Giant monopole resonance in Mo and Zr isotopes

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While the Giant Monopole Resonance (GMR) is a nearly symmetric Gaussian like peak in Sn isotopes and heavier nuclei, the GMR in Zr is an almost symmetric peak with a pronounced high energy tail that significantly affects the energy of the GMR and hence the nuclear compressibility extracted from its position[1]. Hartree-Fock-RPA calculations of ^{90}Zr [2] predicted the shape and relative strength of this tail reasonably accurately, though the energy of the GMR was too high in the calculation. We have studied giant resonances in ^{90,92}Zr, ^{92,96,100}Mo with inelastic scattering of 240 MeV α particles using the MDM spectrometer at small angles including 0^o to see if this feature persists in other nuclei having N,Z ~ 50,40. The horizontal acceptance of the spectrometer was $4^o$and ray tracing was used to reconstruct the scattering angle. The vertical acceptance was set at 2^o. The focal plane detector measured position and angle in the scattering plane and covered from E_x ~ 8 MeV to E_x > 55 MeV, depending on scattering angle. The out-of-plane scattering angle was not measured. Position resolution of approximately 0.9 mm and scattering angle resolution of about 0.09^o were obtained. Sample spectra are shown in Fig. 1. The multipole components of the giant resonance peak were obtained[1] by dividing the peak into multiple

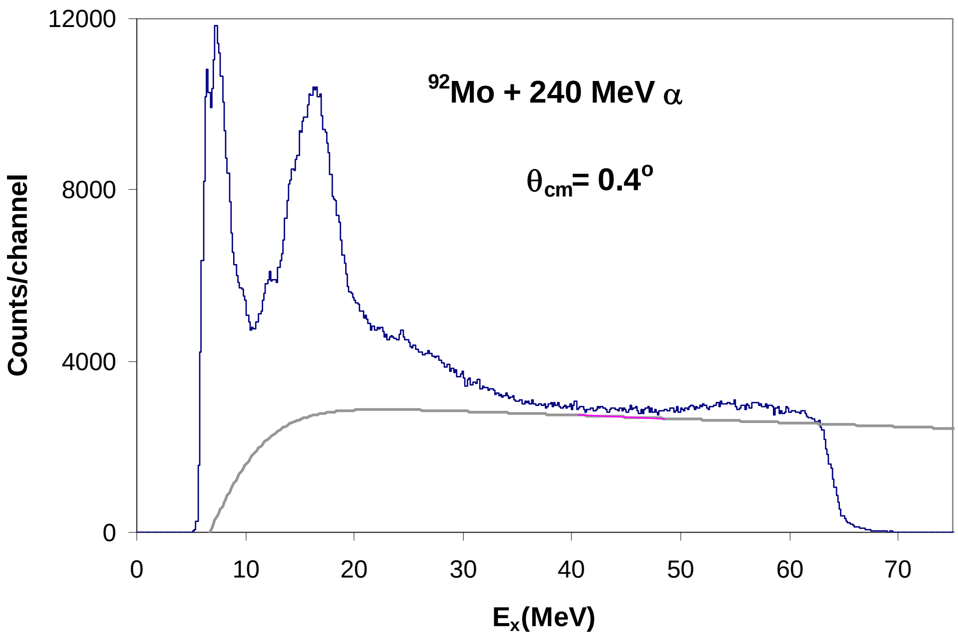

FIG. 1. Inelastic α spectrum obtained at center of mass angle 0.4^o for 240 MeV α particles bombarding ^{92}Mo.

regions (bins) by excitation energy and then comparing the angular distributions obtained for each of these bins to distorted wave Born approximation (DWBA) calculations. The uncertainty from the multipole fits was determined for each multipole by incrementing (or decrementing) that strength, then adjusting the strengths of the other multipoles to minimize total χ^2. This continued until the new χ^2 was 1 unit larger than the total χ^2 obtained for the best fit. Approximately 100% of the E0 EWSR strength was located in each of the nuclei, and the distributions obtained are shown in Fig. 2. In ^{92}Zr and especially ^{92}Mo the high energy component of the GMR is very broad, while in the other nuclei it is much narrower. Moreover in ^{92}Mo, the high energy component contains ~65% of the total E0 strength, so that the centroid energy in ^{92}Mo is more than 2 MeV higher than in ^{90}Zr. The source of this high energy component is not apparent. In deformed nuclei, the GMR splits into two components, one almost coincident with the quadrupole and a second at the normal monopole position[3]. This splitting is very different as the lower and narrower component in ^{92}Mo is approximately where the GMR would be expected, and the other component is substantially higher in energy.

