Spectroscopy of ^{126}Xe

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Introduction

Even-A xenon isotopes in $A \sim 130$ are the classical examples of transitional nuclei. The structure of these nuclei are mainly governed by the prolate driving low-K proton orbitals and oblate driving high-K neutron orbitals. As a consequence, a forking in the ground state band has been taken place beyond 8^+ state to originate two 10^+ states in $^{124-128}$Xe, associated with simultaneous alignments of a pair of $h_{11/2}$ neutrons and a pair of $h_{11/2}$ protons [1–4]. Structure of the strongly populated yrast 10^+_1 state has been interpreted in terms of the alignment of a pair of $h_{11/2}$ neutrons, whereas, the alignment of a pair of $h_{11/2}$ protons originates the weakly populated 10^+_2 state in even-A xenon nuclei. Therefore, a feebler γ-transition between $10^+_2 \rightarrow 8^+$ and a stronger γ-transition between $10^+_1 \rightarrow 8^+$ have been observed in ^{122,124,128}Xe [1–3]. But, an equivalent intensities for these two transitions have been reported in ^{126}Xe [4]. Also, the decay pattern of proton pair aligned band and neutron pair aligned band in ^{126}Xe behave differently compared to neighboring isotopes.

A number of rotational bands based on two-quasineutrons have been reported in $^{122-128}$Xe isotopes [1–4], decaying to the ground state band via *electric dipole* transitions. The spin and parity of these states were assigned on the basis of angular distribution or angular correlation measurements. But, to determine the parity unambiguously linear polarization measurement of the depopulating transitions is necessary, specially for the inter-band unstretched transitions.

Recent experimental investigation on ^{126}Xe have been carried out using heavy-ion fusion evaporation reaction and the states up to $\sim 60\ \hbar$ have been studied. But, the experimental information on low-lying states of ^{126}Xe are lacking. Therefore, an in-beam γ-ray spectroscopy has been carried out in order to investigate the low-lying states of ^{126}Xe.

Experimental Details

Excited states of ^{126}Xe were populated via ^{122}Sn(^{9}Be, 5nγ) fusion-evaporation reaction at 15UD pelletron accelerator facility of Inter-University Accelerator Centre, New Delhi. INGA spectrometer having fourteen clover detectors was used to collect the γ-γ-coincidence events. Offline data analysis was carried out using INGAsort and RadWare computer codes. Details of the experimental set up and data analysis process are reported in Ref. [5].

Results

In the present experiment, the excited states of ^{126}Xe have been observed up to 6.5

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MeV ($\sim$ 18 $\hbar$). The γ-rays of ^{126}Xe have been shown in 800.7 keV energy gated spectra (Fig. 1). Spin of the yrast states up to

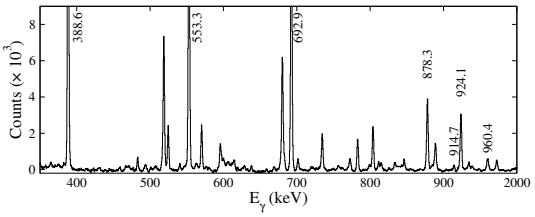

FIG. 1: Energy gated spectra of 800.7 keV γ-ray.

12 $\hbar$ have been verified from DCO ratio and the parity of the states up to 10 $\hbar$ have been confirmed from linear polarization asymmetry results. These two measurements confirm the *electric quadruple* nature of 388.6, 553.3, 692.9, 800.7, 878.3, and 924.1 keV transitions. Experimental results are summarized in Table. I.

TABLE I: Energies (in keV), DCO ratios (R_{DCO}) and linear polarization asymmetries (Δ_{asym}) of γ-rays belonging to ^{126}Xe.

E_γ	R_{DCO}	Δ_{asym}	$I_i \rightarrow I_f$
388.6	1.10 (2)	0.14 (3)	$2^+ \rightarrow 0^+$
553.3	1.08 (1)	0.12 (1)	$4^+ \rightarrow 2^+$
692.9	1.03 (2)	0.11 (1)	$6^+ \rightarrow 4^+$
800.7	1.02 (2)	0.13 (2)	$8^+ \rightarrow 6^+$
878.3	0.96 (3)	0.10 (3)	$10^+ \rightarrow 8^+$
914.7	0.86 (15)		$12^+ \rightarrow 10^+$
924.1	1.00 (3)	0.10 (4)	$10^+ \rightarrow 8^+$
960.4	1.03 (6)		$12^+ \rightarrow 10^+$

The intensities of $10^+_{1\text{ or }2} \rightarrow 8^+$ transitions have been found to be equivalent, as reported in Ref. [4], unlike the same have been reported in neighbouring Xe isotopes [2, 3]. Theoretical investigation on these states is under process.

Conclusion

High spin states of ^{126}Xe have been studied via ^{122}Sn(^{9}Be, 5nγ) reaction at 48 MeV. The spins and parities of the excited yrast states up to 10^+ have been confirmed from angular correlation and linear polarization measurement.

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