Core electron temperature rise due to Ar gas-puff in EC-heated LHD plasmas

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Both spontaneous and externally-triggered changes of transport structure have been observed in magnetically confined toroidal plasmas. Examples of externally-triggered change as well as spontaneous change in the transport include the formation of an internal transport barrier and the transition from the low confinement mode (L-mode) to the high confinement mode (H-mode) in the edge region. An abrupt increment in electron temperature T_e in the core region just after edge cooling, which is so-called "nonlocal transport phenomenon" can be considered as one example of externally-triggered change in the transport, since the core T_e rise due to the edge cooling is, even transiently, accompanied by an improvement in transport. The core T_e rise induced by edge cooling due to a pellet (impurity or hydrogen) injection or laser-blow off has been observed in many tokamaks so far and more recently in a helical device, LHD [1, 2].

In LHD, the core T_e rise in response to a slight argon (Ar) gas-puff in electron cyclotron (EC) heated plasmas has been observed. The core T_e has risen up to about 1 keV after the Ar gas-puff, which is almost the same as that due to pellet injection. At the peak of the core T_e rise, an increment in the electron density has been observed only in the edge region. Transient response analysis shows that there is a similarity in the relationship between the electron heat flux and the T_e gradient between the core T_e rise after the pellet injection and that after the Ar gas-puff. Thus nonlocality in the electron heat transport is essential for the core T_e rise after the Ar gas-puff as well as for that invoked by the pellet injection. The time scale of the core T_e rise due to the Ar gas-puff is much longer than that of the core T_e rise in response to the pellet injection. Detailed comparison between the characteristics of the core T_e rise after the pellet injection and after the Ar gas-puff will give new insight into the causal mechanisms (nonlocality of the electron heat transport) of the core T_e rise.

[1] N. Tamura et al., Phys. Plasmas 12 (2006) 110705.
[2] N. Tamura et al., Nucl. Fusion 47 (2007) 449.

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