High Spin Spectroscopy in ^{105}Cd

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Introduction

Nuclear spectroscopic studies in mass $\sim$ 100 region is of great interest in recent years. This is due to existence of various nuclear phenomena like band termination, shears mechanism, antimagnetic rotation and shape evolution from collective to non-collective structures or vice versa. These structures are attributed due to various coupling schemes between collective and single particle degrees of freedom. The nuclei in this mass region shows smaller deformation at low spins, evolving in to collective structure with increasing angular momentum. This behaviour is observed particularly in lighter odd-A Cd isotopes.

Several odd-A Cd isotopes with A = 103, 105, 107 [1, 2] have been studied in recent years and reported level schemes with spin and parities up to J^{π}= ($47/2^-$), ($47/2^-$), $51/2^+$, respectively. The yrast negative parity band structures of these isotopes were developed on vibrational excitations at low spins, which evolves in to a rotational structures and terminates at higher spins. These rotational structures are interpreted due to the alignment of $\nu h_{11/2}$ pair. Where as the positive parity bands are interpreted based on the configurations involving $\nu g_{7/2}$ and $\nu d_{7/2}$ orbitals. Although, the yrast negative parity bands in ^{103,105,107}Cd isotopes have been reported up to high spins, but still the high spin state information for positive and negative parity states in ^{105}Cd is limited. So the extension of these structures in ^{105}Cd to higher spins has been the subject of interest in the present work, which enable us to understand the interplay between single particle and collective degrees of freedom in this region.

Experimental Details

In the present experiment, high spin states in ^{105}Cd were populated using the fusion evaporation reaction ^{92}Mo(^{16}O, 2pn)^{105}Cd at an incident beam energy of 75 MeV. Beam of ^{16}O ions with current of 1 pnA was delivered by the 14UD Pelletron accelerator at TIFR, Mumbai. The target used in the experiment was of 1 mg/cm^2 thickness with 10 mg/cm^2 Au backing. The de-exciting γ- rays were detected by the Indian National Gamma Array (INGA) [3] facility at TIFR. During this experiment, INGA comprised of fifteen Compton suppressed clover Ge detectors, out of which, four were at 90°, two at 40°, two at 65°, two at 115°, two at 140°, and the remaining three were at 157° with respect to the beam direction.

Data Analysis and Results

The data were collected in list mode using a digital data acquisition system based on XIA Pixie-16 modules [4]. A total of more than two billion $\gamma - \gamma$ and higher fold coincidence events were recorded. The measured coincidence events were sorted in to $\gamma - \gamma$ matrix using TIFR marcos programs and cube using RADWARE [5] program. The offline data analysis were done using RADWARE for the construction of the level scheme. The multipolarity of the γ-transitions were assigned using the observed coincidence angular correlations. For this purpose an angle dependent matrix was constructed by taking energies of the γ-transitions from all the detector at

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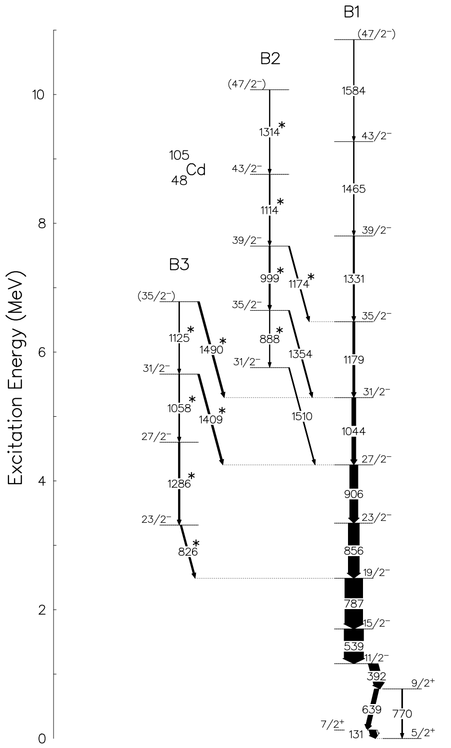

FIG. 1: Partial level scheme of ^{105}Cd. Transitions marked with (*) are newly identified ones in the present work.

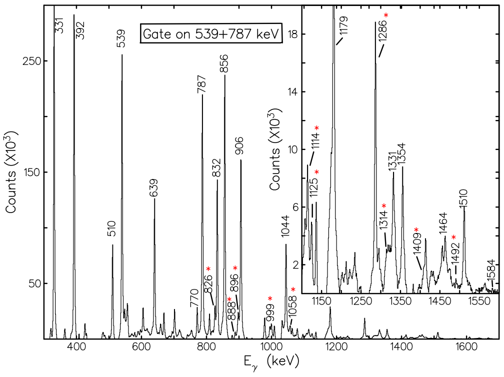

FIG. 2: Summed $\gamma-\gamma$ coincidence spectrum with gate on 539, 787 keV.

forward or backward angle on one axis and the coincidence γ-transitions from the rest of the detectors at 90° on other axis.

In the present work, the level scheme of ^{105}Cd has been verified with the previously established level scheme [2] and made several modifications in the positive and negative parity bands. Fig.1 shows the partial level scheme of ^{105}Cd with the newly identified negative parity band structures (band B1 and B2) deduced in the present work. A representative $\gamma-\gamma$ coincidence spectrum showing the transitions in negative parity bands B1, B2 and B3 in Fig.2. The negative parity side band (B2) has been extended to $J^\pi = (47/2^-)$ by adding four new transitions of energy 888, 999, 1114 and 1314 keV. One more negative parity band (B3) has been identified in the present work and extended to $J^\pi = (35/2^-)$ by adding three new transitions of energy 1286, 1058 and 1125 keV. In addition we have also identified series of dipole transitions connecting between band B1 to band B2 and B3. The positive parity band reported earlier in [2] has the highest observed transition 1292 keV which is decaying from J^π=27/2$^+$ to 23/2$^+$. Whereas in the present work, it is confirmed that 1292 keV is of dipole nature and not in coincidence with the 902, 1034 keV transitions in positive parity band. This positive parity band is extended to higher spins in the present work. The configurations of the observed band structures and the details of the modifications made in the level scheme will be discussed during symposium.

Acknowledgments

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