THE ISOSPIN MAKEUP OF THE GIANT RESONANCES FROM (p,n) REACTION STUDIES AT INTERMEDIATE ENERGIES†

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Neutron spectra above about 20 MeV have been measured[1,2] at reaction angles from 7° to 22° from 61.9 MeV proton bombardment of targets of ^{9}Be, ^{12}C, and ^{28}Si. Time-of-flight measurements were made by suppressing 5 out of 6 beam bursts at a frequency of 32.29 MHz. Timing from the cyclotron r.f. signal resulted in an overall time resolution of about 1.3 nsec (fwhm). The 5" diam x 4" thick NE-102 plastic scintillation counters have an intrinsic time resolution of less than 1.0 nsec (fwhm)[3]. The energy resolution was about 0.3 MeV for 35-MeV neutrons traversing the flight path of 29 meters.

The spectrum from each target is dominated by a single sharp peak as can be seen in Fig. 1 for the $^{12}C(p,n)^{12}N$ reaction at an angle of 10°. This sharp peak is the giant M1 resonance which is excited here by a charge-exchange transition that also flips the spin of a nucleon. This state occurs at 0-MeV excitation in ^{12}N, and at 2.1 MeV in ^{28}P, corresponding to the analogs of the 15.1-MeV state in ^{12}C, and the 11.4-MeV state in ^{28}Si, respectively. In the $^{12}C(p,n)^{12}N$ and $^{28}Si(p,n)^{28}P$ reactions, a broader concentration of strength appears in each spectrum at higher excitation energies, presumably representing a cluster of particle-hole states. At still higher excitation, another concentration of strength might be the analog of the giant E1 resonance.

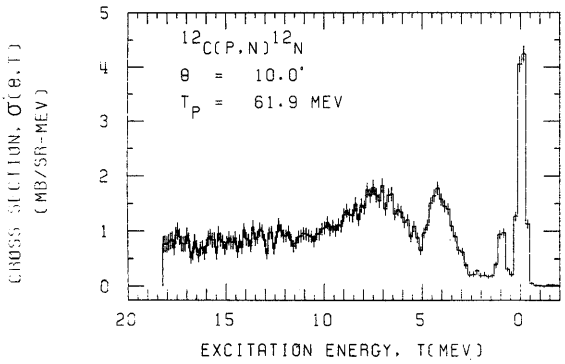

Figure 1.

Additional measurements will be made at 62 and 136 MeV on self-conjugate target nuclei. We will compare our measurements of (p,n) spectra with other measurements of (p, p') and (α, α') spectra to study the isospin makeup of giant resonances. The (p, p') reaction on target nuclei of isospin zero permits excitation of multipole resonances in both isospin T = 1 and T = 0 states of the residual nucleus; however, (p,n) reactions on target nuclei of zero isospin can excite only T = 1 states, and (α, α') reactions on such targets can excite only T = 0 states. The ratio of the (p,n) to (p, p') cross sections is two for exciting a T = 1 state from a self-conjugate target nucleus. Thus, the cross section for a T = 0 state excited by the (p, p') reaction can be deduced by subtracting one-half of the cross section for a T = 1 state in a (p,n) reaction from the total (p, p') cross section

which excites both isospin states.

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