

# Decay of $^{131}\text{La}$

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## Introduction

Decay studies using high resolution  $\gamma$ -spectroscopy techniques provide precise information on the decay half-life, properties of the low-lying states and information about the decaying  $\gamma$ -rays from low-lying non-yrast states.

In this present work, the ( $\beta^+, \epsilon$ ) decay measurements of  $^{131}\text{La}$  has been carried out following high resolution  $\gamma$ -ray spectroscopy techniques. The previous studies were performed by isotopic separation of  $^{131}\text{La}$  by means of mass spectrograph and subsequent determination of activity [1,2] and the decay  $\gamma$ -rays either by NaI(Tl) scintillation detectors [2,3] or Ge(Li) detectors [4]. In the work of Ref.[1-3], the isotopically enriched  $^{131}\text{Ba}$  target was bombarded either by protons or deuterons, to produce  $^{131}\text{La}$ . This was followed by separation of La activities, which yielded decay half-life of  $^{131}\text{La}$  as 58 min, 61(2) min and 56(3) min respectively. The evaluated half-life reported by NNDC [5] is 59(2) min, which is the weighted average of 61(2) min [2] and 56(3) min [3]. Further, many of the decaying  $\gamma$ -transitions are also tentatively placed [4] in the decay scheme. The large uncertainties in the half-life determination and the placement of the decay transitions are mostly due to the unavailability of high resolution spectroscopic setup. The present work reports

precise measurement of the decay half-life and the  $\gamma$ -transitions from  $^{131}\text{La}$  decay.

## Experiment

The activity of  $^{131,132}\text{La}$  has been produced using  $^{14}\text{N}$  beam at 115 MeV bombarded on  $^{124}\text{Sn}$  target, at K-130 Cyclotron facility of Variable Energy Cyclotron Centre (VECC), Kolkata. The active foil of  $^{124}\text{Sn}$  was counted with 10 Nos. of Compton suppressed Clover HPGe detectors of the Indian National Gamma Array (INGA) setup at VECC, coupled to digital data acquisition system [6].

## Data Analysis

The list-mode raw data were processed through BiNDAS [7] sorting program and time-stamped decay data were gathered for a total duration of 5 hours and the event files of the addback of all the Clover HPGe detectors were generated, for 10 minutes duration each, to follow the decay of  $^{131}\text{La}$ . To obtain the  $\gamma$ - $\gamma$  coincidence information, a  $\gamma$ - $\gamma$  symmetric matrix was generated from the time stamped data of all clover detectors, from which coincidence spectra of various transitions of  $^{131}\text{La}$  were obtained.

## Results

The decay spectrum for first 10 min after beam is stopped, is shown in Fig.1 (a), in which the  $\gamma$ -rays from  $^{131,132}\text{La}$  decay are observed clearly.

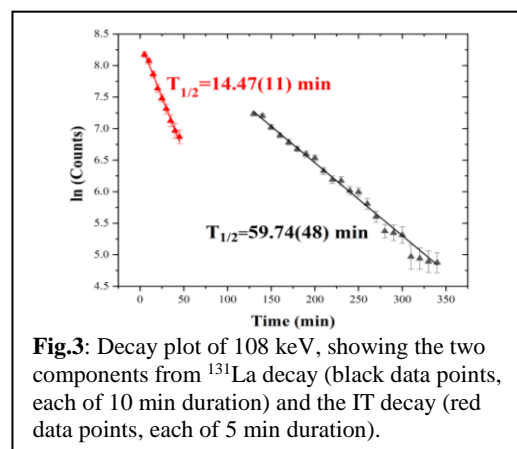
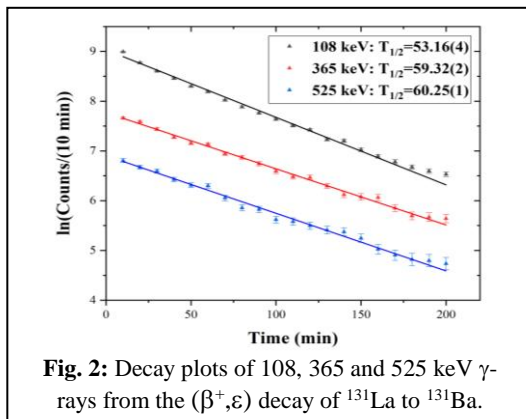
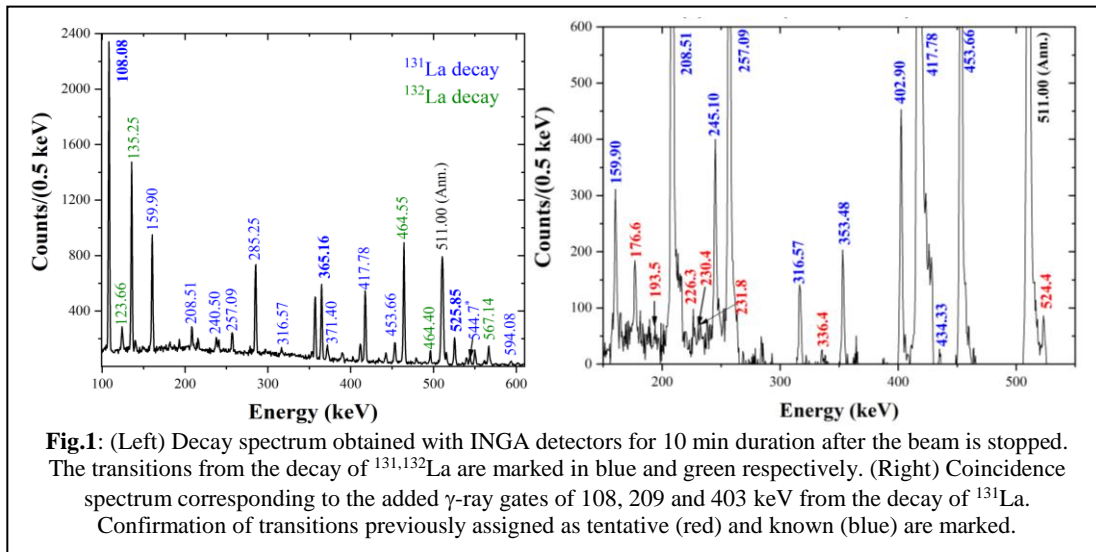


Fig.1 (b) shows the coincidence spectrum of the added  $\gamma$ -ray gates of 108, 209 and 403 keV transitions from  $^{131}\text{La}$  decay. Some of the transitions, previously reported as tentative, could be confirmed from the present data.

Half-lives have been measured by following the intensity of several decay transitions, for about 5 hr. The decay plots of transitions from  $^{131}\text{La}$  decay are shown in Fig.2. The 365 and 525 keV transitions are clean, i.e., not contaminated by the IT decay in  $^{131}\text{Ba}$  or contribution from activity of  $^{132}\text{La}$ , produced in the same reaction. For these transitions, the half-life of  $^{131}\text{La}$  has been determined to be 59.32(2) min and 60.25(1) min respectively. For 108 keV, the slope of the decay curve is found to be different. This is due to the contribution from  $^{131}\text{Ba}$  IT decay of 14.6 min. The decay of 108 keV is therefore followed leaving first 120 min, which gives the half-life of 59.74(48) min, as

shown in Fig.3. The decay of 108 keV for first 50 min after beam off, showing mainly the IT decay component of half-life of 14.47(11) min.

## Summary

The present work reports the precise determination of the ground state decay half-life of  $^{131}\text{La}$ . The previously reported tentative decay transitions have also been confirmed.

## References

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