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ECR プラズマ中の間欠的局所電子流束の二次元画像計測

Two-dimensional Imaging of Optical Emission Distribution Associated with Intermittent Local Electron Flux in an ECR Plasma

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A new intermittent phenomenon related with the spontaneous enhancement of local electron flux has recently been observed in a linear ECR plasma produced in the HYPER-I device [1] at the National Institute for Fusion Science. This electron flux enhancement is attributable to an abrupt increase in the local electron energy. Floating potential signals on a Langmuir probe have so far been utilized to investigate this phenomenon due to its sensitivity to the influx of high-energy electrons. In particular, the statistical analysis based on the waiting-time probability density function (PDF) has revealed that the phenomenon is characterized by a stationary Poisson process [2]. The floating potential has also been utilized to determine the 2D structure of the electron flux. We have developed the High-Impedance Wire Grid (HIWG) that consists of an array of 8x8 electrically-floated tungsten wires [3]. The reconstructed 2D intensity map showed that the enhanced flux has a circular form on the plasma cross-section, and its diameter is typically 30-40 mm. Although the HIWG measurements have successfully given the size and the occurrence position of the intermittent flux, 2D imaging of optical emissions has potential advantages to provide much information, e.g., 2D distributions of the electron temperature and electron density by making use of the line intensity ratio technique based on the collisional-radiative model [4].

Here we present the preliminary results on a non-intrusive direct measurement of the enhanced flux using an ICCD camera with an optical filter. Figure 1 shows a conditional-averaged 2D intensity map of He I line emission at 668 nm, where a floating potential spike associated with the intermittent event was used as a trigger signal. Strong emission region seen around the probe has a size of about 30 mm, which is consistent with that evaluated from the HIWG measurement. The results for other emission lines will also be presented.

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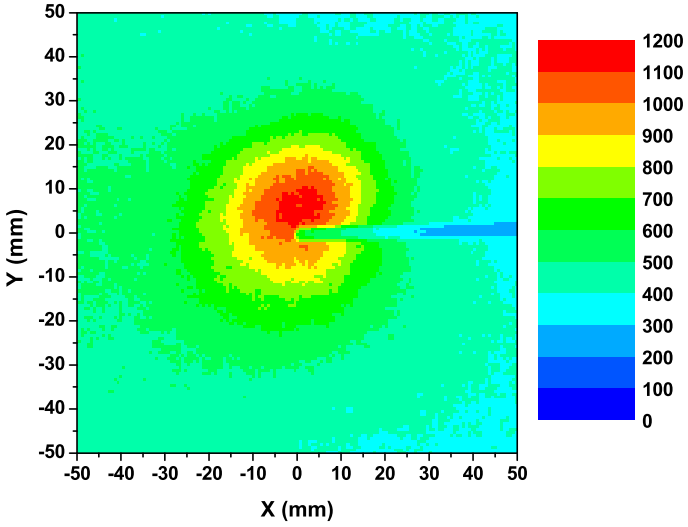

Fig.1 2D intensity map of He I (668 nm) line emission reconstructed from conditional-averaged ICCD images.