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Quadrupole and octupole deformations with effective triaxiality in even-even nuclei

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Abstract

A non-adiabatic collective model for even-even nuclei with effective triaxial quadrupole and octupole deformations was developed. The model describes three-dimensional quadrupole-octupole rotation coupled with axial quadrupole-octupole vibrations. In the present approach the axial quadrupole β_2 and octupole β_3 deformations are considered as dynamical variables, whereas the corresponding non-axial deformations γ=$\gamma_{\mathfrak{eff}} \neq 0$ and η=$\eta_{\mathfrak{eff}} \neq 0$ are taken as effective deformation constants. In this case the total angular momentum projection K takes non-zero values leading to specific description of the alternating-parity-band structure. The moment-of-inertia tensor depends on the angular part of the polar coordinates in the quadrupole-octupole space, the values of which are determined from the ground state of the nucleus. For the analytic solution of the Schrödinger equation the Davison potential was used. The five model parameters $\hbar\omega_\sigma$, $\gamma_{\mathfrak{eff}}$, $\eta_{\mathfrak{eff}}$, ε_0 and μ were adjusted to the experimental levels of the yrast alternating-parity bands. The application of the model to the yrast alternating-parity bands in several nuclei shows a good reproduction of the corresponding experimental energy levels and odd-even staggering effect in the lanthanides ^{154}Sm, ^{154,160}Gd, ^{156}Dy and the actinides ^{228,230,232}Th, ^{230,232,236,238}U, ^{238}Pu.The more detailed analysis of the energy spectra and staggering patters points out on the need of additional consideration of deeper intrinsic effects such as the alignment and related band-mixing/crossing effects.