§ 23. Microwave Heating of Whistler Wave Plasmas in CHS

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Introduction

For the purpose of discharge cleaning and high beta related studies in a low magnetic field strengths of kG range, the plasma production using whistler waves in radio frequency (rf) range [1-2] is useful because high power rf sources are cheaper than microwave ones and plasma production in a wide range of magnetic field strength is available for fixed frequency. The microwave power of 2.45GHz is applied to the whistler wave plasmas to study the effect of additional electron heating on the plasma production.

Plasma production by whistler waves

The rf power of 500kW, pulse duration of 10msec and the frequency of 9MHz is used in this experiment. Nagoya type III antenna is used. The plasma density, electron temperature are measured by the 2mm microwave interferometer and Langmuire probe. For the electron heating of whistler wave plasma, the microwave power of 2.45GHz and 20kW is used. The time evolution of the line averaged density, $<n_e>$, the edge density n_e(edge) and electron temperature Te(edge) at outmost magnetic surface and with rf and microwave powers for helium discharge is shown in Fig.1. The toroidal magnetic field strength Bt is 613G. The plasma with peaked density profile is produced initially by the rf power of 105kW. At the last 4msec of the rf pulse, microwave power of 18kW is applied on the plasma. Additional microwave power which is 17% of rf power causes the increase in average density of 20%, while ne(edge) increases three times as much as the rf plasma. After rf pulse is shut off, the microwave discharge can sustain the plasma but ne(edge) jumps up to show more wider plasma profile than thar of the rf plasma. It is also shown that the plasma density is difficult to start up when the microwave power is applied only. The initial plasma production by the rf can start up the microwave discharge easily. The dependence of rf and microwave powers on $<n_e>$ are shown in Fig.2 It is shown that the increase in $<n_e>$ with the microwave heating is observed above the cut-off density for 2.45GHz microwave.

Reference
1)Shoji, T., Nishimura, K, et al., Nagoya Univ. Ann.Report 6(1989)1
2)Nishimura, K., Shoji, T., et al., Fusion Tech. 17(1990)86

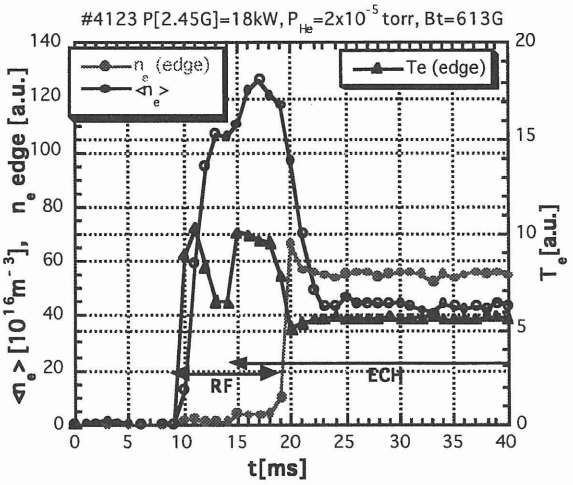

Fig. 1 Time evolution of line averaged density, plasma edge density and electron temperature with and without ECH power for He plasma. f=9MHz..

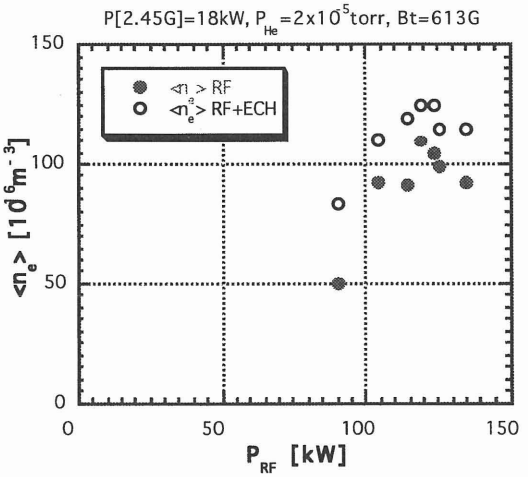

Fig. 2 rf power dependence of averaged density with and without ECH power.