From Chirality to nearly degenerate bands: Context of ^{106}Ag

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In the last decade, a number of nearly degenerate pairs of bands with same parity have been reported in nuclei of mass A∼130 and A∼100 regions. These bands are strongly connected to each other. It has been proposed that a possible reason for the occurrence of these doublet bands is spontaneous breaking of chiral symmetry in triaxial nuclei due to the presence of three orthogonal angular momenta of the valence protons, valence neutrons and the core. However, for the two bands to be chiral partners, the near degeneracy in level energy and spin is a necessary but not a sufficient condition. In addition, these bands should exhibit nearly similar moment of inertia, quasi-particle alignment, signature staggering behaviour and, more importantly, the transition probabilities. The importance of the transition probabilities established in ^{134}Pr and ^{104}Rh which show the closest degeneracy in energy in the observed doublet bands over a wide angular momentum domain. However, in both cases the quasi-particle alignment behaviour has been found to be different indicating different shapes associated with the two bands. Later, this has been supported by dissimilar behaviour of the measured B(E2) rates in the two bands of ^{134}Pr. While such observation rules out the possibility of static chirality, these bands were proposed to be a manifestation of fluctuation between chiral and achiral configurations. In recent times, an alternate view on the origin of doublet bands has emerged based on the framework of the tilted axis cranking model complemented by the random phase approximation (RPA). It attributes the energy difference between the two bands near the band head as a signature of chiral vibration which got damped with increasing angular momentum and, thus, leads to the static chirality. This situation has been realized in ^{128}Cs and ^{135}Nd where the transition rates for the doublet bands were found to be similar and may indicate the onset of chiral rotation at high spins. This observation is crucial for the doublet bands in mass 100 region specially for odd-odd Ag isotopes which are known to be γ-soft and, hence, the possibility of a shape transformation due to the chiral vibrations exist. In this case, the shape corresponding to the main band can be quite different from its partner band. The experimental data on the doublet bands in ^{106}Ag has been interpreted in this way which is supported by total routhian surface calculations. This picture gives an intuitive explanation for the existence of doublet bands with different moments of inertia and quasi-particle alignment behaviour. Recently, electromagnetic transition rates in these two bands have been measured by our group. It is interesting to note that the rates were found to be similar and, hence, a new class of doublet bands emerge having similar transition rate but differ in moment of inertia and alignment behaviour. In this presentation, we shall present the experimental data and discuss the possible origin of such doublet bands in mass 100 region using microscopic triaxial projected shell model.

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