Spectroscopic study of ^{125}Te

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Introduction

Single particle excitations are observed in spherical nuclei whereas in deformed nuclei, higher spins are generated via collective excitations. The A∼125 nuclei lie in the transitional region between the nearly-spherical Sn isotopes and the highly deformed La and Ce isotopes. An interplay between the two types of excitation mechanisms results in the observation of various shape changes and shape coexistence phenomena with increasing spin. At higher spins, one or more nucleon pairs may break up and the particles get excited to higher orbitals. In this region, the unique parity $h_{11/2}$ orbital is responsible for the observed shape changes. Protons in this orbital drive the nucleus to a prolate shape while neutrons drive the nucleus to an oblate shape[1].

The tellurium isotopes have been explored over the past few decades[2–7].These isotopes have two protons greater than Z=50 shell closure. With increase in neutron number along the isotopic chain, we observe the effects of the breaking of the neutron pairs along with the proton pair breaking[6]. The nucleus ^{125}Te is characterized by the presence of low-lying positive parity states attributed to the coupling of $\nu g_{7/2}$, $\nu d_{5/2}$, $\nu d_{3/2}$, $\nu s_{1/2}$ and $\nu h_{11/2}$ to the even-even core. These states have also been interpreted in the framework of IBM formalism where the tellurium isotopes lie in the transition zone between the U(5) and O(6) dynamical symmetries which corresponds to a shape change from spherical to γ-unstable[8, 9].

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Experimental details and analysis

The nuclear levels of ^{125,126}Te were populated via the reaction ^{124}Sn(α,3n/2n)^{125,126}Te. The K-130 cyclotron at VECC, India provided the α beam, operated at 35 MeV and 31 MeV. A ^{124}Sn target of thickness 8.1mg/cm^2 was used. $\gamma - \gamma$ coincidences were recorded by the Indian National Gamma Array (INGA) Spectrometer which at the time of experiment consisted of 7 Compton suppressed HPGe clover detectors arranged in a ring, with 4 detectors at 90°, 2 detectors at 125° and 1 detector at 40°. The event trigger was set as the coincidence multiplicity of at least two Compton suppressed HPGe clover detectors. A total of 5.3x10^6 two- and higher-fold events were acquired in the experiment. The data acquisition system was a digital one principally consisting of PIXIE-16 (XIA LLC, USA) 12-bit 250 MHz digitizer modules running on a firmware conceptualized by the UGC-DAE CSR, Kolkata Centre [10]. The raw data were subsequently sorted using the IUCPIX package [10] into $\gamma - \gamma$ matrices and $\gamma - \gamma - \gamma$ cube and analyzed using the RADWARE package [11]

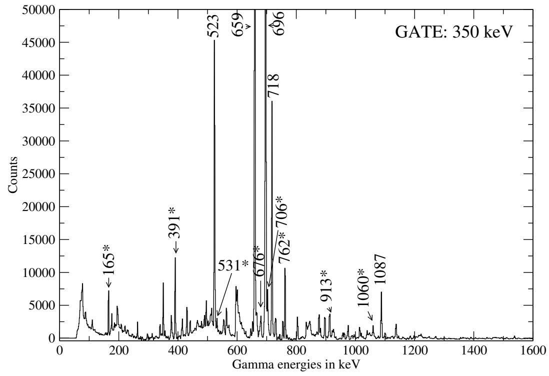

FIG. 1: A single gate on the 350 keV gamma showing some of the prominent transitions. The newly observed transitions are marked with '*'.

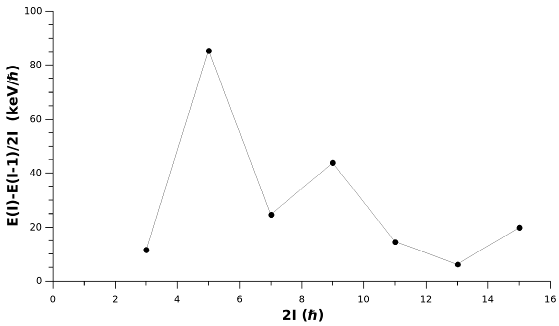

FIG. 2: Observed staggering in the positive parity band of ^{125}Te

Results and Discussions

In our current work, we have verified the previously obtained level scheme [5, 6] along with the placement of 30 new gammas feeding into the previously established positive and negative structures and extending the level scheme to an energy of 5734 keV. The positive parity band based on ground $1/2^+$ level and the $3/2^+$ level have been extended. These structures have been identified to be signature partners as indicated by the staggering observed (FIG:2) with a signature inversion at spin I=11/2 $\hbar$. Such an inversion has been attributed to a change from an axially symmetric nuclear shape [12]. Further analysis is being carried out in order to understand the shape changes in ^{125}Te.

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