Investigation for two quasi-particle negative parity bands in ^{124}Te

S S Tiwary[1], H P Sharma[1],* S Chakraborty[1],† C Majumder[1], A K Gupta[1], P Banerjee[2], S Ganguly[3], S Rai[4], Pragati[5], Mayank[6], S Kumar[7], A Kumar[9], S S Bhattacharjee[8], S Muralithar[8], and R P Singh[8]

[1]*Department of Physics, I.Sc., Banaras Hindu University, Varanasi, India.*
[2]*NPD, Saha Institute of Nuclear Physics, Kolkata, India.*
[3]*Department of Physics, Bethune College, Kolkata, India.*
[4]*Department of Physics, Visva-Bharati, Santiniketan, India.*
[5]*Department of Physics, Indian Institute of Technology, Roorkee, India.*
[6]*Amity Institute of Nuclear Science and Technology, Amity University, Noida, India.*
[7]*Department of Physics and Astrophysics, University of Delhi, New Delhi, India.*
[8]*Nuclear Physics Group, Inter-University Accelerator Centre, New Delhi, India. and*
[9]*Department of Physics, Panjab University, Chandigarh, India.*

Introduction

The study of negative parity states is very limited in heavier even-even $^{122-128}$Te-isotopes. In these nuclei, the negative parity states are mainly based on the 5^-, 7^- and 9^- states, with $\nu h_{11/2} \otimes \nu s_{1/2}$, $\nu h_{11/2} \otimes \nu d_{3/2}$ and $\nu h_{11/2} \otimes \nu g_{7/2}$ configurations, respectively [1, 2]. These states were predicted to have non-collective behaviour in $^{122-128}$Te-isotopes [1], but later studies showed collective band structures associated with these configurations in even-even $^{118-122}$Te [3–5]. This makes interesting aspects to investigate the behaviour of negative parity states in heavier Te-isotopes. Hence, the present work is dedicated to investigate for negative parity bands in ^{124}Te.

Experimental Details

High spin states of ^{124}Te were populated via ^{122}Sn(^{9}Be, α3n)^{124}Te fusion evaporation reaction at 48 MeV beam energy, obtained from 15UD tandem accelerator facility [6, 7] at IUAC, New Delhi. The experiment was carried out at Indian National Gamma Array (INGA) [8], consist of 14 Compton suppressed

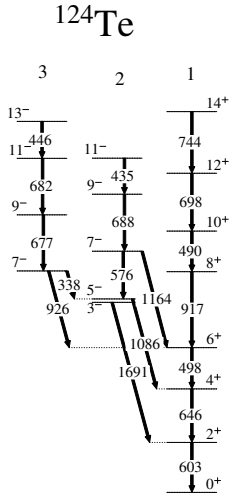

FIG. 1: Partial level scheme of ^{124}Te, established from present work

Clover detectors. The detectors were arranged in three different angles (i.e. 148^o, 123^o and 90^o) with respect to beam direction.The data were recorded with two or higher fold coincidence relationship. Off-line data analysis has been carried out using the computer code INGA-sort [9]. The details of the experimental setup and data analysis procedure were described in refs. [10, 11].

*Electronic address: hpsharma_07@yahoo.com
†Present address: Nuclear Physics Group, Inter-University Accelerator Centre, New Delhi, India.

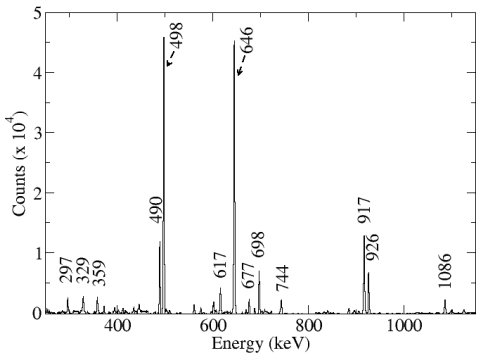

FIG. 2: 603 keV coincidence energy gated spectrum of ^{124}Te.

Results and Discussion

The present analysis was carried out, on the basis of $\gamma - \gamma-$ coincidence measurements. Previously, only few negative parity states were reported up to 11 $\hbar$ in ^{124}Te [12, 13], with very limited information. In present study, two bands have been established on 5^- and 7^- states. The spin and parity of these states were confirmed on the basis of angular correlation and linear polarization asymmetry measurements. The states were suggested to have contribution from only available negative parity $\nu h_{11/2}$ orbital near neutron Fermi surface, which may couple to the $\nu s_{1/2}$, $\nu d_{3/2}$ and $\nu g_{7/2}$ orbitals. Such states have been systematically observed in neighbouring $^{118-122}$Te-nuclei. Further, these orbitals also show very smooth behaviour in neighbouring odd-A Te-isotopes. Hence, on the basis of systematics of neighbouring Te-nuclei, band 2 and 3 are suggested to be associated with 2-quasi-particle $\nu h_{11/2} \otimes \nu s_{1/2}$ and $\nu h_{11/2} \otimes \nu d_{3/2}$ configuration, respectively. However, further analysis is needed in order to understand the structural behaviour of these states in ^{124}Te.

TABLE I: Results of $\gamma-$ray energies, angular correlation ratios (R_{DCO}) and polarization asymmetry (Δ_{asym}) of the $\gamma-$transitions decaying from band 2 and 3 are summarized in the given table.

E_γ	R_{DCO}	Δ_{asym}
435.4	1.16(14)	
446.6	0.92(14)	
576.0	1.05(7)	0.09(7)
677.1	0.98(8)	0.11(7)
682.5	1.09(12)	
687.7	0.96(12)	
926.8	0.54(6)	0.11(6)
1086.4	0.53(6)	0.10(6)
1164.2	0.67(17)	

[a] Uncertainties of $\gamma-$ray energies lie within 0.2 to 0.6 keV depending on intensity. The uncertainties of $\gamma-$ray intensities, angular correlation ratios (R_{DCO}) and polarization asymmetry (Δ_{asym}) lie within bracket, correspond to last decimal value.
[b] Angular correlation ratio (R_{DCO}) has been using stretched quadrupole energy gates.

Acknowledgments

Authors are thankful to the staffs of target lab and Pelletron accelerator facility at IUAC, New Delhi. Authors acknowledge the Indian National Gamma Array (INGA) Collaboration, the Department of Science and Technology (DST) and University Grants Commission (UGC) for providing support for INGA project (IR/S2/PF-03/2003-I). The first author is also thankful to UGC for financial support−vide contract no. 23/06/2013(I)EU−V.

References

[1] M Matoba *et. al.*, NPA **261**, 223, 1976
[2] A Kerek, NPA **176**, 466-480, 1971
[3] S Juutinen *et. al.*, PRC, **61**, 014312 1999
[4] Somnath Nag *et. al.*, PRC, **61**, 014310, 2012
[5] E S Paul *et. al.*, PRC, **53**, 01562, 1999
[6] G K Mehta et al, NIM A **268** 334, 1988
[7] D Kanjilal et al, NIM A **97** 97, 1993
[8] S Muralithar et al, NIM A **281** 281 (2010)
[9] R K Bhowmik et al, DAE-SNP 44B **422** (2001)
[10] S. Chakraborty *et. al.*,BJP, 47, 406, 2017
[11] S S Tiwary *et. al.*EPJ A 55: 163, 2019
[12] N War et al, NPA **636**, 379-418 (1998)
[13] A Astier et al, EPJA **50**, 2, (2014)