High Spin states in $^{86}_{38}Sr_{48}$

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Introduction

Spectroscopic studies of nuclei with Z∼40, N∼50 near subshell and shell closure is a subject of interest in the recent times in nuclear physics. In the last decade, the measurements with modern γ-ray spectrometers have extended the structure of these nuclei to high spin states. Due to the limited number of single particles orbitals $p_{\frac{3}{2}}, p_{\frac{1}{2}}, f_{\frac{5}{2}}$ and $g_{\frac{9}{2}}$ shell model calculations are important to interpret experimental results. Nuclei in this region which have Z∼38 or 40 are considered as candidates of subshell closure. The nuclei Kr, Sr, Zr, Mo, Tc etc. are expected to show single particle characteristics with collective features becoming more important for N≤ 40 and N≥ 58. Previously ^{86}Sr nucleus was studied through $^{84}Kr(\alpha, 2n)^{86}Sr$ [1], $^{74,76}Ge(^{18}O, \alpha 2n, \alpha 4n)^{86}Sr$ [2] and $^{82}Se(^{9}Be, 5n\gamma)^{86}Sr$ [3] reactions and experimental results are interpreted using different models. Present work provides more information on different parity bands in ^{86}Sr.

Experimental details

^{86}Sr nuclei was investigated through high spin spectroscopy by the reaction ^{76}Ge(^{13}C, 3n)^{86}Sr using ^{13}C beam of 45 MeV from the Pelletron accelerator at Tata Institute of Fundamental Research (TIFR), Mumbai. ^{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. The distance of target from detectors was 25cm. 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.

Results and Discussion

In this paper we are reporting high spin spectroscopy of ^{86}Sr which is a biproduct of ^{76}Ge(^{13}C,3n)^{86}Sr reaction [4]. For the assignment of spin and parity a large number of gated spectra are analysed.

The level scheme of ^{86}Sr has been extended up to 10.9 MeV excitation energy and spin I^{π} = $19^{+}\hbar$. Both positive as well as negative parity bands are enhanced by the analysis of available data. A large number of new levels and new γ-rays are identified in this nucleus. The analysis has been done with singles data, 2-D matrix as well as with cubes. The spin and parities has been assigned by using DCO ratios and polarization asymmetry measurements (shown in Fig 1) . Both (dipole as well

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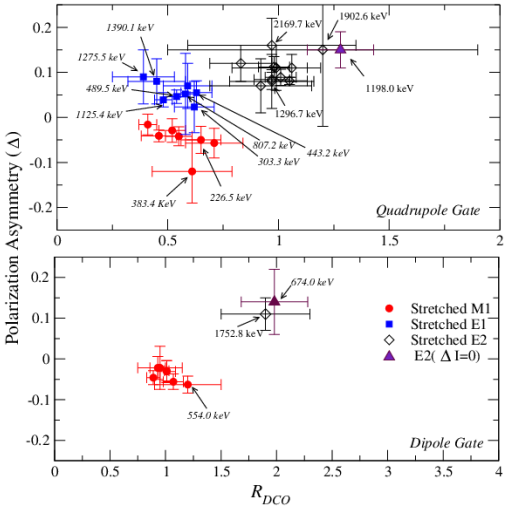

FIG. 1: Linear Polarization Asymmetry Δ vs. R_{DCO} measurements of γ-rays in ^{86}Sr.

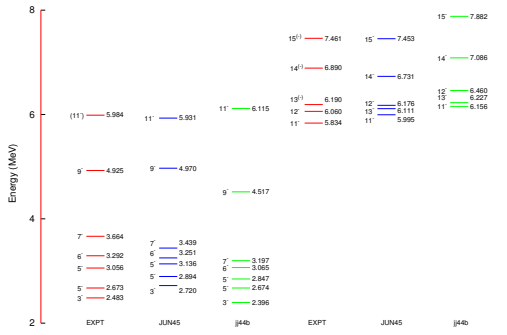

FIG. 2: Comparison of the experimentally obserbed negative parity levels of ^{86}Sr with the results of shell model calculations using different interactions.

as quadrupole) type of transitions are used for gating to calculate DCO. To obtain information about multipolarities an asymmetric matrix was created with events detected in the clover detector at 157° on one axis and 90° on other axis. The DCO ratios for a particular transition are obtained by setting gates on stretched transitions of known multipolarities. The character of transitions were determined by calculating linear polarization of gamma rays for the clovers placed at 90°.The value of polarization asymmetry is positive for electric transitions and negative for magnetic transitions.

The experimental results are compared with theoretical calculations using m-scheme code ANTOINE in $1p_{3/2}$, $0f_{5/2}$, $1p_{1/2}$, $0g_{9/2}$ model space and good agreement between the two has been found. The results of JUN45 interaction are close to experiment within ∼200keV while the results of jj44b ae slightly higher (as shown in fig.2). The results for high spin states reveals the improtance of $g_{\frac{9}{2}}$ orbitals. The systematics of N=48 isotones is also carried out to understand the structural changes in this region. Ground state band up to $I^{\pi} = 8^{+}\hbar$ in ^{84}Kr, ^{86}Sr, ^{88}Zr and ^{90}Mo have almost similar structure. While in the yrare states $g_{9/2}$ is playing its role for dissimilar behaviour. In these isotones there is two neutron hole configuration $\nu(g_{\frac{9}{2}})^{-2}$ dominance and level structure of these isotones show the characteristics of single particle excitations. A more detailed study of electromagnetic properties like B(E2), B(M1), magnetic moments, life time measurements etc. is required to understand the structure of these nuclei.

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