Life time measurements for positive parity dipole bands in ^{85}Sr using DSAM

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Introduction

Nuclei in mass region A∼88 have created interest of experimental and theoretical research. Nuclei in this mass region are important to study because of Z =38 and 40, N=50 both of which are candidates of subshell closure. The structure of these nuclei are studied through different reactions and compared with shell model calculations in $1p_{3/2}$, $0f_{5/2}$, $1p_{1/2}$, $0g_{9/2}$ untruncated model space. These nuclei have already shown a variety of phenomena like single particle excitations, collective excitations, magnetic rotations, antimagnetic rotations, signature splitting etc. Magnetic Rotation phenomenon was very well established in Kr isotopes and hybrid version of TAC (Tilted Axis Cranking) was used to understand the features of negative parity bands in Kr isotopes [1]. Previously ^{85}Sr nuclei was studied through $^{82.84}$Kr(α,xn)[2], ^{82}Kr(α,nγ) [3] etc. and recently through ^{76}Ge(^{13}C,4n)^{86}Sr reaction [4]. In this work we are providing information on lifetime measurements for positive parity dipole bands of ^{85}Sr using DSAM.

Experimental details

^{85}Sr nuclei was investigated through high spin spectroscopy by the reaction ^{76}Ge(^{13}C,4n)^{85}Sr using ^{13}C beam of 45 MeV from the Pelletron accelerator at Tata Institute of Fundamental Research (TIFR), Mumbai. ^{76}Ge target of thickness 850 μg/cm^2 with 7.06 mg/cm^2 ^{181}Ta backing was used. Gamma rays were detected using Indian National Gamma Array (INGA) by using 15 compton-suppressed clover detectors at 157°, 140°, 115°, 90°, 65° and 40° with respect to the beam direction. The distance of target from detectors was 25cm. PCI-PXI digital data acquisition system was used to collect the data in list mode using Pixie-16 Module by XIA LLC software. Data was collected when atleast two clovers fired in co-incidence with a time window of 200ns and co-incidence trigger was kept open for 4 μs. A total of about 2.9 x 10^9 two and higher fold coincidence events were recorded. The data were sorted using Multi-pARameter time stamped based COincidence Search (MARCOS) and analysed by DAMM and RADWARE for different matrices to generate gated spectrum. Two matrices consisting of events at 40° and 140° detectors along one axis and rest of the detectors on other axis were created using MARCOS, and gate spectra were gererated using DAMM and RADWARE for life time analysis to be used in LINESHAPE programme.

Lineshape Analysis

In ^{85}Sr life time of states of the positive parity band was calculated using Doppler Shift Attenuation Method (DSAM). LINESHAPE [5] programme was used to calculate the life time of different transitions. Input

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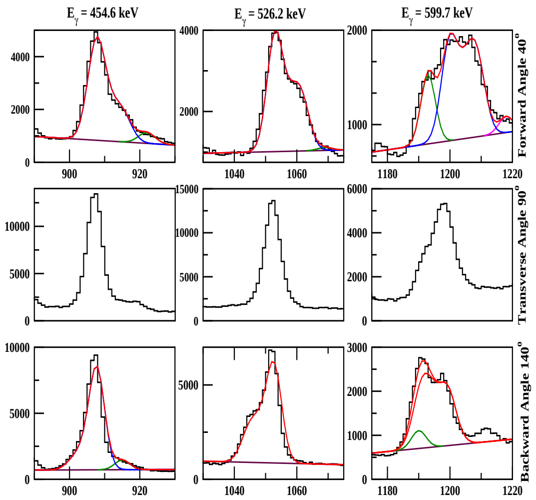

FIG. 1: Lineshape obtained for the 454-, 526- and 599 keV transitions in the positive parity band of ^{85}Sr[4] at 40° and 140° angles.

files required for this programme were obtained by using DECHIST and HISTAVER programmes.Stopping powers are generated internally by shell corrected Northcliffe and Schilling model. The value of time step choosen was 0.01ps and number of recoil histories were 5000. Gating transitions were used which are either below or above the transition of interest. A rotational band of 5 transitions was choosen for side feeding. Moment of inertia for side feeding band was comparable to in-band transitions. In the fitting procedure programme gives χ^2 minimisation for quadrupole moment of transition of interest and quadrupole moment of side feeding transitions. χ^2 minimisation is obtained with three routines SEEK, SIMPLEX and MIGRAD [5]. Forward and backward Doppler-shifted lineshapes for 454-, 526- and 599 keV peaks of positive parity band 2 in ^{85}Sr [4] are shown in Fig 1 and results are given in table 1.

The energies of γ ray transitions and side feeding intensities were used as input parameters. When all the window and level parameters were set to their best values (minimum χ^2) then MINOS error analysis routine was called. MINOS error analysis routine gives uncertainty in transition quadrupole moment.

TABLE I: Life time of 454-, 526-, 599- and 658 keV peaks at 40° and 140° angles. The errors in lifetime are only statistical errors.

Eγ (keV)	E_{level} (keV)	spin ($\hbar$)	Lifetime(ps) forward	Lifetime(ps) backward
454.6	3966	$\frac{23}{2}^+$	$0.641\,^{+0.015}_{-0.014}$	$0.668\,^{+0.071}_{-0.029}$
526.2	4492	$\frac{25}{2}^+$	$0.377\,^{+0.009}_{-0.008}$	$0.477\,^{+0.008}_{-0.009}$
599.7	5093	$\frac{27}{2}^+$	$0.325\,^{+0.016}_{-0.019}$	$0.218\,^{+0.006}_{-0.020}$
658.5	5091	$\frac{27}{2}^+$	$0.118\,^{+0.111}_{-0.037}$	$0.215\,^{+0.011}_{-0.011}$

Lineshape analysis was started for the topmost transition and then including the lower transitions one by one in the analysis .The lineshape analysis of band 3 [4] is in progress. Theoretical calculations based on shell model and TAC model will be used to interpret the results on B(M1) values and its behaviour with spin.

Acknowledgments

The authors thank the INGA collaboration for providing setup, staff at TIFR-BARC Pelletron-linac facility, Mumbai for their valuable help, target laboratory staff at IUAC and Delhi University, CSIR, UGC, DST and DAE for financial support at various stages. Suresh Kumar also thanks to IUSSTF (Indo-US Science and Technology Forum) for his Indo-US research fellowship to visit ANL, USA.

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