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Systematics of β- and γ-bands in the A = 160 region

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By considering the nucleus as a vibrating liquid drop, and assuming the potential to be a function of the elongation β, and triaxiality γ, of the nucleus, the Bohr Hamiltonian can be solved to give the so-called K=0+, β-vibrational and K=2+ γ-vibrational bands. However, as summarized in the review by Garrett[1], very few of the observed 0+2 bands in deformed nuclei possess the properties expected of a β vibration. It is likely that the nature of the 0+2 levels in deformed regions differ according to the precise location of the Fermi level, and contain admixtures of β-vibrational, two-phonon, pairing, and shape-coexisting states.

At iThemba LABS, a systematic investigation of low-lying levels in the mass 160 region has been made. An extensive set of data on the low-lying, positive-parity bands in the nuclides between N = 88 and 92 and Sm to Yb has been obtained from γ-γ coincidence measurements following fusion-evaporation reactions optimized of the population of low-spin states. Some these results point to the role of quadrupole pairing in forming 0+2 bands[2].

In this work, the energies and electromagnetic properties of the so-called β- and γ-bands of nuclei in this region are compared with the solutions of a five dimensional collective Hamiltonian for quadrupole vibrational and rotational degrees of freedom, with moments-of-inertia and mass parameters determined by constrained self-consistent relativistic mean-field calculations using the PC-F1 relativistic functional[3,4]. This model is able to account for features such as vibrations and shpe-coexistence on al equal footing.

A good qualitative agreement is found between the measured energies and of the in-band/out-of-band branching ratios across the entire region.

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