Search for isomers in neutron-rich Cs isotopes

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Neutron-rich nuclei in the northeast region of the doubly-magic ^{132}Sn are attracting much attention for the investigation of shape evolution from spherical (single-particle like) shapes to deformed (collective-like) prolate shapes as a function of the neutron number. Additionally, a variety of collective modes, such as the octupole collective mode and so on, is expected to appear in this mass region. As isomers are efficient probes of nuclear structure, we performed an isomer search experiment for the neutron-rich Cs isotopes in the framework of the EURICA project[1)].

The isomers were produced through in-flight fission of a 345 MeV/nucleon ^{238}U beam. The fission fragment separator system of BigRIPS and Zero Degree Spectrometer[2)] was tuned for neutron-rich Sb, Te, I, Xe, and Cs isotopes with A=140−150. The isotopes with a rate of approximatelly 50 pps were implanted into a stack of 5 double-sided Si strip detectors (WAS3ABi)[1)]. The β rays and γ rays emitted from the stopped isotopes were detected by WAS3ABi and EURICA, which consists of 12 cluster-type Ge detectors, respectively. Particle identification was performed on the basis of the information of time-of-flight (TOF), magnetic rigidity ($B\rho$) and energy loss of the fragments to deduce mass-to-charge ratio (A/Q) and atomic number. The particle identification for our $B\rho$ setting is shown in ref. 3. Figure 1 shows the A/Q spectrum of the Cs isotopes deduced using the information of $B\rho$ at F5 and F7 as well as TOF between F3 and F7. The isomers were searched for on the basis of the timing information between the γ ray detected by EURICA and ion passage in the plastic scintillator just upstream of WAS3ABi. The long flight time (approximately 650 ns) limited the half lives of longer than hundreds of nanoseconds.

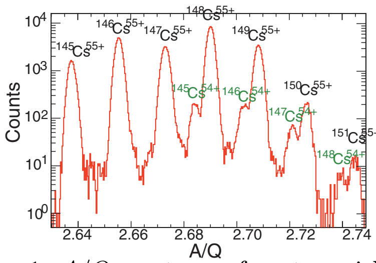

Fig. 1. A/Q spectrum of neutron-rich Cs isotopes.

In this time range, we found new isomers in the nuclei ^{145}Cs, ^{146}Cs, ^{147}Cs, and ^{148}Cs. As an example, a decay curve of the isomer in ^{146}Cs is shown in Fig. 2. The half life and decay scheme obtained in this work for ^{144}Cs were consistent with the results reported in ref. 4. The decay schemes of newly found isomers in $^{145-148}$Cs have been established. The isomers in odd-odd Cs isotopes are caused by the direct low-energy deexcitation from the isomer, which is effected by the proton and neutron interaction. In contrast, the decay pattern of the isomers in the odd-Cs isotopes suggests that these isomers are supposed to be K-isomer candidates.

Systematic studies of the isomers in the Cs isotopes are expected to provide new insights on shape evolution as well as proton-neutron interaction in various deformed systems. Detailed analysis is in progress.

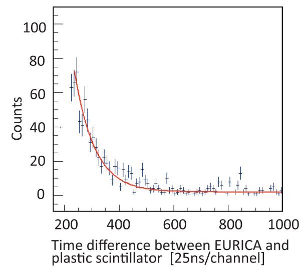

Fig. 2. Decay curve of the newly found isomer in ^{146}Cs.

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