Decay Spectroscopy of ^{134}I

R. Banik[1,*], S. Bhattacharyya[1], Soumik Bhattacharya[1], D. Banerjee[2], S.K. Das[2], G. Mukherjee[1], T. Bhattacharjee[1], A. Choudhury[1], P. Das[1], R. Guin[2], A. Saha[1]
[1]*Variable Energy Cyclotron Centre, Kolkata -700064, India*
[2]*Radiochemistry Division, Variable Energy Cyclotron Centre, BARC, Kolkata – 700064, India*
** email: ranabir.banik@vecc.gov.in*

Introduction

The structure of neutron rich nuclei around the doubly magic shell closure (N=82 and Z=50) are of current interest to obtain information about the single particle structure involving few valance particles or holes in ^{132}Sn. The even-even nucleus ^{134}Xe, with four proton particles and two neutron holes with respect to *Z*=50 and N=82 shell closure provide fertile ground to probe the single particle excitations in this region of neutron-rich nuclei. Although it appears that vibration about a spherical shape do play an important role in the description of the first few excited states in even-even nuclei in this mass region but the transition from second 2^+ state to 0^+ ground state in Xe isotopes indicates that a pure vibrational model may not be applicable in all the cases. The deviation from axial symmetry in ^{134}Xe was also indicated from the energy systematics of first few excited states [1]. For better description of structure of excited states of nuclei in this mass region, it is important to study the low lying excitations. Though prompt spectroscopy of high spin states above the 7^- isomeric state (290ms) in ^{134}Xe have been studied recently [2], but precise measurements of low spin states in ^{134}Xe are very few [3,4]. In these studies, the decay spectroscopy of ^{134}I were carried out using one Ge(Li) and one NaI(Tl) detectors. These studies were not able to resolve close lying gamma energies and many high energy gamma rays (above 1 MeV) could not be placed in the level scheme, mainly due to limited efficiency and resolution of the detectors used. With the availability of new generation HPGe detectors, such decay measurements at present can be carried out more precisely. In the present work the excited states of ^{134}Xe, populated from the beta decay of the ground state of ^{134}I, have been investigated by offline decay spectroscopy using HPGe Clover detectors and Low Energy Photon Spectrometer (LEPS) consisting of Planer HPGe detectors.

Experiment

The neutron-rich nuclei in medium (A=130-136) mass region is difficult to produce in conventional fusion evaporation reaction. In the present work, the neutron-rich Iodine isotopes have been produced from alpha induced fission of ^{nat}U target using 32 MeV, 1 μA alpha beam from the Variable Energy Cyclotron at Kolkata. A stack of ^{nat}U targets (~1mg/cm^2), electrodeposited on Aluminium foils and separated by Aluminum catcher foils have been used. The catcher foils, containing fission products, were used for radiochemical separation of Iodine from all other fission products by solvent extraction method using Iodine carrier. The irradiation of the target was restricted to about 2 hour to optimize the activity of ^{134}I for which the half life is about 52 minutes. The beta decay branch from the 8^- high spin isomer (3.52min) in ^{134}I could not be observed.

The γ singles and γ–γ coincidence measurements were carried out in an offline array setup consisting of four Clover HPGe detectors and two segmented planer HPGe LEPS detectors. The 16 channel amplifiers and other standard NIM electronics were used to collect data in LIST mode with a VME based data acquisition system. In singles mode measurement, spectra have been stored in 10 minute interval to follow the half-lives for various decay transitions to confirm their presence. For γ–γ coincidence measurement the data were collected with a trigger condition of at least one γ-ray or X-rays detected in any of the LEPS detectors OR at least two γ-rays detected in any two of the Clover detectors. The raw data were gain matched to generate various γ–γ matrices using the LAMPS software.

