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# Progress towards Development of Long Pulse ITER Operation through RF Heated H-mode Experiments on EAST and HL-2A

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Recent long pulse experiments in EAST have resulted in a new world record of 100 s long H-mode discharge, sustained by the radiofrequency (RF) systems, predominantly Lower Hybrid Current Drive (LHCD). In parallel, experiments in HL-2A have demonstrated successful LH wave coupling in H-mode plasmas with an ITER-relevant passive-active multijunction (PAM) LHCD launcher. These two achievements, obtained as a part of the specific EU-China collaboration, show the viability of LHCD as a successful method for heating and current drive in high performance H-mode plasmas.

Experimental comparison of the two LHCD systems in EAST shows that the current drive efficiency is higher for the 4.6 GHz system than for the 2.45 GHz system. Higher power was therefore systematically used on the 4.6 GHz launcher in the long pulse experiments. Increasing the radial distance between the plasma and the launchers (up to 8 cm) was employed as method to optimizing the density in front of the launchers and to avoiding hot spots during the long H-modes. Lithium evaporation showed to have a beneficial effect on the LH current drive efficiency. An increase in efficiency from ⊠ = 0.8×1019 AW-1m-2 to 1.1×1019 AW-1m-2 was observed when the accumulated Lithium in the EAST vessel was above 150 g.
Good agreement between experimental results and simulations with C3PO/LUKE is obtained for EAST fully non-inductive discharges. C3PO/LUKE can well reproduce the experimental values of the internal inductance, as well as the non-inductive current profile obtained from equilibrium reconstruction constrained by interfero-polarimetry.

In HL-2A, a 3.7 GHz LHCD system with four klystrons and an ITER-relevant PAM launcher has been successfully brought into operation and used in H-mode experiments. Coupling of LH waves in ELMy plasmas has thus been demonstrated with an ITER-relevant launcher for the first time. The maximum coupled LH power has reached 1 MW in L-mode and 0.9 MW in H-mode. H-modes were triggered and sustained with LHCD together with ~ 700 kW NBI power. In H-modes with ne > 2.5×1019 m-3, a reduction in ELM amplitude and increase in ELM frequency were observed for injected LH power > 300 kW. The divertor peak heat load released by the ELMs was strongly reduced during this phase, which suggests that the LH power can be used for controlling ELMs.

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