## §5. Nonlocal Transport Induced by Fast Current Ramp-Up

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Perturbative transport experiments are very powerful to investigate anomalous transport in a tokamak plasma. These experiments are carried out in many tokamaks, using a heat pulse produced by sawtooth activity and/or electron cyclotron heating or a cold pulse generated by various edge cooling methods. The fast ramp-up or ramp-down of the plasma current is also useful as a perturbation source. In the current ramp experiments we may obtain information about radial diffusion of the toroidal current and effect of edge ohmic heating on electron heat transport.

We have studied the effect of the current ramp-up on electron heat transport. Figure 1 shows an ohmic discharge with the fast current ramp-up. In this discharge, the ramp-up modifies the electron density profile, that is, the profile tends to become flat, enhancing Hα/Dα light. This is in a clear contrast to the current ramp-up plasma heated by NBI[1]. Figure 2 shows the time evolution of electron temperature Te at various minor radii. The edge heating by the ramp-up clearly propagates toward the plasma center from the edge. It is confirmed by the fast-response measurement of the current density profile by a Zeeman polarimeter that the toroidal current density increased by the ramp-up near the edge is confined there for about 15 ms from the start of the ramp-up. However, as seen from Fig.2, the front of electron temperature disturbance produced by the edge ohmic heating reaches the plasma center in about 10 ms from the ramp-up. Moreover, the electron temperature at the center is suddenly decreased much earlier than the arrival of the heat front generated by the edge ohmic heating. The Te-drop occurs only in a narrow central region of $r/a < 0.1$. The above-mentioned phenomena cannot be explained by a usual diffusive transport nature. The nonlocal electron heat transport may correlate with enhanced coherent magnetic fluctuations such as m=4 (m: poloidal mode number) and m=3 tearing modes, because they are destabilized near the edge and have a relative large radial correlation length of the order of the plasma minor radius as discussed in ref.[2]. As seen from Fig.2, m=4 and m=3 modes (presumably the toroidal mode number n=1) are destabilized during the current ramp-up phase. So far this nonlocal electron heat transport is not observed during the current ramp-down. These coherent modes are not observed in the current ramp-down discharges.

[1] K. Toi et al., this issues.
[2] K. Kitachi et al, this issues.

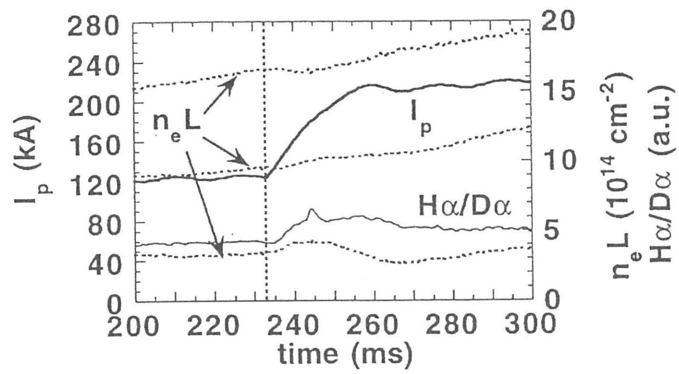


Fig.1 Time evolution of line integrated electron density at the plasma center, halfway and near the edge, and Hα/Dα light in the current ramp-up ohmic discharge.

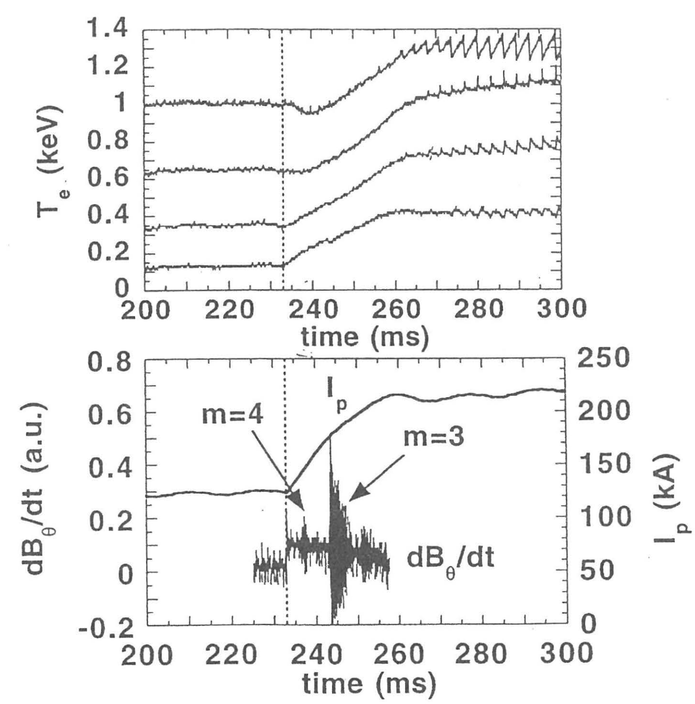


Fig.2 Temporal evolution of electron temperature at various minor radii and magnetic fluctuations detected with Mirnov coils.