INVESTIGATION OF THE EFFECTIVE INTERACTION THROUGH $^{28}Si(\vec{p},\vec{p}')^{28}Si$ POLARIZATION TRANSFER

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The primary objective of Experiment 353 is the measurement of a complete set of polarization transfer observables for the two "stretched" 6^- states in ^{28}Si at 11.58 MeV ($T = 0$) and 14.36 MeV ($T = 1$). These transitions should provide a structure sufficiently simple that differences between calculations and the polarization observables may lead to an improved understanding of the reaction mechanism, especially the medium-modified spin-orbit and tensor effective interactions. Such modifications have been suggested in the study of the 4^-, $T = 1$ transition in ^{16}O (Ref. 1). The study of ^{28}Si will provide both $T = 0$ and $T = 1$ transitions that are well separated from each other and relatively free of the complications of isospin mixing.[2] We plan to measure a full set of $(\vec{p},\vec{p}')$ polarization transfer observables for these two states near the maximum in their cross sections between the angles of 29° and 41°.

The low-lying, natural-parity states in ^{28}Si have been studied previously as a window on the effective interaction,[3] giving rise to systematic medium-modifications for the central and spin-orbit components of these natural-parity isoscalar transitions. The dynamics of a natural-parity excitation tend to obey the same constraints as exist for elastic scattering. Thus any new information will likely come from a study of the in-plane spin rotation, rather than the normal-component spin transfer. We intend to extend the measurement of the in-plane polarization transfer coefficients to forward angles so that this modified interaction can be further tested and constrained by these states.

In addition, information will be available on other states in ^{28}Si with good energy resolution. The precise values of cross section and analyzing power, as well as some information on the polarization transfer coefficients, should provide the information needed to identify additional stretched, high-spin configurations.

Data acquisition began in May, 1991. A sample of the K600 focal plane spectrum is shown in Fig. 1. The 5^- and 6^- states to be investigated are marked with their spin and excitation energy in keV. Discrete states are clearly visible up to an excitation energy of 20 MeV, with a resolution between 40 and 50 keV.

The first run, made with only a vertically polarized beam, included measurements of the differential cross section and analyzing power for elastic scattering (see Fig. 2) and

