

### S3. Penetration of Toroidal Plasma Current during Current Ramp-Up and Ramp-Down

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It is understood that the toroidal current quickly penetrates toward the plasma center in the formation phase of a tokamak plasma. The coherent MHD mode such as tearing modes may play an important role in the fast penetration. Recently, the fast current ramp-up or ramp-down is carried out in many tokamaks, to control the radial profile of the safety factor. We have developed a Zeeman polarimeter with good time resolution of about 2 ms, and successfully employed in the current ramp experiments[1].

Figure 1 shows the time evolutions of the plasma current  $I_p$  and the toroidal current density at various radial positions obtained with the polarimeter in the current ramp-up discharge (CRU). It is found that the current density increased by CRU diffuses toward the plasma interior from the edge. We reconstruct the radial profile of the current density in Fig.2 from the data

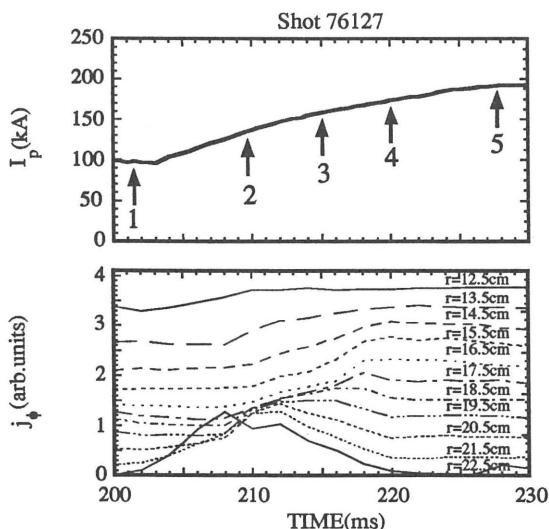


Fig.1. Time evolution of the plasma current and the toroidal current density at each radial position with the polarimeter in the CRU discharge.

of Fig.1. Each profile with the number is obtained at the time marked by the arrows in the  $I_p$  waveform of Fig.1. These profiles clearly indicate the formation of the skin profile near the edge in the  $I_p$ -ramp phase and its decay just before current flat-top.

During the current ramp-down (CRD), the current density profile evolves having the inverse skin effect as shown in Fig.3. The number indicates the change of these profile. In this discharge, the inverse skin effect of plasma edge has been clearly confirmed during current ramping phase.

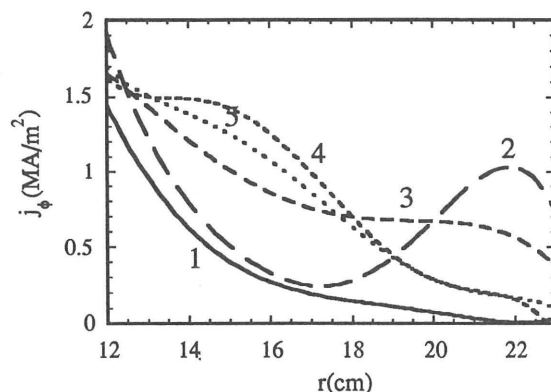


Fig.2. Time evolution of the toroidal current density profile in the CRU discharge shown in Fig.1.

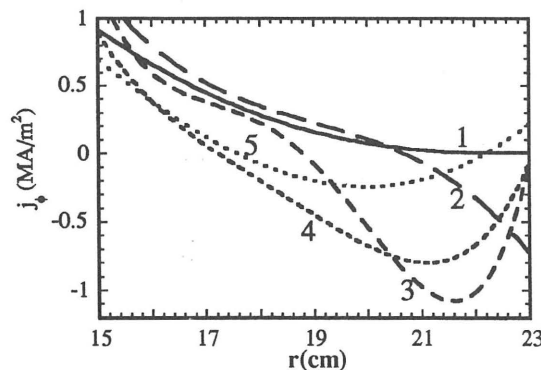


Fig.3. Time evolution of plasma current density profile in the CRD discharge. The profile marked by 1 is obtained at just before CRD, the profiles marked by 2 and 3 during CRD, and those marked by 4 and 5 just after the flat-top with the lower  $I_p$ .

[1]Kuramoto,H., *et al.*, NIFS-397 (1996)