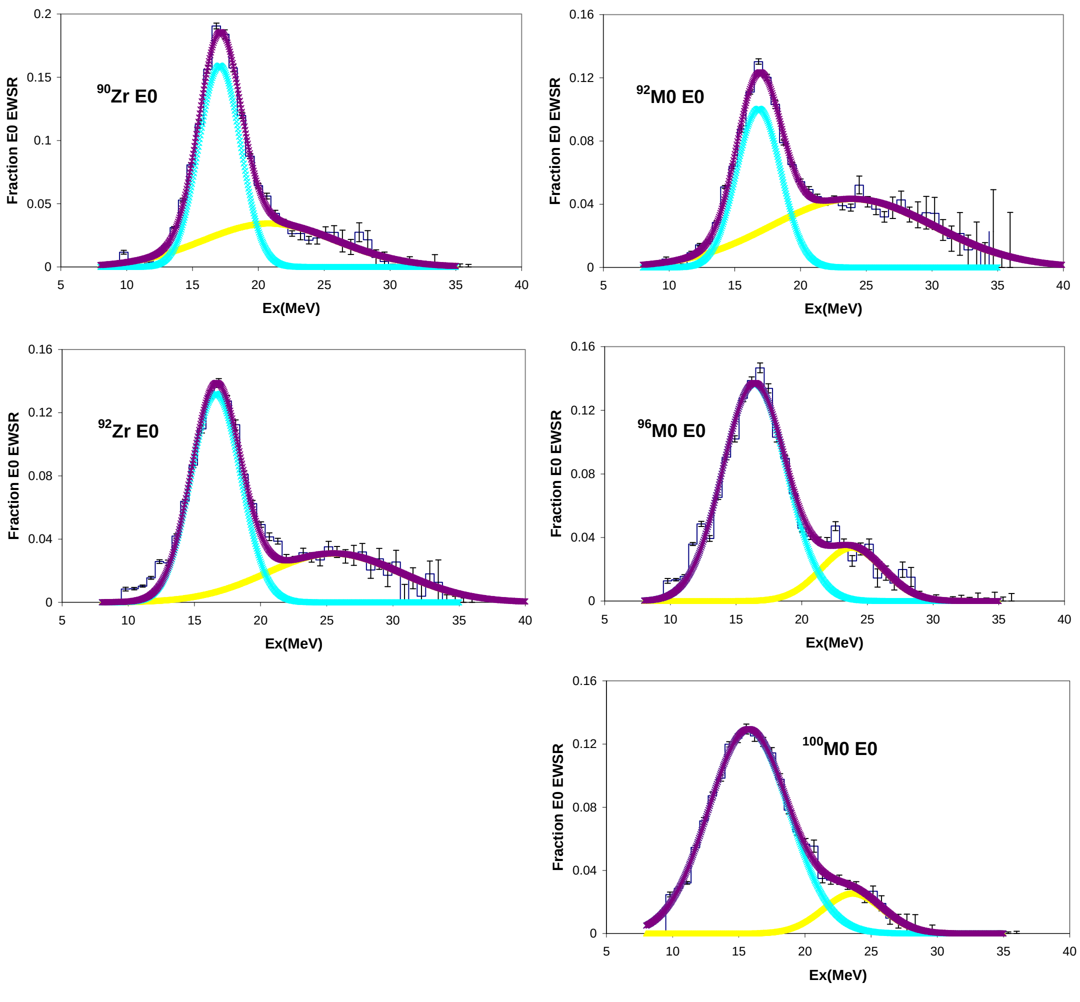

FIG. 2. E0 strength distributions obtained from fits. Two peak Gaussian fits are shown.

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