International Nuclear Physics Conference INPC2013: 2-7 June 2013, Firenze, Italy

Overview of the Search for New Isotopes and New Isomers at RIKEN RI Beam Factory

T. Kubo[1], D. Kameda[1], H. Suzuki[1], N. Fukuda[1], H. Takeda[1], N. Inabe[1], R. Yokoyama[2], S. Go[2], and E. Ideguchi[2]
for the BigRIPS new isotope and new isomer collaboration

[1] *RIKEN Nishina Center, RIKEN, 2-1 Hirosawa, Wako, Saitama 351-0198, Japan*
[2] *Center for Nuclear Study, University of Tokyo, 2-1 Hirosawa, Wako, Saitama 351-0198, Japan*

Contact email: *kubo@ribf.riken.jp*

A new-generation rare-isotope (RI) beam facility called the RI Beam Factory (RIBF) [1] became operational in 2007 at RIKEN Nishina Center, aiming to greatly expand the frontiers of accessible exotic nuclei. The BigRIPS in-flight separator [2,3,4] has been used to produce a variety of RI beams at RIBF, being characterized by its large acceptances and two-stage structure. The large acceptances allow efficient RI-beam production using in-flight fission of a ^{238}U beam, in which fission fragments are produced with large angular and momentum spreads. The two-stage structure allows not only two-stage separation but also excellent particle identification of the fragments. The BigRIPS separator is designed so as to exploit the advantageous features of in-flight fission, which is known to be an excellent mechanism for producing a wide range of neutron-rich exotic nuclei.

Since the commissioning of the RIBF, we have three times performed search for new isotopes using in-flight fission of 345 MeV/nucleon ^{238}U, in order to expand the regions of accessible exotic nuclei. In the first run in May 2007 [5], we easily reached the frontiers of known isotopes and observed the new neutron-rich isotopes ^{125}Pd and ^{126}Pd, although the beam intensity was as low as 0.007 pnA on average and the net running time was only one day. The discovery of these Pd isotopes demonstrated not only the performance of the BigRIPS separator, but also the potential of RIBF.

In November 2008 we revisited the search with ~30 times higher beam intensity than in 2007. The results demonstrated the overwhelming RI-beam production power at RIBF. [6] We ran the measurement at three different settings, each of which targeted the production of new neutron-rich isotopes in the Z ~ 30, Z ~ 40, and Z ~ 50 regions, respectively. The net running time was only four days and the average beam intensity was 0.22 pnA. We were able to identify 45 new isotopes over a wide range of very neutron-rich nuclei with Z numbers ranging from 25 to 56. For Pd isotopes, we observed the more neutron-rich isotopes ^{127}Pd and ^{128}Pd, reaching the r-process waiting point at the N = 82 neutron magic number. While searching for new isotopes, delayed γ-rays emitted from microsecond isomers were simultaneously detected at the focal plane after ion implantation. We observed a total of 54 isomers, including 18 new isomers in very neutron-rich exotic nuclei, and obtained a wealth of spectroscopic information, allowing investigation of nuclear isomerism and nuclear structure over a wide range of neutron-rich exotic nuclei [7].

In October 2011, we ran the search for new isotopes and new isomers in the neutron-rich frontiers with Z ~ 60. The ^{238}U beam intensity was about 0.2–0.5 pnA. Our preliminary results indicate the observation of a number of new isotopes and new isomers in this neutron-rich region.

An overview of the search for new isotopes and new isomers at RIBF will be presented.

[1] Y. Yano, Nucl. Instr. and Meth. B 261, 1009 (2007).
[2] T. Kubo, Nucl. Instr. and Meth. B 204, 97 (2003).
[3] T. Kubo et al., IEEE Trans. Appl., Supercond. 17, 1069 (2007).
[4] T. Kubo et al., Prog. Theor. Exp. Phys. 2012, 03C003.
[5] T. Ohnishi et al., J. Phys. Soc. Japan 77, 083201 (2008).
[6] T. Ohnishi et al., J. Phys. Soc. Japan 79, 073201 (2010).
[7] D. Kameda et al., Phys. Rev. C 86, 054319 (2012).