Study of Magnetic Rotation in mass A = 135 region

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Introduction

The nuclei near A ≈ 135 with the neutron number approaching towards N = 82 shell closure show shape driving effect at high spins with moderate deformation and display a variety of interesting phenomenon such as shape co-existence, Magnetic Rotation (MR) bands and MR band crossing. Nilsson diagram indicates that there are several positive parity states originating from $g_{7/2}$, $d_{5/2}$, $d_{3/2}$ and $s_{1/2}$ orbitals and a negative parity state originating from $h_{11/2}$. For N = 78 odd-Z isotones, some of the dipole bands have been interpreted as Magnetic Rotation bands [1–3] and possible MR band crossing has been seen in few cases [1, 2]. However, in contrast to its isotones, ^{135}La has not been explored for the phenomena of MR. Therefore the present study is focussed on the investigation of the high spin states in this nucleus. Previously, this nucleus has been explored by radioactive decay [4] and $^{128}Te(^{11}B, 4n)$ reaction [5]. But complete information about the high spin structure of ^{135}La populated by the $^{128}Te(^{11}B, 4n)$ reaction is limited. In the present study, we report on the reinvestigation of the high spin states of ^{135}La.

Experimental Details and Results

The high spin states in ^{135}La were populated by the reaction ^{128}Te(^{11}B,4n)^{135}La using a ^{11}B beam of 50.5 MeV obtained from the Pelletron Linac Facility at Tata Institute of Fundamental Research (TIFR), Mumbai. The target consisted of a 1.02 mg/cm^2 ^{128}Te with 4 mg/cm^2 ^{197}Au backing. The gamma rays were detected using Indian National Gamma Array (INGA). The array consisted of 16 Compton suppressed detectors arranged in spherical geometry with 3, 2, 4, 3, 2 and 2 clovers placed at 157°, 140°, 115°, 90°, 65° and 40° with respect to the beam direction respectively. The online data was collected by XIA based triggerless fast Digital Data AcQuisition (DDAQ) system [6]. XIA based four modules each with 16 channels were used in the experiment. Each of the four clovers were handled by a single module. A total of about 3.9 X 10^9 two and higher fold events were recorded. The data was sorted using in-house programs and analysed by software DAMM. The coincidence events were sorted into double and triple gamma coincidence matrices and were analyzed with the RADWARE software pack-

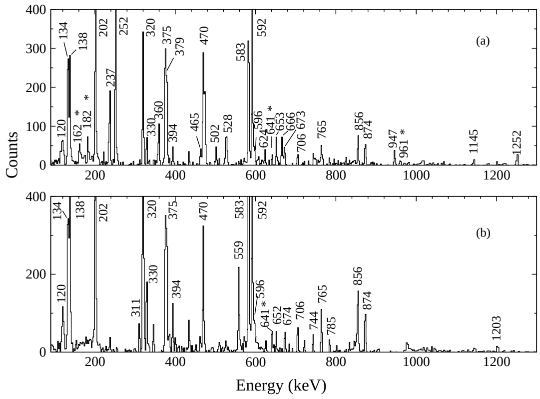

FIG. 1: Double gated spectra obtained by (a) gate on 311 and 386 keV and (b) gate on 360 and 502 keV.

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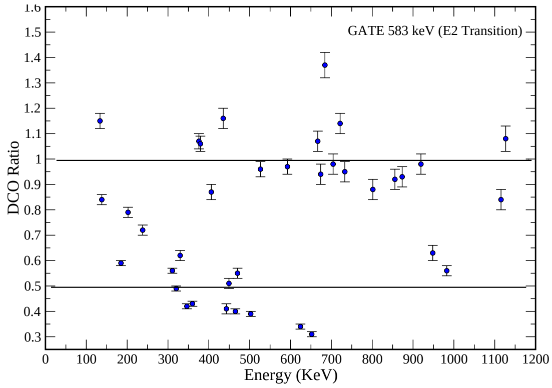

FIG. 2: Plot for DCO ratios of different transitions.

age. On the basis of the analysis of double and triple gamma coincidences, the previously known level scheme has been extended for high spins. The R_{DCO} values and polarization asymmetry factors have been obtained by analysing asymmetric and polarization matrices respectively. We have established two dipole ($\Delta I = 1$) bands showing band crossing which is similar to ^{137}Pr [1]. In the lower spin states the decoupled partner of $g_{7/2}$ band has been observed for the first time in ^{135}La which is similar to ^{133}La [7]. The transitions of the dipole bands ($\Delta I = 1$) observed in the present study are shown in Fig. 1. A new transition of 162 keV has been placed at the band-head of one of the dipole band. Other new transitions have been labeled by asterisk ($*$). Fig. 2 shows the DCO ratios obtained from the present work.

Fig. 3 shows the plot of I vs $\hbar\omega$ for the dipole bands and indicates the possibility of band crossing between the two bands. The TAC calculations have been performed for these dipole bands by using gap energies $\Delta_p = 1.059$ MeV and $\Delta_n = 0.727$ MeV as deduced from 80% of the odd-even mass differences. The two dipole bands have been assigned the configurations $\pi(h_{11/2})^1 \otimes \nu(h_{11/2})^{-2}$ and $\pi(h_{11/2})^1(g_{7/2})^2 \otimes \nu(h_{11/2})^{-2}$ based on the calculations. The analysis is in the final stage.

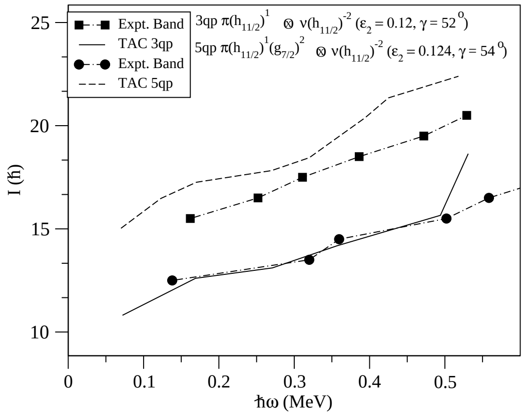

FIG. 3: Plot showing I($\hbar$) vs E behaviour.

Acknowledgments

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