Research Facility Development Division
Accelerator Group

1. Abstract

The Accelerator Group, consisting of seven teams, pursues various upgrade programs on the world-leading heavy-ion accelerator facility, RI Beam Factory (RIBF), to enhance the accelerator performance and operation efficiency. The programs include the R&D of superconducting ECR ion source, charge stripping systems, beam diagnostic devices, radio-frequency systems, control systems, and beam simulation studies. We are also maintaining the large infrastructure to realize effective operation of the RIBF. Moreover, we are actively promoting the applications of the facility to various research fields.

Our primary mission is to supply intense, stable heavy-ion beams for the users through effective operation, maintenance, and upgrade of the RIBF accelerators and related infrastructure. The director members govern the development programs that are not dealt with by a single team, such as intensity upgrade and effective operation. We also discuss the future plans of RIBF along with other laboratories belonging to the RIBF research division.

Various improvements and developments have been carried out for the RIBF accelerators in order to upgrade the beam intensities and stability. Owing to the efforts, for example, we succeeded in accelerating the uranium beam of 117 pnA through SRC in October 2020. This surpassed the long-standing target of 100 pnA, and also means that one of goals of the current mid-term plan of RNC has been achieved. The beam intensity of ^{70}Zn increased to 788 pnA in December 2020, corresponding to the beam power of 19.0 kW.

On the other hand, at the new RILAC facility, which was commissioned at the end of FY2019 with the superconducting booster linac (SRILAC), a superheavy element synthesis experiment was started after the closure of RIKEN due to COVID-19. Despite a problem in one of the superconducting cavities, a high-intensity vanadium beam is being supplied to the users. Construction of a new beam line for the R&D of mass production method of ^{211}At has been also started at the RILAC facility.

An upgrade plan of RIBF for further increasing uranium beam has been continuously discussed. The plan is based on the idea of "charge-stripper ring (CSR)," which is used to improve the overall stripping efficiency of the uranium beam. This device recirculates and re-injects the uranium ions into the charge stripper until the ions have the charge state required for the succeeding acceleration, while the bunch structure is kept with its isometric orbit lengths for all the charge states. We are planning to install two CSRs in the RIBF accelerator chain and the ultimate goal of the uranium beam intensity is 2,000 pnA at the exit of SRC. Initial design study of the first CSR (CSR1) has been almost completed. A pair of quadrupole magnets, that will be used in CSR1, is under fabrication, in order to study the magnetic field in and around the magnets.

2. Major Research Subjects

(1) Intensity upgrade of RIBF accelerators (Okuno)
(2) Effective and stable operation of RIBF accelerators (Fukunishi)
(3) Stable operation of the upgraded RILAC facility
(4) Promotion of the future plan

3. Summary of Research Activity

(1) The maximum intensity of the uranium beam reached 117 pnA at 345 MeV/nucleon, which corresponds to the beam power of 9.6 kW.
(2) The maximum intensity of zinc beam reached 788 pnA, corresponding to 19.0 kW.
(3) The overall beam availability for the RIBF experiments was 90% in 2020.
(4) The new RILAC facility, which was commissioned at the end of FY2019 with the superconducting booster linac (SRILAC), started supplying high-intensity vanadium beam for a superheavy element synthesis experiment.
(5) The large infrastructure was properly maintained based on a well-organized cooperation among the related sections in RIKEN.
(6) An intensity-upgrade plan of the RIBF has been further investigated. Elemental R&D of the first charge-stripper ring (CSR1) is under progress.

Members

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Osamu KAMIGAITO

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List of Publications & Presentations

Publications

[Original Papers]

O. Kamigaito, "Circuit-model formulas for external-Q factor of resonant cavities with capacitive and inductive coupling," arXiv:2005.05843 (2020).

Presentations

[International Conferences/Workshops]

O. Kamigaito (invited), "Commissioning of superconducting linac booster for heavy-ion linac at RIKEN," 30th Linear Accelerator Conference (LINAC20), Liverpool, United Kingdom (ONLINE), September 1–4, 2020.

Outreach Activities

"First beam acceleration test successfully performed at SRILAC," RIKEN NEWS No. 470 (8) 2020.