§8. Response of Neutral Particles to Plasma Fluctuation in Microwave Discharge Plasma

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Measurement of neutral gas pressure modulation in the range of 10 kHz was performed using a piezoelectric transducer near the cylindrical inner wall filled with microwave discharge helium plasma. The signals of the output of the transducer were compared with those of ion saturation currents of two Langmuir probes located at the boundary layer of the plasma [1].

The experiment was made in HYPER-I device, which is illustrated in Fig. 1 (a), with a profile of magnetic field intensity on the axis, as indicated in Fig. 1 (b). Helium plasma was produced using 2.4 GHz microwave injected in the axial direction through a quartz window at $z = 0$ m and the location of the resonance surface with the electron cyclotron frequency of $f_{ce} = 2.4$ GHz was at $z \simeq 106$ mm. A piezoelectric transducer (FUS-300A) with the outer diameter of 13 mm on the top of a cylindrical support was set in the port at $z = 1175$ mm and the surface of the transducer was retracted by 10 mm from the inner surface of the vacuum vessel in the radial direction. To measure ion saturation currents, two Langmuir probes with the bias of -90 V were used. One (Probe A) was set at $z = 1555$ mm from the same side with the transducer, which was able to be moved in the radial direction, and the other (Probe B) at $z = 1175$ mm, which was the same axial location with the transducer, and at $r = 140$ mm from the opposite side to the transducer.

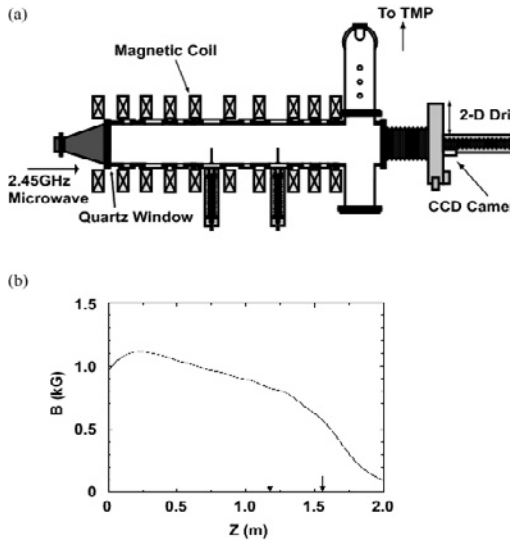

Fig. 1: (a) Sketch of HYPER-I device and (b) profile of magnetic field intensity on the axis.

The radial profiles of the average value, $\langle I_{is} \rangle$, the normalized standard deviation, $\sigma/\langle I_{is} \rangle$, the skewness, and the kurtosis of the ion saturation current of Probe A were obtained in the case of $P_\mu = 12.5$ kW and $p = 3.0 \times 10^{-3}$ Torr. The results indicate that the large values of $\sigma/\langle I_{is} \rangle$, the skewness, and the kurtosis at the boundary layer ($r > 140$ mm) increase sharply to the wall ($\sigma/\langle I_{is} \rangle > 0.3$, $S > 1$, and $K > 4$). Then, correlation of the fluctuation of the output of the piezoelectric transducer with those fluctuations of the ion saturation currents of Probe-A and Probe-B seems to appear as shown in Fig. 2.

1) Tsushima, A., Yoshimura, S., Saitou, Y.: Plasma Fusion Res. **5** (2010) S2075.

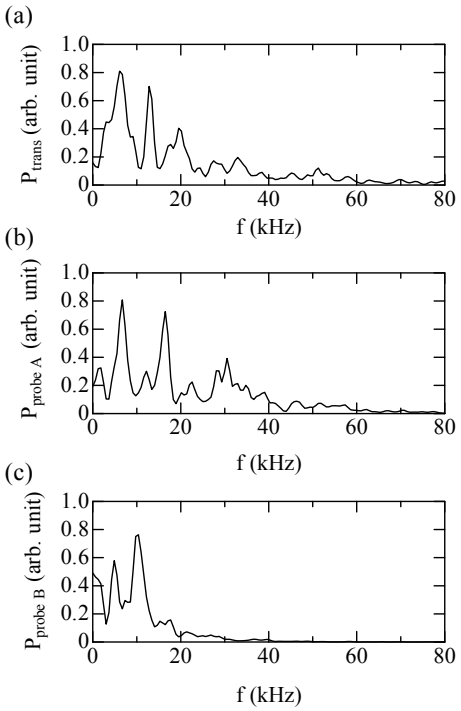

Fig. 2: Power spectra of (a) output of transducer ($z = 1175$ mm), (b) ion saturation current of Probe A ($z = 1555$ mm and $r = 140$ mm) and (c) ion saturation current of Probe B ($z = 1175$ mm and $r = 140$ mm) in the case of $P_\mu = 12.5$ kW and $p = 3.0 \times 10^{-3}$ Torr.