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

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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 $^{118-123}$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, $\alpha$3n)$^{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 Clover detectors. The detectors were arranged in three different angles (i.e. 148°, 123° and 90°) 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].

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

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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.

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