Investigation of octupole correlations of neutron-rich $Z \sim 56$ isotopes by β-γ spectroscopy

R. Yokoyama,[*1] E. Ideguchi,[*2] G. Simpson,[*3] Mn. Tanaka,[*2] S. Nishimura,[*4] P. Doornenbal,[*4] P.-A. Söderström,[*4] G. Lorusso,[*4] Z. Y. Xu,[*5] J. Wu,[*4,*6] T. Sumikama,[*7] N. Aoi,[*2] H. Baba,[*4] F. Bello,[*8] F. Browne,[*9,*4] R. Daido,[*10] Y. Fang,[*10] N. Fukuda,[*4] G. Gey,[*3,*4,*11] S. Go,[*1,*4] N. Inabe,[*4] T. Isobe,[*4] D. Kameda,[*4] K. Kobayashi,[*12] M. Kobayashi,[*1] T. Komatsubara,[*13] T. Kubo,[*4] I. Kuti,[*14] Z. Li,[*6] M. Matsushita,[*1] S. Michimasa,[*1] C.-B. Moon,[*15] H. Nishibata,[*10] I. Nishizuka,[*7] A. Odahara,[*10] Z. Patel,[*16,*4] S. Rice,[*16,*4] E. Sahin,[*8] L. Sinclair,[*17,*4] H. Suzuki,[*4] H. Takeda, [*4] J. Taprogge,[*18,*19] Zs. Vajta,[*14] H. Watanabe,[*20] and A. Yagi[*10]

It has long been a question whether there exist nuclei with static octupole deformation. The interaction between orbits with $\Delta J = \Delta I = 3$ is responsible for octupole correlations and the nuclei with such orbits close to the Fermi surface are expected to have large octupole correlations. The Possible nucleon numbers where this occurs are Z or $N \sim$ 34, 56, 88, and 134. The neutron-rich Ba isotopes ($Z = 56$, $N \sim 88$) are expected to have large octupole correlations and are good candidates for octupole deformation. The even-even Ba isotopes have been studied from $A = 140$ to 148, and low-lying positive- and negative- parity octupole bands connected with enhanced E1 transition rates have been discovered[1]. Although the E1 rates should have a peak at $N = 88$, Ref.[1] revealed that ^{148}Ba$_{92}$ has E1 rates as large as those of ^{144}Ba$_{88}$, whereas ^{146}Ba$_{90}$ has much smaller E1 rates. The theoretical calculations available so far provide different answers for octupole correlations in this region. For example, the microscopic-macroscopic method[2] predicts some β_3 values, whereas Hartree-Fock calculation[3] argues that there is no state with a dipole moment. Therefore, the experimental investigations of more neutron-rich Ba isotopes is required.

We performed β-γ spectroscopy on neutron-rich $Z \sim 56$ isotopes at RIBF. The neutron-rich isotopes were produced using in-flight fission of a 345MeV/nucleon ^{238}U beam bombarding a 3-mm thick Be target. The typical intensity of the primary ^{238}U beam was ~ 6 pnA during the two days of measurement for the Ba region. Fission fragments were identified by measuring the time-of-flight and magnetic rigidity in the second stage of BigRIPS and by measuring the energy loss by using the ion chamber at the final focal plane, F11. The secondary beam was implanted into an active stopper WAS3ABi[4], which consists of five layers of double-sided-silicon-strip detectors for ion-β correlation. The γ rays from the implanted nuclei were detected by using EURICA[5], an array of 12-cluster Ge detectors in which each cluster consists of 7 crystals.

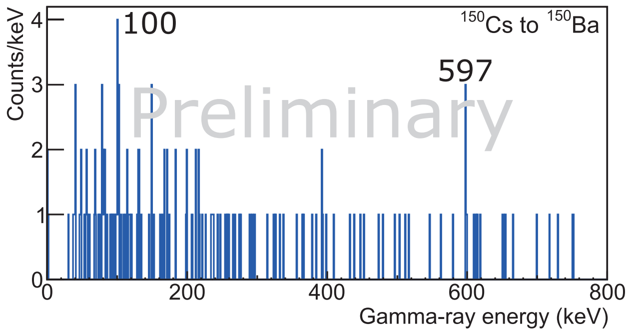

Fig. 1. Preliminary γ-ray energy spectra of the β decay from ^{150}Cs to ^{150}Ba. The time window is 200 ms from the ion implantation.

Figure 1 shows the γ-ray energy spectrum of β-decay events after the implantation of ^{150}Cs. Candidates for peaks are present at energies of 100 and 597 keV. The peaks at 100 keV can be interpreted as the 2^+ to 0^+ γ decays. The energies of the proposed 2^+ level of ^{150}Ba is lower than those in ^{148}Ba, indicating an increase in quadrupole deformation at ^{150}Ba. Test of the significance of the 597-keV peak and examination whether it can be a negative parity state with octupole collectivity are in progress.

*1 Center for Nuclear Study, The University of Tokyo
*2 Research Center for Nuclear Physics, Osaka University
*3 LPSC, Université Grenoble-Alpes, CNRS/IN2P3
*4 RIKEN Nishina Center
*5 Department of Physics, The University of Tokyo
*6 Department of Physics, Peking University
*7 Department of Physics, Tohoku University
*8 Department of Physics, University of Oslo
*9 School of Computing Engineering and Mathematics, University of Brighton
*10 Department of Physics, Osaka University
*11 ILL, Grenoble
*12 Department of Physics, Rikkyo University
*13 Department of Physics, University of Tsukuba
*14 MTA Atomki, Hungarian Academy of Science, Hungary
*15 Department of Display Engineering, Hoseo University
*16 Department of Physics, University of Surrey
*17 Department of Physics, University of York
*18 Instituto de Estructura de la Materia, CSIC
*19 Departamento de Física Teórica, Universidad Autónoma de Madrid
*20 Department of Physiscs, Beihang University

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