Study of Pear-Shape Effects in the Spectra of Even-Even Nuclei

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The experimental confirmation of stable octupole shape in the nucleus ^{224}Ra obtained in REX-ISOLDE [1] and in the nuclei ^{144,146}Ba recently obtained in ANL [2] has attracted a new interest in the structure and properties of the so-called pear-shaped atomic nuclei. These results motivate new applications and further development of a collective model approach capable to describe alternating-parity spectra inherent for the nuclei with pear-shape deformations [3,4]. In its "rigid" version the model describes rotations of a stable quadrupole-octupole (QO) shape with low-energy oscillations in a double-well octupole potential [3], while in the "soft" realization it describes non-adiabatic QO vibrations and rotation [4]. The overall approach allows us to study, from one side, the angular momentum dependence of the QO mode in given spectrum and, from another side, the evolution of alternating-parity spectra in given nuclear region between the manifestation of soft and stable octupole deformations. On this basis it provides a detailed test for the presence of octupole collectivity and can be of special use in less studied nuclei. We demonstrate this for spectra in the region of Nd isotopes. The calculations made and analysis of data for the low-lying alternating-parity levels in $^{130-136}$Nd give an indication for the presence of soft QO mode in $^{130-134}$Nd and possible stabilization of the octupole shape in ^{136}Nd. The approach could be of use in relation to new data expected to appear for the ^{140,142}Ba isotopes.

References

[1] L. P. Gaffney et al., Nature (London) **497**, 199 (2013); P. A. Butler, J. Phys. G: Nucl. Part. Phys. **43**, 073002 (2016).

[2] B. Bucher et al., Phys. Rev. Lett. **116**, 112503 (2016); Phys. Rev. Lett. **118**, 152504 (2017).

[3] N. Minkov, P. Yotov, S. Drenska, W. Scheid, J. Phys. G **32**, 497 (2006).

[4] N. Minkov, P. Yotov, S. Drenska, W. Scheid, D. Bonatsos, D. Lenis and D. Petrellis, Phys. Rev. C **73**, 044315 (2006).