

Investigating discrepancy of the isoscalar giant octupole resonance in ^{92,96,98,100}Mo

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The microscopic mean-field based Random Phase Approximation (RPA) theory provides a good description of collective states in nuclei. It is common to calculate the RPA states $|n\rangle$ with the corresponding energies E_n , and obtain the strength function

$$S(E) = \sum_n |\langle 0|F|n\rangle|^2 \delta(E-E_n), \quad (1)$$

for a certain single particle scattering operator $F = \sum f(i)$, and then determine the energy moments

$$m_k = \int E^k S(E) dE. \quad (2)$$

The constrained energy, E_{con} , centroid energy, E_{cen} , and the scaling energy, E_s , of the resonance are then obtained from:

$$E_{\text{con}} = (m_1/m_{-1})^{1/2}, \quad E_{\text{cen}} = m_1/m_0, \quad E_s = (m_3/m_1)^{1/2}. \quad (3)$$

In a fully self-consistent mean-field calculation of the response function, one adopts an effective two-nucleon interaction V , usually fitted to ground states properties of nuclei, and determines the HF mean-field. Then, the RPA calculation is carried out with all the components of the two-body interaction using a large configuration space. In this sense, the calculations are fully self-consistent.

Recently a paper [1] found the Isoscalar Giant Octupole Resonance at ~ 21.5 MeV, about 5 MeV below the prediction of the KDE0v1 Skyrme effective nucleon-nucleon interaction in ^{92,96,98,100}Mo and ^{90,92,94}Zr. We carried out HF-RPA calculation of the centroid energy for many different Skyrme interactions found in the literature, using an occupation approximation for the single particle orbits of the open shell nuclei. As can be seen in Figs.1 and 2 we find that all the interactions considered predict the Octupole resonance to be above the experimental value. We also see a strong dependence of the Centroid Energy on the effective mass. The reason for the discrepancy between theory and experiment currently under investigation [2].

