

RI beam production at BigRIPS in 2014

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RI beam production at the BigRIPS fragment separator¹⁾ in 2014 is presented. Table 1 lists the experimental programs carried out at BigRIPS in this period and the RI beams produced for each experiment.

The beam time at the RIBF started in March with the Uranium beam campaign, in which 6 experiments were performed. The long-lived fission products, ¹³⁷Cs and ⁹⁰Sr, were produced by the in-flight fission of the ²³⁸U beam to investigate their nuclear-transmutation reaction²⁾. Owing to their proximity to the β -stability line, we experienced difficulties in improving the purities of the isotopes of interest.

The ⁵⁵Ca and ⁵⁶Ca beams were produced by projectile fragmentation of a ⁷⁰Zn beam for a direct mass measurement at the SHARAQ spectrometer. A spectroscopy of deeply-bound pionic atoms was performed using the BigRIPS separator as a high-resolution spectrometer. The spring beam time ended with the ¹⁶O beam experiment at

the SHARAQ spectrometer.

The autumn beam time began in October with the second Uranium beam campaign, which consisted of 6 experiments. First, a machine study was conducted to study particle identification and isotope separation when producing heavier beams with an atomic number (Z) of around 80³⁾. It was the first attempt at the RIBF. The ¹⁷²Dy and ¹⁷⁰Dy beams were delivered to the EURICA experiment. The RI-beam production around Z = 65 at BigRIPS has been pioneered in recent new-isotope-search experiments^{4,5)}.

The ⁴⁸Ca primary beam was provided with a high intensity of approximately 500 pA. Such a high-intensity beam made it possible to search for the neutron drip line for the F, Ne, and Na isotopes.

The experiments to search for new neutron-rich isotopes were performed using the in-flight fission of a ²³⁸U beam^{5,7)}, as shown in Table 1. A total of 28 new isotopes were identified in the preliminary analysis.

Table 1. List of the experimental programs and RI beams produced at the BigRIPS in 2014 (in chronological order).

Primary beam	Proposal No.	Course	RI beam (Primary beam)
²³⁸ U 345 MeV/u	NP1306-SAMURAI17	SAMURAI	¹³² Sn
	NP1306-SAMURAI14	SAMURAI	(²³⁸ U)
	NP1306-RIBF31R1	ZeroDegree	¹³⁰ Cd
	DA14-01	ZeroDegree	¹³⁷ Cs, ⁹⁰ Sr
	DA14-02-01 NP1312-RIB118	BigRIPS ZeroDegree	New isotope search (Z ~ 55–70 region) ⁷⁹ Cu, ⁷³ Co, ⁶⁷ Mn
⁷⁰ Zn 345 MeV/u	NP1312-SHARAQ3R	SHARAQ	⁵⁶ Ca, ⁵⁵ Ca, ⁵⁴ Sc
² H 250 MeV/u	NP1312-RIBF54R1	BigRIPS	¹ H, ³ He *(d, ³ He) reaction for pionic atom
¹⁶ O 250 MeV/u	NP1112-SHARAQ08	SHARAQ	¹ H, (¹⁶ O)
^{aa238} U 345 MeV/u	MS-EXP13	BigRIPS	RI-beam production in the region of Z ~ 80
	NP1012-RIBF63	BigRIPS	⁸² Ga
	NP1012-RIBF61	ZeroDegree	¹³² Sn, ¹²⁸ Sn
	NP1306-RIBF51R1	ZeroDegree	⁷⁰ Ni
	DA14-02-02 NP1112-RIBF88R1	BigRIPS EURICA	New isotope search (Z ~ 33 region) ¹⁷² Dy, ¹⁷⁰ Dy
⁴⁸ Ca 345 MeV/u	NP1312-RIBF56R1	ZeroDegree	²⁴ O, ²² O, ²⁰ O
	NP1312-SAMURAI18R1	SAMURAI	¹⁹ B, ¹⁷ B, ¹⁴ Be, ¹¹ Li
	DA14-02-03	BigRIPS	Drip line search for F, Ne, Na

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Fig. 1 shows the nuclear chart, in which all the isotopes produced at the BigRIPS from the commissioning in March 2007 to December 2014 are indicated along with the new isotopes observed at BigRIPS. The number of RI-beams produced amounted to approximately 350, and the number of new isotopes reached approximately 140. Production yields for more than 1,000 isotopes were obtained.

The number of experiments using RI beams at BigRIPS is tallied in Table 2, for various primary beams in each year. A total of 89 experiments have been performed so far.

