Nuclear dipole polarizability from mean-field models constrained by chiral effective field theory

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We have constructed three extended Skyrme interactions [1] by fitting the EOSs of nuclear matter with various isospin asymmetric as predicted by chiral effective field theory [2,3] together with the binding energies of selected closed shell doubly-magic nuclei. Using these interaction, we have then studied the isovector dipole response of ^{48}Ca, ^{68}Ni, ^{120}Sn, and ^{208}Pb in the random-phase approximation (RPA). We have found that although the RPA calculations using the three extended Skyrme interactions slightly underestimate the peak energy of the giant dipole resonance, they nevertheless well reproduce the experimental data on the electric dipole polarizability as shown in Fig.1. We have further investigated the correlation between the neutron skin thickness and the product of the electric dipole polarizability and symmetry energy at saturation density. The predicted results from the three extended Skyrme interactions are found to be consistent with the linear relations extracted from RPA calculations using a representative set of energy density functionals. The predicted neutron skin thickness of ^{208}Pb from our study is also consistent with the experimental values [4-6]. Our results thus confirm the usefulness of these extended Skyrme interactions in studying the isovector properties of nuclei in regimes where *ab initio* calculations with chiral nuclear forces have not been feasible.

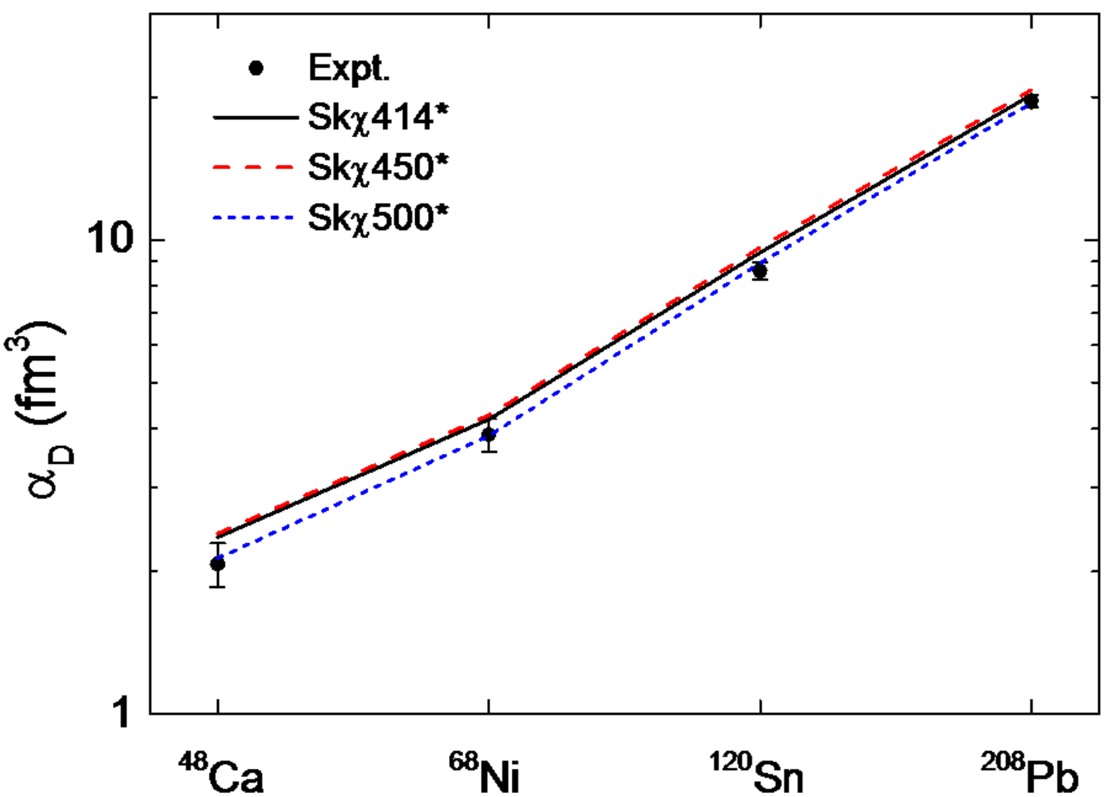

FIG. 1. Electric dipole polarizabilities of ^{48}Ca, ^{68}Ni, ^{120}Sn, and ^{208}Pb predicted by Skχ414*, Skχ450* and Skχ500*. For comparison, experimental data [4-7] are shown as black solid circles.

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