"0 $\hbar\omega$" STRETCHED STATES EXCITED WITH THE (p,n) REACTION ON MEDIUM- AND HEAVY-MASS NUCLEI

B.D. Anderson, C. Lebo, A.R. Baldwin, T. Chittrakarn, R. Madey, and J.W. Watson
Kent State University, Kent Ohio 44242

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

The (p,n) reaction at 135 MeV was studied on several medium- and heavy-mass nuclei at the Indiana University Cyclotron Facility. Neutron energies were measured by the time-of-flight technique in the beam swinger facility with overall energy resolutions of 320 to 450 keV. The wide-angle spectra are dominated by a strongly-excited peak observed at low excitation energy, as shown in Fig. 1. These transitions exhibit angular distributions consistent with the interpretation that these are the "0 $\hbar\omega$" stretched-state excitations[1] in the residual nuclei (see Fig. 2). Such states correspond to 1p-1h

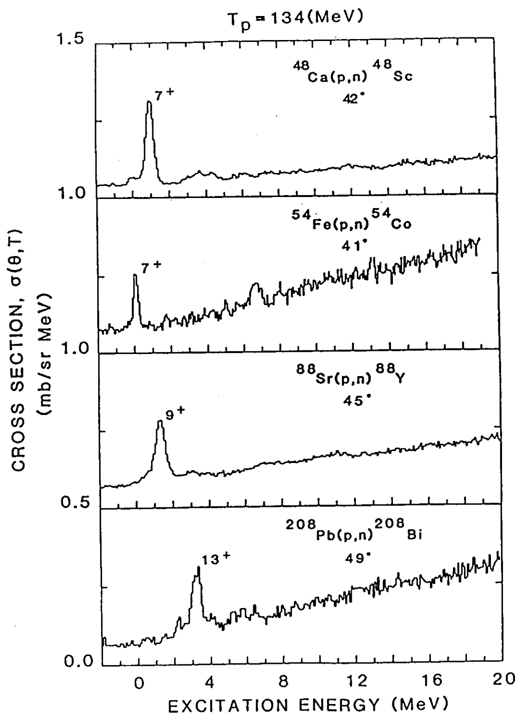

Figure 1. Time-of-flight spectra measured for the (p,n) reaction from ^{48}Ca, ^{54}Fe , ^{88}Sr, and ^{208}Pb.

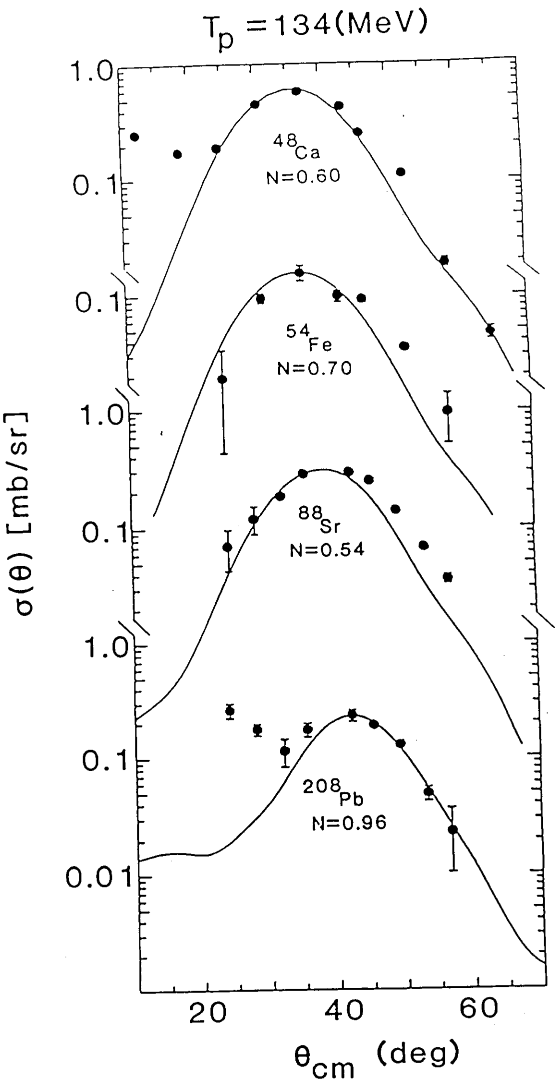

Figure 2. Angular distributions measured for (p,n) reactions leading to "0$\hbar\omega$" stretched states.

configurations where the particle and hole are in the same shell-model orbital and coupled to the state of maximum possible spin; furthermore, these states are formed in the orbital of highest spin in the excess neutrons. These excitations have unique 1p-1h configurations (in the Tamm-Dancoff approximation) up to 2 $\hbar\omega$ of excitation.

Perhaps the most remarkable characteristic of these "0 $\hbar\omega$" excitations is that, in contrast to "1 $\hbar\omega$" stretched-state excitations in medium- and heavy-mass nuclei, the stretched-state strength is apparently concentrated into a single state. This results primarily because both the particle and hole states which combine to form the "0 $\hbar\omega$" stretched-state are at (or near) the Fermi surface of the residual nucleus. In contrast, the "1 $\hbar\omega$" transitions necessarily involve an excitation from one major shell to the next, resulting in the excitation of either a deep-hole state or a high-lying particle state. For medium- and heavy-weight nuclei, these large energy excitations are usually highly fragmented. The "0 $\hbar\omega$" stretched-state excitations eliminate the normally difficult experimental task of locating and identifying all of the stretched-state strength; thus, they provide important tests of such strength in these nuclei and information of the target wave functions.

The angular distributions for these four transitions are shown in Fig. 2 compared with "standard" DWIA calculations, performed with the code DWBA70 and the 140 MeV nucleon-nucleon effective interaction of Love and Franey,[2] harmonic-oscillator wave functions, and the global optical-model parameters of Schwandt, et al.[3] The transitions all indicate a larger fraction (typically>0.5) of the expected strength than do "1 $\hbar\omega$" excitations, consistent with the interpretation that these states have concentrated particle-hole strength.

1) J.W. Watson, et al., Phys. Rev. C 23, 2373 (1981).

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

3) P. Schwandt, H.O. Meyer, W.W. Jacobs, A.D. Bacher, S.E. Vigdor, M.D. Kaitchuck, and T.R. Donaghue, Phys. Rev. C 26, 55 (1982).