Results and Discussion

The ground state of ^{134}I undergoes beta decay to populate the low lying excited states of ^{134}Xe. The decay transitions corresponding to 4^{+}-2^{+}-0^{+} cascade in ^{134}Xe are 884-847 keV. In Fig. 1, the decay curves of these transitions of ^{134}Xe along with two new gamma rays of 565 keV and 1541 keV, observed in the present work, are plotted. The deduced half lives confirm that these transitions belong to ^{134}Xe. Indication of presence of few more new transitions in ^{134}Xe was also obtained by following their half lives.

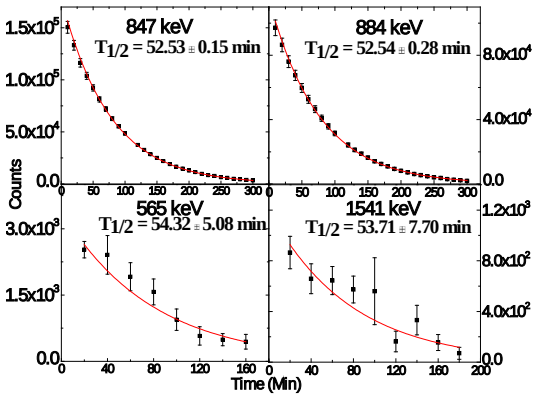

Fig.1: *Decay curve of gamma rays from excited states of ^{134}Xe populated by ^{134}I decay.*

Placement of new gamma rays observed in ^{134}Xe was confirmed from the analysis of γ–γ coincidence matrix. All the new gamma rays have been found to be in coincidence with the 847 keV 2^{+} - 0^{+} transition. We have confirmed the presence of almost 12 new gamma rays in the decay scheme of ^{134}I which were not placed in the level scheme from previous work. The coincidence spectrum of 847 keV gamma ray is shown in the Fig.2 where the new gamma rays observed from the present work are shown by '*' marks. Coincidence spectra corresponding to all these new transitions were also generated to confirm their placements. Presence of few more new transitions was also indicated from these coincidence spectra, but placement of those are yet to be confirmed. Fig.3 shows coincidence spectra corresponding to 2312 keV and 1655 keV new γ-rays, observed in the present work. It is clearly seen that 302 keV γ-ray is in coincidence with 2312 keV and 958 γ-ray is in coincidence with 1655 keV. These new γ-rays give the evidence of presence of a new level at 3460 KeV. The presence of 162 keV transition, tentatively placed in previous work as decaying out from 3477 keV level, could also be confirmed from the present data. The spin parity assignment of the new levels and construction of new level structure are in progress.

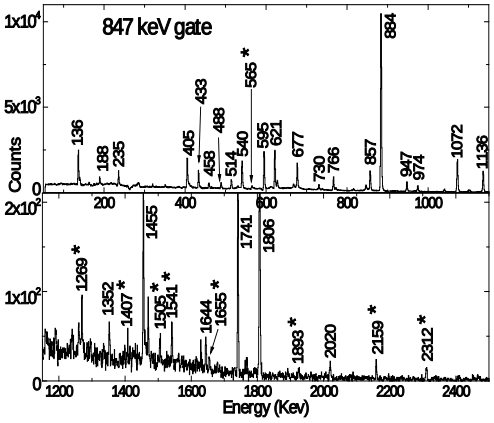

Fig. 2*: Coincidence Spectrum of the 847 keV with the new transitions marked with" *".*

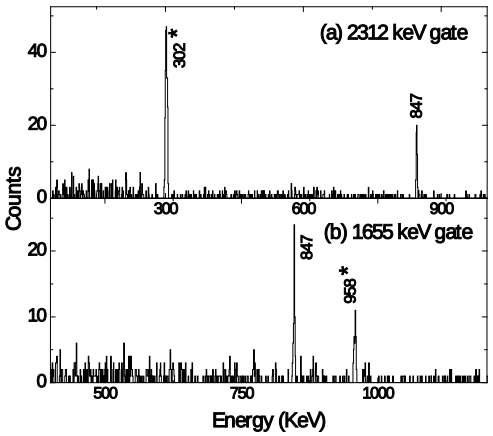

Fig. 3*: Coincidence spectrum of (a) 2312 keV and (b) 1655 keV.*

Reference

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