



Contribution ID: 14

Type: **Poster**

In-ring detector developments for the Rare-RI Ring facility

We present several particle detectors dedicated for the Rare-RI Ring (R3) storage ring. Since R3 in the cyclotron facility stores only a single ion at each injection, conventional beam diagnostics such as beam profile monitors and wire scanners are inapplicable. Thus, we have developed unique detectors as follows,

1. Revolution time monitor, “delta-ray” detector which directly measures high-energy secondary electrons emitted from a thin foil by means of plastic scintillation detectors without any guiding field. Multi-pixel photon counters (MPPC) are employed for readout.
2. Shaped plastic and fiber scintillation detectors for position detection. The number of readout channels is reduced for convenience and versatility for users but also for a general beamline monitor.
3. GAGG(Ce) in-ring total energy detector. A compact shape with the high density fits the ring aperture. Fast signal character is also suitable for timing measurements.

These detectors were tested with heavy ion beams at the Heavy-Ion Medical Accelerator in Chiba (HIMAC) synchrotron facility, and we achieved a reasonable performance; approximately 300 ps in time resolution, 1 mm position resolution, and 1% in energy resolution for a typical case. Some of them were installed and were successfully used at R3. The details of the detectors will be presented.

The present work is part of master theses by S. Omika, N. Tadano, K. Inomata, D. Kajiki, K. Okubo for the delta-ray detection technique, by K. Wakayama, D. Hamakawa, M. Kanda, K. Sasaki for several position monitors, and by K. Yokota, N. Shinozaki for the GAGG(Ce) crystal detectors.

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