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Quadrupole-octupole coupling and the onset of octupole collectivity

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Octupole deformations and related collective phenomena are studied using the framework of nuclear density functional theory. Axially-symmetric quadrupole-octupole constrained self-consistent mean-field calculations with a choice of universal energy density functional are performed for actinides, Xe, Ba, Ce, and Nd isotopes from proton-rich to neutron-rich sides, and neutron-rich Ge, Se, and Kr, in which enhanced octupole correlations are expected to occur. Low-energy positive- and negative-parity spectra and transition strengths are computed in terms of the interacting boson model, with the parameters determined by the constrained mean-field calculations. Octupole-deformed equilibrium states are found in the potential energy surfaces of those nuclei in the regions corresponding to the neutron or/and proton numbers equal to 34, 56, 88, and 134. The evolution of the calculated spectroscopic properties indicate the onset of octupole deformation and exhibit signatures of octupole shape-phase transitions around these nucleon numbers.

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