Isoscalar E1-E3 strength in Mo isotopes

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Isoscalar giant resonances in ^{92,96,98,100}Mo have been studied with inelastic scattering of 240 MeV α particles at small angles including 0^{o}. We have reported the results obtained for the E0 distributions in these nuclei as well as in ^{90,92,94}Zr[1]. However, a significant fraction of the EWSR was also found for isoscalar E1(71%, 71%, 70%, 55%), E2(73%, 69%, 85%, 79%) and high energy octupole E3(52%, 65%, 61%, 53%) resonances in ^{92,96,98,100}Mo, respectively. The techniques used for the experiments, data analysis, and DWBA calculations are described in Ref. [1] and references therein. The E0-E3 distributions obtained for ^{92}Mo and ^{96}Mo are shown in Fig.

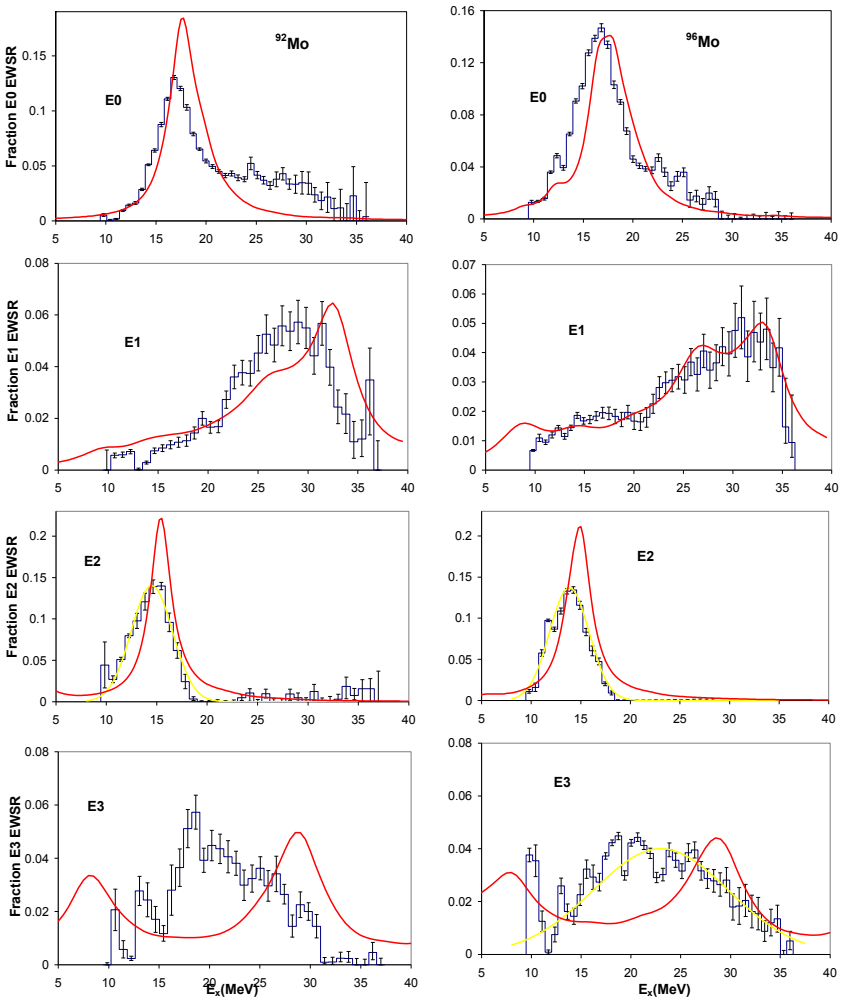

FIG. 1. Strength distributions obtained for ^{92}Mo and ^{96}Mo are shown by the histograms. The thin (red) lines are the strength distributions obtained with the HF-RPA calculations using the KDE0v1 interaction.

1 and those for ^{98}Mo and ^{100}Mo are shown in Fig. 2. Spherical Hartree-Fock-based random-phase approximation calculations[2] were made for each multipole using the KDE0v1 Skyrme-type effective interaction. This interaction was the only one to pass a test of 240 Skyrme interactions, published in the literature, analyzed [3,4] for their ability to pass constraints relating to experimental data on properties of nuclear matter and nuclei, such as incompressibility coefficient, symmetry energy, effective mass, binding energies, radii and fission barriers and observational data of neutron stars. The calculated distributions, using smearing widths of Γ = 10 MeV for the ISGDR and Γ = 5 MeV for the other multipoles, are shown superimposed on the experimental results in Figs. 1 and 2.