References

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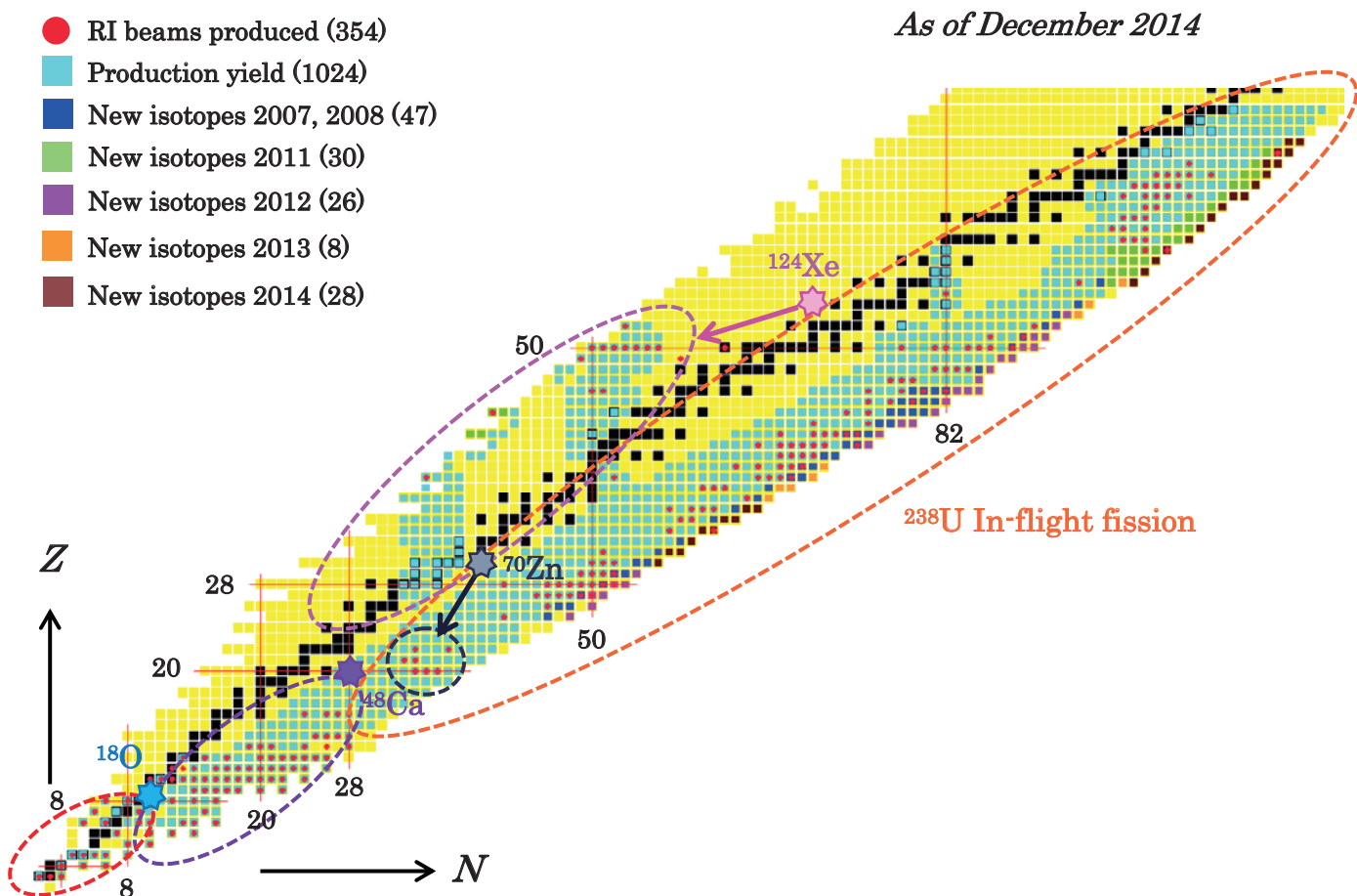


Fig. 1. RI beams produced at the BigRIPS separator from March 2007 to December 2014.

Table 2. Number of experiments using RI beams at the BigRIPS.

Year	²³⁸ U	¹²⁴ Xe	⁸⁶ Kr	⁷⁰ Zn	⁴⁸ Ca	¹⁸ O	¹⁶ O	¹⁴ N	⁴ He	² H	Yearly total
'07	4		1								5
'08	2				4						6
'09	3				3			3	1		10
'10					10	1		2		1	14
'11	4	2				2					8
'12	6	3		1	4	6					20
'13	4	2				3	1				9
'14	11			1	3					1	17
Total	34	7	1	2	24	12	1	5	1	2	89