

RI beam production at BigRIPS in 2020

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The radioactive isotope (RI) beam production at the BigRIPS fragment separator¹⁾ in 2020 is presented here. Table 1 summarizes the experimental programs that involved the use of the BigRIPS separator in this period and the RI beams produced for each experiment. All the experiments originally scheduled for the spring beamtime were postponed owing to the COVID-19 pandemic. In the autumn beamtime, ²³⁸U and ⁷⁰Zn primary beams were provided.

The ²³⁸U beam campaign started in October. During a tuning phase of BigRIPS at startup, an auto-focusing and auto-centering system was tested with a ⁸²Ge beam for the first time at RIBF.²⁾ After the BigRIPS tuning phase followed by the commissioning of HiCARI, a PALIS experiment was performed with an RI beam around ¹⁹¹Bi to evaluate the extraction efficiency using alpha emitters in the ¹⁹¹Bi region.

Five HiCARI experiments were subsequently performed with the ZeroDegree spectrometer. A cocktail beam of ⁸⁴Ge/⁸³Ga/⁸²Zn was produced to study neutron intruder states and collectivity. ⁸⁶Se/⁸⁴Ge, ⁸⁸Se/⁸⁶Ge, and ⁹⁰Se beams were produced to explore quadrupole and octupole collectivity. A cocktail ¹¹¹Nb/¹¹²Mo/¹¹³Tc beam was produced to perform high-resolution spectroscopy and lifetime measurements. A ¹³⁰Cd beam was produced to study single-particle states in ¹²⁹Ag. A ¹³⁶Te beam was produced to characterize a strongly Coulomb-excited state above 4 MeV in ¹³⁶Te. During these HiCARI experiments, mass measurements with a multi-reflection time-of-flight mass spectrometer (MRTOF-MS) located downstream of the ZeroDegree spectrometer were performed symbiotically. Subsequently, a machine study for the Rare RI Ring was

performed with a ⁷⁵Ga beam.

At the end of the ²³⁸U beam campaign, a machine study for a high-purity Th-beam development including performance evaluations of beamline detectors for a high-Z, high-rate RI beam was performed using a ²²⁰Th beam.³⁾

After switching to the ⁷⁰Zn primary beam, two HiCARI experiments were conducted with the ZeroDegree spectrometer. ⁵⁶Ti and ⁵⁸Ti beams were produced to study the evolution of collectivity in Ti isotopes. ³⁶Ca, ³⁸Ca, ⁴⁸Ca, and ⁵⁴Ca beams were produced to investigate systematically the reduction factor for the deduced spectroscopic factors. A symbiotic MRTOF experiment was performed again.

A new isotope search experiment was conducted around the ⁴⁵Si region at the end of the ⁷⁰Zn beam campaign.⁴⁾

The RI beam production at BigRIPS from the start of operation in March 2007 is summarized in our database.⁵⁾ At first, you will be redirected to the welcome page. Follow the links “Database of RI Beams Produced at BigRIPS” → “List of Experiments” → “Summary” to reach the summary page; you can reach the page in subsequent attempts.

References

- 1) T. Kubo, Nucl. Instrum. Methods Phys. Res. B **204**, 97 (2003).
- 2) Y. Shimizu *et al.*, in this report.
- 3) N. Fukuda *et al.*, in this report.
- 4) H. Suzuki *et al.*, in this report.
- 5) Y. Shimizu *et al.*, Nucl. Instrum. Methods Phys. Res. B, **463**, 158 (2020). Available at <https://ribeam.riken.jp/>.

Table 1. List of experimental programs together with RI beams produced at the BigRIPS separator in 2020.

Primary beam (Period)	Exp. Prog. No.	Spokesperson	Course	RI beams
²³⁸ U 345 MeV/nucleon (Oct. 25–Nov. 24)	NP1712-RIBF166-03	T. Sonoda	PALIS	¹⁹¹ Bi
	NP1912-RIBF196-01	F. Flavigny	ZeroDegree	⁸⁴ Ge/ ⁸³ Ga/ ⁸² Zn
	NP1912-RIBF190-01	F. Browne	ZeroDegree	⁸⁶ Se/ ⁸⁴ Ge, ⁸⁸ Se/ ⁸⁶ Ge, ⁹⁰ Se
	NP1912-RIBF187-01	W. Korten	ZeroDegree	¹¹¹ Nb/ ¹¹² Mo/ ¹¹³ Tc
	NP1912-RIBF189-02	Z. Podolyak	ZeroDegree	¹³⁰ Cd
	NP1912-RIBF193-01	A. Jungclaus	ZeroDegree	¹³⁶ Te
	PE19-02 / PE20-01	M. Wada	ZeroDegree	(symbiotic)
	MS-EXP20-04	Y. Yamaguchi	Rare RI Ring	⁷⁵ Ga
⁷⁰ Zn 345 MeV/nucleon (Dec. 2–Dec. 13)	MS-EXP20-02	N. Fukuda	ZeroDegree	²²⁰ Th
	NP1912-RIBF142R1-01	T. Koiwai	ZeroDegree	⁵⁶ Ti, ⁵⁸ Ti
	NP1912-RIBF170R1-01	H. Crawford	ZeroDegree	³⁶ Ca, ³⁸ Ca, ⁴⁸ Ca, ⁵⁴ Ca
	PE20-02	M. Wada	ZeroDegree	(symbiotic)
	DA20-03	H. Suzuki	BigRIPS	⁴⁵ Si

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