Octupole correlation in ^{114}Te

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I. INTRODUCTION

The diversity of structure in neutron-deficient transitional nuclei with $A \approx 115$ $(52 \leq Z \leq 56)$ has attracted much attention in recent years, as they show variety of structural phenomena, such as, octupole correlation, shape coexistence, γ-vibration and many more due to the alignment of proton and/or neutron in intruder $h_{11/2}$ orbitals [1]. In particular, octupole correlation arises when nucleons near the Fermi surface occupies opposite parity orbitals with $\Delta j = \Delta l = 3$. This effect is most prominent in nuclei having $N, Z = 34,\ 56,\ 88,\ 136$. This mode of excitation will result in a separation between centre of charge and centre of mass of the nucleus, thereby leading to the observation of alternating parity bands, which are connected by strong $E1$ transitions [2]. Recently, the octupole correlation has been explored in ^{123}Ba and ^{72}Se on the basis of $B(E1)/B(E2)$ ratio and the magnitude of the δE (≈ 0) between positive and negative parity bands. Neutron deficient Te isotopes having both Z and N close to octupole magic number 56 are good candidates to study this kind of correlation [3]. Consequently, octupole correlation has been reported in $^{108\text{-}112}$Te nuclei. In this work, an attempt has been made to search for octupole correlation in heavier ^{114}Te.

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II. EXPERIMENTAL DETAILS

The excited states of ^{114}Te were populated through ^{112}Sn(^{4}He, 2nγ)^{114}Te reaction at a beam energy of 37 MeV, delivered by the K-130 cyclotron of VECC, Kolkata. The effective thickness of the self-supporting target was 4.5 mg/cm^2. The γ-rays were detected by the INGA spectrometer consisting of seven Compton suppressed HPGe clover detectors and one LEPs detector [4]. Detailed description was published in Ref. [5].

III. RESULTS AND DISCUSSION

In this work, in addition to the already known γ rays, 11 new γ-transitions have been observed. The multipolarities of this new transition is determine from DCO ratio, estimated using the angular correlation analysis. The DCO ratio is defined as:

$$R_{DCO} = \frac{I\gamma_1 \; at \; 125^\circ, \; gated \;\; by \; \gamma 2 \; at \; 90^\circ}{I\gamma_2 \; at \; 90^\circ, \; gated \;\; by \; \gamma 1 \; at \; 125^\circ}$$

The value of R_{DCO} for a pure dipole (quadrupole) transition gated by a stretched quadrupole (dipole) transition is 0.7 (1.6). Clover detectors facilitates the linear polarization measurement studies of EM radiation. The polarization asymmetric parameter Δ_{asym} is positive (negative) for electric (magnetic) transitions. The parameter is defined as $\frac{aN_\perp - N_\parallel}{aN_\perp + N_\parallel}$ where $N_\perp$ and $N_\parallel$ are the number of scattered photons in direction perpendicular and parallel to the direction of reaction plane respectively. The correction factor a as a function of γ energy comes out to be 1.000(3) (the value only includes fitting error as per Ref. [5]). Out of 11 new transitions, two new transitions are found between positive and negative parity band.

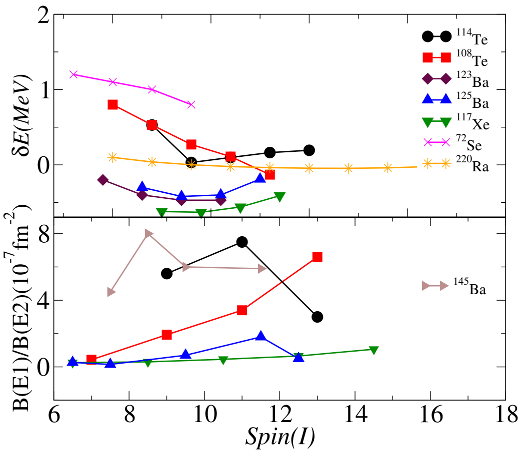

FIG. 1: Variation of δE and $B(E1)/B(E2)$ branching ratio with spin.

To investigate the octupole correlation in ^{114}Te, the $B(E1)/B(E2)$ ratio of two new γ transition and one old transition are extracted and compared with the other nuclei. The observed value of $B(E1)/B(E2)$ lying between ^{108}Te and ^{145}Ba. The value of $B(E1)$ for transition $7^- \rightarrow 6^+$ of ^{114}Te is 8×10^{-4} (e^{2}fm^2), which is slightly larger than ^{108}Te [6]. Another parameter to describe the octupole deformation is δE between the positive and negative parity band. In the limit of stable octupole deformation the value of δE is close to zero. From the FIG. 1, it is clear that the value of δE in ^{108}Te decreases and moves towards zero as the spin increases whereas, in ^{114}Te δE first decreases to zero and then there is a slight increase. The different variation of δE in ^{114}Te may be due to the mixing and repulsion between the zero phonon and two phonon bands, which increases with increasing the number of neutrons [7].

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