Search for chiral partner bands in ^{98}Tc

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Introduction

Chirality in nuclei was first predicted in the year 1997 by Frauendorf and Meng [1]. Since then to prove experimentally the existence of this phenomenon and for a detailed understanding of it, there has been a lot of interest and excitement in this field of research. Its importance lies in the fact that static chirality is a unique signature for the occurrence of stable triaxial nuclear shapes. Candidate chiral doublet bands have been observed in a number of nuclei in the mass $A \sim 130$, ~ 100 and in some nuclei in ~ 188 regions. These are based on unique parity high-j particle-hole nucleon configurations.

In the mass $A \sim 100$ region, such bands have been found in several of the odd-odd and odd-A Rh,Tc and Ag nuclei [2, 3]. For a deeper understanding of the phenomenon of chirality, it is important to map out the $A \sim 100$ region to search for signatures of this phenomenon. Therefore, the aim of the present experiment is to look for possible chiral candidate doublet bands in ^{98}Tc (Z=43, N=55). We performed the Total Routhian Surface calculations for the negative parity band based on the $\pi g_{9/2}^{-1} \otimes \nu h_{11/2}$ configuration in ^{98}Tc at rotational frequencies of $\hbar\omega$ = 0.1, 0.2, 0.3 and 0.4 MeV. The results of the TRS calculations are shown in Fig. 1. Minima at $\beta_2 \sim 0.2$ and $\gamma \sim$ -29^0-27^0 are obtained depicting triaxial shape for the nucleus. These results encouraged us to perform this experiment. Taking advantage of the high coincidence detection efficiency of the INGA, we expect to extend the existing band in ^{98}Tc to higher spins and at the same time will search for the candidate chiral doublet partner band based on the above mentioned configuration.

Experimental Details

High spin states in the odd-Z ^{98}Tc nucleus were populated using the ^{94}Zr(^{7}Li, 3n)^{98}Tc reaction at an incident beam energy of 32 MeV. The ^{7}Li beam was delivered by the 15-UD Pelletron accelerator at Inter University Accelerator Centre (IUAC), New Delhi. The de-exciting γ-rays were detected utilizing the Indian National Gamma Array (INGA) which at the time of the experiment comprised of 15 Compton suppressed Clover detectors. The Clover detectors were arranged in five rings *viz.* 32^0, 57^0, 90^0, 123^0 and 148^0 with respect to the beam direction. The total coverage of Ge crystals is about 25% of 4π corresponding to a total photopeak efficiency of $\sim$ 5%. The distance between the target and the detector is $\sim$24 cm. The isotopically enriched ^{94}Zr self

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supporting target was $\sim$ 4.4 mg/cm^2 thick. The data were collected in the list mode using the CAMAC-based MULTI-CRATE syncronization mode coupled with PC-LINUX enviornment. The energy and timing information from the clover detectors were processed using the indeginously developed (at IUAC) Clover modules and ADC's. A total of about 850 million two or higher fold coincidences were recorded.

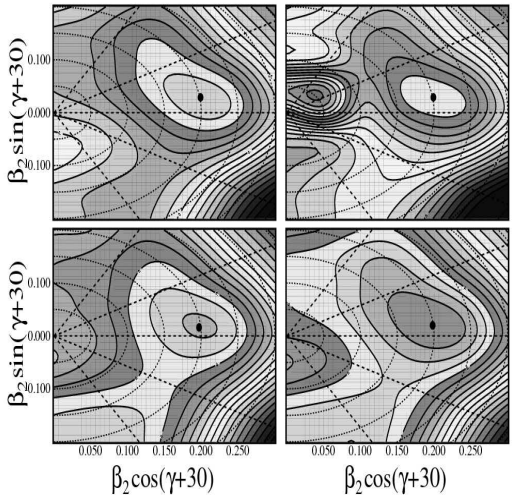

FIG. 1: TRS calculations for ^{98}Tc for four rotational frequencies, *viz.* $\hbar\omega$=0.1, 0.2, 0.3 and 0.4 referred to upper-left, lower-left, upper-right and lower-right panels respectively.

Data analysis and results

The data analysis is underway using the programs INGASORT & CANDLE. The coincidence events were sorted into the conventional $\gamma - \gamma$ symmetric as well as asymmetric matrices. The 4k $\times$ 4k matrices had an energy dispersion of 0.5 keV/channel. From the preliminary analysis we confirmed the reported [4] level structure of ^{98}Tc. We hope to get new information, especially on the chiral partner -ve parity band, if present and on the interconnecting transitions between the two bands. A representative γ-ray spectrum of gated sum of 373, 452, 721 and 826 keV transitions of the positive parity band of ^{98}Tc is illustrated in

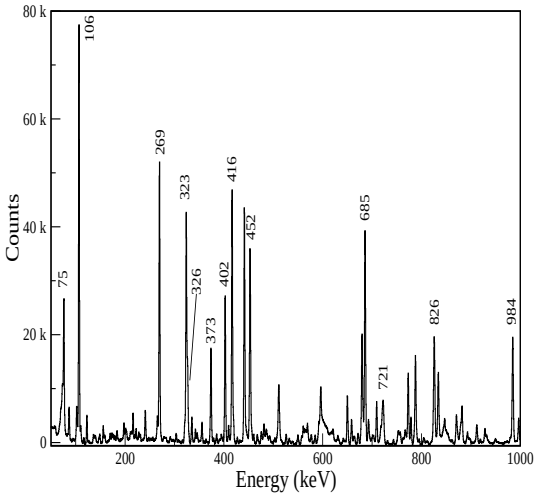

FIG. 2: Gated sum of spectrum of 373, 452, 721 and 826 keV transitions of the positive parity band in ^{98}Tc.

Fig. 2. The peaks marked in Fig. 2 are the in-band and decay out transitions of the positive parity band in ^{98}Tc.

The observed level structure in reference to chiral partner bands would be reported during the presentation.

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