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Effect of the Coulomb interaction on nuclear moments

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Solving the Hartree-Fock-Bogoliubov (HFB) equation self-consistently with a harmonic oscillator basis, we have systematically calculated even-even nuclei with proton numbers ranging from 2 to 118 using the SLy4 parameter set of the Skyrme functional and a mixed-type pairing interaction. To investigate the origin of nuclear deformation, which is crucial in various topics such as nuclear fission and cross-section calculations, we have focused on the effect of the Coulomb interaction on nuclear shape evolution. Our calculations compare cases where the Coulomb interaction, with the exchange term treated using the Slater approximation, is either included or omitted.

The results show that the Coulomb interaction interestingly enhances quadrupole and octupole deformations across a wide range of nuclei. Notably, in the hyper-deformation region, the absolute difference in quadrupole deformation between the two cases becomes particularly pronounced. Additionally, in some nuclei, the Coulomb interaction induces a shape transition from oblate to prolate or vice versa.

We will report on the mechanism behind the deformation enhancement and shape transitions by analyzing the impact of the Coulomb interaction on single-particle energies and energy landscapes.

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