Isovector giant dipole resonances in ^{40,48}Ca, ^{68}Ni, ^{90}Zr, ^{116}Sn, ^{144}Sm, and ^{208}Pb and the energy weighted sum rule enhancement factor

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We have performed fully self-consistent Hartree-Fock (HF)-based random phase approximation (RPA) calculations of the centroid energies for the isovector resonances up to L=3 multi-polarity for several spherical nuclei over a wide range of mass. The calculations were done using 33 different Skyrme-type effective nucleon-nucleon interaction commonly adopted in the literature.

The Pearson correlation coefficient is calculated for every nuclear matter (NM) property. We then compare our theoretical calculation to the available experimental data and in the cases where we have high correlation we can set limiting values on the NM properties. Here we report on a strong correlation between the Centroid Energies of the Isovector Giant Dipole Resonances and the energy weighted sum rule enhancement factor κ, which is obtained from the m_1 energy moment as

$$m_1(L,T=1) = \frac{NZ}{A^2} m_1(L,T=0)\left[1+\kappa-\kappa_{np}\right] \quad (1)$$

where the isoscalar moment is defined as $m_1(L,T=0) = \frac{3}{4\pi}\frac{\hbar^2}{2m}A$, κ_{np} is a correction due to the profiles of the neutron and proton density distributions and N, Z, and A are the number of neutrons, protons and nucleons, respectively. In Fig. 1 we show that the centroid energies, of the isovector giant dipole resonance associated with each Skyrme interaction and every resonance, as a function of κ, have a strong Pearson correlation coefficient close to C~0.82 for all nuclei shown. Using the experimental data we can limit the value of κ to be between 0.2 and 0.7. Similar results were found for the isovector resonance with L=2 and 3. Analysis is performed for all the resonances and nuclei [1] and other nuclear matter quantities. These results will be used to determine the next generation nuclear energy density functional with improved predictive power for properties of nuclei and nuclear matter.

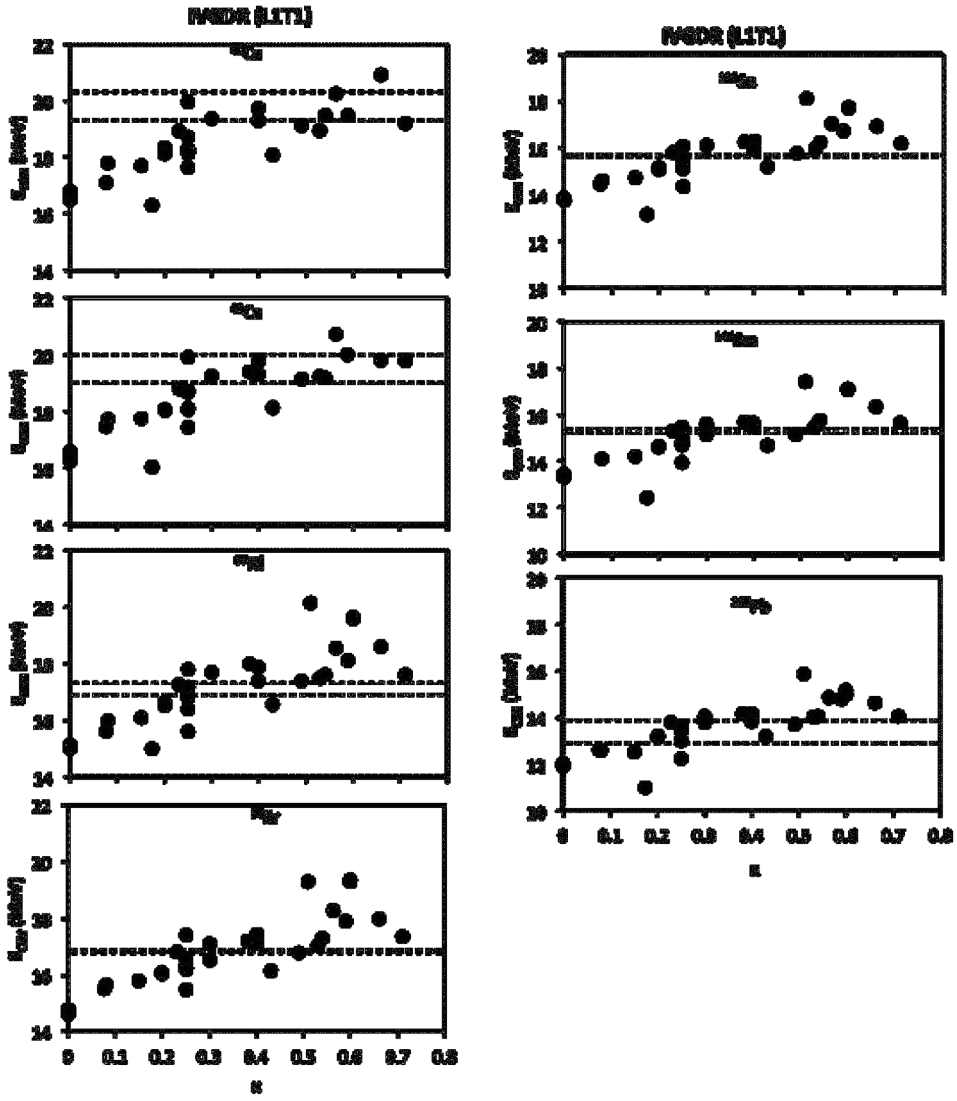

FIG. 1. Calculated Centroid Energies in MeV (full circle) of the isovector giant dipole Resonance, for the different interactions, as a function of the energy weighted sum rule enhancement factor κ. Each nucleus has its own panel and the experimental uncertainties are contained by the dotted lines. The Pearson coefficient is C~0.82 for all nuclei shown.

[1] G. Bonasera *et al*., (to be submitted)..