Transition probability ratios of dipole bands in ^{129}La

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I. INTRODUCTION

In high spin phenomena, the configuration of the valence nucleons and their angular momentum coupling are responsible for generating different shapes and the structure of a nucleus. In the mass $A = 130$ region, the Fermi surface is occupied by the $g_{7/2}$, $d_{5/2}$, $h_{11/2}$, $s_{1/2}$, $d_{3/2}$ protons and, $d_{5/2}$, $g_{7/2}$, $s_{1/2}$, $d_{3/2}$ and $h_{11/2}$ neutrons, single particle orbitals. The nuclei in this mass region are known for their γ soft [1] and exhibit different high spin phenonenon such as magnetic rotation, anti-magnetic rotation, chiral rotation, identical bands, etc. The multiple dipole bands and the degenerate dipole bands were reported in the ^{133}Ce [2] and ^{133}La [3] nuclei, respectively. The ^{129}La (Z=57) nucleus come out to be an interesting candidate for the present study of nuclear high spin phenomenon as mention above. In the previous study of this nucleus, two dipole bands and many rotational bands were established having most of tentative spin and parity assignment [4].

In the present work, the R_{DCO} and polarization asymmetry (Δ) measurements were performed to confirmed the spin-parity of the levels and the transition probability ratios ($\frac{B(M1)}{B(E2)}$) of the two dipole bands were reinvestigated.

II. EXPERIMENTAL DETAILS

The excited states of ^{129}La nucleus were populated through the reaction ^{121}Sb(^{12}C, $4n$)^{129}La at a beam energy of 66 MeV provided by the 15-UD pelletron at Inter University Accelerator centre (IUAC), New Delhi. The target used was ^{121}Sb of thickness 900 $\mu g/cm^2$ with a backing of 10.0 mg/cm^2 thick ^{197}Au. The γ-rays were detected by using the INGA spectrometer at IUAC [5] which consist of 18 Compton- suppressed clover detectors with four, four, six, two and two number of detectors placed at angles 148°, 123°, 90°, 57° and 32°, with respect to the beam direction, respectively. The distance between the target position and the detectors was 25 cm. The list mode data were taken in double and higher fold γ-ray coincidence using a computer automated measurement and control based multiparameter data-acquisition system along with the Collection and Analysis of Nuclear Data using Linux nEtwork (CANDLE) software.

III. DATA ANALYSIS AND RESULTS

From the analysis of $\gamma - \gamma$ coincidence and anti-coincidence relationship and considering the γ-ray intensities, a partial level scheme of the ^{129}La nucleus was constructed and the two

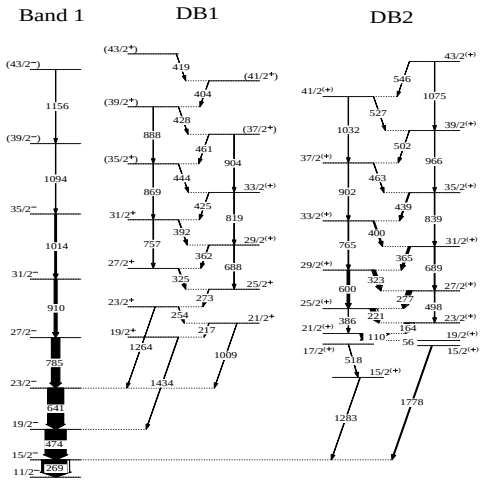

FIG. 1: Partial level scheme of the ^{129}La nucleus.

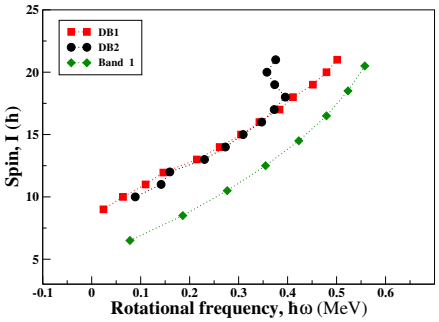

FIG. 2: (a) Spin $I(\hbar)$ vs. Rotational frequency $\hbar\omega$ (MeV) plot for the dipole bands in ^{129}La.

dipole bands are named as DB1 and DB2, as shown in the FIG. 1. The intensities of the γ-ray transitions are normalized with respect to the 269 keV transition. FIG. 2 represents the Rotational frequency $vs.$ Spin. From the FIG. 2, it is observed that upto the spin $I(\hbar) = 37/2^+$ the two bands have very similar behavior. The experimental transition probability ratios, $\frac{B(M1)}{B(E2)}$ were obtained from the measured intensities of the γ-ray transitions using the relation [4],

$$\frac{B(M1; I \rightarrow I-1)}{B(E2; I \rightarrow I-2)} = 0.697 \frac{I_\gamma(M1)}{I_\gamma(E2)} \frac{E_\gamma^5(E2)}{E_\gamma^3(M1)} \left[\frac{\mu_N}{eb}\right]^2$$

$\frac{B(M1)}{B(E2)}$ ratio as a function of $I(\hbar)$ is shown in the FIG. 3. From the FIG 3, it is seen that

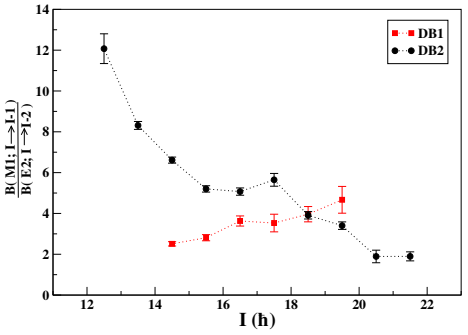

FIG. 3: Transition probability ratios of the dipole bands in ^{129}La as a function of spin I $(\hbar)$.

DB2 has much higher value of the $\frac{B(M1)}{B(E2)}$ at the lower spin as compare to the DB1 and the value decreases sharply with increasing spin. On the other hand the $\frac{B(M1)}{B(E2)}$ ratio for band DB1 shows smooth increasing along the band. Theoritical calculations to understand the experimental results are in progress.

Acknowledgments

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