

Three-quasiparticle Band in Iodine Nuclei

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Introduction

Iodine nuclei (Z=53) having three protons outside the spherical core (Z=50) are the representative of transitional nuclei, lying between the spherical (Z=50) and well deformed (Z=57) nuclei. Bands based on $d_{5/2}$, $g_{7/2}$, $g_{9/2}$ and $h_{11/2}$ orbitals have been observed in these nuclei. Several multi-quasiparticles bands are also reported in lighter mass ^{123,125}I iodine nuclei [1,2]. The experimental

information on multi-quasiparticle bands in ¹²⁷I nucleus [3] is lacking compare to ^{123,125}I nuclei. The aim of the present investigation was to study the multi-quasiparticle bands in ¹²⁷I.

Experimental Details

In beam γ -ray spectroscopy was carried out using beam from the 15 UD pelletron accelerator [4] at Inter University Accelerator Centre, New Delhi via ¹²⁴Sn (⁷Li, 4n) ¹²⁷I reaction at 33 MeV. The γ - γ coincidence, γ -ray angular distribution and γ -ray polarization measurements were carried out. Data was collected using INGA facility

comprising of 15 Compton suppressed clover detectors [5,6]. About 2×10^8 γ - γ coincidence events were collected. Offline data analysis was carried out using INGASORT computer code [7].

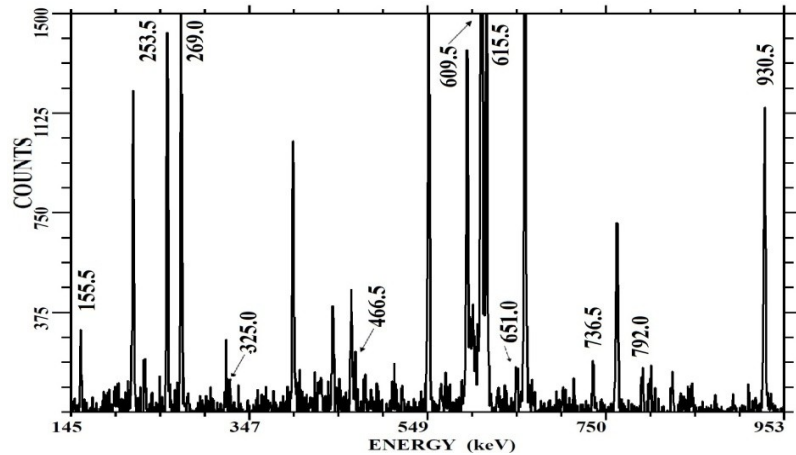


Fig. 1: The γ -rays of interest belonging to the multi-quasiparticles band are shown in the energy sum gate on 253.5 keV and 930.5 keV.

Results

The γ -rays belonging to the multi-quasiparticle band are shown in the energy sum gate on 253.5 keV and 930.5 keV γ -rays of ¹²⁷I (Figure 1). The partial level scheme of ¹²⁷I, confirmed in this work, is shown in figure 2, along with the level schemes of ^{123,125}I. Spins and parities of several levels were confirmed in this work.

The propose multi quasiparticle band may be associated with any of the following mentioned three quasi-particle configurations:

$$\pi g_{7/2} \otimes \nu h_{11/2}^2 ; \pi d_{5/2} \otimes \nu h_{11/2}^2 ; \pi h_{11/2} \otimes \nu [g_{7/2} h_{11/2}]$$

