Band Structures in ^{100}Pd

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Introduction

Investigations have revealed diversity in level structures resulting from coupling of the $g_{9/2}$, $d_{5/2}$, $g_{7/2}$, and $h_{11/2}$ valence nucleons and the core-excited configurations. The proton particle-hole excitations across the major shell gap are energetically possible due to the strong proton-pair correlations and proton-neutron interaction between the spin-orbit partner orbitals [1]. For the nuclei approaching Z = 50 from below, the proton Fermi surface lies near the oblate-driving high-Ω orbitals of the intruder $\pi g_{9/2}$ subshell. Strongly prolate-driving low-Ω $\nu h_{11/2}$ subshell orbitals are accessible at low excitation energies for the nuclei receding the N = 50 shell closure. The delicate interplay of strongly shape-driving $\pi g_{9/2}$ and $\nu h_{11/2}$ orbitals can influence the overall shape of the nucleus, and result in γ-soft (triaxial) shapes with modest deformation (ϵ_2) $\approx$ 0.15 [2].

The twin degenerate dipole bands with similar energy staggering have been reported in this mass region and explained with aplanar tilted rotation of the triaxial core along with the valence neutrons and protons aligned along the two extreme axes of the core. Band structures with the values and trends of dynamic moment of inertia and transition rates as a function of angular momentum have been observed to be different from those in case of the axial deformed nuclei, wherein rotational bands are known to exhibit nearly constant electric quadrupole transition rates. This led to various new phenomenon, namely, smooth band termination (ST), magnetic rotation (MR) [3] and antimagnetic rotation (AMR) [4].

Experimental details

Band structures in the ^{100}Pd nucleus were populated in the ^{75}As(^{31}P, 2p4n)^{100}Pd and ^{75}As(^{28}Si, p2n)^{100}Pd fusion-evaporation reactions at E_{lab}= 125 MeV and =120 MeV, at TIFR, Mumbai and IUAC, New delhi, respectively. The de-excitations were investigated through in-beam gamma-ray spectroscopic techniques. The ^{31}P beam was provided by the Pelletron-LINAC facility at TIFR, Mumbai. The ^{75}As target of thickness 2.8 mg/cm^2 was prepared by vacuum evaporation and rolled onto a 10 mg/cm^2 thick Pb backing. The recoiling nuclei in the excited states were stopped within the target and the de-exciting gamma-rays were detected using the Indian National Gamma Array (INGA) consisting of 21 Compton suppressed clover detectors. Two and higher fold clover coincidence events were recorded in a fast digital data aquisition system based on Pixie-16 modules of XIA LLC [5]. The data sorting routine "Multi pARameter time stamped based COincidence Search program (MARCOS)", developed at TIFR, sorts the time stamped data to generate E_γ-E_γ matrices and E_γ-E_γ-E_γ cubes compatible with Radware format. The ^{28}Si beam was provided by the Pelletron-LINAC facility at IUAC, Delhi. The ^{75}As target of thickness 3 mg/cm^2 was prepared by vacuum evaporation and rolled onto a 10 mg/cm^2 thick Pb backing. The recoiling nuclei in the excited states were stopped within the target and the de-exciting gamma-rays were detected using the Indian National Gamma Array (INGA) consisting of 18 Compton suppressed clover detectors.

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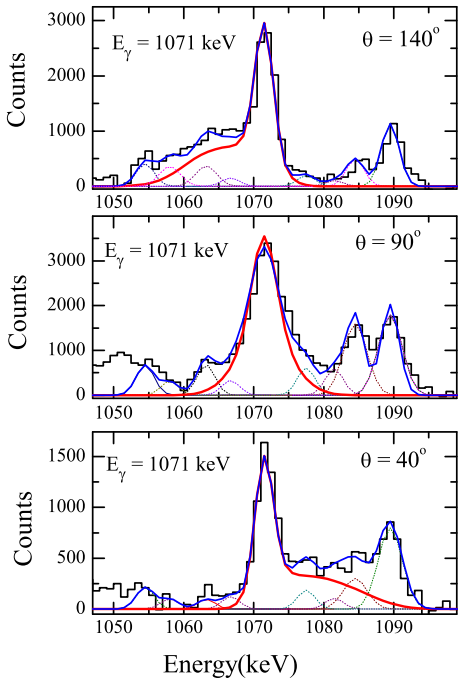

FIG. 1: The lineshape fits for the 1071 keV transition at various angles w.r.t, the incident beam direction.

Discussion

The present level scheme of ^{100}Pd is built on the I = 0^+ ground state. The level scheme has been extended substantially with addition of many new transitions to the earlier reported ones [6, 7]. The level scheme is established up to $\sim$ 17 MeV excitation energy. Previously reported levels in positive parity band[6] are differ from the work reported by the Zhu et al., [7]. Earlier observed band consisting of 276-, 633-, 298-, 374-, 466,1167-, and 466-, keV transitions has been observed. The states of this band decay to yrast band by various γ rays that have been observed in the present work. The yrast band is extented at the top. In the earlier work the negative parity band has been reported as AMR band [7]. The DSAM lifetime measurements [8] are in process to investigate the possible AMR character. The example of lineshape of 1071- keV transition from the present work is shown in spectrum [Fig. 1]. The results related to AMR character will be presented.

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