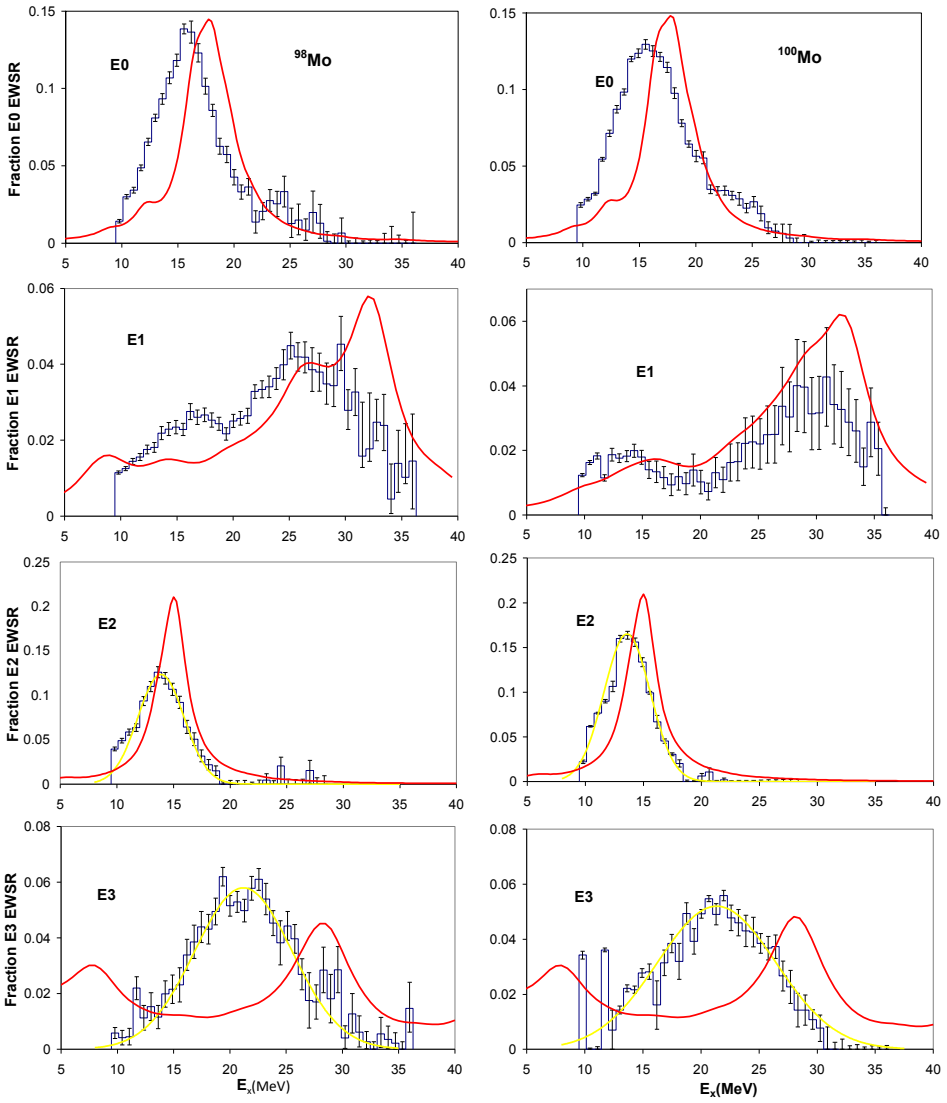

FIG. 2. Strength distributions obtained for ^{98,100}Mo are shown by the histograms. See Fig.1 caption.

Moalem *et al.* [5] studied the isoscalar giant quadrupole resonance (GQR) with inelastic scattering of 110 MeV ^{3}He in all of the stable Mo isotopes while Duhamel *et al.* [6] reported results for the GQR and the isoscalar giant monopole resonance (GMR) in ^{92}Mo obtained by inelastic scattering of 152 MeV α particles. Our results for the energies of the GQR in these nuclei are compared to those studies and the KDE0v1 calculations in Fig. 3. Our results for strength observed, the energy and width of the GQR agree within the errors with the Moalem *et*

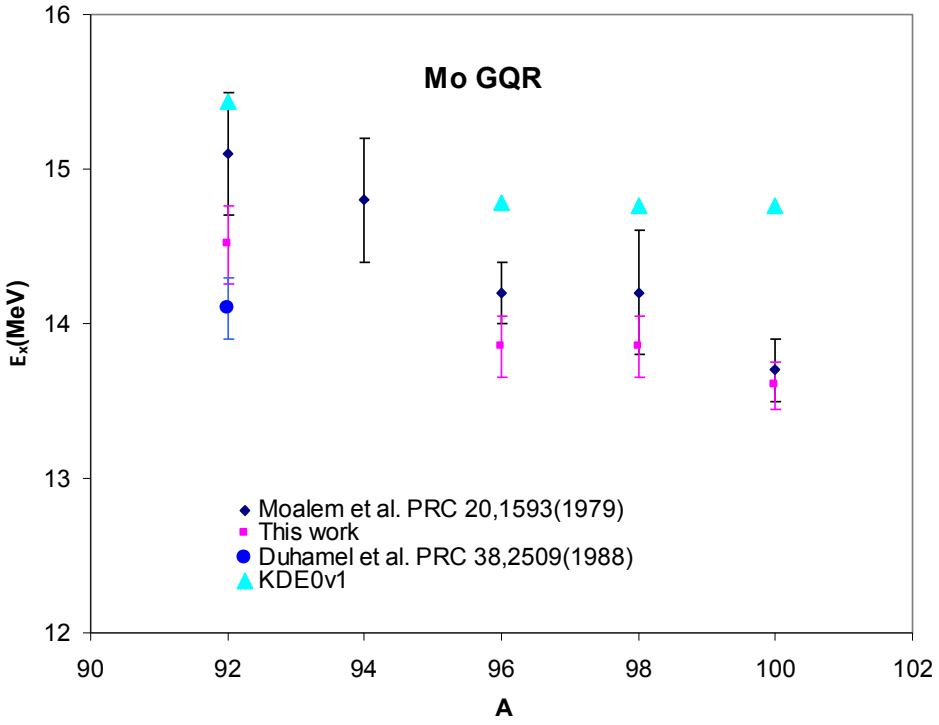

FIG. 3. The centroid of the E2 strength in each of the Mo isotopes obtained in this work [red squares] is plotted vs. A. The error bars indicate the uncertainty obtained using the errors shown in Figs. 1 and 2. Also shown with error bars are centroids reported in Ref. [3] (black diamonds) and a measurement for ^{92}Mo [4] (blue circle). The light blue triangles show the centroid of the E2 strength obtained from HF-RPA calculations with the KDE0v1 interaction.

al. work. The energy and width obtained for the GQR in ^{92}Mo by Duhamel *et al.* also agree within the errors with our result, but they only identified 23±5% of the E2 EWSR strength compared to our 73±13%.

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