Search for unobserved transitions in ^{142}Eu

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Introduction

Spectroscopic investigation of weakly deformed nuclei in mass region A $\sim$ 140 with Z $\sim$ 64 and N $\sim$ 82 provides us copious sources of information both from the experimental findings as well as theoretical understanding of various excitation mechanism. They exhibit shell model structures at low spins and at high excitation energy multi-particle excitation leads to the generation of high angular momentum states due to many symmetry breaking phenomena.

In order to understand the excitation mechnisms responsible for the generation of high spin states in this mass region we have studied ^{142}Eu nucleus. The high spin states of the ^{142}Eu was reported earlier by M. Piiparinen et al. [1]. Based on thei experimental data, they have proposed a level scheme of ^{142}Eu. The motivation of current work is to remove the remaining incompleteness of the previously reported level scheme of ^{142}Eu.

Experimental Details

High spin states of ^{142}Eu have been populated using the reaction ^{116}Cd (^{31}P, 5n) at a beam energy of 148 MeV provided by the Pelletron Linac facility at TIFR, Mumbai. The target was 2.4 mg/cm^2 of ^{116}Cd (99% enriched) on a 14.5 mg/cm^2 thick Pb backing. The de-exciting γ-ray transitions were detected by the Indian National Gamma Array (INGA) which was consisted of nineteen Compton-suppressed clover detectors at the time of experiment.

Experimental Results and Discussions

The partial level scheme (Fig. 1) of ^{142}Eu was established using the coincidence relationship, I_γ, R_{DCO}, $R(\theta)$ and linear polarization (P) measurements. The P vs R_{DCO} plot for several transitions are shown in Fig 2.

In the earlier measurement 602-keV transition was reported as a $\Delta I = 0$, M1 transition [1]. But in the present measurement the R_{DCO}, $R(\theta)$ and P (Fig. 2) values indicate it to be a $\Delta I = 0$, E1 transition. In addition 1021-keV transition has been found to be an E1 transition instead of M1 as reported earlier. As a result parities of the states in the E2 structure (Band II in Fig. 1) has been changed in the proposed level scheme.

The same work also reported two E2 cascades which were not connected to the lower part of the proposed level scheme [1]. We have observed several linking transitions which connected the suspended E2 cascades to the different excited states in the level scheme of ^{142}Eu as shown in Fig. 1. The first E2 cascade, labeled as band III, depopulates into

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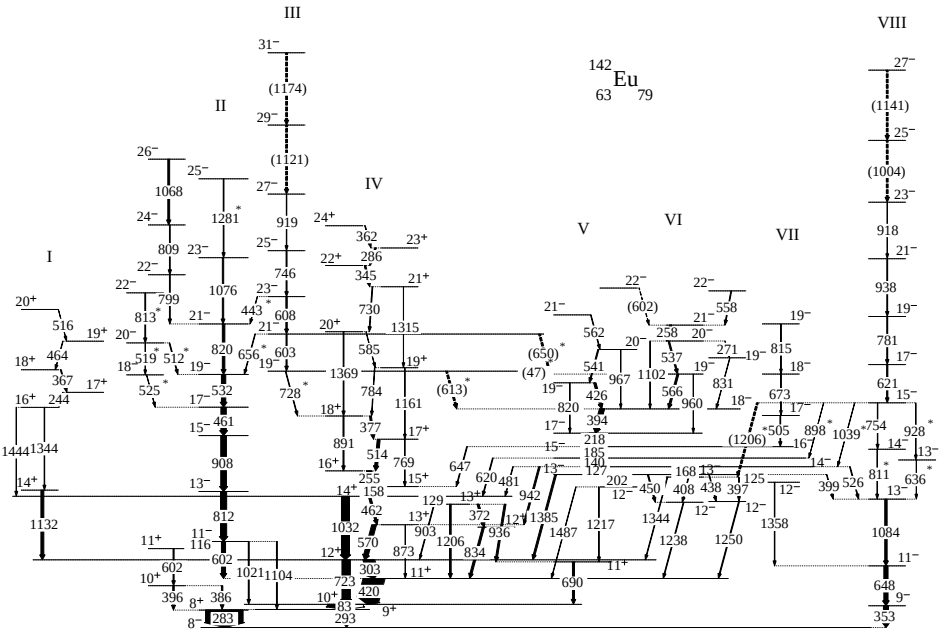

FIG. 1: The partial level scheme of ^{142}Eu obtained in the present work. The γ-ray energies are rounded off to the nearest keV. Placements of toggled γ-rays are tentative. Transitions with $*$ are newly observed in the present work.

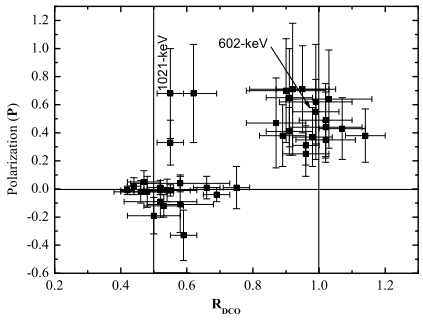

FIG. 2: Polarization vs. R_{DCO} plot for several γ transitions

three structures II, IV and V (Fig. 1). The estimated values of R_{DCO}, $R(\theta)$ and P for the linking transitions prompted us to assign spin-parity of the lowest state of this cascades (band III) as 19^- which depolpulates into band IV by 728-keV, band II by 443 and 656-keV and band IV by 47, 613 and 650-keV transitions.

Also the spin-parity of the lowest state of the second suspended E2 cascade labeled as band VIII assign as 14^- from the measurements of R_{DCO}, $R(\theta)$ and P values of the connecting transitions of energy 811, 636 and 928-keV.

Conclusion

The high spin states and linking transitions of the previously observed suspended quadrupole bands in ^{142}Eu have been investigated and connected to the main excitation scheme. Also multipolarity of these linking transitions were extracted using R_{DCO}, $R(\theta)$ and linear polarization (P) measurements. Several new transitions were also obtained and placed in the proposed level scheme (see Fig. 1).

Acknowledgments

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References

[1] M. Piiparinen *et al.*, Nucl. Phys. **A 605**, 191 - 268 (1996).