EVIDENCE OF DECREASING COLLECTIVITY IN ^{103}PD

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Atomic nuclei display various exciting phenomena depending on their location along the nuclear chart and values of other parameters such as angular momentum, excitation energy, isospin etc. One such location is the $100 \leq A \leq 110$ mass region, which has generated considerable research interest since last two decades. The nuclei in this region exhibit admixture of single particle and collective excitations, and the interplay between the two modes of excitation still remains central to the study of evolution of nuclear structure. The effect of this interplay is pronounced in nuclei where both the mechanisms are responsible for angular momentum generation for a particular band under consideration. The band-termination [1] phenomenon is the most suitable to investigate the above aspect of nuclear structure. In the band-termination, angular momentum evolves from a purely collective rotation at the band-head to a pure single-particle configuration at the terminating spin, which is built from the alignment of all single-particle angular momenta of the specific configuration of the band. As a result of this, the quadrupole moments show a characteristic decrease along the band, which is reflected in decreasing B(E2) values. Although several nuclei are identified to exhibit the band termination phenomenon, only in few nuclei the B(E2) values have been measured. The first definitive experimental evidence for the decreasing collectivity was reported in the A~110 mass region [2]. Additional terminating bands are reported in the A~100 region [1]. In order to examine the prediction of terminating bands, an experiment was performed to measure the lifetimes of the states in the negative parity band in the ^{103}Pd nucleus.

Excited states in ^{103}Pd were populated using ^{80}Se(^{30}Si, α3n) reaction at beam energy of 120 MeV. The beam was provided by the 15 UD pelletron accelerator at Inter University Accelerator Centre (IUAC) in New Delhi. The gamma rays were detected using an array of 12 Compton-supressed high-purity germanium detectors. Doppler-broadened lineshapes were observed for transitions in the region 847-1267 keV in the earlier reported negative band of ^{103}Pd [3]. These lineshapes were fitted with calculated lineshapes using LINESHAPE program [4] in order to extract lifetimes of the states.

The band-termination in the A~100 mass region is termed as rigid-rotation like band-termination since the angular momenta near the termination are built at an energy cost close to their values of a rigid rotor reference [1]. Several bands in ^{102}Pd were observed up to their terminating spins. These bands show transition from a collective near prolate shape to non-collective oblate shape [5]. Another candidate for the band-termination in this region is ^{103}Pd in which some of the bands have already been interpreted using Nilsson-Strutinsky formalism and explained in terms of terminating configurations [6]. The unique negative parity band was observed upto the spin of $51/2^-$, which is predicted to terminate at $59/2^-$ based on the $\pi(g9/2)^6 \otimes \nu(g_{7/2}d_{5/2})^6(h_{11/2})$ configuration [3]. The B(E2) values which were calculated using the measured lifetimes show a decrease from 0.1911 $(eb)^2$ at $23/2^-$ to 0.0801 $(eb)^2$ at $31/2^-$. This is the first experimental evidence of decreasing collectivity with increasing spin in the A~100 mass region, which is an indication of the band-termination phenomenon.

The experimental details, data analysis, and results along with their interpretation will be discussed.

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