Polarisation measurements and Re-investigation of the Intermediate States in ^{86}Rb

S. Kumar[1],[*] Naveen Kumar[1], S. K. Mandal[1], and R. Palit[2]

[1]*Department of Physics and Astrophysics,*
University of Delhi, Delhi - 110007, India and
[2]*Tata Institute of Fundamental Research, Mumbai- 400005, India*

Introduction

Investigation of nuclear structure in mass A $\sim$ 90 region is an important domain to understand their high spin states as well as to test the modern shell model codes based on new interactions i.e. JUN45 and jj44b [1]. The nuclei of this mass region also fall in the extreme which can not be populated/explored using the stable beam by heavy ion fusion reactions. Apart from single particle structure the collective excitations also seen to play a role in their structutre. In the recent years, we have studied the level structure of N=47,48 nuclei [2, 3] to study the change from collective to shell model behaviour.

In the present work, the intermediate states of ^{86}Rb nucleus have been re-investigated using the reaction ^{76}Ge(^{13}C,p2n)^{86}Rb at 45 MeV. Previously the ^{86}Rb nucleus was only studied using the reaction ^{82}Se(^{7}Li,3n)^{86}Rb [4]. INGA array data from Tata Institute of Fundamental research (TIFR) will will help to establish the spin parity assignment by measuring the polarisation asymmetry using γ-γ, and γ-γ-γ coincidence measurements.

1. Experimental Setup

The ^{86}Rb nucleus was re-investigated for the intermediate states those were populated by the reaction ^{76}Ge(^{13}C,p2n)^{86}Rb using ^{13}C beam of 45 MeV from the Pelletron accelerator at Tata Institute of Fundamental Research (TIFR), Mumbai. The ^{76}Ge target of thickness 850 μg/cm^2 with 7.06 mg/cm^2 ^{181}Ta backing was used. Gamma rays were detected using Indian National Gamma Array (INGA) by

using 15 compton-suppressed clover detectors at 157°, 140°, 115°, 90°, 65° and 40° with respect to the beam direction. PCI-PXI digital data acquisition system was used to collect the data in list mode using Pixie-16 Module by XIA LLC software. Data was collected when atleast two clovers fired in co-incidence with a time window of 200ns and co-incidence trigger was kept open for 4 μs. A total of about 2.9 x 10^9 two and higher fold coincidence events were recorded. The data were sorted using Multi-pARameter time stamped based COincidence Search (MARCOS) and analysed by DAMM and RADWARE for different matrices to generate gated spectrum.

2. Results and Conclusions

In the present study, we have re-investigated the level scheme as given in the ref. [4] using the γ-γ, and γ-γ-γ coincidence measurements. Fig. 1 represents the coincidence spectrum which was obtained by a coincidence gate on 732.5-keV γ-ray transition as well as coincidence of 125.1- and 224.5-keV. Apart from this, the DCO and polarisation asymmetry measurements were carried out to confirm the spin and parity of states given in level scheme [4]. The DCO and polarisation asymmetry measurements are given in Table 1. It is clear that 224.5-, 264.1-, 331.4-, 555.6-, 732.5-, 865.6-, 1003.5-, 1161.2-, 1814.2-, and 1881.5-keV γ-ray transitions has dipole (D) character whereas 778.5-, 1426.2- and 1598.4-kev γ-ray transitions have quadrupole (Q) character.

The 732.5-, 865.1-, and 1161.2-keV transitions are assigned M1 + E2 character, and 1426.2- and 1598.4-keV γ-ray transitions are assigned E2 character. The 778.1-keV γ-ray transition is assigned E1 character with $\Delta J =$ 0. Also polarisation measurements shows that
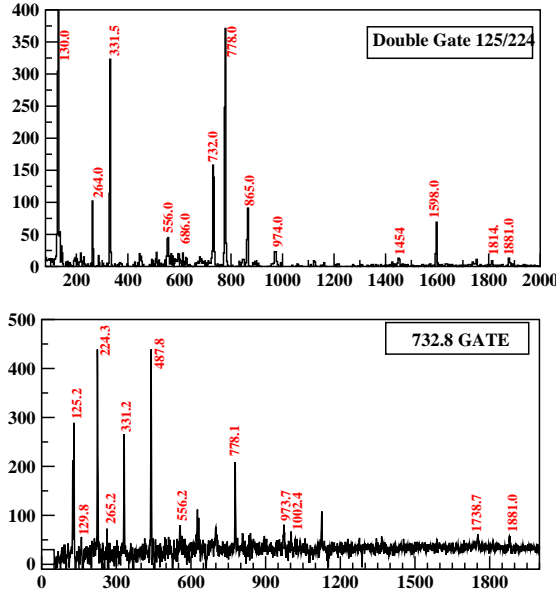
———
[*]Electronic address: `sursvmk123@gmail.com`

FIG. 1: (Colour Online) Background subtracted coincident spectrum of ^{86}Rb using the coincidence gate of 125.1/224.5- and 732.5-keV γ-ray.

331.4- and 552.6-keV γ-ray transitions has pure M1 character and 1814.5-, 1881.5-keV γ-ray transitions has E1 character. Further analysis is in process and results will be reported.

TABLE I: This is a table which shows DCO ratio and polarization asymmetry values of some transitions in ^{86}Rb

Enregy	R$_{DCO}$ (Q)	R$_{DCO}$ (D)	Pol. Asy.	Multi.
125.1	0.98 (17)			
130.1	0.96 (15)			
224.5	0.71 (7)		-0.045 (12)	M1 + E2
331.4	0.53 (4)	1.22 (10)	-0.06 (16)	M1
264.1	0.70 (7)			(M1)
555.6	0.55 (5)		-0.12 (4)	M1
732.5	0.46 (4)		-0.055 (15)	M1 + E2
778.1	1.06 (12)	2.51 (18)	-0.103 (14)	E1 ($\Delta J = 0$)
865.1	0.60 (7)	1.26 (12)	-0.074 (20)	M1 + E2
1003.5		1.11 (23)	0.012 (32)	E1
1161.2	0.60 (30)		0.16 (6)	M1 + E2
1426.9	0.97 (17)		0.023 (46)	E2
1598.4	0.86 (10)	2.17 (28)	0.052 (30)	E2
1814.5	0.56 (19)	1.01 (48)	0.061 (36)	E1
1881.5	0.55 (4)	1.02 (28)	0.046 (37)	E1

Acknowledgments

References

[1] S. Saha *et al.*, Phys. Rev. **C 89**, 044315 (2014).
[2] S. Kumar *et al.*, Phys. Rev. **C 90** , 024315 (2014).
[3] Naveen Kumar *et al.* submitted for publication .
[4] G. Winter *et al.* Phys. Rev **C 49**, 5 (1994).