EVIDENCE FOR FRAGMENTATION OF "STRETCHED" 6^- STRENGTH IN $^{28}Si(\vec{p},\vec{p}')^{28}Si$

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A "stretched" particle-hole transition excites a particle from the orbital of the largest angular momentum in one major shell, into the orbital of the largest angular momentum in another major shell, with the angular momentum of the final state coupling to the largest possible value. These excited states, for the even-even nuclei typically studied, have negative parity and total angular momentum $J = j_p + j_h$, with $j_p = l_p + 1/2$ and $j_h = l_h + 1/2$. For ^{28}Si, the 6^- (T=0) and 6^- (T=1) transitions are "stretched" states. With this spin and parity in a 1 $\hbar\omega$ basis, only the stretched configuration $1f_{7/2}1d^{-1}_{5/2}$ can contribute to a one-step M6 transition from the ground state. These are therefore believed to be states of relatively simple structure. But the strength observed experimentally is reduced from this prediction.[1] One simple reason for this is that the one-particle one-hole state is not the eigenstate of the nuclear hamiltonian. The true eigenstate should also involve the excitations of the other nucleons. For this reason, the one-particle one-hole excitation strength is fragmented among many excited states. A large basis shell model calculation was published[2] which allows for all configurations of the type $(d_{5/2}, s_{1/2})^{11-n} d^n_{3/2} f_{7/2}$ with up to n=4. This calculation successfully explained the strength of the 11.58-MeV 6^- (T=0) and 14.36-MeV 6^- (T=1) states, and predicted fragmentation regions for both the 6^-, T=0 and 6^-, T=1 states. A state with an excitation energy about 3 MeV above the 6^-, T=1 state was reported in a ^{28}Si(e,e')^{28}Si experiment,[3] and this state was identified to be a 6^-, T=1 state, which is the same as the prediction. A ^{28}Si(p,n)^{28}P experiment[4] has shown some interesting results while trying to search for and identify the 6^- strength. Seven states were reported to be 6^- candidates.

Our $^{28}Si(\vec{p},\vec{p}')^{28}Si$ data were taken using the K600 magnetic spectrometer with an energy resolution of about 45 keV. The experiment (E353) has been discussed in another Annual Report contribution.[5] A sample of the K600 focal plane spectrum is shown in Fig. 1.

It was assumed in our analysis that configurations other than $1f_{7/2}1d^{-1}_{5/2}$ would involve multiple particle-hole configurations and would not contribute to the single-step excitation of the 6^- states favored by proton inelastic scattering. Thus the angular distributions of cross section and analyzing power for the states at 11.58 and 14.36 MeV could be used as templates to identify other 6^- states. As seen in Fig. 2, the values of $D_{NN'}$ vary from near one for the T=0 state to close to zero for the T=1 state. So $D_{NN'}$ can be used as an indicator of isospin mixing.

A peak fitting routine using Gaussian shapes with independent left and right widths and exponential tails was used to extract the peak sums from spectra similar to Fig. 1 gated

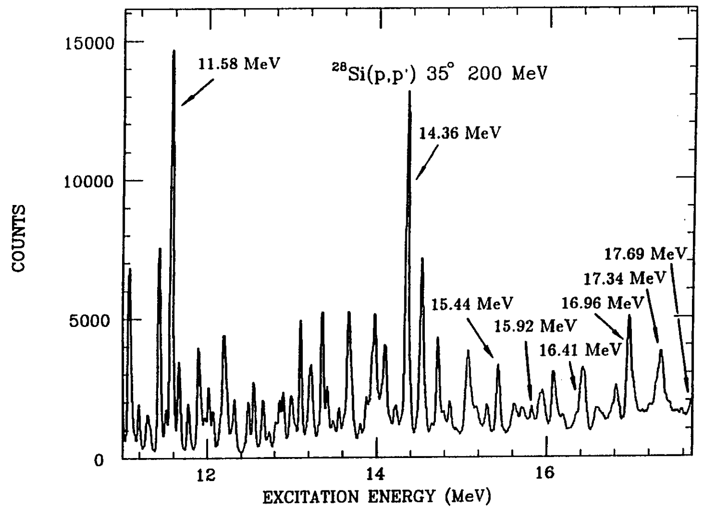

Figure 1. K600 focal plane spectrum for part of the excited states in ^{28}Si($\vec{p}$,$\vec{p}'$)^{28}Si. The stretched 6^- candidates are marked by their excitation energy in MeV.

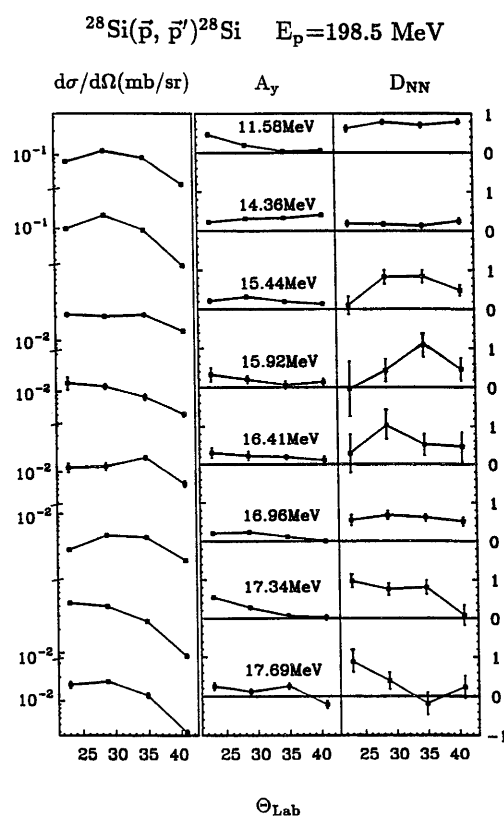

Figure 2. ^{28}Si($\vec{p}$,$\vec{p}'$)^{28}Si 6^- state candidates, with the measured $d\Omega/d\sigma$, A_y and $D_{NN'}$. Excitation energy is noted for each transition.

by polarization state and "left" or "right" scattering in the focal plane polarimeter. The energy scale was determined by extrapolating in momentum along the position axis of the focal plane detector using known transitions to set the scale. This procedure should yield energies below 18 MeV with an error less than ± 50 keV. From this information, angular distributions were calculated for over 40 candidate states above 12-MeV excitation. In addition to the known 6^- states at 11.58 and 14.36 MeV, only six other states appear to carry 6^- strength. The angular distributions for these states are shown in Fig. 2. Some variation was allowed in both cross section and analyzing power in making the comparison. The two states at 15.92 and 16.41 MeV are small peaks resting under larger states at higher excitation energy; thus the errors in the extraction of $D_{NN'}$ are larger. The values of $D_{NN'}$ would suggest that there is some degree of isospin mixing in all of the transitions above 15 MeV. The state at 17.34 MeV probably corresponds to the transition seen by Yen,[3] but in this analysis the large values of $D_{NN'}$ would suggest a significant T=0 component in this transition. States at higher excitation were not analyzed due to the spreading of the state width and the difficulties determining an accurate quasielastic background.

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