Improvements on the racetrack microtron at SCRIT

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The SCRIT group has successfully performed its first physics experiment using stable ^{132}Xe target[1)] and opened a new window to the research of unstable nuclei by means of electron scattering. An upgrade of the SCRIT facility is currently in progress, aiming at the world's first electron scattering experiment using short-lived RI targets.

For the SCRIT experiment, a racetrack microtron (RTM; Fig. 1) was used to inject the electron beam not only into a storage ring but also into the Electron-beam-driven RI separator for SCRIT (ERIS) to irradiate a uranium target to generate RIs.[2)] A typical output power of the electron beam is currently ∼20 W (with 20 Hz operation), but 1 kW is required to generate a sufficient number of ^{132}Sn to achieve the luminosity of more than 10^{26} cm^{-2}s^{-1}. As such a high power RTM needs massive modifications, *e.g.*, a new modulator power supply, we decided to improve the 20 W beam power up to 50 W by using the current RTM configuration with several minor upgrades before the future 1 kW upgrade. For example, a study of a gun-grid-pulsing device and its upgrade plan was reported by Watanabe *et al.*[3)] In addition to the upgrade, the cause of electron-beam instabilities must be determined out and fixed. The RTM device is already 20 years old, and some of its components are becoming the source of the instabilities. We found that a surface of a ceramic RF coupler was carbonized and blackened, as shown in Fig. 1 (inset). As such a carbonized coupler is known to be easily discharged at a high power input, we carefully polished the surface. Further, we found that the charge-up of a ceramic duct coupler for the CT monitor located at the exit of the electron gun causes beam instability, and the shape of the beam profile monitored by a camera installed after the CT monitor was observed to change. After installing an additional SUS pipe to hide the ceramic part from the electron beam, the beam profile stabilized. We are also attempting to stabilize the RF power input, *e.g.*, the klystron module and the power variator, in the waveguide.

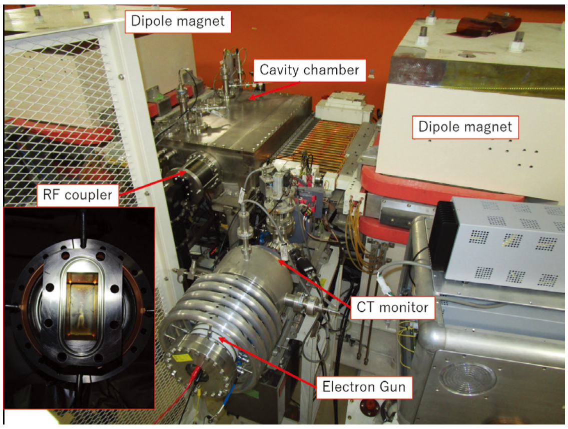

Fig. 1. Overview of SCRIT RTM device.

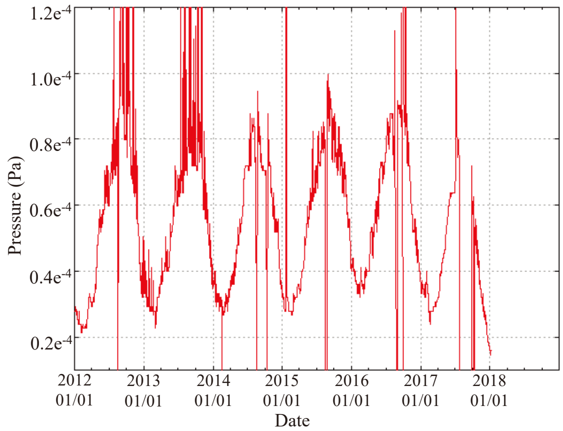

Fig. 2. Trend of the vacuum at RTM cavity in the past six years. TMPs were upgraded in August 2017.

The RTM operation is also frequently disrupted by arc detections especially at higher RF power inputs, and it unfortunately reduces the duty factor of the experiment time. This issue is considered to be caused partly by the discharge inside a cavity chamber, and in such a case, the vacuum improvement of the chamber could be helpful. A better vacuum is also important for a stable operation and longer lifetime of RF components. The two (400 L + 300 L) TMPs attached to the chamber were replaced with two larger (520 L + 520 L) TMPs. A typical vacuum range during the RTM operation was 2–8×10^{-5} Pa, as shown in Fig. 2, and with the TMP upgrade, the vacuum was improved by more than 20%. Note that the seasonal dependence, which presumably originates from the temperature in the RTM room, results in a difference in the vacuum by a factor of 3–4. Therefore, it is also important to control the room temperature or develop a new cooling system for the cavity chamber.

In summary, the improvements of the RTM at SCRIT are in progress to achieve a stable operation at ∼50 W. This work must be successfully completed before the future RTM upgrade to 1 kW operation.

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References
1) K. Tsukada *et al.*, Phys. Rev. Lett. **118**, 262501 (2017).
2) T. Ohnishi *et al.*, PoS (INPC2016) 088.
3) M. Watanabe *et al.*, in this report.