Intermittent Generation of Localized Higher Electron Temperature Regions in a Weakly-Ionized Electron Cyclotron Resonance Plasma

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Laboratory plasmas are intrinsically nonequilibrium open systems in which matter and energy may flow in and out through the system boundaries. It is widely known as the characteristics of such systems that various intermittent activities may take place spontaneously, e.g. bursty particle transport in the form of plasma blobs observed in the edge region of magnetically confined plasmas.

Here we report a new intermittent behavior of electron temperature in a cylindrical electron cyclotron resonance (ECR) plasma produced in the HYPER-I device [1] at NIFS, Japan. The phenomenon was firstly observed as randomly-repeated negative spikes on the floating potential signal. The abrupt change in the floating potential is attributable to the intermittent enhancement of electron influx, which is determined by the effective electron temperature (T_e). Two-dimensional distribution of the electron flux on the plasma cross-section has been measured by a newly developed high-impedance wire grid (HIWG) detector [2]. The high T_e region with a circular cross-section of which diameter is 1/10 of that of plasma cross-section appears at random positions. In addition, the probability density function of the waiting time (the time interval between two negative spikes) exhibits an exponential distribution, suggesting that the phenomenon is characterized by a stationary Poisson process [3].

As the next step, the time development of T_e has been measured using conditional averaging method. Since the line emission intensities from excited atoms are positively correlated with T_e, the high T_e region can be visualized by 2D imaging using an ICCD camera. The successive ICCD images with different delay times clearly show the time development of high T_e region. The conditionally averaged *I-V* characteristics also show the rapid change in T_e. The effective temperature of the electrons that constitute the intermittent flux is found to be three to four times higher than that of bulk electrons. We will discuss the possible generation mechanism of the intermittent high T_e electrons at the conference.

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