

§49. Core Electron Temperature Rise Due to Ar Gas-puff in EC-heated LHD Plasmas

Tamura, N., Inagaki, S., Ida, K., Tanaka, K., Michael, C., Tokuzawa, T., Goto, M., Morita, S., Shimozuma, T., Kubo, S., Igami, H., Fukuda, T. (Osaka Univ.), Itoh, K., Nagayama, Y., Kawahata, K., Sudo, S.

In order to investigate the electron heat transport in LHD plasmas closely, several temperature perturbation techniques, such as a TESPEL injection and a hydrogen ice pellet injection, have been applied. Under some conditions, an abrupt increase in core electron temperature T_e has been observed just after those perturbations. The response time of the core T_e rise to the edge perturbation is beyond the standard transport paradigm (local and diffusive). One of the candidates for explaining this phenomenon

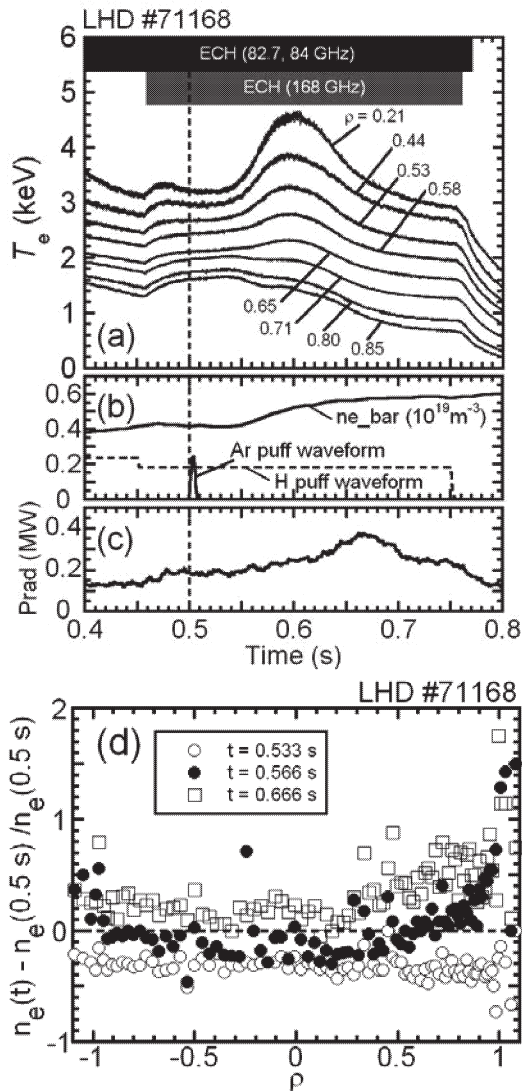


Fig. 1. Time evolution of (a) the T_e measured with the ECE radiometer at different normalized minor radii, (b) the line-averaged n_e and (c) the total radiated power. (d) Normalized radial profiles of the incremental n_e normalized by the base n_e ($t = 0.5$ s) measured with the Thomson scattering diagnostics. In (b), the waveforms of gas-puffs (H and Ar) are also plotted.

is non-locality in turbulence, such as turbulence spreading. In this regard, however, further experimental and theoretical investigations are necessary.

In 10th LHD campaign, after a slight Ar gas-puff, the similar core T_e rise has been observed as shown in Fig. 1(a). In this discharge, the plasma was sustained only by ECH (total injected power ~ 1.6 MW around the timing of the Ar gas-puff). The maximum increment of the core T_e is about 1.3 keV, which is comparable to the case with the TESPEL injection under the same plasma conditions. The line-averaged electron density $n_{e, \text{bar}}$ is increased slightly about 30 ms after the Ar gas-puff. This increase in $n_{e, \text{bar}}$ is attributed mainly to the increase in edge n_e , as indicated in Fig. 1(d). And there is almost no change in the total radiated power before and after the Ar gas-puff. Thus the core T_e rise cannot be caused by the RI mode, which has characteristically a density peaking and a significant enhancement of radiated power.

A transient response analysis reveals a similarity of the core T_e rise between with the Ar gas-puff and with the TESPEL injection. In both cases, as shown in Fig. 2(a) and (c), the relation of the perturbed electron heat flux normalized by the base n_e to the gradient of perturbed T_e shows a similar hysteresis loop. And the maximum of normalized perturbed electron heat flux appears around $\rho \sim 0.5$ (see Fig. 2(b) and (d)). Thus the non-locality in the electron heat transport would be essential for the core T_e rise after the Ar gas-puff as well as for that due to the TESPEL injection.

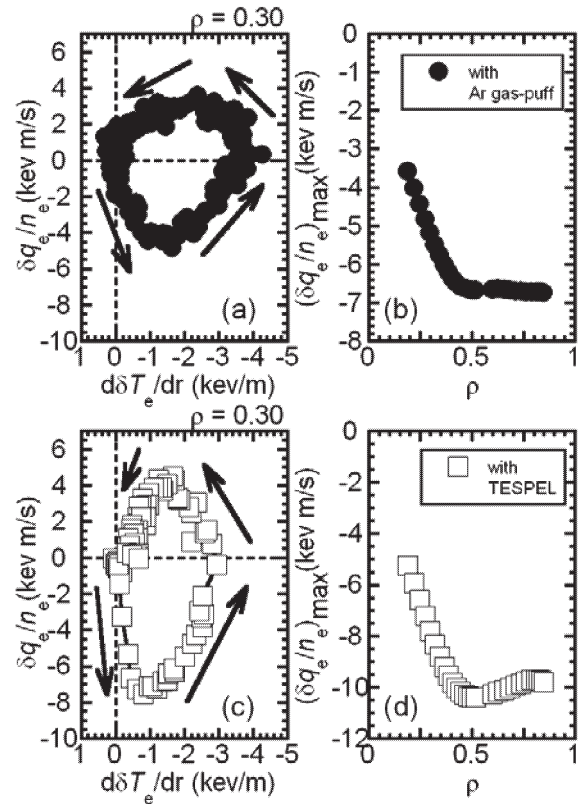


Fig. 2. The relation of the perturbed electron heat flux normalized by the base n_e to the gradient of perturbed T_e (left) and normalized radial profile of the maximum of normalized perturbed electron heat flux (right). The data with the Ar gas-puff is depicted in (a, b) and that with the TESPEL injection in (c, d).