

Observation of a rotational band at $19/2^+$ state in ^{127}Xe

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Introduction

A number of rotational bands, associated with multi-quasiparticle configurations, were reported in *odd-A* Xe nuclei. The configurations of many of these bands in ^{125}Xe [1] differ from the configuration proposed in the neighbouring ^{129}Xe nucleus [2]. Particularly, in the case of a band reported above $19/2^+$ state in $^{125,129}\text{Xe}$ [3] was suggested different configurations: in ^{125}Xe , the $\nu d_{3/2} \otimes \pi h_{11/2}^2$ configuration was suggested [1], where as, in ^{129}Xe the $\nu f_{7/2} \otimes \pi g_{7/2} \cdot h_{11/2}$ configuration was proposed [2]. The sudden change in configuration in between $N = 71$ and $N = 75$ was unexplained [2]. This may be better understood with the experimental data at $N = 73$, which is lacking. In ^{127}Xe no similar type of band was reported above $19/2^+$ state. Due to present interest in the configuration of multi-quasiparticle band above $19/2^+$ state in $^{125-129}\text{Xe}$ and the sys-

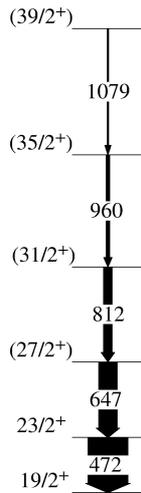


FIG. 1: Level scheme (partial) of ^{127}Xe .

tematic evolution of structure of these nuclei, there is a need of experimental investigation of ^{127}Xe . In this work, the experimental results on the present experimental investigation and the expected rotational band above $19/2^+$ state are presented.

Experimental Details

Excited states of ^{127}Xe were populated via $^{122}\text{Sn}(^9\text{Be}, 4n\gamma)$ fusion-evaporation reaction at a beam energy of 48 MeV, delivered by 15UD pelletron accelerator facility of IUAC, New Delhi [4]. The INGA spectrometer [5], consists of fourteen clover detectors, was employed to detect the coincident γ -rays. Offline data analysis was carried out using INGAsort and RadWare computer codes [6, 7]. Detail of the experimental setup is available in Ref. [8].

Results

First time, a new $\Delta I = 2$ band has been observed in ^{127}Xe as shown in Fig. 1. A sequence of five levels above $19/2^+$ state, connecting via 472, 647, 812, 960 and 1079 keV γ -transitions, has been established on the basis of $\gamma\gamma$ -coincidence and intensity relationship. Thickness of the arrows is proportional to the intensity of the corresponding transitions. Some of the important energy gated spectra, such as, 1079 KeV (Fig. 2) and 960 keV (Fig. 3) have been presented, in favour of the present placements. It is important to

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mention that the contribution of neighbouring 1076 keV and 961 keV close-by transitions from the negative parity yrast $h_{11/2}$ band has been subtracted from the presented energy gates of 1079 keV and 960 keV. Spin and

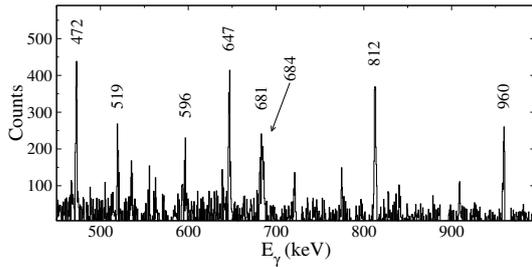


FIG. 2: Partial energy gate on 1079 keV γ -ray, showing the γ -transitions of new band. Transitions of low lying bands are also marked. The contribution of 1076 keV γ -ray [8] is subtracted.

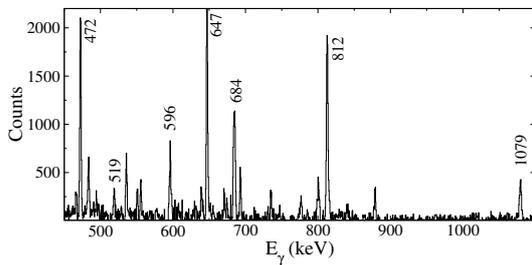


FIG. 3: Partial energy gate on 960 keV γ -ray, showing the γ -transitions of new band. Transitions of low lying bands are also marked. The contribution of 961 keV γ -ray [8] is subtracted.

parity up to $23/2^+$ state have been adopted from Ref. [3]. Preliminary analysis of angular correlation data indicates $\Delta I = 2$ nature of all the γ -rays belonging to this band. Further details of the angular correlation and linear polarization results will be discussed during the symposium.

Discussions

The newly identified band is consists of five γ -transitions. The unfavored signature part-

ner of this band has not been observed in this work, indicating the presence of large signature splitting. This band is very much similar to the bands reported in neighbouring $^{125,129}\text{Xe}$ [1, 2] which were suggested to associate with low- Ω orbitals in order to explain the large signature splitting. Interestingly, the observed decay pattern of these bands found different. While the bandhead, $19/2^+$, is reported to decay mainly in $\nu d_{3/2}$ band in ^{125}Xe , in ^{129}Xe it is found to decay in $\nu h_{11/2}$ band intensely. In the present case of ^{127}Xe , this band is found to decay mainly in $\nu g_{7/2}$ band [3]. Further investigation is continued in order to infer the structure of this band in ^{127}Xe .

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References

- [1] A. Al-Khatib et al. *Phys. Rev. C*, 83:024306, 2011.
- [2] Y. Huang et al. *Phys. Rev. C*, 93:064315, 2016.
- [3] S. Chakraborty et al. *EPL (Europhys. Lett.)*, 121:42001, 2018.
- [4] G. K. Mehta et al. *Nucl. Instrum. Meth. Phys. Res. A*, 268:334 – 336, 1988.
- [5] S. Muralithar et al. *Nucl. Instrum. Meth. Phys. Res. A*, 622:281 – 287, 2010.
- [6] R. Bhowmik et al. In *Proc. DAE Symp. Nucl. Phys.*, volume 44B, page 422, 2001.
- [7] D. C. Radford. *Nucl. Instrum. Meth. Phys. Res. A*, 361:297 – 305, 1995.
- [8] S. Chakraborty et al. *Braz. J. Phys.*, 47:406–410, 2017.