# Shape transition in $^{75}$Kr and $^{75}$Br nuclei

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## Introduction

During the recent years the physics of neutron deficient nuclei in A = 70 - 80 mass region have been investigated by numerous groups due to very fascinating features like shape coexistence, gamma softness, band termination etc. We have carried out an experiment, where we have focused our attention to measure nuclear collectivity as a function of spin in A = 75, Kr and Br nuclei. Lifetime measurement of high spin states gives more information about shape polarization in these lighter neutron deficient odd A nuclei. In present investigation, we have studied the shape evolution due to occupation of valence particle in $g_{9/2}$ orbital by measuring lifetimes high spin states by Doppler shift attenuation method beyond the band crossing.

## Experimental Details

High spin states of $^{75}$Kr and $^{75}$Br nuclei have been populated by bombarding $^{28}$Si beam on the $^{50}$Cr target at an incident beam energy of 90 MeV. The $^{28}$Si beam was delivered by the 15-UD Pelletron accelerator at Inter University Accelerator Centre (IUAC), New Delhi. The target consisted of $\sim$ 550 $\mu$g/cm$^2$ isotopically enriched 96% $^{50}$Cr with backing of $\sim$ 12 mg/cm$^2$ gold to stop the recoiling ions produced in the reaction. Prompt $\gamma$-rays were detected with the Indian National Gamma Array (INGA)[1] consisting of 17 Compton suppressed Clover detectors at the time of the experiment. The Clover detectors were arranged in five rings viz., at 32°, 57°, 90°, 123° and 148° with respect to the beam direction.The data were collected in the list mode when two or more detectors fired simultaneously.The gain matched data were stored off-line into several 4k x 4k square matrices with a dispersion of 0.5 keV/channel using the program INGASORT.

## Analysis Method and Results

The sub-picosecond lifetimes have been measured by analyzing the Doppler Broadened lineshapes using LINESHAPE program, developed by J. C. Wells. The Monte Carlo simulation technique has been used in this program for the velocity and directional history of a series of recoiling nuclei in the target and in the backing. In the analysis of Doppler broadened lineshapes, an effective lifetime was obtained for the top most level by assuming a prompt feed to this level and for the rest of the transitions we have used a rotational

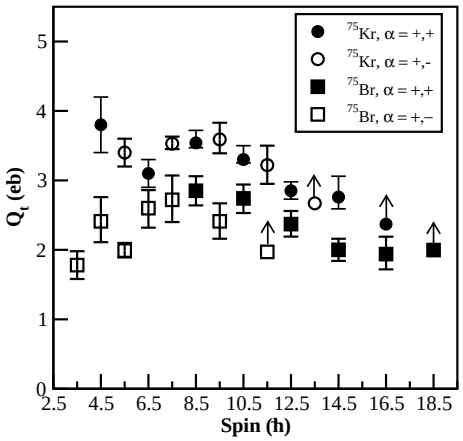


FIG. 1: Comparison of transitional quadrupole moments $Q_t$ for the excited states of positive parity bands in $^{75}$Kr and $^{75}$Br.

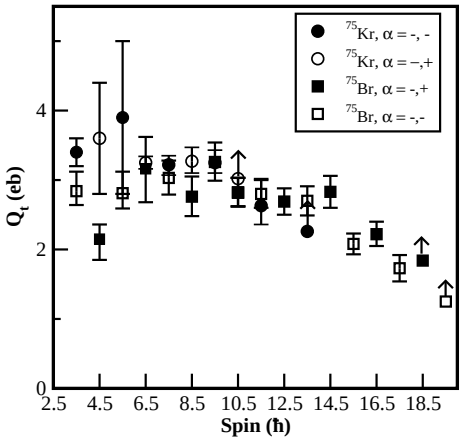


FIG. 2: Comparison of transitional quadrupole moments $Q_t$ for the excited states of negative parity bands in $^{75}$Kr and $^{75}$Br.

cascade side feeding model of five transitions. The lineshapes were obtained from coincidence spectra of transition gated from below the transition of interest and lifetimes were obtained by analyzing the Doppler broadened lineshapes in 32° and 148° coincidence spectra.

The systematic studies of transition qudrupole moments $Q_t$ with spin for the yrast positive and negative parity bands of $^{75}$Kr and $^{75}$Br, are shown in Figs. 1 and 2 which summarizes the results of present work. For completeness, the present measurements of transitional quadrupole moments for spin above $I^\pi = 15/2$ are plotted along with the previous measurements from Refs. [2] and [3]. In the positive parity band of both the nuclei the average value of $Q_t$ are found to be constant before the band crossing, which decreases slightly after the alignment by around 15-20 %. These results indicate the slight reduction of collectively in both the nuclei after spin $I^\pi = 25/2^+$, where the proton and neutron alignment takes place, respectively. It means $\pi g_{9/2}$ and $\nu g_{9/2}$ alignments have similar effect on the shape evolution of these nuclei. However in negative parity bands the average value of transition qudrupole moments $Q_t$ are 3.2 (eb) for $^{75}$Kr and 2.8 (eb) for $^{75}$Br before the band crossing, which decreases by around 20 % in case of $^{75}$Br, where as in case of $^{75}$Kr measurements are scare. Further measurement of lifetime of excited states will be useful for better picture of alignment in these nuclei.

## Summary

Lifetimes of the high spin states were measured up to highest possible spins along the yrast positive and negative parity bands of $^{75}$Kr and $^{75}$Br using the Doppler-shift attenuation method. The extracted transitional quadrupole moments of positive and negative parity bands remain constant before the band crossing and then decrease after band crossing, however decrease in negative parity band of $^{75}$Br is more pronounce as compared to the positive parity bands.

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