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First Experiments in H-mode Plasmas with the Passive-Active Multijunction LHCD Launcher in HL-2A and Impact on Pedestal Instabilities

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The passive-active multijunction (PAM), a relevant lower hybrid current drive (LHCD) launcher design, was developed in view of a LHCD system for the second phase of ITER [1]. PAM launchers have so far been successfully tested in L-mode plasmas on FTU [2] and Tore Supra [3]. This paper presents the first ever experiments with a PAM on H-mode plasmas, carried out on HL-2A tokamak [4] as a joint project between SWIP and CEA/IRFM. This paper gives an overview of the LHCD system on HL-2A, the design of the PAM launcher and the first experiments performed. This involves coupling experiments in L-mode and H-mode plasmas, ELM-mitigation studies and modification of the plasma turbulence at the pedestal. The coupling experiments in H-mode were carried out in lower single null plasmas with ~ 1 MW of Neutral Beam (NB) heating. If the NB power was less than 800 kW, the additional LHCD power (200 –500 kW) allowed trigger and sustain the H-mode. The LHCD power was coupled during type I ELMs at large plasma-launcher gap (> 10 cm). Non-homogeneous power reflection coefficients (RC) were observed along the poloidal rows on the launcher, which could partly be attributed to larger plasma-launcher gap for the top rows. Local gas injection from the near gas puffing system was found primordial to reduce RC at large plasma-launcher gaps. Increase in ELM frequency and decrease in ELM amplitude were observed during LHCD power modulations. This ELM mitigation effect was sensitive to electron density and LHCD power. Increase of the pedestal turbulence measured by Doppler reflectometry was also observed, suggesting that an enhancement of the particle transport due to pedestal turbulence could be the reason for the ELM mitigation. In summary, these first LHCD PAM experiments on HL-2A have shown that the PAM launcher is a viable concept for high performance scenarios. The LHCD power can be coupled at large plasma-launcher gap, assist in triggering and sustaining H-modes, as well as affect the ELM behaviour.
[1] G.T. Hoang et al, Nucl. Fusion 49 (2009) 075001
[2] V. Pericoli Ridolfini et al, Nucl. Fusion 45 (2005) 1085
[3] A. Ekedahl et al., Nucl. Fusion 50 (2010) 112002
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