

proton and neutron core contributions or a deficiency in the harmonic oscillator orbitals. The level of agreement here is comparable to that for the first 3^- state of ^{16}O for which the larger-angle cross section was also somewhat overpredicted. No attempt was made, for either ^{18}O state, to achieve a perfect fit. These two examples demonstrate the sensitivity of the inelastic cross section data to the neutron transition density. Regardless of whether the preliminary interpretation of the origin of these densities is valid, a model must nonetheless reproduce them.

In the immediate future we plan to make cross section and analyzing power measurements for ^{16}O at 180 MeV to test the energy dependence of the effective

interaction, in the LDA, and to test the reaction mechanism for those states that appear to have a significant two-step contribution. We plan to extend the analyzing power measurements to ^{17}O and ^{18}O and to higher excited states of ^{16}O as part of our unified study of the nuclear structure of the oxygen isotopes. The (p,n) reaction is also an integral component of this program.

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- 1) J. Kelly, et al., IUCF Scient. and Techn. Report 1979, p. 6.
- 2) J. Kelly, et al., Phys. Rev. Lett. 45, 2012 (1980), and references therein.
- 3) A.M. Bernstein, V.R. Brown, and V.A. Madsen, Phys. Rev. Lett. 42, 425 (1974).

INELASTIC PROTON SCATTERING FROM ^{12}C AT 200 MeV

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As part of an ongoing program to examine the effective interaction of proton scattering from nuclei at intermediate energies, cross sections and analyzing powers for the $^{12}\text{C}(p,p')^{12}\text{C}$ reaction have been measured at 200 MeV. Earlier measurements of the cross sections at 122 MeV have been published and a paper regarding the analyzing powers at 120 MeV is in preparation. Although a description of the scattering in the impulse approximation was found to be moderately successful, particularly for isovector spin-flip transitions that are dominated by the long-range one-pion-exchange interaction, several difficulties were also encountered. The present data were obtained in order to elucidate the nature of the problems.

The data were obtained at IUCF with a polarized proton beam of energy 200 MeV. The beam polarization

was typically about 70% and the scattered protons were detected in a helical-cathode proportional chamber in the focal plane of the magnetic spectrograph. The data cover the entire excitation energy range of 0-21 MeV and they span the angular range $6-60^\circ$, typically in steps of $2-3^\circ$.

A spectrum of the unpolarized cross sections and analyzing powers for the high-excitation region is shown in Fig. 1. The three strong sharp peaks on the right-hand side correspond to the 1^+ states at 12.71 MeV ($T=0$) and 15.11 MeV ($T=1$), and to the 2^+ , $T=1$ state at 16.11 MeV. On the left-hand side very strong peaks are found near 18.4, 19.6 and 20.6 MeV. It is apparent from spectra at other angles that the peaks at the lower two energies each contain more than one state.

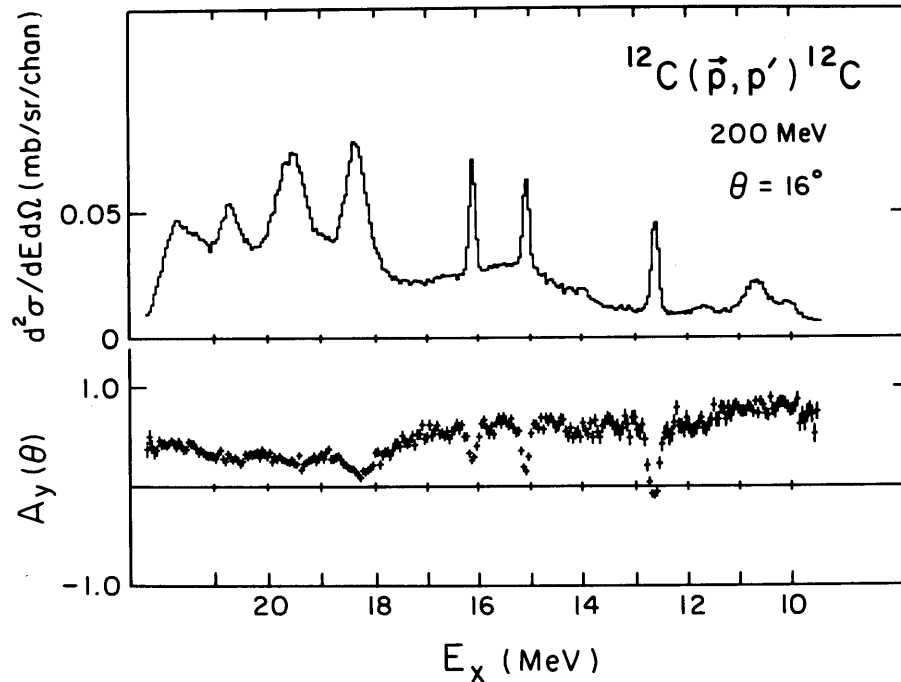


Figure 1. Unpolarized cross sections and analyzing powers for the $^{12}\text{C}(\vec{p}, p')^{12}\text{C}$ reaction at 200 Mev and laboratory angle 16° .

