§2. Successful Sustainment of the Core Electron Temperature Increased by the Nonlocal Transport Phenomenon in LHD

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In LHD, a core electron temperature T_e rise in response to an edge cooling, so-called "nonlocal transport phenomenon (NTP)" has been observed[1]. Unfortunately, the increased T_e in the core region due to the NTP cannot be sustained, even though a heating power remains the same before and after the edge cooling, and then goes back the pre-cooling level. In the 13th LHD experimental campaign, we tried to keep the core T_e elevated by the NTP above the level before the edge cooling by means of the continuum occurrence of the NTP. In this trial, the key is the timing of the following edge cooling after the first one. This time a supersonic gas puff (SSGP), which is recently installed on LHD, is used for invoking the following edge perturbation.

The successful sustainment of the core T_e increased by the NTP by means of the continuum occurrence of the NTP is shown in Fig. 1(a, c). Conditions of the discharge (LHD pulse #94658) for Fig. 1(a, c) are as follows; magnetic axis position of 3.6 m, toroidal magnetic field strength of 2.85 T, port-through power of negative-ion based tangential NBI of 4.7 MW, injected ECH power of 2.4 MW. The line-averaged electron density just before the TESPEL injection is 0.58 x 10^{19} m^{-3} and the TESPEL deposition zone is estimated to be outside $\rho \sim 0.76$. As a reference, the core T_e rise in response to the single edge cooling induced by the TESPEL injection is shown in Fig. 1(b, d). Almost all the conditions of the discharge (LHD pulse #94661) are the same as LHD pulse #94658. As can be easily recognized from Fig. 1(c, d), the core T_e increased by the first edge cooling induced by the TESPEL injection is sustained for a while by the second edge cooling induced by the SSGP. The duration that the core T_e is elevated above the pre-cooling level seems to be more than twice the duration of the core T_e rise in response to the single edge cooling. It should be noted here that the increase in the electron density by the SSGP is much larger than that by the TESPEL injection, as seen in Fig. 1(a, b). Thus, in order to assess precisely the continuum occurrence effect of the NTP, the change in a heating efficiency should be also evaluated precisely. Nevertheless, the sustainment of the core T_e increased by the NTP in LHD was accomplished successfully.

1) N. Tamura et al.: Nucl. Fusion **47** (2007) 449.

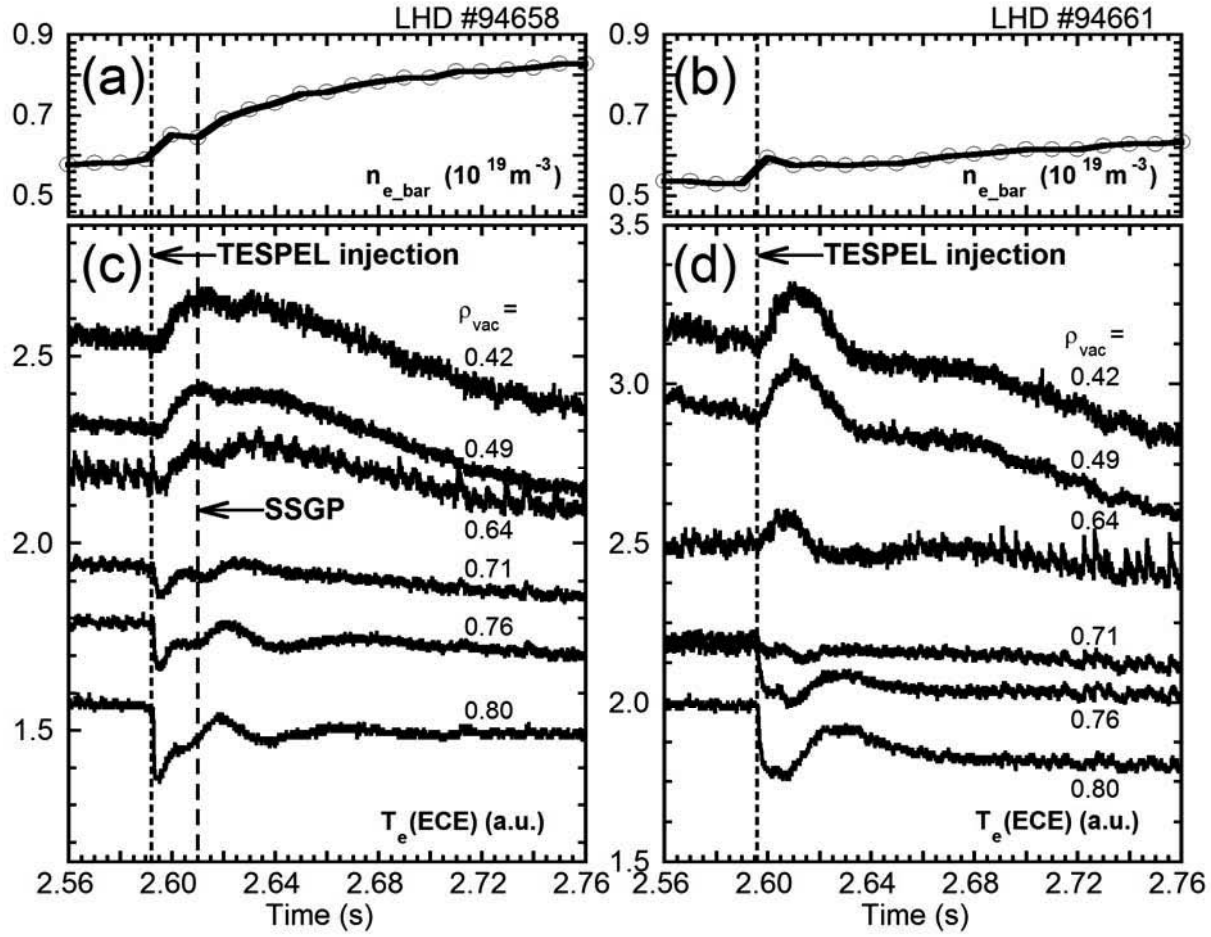

Fig. 1. Temporal evolutions of (a, b) the line-averaged electron density and (c, d) the electron temperature measured with the ECE radiometer at different normalized minor radii for LHD pulses #94658 (a nonlocal transport phenomenon was invoked twice) and #94661 (a single nonlocal transport phenomenon was invoked). The vertical short-dashed-lines and the long-dashed-line represent the times of the TESPEL injection and the supersonic gas puffing (SSGP), respectively.