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§23. Formation of Peaked Density Profile in Dimensionally Similar Low Temperature Plasmas at Very Low Toroidal Magnetic Field on CHS

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We are attempting experimental simulation of particle and energy transport in high temperature plasma produced at high toroidal field (Bt ≥ 1T) using dimensionally similar low temperature and density plasma produced at very low Bt (≤ 0.1T) in CHS [1, 2]. The latter plasma is produced by two sets of 2.45 GHz micro-wave source of which launching power P_{ECH} is up to 20 kW, respectively. Over-dense plasma is routinely obtained. It is interpreted that heating by electron Bernstein waves converted from launched electron cyclotron waves near the plasma edge having steep density gradient is dominant [3].

When the second heating pulse is superimposed from t=120 ms on an over-dense plasma produced by the first pulse, strong peaking of electron density profile occurs during the second pulse. In this plasma, electron temperature is in Te=10-30eV and electron density in 1-3x10^{17} m^{-3}. Typical waveforms are shown in Fig.1. This phenomenon is more pronounced in the case that a target plasma produced by the first pulse is in lower collisionality. The information of neutral density was obtained with a fast ionization gauge and a multi-channel visible spectrometer. In Fig.2, local emission profiles of Hα light are shown for the times before and during the second pulse, where a crude assumption is introduced that local Hα emissivity is constant on the magnetic surface. These profiles have almost the same shape as those of electron density as shown in Fig.3. This indicates hydrogen atoms fully penetrates into this low density plasma. Figure 3 also shows time evolution of electron temperature and space potential profiles. As seen from Fig.3, electron density profile becomes strongly peaked around ρ~0.3 and has steep gradient in the region of ρ=0.3-0.6 during the second heating pulse, while electron density is reduced by a factor of ~2 in the outer portion of the plasma (ρ>0.6). During the second heating pulse, the effective particle diffusivity is reduced by a factor of ~2 in ρ=0.3-0.6 and enhanced by a factor of ~2 in the outer part of ρ>0.6. During the second heating pulse, the turbulence induced particle flux increases. The radial electric field in ρ<0.7 is relatively weak and electron temperature profile is almost flat there. Therefore, neoclassical flux will not be changed by the second pulse. Electron Bernstein waves (EBW) converted near the edge from electron cyclotron waves will play an important role in the change in particle transport phenomena shown here. The EBW power is absorbed in the core region, which has been clarified by heating power modulation technique [4].

References

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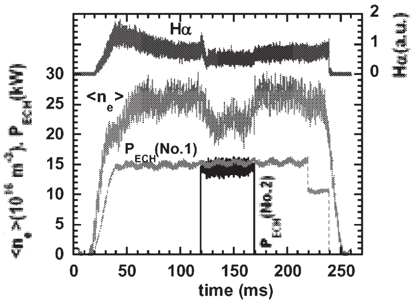

Fig.1 Typical waveforms of microwave heating power, line averaged electron density and Hα light.

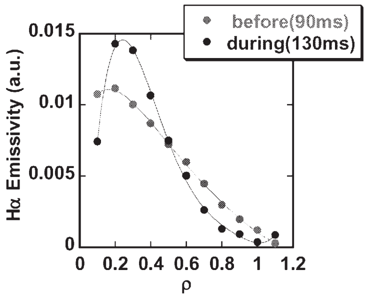

Fig.2 Radial profiles of Hα emissivity before and during the 2^{nd} heating power.

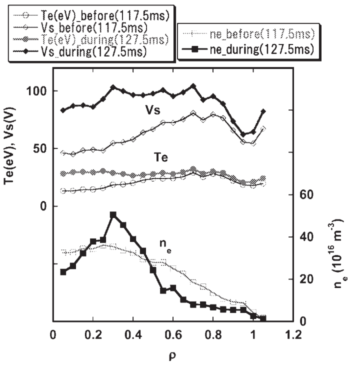

Fig.3 Radial profiles of electron density, electron temperature and plasma potential before and during the 2^{nd} heating power.