Isoscalar and isovector giant resonances in ^{208}Pb

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The study of collective modes in nuclei has been the subject of extensive theoretical and experimental studies during several decades, since it contributes significantly to our understanding of bulk properties of nuclei, their non-equilibrium properties and properties of the nuclear force. Very recently, a thorough study of isoscalar and isovector giant resonances of the doubly magic nuclei, ^{40}Ca and ^{48}Ca, for multipolarities: L=0-3 was conducted [1]. This work determined the sensitivities of E_{CEN} and of the isotopic differences $E_{CEN}(^{48}Ca) - E_{CEN}(^{40}Ca)$ to physical quantities, such as nuclear matter incompressibility coefficient, symmetry energy density, and effective mass, associated with the Skyrme interactions and compared the results with the available experimental data.

In this work we extend this theoretical investigation by considering the isoscalar and isovector giant resonances of multipolarities $L = 0 - 3$ of the doubly magic nucleus ^{208}Pb. For this purpose, we have carried out [2] fully self-consistent Hartree-Fock (HF) based RPA calculations of these giant resonances, for ^{208}Pb, using a wide range of 34 commonly employed Skyrme type interactions. These interactions, which were fitted to ground state properties of nuclei are associated with a wide range of nuclear matter properties such as incompressibility coefficient K_{NM} = 200 - 258 MeV, symmetry energy J = 27 - 37 MeV and effective mass m* = 0.56 - 1.00. We investigate the sensitivities of E_{CEN} to physical quantities, such K_{NM}, J and the symmetry energy density and effective mass, associated with the effective nucleon-nucleon interactions and compare the results with available experimental data. As examples we present below results of our calculations [2] for the isoscalar giant monopole resonance (ISGMR) and the

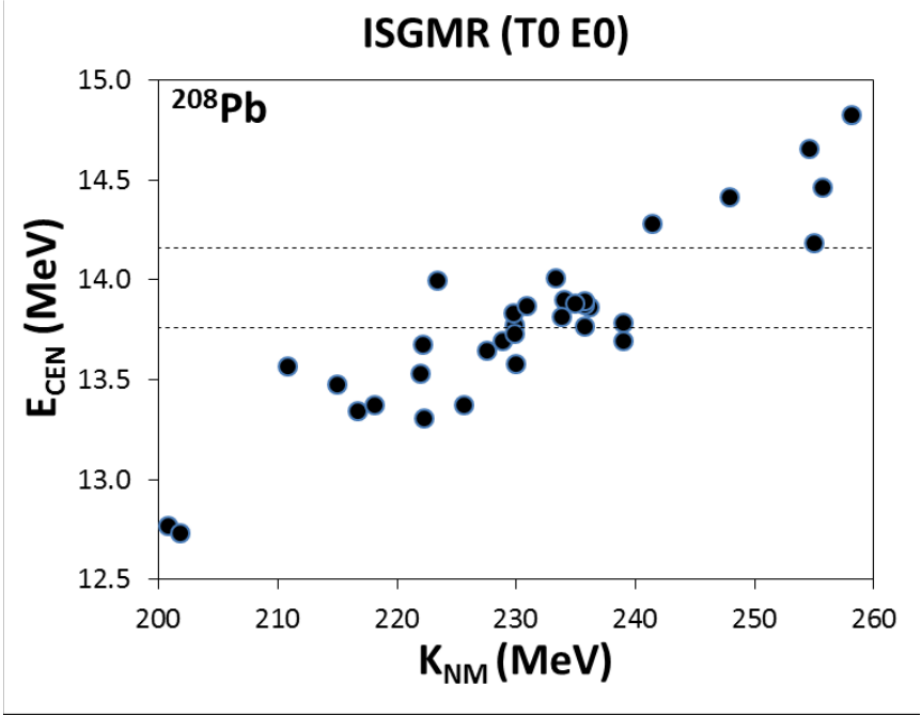

FIG. 1. ISGMR centroid energies vs K_{NM}.

isovector giant dipole resonance (IVGDR).

In Fig. 1. we compare the experimental data of the ISGMR centroid energies E_{CEN} of ^{208}Pb, shown as the regions between the dashed lines, with the results of fully self consistent HF based RPA calculations (full circles), using the Skyrme type interactions having nuclear matter incompressibility coefficients K_{NM} = 200-258. The energies shown were calculated over the experimental excitation energy range of 5 - 30 MeV. A clear correlation between E_{CEN} of ^{208}Pb can be seen with K_{NM}.

In Fig. 2, we show our results for the centroid energies of the IVGDR in ^{208}Pb as a function of J, the symmetry energy at saturation density ρ_0. An agreement with experimental data is obtained for several interactions. However, only weak correlation is obtained between the centroid energy J and E_{CEN}.

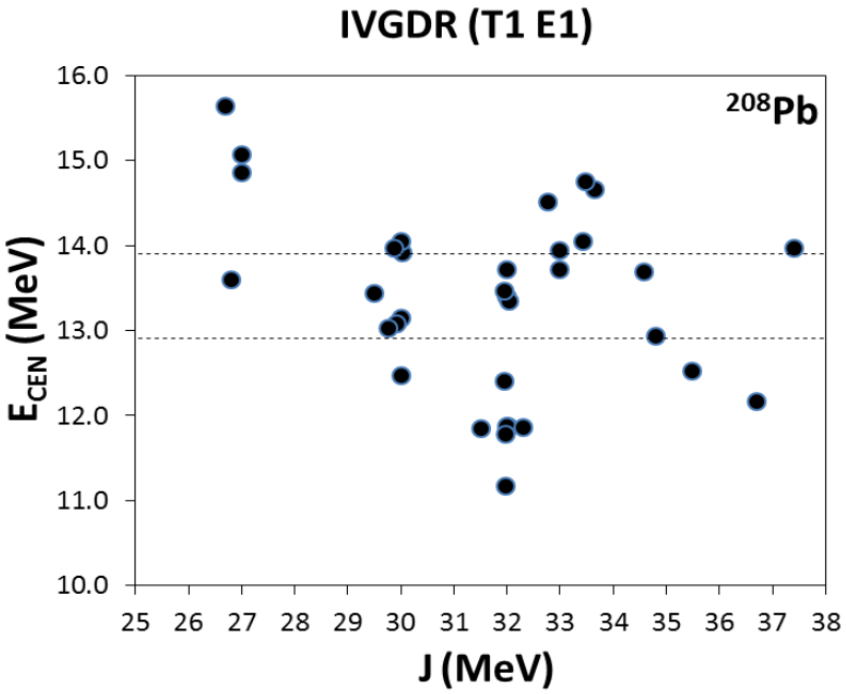

FIG. 2. Centroid energies of the IVGDR as a function J.

[1] M.R. Anders, S. Shlomo, Tapas Sil, D.H. Youngblood, Y.-W. Lui, and Krishichayan, Phys. Rev. C. **87**, 024303 (2013).

[2] M.R. Anders *et al.*, in preparation.