Nuclear Structure in ^{98}Tc: Linear Polarization and DCO ratio measurements

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Introduction

Chirality is a direct consequence of the perpendicular coupling of angular momentum vectors from the odd proton and neutron occupying high-j particle-like and high-j hole-like orbitals, which lie along the short and long axes, respectively, and the triaxial core rotation vector which is oriented along the intermediate axis [1]. Theoretically this gives rise to two nearly degenerate $\Delta I = 1$ bands in the laboratory frame, which is one of the key signatures for the formation of chiral geometry in the nuclear intrinsic frame. Evidence for a new region of chirality around mass 104 has recently been found in the odd-odd isotopes ^{102,106}Rh [2] and also in the odd-A neighbour ^{105}Rh [3]. The work on the investigation of the level scheme of ^{98}Tc was reported earlier [4] in which the candidate chiral partner bands were found for the first time. To facilitate the spins and parity assignment of levels, the present work describes the measurement of linear polarisation and DCO ratios for the $\gamma-$ray transitions in this nucleus.

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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. An isotopically enriched ^{94}Zr targat of thickness $\sim$ 4.4. mg/cm^2 was used. 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.

Data Analysis and Results

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.

The multipolarity of the γ - transitions were assigned using the observed coincidence angular correlations. The details of this procedure are given in Stephens *et. al.* [5]. Fig. 1 depicts the R_{DCO} values of a number of $\Delta J = 2$ and $\Delta J = 1$ transitions in ^{98}Tc. R$_{DCO}$ value $\sim$ 1 are for a stretched dipole (quadrupole) transitions when the gating transition is also a stretched diple (quadrupole) transition, whereas the value is $\sim$ 0.5 (or $\sim$ 1.85) for a stretched quadrupole (dipole) transition if the gating transition is a stretched dipole (quadrupole) transition.

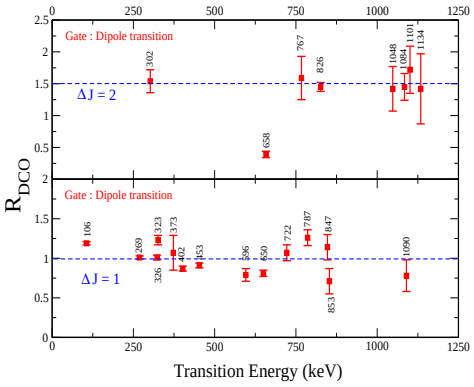

FIG. 1: R_{DCO} for a number of γ - ray transitions in ^{98}Tc.

Besides the R_{DCO} ratios, that we did also linear polarization measurements for some of the transitions of ^{98}Tc were performed using the integrated polarization directional correlation from oriented nuclei (IPDCO) method [6].

The asymmetry factor (Δ) for some of the transitions for ^{98}Tc is shown in Fig. 2. The correction factor 'a' in this relation is a measure of any asymmetry in the response of the perpendicular and the parallel detectors and was obtained from radioactive source data (^{152}Eu). It is defined as

$$a = \frac{N_{\parallel}(unpolarized)}{N_{\perp}(unpolarized)} \qquad (1)$$

Detailed analysis procedure are described in ref.[6]. DCO measurements along with polarization analysis confirms the electromagnetic nature of some of the gamma transitions of ^{98}Tc.

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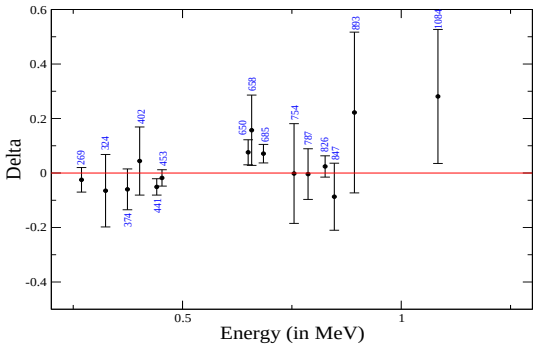

FIG. 2: Asymmetry parameter (Δ) for different transitions for ^{98}Tc.

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