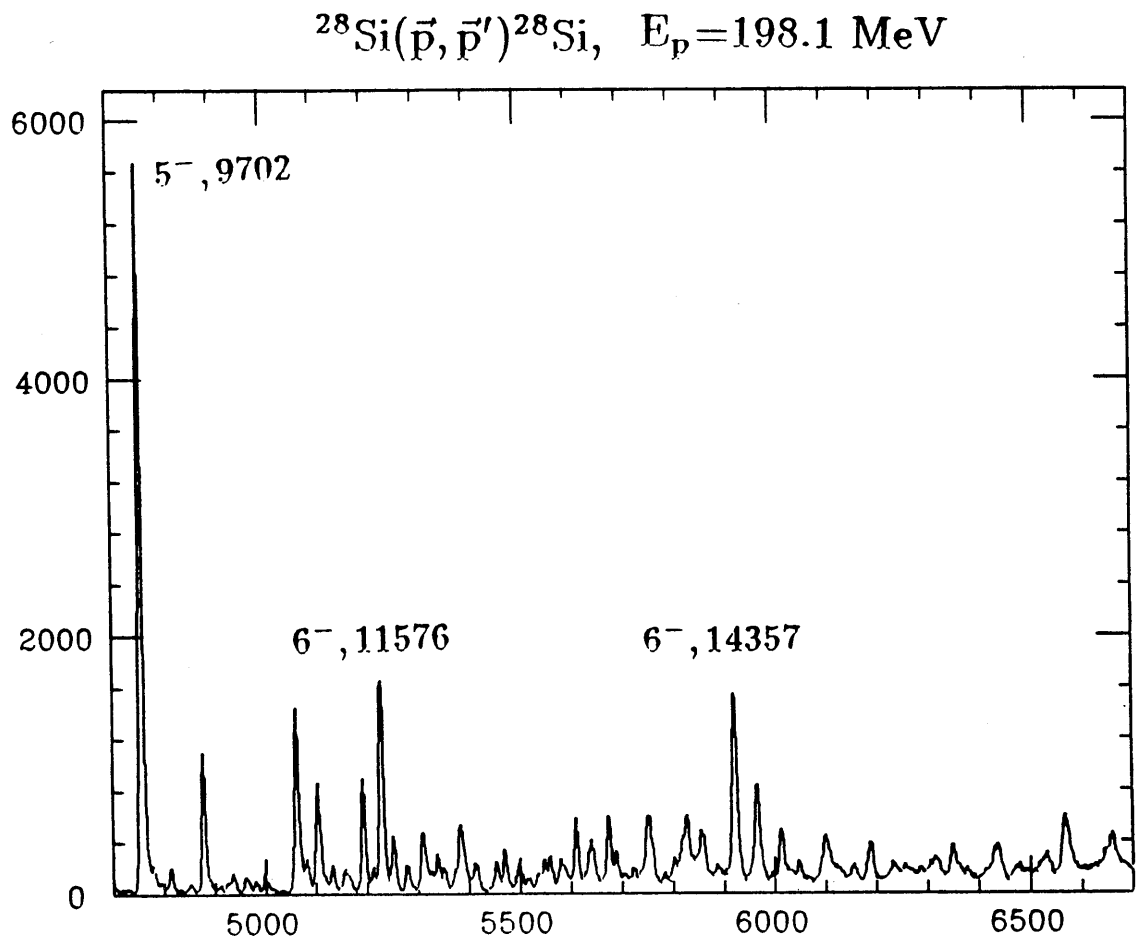

Figure 1. K600 focal plane spectrum for part of the excited states in ^{28}Si(p,p')^{28}Si. The stretched 5^- and 6^- transitions are marked by their spin and excitation in keV.

measurements of $D_{NN'}$ for excited states in ^{28}Si at laboratory angles of 29°, 35°, and 41°. Particles were momentum analyzed with the K600 magnetic spectrometer, and outgoing proton polarizations were measured with the focal plane polarimeter. The beam energy of 198.1 MeV was chosen to be close to that used in earlier studies of ^{16}O and ^{10}B so that results on the effective interaction could be compared among these nuclei. Beam polarizations were monitored continuously using the two p+d polarimeters located in the high-energy beam line. This feature was crucial, since occasional changes in tune resulted in changes in the vertical polarization component of the extracted beam.

Calculations with an optical potential reproduce the measurements in Fig. 2 using parameters consistent with the trends in Olmer, *et al.*[4] A complex spin-orbit potential was used, and the diffuseness of the various terms was held constant at values taken from Ref. 4.

