Investigation of rotational band structure in ^{152}Eu

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Introduction

The odd-odd nucleus ^{152}Eu lies in a mass region where the nuclear shape seems to make a transition from spherical to deformed. The "transitional" nature of this nucleus has sparked several experimental studies to ascertain the low-lying structure and thereby understand, in detail, the nature of the shape change occuring in $A \sim 150$ mass region. The unpaired proton in the $h_{11/2}$ orbital and the unpaired neutron in the $i_{13/2}$ orbital couple to form various angular momentum states resulting in the formation of even spin sequence of the band structure. One of the previous studies on ^{152}Eu [1] reported a few levels which originate from the coupling of available neutron-proton Fermi orbitals. T. von Egidy et al. [2] were the first to demonstrate that the ground state of ^{152}Eu exhibits a rotational structure. It is worthwhile mentioning that this nucleus exhibits highly complex level energy spectrum, a feature typical for transitional nuclei. Several of the previously observed energy levels of this nucleus have been explained as rotational structures [3]. The present work aims to scrutinize the previously reported rotational band structure of ^{152}Eu, and to look for its possible extension.

Experimental details and data analysis

The excited states of ^{152}Eu were populated using fusion evaporation reaction, ^{150}Nd(^{7}Li, $5n$). About 4 mg /cm^2 thick target of Nd_2O_3, enriched to 90 % in ^{150}Nd, was bombarded with ^{7}Li beam delivered from the 15UD pelletron accelerator at a beam energy of 38 MeV at IUAC, New Delhi. The emitted γ-rays were detected using the INGA array comprised of 16 Compton-suppressed high resolution HPGe Clover detectors and 2 low energy photon spectrometer (LEPS) during the experiment. The number of coencidence events recorded during the experiment is $\sim 1.2 \times 10^8$.

The data presorting, sorting, and analysis were carried out using various computational packages, including Radware [4] and INGA-

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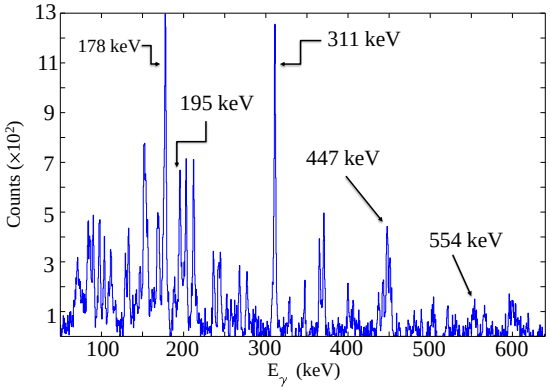

FIG. 1: A representative of γ-γ coencidence spectram with Gate set at 161 keV for ^{152}Eu

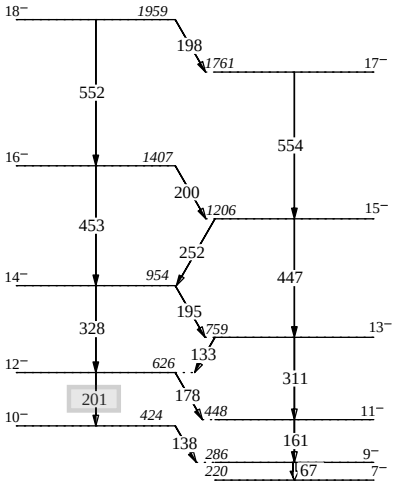

FIG. 2: Partial level scheme of ^{152}Eu as observed from the present work in high-spin regime.

SORT [5]. Some preliminary observations are presented here.

Results

Here we have confirmed the previously known γ ray transitions belonging to the rotational structure [3] of ^{152}Eu. The gated spectrum of 161 keV γ ray transition of ^{152}Eu (see Fig. 1) exhibits the notable transitions of ^{152}Eu, viz, 554 keV, 447 keV and 311 keV transitions which correspond to the rotation aligned $[\pi h_{11/2} \otimes \nu i_{13/2}]$ band (see Fig.2). The transitions shown correspond to $17^- \rightarrow 15^-$, $15^- \rightarrow 13^-$ and $13^- \rightarrow 11^-$ sequences, respectively. From intensity arguments, placements of these γ rays in the present sequence are confirmed. A new γ ray transition has been observed in the 328 keV gated spectrum, which might belong to the even-spin negative parity band. Tentatively, we have assigned it as the $12^- \rightarrow 10^-$ transition with a γ ray transition energy of 201.3 keV. The necessary DCO and polarization measurement is underway in order to ascertain the placement of this new transition in the observed band structure. The partial level scheme corresponding to these bands has been shown in Fig 2.

Conclusions

High-spin states of ^{152}Eu have been populated with the fusion-evaporation reaction. Several of the previously reported γ ray transitions have been confirmed. A few γ ray transitions have newly been observed. Detail analysis related to the extension of the previously reported rotational band structure of ^{152}Eu is under process.

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