

## 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 operate RIBF effectively. 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 oversee 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.

### 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 applied research through collaborations
- (5) Promotion of the RIBF upgrade plan

### 3. Summary of Research Activity

- (1) In December 2022, a high intensity zinc beam damaged the beam pipe in the last magnetic deflection channel (MDC3) in SRC, causing a vacuum leak and stopping beam service. One of the main reasons was that the thickness of the baffle slits, that are used to keep the beam position appropriately, was insufficient for the zinc beam. Therefore we replaced the baffle slits with the ones having sufficient thickness. We also installed thermometers on the MDC3 pipe to prevent excessive beam loss. On the other hand, there was a trouble with the liquid helium supply system of SRC in June. These repairs and restoration took until the end of FY2023.
- (2) The SRILAC facility has provided a stable supply of high intensity vanadium beams for new superheavy element synthesis experiments. The operating parameters of the helium refrigerator were adjusted and the pressure fluctuations were significantly reduced. Pulsed rf conditioning of the superconducting cavities has also been carried out successfully. A study to determine the beam spread from the signals of non-destructive beam position monitors is also in progress.
- (3) We have supplied a wide variety of beams for applied research aimed at solving social problems, such as ion beam breeding, irradiation of semiconductors for space applications, and radioactive isotope production. Recently, a  $^{129}\text{Xe}$  beam of 36 MeV/nucleon, accelerated through AVF and RRC, has been well received for testing semiconductors for space use.
- (4) The RIBF upgrade plan has been further investigated. The main focus of this plan is to increase the effective transmission efficiency of the accelerator chain from the current 5% to 50% by installing two Charge Stripper Rings (CSRs). The final goal of this plan is to increase the uranium beam intensity by 20 times of the present value, namely up to 2000 particle nA, at the exit of SRC. In June 2023, an International Technical Advisory Committee was held by Nishina Center, and young researchers presented their study for the RIBF upgrade plan, including the conceptual design of the CSR. The review results were submitted to the Nishina Center Advisory Council held in July, and the project was evaluated as the one that should be advanced as a top priority.

### Members

#### Director

Osamu KAMIGAITO

#### Deputy Directors

Hiroki OKUNO (for intensity upgrade)

Nobuhisa FUKUNISHI (for stable and efficient operation)

#### Senior Visiting Scientist

Takahide NAKAGAWA

#### Research Consultants

Tadashi FUJINAWA

Eiji IKEZAWA

#### Visiting Scientists

Eiji KAKO (KEK)

Hirohito NAKAI (KEK)

Kensei UMEMORI (KEK)

Hiroshi SAKAI (KEK)

Masahiro OKAMURA (BNL)

Yasutaka IMAI (Okayama Univ.)

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Ryoko UMEZAKI