

Sensitivity of Giant Resonances Energies of Nuclei to Properties of Nuclear Matter

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We have studied the sensitivity of the values of the energies of giant resonances in nuclei to the values of nuclear matter properties, such as the effective mass m^*/m , nuclear matter incompressibility coefficient K_{NM} , enhancement coefficient κ of the energy weighted sum rule for the isovector giant dipole resonance and the symmetry energy and its first and second derivatives at saturation density, associated with the Skyrme interactions. For this purpose we have: (i) carried out calculations of the centroid energies, E_{CEN} , of the isoscalar ($T = 0$) and isovector ($T = 1$) giant resonances of multipolarities $L = 0 - 3$ in $^{40,48}\text{Ca}$, ^{68}Ni , ^{90}Zr , ^{116}Sn , ^{144}Sm and ^{208}Pb , within the fully self-consistent spherical Hartree-Fock (HF)-based random phase approximation (RPA) theory, using 33 different Skyrme-type effective nucleon-nucleon interactions of the standard form commonly adopted in the literature; (ii) Calculated the Pearson linear correlation coefficient between the calculated values of E_{CEN} and the values of nuclear properties and constrained the values of the NM properties, by comparing the calculated values of E_{CEN} to the experimental data. We find that interactions associated with the values of $m^*/m = 0.70$ to 0.90 , $K_{NM} = 210$ to 240 MeV and $\kappa = 0.25$ to 0.70 best reproduce the experimental data. These constraints can be used to construct the next generation energy density functional (EDF) with improved prediction of properties of nuclei and nuclear matter.