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203 GHzコンパクトジャイロトロンFU CW CIIの開発
Development of 203 GHz compact gyrotron FU CW CII

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High frequency gyrotrons are expected as wave sources for various applications such as the electron spin resonance spectroscopy, the sensitivity enhancement of nuclear magnetic resonance spectroscopy and so on. These application studies are carried out in a limited laboratory space. General gyrotron systems including a superconducting magnet and power supplies are large size for these applications. Sometimes a strong fringing field from the large superconducting magnet strongly influences the measurement accuracies. To attract application researchers of various applications, it is important that good usability, compactness and high cost performance are realized.

At FIR FU, a compact gyrotron with an internal mode convertor (FU CW CII) has been developed [1]. This gyrotron was designed for the experimental measurement of hyperfine splitting of positronium [2]. The required output power and oscillation frequency are 1 kW and 203.4 GHz, respectively. Figure 1 shows FU CW CII which is mounted on an 8 T compact superconducting magnet. The height and width are 860 mm and 890 mm, respectively. This gyrotron system including power supplies became much smaller than the existing systems.

As a preliminary experiments, we have carried out short-pulse operation at the condition of the repetition rate 1 Hz and the duty ratio 1 %. Figure 2 shows the beam current dependence of the output power and the output efficiency. The operation conditions are as follows, a magnetic field strength B_c = 7.43 T, a cathode voltage V_k = 20.0 kV and an anode-cathode voltage V_{ak} = 5.6 kV. The output power increased linearly with the beam current and the maximum power reached about 900 W at the beam current I_b = 500 mA. The obtained efficiencies were 7 ~ 9 %. These values are lower than designed values. We will try to expand the oscillation time. More fine alignment correction is needed to obtain higher power. The measured oscillation frequency was 202.9 GHz. Gaussian-like beam was radiated. The radiation profile and size agreed well with the calculation results.

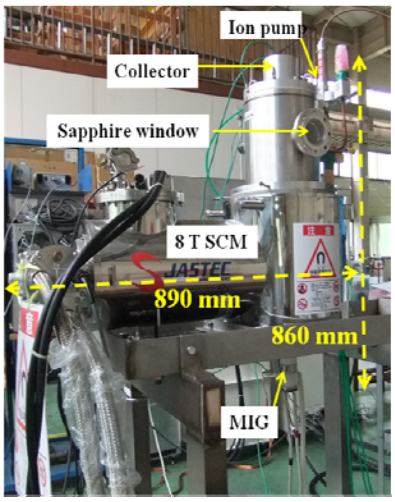

Fig.1 Photograph of gyrotron FU CW CII

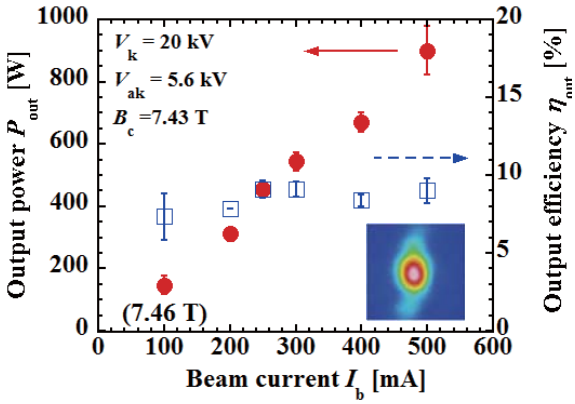

Fig.2 Beam current dependences of output power and output efficiency. Measured radiation pattern is described.

References
[1] R. Ikeda *et al.*, proceedings of 37 th IRMMW-THz, Mon-C-3-4 (2012).
[2] T. Yamazaki *et al.*, Phys. Rev. Lett., 108, pp.253401-1~253401-5 (2012).