Parity effects in nuclear collective and single particle motion

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Abstract

Recently proposed model approach [1,2] is applied to study parity effects in the spectra of heavy deformed nuclei. The collective nuclear motion is described by a two-dimensional angular-momentum-dependent potential providing coherent quadrupole-octupole oscillations and rotations of the system [1]. The model reproduces parity shift effects in the spectra of even-even nuclei [1] and the parity-doublet splitting in the spectra of odd-mass nuclei [2]. The extended application of the model provides a description of the yrast band together with the higher non-yrast alternating-parity and split-parity-doublet sequences in even-even and odd-mass nuclei, respectively. In odd nuclei the motion of the single nucleon in the field of the quadrupole-octupole deformed core is described within a reflection-asymmetric deformed shell model with the Coriolis interaction being microscopically taken into account [3]. On this basis a strong coupling between the parity mixed single particle (s.p.) state and the collective quadrupole-octupole mode to a good total parity of the system is considered. The average parity of the s.p. state is examined as a function of the axial quadrupole and octupole deformations β_2 and β_3 in a number of odd-mass nuclei. It is shown that the magnitude of the parity mixing in the s.p. state carries an important information about the interplay between the quadrupole-octupole deformed core and the single particle degree of freedom in the nucleus. The respective behaviour of the Coriolis decoupling factor allows one to determine physically reasonable regions of deformations in odd-A nuclei. The obtained results outline the possibility for a consistent collective and microscopic model description of nuclei with reflection asymmetric degrees of freedom.

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[3] N. Minkov, S. Drenska, M. Strecker and W. Scheid, J. Phys. G: Nucl. Part. Phys., **36**, 025108 (2009); **37**, 025103 (2010).