Structure of positive parity bands in odd-odd ^{108}Ag

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Introduction

Nuclei in the transitional A $\sim$ 110 region near the Z = 50 shell closure are known to exhibit a variety of phenomena like magnetic rotation, anti-magnetic rotation, chiral rotation and collective behavior as well. In this mass region the alignment of the high-Ω $g_{9/2}$ proton hole and low-Ω $h_{11/2}$ neutron particle gives rise to a magnetic rotation (MR) band. The proton and neutron angular momenta are almost perpendicular to each other at the band head. Gradually, the step by step alignment of the proton and neutron angular momenta generates higher spin states of the MR band. Such bands are very well established in this mass region in various isotopes of Rh, Ag, Cd, Sn, In, *etc.* For odd-odd ^{108,110,112}In isotopes, magnetic rotation bands based on a 4 quasi-particle configuration $\pi g_{9/2} \otimes \nu(h_{11/2})^2(g_{7/2}/d_{5/2})$ are established [1]. A similar band structure in ^{108}Ag is under investigation. The present work provides significant new information on the spectroscopic levels of the positive parity bands in ^{108}Ag nucleus. The comparison of the experimental data of high spin states of a ΔI = 1 band with Tilted Axis Cranking (TAC) model calculations suggests its origin is due to magnetic rotation.

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Experimental Details

High spin states of the doubly odd ^{108}Ag nucleus were populated using ^{94}Zr(^{18}O, p3n) reaction at a beam energy of 72 MeV. The ^{18}O was provided by TIFR-BARC Pelletron LINAC facility at Mumbai. The target consisted of 0.9 mg/cm^2 thick ^{94}Zr backed with a ^{197}Au foil of thickness 10 mg/cm^2. The emitted γ-rays from the excited states of the populated nuclei were detected using the Indian National Gamma Array (INGA) consisting of 20 Compton suppressed clover detectors. Two- and higher-fold clover coincidence events were recorded in a fast digital data acquisition system based on Pixie-16 modules of XIA LLC [2], which were sorted to generate $E_\gamma - E_\gamma$ matrices and $E_\gamma - E_\gamma - E_\gamma$ cube.

Results and Discussion

Based on the $E_\gamma - E_\gamma$ matrix and $E_\gamma - E_\gamma - E_\gamma$ cube analysis, the full level scheme of the ^{108}Ag nucleus has been established and extended substantially with the addition of 60 new transitions and a few changes in the earlier reported work [3] have been made. The spins and parities of the levels were assigned by using the directional correlation of oriented nuclei (DCO) ratio analysis followed by the linear polarization measurements. A pair of nearly degenerate negative parity bands have been established. Also, the linking transitions to the yrast band from the nearly degenerate partner band have also been identified. These bands have been studied using the microscopic

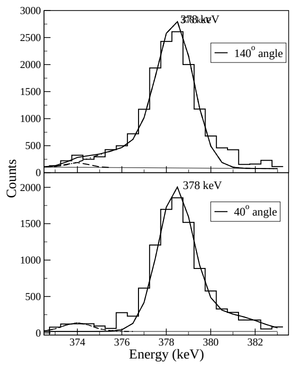

FIG. 1: Lineshape fit of 378-keV transition (Top) at 140° and (Bottom) at 40° *w.r.t* beam axis, gated on 322-keV transition.

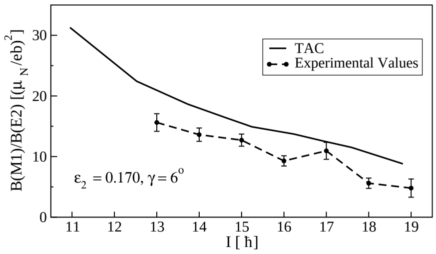

FIG. 2: Variation of B(M1)/B(E2) ratios with spin for experimental data (solid circles) and TAC calculated values (solid line).

Triaxial Projected Shell Model (TPSM) which reveals that these bands have different quasi-particle configurations [4].

Two positive parity dipole bands have also been observed. One of these bands is a completely new structure. Another positive parity has been extended in spin up to $19\hbar$, which is the main focus of the presented work. Lifetimes of the high spin states of this band are being determined using the Doppler Shift Attenuation Method (DSAM). Doppler broadened lineshapes were obtained from the background subtracted spectra projected from the angle dependent matrices with events in detectors at 157°, 140°, 90° or 40° on one axis and coincident events in rest of the detectors on the other axis. LINESHAPE program by J.C. Wells was used to fit the lineshapes of various transitions. For this band lineshapes have been observed for 5 transitions 322-, 378-, 440-, 485- and 542-keV. The preliminary fitting of the lineshape of 378-keV transition, with a gate on 233-keV, at backward 140° angle and forward 40° angle is shown in Fig.1.

The experimentally obtained transition strength ratios were compared to the Tilted Axis Cranking (TAC) calculations, shown in Fig. 2. The TAC calculation very well reproduces the trend of B(M1)/B(E2) ratios. A four quasi-particle configuration $\pi g_{9/2} \otimes \nu(h_{11/2})^2(g_{7/2})$ is used in the TAC calculation for the above mentioned ΔI = 1 band. The value of the deformation parameters $\epsilon = 0.170$, $\gamma = 6°$ is chosen by minimization of the total energy of the nucleus in the intrinsic frame.

In conclusion, the level scheme of ^{108}Ag has been established. Spins and parities of the levels have been assigned. The positive parity dipole band has been studied using TAC. The experimental transition strength ratios are in conformity with the TAC calculated values. Detailed line shape analysis is in progress to obtain the B(M1) strengths for the Δ I =1 band. A good agreement of the experimental data with the TAC calculation hints at the possible presence of shears mechanism in this nucleus.

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