Contribution ID: **153** Type: **Oral contributed talk**

Development of high-flux MRTOF isobar separator at SCRIT facility

Friday, 24 October 2025 11:00 (20 minutes)

The SCRIT facility at RIKEN recently achieved the world's first electron scattering experiments with online-produced radioactive isotopes (RIs)[1,2]. The next milestone is an electron scattering experiment using a high-purity ^{132}Sn ion beam. However, the current ISOL-type RI production system at SCRIT, ERIS, inherently produces isobaric contaminants, particularly ^{132}Sb, which impede experimental precision. We are developing a high-flux Multi-Reflection Time-of-Flight (MRTOF) isobar separator to address this challenge, taking advantage of its inherently high mass resolving power.[3]
The required luminosity for electron scattering experiments necessitates processing ion beams at rates up to 10^8 ions per second—approximately four orders of magnitude higher than typical MRTOF specifications. Although high ion flux could substantially degrade mass resolving power due to space-charge effects, the target mass resolution required for separating isobars is around 40,000, significantly lower than the intrinsic resolving power ($>10^5$) demonstrated in conventional MRTOF systems. The key technical challenge thus lies in optimizing system performance to maintain sufficient resolving power under these extremely high-flux conditions.
A prototype MRTOF system is currently under construction. It comprises an ion trapping section, electrostatic mirrors, and fast kicker electrodes for ion selection. Offline tests with alkali ion sources have been conducted to evaluate transport efficiency, mass resolving power, and electronic system performance. These tests have confirmed promising results, demonstrating a path toward achieving the required operational parameters.
Successful implementation of this MRTOF system will enable production of high-purity, high-intensity, and low-emittance RI beams, significantly enhancing not only electron scattering experiments but also opening avenues for various other precision measurements.
[1] M. Wakasugi et al., Nucl. Instr. and Meth. B317, 668 (2013).
[2] K. Tsukada et al., Phys. Rev. Lett. 131, 092502 (2023).
[3] M. Rosenbusch et al., Nucl. Instr. and Meth. A1047, 167824 (2023).

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Classification

Ion guide, gas catcher, and beam manipulation techniques

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Session Classification: Instrumentation for RIB experiments II

Track Classification: Ion guide, gas catcher, and beam manipulation techniques