Study of shape evolution in neutron-rich Cs isotopes using β-decay spectroscopy

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Shape evolution in neutron-rich nuclei with the neutron number $N>82$ and the proton number $Z>50$ beyond the doubly magic ^{132}Sn nucleus have been investigated along several isotopic chains. The EURICA project[1)] provides us with an opportunity to study extremely neutron-rich nuclei using β-decay and isomer-decay spectroscopy. We reported the results of the isomer-search experiment for neutron-rich Cs isotopes[2)], where new isomers were found in ^{145}Cs, ^{146}Cs, ^{147}Cs, and ^{148}Cs. To understand the nuclear structure of these neutron-rich Cs isotopes in the low-spin states, we studied the β decay of neutron-rich Xe to Cs isotopes.

The neutron-rich Xe isotopes were produced through in-flight fission reaction using a 345-MeV/nucleon ^{238}U beam. Particle identification was performed using the mass-to-charge ratio (A/Q) and the atomic number deduced from the information of time-of-flight (TOF), magnetic rigidity ($B\rho$) and energy loss of fission fragments through BigRIPS and ZeroDegree Spectrometer[3)]. The isotopes were implanted into a stack of five double-sided Si-strip detectors (WAS3ABi)[1)]. β rays emitted from the isotopes were also detected by WAS3ABi. The parent nuclei of the β decay were identified by position correlation on the WAS3ABi between the implanted fragments and the detected β rays. γ rays emitted after the β decay were detected by the γ-ray detector array which is called EURICA[1)].

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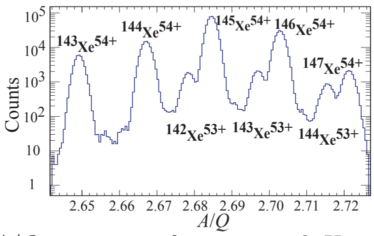

Fig. 1. A/Q spectrum of neutron-rich Xe isotopes.

Figure 1 shows a spectrum of particle identification for the Xe ($Z = 54$) isotopes as a function of A/Q. The fully-stripped ^{A}Xe^{54+} ions are separated from the hydrogen-like $^{A-3}$Xe^{53+} ones owing to the high A/Q resolution.

Coincidence data of β-γ and β-γ-γ with particle identification of ^{143}Xe, ^{144}Xe, ^{145}Xe, ^{146}Xe, and ^{147}Xe isotopes is analyzed. As an example, the γ-ray energy spectrum and the decay curve for the β decay of ^{145}Xe to ^{145}Cs are shown in Fig. 2. We found 11 new γ rays associated to the transitions in ^{145}Cs emitted after the β decay of ^{145}Xe. These γ-ray peaks are represented as full circles in Fig. 2. Other peaks are mostly assigned to transitions in the granddaughter ^{145}Ba nucleus. The inset in Fig. 2 shows the decay curve deduced by the time difference between the implantation of ^{145}Xe and the detection of the β rays gated on newly found 5 γ rays in ^{145}Cs. The half-life of the β decay was determined to be 197(10) ms, which is consistent with the reported one in Ref. 4. Detailed analyses are in progress.

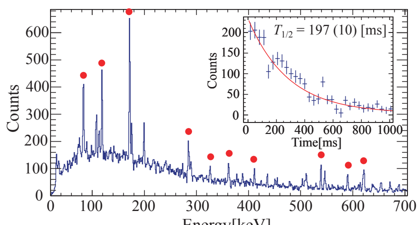

Fig. 2. γ-ray energy spectrum and decay curve of the β decay of ^{145}Xe to ^{145}Cs.

References

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