Observation of the Unfavoured Signature Partner band in ^{81}Br

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Introduction

Nuclei within the *fpg* valence space have been the focus of extensive experimental exploration over the last two decades [1]. Several nuclear structure phenomena have been identified in these nuclei. These includes, significant signature splitting, band crossing associated with the pair of $g_{9/2}$ neutron alignment, the presence of a triaxial shape, and the variation of the triaxial parameter γ with increasing spin [1, 2]. In this context, we are reporting here the effects of quasiparticle alignments in the yrast positive-parity band structure built on the $\pi(g_{9/2})$ [3] excitation and the possible presence of unfavored partner band of the yrast favored band in ^{81}Br.

Experimental Details

The excited states in the low- and medium-spin regimes of ^{81}Br were populated using the ^{80}Se(α, p2n) fusion-evaporation reaction. The accelerated α beam was delivered by the K-130 cyclotron facility at VECC, Kolkata. The target comprising of enriched ^{80}Se isotope was prepared using sedimentation method. The deexciting γ rays were detected using INGA. The data were recorded using a 250-MHz, 12bit PIXIE-16 digitizer which operates on firmware conceptualized by UGC-DAE-CSR, Kolkata [4]. The off-line data sorting process was carried out using the Multi-DAQ-Compatible Data Sorting and Analysis Software Suite-BiNDAS [5]. The data were sorted into conventional $\gamma\gamma$ coincidence matrix for detailed off-line analysis.

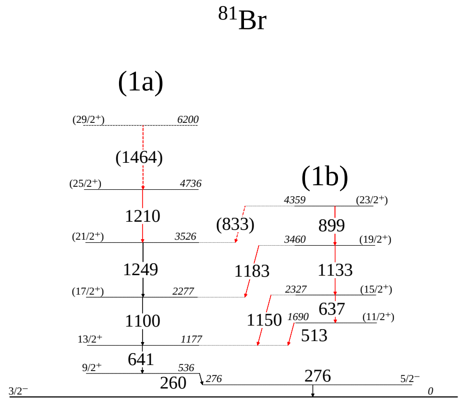

FIG. 1: Partial level scheme of ^{81}Br as obtained from the present work. The newly observed transitions are marked with red color.

Results and Discussion

A part of the level scheme of ^{81}Br as obtained from the present $\gamma\gamma$ coincidence analysis is shown in Fig. 1. A total of nine new transitions have been placed in the present level scheme. This lead to the extension of the level scheme up to $E_x \approx 6.2$ MeV. As can be seen in Fig. 1, the presented level scheme has been grouped under two heads (1a) and (1b).

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The yrast positive-parity band (see band-(1a)) built upon the isomeric $9/2^+$ state ($T_{\frac{1}{2}} = 37\mu s$) was known previously up to $E_x \approx 3.5$ MeV [3]. In the present work, the band has been extended up to $E_x = 6200$ keV with $J^\pi = (29/2^+)$ by placing two new γ rays having energies 1210 and 1464 keV that feed the $(21/2^+)$, 3526 keV, and $(25/2^+)$, 4736 keV levels, respectively. The newly observed sequence of levels having energies 1690-, 2327-, 3460-, and 4359-keV (see band-(1b)) are proposed to form the possible signature partner band of band-(1a). A representative $\gamma\gamma$ coincidence spectrum with energy gate set on 1100 keV transition of ^{81}Br is shown in Fig. 2. The placements of some of the new transitions are justified from Fig. 2.

Based on the extended level scheme derived from the present work, the kinematic moment of inertia ($J^{(1)}$), dynamic moment of inertia ($J^{(2)}$), and aligned momenta (i_x) have been calculated for band-(1a) at various rotational frequencies ($\hbar\omega$). The variations are illustrated in Fig. 3. For the sake of comparison, the variations are also shown for the yrast positive-parity band of the nearest isotope, ^{79}Br. As can be seen from Fig. 3 (b), a large enhancement in $J^{(2)}$ value occurs for both ^{79,81}Br at rotational frequency, $\hbar\omega = 0.60$ MeV. The large enhancement in $J^{(2)}$ value for ^{79}Br is attributed due to a pair of $\nu(g_{9/2})$ alignment with a weaker interaction between the crossing bands. The pronounced peak observed at $\hbar\omega = 0.60$ MeV in ^{81}Br is possibly due to the similar type of alignment occurring among the $\nu(g_{9/2})$ pair. This lead to the crossing of band above the 4736-keV, $(25/2^+)$ state in ^{81}Br. Further detailed characteristic features associated with the yrast positive-parity band (see band-(1a) in Fig. 1) and the newly proposed partner band (see band-(1b) in Fig. 1) will be presented during the conference.

Acknowledgement

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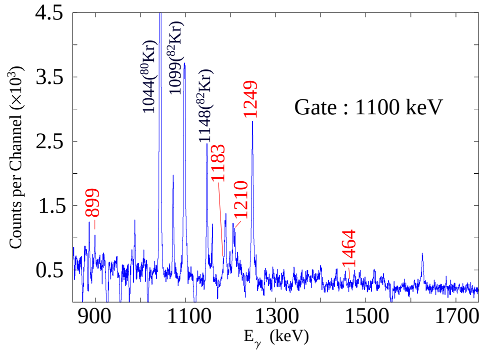

FIG. 2: Representative $\gamma\gamma$ coincidence spectrum with the energy gate set on 1100-keV $[(17/2^+) \to 13/2^+]$ transition. The peaks assigned to ^{81}Br are marked by red color.

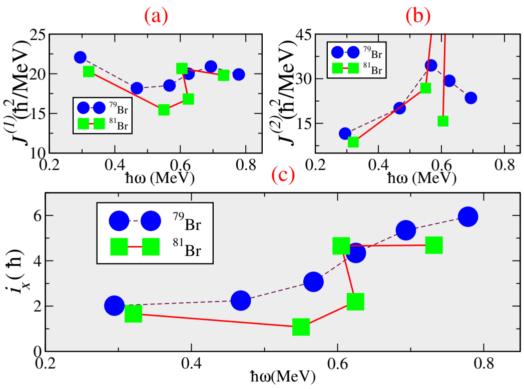

FIG. 3: The variation of (a) kinematic moment of inertia ($J^{(1)}$), (b) dynamic moment of inertia ($J^{(2)}$), (c) alignment of angular momenta (i_x) as a function of rotational frequency, $\hbar\omega$ for the yrast positive parity states of ^{79}Br and ^{81}Br. The Harris parameters used for calculation have been taken from Ref. [2].

References

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