Int. Workshop “Shapes and Dynamics of Atomic Nuclei: Contemporary Aspects”
ed. Nikolay Minkov, Heron Press, Sofia 2017

Symmetry-based approach to shape coexistence in nuclei

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Abstract

We present a symmetry-based approach for shape coexistence in nuclei, founded on the concept of partial dynamical symmetry (PDS) [1]. The latter corresponds to a situation when only selected states (or bands of states) preserve the symmetry, while other states are mixed. Hamiltonians with a single PDS have been shown to be relevant to the spectroscopy of nuclei supporting a single shape [1–4]. In the present contribution, we extend such a symmetry-based approach to encompass the occurrence of multiple nuclear shapes [5–7]. We construct explicitly critical-point Hamiltonians with two or three PDSs of the type U(5), SU(3), $\overline{\mathrm{SU}(3)}$ and SO(6), appropriate to double or triple coexistence of spherical, prolate, oblate and γ-soft deformed shapes, respectively. In each case, we analyze the topology of the energy surface with multiple minima and corresponding normal modes. Characteristic features and symmetry properties of the quantum spectra and wave functions are discussed. Analytic expressions for quadrupole moments, and E2 and E0 rates, involving the remaining solvable states, are derived and isomeric states are identified by means of selection rules.

References

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