Signature inversion in $\nu g_{7/2}$ band of ^{127}Xe

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Introduction

Study on the triaxial shapes in transitional nuclei has been a subject of interest since long due to the observation of a large number of physical phenomena. Xe isotopes are the good candidates to study for these phenomena due to their well known triaxial shapes. Bands at the low spin region in these nuclei are mainly associated with $h_{11/2}$, $g_{7/2}$, $d_{5/2}$, $d_{3/2}$, $s_{1/2}$ neutron orbitals.

There are four negative parity bands, based on $\nu h_{11/2}$ orbital, were reported in $^{119-125}$Xe at low angular momentum [1–4]. The magnitude of the observed signature splitting in the yrast negative parity bands were found large and also unexpectedly constant as a function of neutron number [4]. Therefore, in this work, an attempt is made to study the signature splitting in $\nu g_{7/2}$ band of ^{127}Xe and its dependency on the configuration.

Experiment

Excited states of ^{127}Xe were populated via ^{122}Sn(^{9}Be, 4nγ) fusion-evaporation reaction at E_{Lab}=48 MeV. The energetic ion beam was delivered by 15UD pelletron accelerator of Inter-University Accelerator Centre, New Delhi [5]. A ^{122}Sn foil rolled to a thickness of 8.4 mg/cm^2 to form the target [6]. The Indian National Gamma Array, consisting of fourteen Compton suppressed clover detectors, was used to detect the de-exciting γ-rays [7]. A CAMAC based data acquisition system (CANDLE) was used to record the valid events [8]. Offline data analysis was carried out using INGAsort code [9]. Details of this experiment are available in Ref. [10].

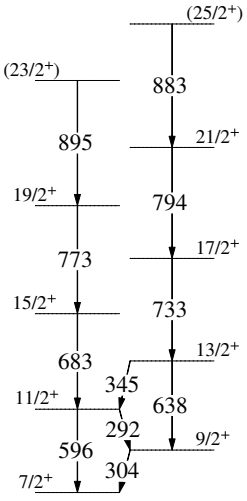

FIG. 1: Levels of $\nu g_{7/2}$ band in ^{127}Xe.

Results

The deduced level scheme of the $\nu g_{7/2}$ band in ^{127}Xe has been shown in Fig. 1. A positive parity band based on 343 keV isomeric state ($J^\pi = 7/2^+$, $\tau_{1/2} = 37\ ns$) was reported up to $J^\pi = 19/2^+$ at 2395 keV [11]. This band has been extended up to $(23/2^+)$ by placing an 895 keV γ-ray on the basis of observation of this transition in 773 keV and other low lying energy gates (Fig. 2). The unfavoured partner of this band was reported earlier up to 2017 keV with $I \leqslant 17/2$ [12]. This band has been extended upto $(25/2^+)$ state by placing two more γ-rays of 794 and 883 keV energies, observed in

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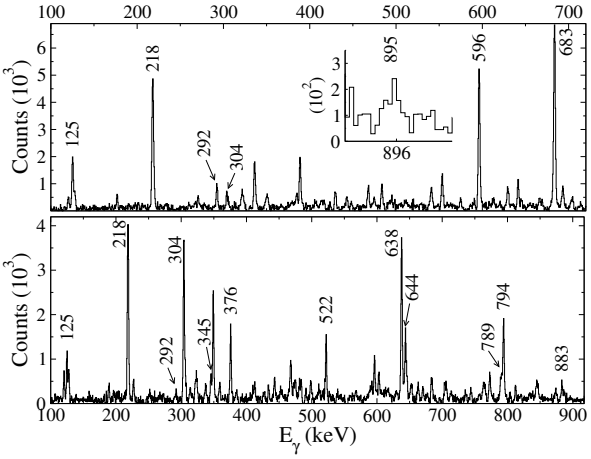

FIG. 2: Prompt γ-ray spectrum observed in coincidence with (above) 773 and (below) 733 keV γ-rays.

TABLE I: Energy (in keV), intensity, DCO ratio and linear polarization asymmetry of the γ-rays.

E_γ	I_γ	R_{DCO}	E_{Gate}	Δ_{asym}
292.2	07.7 ± 0.3	0.41 (04)	683	
303.8	23.8 ± 0.2	0.45 (03)	638	+0.028 (096)
345.4	02.2 ± 0.2	0.52 (20)	733	
596.0	83.6 ± 1.1	1.07 (05)	683	+0.123 (024)
637.5	31.1 ± 0.7	1.08 (08)	733	+0.135 (119)
683.4	74.0 ± 1.6	1.10 (08)	773	+0.101 (073)
733.2	24.0 ± 0.6	1.09 (09)	638	+0.139 (096)
772.6	22.3 ± 0.5	1.05 (05)	683	+0.145 (071)
793.8	10.6 ± 0.5	0.98 (13)	733	+0.163 (173)
883.2	02.4 ± 0.4			
895.3	00.9 ± 0.2			

733 keV and other low lying energy gates (Fig. 2). Spin and parity of the states have been determined from angular correlation and linear polarization measurements, as summarised in Table I.

Discussions

The band of present interest (Fig. 1) is looking like a strongly coupled band with both the signature partners. The signature splitting observed in this band is very small in magnitude and also getting inverted at higher angular momentum [13]. The variation of signature splitting and Routhian as a function of angular frequency/momentum is shown in Fig. 3 from the present data. Observed

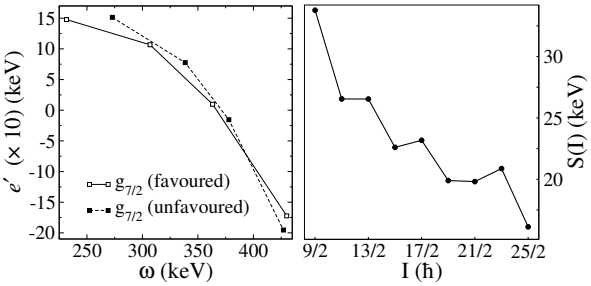

FIG. 3: Plot of (left) Routhian (e') as a function of angular frequency (ω) and (right) signature splitting [S(I)] as a function of spin (I) for $\nu g_{7/2}$ band in ^{127}Xe.

small signature splitting is also indicating the high-Ω configuration ($\nu g_{7/2}[404]7/2^+$), available in the prolate side near the Fermi surface, of this band. In this context, it may be noted that the signature inversion in $\nu g_{7/2}$ band has not been reported in any other $Z = 54$ isotopes or $N = 73$ isotones near $A = 130$. The further theoretical calculation is underway to understand the structure of this band. Observation of expected low signature splitting in this band indicates that further experimental investigation on negative parity bands is required in order to infer their structure.

Acknowledgments

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