Study of high spin states and magnetic dipole band structure in odd-A ^{107}Cd

Deepika Choudhury[1], R.Palit[1], P. Singh[1], J. Sethi[1], S. Saha[1], S. Biswas[1], H.C. Jain[1], V. Nanal[1], R.G. Pillai[1], R. Dhonti[1], S.K. Jadav[1], B.S. Naidu[1], A.K. Jain[2], S.C. Pancholi[3], R.P. Singh[3], Rojeeta[4], Sukhjeet Singh[5], L. Chaturvedi[6], L.S. Danu[7], S. Mukhopadhyay[7], D.C. Biswas[7], and S. Tandel[8]

[1]*Department of Nuclear and Astrophysics, Tata Institute of Fundamental Research, Mumbai-400085, India*
[2]*Department of Physics,Indian Institute of Technology, Roorkee-247667, India*
[3]*Inter University Accelerator Center, New Delhi-110067, India*
[4]*University of Delhi, Delhi-110007, India*
[5]*Maharishi Markandeshwar University, Mullana, Ambala-133207, India*
[6]*Guru Ghasidas University, Bilaspur-495009, India*
[7]*Bhaba Atomic research Centre, Mumbai, India and*
[8]*Centre for Basic Sciences, Mumbai, India*

Introduction

For nuclei in 110 mass region, the low-Ω $h_{11/2}$, $g_{7/2}$, $d_{5/2}$ and high-Ω $g_{9/2}$ orbitals lie near the Fermi surface and play an active role in deciding the nuclear structure and property at various excitation energies. The observation of magnetic (MR) and antimagnetic (AMR) rotation bands, well understood in terms of shears mechanism [1] are eye catching. A regular patter of M1 transitions have been observed in even-even ^{106,108}Cd nuclei at spins 18 and 12 respectively, based on the $h_{11/2}$, $g_{7/2}$, $d_{5/2}$ and high-Ω $g_{9/2}$ neutron-proton orbitals [2, 3]. In ^{108}Cd isotope, crossing of the MR bands has also been observed. The odd-A ^{107}Cd nucleus is also expected to show up such band structure with the proton particles being excited to the $g_{7/2}$ orbitals. It would be interesting to search for and study the structure and properties of such band structure in this isotope. ^{107}Cd is situated in a transitional region between spherical and deformed nuclei. An earlier work on the high spin states was carried out by Jerrestam *et al.* [4] in 1992. Recently, the nucleus have also been shown to be having a pair of AMR bands at a higher deformation [5]. We also got some signature of a pair of partner bands based of a special kind of symmetry breaking [6] due to time-odd mean field, which needs to be confirmed. In the present work, we aim at further developing the level scheme of ^{107}Cd to high spin states so as to unfold the information about the various exciting properties of this nucleus, unobserved till date.

Experimental details

An experiment has been recently performed to populate the high spin states of ^{107}Cd nuclei by using the ^{94}Zr(^{16}O,5n) reaction at a beam energy of 90 MeV. The ^{16}O beam was provided by the TIFR-BARC Pelletron facility at TIFR, Mumbai. An isotopically enriched self supporting ^{94}Zr target of thickness 0.99 mg/cm^2 was used for the experiment. The de-exciting γ-rays were detected by using the Indian National Gamma Array (INGA) comprising of 20 Compton suppressed germanium clover detectors arranged in six rings (at 40°, 65°, 90°, 115°, 140° and 157°) with respect to the beam direction. A digital data acquisition (DDAQ) system based on Pixie-16 modules developed by XIA LLC [7] was used for collecting the in-beam data. Two and higher fold coincidence events were collected. The data collection was done in the list mode format.

Data Analysis and Results

Offline calibration and gainmatching was carried out using the DAMM analysis program. The 2-fold coincidence events, after

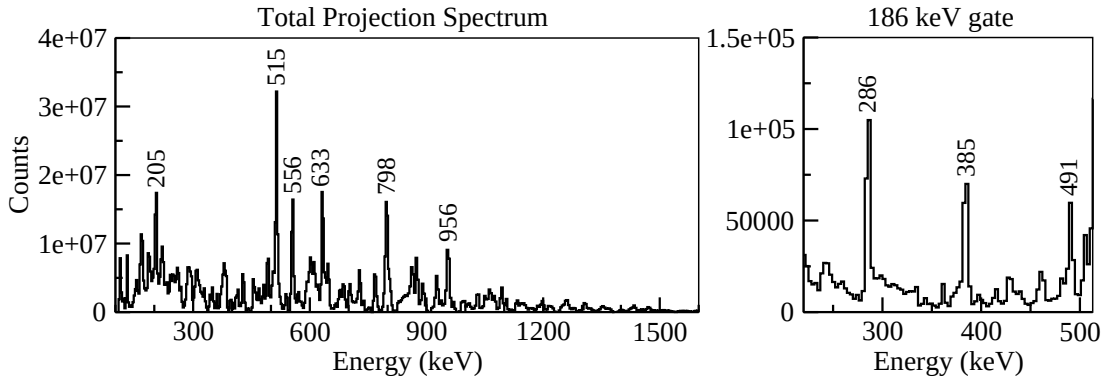

FIG. 1: Left panel: Total projection stectrum prepared from the $E_\gamma - E_\gamma - E_\gamma$ cube, Right panel: 186 keV gated spectrum showing the coincident $\Delta I = 1$ transitions.

proper doppler correction, were sorted into the traditional $4K \times 4K$ $E_\gamma - E_\gamma$ symmetric as well as angle dependent asymmetric matrices. The $E_\gamma - E_\gamma - E_\gamma$ cube is also prepared for coincidence analysis using the three fold coincidence events. The left panel of Fig. 1 shows the total projection spectrum of the cube. The analysis program RADWARE is used for coincidence analysis, DCO ratio and polarization measurements for the various transitions.

The earlier known level scheme [4] has been confirmed with few additions. Till now, four $\Delta I = 1$ transitions have been observed to be in coincidence with each other and decaying to the low spin negative parity band structure. These and the 186-, 286-, 385- and 491 keV transitions. The right panel of the Fig. 1 shows the 186 keV gated spectrum containing the 286-, 385-, and 491 keV peaks. There DCO ratios assign a dipole nature to these transitions. Their relative intensities place them in increasing order with constant dynamic moment of inertia. Further analysis is in progress to establish the complete band structure and investigate any crossing of the dipole bands. The tilted axis cranking calculations will be performed to understand the properties of the band structures. Many new transitions have been found and are being placed in the level scheme (analysis in progress). The detailed results will be presented. A complete study the structure of the ^{107}Cd nucleus at various high spin states is interesting as the nucleus seems to exhibit a variety of interesting properties.

Acknowledgments

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