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New region of maximum octupole collectivity in the rare-earth nuclei: the case of Gd isotopes

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We present the first evidence of maximum octupole collectivity in the Gd isotopic chain through a direct measurement of an enhanced $B(E3)$ value in ^{150}Gd . This result was achieved via two highly sensitive experiments designed to determine the lifetime of the first 3^- state and the weak $E3$ decay branch to the ground state. With a measured $B(E3)$ strength of $45(5)$ W.u., this value ranks among the highest and the most precise recorded in this region, comparable in strength to those observed in neutron-rich Ba nuclei, a region traditionally known for its enhanced octupole collectivity. We compare the available experimental results for the $E3$ strengths in the Gd isotopic chain with five state-of-the-art theoretical models: the quasi-particle random phase approximation (QRPA), the time-dependent Hartree-Fock (TDHF), the quadrupole-octupole collective Hamiltonian (QOCH), the mean-field mapped interacting boson model (m-IBM), and the triaxial projected shell model (TPSM). We conclude that the QRPA provides a strong explanation for the increasing trend of $B(E3)$ values in Gd nuclei with $N=82-86$.

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