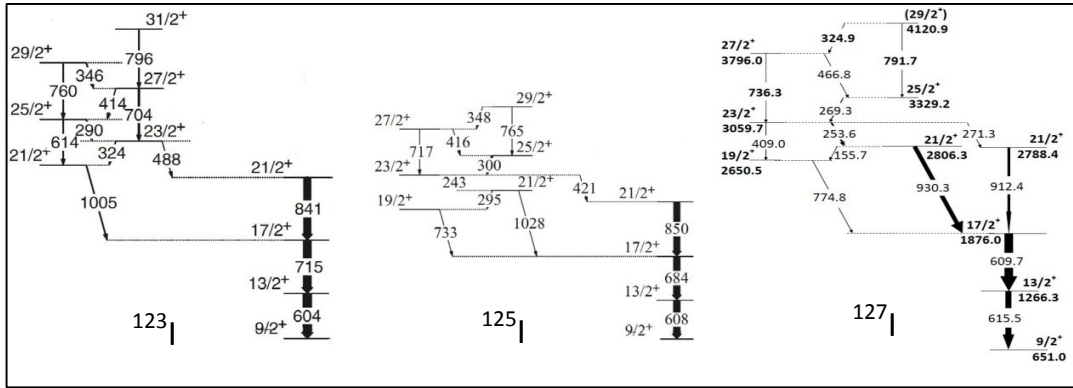


Fig. 2: Partial level schemes of ^{123}I [1], ^{125}I [2], and ^{127}I [present work] showing states of multi-quasiparticles band of interest.

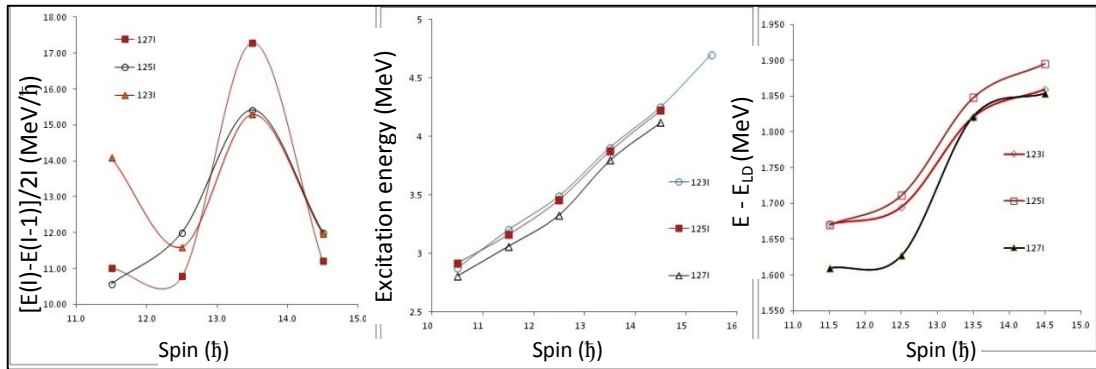


Fig. 3: The plots of (a) energy staggering vs spins, (b) excitation energy vs spins and (c) $E - E_{LD}$ vs spins for $^{123-127}\text{I}$.

Similar types of bands are reported in $^{123,125}\text{I}$ [1,2] nuclei and $\pi g_{7/2} \otimes \nu h_{11/2}^2$ configuration is assigned. As the nature and magnitude of energy staggering, excitation energy and ($E - E_{LD}$) of this band is found similar to the features of the bands in $^{123-125}\text{I}$ (Fig. 3), hence, this band may be associated with the similar configuration as reported in $^{123-125}\text{I}$. The theoretical CSM calculations are being carried out and results will be presented in the symposium.

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References

[1] Core excitations beyond maximally aligned configurations in ^{123}I , Purnima Singh et al., *Phys. Rev. C* 85, 034319 (2012).

[2] Noncollective aligned and anti-aligned states in ^{125}I , Purnima Singh et al., *Phys. Rev. C* 82, 034301 (2010).
 [3] High-spin states in ^{127}I , B. Ding et al, *Phys. Rev. C* 85, 044306 (2012).
 [4] 15 UD Pelletron of NSC - status report, G. K. Mehta and A. P. Patro, *Nucl. Instr. and Meth. A* 268 (1988) 334.
 [5] Clover electronics module for INGA at NSC, S. Venkataramanan et al., *DAE Symp. On Nucl. Phys.* 45B (2002) 424.
 [6] Indian National Gamma Array at Inter University Accelerator centre, New Delhi, S. Muralithar et al, *Nucl. Instr. and Meth. A* 622(2010)281.
 [7] INGAsort - A new program for the analysis of multi detector array, R.K. Bhowmik, S. Muralithar, R.P. Singh, *DAE Symp. on Nucl. Phys.* 44B (2001) 422.