§20. Radial Electric Field Control by Electrode Biasing in Heliotron J

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In L–H transition theories, the local maximum in ion viscosity versus poloidal Mach number plays a key role.[1] This maximum is considered to depend on Fourier components of a magnetic configuration. In the Tohoku University Heliac (TU-Heliac), the effects of the viscosity maxima on the L-H transition have been experimentally investigated. The poloidal viscosity was estimated from the ***J*** x ***B*** external driving force for a plasma poloidal rotation, where ***J*** was a radial current controlled externally by the LaB_6 hot cathode biasing. It was experimentally confirmed that the local maxima in the viscosity play the important role in the L-H transition.[2-3] Therefore it is important to perform this biasing experiments mentioned above in the confinement system that has changeability of the Fourier components of the magnetic configurations. The purposes of our electrode biasing experiments in Heliotron J were, (1) to estimate the ion viscous damping force from the driving force for the poloidal rotation, and (2) to study the dependence of the ion viscosity on helical ripples and bumpiness.

In this campaign the target plasma for the biasing in Heliotron J was produced by the ECH (f = 2.45 GHz P_{max} ~ 19 kW) in the magnetic configuration (DCC). In this biasing experiment, we observed the intermittent increase in the electrode current. Figure 1 shows the time evolutions of the electrode voltage, the electrode current, the electron density, the electron temperature, the floating and the space potential. It clearly shows that the electrode current, density and temperature play the periodic feature. In constant voltage biasing results we chose the electron density and temperature value on the top and bottom envelopes of the periodic figure, and we plotted the radial profiles of density and temperature in Fig. 2 (a) and (b). Figure 2 shows the data on the top and bottom envelopes of the periodic figure were similar to the radial profiles of the L mode and the improved confinement mode respectively. Form these profiles reveals that this periodic feature was the periodic transition from L mode to improved confinement mode. We expect to derive the time constant of various parameters from the conditional averaging of the periodic data and it is available to estimate transition conditions.

1) Shaing K. C.: Phys Rev. Lett. **76**, (1996) 4364.
2) Kitajima, S., *et al.*: Nucl. Fusion, **46**, (2006) 200.
3) Kitajima, S., Takahashi, H. *et al.*: Nuclear Fusion, **48** (2008) 035002.

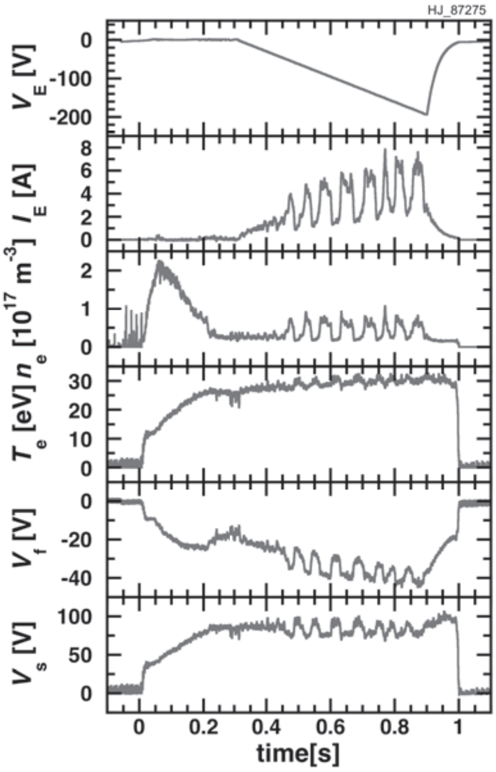

Fig.1 Time evolutions of the electrode voltage, the electrode current, the electron density, the electron temperature, the floating and the space potential

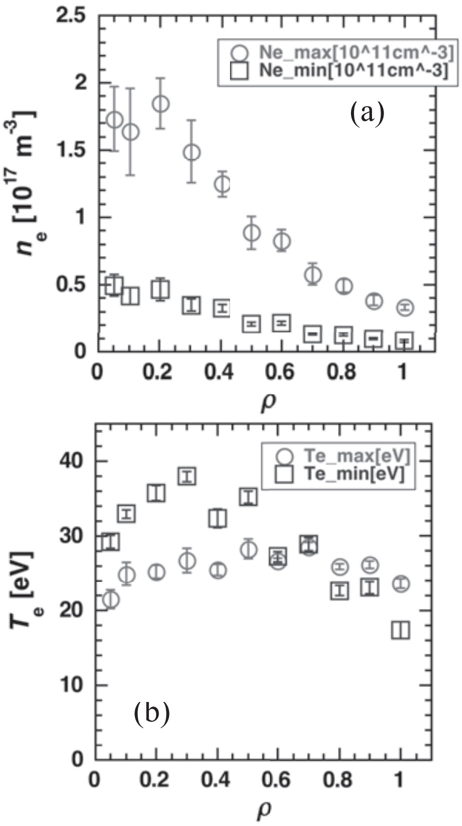

Fig. 2 Data on the top and bottom envelopes of the periodic figure, (a) electron density and (b) electron temperature