Energies and Transition Probabilities from the Full Solution of Nuclear Quadrupole-Octupole Model

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We develop a nuclear collective model whose Hamiltonian consists of vibrational and rotational parts in the axial quadrupole (β_2) and octupole (β_3) degrees of freedom. Under certain limitations, which especially imply equal (coherent) quadrupole and octupole oscillator frequencies ω_2 and ω_3, analytic solutions for the energies and wave functions could be found. We have shown [1] that beyond this coherent limit the full model solution can be obtained by numerical diagonalization of the unrestricted Hamiltonian in the basis provided by the analytic solution.

In the present work we describe the energy levels and transitions probabilities in the yrast positive and negative parity bands of several rare earth nuclei. We show that the simultaneous fit of energies and transition probabilities allows to determine the model parameters unambiguously in a physically reasonable range. As a consequence the shape of the quadrupole-octupole potential which governs the collective motion as well as the wave functions in the corresponding excited states are uniquely determined.

References

[1] M. Strecker, N. Minkov, and H. Lenske,"Full solution of nuclear quadrupole-octupole model", *Nuclear Theory*, vol. **30**, eds. A.I. Georgieva and N. Minkov, Heron Press, Sofia (2011) p. 53.