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1.24 Excitation of the T=1 and T=0 0^- States in the $^{16}O(\vec{p},p')$ Reaction

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Recently an enhancement of cross sections has been observed[1] at large momentum transfer in the $^{16}O(p,n)^{16}F(0^-)$ reaction at E_p=35 MeV. Such isovector $0^+ \rightarrow 0^-$ transitions should provide information on the pure longitudinal response of nuclei. An explanation of this enhancement in terms of the dimesic polarization due to the pionic correlation has been given[2]. The analog of the $^{16}F(0^-)$ state, the 12.80-MeV(0^-, T=1) state in ^{16}O, has been excited in the $^{16}O(\vec{p},p')$ reaction at E_p = 65 MeV[3]. A comparative study of the (p,n) and (p,p') reactions is highly valuable to untangle problems associated with the reaction mechanism, effective interactions, wave functions, etc. However, in the case of $^{16}F(0^-)$ and $^{16}O(0^-,T=1)$, almost a factor of two difference in the incident proton energies used to obtain the existing (p,n) and (p,p') data makes their comparison quite complicated. At intermediate energies, where the reaction mechanism is supposed to be simpler, the excitation of the 0^- states is very weak.

We have studied the $^{16}O(\vec{p},p')$ reaction at E_p = 35 MeV to obtain data directly comparable with the (p,n) data. The experiment was performed at the Institute for Nuclear Study, University of Tokyo, using a polarized proton beam from the AVF cyclotron and a magnetic spectrometer. The target was oxygen gas of natural abundance and at 0.5-1.0 atm. A typical proton spectrum around the region of interest is shown in Fig. 1. The differential cross sections and analyzing powers for the T=1 and T=0, 0^- states are shown in Figs. 2 and 3.

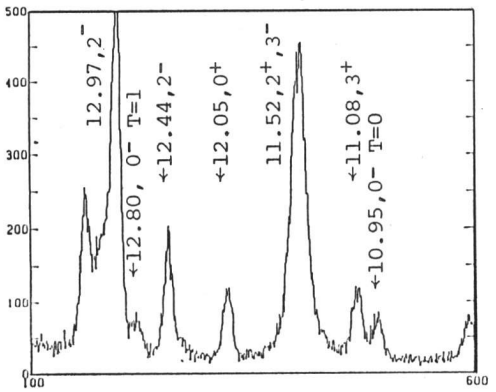

Fig. 1. Sample proton spectrum obtained for the $^{16}O(\vec{p},p')$ reaction at $\theta_{LAB} = 30^o$.

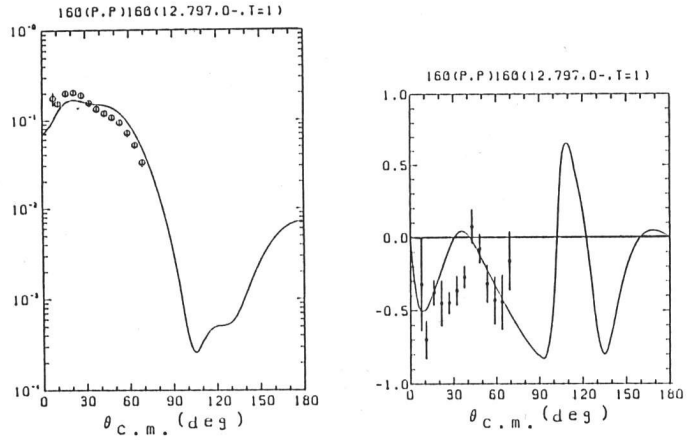

Fig. 2. Differential cross sections and analyzing powers for the 12.80-MeV, 0^- T=1 state. The curves are DWBA calculations.

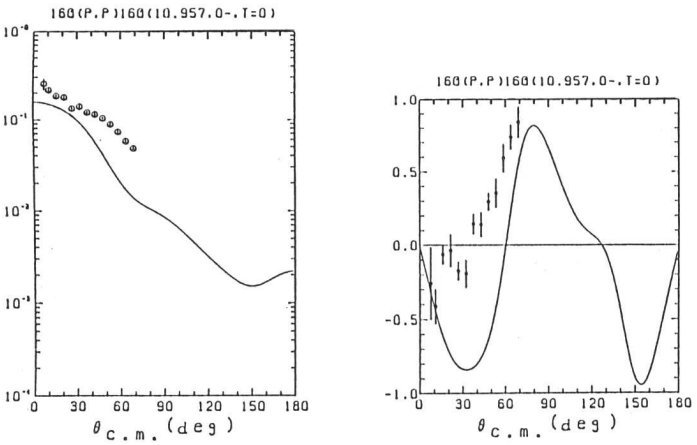

Fig. 3. Differential cross sections and analyzing powers for the 10.96-MeV, 0^- T=0 state. The curves are DWBA calculations.

Preliminary DWBA calculations are carried out using the code DWBA74[4]. The proton distorting potential parameters of Fabrici et al.[5] and the M3Y interaction[6] are used. Transition amplitudes are obtained from the Millener-Kurath wave functions[7]. Both the T=1 and T=0 $0^+ \rightarrow 0^-$ transitions are essentially the $p_{1/2} \rightarrow s_{1/2}$ transition according to these wave functions. The DWBA results are compared with the data in Figs. 2 and 3. Experiment is still under way, and large-angle data are currently being taken.

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