Lifetime measurements in ^{123}Cs

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Introduction

Nuclei which are lying between spherical and well-deformed region are generally known as transitional nuclei. The alignment of the valence nucleons outside the spherical ^{114}Sn core, in the transitional nuclei of mass 125 region drives the nuclei into different shapes. The shape co-existance, which occurs in the excited nuclei are mainly due to the collective and noncollective excitations of the nucleons. The shape driving properties of the excited nucleons depends upon the position of the its fermi surface, for example the neutron fermi surface lies in the middle or upper part of the $h_{11/2}$ subshell favors oblate shape, whereas, the proton fermi surface which lies in the lower part of the $h_{11/2}$ subshell favors prolate shape. Total Routhian surface (TRS) calculation also conforms these shape transition from prolate at low spin to oblate at high spin through intermediate triaxial shape with different values of γ, the triaxial parameter[1, 2]. Recent investigation in the neutron deficient isotope ^{123}Cs shows that the single-particle excitations takes over the collective phenomena at high spins, which favors the band termination [3]. The aim of the present work was to measure the mean lifetimes of the excited states in the bands, which can be useful in understanding the shape co-existence phenomenon. The deformation parameter can be extract from the mean lifetime of the excited states. The Doppler Shift Attenuation Method (DSAM) technique is used for the lifetime measurements.

Experimental Details

The excited states of ^{123}Cs were populated in the ^{96}Zr(^{32}S,p4n)^{123}Cs reaction. The ^{32}S beam of energy 140 MeV was provided by 15UD Pelletron accelerator at Inter University Accelerator Center, NewDelhi. The target used was 1mg/cm^2 enriched ^{96}Zr deposited on lead backing of thickness 10gm/cm^2. Gamma ray coincidence events were collected by the Indian National Gamma ray Array(INGA) spectrometer consisting of 18 compton-suppressed HPGe detectors at the time of experiment [4]. The detectors were grouped into five rings at angles 57^0, 32^0, 90^0, 123^0 and 148^0 with respect to the beam axis. The events were collected in the list mode by CANDLE[5], the data acquisition system, with the condition of minimum three detectors were fired at the same time.

Lineshape Analysis and Results

In the offline analysis, the data were calibrated for energy and efficiency by using ^{152}Eu source. The calibrated data were sorted into symmetric $4k{\times}4k$ matrix using INGASORT[6] for intensity measurements. For the lineshape analysis an asymmetric $4k{\times}4k$ matrix were formed. The

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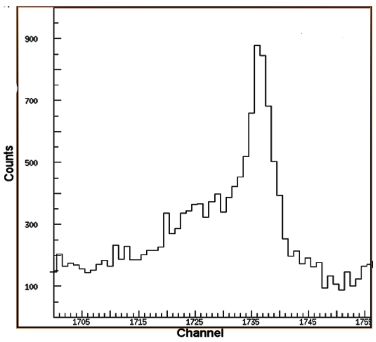

FIG. 1: The obtained lineshape for the transition of energy 868 keV in the negative parity band of ^{123}Cs at the backward angle detector (148^0).

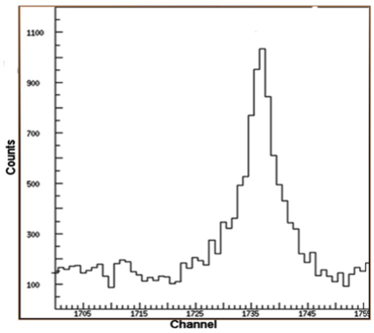

FIG. 2: The obtained lineshape for the transition of energy 868 keV in the negative parity band of ^{123}Cs at the 90^0 detector.

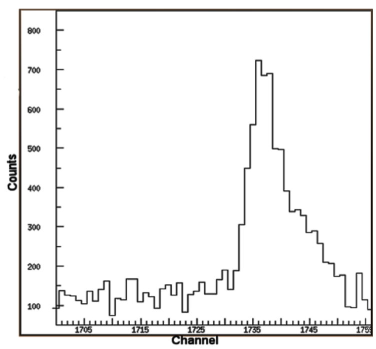

FIG. 3: The obtained lineshape for the transition of energy 868 keV in the negative parity band of ^{123}Cs at the forward angle detector (57^0).

lineshape analysis were carried out by using three codes namely DECHIST,HISTAVER and LINESHAPE[7].

In the preliminary analysis, the program dechist was used to simulate the velocity histories for a set of 5000 recoiling nuclei for every 0.005ps time steps in the target with Pb backing. The slowing down process of the recoiling nuclei were converted into time-dependent velocity profiles for the detectors at particular angle, this was done by the code histaver. The lineshapes were observed for the transition of energies (956, 905, 868 and 801 keV) from the states $39/2^-$,$35/2^-$,$31/2^-$ and $27/2^-$ of the negative-parity band[3]. The observed lineshapes were obtained by gatting the stopped transitions. The lineshapes for the one of the transition from the negative-parity band at the angles 148^0, 90^0 and 57^0 are shown as in the FIG 1, 2 and 3 respectively. The mean lifetime of the excited states can be calculated by fitting the observed lineshapes with the theoritical lineshapes(generated from the time-dependent velocity profiles), by using the code LINESHAPE. The extraction of mean lifetime from the preliminary anlysis are in progress.

Acknowledgments

This work was supported by the Department of Science and Technology(DST/SR/S2/HEP-09/2005),New Delhi.The authors would like to thank the pelletron and Electronics group of IUAC for their kind support during the experiment.

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