§19. Electron Heating near the Plasma Center with 130 MHz Fast Waves

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Noninductive current drive is required for steady state operation of tokamak devices. Fast wave current drive is proposed as a promising method which can be applied theoretically even to the high density and high temperature plasmas such as a reactor plasma.

In the JIPP T-IIU tokamak the new type antenna for the fast wave current drive experiment was installed[1),2)] and the experiment has been conducted.

To drive the plasma current noninductively by the waves, the electrons must obtain the momentum through the interaction with the waves so that they are accelerated in a toroidal direction. Thus first of all it is important to judge whether the electrons interact with the waves or not. The electron cyclotron emission (ECE) signal is sensitive to the electron temperature. From the ECE signals we can recognize the variation in the electron temperature caused by the interaction between the electrons and the waves.

Figure 1 displays the time evolution of the ECE signals in a typical shot. The plasma current is 220 kA. The toroidal magnetic field is 3 T. The experiment was performed in the deuterium gas. Though there is the 6th harmonic ion cyclotron resonance layer of the deuterium at the plasma center, it is confirmed theoretically and experimentally that the waves are hardly absorbed at such a higher harmonic resonance layer[3)]. The radio frequency (RF) power radiated from antenna is about 100 kW.

The ECE signals in Fig. 1 rise when RF power is applied to the plasma. While the electron temperature near the plasma center rises immediately at the turning on the RF power, the temperature near the edge does not rise. This indicates that the fast wave is directly absorbed by the electrons near the plasma center. The electron temperature profile is peaked at the plasma center with the injection of the fast wave. The ECE signals decrease gradually after RF power is turned on because the density increases during the injection of RF power (Fig. 2).

At present we can't increase the RF input power because of the disruption induced by the increase of the impurity ions (Fig. 3). In JIPP T-IIU boronization will be carried out and it is expected to reduce the impurities.

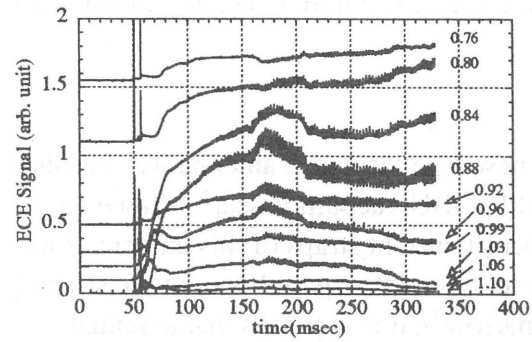

Fig. 1. The time evolution of the ECE signals.The position of plasma center is 0.93 m. The position of each chord is indicated in the figure.

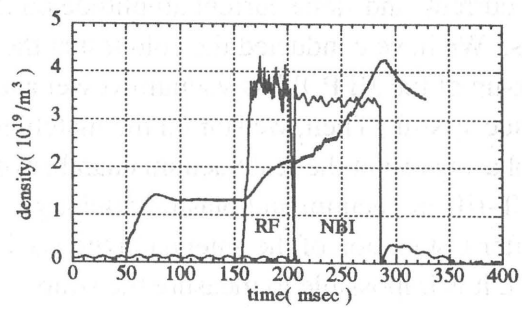

Fig. 2. The time evolution of the line averaged density

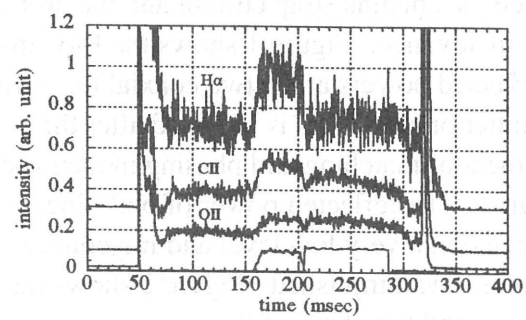

Fig. 3. The line emission of the impurities

Reference
1)Seki, T., et al. : Ann. Rep. NIFS (1993-1994) 166
2)Seki, T., et al. : Ann. Rep. NIFS (1994-1995) (to be published)
3)Seki, T., et al. : Nucl. Fusion 31 (1991) 1369