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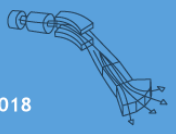

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Development of a new in-ring beam monitor in the Rare-RI Ring

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The precise masses of neutron-rich nuclei are important for the study of the r-process nucleosynthesis as well as nuclear structure far from stability. The newly constructed storage ring, Rare-RI Ring, is a device dedicated for the precise mass measurements for short-lived nuclei [1][2]. The masses are determined by comparing the revolution time of a reference particle with known mass and that of a particle of interest with unknown mass, based on the isochronous mass spectrometry.
To adjust several magnets in the injection orbit properly, we need a detector to confirm the circulation of the stored particle. The detector should be sensitive to a single ion because the Rare-RI Ring handles only one particle at each injection. In addition, it is necessary to measure the revolution time to adjust the isochronous magnetic field precisely using a narrow-band Schottky pick-up [3]. Therefore, we developed a new in-ring beam monitor which consists of a thin foil, a scintillator, and multi-pixel photon counters (MPPCs) [4].
The operation principle is based on the secondary electrons including delta-rays which are generated when the stored particle passes through the foil at each revolution. The secondary electrons are detected by a scintillator coupled with MPPCs without any guiding field. We carried out beam experiments to verify the principle for a prototype detector at the Heavy-Ion Medical Accelerator in Chiba (HIMAC) synchrotron facility.
After verification, we installed the detector in the ring. The detector consists of a 3-μm-thick aluminum foil, one large plastic scintillator (100 × 100 mm^2 with 3-mm thickness) and two small ones (80 ×50 mm^2 with 3-mm thickness), and 10 MPPCs (S12572-100C) for scintillation light readout. In November 2016, we conducted a machine study of the Rare-RI Ring and successfully measured revolution times using present detector. The result showed that the revolution time was determined in a precision of 8.0×10^{-4}.
In this contribution, we will present the details of the experiments, analysis, and results.

References

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