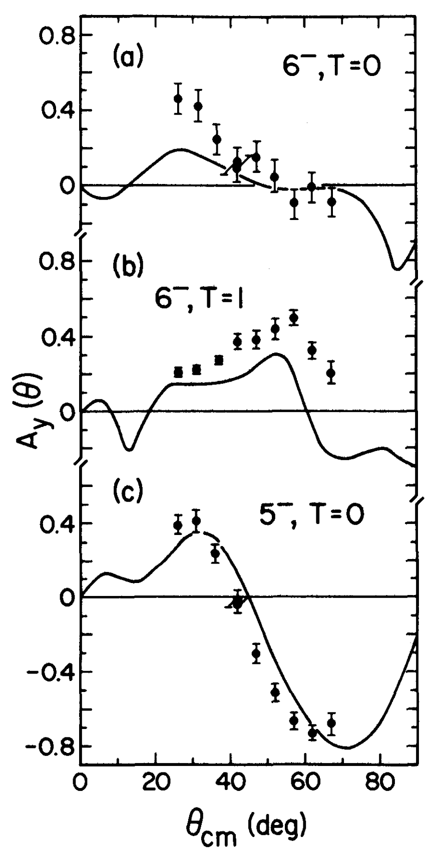

Figure 1. Analyzing powers, $A_y(\theta)$, for the 135-MeV $(\vec{p},p')$ excitation of (a) the 6^-, T=0, state at 11.58 MeV, (b) the 6^-, T=1, state at 14.35 MeV, and (c) the 5^-, T=0, state at 9.70 MeV. The experimental data are compared with results of DWIA calculations using the Love t-matrix.

the t-matrix. For the 5^- state, on the other hand, the calculated result for A_y is predominantly sensitive to central-spin-orbit interference, and the change of sign of A_y near 40^o is rather well correlated with the change of sign in the central part of the t-matrix at the corresponding momentum transfer, as given by the Love interaction.

The differential cross sections and analyzing powers for the lower-lying states of ^{28}Si and ^{24}Mg have also been measured. In ^{24}Mg, for example, the excitation of states in the K=0 and K=2 bands can be compared to calculations using the Chalk River projected-Hartree-Fock wave functions. The remarkable agreement between theory and experiment for inelastic electron scattering[3] allows a detailed study of the proton scattering mechanism. The totally anomalous shape of the electromagnetic form factor for the 4_1^+(K=0) state in ^{24}Mg is well reproduced in the differential cross section for (p,p').

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SPIN-ORBIT EFFECTS IN THE EXCITATION OF PROTON AND NEUTRON STATES IN THE (p,p') REACTION AT 160 MeV, 120 MeV, AND 95 MeV

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Large differences in the shapes of measured differential cross sections were found earlier[1] for the excitations of the 4_1^+ proton state in ^{90}Zr and the 4_1^+ neutron state in ^{92}Zr. To obtain a good fit to the data for this proton state in ^{90}Zr with purely collective calculations, an enhanced spin-orbit contribution (β_4^{so}/β_4=1.25) was required, but no satisfactory fits were found for this neutron state in ^{92}Zr. Collective fits to the data for the 2_1^+, 4_1^+, 6_1^+, 8_1^+ proton states in ^{90}Zr showed[2] the increasing dominance of the spin-orbit contribution as the multipolarity increased. Recent calculations show the cross sections for the 2_1^+, 4_1^+, 6_1^+, and 8_1^+ states in ^{90}Zr to be underpredicted in the DWIA by factors of 30, 10, 3, and 2 respectively when only the $(g_{9/2})^2$ valence terms are included for the central, spin-orbit and tensor amplitudes,[3] suggesting the need for core polarization amplitudes similar in magnitude to those required at lower energies.[4,5] These DWIA calculations showed the relative importance of the spin-orbit part of the t-matrix increased in this sequence as the multipolarity increased.[3] The dominance of the spin-orbit contributions for the 8_1^+ state in ^{90}Zr is shown in the DWIA and collective calculations of Figures 1(a) and 1(b) respectively.

Large spin-orbit effects at this energy (E_p= 160 MeV) clearly suggested the need for (p,p') asymmetry measurements. Analyzing power data have been obtained at 14 angles from 16° to 44° for the 2_1^+, 4_1^+, 5_1^-, 3_1^-, and 2_2^+ states in ^{90}Zr and for the 2_1^+, 4_1^+, 3_1^-, 2_2^+, 2_3^+, and 5_1^- states in ^{92}Zr, and at 8 angles from 26°