

§8. Plasma Current Penetration during Rapid Ramp-Down of Plasma Current

Kuramoto, H., Hiraki, N. (Kyushu Inst. Tech.)
Toi, K., Narihara, K., Sato, K., JIPP T-IIU Group

In order to study current penetration during rapid ramp-down of the plasma current, the current density profile near the plasma edge has been measured with a Zeeman polarimeter in JIPP T-IIU. The current density profile realized during current ramp-down may have an important effect on plasma confinement[1].

Figure 1 shows a typical discharge with rapid current ramp-down. The plasma current was ramped down and kept approximately constant at 130kA during the neutral beam heating phase. In this discharge, we have measured poloidal magnetic field profiles shot-by-shot.

Figure 2 shows examples of electron temperature and density profiles just before ($t=230\text{ms}$) and after ($t=250\text{ms}$) the ramp-down, where these profiles are measured every 10ms with YAG Thomson-scattering system.

Data points in Fig.3 show the current density profiles obtained with a Zeeman polarimeter. In this figure, inverse skin effect is clearly seen near the edge. This figure also shows the current density profiles calculated with the following magnetic diffusion equation :

$$r \frac{\partial}{\partial t} \left[\frac{1}{q(r,t)} \right] = \frac{1}{\mu_0} \frac{\partial}{\partial r} \left[\frac{1}{r\sigma(r,t)} \frac{\partial}{\partial r} \left(\frac{r^2}{q(r,t)} \right) \right] \quad (1)$$

where $\sigma(r,t)$ is assumed to be the neoclassical value estimated from experimentally obtained T_e and n_e profiles(Fig.2.). In this analysis, Z_{eff} profile is adjusted so that the calculated loop voltage and location of the $q=1$ surface agree well with the measured ones[2].

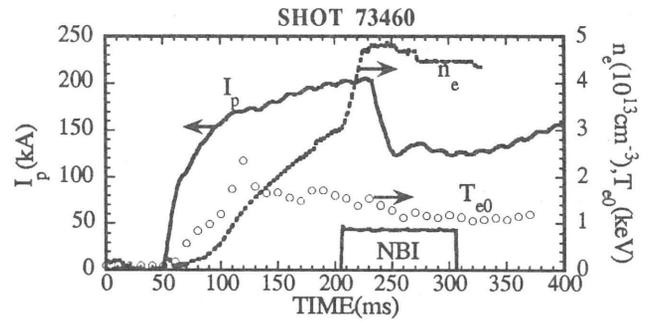


Fig. 1. Time evolution of plasma current(I_p), line-averaged electron density(n_e), and electron temperature along a central chord(T_{e0}).

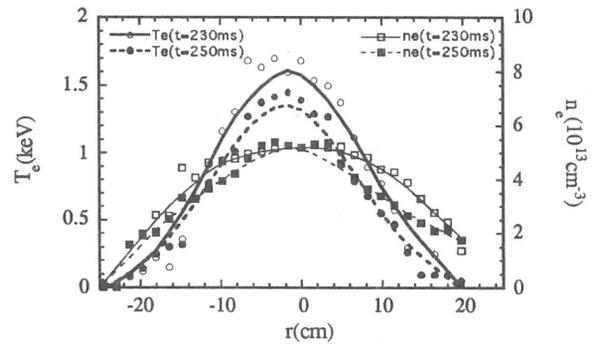


Fig.2. Time evolution of electron temperature and density profiles.

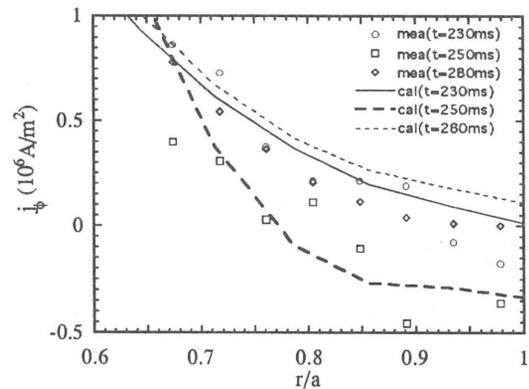


Fig. 3. Time evolution of measured and calculated current density profiles.

References

- 1) K.Toi et al.,Phys.Rev.Lett.**64** (1990) 1895.
- 2) K.Toi et al ,Nucl.Fusion **19** (1979) 1643.