Observation of highly deformed bands in ^{122}Te

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Introduction

The stable ^{122}Te lies in a transitional region between near spherical Z = 50 and strongly deformed Z =57. A few yet finite number of valence nucleons can break the spherical symmetry and induce finite deformation [1]. Deformed rotational bands with $\beta \approx 0.2$ based on 4p-2h configuration showing a decrease in dynamic moment of inertia $J^{(2)}$ with increasing spin are common at high excitation energy due to the excitation of protons from $g_{9/2}$ orbitals across the shell gap. Five highly deformed bands based on two proton holes in $g_{9/2}$ and six or five neutrons in $h_{11/2}$ have been reported in ^{120}Te [2]. Recently, in nuclei with N $\approx$ 70; highly deformed rotational bands involving the neutrons from $i_{13/2}$ have been observed [3, 4] with $\beta \approx 0.35$. Motivation of the present work was to search for highly deformed bands in ^{122}Te.

Experimental Details

High-spin states in ^{122}Te were populated using the heavy-ion fusion reaction ^{82}Se(^{48}Ca, α4n)^{122}Te. The ^{48}Ca beam with energy of 205MeV and 4pnA current was provided by ATLAS accelerator at Argonne National Laboratory. Target with a thickness of 0.5mg/cm^2 was made by sandwitching ^{80}Se in between a protecting layer of Au and a 0.5mg/cm^2 Au backing which faced the beam. As a result, the beam energy at the mid target came down to 199 MeV. The $\gamma-\gamma$ coincidence was measured using 100 Compton suppressed Ge detectors in Gammasphere spectrometer. A total of 2.8×10^9 events were obtained with Ge fold $\geq$ 5 in 7 days of beam-time. Radware software was used for off-line analysis of the data [5].

Results and Discussion

In an earlier work by E. S. paul et al. [1] low lying positive parity states upto 16^+ and 5.409 MeV dominantly based on $\pi[g_{7/2}, d_{5/2}]^2 \otimes \nu[(d_{3/2}s_{1/2})^2, h^4_{11/2}]$ in ^{122}Te have been discussed. The above sequence was extended by Nag et al. [6] upto spin 25$\hbar$. In the present work, the level scheme was further extended by 4$\hbar$ of spin units. Seven highly deformed bands extending upto $\approx$ 50$\hbar$ were observed to feed the above mentioned level structure at and around 22 - 26$\hbar$. Fig. 1 shows the summed triple gated spectra of four most intense bands among these seven bands. Since, linking transitions are yet to be unveiled, spin and parities are not confirmed. Spin independent dynamic moments of inertia $J^{(2)} \approx 4/\Delta$E

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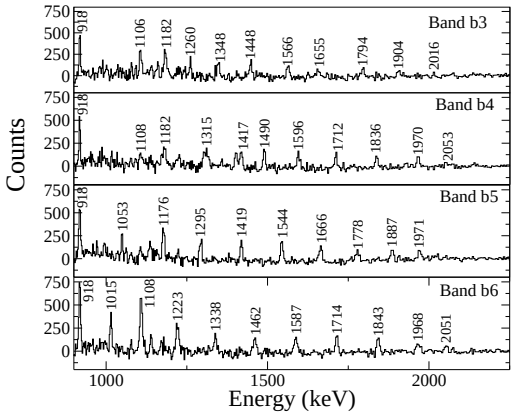

FIG. 1: Summed triple-gated γ ray coincidence spectra of four most intense highly deformed bands in ^{122}Te with a single gate on a list of transitions 564-, 617-, 570-, 918-, 622- and 685 - keV and with double gates on all transitions of the respective bands.

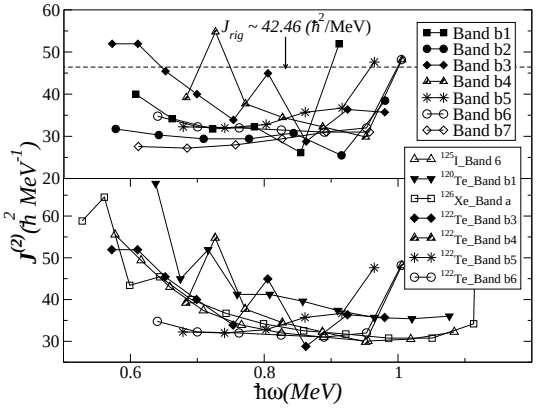

FIG. 2: Dynamic moments of inertia $J^{(2)}$ as a function of rotational frequency for seven highly deformed bands in ^{122}Te(upper panel). $J^{(2)}$ vs rotational frequency for bands b3, b4, b5, and b6 in ^{122}Te, for similar bands in ^{126}Xe [3], ^{125}I [4], and ^{120}Te [6] (lower panel).

with respect to the rigid body dynamic moment of inertia J_{rig} for seven highly deformed bands in ^{122}Te are shown in the upper panel of Fig. 2. Bands b1 and b4 show spikes in $J^{(2)}$ at $\hbar\omega = 0.72$ and 0.80 MeV respectively which are generally caused by neighboring interband interactions. All other bands show more or less constant value of $J^{(2)}$ in a range of 27 - 35 $\hbar^2$/MeV with $\hbar\omega$ range varying from 0.6 to 0.85 MeV highlighting no change in shape in this region. Except band b1 all other bands show an increasing trend in $J^{(2)}$ value at the respective highest attended spin states similar to that of band a in ^{126}Xe [Fig. 2 (lower panel)]. A possible band crossing may be the underlying reason. Lower panel of Fig. 2 shows that dynamic moment of inertia of the bands b3, b4, b5, and b6 are close to those of band a in ^{126}Xe whose quadrupole moment Q has been estimated to be 5.2 b [3]. The data analysis is in progress and we are expecting probable configurations analogous to ^{120}Te.

Acknowledgments

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