Splitting of the giant monopole resonance in ^{92}Mo

D. H. Youngblood, Y. -W. Lui, Krishichayan, J. Button, S. Shlomo, and M. Urin[1]

The mass 90 region is a transitional region for the giant monopole resonance(GMR). In ^{90}Zr about 78% of the strength lies in a symmetric peak[1], with the rest in a shoulder about 7 MeV higher in energy. In heavier (spherical) nuclei the monopole strength is concentrated in a mostly symmetrical peak, and in lighter nuclei the strength is located either in a peak with significant tailing to the high energy side or with obvious broad components above the main peak. We investigated[2] ^{90,92}Zr, ^{92,96,100}Mo and the results are shown in Fig. 1. ^{92}Mo stood out with about 65% of the E0 EWSR strength located in a broad high energy peak (~ 24 MeV) and the remainder in a narrower peak at ~ 16.9 MeV[2]. Another contribution to this report describes a second ^{92}Mo experiment which verified the earlier result, and also shows results for ^{94}Zr and ^{98}Mo.

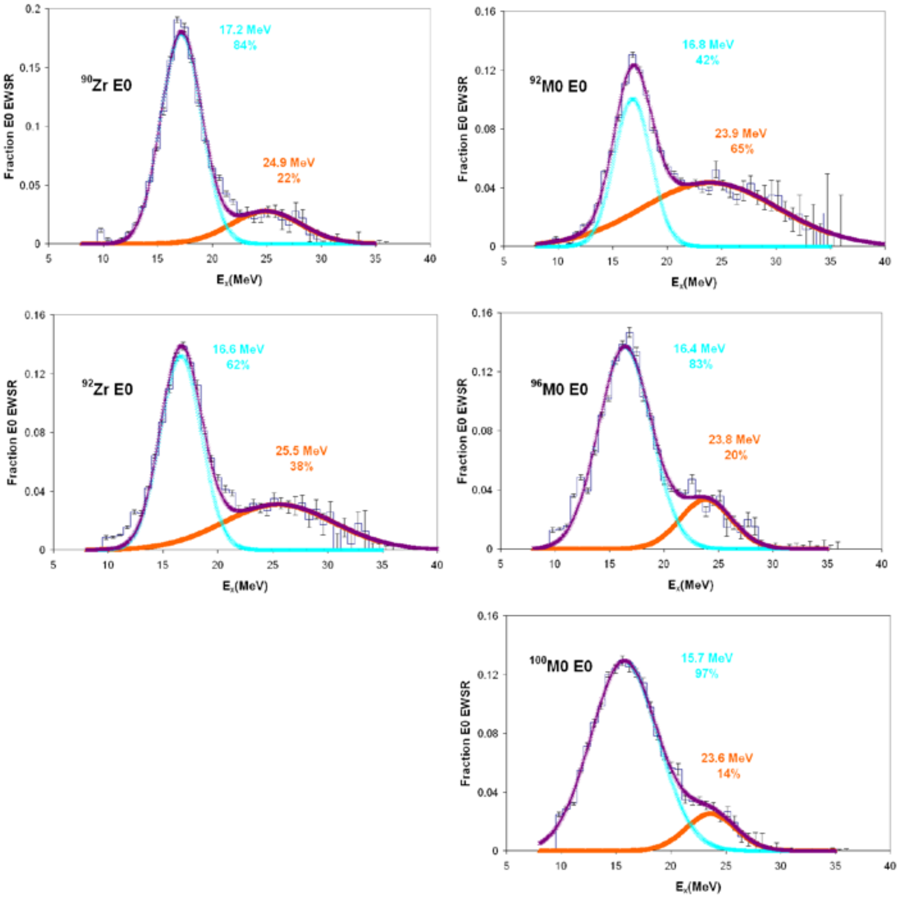

FIG. 1. GMR strength in Zr and Mo nuclei. The centroids and E0 EWSR strengths of the two components obtained with collective model transition densities are shown.

To attempt to understand the behavior in ^{92}Mo, in a collaboration with Dr. Shlomo(TAMU) and Dr. Michael Urin (Moscow), Dr. Urin's group calculated microscopic transition densities for ^{92}Mo using

Woods-Saxon based RPA and we used them to calculate cross sections for E0 excitation at E_x=17.5 MeV and 27.5 MeV. Using the collective transition density, the cross section for excitation of the ISGMR at E_x=27.5 MeV is ~1/5 that at E_x= 17.5 MeV, whereas with the microscopic transition density this ratio is ~ 1/12. Thus, using the microscopic transition density will enhance the upper peak by more than a factor of 2 in ^{92}Mo and result in the upper peak alone exhausting more than 100% of the EWSR.

We also investigated the possibility that this second peak could be the "overtone" ISGMR (operator r^4Y_{00}) [3]. Dr. Shlomo provided the collective transition density and sum rule for the overtone and we did 2 calculations. The first assumed that the second peak was entirely due to the overtone. That would require 228% of the sum rule for the overtone and leave only the 42% of the EWSR for r^2Y_{00} in the lower peak (lower panel in Fig. 2). We then placed the overtone at twice the energy of the ISGMR with twice the width, with 100% of the r^4Y_{00} sum rule and subtracted that from the ^{92}Mo E0 strength shown in Fig. 1. This is shown in the upper panel of Fig. 2 and leaves E0 strength corresponding to 91% of the r^2Y_{00} sum rule, which is quite plausible. Unfortunately this interpretation does not work for ^{90}Zr or ^{96,100}Mo, because the r^4Y_{00} strength would considerably exceed the strength seen experimentally in the higher energy region.

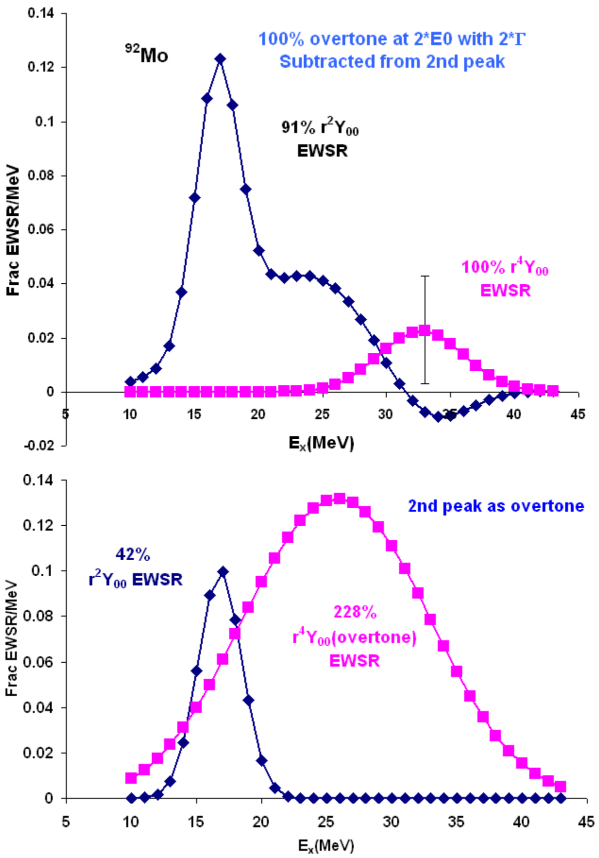

FIG. 2. Two assumptions about overtone in ^{92}Mo.

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[3] M.L. Gorelik, I.V. Safonov, and M.H. Urin, Phys. Rev. C **69**, 054322 (2004);