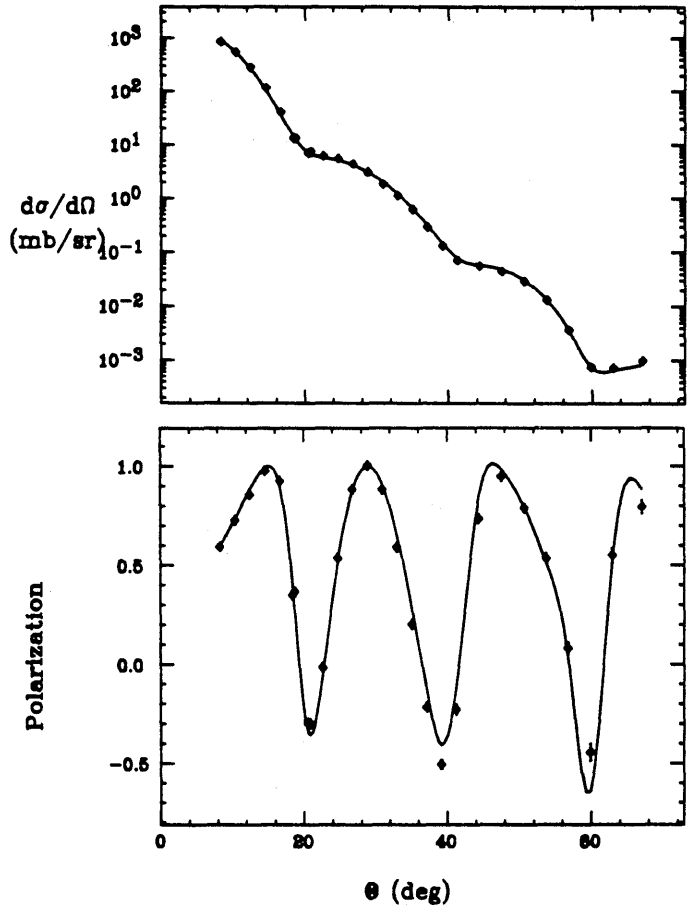

Figure 2. Angular distribution measurements of the differential cross section and analyzing power for protons elastically scattered from ^{28}Si at 198.1 MeV. The curves represent a "best-fit" optical model calculation.

Preparations for measurements of the in-plane polarization transfer observables are underway. Separation of the longitudinal and sideways polarization components at the focal plane polarimeter requires two sets of measurements. One scheme involves the comparison of polarization transfer on the left- and right-hand sides of the beam. Tests made in January, 1992, showed that it would be difficult to place enough shielding around an internal Faraday cup to make measurements on the right-hand side efficient. After some consideration, we have chosen to adopt an alternative scheme that requires a second focal-plane polarimeter to be built and mounted at the low-dispersion port on the K600. Ray-trace calculations indicate that there should be a sufficient change in precession in the K600 dipole field from the present medium-dispersion polarimeter to make a separation of the longitudinal and sideways polarization components. The medium dispersion measurements are planned for the summer of 1992, and will be made with the possibility of additional low-dispersion measurements taken into consideration.

1. E.J. Stephenson and J.A. Tostevin, IUCF Sci. and Tech. Report, May 1990 – April 1991, p. 29.
2. C. Olmer, *et al.*, Phys. Rev. Lett. **43** (1979) 612.
3. Q. Chen, *et al.*, Phys. Rev. C **41** (1990) 2514.
4. C. Olmer, *et al.*, Phys. Rev. C **29** (1984) 361.

THE ($\vec{p}$,2p) REACTION ON ^{2}H, ^{3,4}He AND ^{40}Ca AT 200 MeV

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Recent experiments with intermediate energy protons have examined inclusive A(p,p′) reactions in the quasi-free scattering (QFS) region, measuring not only cross sections but also analyzing powers, and in some cases, spin-transfer coefficients. These studies are, in part, motivated by an attempt to understand possible modifications of the N-N interaction in the nuclear environment. Within the framework of relativistic dynamics models, *inclusive* QFS spin observables are predicted to be modified from their corresponding free–space values.[1] This possibility hinges strongly on the assumption that the QFS peak present in *inclusive* (p,p′) data originates from a single scattering process. This assumption has not been tested in any detail, and such tests require *exclusive* measurements allowing the decomposition of the (p,p′) spectrum into its various components.

In the recently completed experiments (E336/337), we have performed such measurements for a range of nuclear targets: ^{1,2}H, ^{3,4}He, and ^{40}Ca. Included were measurements of the cross section, analyzing power, and spin–transfer coefficient ($D_{nn'}$) for concurrently measured *inclusive* (p,p′) reactions and *exclusive* (p,2p) reactions, utilizing a large solid angle array of NaI detectors (LSAA) as a second–arm detector in coincidence with the K600 spectrometer. The 0.75 sr solid angle of the LSAA covers approximately 50% of the associated particle cone expected for single–step *exclusive* QFS. The NaI array provides a better than 1% determination of the kinetic energy thus enabling separation of the hole