Spectroscopy of neutron rich fission fragments around ^{132}Sn nuclei in ^{238}U (^{18}O, f) reaction

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Introduction

Neutron-rich nuclei are of particular interest since they might reveal new aspects of nuclear structure associated with an excess of neutrons, such as a neutron skin, a modified shell structure, and new modes of excitation [1]. These nuclei are difficult to produce, particularly in high-spin states, using stable beams and targets by the conventional fusion-evaporation reactions. However, using the fission reactions, neutron-rich nuclei in the mass region of $100 < A < 150$ can be produced as fission fragments with spin as high as 20ħ. Thus the spectroscopic studies of fission fragments does provide the information of the nuclear excited states of various neutron rich nuclei, which otherwise cannot be studied by the conventional fusion-evaporation reactions.

In this paper we report the spectroscopy of neutron rich fission fragments around Sn nuclei produced in ^{238}U (^{18}O, f) reaction. The experiment was carried out at 15UD IUAC Pelletron facility, New Delhi, using ^{18}O beam of energy 100 MeV to bombard a self supporting ^{238}U target of thickness ~ 15 mg/cm^2. The gamma rays emitted by the fission fragments were detected using Indian National Gamma Array (INGA) comprising of eighteen Compton suppressed Clover detectors, each having intrinsic photo peak efficiency ~ 0.2[2]. The details of the experiment and the method of data analysis has been published earlier [3].

Results and discussions

In the data analysis, a total of $\sim 1.9 \times 10^8$ three and higher fold events have been considered and the Eγ -Eγ matrix is constructed from the prompt γ -ray coincidence data. The data were analyzed using RADWARE software. The independent yield of a particular fragment nucleus has been determined from the coincidence of γ rays of $2^+ \rightarrow 0^+$ and $4^+ \rightarrow 2^+$ transitions [4]. The detailed mass distribution of even-even fragments produced in ^{238}U (^{18}O, f) reaction has been reported earlier [3].

The neutron rich nuclei around the double shell closure nucleus ^{132}Sn (Z=50 & N=82) have been of special interest both in experimental and theoretical aspects. In Fig.1, we have plotted the relative yield distribution of various neutron rich fission fragments around Sn nuclei produced in ^{238}U (^{18}O, f) reaction. Some of these nuclei have been studied earlier using deep inelastic reactions.

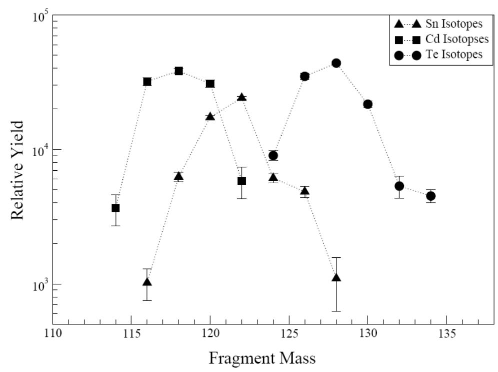

Fig. 1 Relative yield distribution of various neutron rich fission fragments around Sn nuclei produced in the ^{238}U (^{18}O, f) reaction.

As an example of the quality of the data obtained in this experiment, the γ -energy spectra gated on the transition of ^{130}Te is shown. The γ -ray energy spectra obtained with gates on $4^+ \rightarrow 2^+$ ($E\gamma$ = 794 keV), and $9^- \rightarrow 7^-$ ($E\gamma$ = 935 keV), transitions of ^{130}Te are shown in Fig.2. The labeled lines shown in the figure belong to ^{130}Te and some of the unlabeled lines are due to complementary fragments and contamination from other fragments. Gamma ray transitions up to $13^- \rightarrow 11^-$ (711 keV) are clearly seen in the 935 keV, gated spectrum.

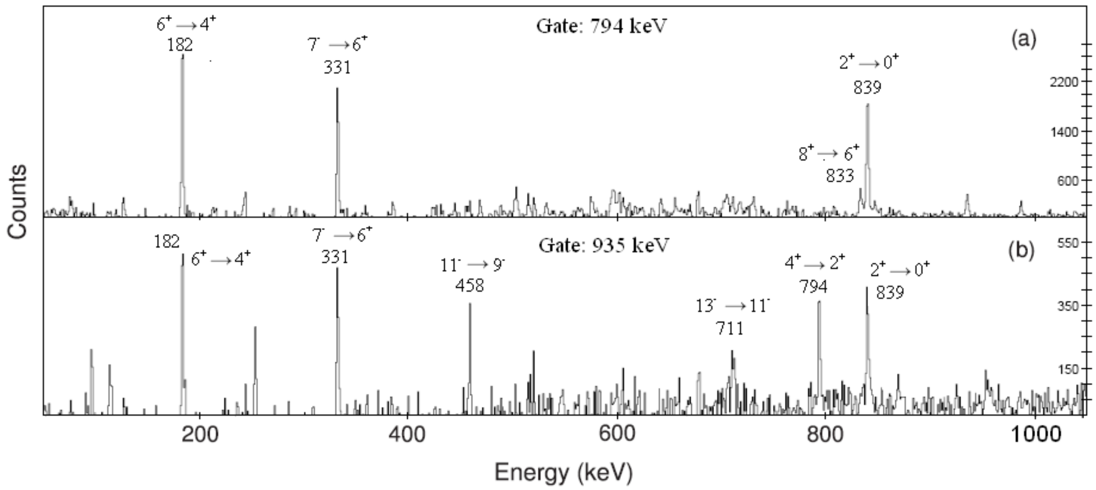

Fig.2. The γ -ray energy spectra obtained with gates on $4^+ \rightarrow 2^+$ ($E\gamma$ = 794 keV), and $9^- \rightarrow 7^-$ ($E\gamma$ = 935 keV), transitions of ^{130}Te.

The partial level scheme of ^{130}Te obtained from the present work is shown in Fig.3.

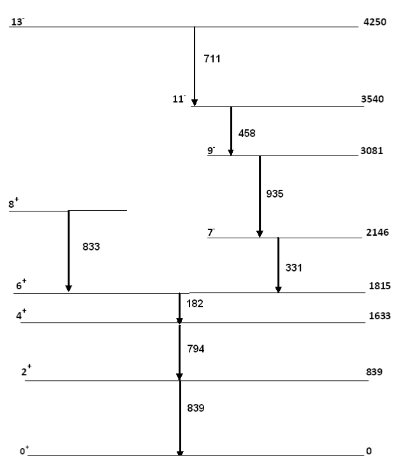

Fig.3. Partial level schemes of ^{130}Te.

The detailed data analysis for the spectroscopy of the neutron rich nuclei around the double shell closure nucleus ^{132}Sn is in progress.

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