Ramping up RF power and increasing pulse length in the full tungsten environment of WEST

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WEST is a full tungsten (W) superconducting tokamak with a major radius of 2.5 m, an aspect ratio of 5 and a nominal magnetic field of 3.7T. WEST programme aims at power exhaust studies on the ITER-like actively cooled tungsten divertor and at bulk plasma performance in discharges reaching 1000s.

So far up to 5.3 MW of LHCD and 1.4 MW of ICRH have been injected in L mode plasmas. In these conditions, the central electron temperature reaches 5 keV (at n_e of 3.5×10^{19} m^{-3}) with a radiated fraction of ~50% with LHCD and between 60 to 100% with ICRH. In the plasma edge, Doppler reflectometry measures a radial electric field well reaching -12kV/m as the power crossing the separatrix increases, though still below the L to H power scaling law [1].

Repetitive and reliable long L-mode discharges (~ 30 s) were achieved, accumulating ~ 20 minutes of plasma over two days. They were performed on the actively cooled upper divertor using 2.7 MW LHCD power with I_P= 400 kA, B_T=3.7 T, n_e = 3.2×10^{19} m^{-3}. The plasma radiation and density remained constant, indicating the absence of W accumulation. During N_2 seeding, an increase of the core temperature was measured.

Using the 1.5D METIS code [2], the plasma composition is inferred thanks to synthetic diagnostics (bolometer, SXR, etc) [3]. The LHCD power deposition and current drive efficiency are modelled thanks to the 3D C3PO/LUKE code [4]. The ICRH absorption is modelled thanks to EVE/AQL [5]. The respective core W transport contributions: turbulent vs neoclassic; diffusion vs convection, are obtained thanks to NEO [6] and QuaLiKiz [7].

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