

Research Facility Development Division  
Accelerator Group  
Beam Dynamics & Diagnostics Team

## 1. Abstract

Aiming at stable and efficient operation of the RIBF cascaded cyclotron system, Beam Dynamics and Diagnostics Team develops power supplies, beam instrumentation, computer control, and beam dynamic studies. We have successfully increased the beam availability for user experiments to over 98%. We have also established small-beam-loss operations, which strongly contribute to recent high-power operations at RIBF.

## 2. Major Research Subjects

- (1) Efficient and stable operations of the RIBF cascaded cyclotron system
- (2) Maintenance and development of the beam instrumentation
- (3) Developments of the computer control system for more intelligent and efficient operations
- (4) Maintenance and improvements of the magnet power supplies for more stable operations
- (5) Upgrade of the existing beam interlock system for high-power beams with a few tens of kW

## 3. Summary of Research Activity

- (1) High-intensity heavy-ion beams such as 117-particle-nA (particle nA) uranium, 173-particle nA xenon, 690-particle nA krypton, 830-particle nA Zinc and, 740-particle nA calcium beams, have been obtained.
- (2) The world-first high-Tc SQUID beam current monitor has been developed. The Beam Energy and Position Monitor has been successfully developed and introduced into the beamline of the superconducting rilac (SRILAC). Construction of a new Faraday cup capable of withstanding 50-kW beams is nearly completed by the end of FY2022.
- (3) The replacement and upgrade of the old power supplies used in Riken Ring Cyclotron (RRC) are in progress. Two-thirds of the outdated power supplies that energize the trim coils of RRC have been replaced with new ones. The power supplies applying currents to beam injection and extraction systems have been upgraded in their current feedback systems, improving long-term stability.
- (4) The new beam interlock system with a response time of less than 1 ms has been successfully developed utilizing National Instruments' CompactRIO technology.
- (5) The RIBF control system has been operated stably by replacing legacy hardware controllers inherited from our old facility with new ones. Several useful operation tools are also developed.

## Members

### Team Leader

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## List of Publications & Presentations

### Publications

#### [Original Paper]

T. Maeyama, A. Mochizuki, K. Yoshida, N. Fukunishi, K. L. Ishikawa, and S. Fukuda, "Radio-fluorogenic nanoclay gel dosimeters with reduced linear energy transfer dependence for carbon beam radiotherapy," *Med. Phys.* **50**, 1073 (2023). <https://doi.org/10.1002/mp.16092>.

**[Proceedings]**

- T. Watanabe, A. Kamoshida, T. Nishi, A. Uchiyama, and K. Kaneko, "Beam profile measurement using helium gas light emission for superheavy element search experiment," Proceedings of the 19th Annual Meeting of Particle Accelerator Society of Japan, October 18–21, 2022, Online (Kyushu University), Japan, p. 764.
- A. Uchiyama, M. Kidera, M. Komiyama, and K. Kaneko, "Deployment of archiver appliance to RIBF control system," Proceedings of the 19th Annual Meeting of Particle Accelerator Society of Japan, October 18–21, 2022, Online (Kyushu University), Japan, p. 9.
- K. Yamada, "Upgrade and current status of high-frequency systems for RIKEN Ring Cyclotron," Proc. 23rd International Conference on Cyclotrons and their Applications (CYC2022), Beijing, China, December 5–9, 2022, MOAI02.
- A. Uchiyama, K. Kumagai, M. Komiyama, and N. Fukunishi, "Evaluation of PLC-based EtherNet/IP communication for upgrade of electromagnet power supply control at RIBF," Proc. 23rd International Conference on Cyclotrons and their Applications (CYC2022), Beijing, China, December 5–9, 2022, TUBO04.

**Presentations****[International Conferences/Workshops]**

- K. Yamada (invited), "Upgrade and current status of high-frequency systems for RIKEN Ring Cyclotron," 23rd International Conference on Cyclotrons and their Applications (CYC2022), Beijing, China, December 5–9, 2022.
- A. Uchiyama (oral), K. Kumagai, M. Komiyama, and N. Fukunishi, "Evaluation of PLC-based EtherNet/IP communication for upgrade of electromagnet power supply control at RIBF," 23rd International Conference on Cyclotrons and their Applications (CYC2022), Beijing, China, December 5–9, 2022.

**[Domestic Conferences/Workshops]**

- T. Watanabe (poster), A. Kamoshida, T. Nishi, A. Uchiyama, and K. Kaneko, "Beam profile measurement using helium gas light emission for superheavy element search experiment," 19th Annual Meeting of Particle Accelerator Society of Japan, October 18–21, 2022, Kyushu University, Online, Japan.
- A. Uchiyama (oral), M. Kidera, M. Komiyama, and K. Kaneko, "Deployment of archiver appliance to RIBF control system," 19th Annual Meeting of Particle Accelerator Society of Japan, October 18–21, 2022, Kyushu University, Online, Japan.