Modeling the Shape: Some Contemporary Approaches to Quadrupole-Octupole Deformations in Atomic Nuclei

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Abstract

We will briefly review a few collective and microscopic model approaches currently developing with the aim to explore nuclear dynamic properties ensuing from the appearance of quadrupole-octupole deformations. We will depict the present status of the study of alternating-parity spectra in even-even nuclei and parity quasi-doublet sequences in odd-mass nuclei. Different model limits of octupole softness will be discussed in terms of one- and two-dimensional deformation potentials as well as in terms of parameters-constrained analytic and full numeric solutions of the problem in the case of axial symmetry. The influence of the complex deformation on other related nuclear properties, such as the Coriolis decopling/mixing effects, isomeric properties and magnetic moments will be also discussed. At the same time we shall outline a number of challenges met by the present approaches, such as the need to better understand the underlying symmetry, some difficulties in the concomitance of collective and single-particle motions in the model pattern, the need to consistently include the non-axial deformations in the problem. On this basis we shall try to formulate a few priority tasks on which some future research activities may concentrate.