Staircase bands in odd-odd Ag isotopes: ^{107}Ag a case study

P. Datta[1],* Niyaz Rather[2], Santosh Roy[2], S. Chattopadhyay[2],
A. Goswami[2], S. Nag[3], R. Palit[4], S. Saha[4], and T. Trevadi[4]
[1]*Ananda Mohan College, Kolkata-700009, India.*
[2]*High Energy Nuclear and Particle Physics Division,SINP Kolkata-700064, India*
[3]*IIT Kharagpur, West Bengal, India and*
[4]*Tata Institute of Fundamental Research, Mumbai-400005, India*

Nuclei near Z=50 shell closer display various facets of tilted axis rotation (TAR) as predicted both from mean field tilted axis cranking results (TAC) as well as more intuitive, geometrical model approach, popularly known as Shears mechanism. These include pure TAC features such as the observation of Chiral bands, Anti-magnetic rotation and Magnetic Rotation (MR). These excitations are predominantly generated by the valance neutrons in low-Ω orbitals of $h_{11/2}$ and the valance protons in high-Ω orbitals of $g_{9/2}$. In contrary to the common notion of MR, significant core rotation were reported in these nuclei which were attributed to the neutron occupation in shape driving $h_{11/2}$ orbital. However, the interplay/competition between the core rotation (Principal axis rotation (PAR)) and the tilted angular momentum generated by the Shears structure, exhibit variety of phenomena already observed by our group in Ag [1, 2] and Cd [3] isotopes. It is to be noted that the relatively small level densities near the Fermi levels for both neutron and proton sector in mass-100 region allow us to study such subtle effects which otherwise are not reported in any other mass region.

The +ve parity bands of the odd-A Ag isotopes (^{105,107,109}Ag) are especially interesting in this context as the single particle configuration becomes favourable for TAR in these bands ($\pi g^1_{9/2} \otimes \nu h^2_{11/2}$) with the neutron alignment in $h_{11/2}$ orbital. The ground state +ve parity bands in these isotopes show strong signature splitting. In ^{109}Ag, it has been explained as the manifestation of significant triaxial deformation of the deformed core. However, with the onset of the neutron alignment, the signature splitting disappears and a relatively smoother band has been observed which de-excites by strong M1 transitions. It is interesting to note that the well known energy staggering plot (E(I) -E(I-1)) for these bands resembles more like staircase type graph. This characteristic is neither a finger print of collective rotation (PAR) nor MR, in stead indicating a mechanism which is an admixture of both. This behavior was first investigated in ^{109}Ag [2]. The comparison between the experimentally measured transition rates and the prediction of Projected Shell model calculation suggested a sudden change from PAR

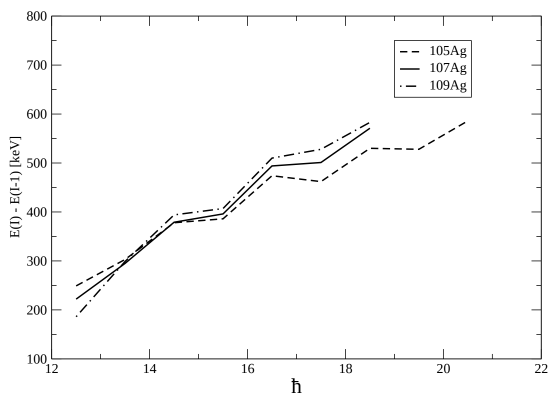

FIG. 1: Staircase plot (E(I)-E(I-1)) plot for aligned +ve parity band of ^{107}Ag.

*Electronic address: pdatta.ehp@gmail.com

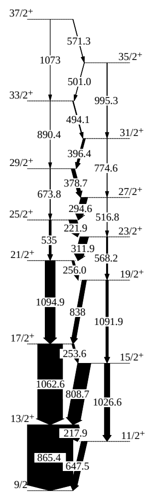

FIG. 2: Positive parity yrast band of ^{107}Ag.

to TAR. It is, however, not well understood whether this observed enhancement in B(M1) rates and its slow fall are the manifestations of under lying MR, t-band [4] or tunneling effect [1] between stable TAR and PAR minima. In the present work, the answer to this question has been searched in ^{107}Ag.

^{107}Ag were populated through the ^{100}Mo (^{11}B, 4n) reaction using the 14UD TIFR-BARC Pelletron Accelerator at TIFR, Mumbai. The 39 MeV ^{11}B beam bombarded an enriched thick target of thickness 9.9 mg/cm^2 of ^{100}Mo which is sufficient to stop the recoiling nuclei. The γ-rays were detected in the upgraded INGA spectrometer [5], which consisted of 18 Compton suppressed Clover detectors arranged in six rings at 40°, 65°, 90°, 115°, 140° and 157° with respect to the beam direction.

The coincidence data has been arranged in a symmetrized matrix and in a cube to build the level scheme as shown in fig. 2. The spins and the parities of excited levels has been measured from DCO and PDCO ratios, respectively. It is to be that the low spin levels are consistent with the previously known level scheme [6]. The level lifetimes measurements of this band using DSAM is currently being pursued. Theoretical calculation based on the Shears model (semi-classical approach) + core rotation [3] is also under development. The results of the theoretical calculation along with the lifetime measurements data will be presented.

The authors would like to thank all the technical staff of the TIFR-BARC Pelletron facility at TIFR, Mumbai for smooth operation of the machine. P. Datta was supported by the University Grants Commission, India through grant number PSW-026/11-12.

References

[1] P. Datta *et al.*, Phys. Rev. C **67**, 014325 (2003)

[2] P. Datta *et al.*, Phys. Rev. C **78** 021306 (2008)

[3] Santosh Roy *et al.*, Phys. Lett. **B 694** 322 (2011)

[4] P. M. Walker *et al.*, Phys. Rev. Lett. **67**, 433 (1991)

[5] S. Muralithar *et al.*, Nucl. Instrum. Methods A **622** 281 (2010)

[6] D. Jerrestam *et al.*, Nucl. Phys. A **577** 786 (1994)