HIGH-SPIN STATES IN NUCLEI EXCITED VIA (p,n) REACTIONS

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We analyzed data obtained during a preliminary run for the excitation of high-spin states via the (p,n) reaction on targets of ^{12}C, ^{16}O, ^{24}Mg, and ^{28}Si at 61.9 and 135 MeV incident proton energies. In each case we see a state (or a complex of states) which dominate the neutron energy spectra at the largest angle studied (vis., 24°). Although the 0° spectrum for the $^{12}C(p,n)^{12}N$ reaction is dominated by the Gamow-Teller peak at 0 MeV excitation, the 24° spectrum is dominated by a peak at about 4 MeV excitation and believed to contain a 2^- and 4^- state as predicted by Moffa and Walker.[1] The identification of this state agrees with the identification by Donnelly et al.[2] of the analog state at 19.5 MeV of excitation in ^{12}C by inelastic electron scattering. Also we have data over the same angular range for ^{12}C at 119.8 MeV and for ^{12}C and ^{16}O at 160 MeV. The high-spin states seen in the $^{16}O(p,n)^{16}F$ and the $^{28}Si(p,n)^{28}P$ reactions are within 1 MeV of the excitation energies predicted by Moffa and Walker for high-spin states in these cases. Tentatively, we identify the high-spin state seen in the $^{24}Mg(p,n)^{24}Al$ reaction to be the analog of the high-spin (6^-) state seen in ^{24}Mg by Zarek et al.[3] with inelastic electron scattering and by Adams et al.[4] with inelastic proton scattering. A more positive identification of this state from our (p,n) studies awaits measurements at wider angles and with better energy resolution. It is largely because these high-spin states can be studied via different reactions that they will be important to test the various reaction models used to describe medium energy reactions. Also, the study of the excitation of high-spin states will help determine certain terms of the effective nucleon-nucleon interaction to complement the studies of analog and Gamow-Teller transitions.

At the largest angle available in the temporary neutron time-of-flight facility at the IUCF (viz., 24°), the calculations of Moffa and Walker predict that these high-spin state complexes still contain contributions from lower-spin states. We plan to extend these measurements out to about 60° with the beam-swinger facility in order to minimize the low-spin state contributions to the complexes. Also we plan to use longer flight paths for better energy resolution.

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1) P.J. Moffa and G.E. Walker, Nucl. Phys. A222, 140 (1974).

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3) H. Zarek et al, Phys. Rev. Lett. 38, 750 (1977).

4) G.S. Adams et al., Phys. Rev. Lett. 38, 1387 (1977).