Coherent Quadrupole-Octupole States from a SUSY-QM Hamiltonian Hierarchy and Shape Invariance

N. Minkov, **S. Drenska**

Institute of Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, Tzarigrad Road 72, BG–1784 Sofia, Bulgaria

We briefly review the basic concept of the supersymmetric (SUSY) approach in quantum mechanics (QM) referring to the Schrödinger equation for a class of solvable one-dimensional potentials which satisfy the so-called shape-invariance condition [1,2]. On this basis we show that the potential in the radial equation in the model of coherent quadrupole-octupole motion (CQOM) in nuclei [3–6] generates a sequence of superpotentials and subsequent series of effective potentials which satisfy the shape-invariance condition and correspond to a SUSY-QM hierarchy of Hamiltonians. It is known that the set of operators involved in such a hierarchy has a superalgebraic structure. On this basis we suggest that the original CQOM level scheme possesses a generic supersymmetric structure of the spectrum inherent for the coherent quadrupole-octupole mode. We outline the mechanism in which the real quadrupole-octupole spectra in even-even and odd-even nuclei deviate from the genuine symmetry. By using it we illustrate the possibilities to identify the signs of supersymmetry in the alternating-parity spectra of even-even nuclei and the quasi-parity doublet levels of odd-mass nuclei described within the CQOM model approach. The analysis supports the relevance of the model classification scheme in nuclear quadrupole-octupole spectra and its applicability as a basis to solve the more general problem of quadrupole-octupole motions beyond the restrictions imposed by the coherent mode.

References

[1] F. Cooper, A. Khare and U. Sukhatme, Phys. Rep. **251**, 267 (1995).

[2] F. Cooper, A. Khare and U. Sukhatme, *Supersymmetry in Quantum Mechanics* (World Scientific, Singapore, 2001).

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

[4] N. Minkov, S. Drenska, P. Yotov, S. Lalkovski, D. Bonatsos and W. Scheid, *Phys. Rev. C* **76** 034324 (2007).

[5] N. Minkov, S. Drenska, M. Strecker, W. Scheid and H. Lenske, *Phys. Rev. C* **85** 034306 (2012).

[6] N. Minkov, S. Drenska, K. Drumev, M. Strecker, H. Lenske and W. Scheid, *Phys. Rev. C* **88** 064310 (2013).