

## RI beam production at BigRIPS since its commissioning in 2007

N. Inabe,\*<sup>1</sup> N. Fukuda,\*<sup>1</sup> H. Takeda,\*<sup>1</sup> D. Kameda,\*<sup>1</sup> H. Suzuki,\*<sup>1</sup> Y. Shimizu,\*<sup>1</sup> H. Sato,\*<sup>1</sup> D. Murai,\*<sup>1</sup> D. S. Ahn,\*<sup>1</sup>  
T. Ohnishi,\*<sup>1</sup> K. Kusaka,\*<sup>1</sup> Y. Yanagisawa,\*<sup>1</sup> A. Yoshida,\*<sup>1</sup> K. Tanaka,\*<sup>1</sup> M. Ohtake,\*<sup>1</sup> K. Yoshida,\*<sup>1</sup> and T. Kubo\*<sup>1</sup>

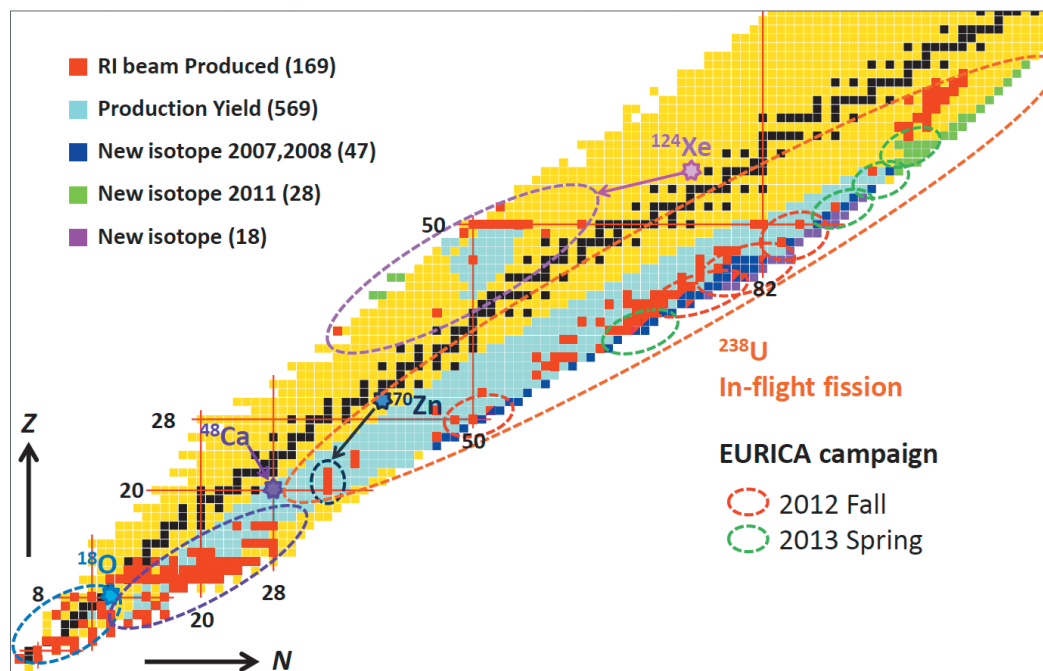


Fig.1 RI's produced at BigRIPS from March 2007 to July 2013.

Since the commissioning of the BigRIPS separator<sup>1)</sup> in March 2007, a variety of RI beams have been produced at the BigRIPS and used for experiments. Figure 1 shows the nuclear chart in which all isotopes produced at the BigRIPS from March 2007 to July 2013 are indicated in different colors. Red indicates isotopes used for experiments and light blue indicates isotopes whose production yields and cross sections were measured. New isotopes are shown in different colors according to the year in which they were discovered: blue in 2007 and 2008, green in 2011, and purple in 2012. Light isotopes with  $Z < 25$  were produced using projectile fragmentations of  $^{18}\text{O}$ ,  $^{48}\text{Ca}$ , and  $^{70}\text{Zn}$  beams. The projectile fragmentation of  $^{124}\text{Xe}$  is used for proton rich isotopes, and the in-flight fission of  $^{238}\text{U}$  for medium and heavy ( $Z = 20\sim 68$ ) isotopes. The production yields were measured for 569 isotopes. A total of 169 RI beams were used in the experiments. 89 new isotopes were discovered by the in-flight fission of  $^{238}\text{U}$  and 4 new isotopes were discovered by the projectile fragmentation of  $^{124}\text{Xe}$ .

The number of experiments performed using RI beams for various primary beams in each year is summarized in Table 1. Before 2010, RI beams were mainly produced using the  $^{238}\text{U}$  beam with low intensity and  $^{48}\text{Ca}$ . In December 2011, proton rich RI beams including  $^{100}\text{Sn}$  were produced from the accelerated  $^{124}\text{Xe}$  beam for the first time. In 2012, RI beams around  $^{78}\text{Ni}$ ,  $^{115}\text{Nb}$ ,  $^{123}\text{Rh}$ ,  $^{128}\text{Pd}$ , and  $^{136}\text{Sn}$  including

new isotopes discovered in 2008 were produced from the  $^{238}\text{U}$  beam with increased intensity ( $\sim 10$  pNA) and delivered to EURICA. Another 18 new isotopes were discovered at this time.

In April 2013,  $^{16}\text{C}$  was delivered to ESPRI and  $^{16}\text{C}$  and  $^{12}\text{C}$  were delivered to SAMURAI. Heavy RI beams around  $^{142}\text{Te}$ ,  $^{150}\text{Ba}$  and  $^{158}\text{Nd}$  and middle ones around  $^{104,108}\text{Y}$ ,  $^{108}\text{Zr}$ , and  $^{72}\text{Fe}$  from  $^{238}\text{U}$  were delivered to EURICA in May and June 2013. Very proton rich RI beams of  $^{100}\text{Sn}$  and  $^{73}\text{Sr}$  from  $^{124}\text{Xe}$  were also delivered to EURICA in June 2013.

Production yields and cross sections of isotopes produced in 2013 are currently being analyzed.

Table 1. Number of experiments performed using RI beams in each fiscal year.

	$^{238}\text{U}$	$^{124}\text{Xe}$	$^{86}\text{Kr}$	$^{70}\text{Zn}$	$^{48}\text{Ca}$	$^{18}\text{O}$	$^{14}\text{N}$	$^4\text{He}$	Tot
'07	4		1						5
'08	2				4				6
'09	3				3		3	1	10
'10					10	1	2		13
'11	4	2				2			8
'12	6	3		1	4	6			20
'13	4	2				3			9
Tot	23	7	1	1	21	12	5	1	71

### References

1) T. Kubo: Nucl. Instr. Meth. **B 204**, 97 (2003).

\*<sup>1</sup> RIKEN Nishina Center