Rotations in ^{152}Gd nucleus

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Rotations are beautiful both in macroscopic and microscopic world. In the femtoscopic world of nuclei, In the femtoscopic world of atomic nuclei, they exhibit a remarkable elegance, offering deep insights into nuclear structure. If we could quantify various aspect of these rotations, e.g. transition probabilities, quadrupole moments, dipole moments and higher order moments, rotational frequencies, and branching ratios etc, they collectively provide precise information about the shape and dynamics of the nucleus. Nuclei in the mass region A $\approx$ 150 are among the best examples of nuclear rotors across the entire nuclear chart.

In particular, the light rare-earth nuclei around neutron number N $\approx$ 88 and proton number Z $\approx$ 64 are transitional in nature, where the addition of a couple of neutrons can drive the nucleus from a vibrational to a rotational regime. The presence of negative parity bands near to the ground state of even-even nuclei indicates a mixing of dipole, quadrupole, and octupole modes of excitation. Additionally, the presence of excited 0^+ bands points to shape coexistence phenomena in these nuclei. The Gd nuclei being in the middle of the region, are interesting to study, as they can give a straightforward interpretation in terms of interplay between these different degrees of freedom.

High spin states in ^{152}Gd nucleus were populated via ^{138}Ba(^{18}O, 4nγ) fusion-evaporation reaction at a beam energy of $\approx$ 73 MeV, delivered from the 15UD pelletron accelerator facility at Inter-University Accelerator Centre (IUAC), New Delhi. Target was backed with thick Ta backing to get attenuated Doppler shifted gamma peaks for sub-ps lifetimes of the nuclear levels. Fifteen Compton-suppressed clover HPGe detectors were employed in the Indian National Gamma Array (INGA) to detect the de-exciting γ-rays [1]. Lifetimes of the nuclear states in ground state positive parity yrast band has been measured using Doppler Shift Attenuation Method (DSAM) from which the reduced transition probabilities B(E2) were extracted. Additionally, lifetimes of several states in a proposed negative-parity octupole band connected to the ground state band via E1 transitions were measured. This enabled the determination of both B(E1) and B(E2) transition strengths for the octupole band. Further aspects related to the shape and structure of the nucleus will be discussed based on the experimental results obtained.

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