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Effect of edge ECRH power deposition on the plasma confinement in EAST

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The ELMs erupted at the pedestal is generally because that the plasma current and the plasma pressure gradient exceed the peeling and ballooning boundary, especial the combined peeling-ballooning mode for large ELM events. To avoid the large ELM events, several methods, such as external resonant magnetic perturbation (RMP), impurity seeding and so on, are developing. An edge ECRH power deposition is also found to enhance the ELM frequency and reduce the ELM amplitude as observed in TCV[1] and AUG[2]. While unfortunately the plasma confinement is deteriorated as the ECRH power moved to edge.

This presentation reports a promising edge ECRH power deposition experiment conducted at EAST as shown in figure 1. The idea is to externally add a heat pulse to the pedestal region, to trigger the ELMs close to the peeling boundary and away from the ballooning and peeling-ballooning boundaries. By changing the mirror of the ECRH system, the ECRH power deposition has been changed from the plasma core (rho~0.15) #116466 to the plasma edge (rho~0.75) #116467. When the ECRH power deposited at core, the plasma density and the tungsten impurity gradually and slowly decrease until steady state (at ~5.5s), at which time the ELMs begin to erupt. The edge and core plasma temperature are gradually increased accordingly. When the ECRH power deposited at edge, a sudden decrease of edge plasma density and a subsequent L-H mode transition lead to a fast increase of edge and core plasma temperature. This increased temperature and its gradient have impeded the particle and impurity sources to further transport to the core and help to trigger the ELMs. The core plasma density and the tungsten impurity evolve much faster to the steady state (at ~4s) than that in #116466. Unlike TCV and AUG's experiments, the edge ECRH heated discharge maintains comparable plasma confinement with the core ECRH heated discharge due to larger electron temperature gradient. Since ITER will operate with ECRH dominant heating, this edge ECRH heated experiment may help ITER to flexible adjust the ECRH deposition position for controlling the edge pedestal structure and without deteriorating the high confinement.

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References

[1] J.X. Rossel et al., Nucl. Fusion 52 (2012) 032004
[2] A. Burckhart et al., Nucl. Fusion 56 (2016) 056011

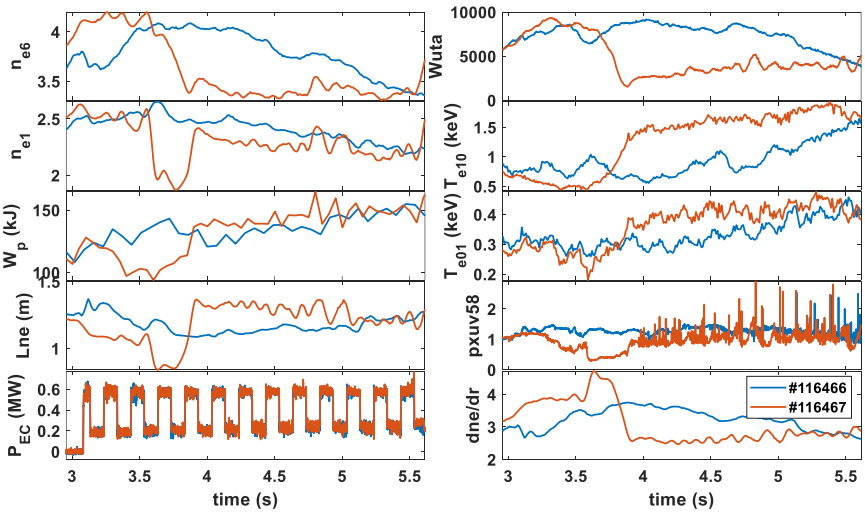

Figure 1. Edge ECRH power deposition experiment conducted at EAST.