Study of multi-quasiparticle band in ^{125}I

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Introduction

The nuclei near the shell closure at Z=50 with mass number A∼120–130 exhibit significant variation in shape and deformation. The iodine (Z=53) nuclei, lying in between spherical Sn (Z=50) and deformed Cs (Z=58), portray a rich variety of structural features in this transitional region. In the light odd-mass iodine nuclei (A<121) rotational structure corresponding to the proton $h_{11/2}$ band was reported [1]. In contrast, the nuclei having mass number above 121 exhibit vibrational structure correlated to neutron $h_{11/2}$ band [2].

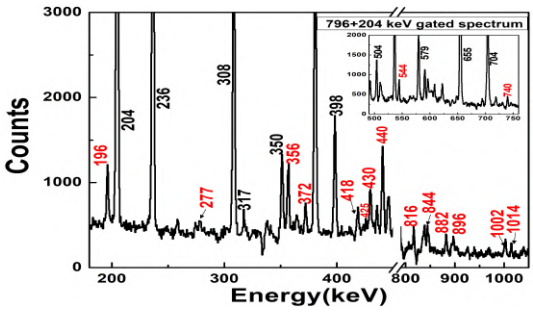

FIG. 1: Added gates corresponding to the decay of Band-4 of Ref. [4].

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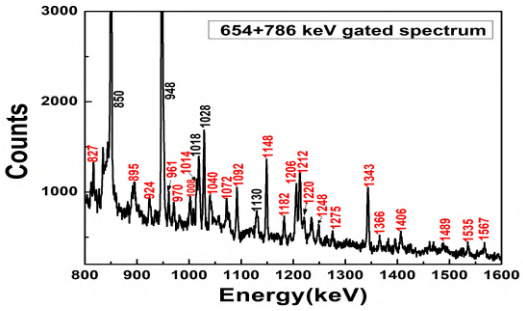

FIG. 2: Added gates corresponding to the decay of Band-4 of Ref. [3].

The existence of triaxial shape has been observed in several nuclei in this region as understood from observation of signature splitting, γ vibration, wobbling motion, chirality, etc.

The competition and combination of prolate and oblate shape was proposed with different multi-quasiparticle rotational bands in ^{125}I [3, 4]. Different multi-quasiparticle configurations in comparatively higher angular momentum states were reported in light and heavy ion studies. In a study, Chakraborty et al. [5] proposed γ-vibrational and chiral configuration in ^{125}I based on available experimental data. Therefore, ^{125}I is an interesting candidate to explore the different distinctive structural phenomena. In the present work, ^{125}I has been investigated with α-induced fu-

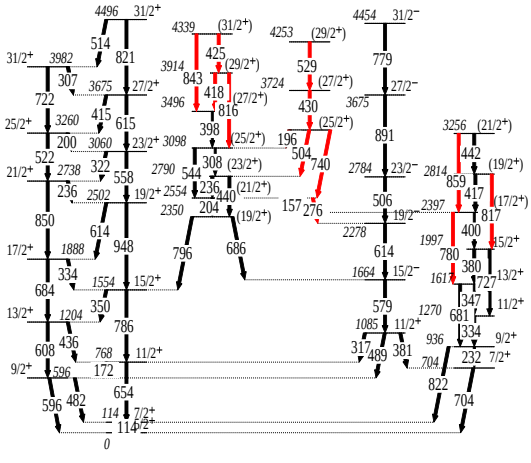

FIG. 3: Proposed level scheme of ^{125}I from the present analysis.

sion evaporation reaction data.

Experimental Details

^{125}I was populated through the ^{123}Sb(α,2nγ) reaction at $E_{\rm lab}$ = 30 MeV using the K-130 cyclotron at VECC, Kolkata. The emitted gamma rays were detected by a multi-detector array (INGA) of six Compton-suppressed clover detectors (4 at 90° and 2 at 55°) and one LEPS detector. Coincidence data were collected by using a digital data acquisition system.

Results and Discussion

The experimental data were sorted into symmetric and asymmetric γ–γ matrices to build up the level scheme. The data were analyzed using the program INGASORT [6] and RADWARE [7]. From our analysis, the earlier reported level scheme constructed with light ion data [4] has been confirmed.

We have observed a significant number of new γ transitions in ^{125}I in addition to our preliminary study [8]. Figures 1 and 2 show schematic representations of some newly observed gamma transitions in ^{125}I. The γ transitions have been placed in the level scheme (Fig. 3) based on coincidence relationships and relative intensities. Our primary motivation in this work is to study the multi-quasiparticle configuration in ^{125}I, and further study to confirm this is in progress. Directional correlation of oriented nuclei (DCO) and polarization measurement has been carried out using angle-dependent asymmetric matrices for a few excited states of this nucleus. Based on the calculated results, we have tentatively assigned the spin-parity of some levels.

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