Spectroscopy of ^{126}Te

Atreyee Dey[1],[*] Anwesha Basu[1], A.K Singh[1], S.Nag[2], G. Mukherjee [3], S.Bhattacharyya[3], R. Banik[3], S. Nandi[3], S. Bhattacharya[3], R. Raut[4], S. S. Ghugre[4], S. Das[4], S. Samanta[4], S. Chatterjee[4], A.Goswami[5] [†], S. Ali[5], H. Pai[5], and S. Rajbanshi[6]
[1]*Indian Institute of Technology, Kharagpur-721302, India*
[2]*Indian Institute of Technology(BHU), Varanasi-221005, India*
[3]*Variable Energy Cyclotron Centre, Kolkata- 700064, India*
[4] *UGC-DAE CSR, Kolkata Centre, Kolkata- 700098, India*
[5]*Saha Institute of Nuclear Physics, Kolkata- 700064, India and*
[5]*Presidency University, Kolkata-700073, India*

1. Introduction

The nuclei in the mass region A $\sim$125 are known to be transitional, lying between the Sn isotopes (Z=50, nearly spherical) and the La and Ce isotopes (Z=57 and 58 respectively, deformed).Owing to this unique position, these nuclei are known to be favourable with respect to deformation effects leading to shape changes and shape co-existence. This can be attributed to the presence of the unique parity intruder $h_{11/2}$ orbital which aligns towards a prolate shape when occupied by protons and an oblate shape in case of neutrons. [1]

The even Te isotopes, in particular, have been shown to exhibit some transitional characters. The low-lying levels of ^{126}Te exhibit vibrational features. The rotational excitation $E(4_1{}^+)/E(2_1^+)$ comes out to be 2.04 which is in excellent agreement with the spherical vibrator value of 2.00. [2]In the IBM, these states are described using U(5) dynamical symmetry. However, the energy levels of two-phonon multiplets appear to deviate from this vibrational character, exhibiting a deformed γ-soft nature (O(6) limit in the IBM). Studies of the $^{120-128}$ Te isotopes have indicated that the isotopes ^{124}Te and ^{126}Te exhibit E(5) critical-point symmetry.[2–4]

2. Experimental details

The aim of the experiment was to populate the states of ^{125,126}Te with the reaction ^{124}Sn(α, 3n/2n)$^{125/126}$Te. The target was ^{124}Sn of 8.1 mg/cm^2 thickness. The α beam was used at an energy 35 MeV (to populate the excited states of ^{125}Te) and 31 MeV (to populate the excited states of ^{126}Te). The α beam was obtained from the K-130 cyclotron at the Variable Energy Cyclotron Centre (VECC) at Kolkata, India. The γ-γ coincidence events were recorded by the Indian National Gamma Array (INGA) spectrometer. The INGA spectrometer had 7 Compton-suppressed HPGe clover detectors arranged in a ring and at various angles- 4 detectors at 90°, 2 detectors at 125° and 1 detector at 40°. A total of 5.3×10^6 coincidence events were recorded with Ge-fold$\geq$ 2 using the 16-module PIXIE data acquisition system. The data was calibrated for energy and efficiency and sorted into symmetric matrices and cube.

3. Discussions

The high-spin structures of $^{126-131}$Te have been explored in previous works.[5,6] The level scheme was extended to spin $\sim 17\hbar$ and excitation energies $\sim$ 6MeV. The spin and parity assigned to some of the levels were tentative. [5] A new negative-parity band was established in a subsequent work.[6] Shape coexistence was also interpreted from the study. The potential energy surface for the 8^+ state appears to show three minima with two triaxial states($\gamma$$\sim$30° and $\gamma$$\sim$ -45°) and one aligned

[†]deceased
[*]Electronic address: atreyee_dey@iitkgp.ac.in

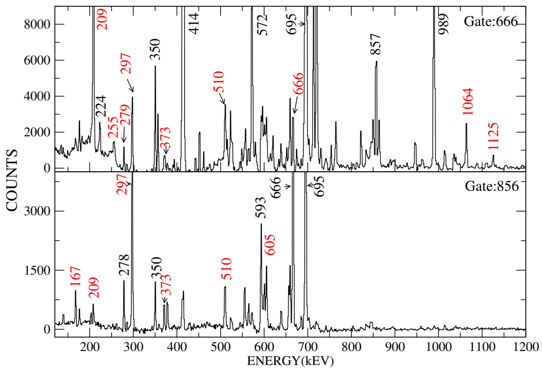

FIG. 1: A few of the single-gated transitions in ^{126}Te have been shown. The new transitions are marked in red.

state ($\gamma\sim$ -120°).[6]

In the present work, all the gamma rays observed in previous works are confirmed and 33 new transitions and 15 new levels have been placed. Measurements are being carried out for spin and parity.

The search for mixed symmetry states is in progress. Our work is in the preliminary stage and analysis is being carried out.

4. Acknowledgements

We would like to thank the VECC-INGA collaboration for their support in this experiment.

References

[1] A. Granderath, et al 1996 Nucl. Phys. A **597**, 427.

[2] H.Sabri et al., Nuclear Physics A 946 (2016) 1128

[3] M.Saxena et al. Physical Review C **90**, 024316 (2014)

[4] S.F Hicks, et al., Physical Review C, Volume 95, Issue 3

[5] A. Astier, M.-G. Porquet, T. Venkova et al, The European Physical Journal A, **50**: 2 (2014)

[6] Liu-Chun He et al 2017 Chinese Phys. C **41** 044003

[7] D. C. Radford, Nucl. Instrum. Methods A **361**, 297 (1995).