

## Study of $\nu h_{11/2}$ Band in $^{127}\text{Xe}$

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### Introduction

The structure of odd-A xenon nuclei explicitly depends on the negative parity intruder  $h_{11/2}$  orbitals, lying near the neutron Fermi surface. As a result, the strongly populated yrast  $\nu h_{11/2}$  band were reported systematically in odd-A Xe isotopes [1–3]. Particularly, in  $^{125}\text{Xe}$ , the alignment of the second pair of  $h_{11/2}$  neutrons was reported at  $\hbar\omega \sim 480$  keV in  $\nu h_{11/2}$  band [3] along with the alignment of a pair of  $h_{11/2}$  protons, beyond  $27/2^-$  state [2]. In  $^{129}\text{Xe}$ , the similar two sequences of E2 transitions were also observed above  $23/2^-$ . Authors suggested one of them due to two proton alignment and the other sequence of transitions was suggested to be associated with  $\pi(g_{7/2})^2 \otimes \nu f_{7/2}$  configuration. Interestingly, the neutron pair alignment is not reported in  $^{129}\text{Xe}$ , which is expected to

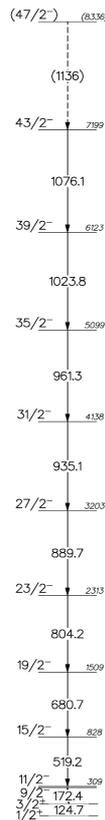


FIG. 1: Partial level scheme of  $^{127}\text{Xe}$  deduced from this work

be seen at lower frequency compared to the proton alignment, as reported in the case of  $^{125}\text{Xe}$ . The change in the structure of  $\nu h_{11/2}$  band at high spin occurs between  $N=71$  and  $75$ . For  $N=73$ , the states beyond  $19/2^-$  were known with tentative spin and parity and no further structural information was available [4–6]. Therefore, in-beam  $\gamma$ -ray spectroscopy of  $^{127}\text{Xe}$  has been carried out to infer the structure of this band at high spin.

### Experimental Details

High spin states of  $^{127}\text{Xe}$  have been populated via  $^{122}\text{Sn}(^9\text{Be}, 4n\gamma)$  fusion-evaporation reaction at 48 MeV, at 15UD pelletron accelerator facility of the IUAC, New Delhi [7]. A  $8.4 \text{ mg/cm}^2$  thick  $^{122}\text{Sn}$  foil has been used as target. The de-exciting  $\gamma$ -rays were detected in fourteen clover detectors of INGA spectrometer [8]. CANDLE, a CAMAC based analogue data acquisition system has been used to record the valid events [9]. The offline data analysis was carried out using the computer codes INGAsort and RadWare [10, 11]. The spin of nuclear states were determined from  $R_{\text{DCO}}$  results [12].

### Results

The important transitions belonging to  $\nu h_{11/2}$  band are shown in 1023.8 keV energy gated spectrum [fig 2]. On the basis of the coincidence relationship and intensity distribution, the partial level scheme has been developed [fig 1]. The spin and parity of the high spin states have been confirmed in the present

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study. The values of  $R_{\text{DCO}}$  (with error) for eight transitions belonging to this band have been determined and listed in table I.

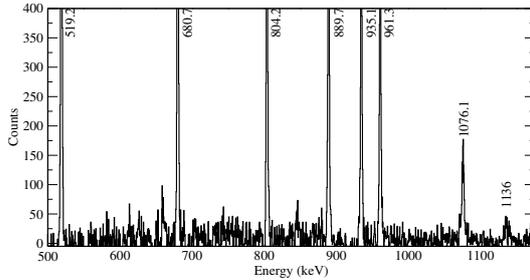


FIG. 2: Energy gate on 1023.8 keV  $\gamma$ -ray, showing the  $\gamma$ -rays of interest belonging to  $\nu h_{11/2}$  band.

TABLE I: Energies of  $\gamma$ -rays and DCO ratios for levels of  $^{127}\text{Xe}$ .

$E_\gamma$ (keV)	$R_{\text{DCO}}$	Assigned multipolarity	$I_f \rightarrow I_i$
519.2	1.00 (1)	E2	$15/2^- \rightarrow 11/2^-$
680.7	0.99 (2)	E2	$19/2^- \rightarrow 15/2^-$
804.2	1.01 (2)	E2	$23/2^- \rightarrow 19/2^-$
889.7	0.98 (3)	E2	$27/2^- \rightarrow 23/2^-$
935.1	0.97 (4)	E2	$31/2^- \rightarrow 27/2^-$
961.3	0.94 (7)	E2	$35/2^- \rightarrow 31/2^-$
1023.8	0.92 (13)	E2	$39/2^- \rightarrow 35/2^-$
1076.1	0.92 (31)	E2	$43/2^- \rightarrow 39/2^-$

## Discussions

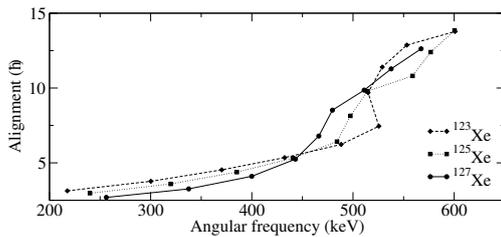


FIG. 3: Aligned angular momentum  $i_x$  as a function of frequency for  $\nu h_{11/2}$  band in  $^{123-127}\text{Xe}$ .

The aligned angular momentum ( $i_x$ ) relative to a reference has been calculated with Harris parameters,  $\mathfrak{S}_0=16\hbar^2 \text{ MeV}^{-1}$  and

$\mathfrak{S}_1=7\hbar^4 \text{ MeV}^{-3}$ , for yrast  $\nu h_{11/2}$  band in  $^{123-127}\text{Xe}$  [fig. 3]. The alignment plot of  $^{127}\text{Xe}$  has been found similar to that of  $^{123,125}\text{Xe}$ . The alignment gain of  $\sim 6\hbar$  is observed at  $\hbar\omega \sim 440 \text{ keV}$  in  $^{127}\text{Xe}$ , which may be caused by the alignment of the second pair of  $h_{11/2}$  neutrons, as explained in case of  $^{123}\text{Xe}$  at  $\hbar\omega \sim 525 \text{ keV}$  [1] and  $^{125}\text{Xe}$  at  $\hbar\omega \sim 490 \text{ keV}$  [3]. The back-bending frequency shifted towards lower side with increasing A from 123 to 127. For the proton aligned band, data analysis is under process and results will be discussed during symposium.

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