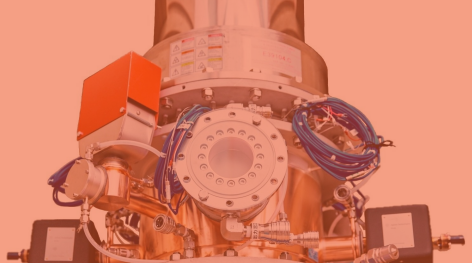
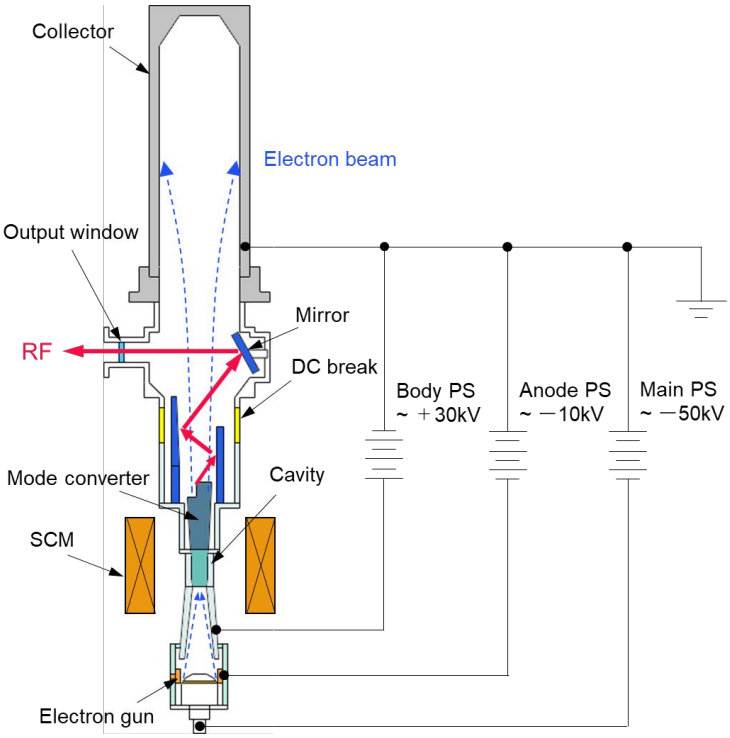
Gyrotron



In Japan, as part of fusion plasma research, National Institutes for Quantum Science and Technology (QST), University of Tsukuba, Canon Electron Tubes & Devices (CETD), and other national institutions and national universities have been actively engaged in research and development of high-power, high efficiency gyrotrons.
28 GHz to 200 GHz gyrotrons have been developed and are being used for plasma research in ITER and at Japanese universities.

Kyoto Fusioneering (KF) aims at research and industrial application of gyrotrons using these outcomes, and cooperates with major Japanese companies such as Canon Electron Tubes & Devices (gyrotron tube), JASTEC (superconducting magnet) and KYOCERA (ceramic window) to develop business. KF can provide commercially viable gyrotrons to global markets.



KF gyrotron is a large vacuum tube capable of continuous 1 MW-class output power with high-power millimeter waves, which consists of the gyrotron body, a superconducting magnet, and a DC power supply. The cavity resonator inside the gyrotron oscillates 1 MW-class millimeter waves, which are reflected by an internal mirror and output to the outside through a vacuum-sealed window.

KF gyrotrons have the following key performance features.

Product Index	
Output Power	1MW (guaranteed)
Frequency	Selectable(※) from 28 GHz to 203 GHz (※)The frequency can be changed by setting parameters based on customer request
Pulse width	CW operation
Efficiency	>50%, from input power to output RF
Mode Purity	>90%, from TE mode to HE11 mode
Aging (Conditioning)	Shall be operated by KF
Leadtime	~ approx. 20 months from the order to delivery

Reference

- K. Sakamoto *et al.* "Major Improvement of Gyrotron Efficiency with Beam Energy Recovery." *Physical Reciew Letters*, vol. 73, no. 26, 1994, pp. 3532-3535.
- K. Sakamoto *et al.* "High power 170 GHz gyrotron with synthetic diamond window ." *Reviews of Scientific Instruments*, vol. 70, no. 1, 1999, pp. 208-212.
- K. Sakamoto *et al.* "Achievement of robust high-efficiency 1MW oscillation in the hard-self-excitation region by a 170 GHz continuous-wave gyrotron ." *Nature Physics*, vol 3, 2007, pp.411-414.
- K. Sakamoto *et al.* "Progress of high power 170 GHz gyrotron in JAEA." *Nucl. Fusion*, vol 49, no. 9, 2007, pp.095019_1-095019_6.
- K. Sakamoto *et al.* "Development of 170 and 110 GHz gyrotrons for fusion devices" *Nucl. Fusion*、vol 43, no. 7, 2003, pp.729-737.

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KF Gyrotrons Key Profiles

- **Developed and demonstrated at QST with 1MW oscillations for each frequencies (104-203GHz).**
  R.Ikeda, et al., Journal of Infrared, Millimeter,and Terahertz Waves volume 38, pages 531–537 (2017)
- **28/35 GHz Gyrotron: Developed at University of Tsukuba.** K.Kariya, et al., Nucl. Fusion 59 (2019) 066009.
- 236 GHz Gyrotron: 9.5T SCM is under manufacturing for the testing at KF and to be tested in 2023.

28/35 GHz | **104 -236GHz**

Frequency	236GHz	203.1GHz	170.0GHz	137GHz	104GHz
Oscillation Mode	TE43,15	TE37,13	TE31,11	TE25,9	TE19,7
Output Mode		Gaussian Beam	Gaussian Beam	Gaussian Beam	Gaussian Beam
Magnet	9.29T	7.98T	6.63T	5.32T	4.08T
Power (>1s)	1MW (To be tested)	1MW	1.2MW 1MW(300s)	1MW	1MW

KF Gyrotron Executive Team (KF team has total 10+ members)

Keishi Sakamoto Executive Officer
Led the design and development of the ITER gyrotron at QST for many years. Served as a professor at the Institute of Fusion Science, University of Tsukuba and University of Fukui, and as a director of the Plasma and Fusion Society of Japan. Joined KF in April 2021. Ph.D from Kyushu University.

Yosuke Hirata General Manager
Started his R&D career at Toshiba Corporation in the gyrotron, high-power mm-wave transmission development followed by various simulations and mechanics for nuclear power plants. A visiting scientist at UC Davis. Involved in the IFMIF project at QST in developing the central control system. Joined KF in Jan, 2021. Ph.D from Kyoto University.

Yasuhisa Oda Advisor
Participated in the CubeSat project while still a student. Participated in the ITER project at QST and worked on the gyrotron operation system design. Member of the Joint Special Team for DEMO Design at QST. Joined KF in April 2021. Ph.D. from University of Tokyo.

Tsuyoshi Imai Advisor
Led the Microwave Heating and Current Drive in JT-60 as Head of RF Heating Lab. Developed ITER gyrotron at QST, and served as a professor and director of Plasma Research Center in University of Tsukuba, and a director of the Japan Society of Plasma Science and Nuclear Fusion Research. Led the development of NIFS (77GHz and 154GHz) and university (28/35GHz) gyrotrons at the University. Ph.D from Osaka University.

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Digital Version of this Catalogue

KF Official Website