Advanced Research Center for Beam Science – Particle Beam Science –

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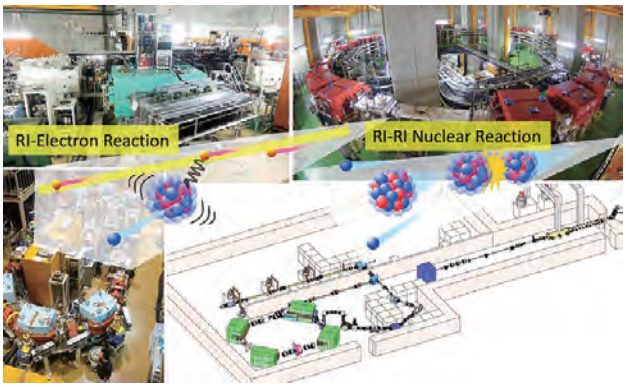
Scope of Research

One of our research is an experimental research for unstable nuclear structures by means of the electron and heavy-ion accelerators. We address the technical development in an RI beam production driven by a high-energy electron beam, an electron scattering from the RI's in combination with the RI target inserted in an electron storage ring, and the precision mass measurement for extremely short-lived and rare exotic nuclei using a heavy-ion storage ring. We will address some technical development aiming at a nuclear photo-absorption cross-section measurement and the beam recycling in a heavy-ion storage ring to study the nuclear reactions involving rare exotic nuclei.



KEYWORDS

Beam Physics
Accelerator Physics
Neutron Optics
Storage Ring
Unstable Nuclear Physics

Selected Publications

Wakasugi, M.; Togasaki, M.; Ohnishi, T.; Kurita, K.; Toba, R.; Watanabe, M.; Yamada, K., FRAC: Fringing-RF-Field-Activated DC-to-Pulse Converter for Low-Energy Ion Beam, *Rev. Sci. Instrum.*, **89,** 095107 (2018).

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Tsukada, K.; Enokizono, A.; Ohnishi, T.; Adachi, K.; Fujita, T.; Hara, M.; Hori, M.; Hori, T.; Ichikawa, S.; Kurita, K.; Matsuda, K.; Suda, T.; Tamae, T.; Togasaki, M.; Wakasugi, M.; Watanabe, M.; Yamada, K., First Elastic Electron Scattering from ^{132}Xe at the SCRIT Facility, *Phys. Rev. Lett.*, **118,** 262501 (2017).

Kitaguchi, M.; Iwashita, Y.; Shimizu, H. M., Concentration of the Velocity Distribution of Pulsed Neutron Beams, *Prog. Theor. Exp. Phys.*, **2017,** 043D01 (2017).

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Developments of Charge Breeder for the Beam Recycling Technology

We promote the KAKEN-RNC collaboration to drive a new research field in unstable nuclear science. One of the attempts in the collaboration is a co-development of a beam recycling technique in a heavy-ion storage ring, which aims to a study of nuclear reaction especially for rarely-produced radio-active isotopes (RI) and RI-RI collision experiments. Unlike a conventional way using an extracted beam and a fixed target, the beam passing through the target without any reaction is recirculated in the ring and the accumulated beam hits the target turn by turn. We believe that the beam recycling technology will open up new research area such as an RI-RI collision experiment. Last year, the heavy-ion cooler storage ring (s-LSR) were moved from KAKEN to RIKEN RI Beam Factory (RIBF) for the R&D study. We will reconstruct s-LSR as a new storage ring named RUNBA (Recycled-Unstable Nuclear Beam Accumulator) which will be connected to the ISOL (Isotope Separator Online) system in RIBF as an RI beam injector.

One of the important techniques to be developed for the beam recycling is a charge breeder (CB) which is implemented between the ISOL and the RUNBA to convert the singly-charged ions to highly-charged ions. Due to a scarcity of RI, the conversion efficiency of the CB should be as high as possible. This year, a prototype of a resonant extraction CB (RECB) by which only desired charged state ions are selectively extracted was constructed as shown in Figure 1, and the performance study is ongoing.

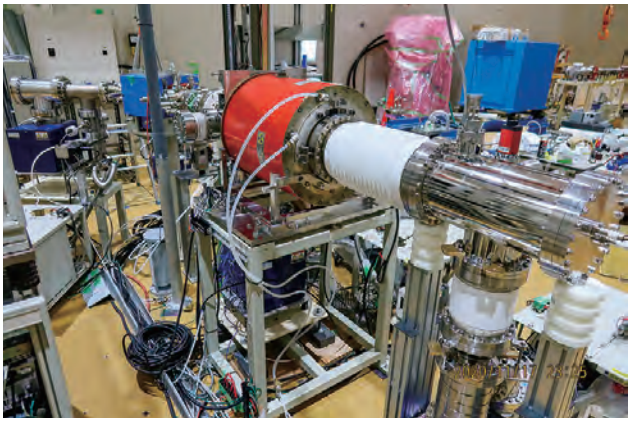

Figure 1. Prototype of Charge Breeder.

Renewal of KAKEN Accelerator Facility

We address some technical developments not only for the beam recycling but also for a nuclear physics measurement with KAKEN accelerators, namely an electron linac (KEL) and a storage ring (KSR). With a combination of KAKEN accelerators and a novel RI target forming technique developed at RIKEN ISOL facility, the photo-absorption cross sections of various nuclei including unstable ones will be measured by the virtual-photon tagging method. This is a unique and world's first way to access the giant resonance of unstable nuclei within a wide photon energy range.

This year, some maintenances and renewals of equipment of the KAKEN accelerator facility, such as an interlock system, an entrance and exit management system, a radiation safety system, and accelerator control systems have been done aiming to restart the facility from the next fiscal year because those systems were severely deteriorated by aging and some devices were broken. Figure 2 shows the renewed entrance and exit management system which controls the electronic lock and records when and who enters the controlled area by using a QR code. These works are supported by the International Joint Usage/Research Center and the Kyoto University President's Discretionary Fund.

Figure 2. Renewed Entrance and Exit Management System.