ECRH Superposition on Linear Cylindrical Helicon Plasma in LMD-U

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The electron cyclotron resonance heating (ECRH) is superimposed on a linear cylindrical helicon plasma in LMD-U to investigate the characteristics of a combined ECRH-helicon plasma. The LMD-U has a vacuum vessel, 3.74 m long and 0.44 m in diameter. At the one end of the device, a conventional helicon source (with a frequency of 7 MHz and rf power of 3kW) is installed for plasma production. At the opposite end of the device, the microwave launcher (with a frequency of 2.45 GHz and the microwave power of 0.8 kW) is installed. The magnetic field configuration is adjusted so that the resonance layer is around the axis position z = 2.3 m. Here, z = 0 shows the position of the boundary of the cylindrical vacuum chamber and the helicon source [1, 2]. The magnetic configuration is different from previous works [1,2] in LMD-U, and thus plasma features are different. Typical time evolution of ion saturation current I_{is} is shown in Fig. (a). The radial profiles of electron density and electron temperature are measured with the double probe system. The maximum electron density increases from $0.9 \times 10^{19} m^{-3}$ to $1 \times 10^{19} m^{-3}$ and the electron temperature changes from 2.4 eV to 2.5 eV during ECRH injection. Figure (b) shows the typical auto-power spectra of I_{is} for both helicon discharge phase and ECRH injection phase. A peak at 1 kHz observed in both phases has a m = 1 structure propagating in the ion diamagnetic direction, where m is poloidal mode number. In the helicon discharge phase, three peaks located near 3.1, 5.3, 6.3 kHz have m = 1, 3, 2 structures propagating in the electron diamagnetic direction. In the ECRH phase, frequencies of these mode structure are changed to 2.7, 4.1, 5.1 kHz, respectively. By the bi-spectrum analysis, the nonlinear coupling between a 1 kHz coherent mode and high frequency broadband components (f > 10 kHz) is observed in the helicon discharge phase. On the other hand, such nonlinear coupling is not observed in ECRH injection phase. This work is partly supported by the Grant-in-Aids for Scientific Research (S) from JSPS (21224014), by collaboration programs of RIAM of Kyushu University and NIFS, and by Research Fellowships of the JSPS for Young Scientists.

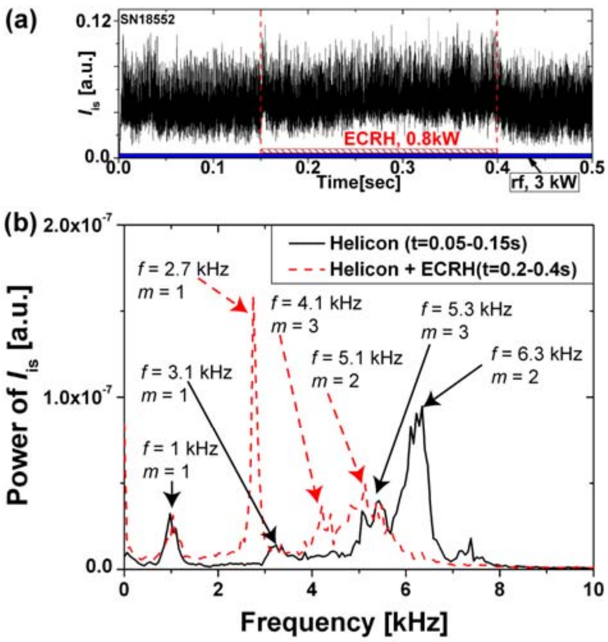

Figure (a) time evolution of ion saturation current, (b) the power spectrum in the pure-helicon and ECRH injection phases at r = 4cm, z = 1.885 m.

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[2] H. Arakawa *et al*., Plasma Phys. Control. Fusion **51** (2009) 085001.