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コンディショナルアベレージングを用いたECRプラズマ中の間欠的電子流束の評価

A study on intermittent electron flux utilizing the conditional averaging method

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Recently, we have observed an intermittent floating potential negative spike in an ECR plasma [1]. The generation of the spike is caused by excitation of the spatially-localized electron fluxes parallel to the external magnetic field. To study the spatial structure and the energy of the electrons, we have developed a high-impedance wire grid (HIWG).

Experiments were performed in the HYPER-I device at National Institute for Fusion Science. The HYPER-I device consists of a cylindrical vacuum vessel with a diameter of 0.3 m and an axial length of 2.0 m. A helium plasma was produced by the electron cyclotron resonance (ECR) heating with a 2.45 GHz microwave. The gas pressure and the input microwave power were 1.5 mTorr and 20 kW, respectively.

The HIWG consists of eight horizontal and eight vertical tungsten wires with a diameter of 0.75 mm and with an axial length of 90 mm. Each horizontal/vertical wire was arranged with a distance of 10 mm between them, and thus, the 64 lattice points are included in the lattice plane of $4,900$ mm^2 (see Fig.1). All the wire measure the floating potential, because it is sensitive to the variation of the electron flux toward the wire. The 2D structure of intermittent electron flux is visualized by calculating the product of data set of floating potential variation made by horizontal wire and the vertical wire. We also evaluated the characteristic electron energy with a single-grid energy analyzer by measuring the current-voltage characteristic. The HIWG was used as a reference probe to collect the pulses with the amplitude of (4-8)σ, where σ stands for the standard deviation of the floating potential.

It is found that the electron flux is localized in the plasma, and has a typical diameter of 30 mm. In addition, the flux randomly occurs in space. Figure 2 shows the current-voltage characteristics (semi-log) measured with the energy analyzer. When the electron flux is generated, the characteristic electron energy (temperature) becomes 40 eV, which is higher than the background electron temperature of 18 eV. This result shows that the local energy transition takes place in an ECR plasma.

[1] S. Yoshimura *et al.*, Bull. Am. Phys. Soc. **56**, 209 (2011).

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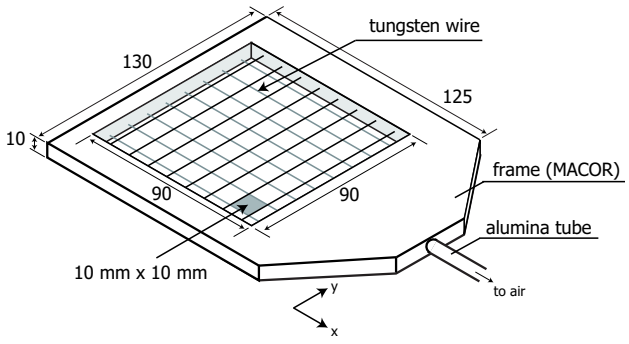

Fig. 1: A schematic diagram of the HIWG.

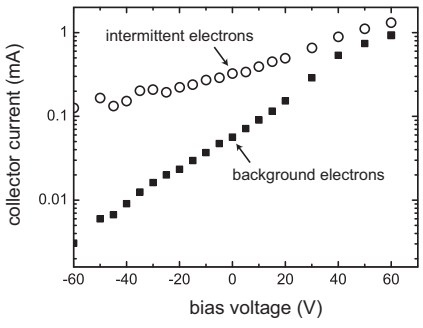

Fig. 2: Current-voltage characteristics.