

## Diamond recoil particle telescope for primary-beam current measurements at BigRIPS

N. Fukuda,<sup>\*1</sup> Y. Yanagisawa,<sup>\*1</sup> Y. Shimizu,<sup>\*1</sup> S. Michimasa,<sup>\*1</sup> K. Kusaka,<sup>\*1</sup> M. Ohtake,<sup>\*1</sup> H. Suzuki,<sup>\*1</sup>  
H. Takeda,<sup>\*1</sup> Y. Togano,<sup>\*1</sup> M. Yoshimoto,<sup>\*1</sup> and N. Fukushima<sup>\*1</sup>

A new telescope-type diamond recoil particle detector for beam-current measurements has been developed to complement the existing plastic scintillator based detector<sup>1)</sup> at BigRIPS. This system was specifically designed for the measurement of the primary beam current, which is essential for precise diagnostics and experiments at BigRIPS. The detector features high radiation resistance and stable long-term operation, ensuring reliable beam current measurements.

The detector consists of a telescopic arrangement of five diamond detectors stacked at 10-mm intervals along a common axis, as shown in Fig. 1. The detectors are housed in a single aluminum enclosure to provide a compact and robust unit. The housing has a 5 mm × 5 mm square entrance window protected by a 0.5-mm thick aluminum foil to allow recoil particles to pass through for detection.

Each diamond sensor is electronic-grade single-crystal CVD diamond with a thickness of 500 μm. The active area is circular with a diameter of 3.6 mm, covering an area of 10 mm<sup>2</sup>. These sensors are mounted on PEEK resin substrates, with signals from each sensor individually read out via SMA coaxial connectors. This detector was manufactured by Advanced Fusion Technology Co., Ltd. and CIVIDEC Instrumentation.

Preparations for full-scale operation are currently underway. The detector will be installed at approximately 600 mm from the F0 target at 120 degrees backward relative to the beam axis. It will be equipped with a drive mechanism to adjust the distance from the target according to particle count rates. The signal processing chain is depicted in Fig. 2. The detector system will use iseg NHR-4060 high-voltage power supply modules to apply bias voltages (approximately +400 V). Signals from the five detectors will be amplified using CIVIDEC C2-HV broadband amplifiers. The amplified signals will then be transmitted via optical fibers using the optical signal transmission system<sup>2)</sup> developed at RIBF, from the BigRIPS room on B2F to the BigRIPS control room on B3F, where optical receivers will reconvert them to electrical signals. These signals will be processed by a discriminator to generate logic pulses. Finally, the processed signals will be used to form coincidence signals, which will be recorded by the scaler system. The placement of operational and signal processing modules in the high-radiation (B2F) area will be determined based on detailed radiation level evaluations. The system is expected to be operational by the end of the fiscal year 2025.

<sup>\*1</sup> RIKEN Nishina Center

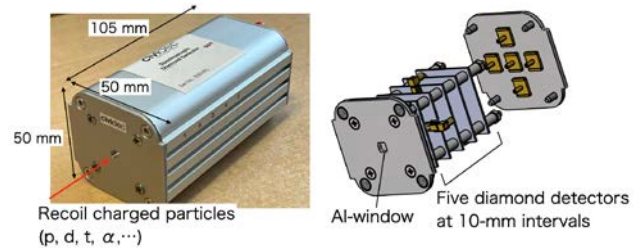


Fig. 1. Diamond telescope for beam current monitoring. Left: Photograph of the detector housing, which contains stacked diamond sensors designed to detect recoil charged particles. Right: Schematic view of the arrangement of five diamond detectors, spaced at 10-mm intervals.

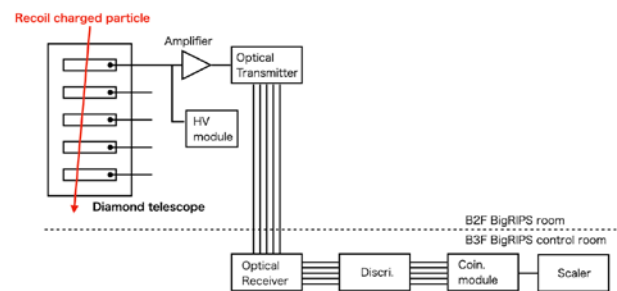


Fig. 2. Schematic of the signal processing system for the diamond recoil particle telescope. Signals processed in the BigRIPS room on B2F are transmitted via optical fibers to the BigRIPS control room on B3F, where they undergo further processing and are recorded by the scaler system.

### References

- 1) Y. Yamaguchi *et al.*, RIKEN Accel. Prog. Rep. **42**, 161 (2009).
- 2) H. Kumagai *et al.*, RIKEN Accel. Prog. Rep. **41**, 121 (2008).