Test of Axel-Brink predictions in the $^{167}\text{Er}(n,\gamma)^{168}\text{Er}$ reaction

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Abstract. The average radiation widths of primary $\gamma$ rays in the reaction $^{167}\text{Er}(n,\gamma)^{168}\text{Er}$ are in reasonable agreement with the Axel-Brink predictions based on a giant dipole resonance model.

In recent years, the limitations imposed by Porter-Thomas fluctuations in the study of primary $\gamma$ rays following neutron capture have been partly overcome by "resonance-averaging" techniques. The incident neutron beam is chosen with an energy distribution sufficiently broad that many compound nucleus resonances contribute to the capture process. The two techniques most commonly employed in average-resonance-capture measurements involve the use of "reactor-neutrons" and "filtered-beams". A third method of obtaining individual $\gamma$-ray spectra from a large number of resonances and summing them after appropriate normalizations was accomplished recently by Raman, Shahal and Slaughter (1981) in the case of the $^{173}\text{Yb}(n,\gamma)$ reaction. The resulting average radiation widths (and hence the $\gamma$-ray strength function) were found to be in good agreement with the Axel-Brink predictions. The predictions are based on two key ideas: (1) The giant dipole resonance (GDR) governs the width of the transition from the capturing state to the ground state (Axel 1962), and (2) If it were possible to perform a photoabsorption experiment on an excited state, the cross section would still have the same Lorentzian energy dependence as the GDR (Brink 1955).

Fig. 1. Selected portion of the summed spectrum from 87 resonances below 590 eV.
In the present study, we have obtained one hundred and ten 4096-channel spectra (87 on-resonance and 23 off-resonance) from the $^{167}$Er$^\text{(n,\gamma)}$ reaction. The spectra were normalized through the use of the $816\text{-keV, } 3^+ \to 2^+$ transition, which has a measured absolute intensity (Davidson et al 1981) of 30 photons per 100 thermal neutron captures. The measured average intensity values deduced from the summed spectrum (see Fig. 1) were in good agreement with the "2-keV" results of Davidson et al (1981).

The measured $\gamma$-ray strength function ($f = \Gamma_\gamma / D E_i$) is compared to the Axel-Brink predictions in Fig. 2. The giant resonance parameters are from recent photodisintegration measurements (Gurevich et al 1981). The predictions are, on the average, $\approx 20\%$ higher than the measurements but the overall agreement is quite reasonable. As the next step, we plan to test whether the strength function is independent of the spin of the capturing state as generally supposed.

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