THE 0^+ TO 0^- TRANSITION IN THE $^{16}O(p,n)^{16}F$ REACTION

R. Madey, B.S. Flanders, B.D. Anderson, A.R. Baldwin and J.W. Watson
Kent State University, Kent, Ohio 44242

J.J. Kelly and M.V. Hynes
Los Alamos National Laboratory, Los Alamos, New Mexico 87544

W. Bertozzi, J.M. Finn and C. E. Hyde-Wright
Massachusetts Institute of Technology, Cambridge, Massachusetts 02139

C.C. Foster
Indiana University Cyclotron Facility, Bloomington, Indiana 47405

J.R. Comfort
Arizona State University, Tucson, Arizona 84721

H. Orihara
Tohoku University, Sendai 980, Japan

In a short (five shift) feasibility study carried out in March, 1983 as Experiment E204, we achieved an energy resolution of 140 keV for 63 MeV neutrons using a flight-path distance of 125.2 meters. We extracted the angular distribution of the differential cross section at four forward angles [Θ(cm) = 0, 4.2, 8.5 and 12.5 degrees]. Fig. 1 is the time-of-flight spectrum observed at a laboratory angle of 8 degrees for an incident proton energy of 80 MeV. The counts in each four channels on a scale of 4096 channels are summed and binned here into one channel. The background level is about 2200 counts per channel in this reduced spectrum of 1024 channels. The signal level at the peak of the 0^- state is about 390 counts per channel. The total number of 0^- counts is 2118 distributed over 14 channels in a spectrum of 1024 channels. The solid lines represent the results of a fit to the spectrum. The energy of each peak is known and the shape of the peaks is determined from the observed shape of ^{12}N ground state peak from the $^{12}C(p,n)^{12}N$ reaction.

Figure 2 is the differential cross section in the center of mass frame plotted as a function of momentum transfer for the 0^-, 1^-, 2^- and 3^- states in ^{16}F. Statistical error bars are indicated only when the uncertainty is larger than the symbol size. The solid lines represent distorted-wave-impulse-approximation (DWIA) calculations performed with (1) the shell-model

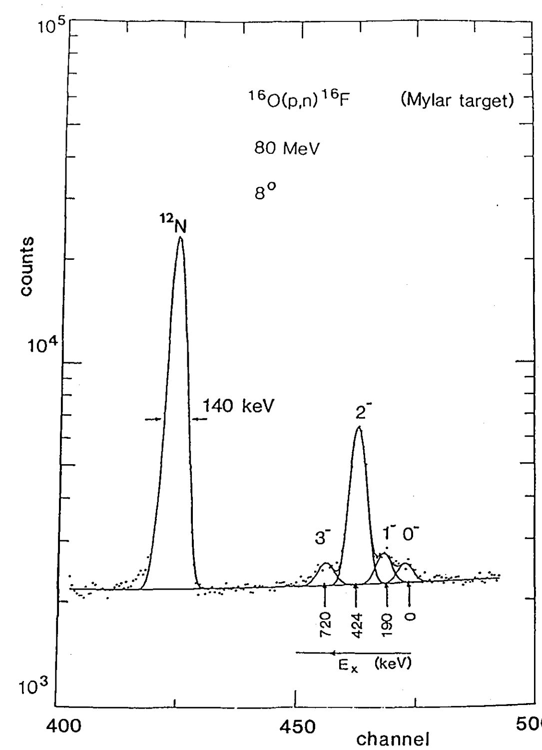

Figure 1. Time-of-flight spectrum measured at 8° for the $^{16}O(p,n)^{16}F$ reaction.

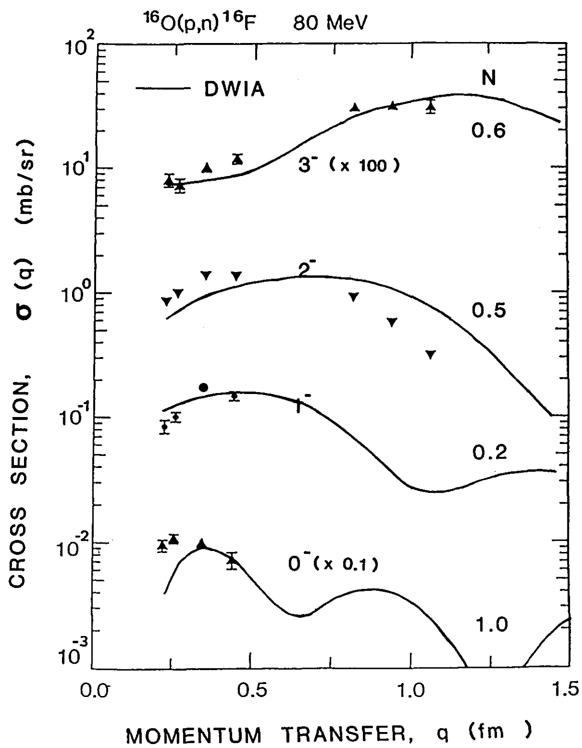

Figure 2. Angular distributions measured for the reaction $^{16}O(p,n)^{16}F$. The solid lines are DWIA calculations described in the text.

wave functions of Donnelly and Walker,[1] (2) the effective interaction of Love and Franey[2] at 100 MeV, and (3) the optical-model parameters of Comfort and Karp[3] for 99 MeV protons on ^{12}C. The calculations are normalized by a factor N = 1.0 for the 0^- state, N = 0.2 for the 1^- state, N = 0.5 for the 2^- state and N = 0.6 for the 3^- state. This reaction was studied at 35 MeV by Orihara et al.[4] They report a normalization of N = 0.4 for all four states using the M3Y interaction.[5]

Beam time was approved to extend our measurements to larger momentum transfer. We expect to make a significant improvement in the signal-to-background ratio by using the stripper loop.[6] The longer period between beam bursts will allow us to eliminate the background from "overlap" in the neutron time-of-flight spectrum between fast neutrons from one beam burst and slower neutrons from earlier beam bursts. Also, the ability to lower thresholds will increase the neutron detection efficiency.

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2) W.G. Love and M.A. Franey, Phys. Rev. C 24, 1073 (1981).

3) J.R. Comfort and B.C. Karp, Phys. Rev. C 21, 2162 (1980).

4) H. Orihara, S. Nishishara, K. Furukawa, T. Nakagawa, K. Maeda, K. Miura and H. Ohnuma, Phys. Rev. Lett. 49, 1318 (1982).

5) G. Bertsch, J. Barysowicz, H. McManus and W.G. Love, Nucl. Phys. A284, 399 (1977).

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