Evidence of antimagnetic rotational band in ^{82}Kr

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Introduction

Band-like structures in weakly deformed nuclei characterized by decreasing $B(E2)$ values with increasing spin has been visualized as a new form of quantized rotation, known as antimagnetic rotation (AMR) and has been interpreted in the framework of a shears mechanism [1]. In this description the angular momentum is generated by the closing of the two blades of conjugate shears, produced by the valence particles (holes). These valence particles (holes) are initially aligned in time reversed orbits at the bandhead. There is no net perpendicular component of the magnetic dipole moment for this configuration and it is symmetric with respect to a rotation by π about the total angular momentum axis (rotational axis). The resulting quadrupole transition strength will decrease with the increase in spin along the band due to the gradual closing of the angular momentum blades.

The AMR bands have been interpreted in the framework of a simple geometric model and as well as in the fully self-consistent microscopic tilted axis cranking method based on covariant density functional theory [1]. The observation of a conjugate shear structure responsible for the generation of angular momentum in near spherical systems in the form of AMR in the form of double shear structure have been found in mass regions viz. A $\sim$ 100 and 140 mass regions. But, it is expected to observe the double shear structure in the A $\sim$ 80, 100, 140 and 190 mass regions where firm experimental evidence of the single shear structure has been reported [2] since both of the shear structures (single and double shear structure) are the consequence of the shears mechanism.

It is noteworthy that the configurations of the AMR bands, in the Pd, Cd, and Eu nuclei, observed until today have different orbitals for valence protons and neutrons. The possible candidate of the AMR band, identified on the basis of theoretical arguments, in the ^{144}Dy nucleus is the only instance of the band originating from the valence protons and neutrons in the same orbital. However, due to the absence of lifetime data, the nature of the excitation mechanism for this band cannot be firmly established as AMR.

The weakly deformed nuclei the A $\sim$ 80 mass region are the ideal candidate of observ-

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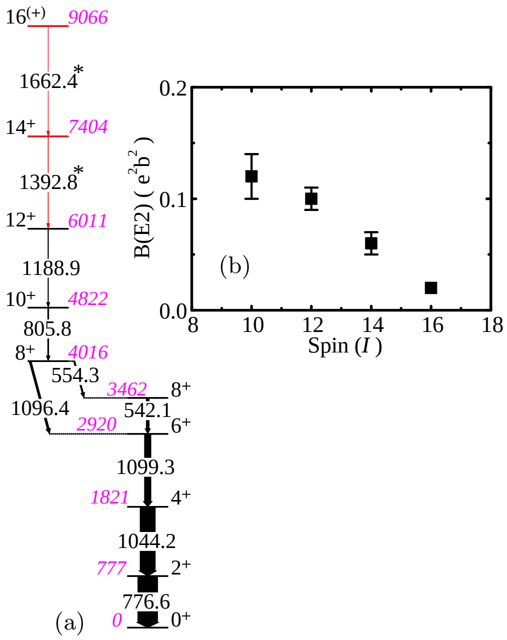

FIG. 1: (a) Level structure of ^{82}Kr obtained from the present experiment. The red coloured transitions, marked by an asterisk, are newly observed γ-ray transitions. (b) B(E2) values against spin of the states.

ing the AMR band originating from the valence $g_{9/2}$ protons and $g_{9/2}$ neutrons. Present work narrates a quest of such an AMR band in ^{82}Kr.

Results and Discussions

High spin states of ^{82}Kr were populated using ^{76}Ge(^{9}Be,3n) reaction at $E_{lab} \sim 31$ MeV. The target was 4.2 mg/cm^2 ^{76}Ge (99% enriched) on a 10.8 mg/cm^2 thick lead backing. The latter was positioned to face the beam, before the target, so as to degrade the beam energy from $E_{lab} = 37$ MeV to the aforementioned value. The de-exciting γ-ray transitions were detected by the Indian National Gamma Array (INGA) which was consisted of fourteen Compton-suppressed clover detectors at the time of experiment.

The structure of interest obtained from the present work is shown in Fig. 1(a). Two new levels are added to the previously observed structure by Kemnitz *et al.* [3]. Level lifetimes of the states have been determined by analyzing the Doppler-broadened lineshape of the γ-rays using the Doppler Shift Attenuation Method (DSAM) and a combination of developments reported in Ref. [4]. The uncertainties on the lifetimes, derived from the χ^2-minimization analysis, do not include the systematic contribution of the stopping powers from the SRIM database that was expected to be $\sim$ 5%.

The measured B(E2) values show decreasing trend with spin which is a characteristic signature of the AMR band (Fig. 1(b)). The ratio $J^{(2)}/B(E2)$ increases sharply along the band. Thus it may be concluded that the AMR band exists in ^{82}Kr. The detailed calculations will be present to fathom the intrinsic stucture of this band at this spin region.

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