The analyzing-power spectrum shows structures in the regions of the peaks in the spectrum. What is somewhat surprising is the fact that the underlying continuum also has large analyzing powers. Little if any of this continuum comes from unrelated experimental background effects.

The differential cross sections for most of the discrete states of ^{12}C do not change appreciably from those obtained at lower energies^{1,2)} when plotted against momentum transfer. However, there are interesting changes in the analyzing powers when

compared with the 120-MeV results. A characteristic feature of the 200-MeV data is that $A_y(\theta)$ for five scalar-isoscalar excitations ($J^\pi = 0^+ \text{ to } 4^+$) show very strong oscillations between approximately ± 1 . The angular pattern of the continuum is like that of 2^+ state, but somewhat dampened. Another notable result is that $A_y(\theta)$ for the 12.71-MeV transition changes sign over the entire range of momentum transfer between 120 and 200 MeV. Fig. 2 shows some of the A_y data at both energies in comparison with DWIA calculations at 120 MeV. Additional analyses are in progress.

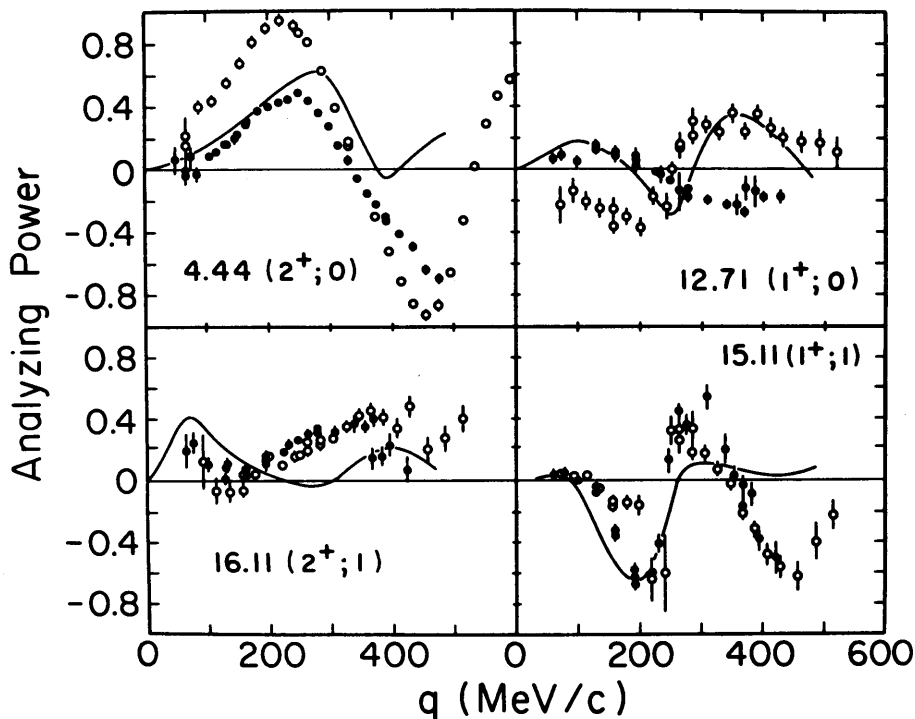


Figure 2 Analyzing powers for the $^{12}\text{C}(\vec{p}, \vec{p}')^{12}\text{C}$ reaction at 120 Mev (solid points) and 200 Mev (open points). States are labelled by $E_x(J^\pi; T)$. The curves are DWBA calculations at 120 Mev.

1) J.R. Comfort et al., Phys. Rev. C21, 2147 (1980).

2) J.R. Comfort, R.E. Segel, G.L. Moake, and D.W. Miller, to be published.

POLARIZATION AND SPIN-FLIP IN PROTON INELASTIC SCATTERING

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This report summarizes the first year's progress in a program which has as its general aim the detailed investigation of the spin-flip probability in proton inelastic scattering. To achieve this goal we have developed a flexible experimental system which permits concurrent measurement of all four partial differential cross sections σ_{ij} ($i, j = +, -$) for scattering polarized protons from initial spin state i to final spin state j . With them we can then construct the total

differential cross section, σ ($= \sigma_{++} + \sigma_{+-} + \sigma_{-+} + \sigma_{--}$), the analyzing power, A ($\sigma A = \sigma_{++} + \sigma_{+-} - \sigma_{-+} - \sigma_{--}$), the final-state polarization, P ($\sigma P = \sigma_{++} - \sigma_{+-} + \sigma_{-+} - \sigma_{--}$) and the spin-flip probability, S ($\sigma S = \sigma_{+-} + \sigma_{-+}$). Whereas A is primarily sensitive to the average nucleon-nucleus spin-orbit field, S has been shown to be primarily dependent on the central and tensor spin-dependent terms of the effective nucleon-nucleon interaction¹). In proton scattering these interactions