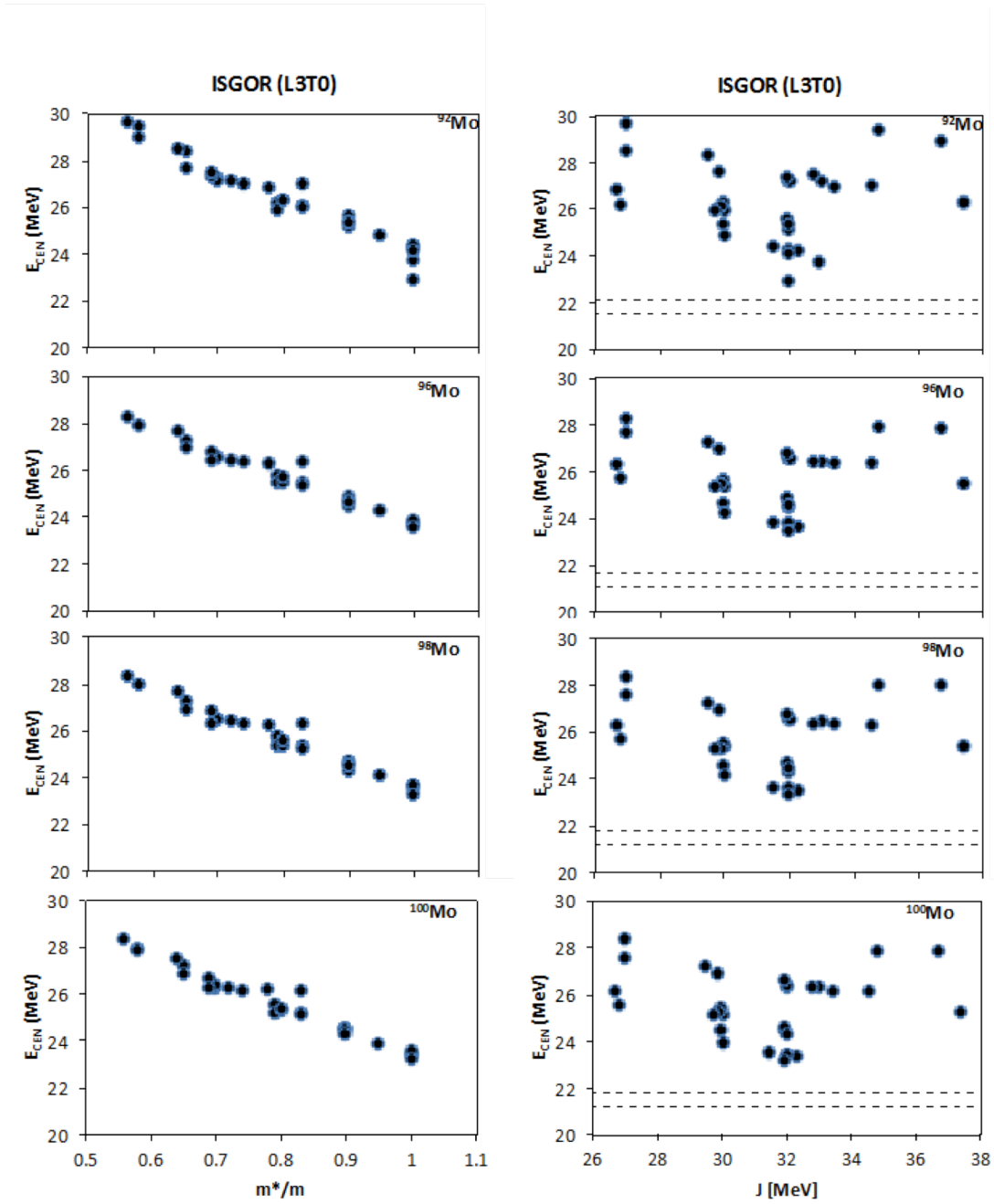


FIG. 1. Results of the HF-RPA calculations, each point is a different Skyrme interaction. Plotted are the centroid energies, E_{cen} , of the ISGOR for $^{92,96,98,100}\text{Mo}$ as a function of the effective mass (left) and the Symmetry Energy coefficient (right).

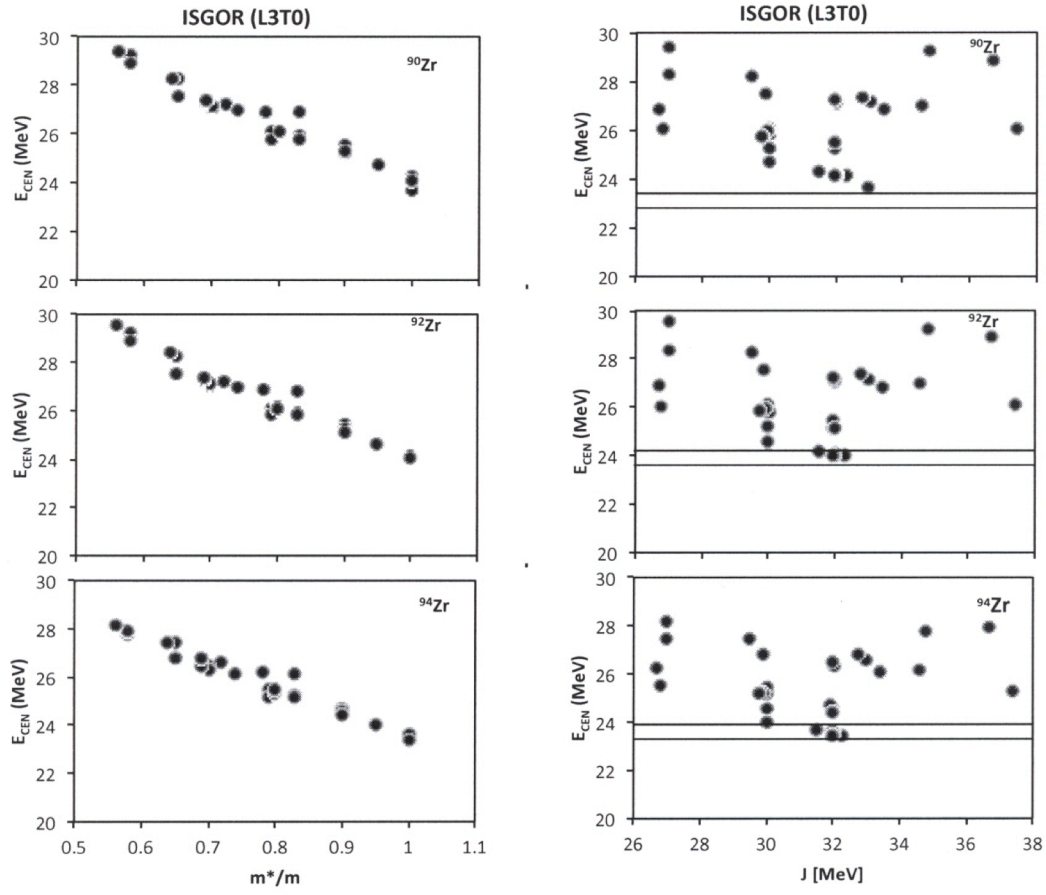


FIG. 2. Results of the HF-RPA calculations, each point is a different Skyrme interaction. Plotted are the centroid energies, E_{cen} , of the ISGOR for $^{90,92,94}\text{Zr}$ as a function of the effective mass (left) and the Symmetry Energy coefficient(right).

- [1] D.H. Youngblood *et al.*, Phys. Rev. C (submitted).
- [2] G. Bonasera *et al.*, in preparation.