ANALYZING POWER MEASUREMENTS FOR $^{13}C(p,p')$ AT 120 MEV

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In a previous experiment[1], differential cross sections for the excitation of ^{13}C by inelastic proton scattering at 135 MeV were obtained. Results have been reported[1] for states up to an excitation energy of about 11 MeV, and for the $3/2^-$, T = 3/2 state at 15.11 MeV.

This experiment was aimed mainly at elucidating information about excited states above 11 MeV. An 8.9 mg/cm^3 ^{13}C target was placed in the 64" scattering chamber, and scattered protons were observed using intrinsic Ge E-ΔE detector telescopes. Particle identification was achieved using a hard-wired circuit. Spectra were measured at angles between about 20° and 50°, and covered a range from 0 MeV to greater than 30 MeV excitation. The experimental resolution was typically 250 - 300 keV. Despite the good statistics, the lack of resolution has made the extraction of peak areas difficult. Consequently for some of the weaker states the uncertainties are quite large.

Results are presented here for three of the best understood transitions in ^{13}C, namely the $3/2^-$ state at 3.68 MeV, the $5/2^-$ state at 7.55 MeV and the $9/2^+$ state at 9.50 MeV. The measured analyzing powers are compared to microscopic DWBA calculations for these states. The parameters used in these calculations are the same as those used in our previous work[1], with the exception of the nucleon-nucleon interaction. Here we have used the 140 MeV complex t-matrix of Love and Franey,[2] which is similar to the interaction[3] used in our previous work.[1] Results are plotted as a function of q_{cm} (calculated relativistically), rather than θ_{cm}, because these calculations were done for a bombarding energy of 135 MeV.

The spectroscopic amplitudes used for the $3/2^-$ and $5/2^-$ states were obtained from the wavefunctions of Cohen and Kurath.[4] The angular distributions for these states are very similar to the angular distribution for the 2^+, T = 0 state of ^{12}C at 4.44 MeV, consistent with a weak coupling model of these 2 states, with the $^{12}C(2^+,T=0)$ coupled to a $1p_{1/2}$ neutron. The analyzing power measurements for these 2 states are shown in Figs. 1 and 2, and are also quite similar to the analyzing power measured for the 4.44 MeV state of ^{12}C in $^{12}C(p,p')$ at 120 MeV.[5]

In Fig. 1 the experimental analyzing power for the $3/2^-$ state is compared with the DWBA calculation.

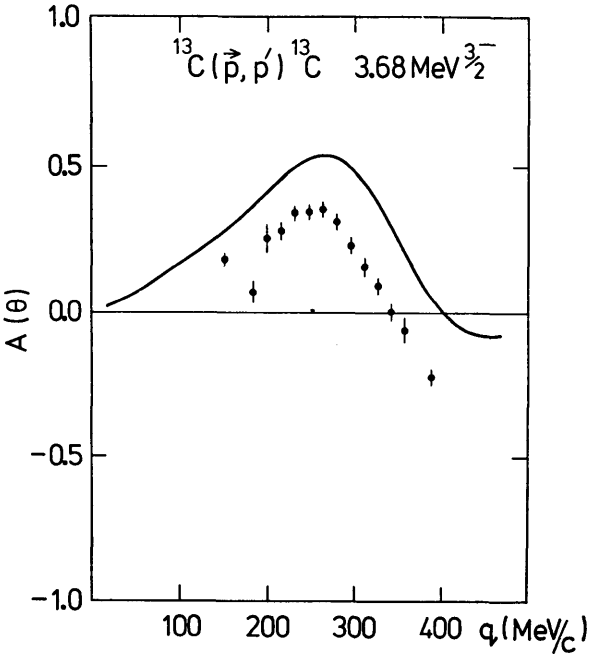

Figure 1. Analyzing power measurements compared to with DWBA calculations for the $3/2^-$ state of ^{13}C at 3.68 MeV.

Results for the $5/2^-$ state are presented in Fig. 2. In both instances the magnitude of the calculated analyzing powers is too large. The calculation for the 4.44 MeV state of ^{12}C at a projectile energy of 120 MeV,[5] (which used the same interaction[2]), exhibits a similar discrepancy.

The results for the $\Delta J=4$, $\Delta L=3$, $\Delta S=1$ transition to the "stretched" $9/2^+$ state at 9.50 MeV are shown in Fig. 3. The calculation has the right magnitude but does not reproduce the phase of the experimental analyzing powers.

Data reduction is continuing for the states at higher excitation energies with the objective of using the combination of our differential cross-section measurements and these new analyzing power measurements to assist in the determination of spins and parities of levels where these are unknown.

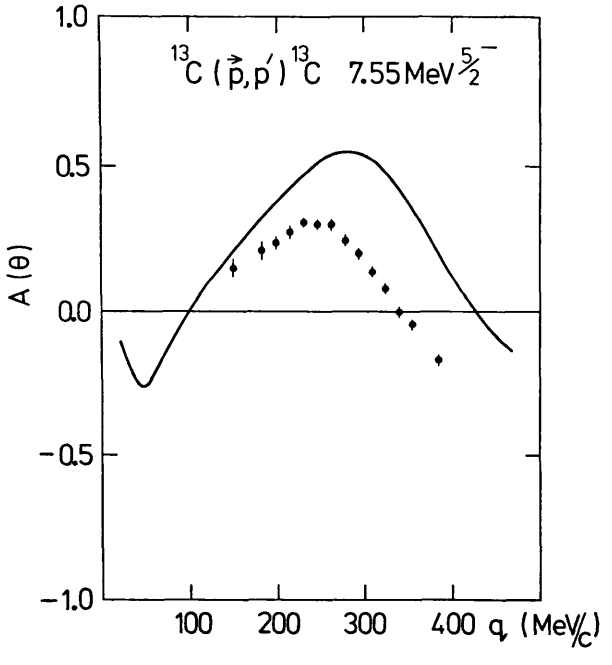

Figure 2. Analyzing power measurements compared with DWBA calculation for the $5/2^-$ state of ^{13}C at 7.55 MeV.

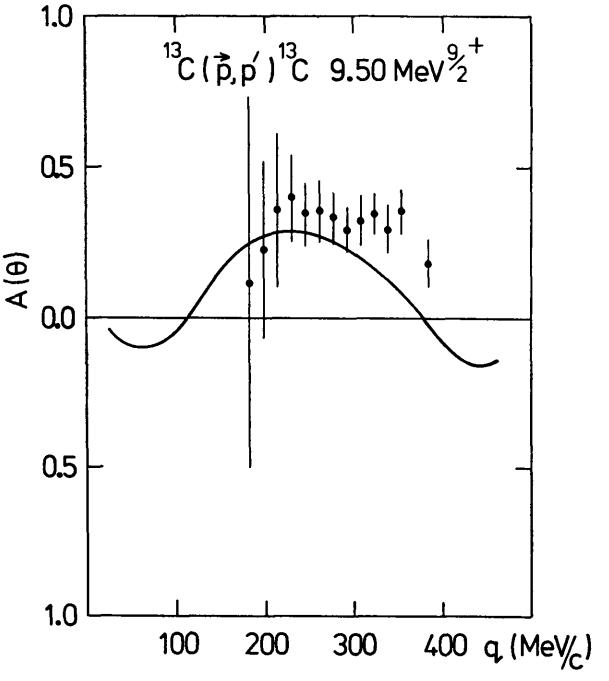

Figure 3. Analyzing power measurements compared with DWBA calculations for the $9/2^+$ state of ^{13}C at 9.50 MeV.

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