DEEP HOLE STATES IN THE MIRROR NUCLEI ^{23}Mg AND ^{23}Na

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The mirror reactions ^{24}Mg(d,t)^{23}Mg and ^{24}Mg(d,^{3}He)^{23}Na have been studied at E_d = 76 MeV, with special emphasis on the region of excitation between 8 and 12 MeV, where comparison of earlier (p,d)[1] and (d,^{3}He)[2] results suggests pronounced discrepancies in the spectrum of major 1p-shell neutron-hole vs. proton-hole fragments. Comparison of the (d,t) and (d,^{3}He) results should allow us to distinguish whether the previous discrepancies reflect true differences in the structure of the mirror nuclei at high excitation, or arise instead from differences in reaction mechanism or mis-identification of peaks.

In the present study, spectra were obtained up to at least 15 MeV excitation, in the angular range $6° \leq \Theta_{lab} \leq 50°$, using both the QDDM spectrograph (∿ 80 keV resolution) and silicon-detector telescopes (∿120-150 keV resolution). Representative QDDM spectra are shown in Fig. 1. These spectra reveal considerable fragmentation of the strength in the region E_x = 8-12 MeV. The largest sharp peaks in this region (corresponding to maximum cross sections between 0.1 and 1.0 mb/sr) appear to have mirror counterparts, but with substantially greater scatter (from state to state) in the Coulomb energy differences and relative strengths than one observes for states below 6 MeV excitation (see fig. 1).

Data reduction and DWBA analysis of the results are still in progress. It is encouraging that initial calculations show a substantial ℓ-dependence of the (d,t) and (d,^{3}He) angular distributions, and that the data for the largest peaks in the high excitation region do appear to be characteristic of ℓ = 1 transfer. This is in qualitative agreement with preliminary shell-model calculations[3], which predict a concentration of the $1p_{3/2}$-hole strength in this region. The shell-model calculations performed to date do not, however, include Coulomb effects in the residual interaction. Such calculations are needed before one can judge whether the apparent anomalies at high excitation in fig. 1 are likely to result simply from the Coulomb force.

We are planning further measurements on other sd-shell nuclei as part of a systematic study of p-shell hole strength. We are interested in particular in seeing if similar differences in high-excitation mirror states persist in nuclei closer to shell closure (e.g., ^{39}Ca vs. ^{39}K).

1) D.W. Miller, D.W. Devins, R.E. Pollock, R. Kouzes, and V.C. Officer, Bull. Am. Phys. Soc. 21, 978 (1976).

2) M. Arditi, L. Bimbot, H. Doubre, N. Frascaria, J.P. Garron, M. Riou, and D. Royer, Nucl. Phys. A165, 129 (1971); E. Krämer, G. Mairle, and G. Kaschl, Nucl. Phys. A165, 353 (1971).

3) S. Maripuu, private communication.

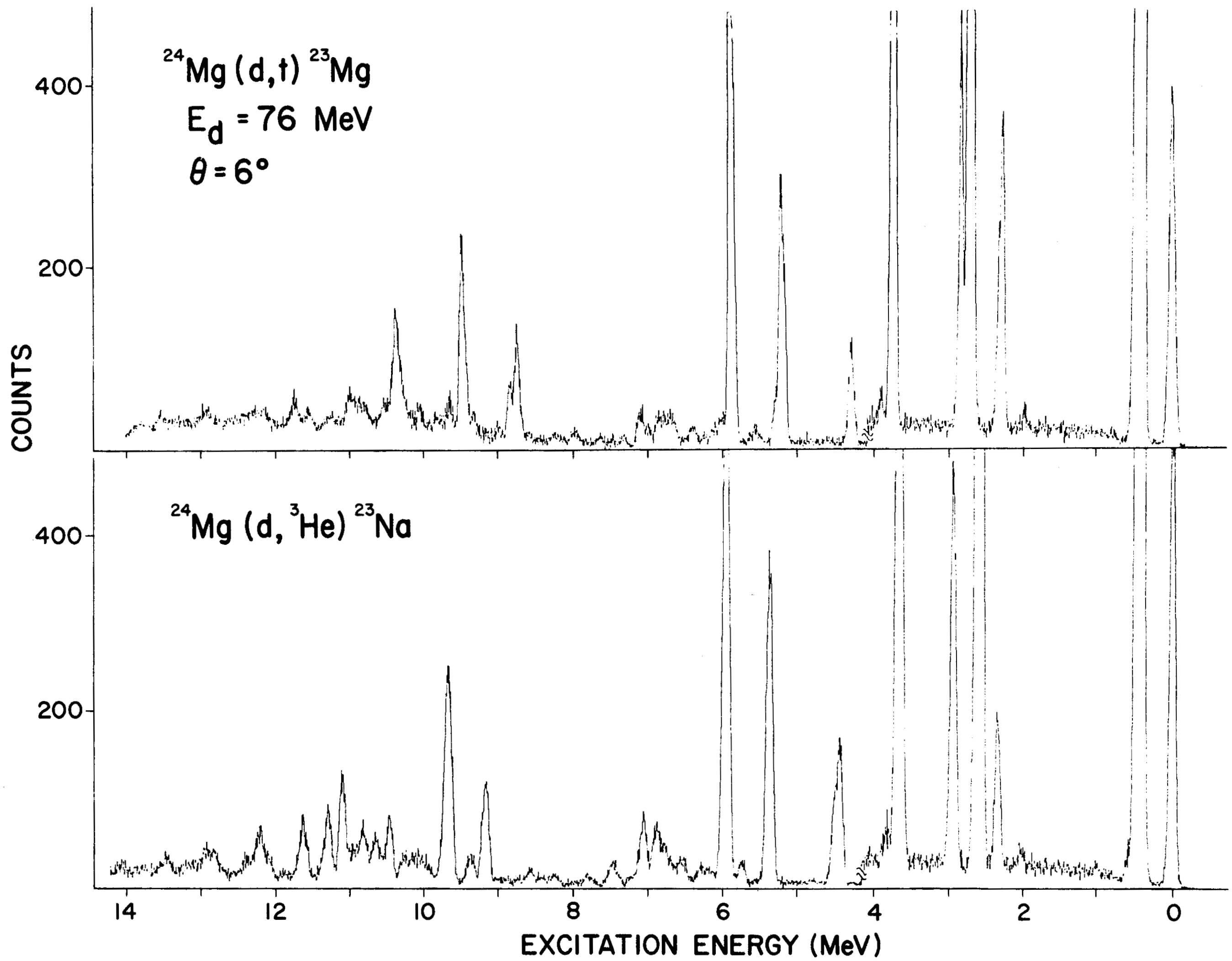

Figure 1. Representative (d,t) and (d,^{3}He) spectra acquired with a ^{24}Mg target and the QDDM spectrograph. The energy resolution is $\simeq$ 80 keV. The spectra are compositions of several smaller energy bites taken with different field settings; the lowest energy bite has a large background due to high counting rate.