Observation of triaxial deformation in ^{110}Ag isotopes

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The gs-bands of odd-odd Ag isotopes exhibit an interesting behavior. The lighter isotopes, namely ^{104,106}Ag do not exhibit signature splitting although the neutron Fermi Level is close to the $(1/2)^-$ orbital for the negative parity gs-band. However, ^{110}Ag exhibit clear signature splitting and an inversion at $I = 13\hbar$ and the neutron Fermi Level is close to $(3/2)^-$ orbital. This is in contradiction to the general understanding of the origin of signature splitting. The experimental data on Ag has been reported[1].

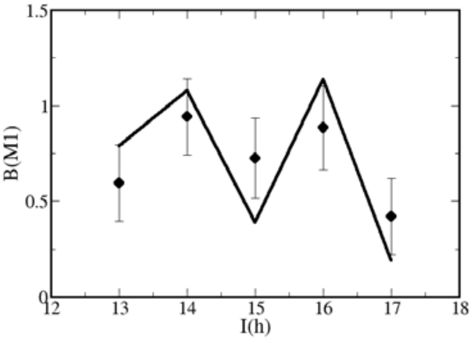

Fig. 1. B(M1) transition rates vs. I in ^{110}Ag. The dot represents the experimental data and the solid line shows the theoretical values calculated using PRM.

In order to investigate this interesting observation, the transition rates of the high spin levels of ^{110}Ag have been measured using the Doppler Shift Attenuation Method (DSAM). In the present work, the line shapes were observed above $I=13^-$ level. The lifetime of these levels were estimated by using the LINESHAPE analysis code of Wells and Johnson [2]. The energies of γ-transitions and the side feeding intensities were used as input parameters for the lineshape analysis. The side feeding intensities were estimated from the intensity profile obtained from the gated spectra at 90°. The effective lifetime for the observed top most level 18^- was estimated by assuming 100% side feed. For 17^- level, the effective lifetime of the 18^- level and the side feeding lifetime were considered as effective parameter.

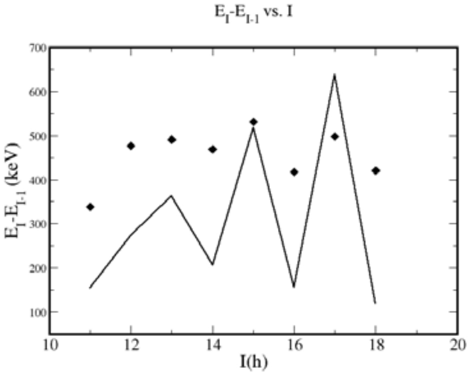

Fig. 2. $(E_I - E_{I-1})$vs. I in ^{110}Ag. The dot represents the experimental data and the solid line shows the theoretical values calculated using PRM.

In this way, each lower five levels have been added one by one. Fig.1 shows the B(M1) values which have been estimated from the measured level lifetimes. The average B(E2) for these levels has been found to be 0.18(eb)^2. This corresponds to a quadrupole deformation of 0.20.

It is evident from Fig.1. that the B(M1) values exhibit the characteristic staggering of a decoupled band. Thus, we have carried out Particle Rotor Model (PRM) [3] calculations in order to explain the observed staggering in level energies and B(M1) rates in ^{110}Ag.

In this calculation, the proton $g_{9/2}$ and neutron $h_{11/2}$ orbital have been considered and the Fermi Levels have been obtained by solving the BCS equation.

It has been found that the observed energy and B(M1) staggering can only be reproduced if a triaxial core is assumed with a quadrupole deformation of 0.20.

Fig.2. show the observed (dots) and the calculated (line) values for observed energy staggering in ^{110}Ag. The solid line in Fig.1. show the calculated B(M1) values. It is observed from Fig 1. and 2. that the staggering in both energy and B(M1) rates have been well reproduced by the PRM calculation. However, it is to be noted that the signature inversion at $I=13^-$ has not been reproduced.

In these calculations the triaxiality parameter (γ) has been assumed to be -40^o. It is to be noted that this value is consistent with the TRS calculations.

Thus, the present work seems to indicate that the observed staggering in energy and B(M1) rates in ^{110}Ag is due to a deformed triaxial core.

References

[1] S. Roy *et al.,* DAE-BRNS Symp. on Nuclear Phys. **53** p. 233 (2008).
[2] J.C. Wells and N.R. Johnson (private communication).
[3] S.E. Larsson, G. Leander and I. Ragnarsson, Nucl. Phys. A307, 189 (1978).