Giant Resonances in $^{40,48}Ca$, ^{68}Ni, ^{90}Zr, ^{116}Sn, ^{144}Sm and ^{208}Pb and Properties of Nuclear Matter

S. Shlomo, G. Bonasera and M. R. Anders

Cyclotron Institute, Texas A&M University, College Station, Texas 77843, USA.

E-mail: s-shlomo@tamu.edu

We have carried out calculations of centroid energies, E_{CEN}, of the isoscalar (T = 0) and isovector (T = 1) giant resonances of multipolarities L = 0 - 3 in $^{40,48}Ca$, ^{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. We also study the sensitivity of E_{CEN} to physical properties of nuclear matter (NM), 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 used in the calculations. Constraining 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 κ = 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.