Re-investigation of some low and medium-spin level structure in ^{67}Ga

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Introduction

Generation of angular momentum in a nucleus may proceed via single-particle or collective mode of excitation. Simultaneous presence of the two modes is also possible, leading to a plethora of complex excitations. Low angular momentum states in ^{63,65,67}Ga are known to exhibit complex excitations [1–3]. Previous studies on the nature of the decaying transitions in ^{67}Ga were done with angular distribution measurement. Here, we report on the results of re-investigation of the nature of transitions connecting low-angular momentum states in ^{67}Ga using the Directional Correlation of Oriented states(DCO) ratio and linear polarization measurements obtained from a high-resolution Compton-suppressed clover detector array. These values will be used to assign spin-parities to the corresponding excited states in ^{67}Ga.

1. Experimental details and data analysis

The nucleus of interest was populated via fusion-evaporation reaction. In this reaction a beam of ^{18}O at 72.5 MeV was obtained from the 15-UD pelletron accelerator [4] at Inter University Accelerator Centre (IUAC), New Delhi. The Indian National Gamma Array (INGA) [5] was used to detect the emitted γ-rays. Multipolarity of a transition was determined from the DCO ratio (R_{DCO})[6]. The detectors at 90° and 148° were considered for R_{DCO} measurement. Electric or magnetic nature of γ-ray transitions were determined from the linear polarization measurement[7, 8] from the data recorded in the 90° detectors. Details of the experimental set-up and analysis methods are given in Ref. [3].

2. Results

A gated spectrum obtained in the present experiment by gating on strong 359 keV ground state transition is shown in FIG. 1. A partial level scheme of ^{67}Ga, relevant for the present work, is shown in FIG. 2. The ground state spin-parity of ^{67}Ga is reported as $\frac{3}{2}^-$ [1]. TABLE I shows the measured values of the R_{DCO} and polarization asymmetry ratio (Δ_{asym}) as obtained in the present work. The R_{DCO} values of the transitions are obtained with gate on the 958 keV stretched E2 transition. Multipolarity and electromagnetic nature of this transition is adopted from Ref.[1].

Level at 359 keV decays to the $\frac{3}{2}^-$ state via 359 keV transition. The measured values of R_{DCO} and Δ_{asym} of this transition suggest $\frac{5}{2}^-$ spin-parity for the state at 359 keV. The level at 1202 keV feeds the ground and the excited $\frac{5}{2}^-$ states, respectively, by 1202 and 843 keV γ-rays. The measured R_{DCO} and Δ_{asym} values of 1202 keV γ-ray suggest stretched electric quadrupole (E2) nature for this transition. Thus the 1202 keV state is assigned with spin-

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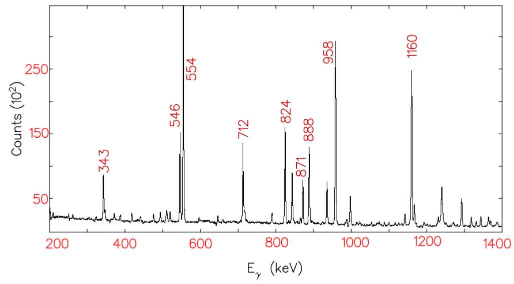

FIG. 1: Background subtracted $\gamma-\gamma$ coincidence spectra for ^{67}Ga obtained with a gate on 359 keV γ-ray transition.

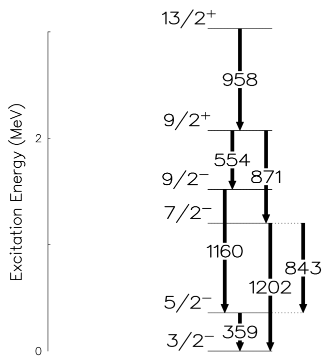

FIG. 2: Partial level-scheme of ^{67}Ga.

parity $\frac{7}{2}^-$.

The 871 keV transition has a large positive Δ_{asym} value and the R_{DCO} value has a large uncertainty. So, it is more likely to be an E1 transition. The calculated value of R_{DCO} for this transition is $\approx$ 0.74 for a mixing ratio δ = 0.2. So, within the measured uncertainty it is in agreement with E1(+M2) assignment. So, spin-parity of $\frac{9}{2}^+$ may be assigned to the 2073 keV level. The R_{DCO} and Δ_{asym} values of the 554 keV γ ray are also consistent with a $\Delta J = 0$, E1 transition, which gives further support to this assignment. The level at 1519 keV decays to the $\frac{5}{2}^-$ state via a 1160 keV strong transition. The R_{DCO} and Δ_{asym} values indicate E2 nature of this transition and hence, a spin-parity of $\frac{9}{2}^-$ is assigned to this state.

Further analysis of the data is in progress.

TABLE I: Values of the γ-ray energies (E_γ) in keV, DCO ratio (R_{DCO}), polarization asymmetry (Δ_{asym}) and multipolarity assignment of few γ-ray transitions in ^{67}Ga.

E_γ	R^a_{DCO}	Δ_{asym}	Assignment
359	0.73(25)	-0.061(9)	M1+E2
554	1.06(11)	-0.080(4)	E1
843	0.57(35)	-0.075(35)	M1+E2
871	0.73(41)	0.101(14)	E1(+M2)
958	—	0.056(6)	E2^b
1160	1.06(11)	0.026(2)	E2
1202	1.11(13)	0.070(13)	E2

^{a}Gate on E2, 958 keV.
^{b}adopted from Ref. [1]

Shell model calculations are performed and the results will be shown in the conference.

3. Acknowledgement

We are thankful to SERB, New Delhi (project No. CRG/2020/000715), IUAC New Delhi (project No. UFR-67309), and UGC-DAE CSR Kolkata Centre (project No. CRS/2021-22/02/468) for financial grants.

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