Scaling of the scrape-off layer width in MAST L-mode plasmas as measured by infrared thermography

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Understanding the plasma parameters that affect the scrape off layer (SOL) width is a key issue for future tokamaks as the power entering the SOL (of order 100 MW [1] in ITER) and the SOL width (of order millimetres [2]) determine the heat flux to the divertor surfaces. The Eich scaling [2] can be used to characterise the divertor heat flux profile as an exponential decay for the SOL width and a Gaussian spreading factor due to diffusion around the last closed flux surface (LCFS). In this work, attached, double null, L-mode infrared (IR) profiles measured at the upper outer divertor on MAST are characterised by the fall off length, λ_q, and the spreading factor, S as returned from profile fits to the data using the Eich parameterisation for plasmas spanning an operational space of 400 kA $\leq I_P \leq$ 900kA, 0MW $\leq P_{NBI} \leq$ 3.1MW, $0.87 \times 10^{19} m^{-3} \leq \overline{n_e} \leq 4.6 \times 10^{19} m^{-3}$; where I_P is plasma current, P_{NBI} is neutral beam heating power and $\overline{n_e}$ is line-averaged density. Regression of the data has shown that the strongest dependence of λ_q is on I_P to the power of -1.04, which is consistent with multimachine scalings of H-mode plasmas [3]. Regressions including other variables for example, the parallel connection length ($L_\parallel$), will be performed to assess how they affect λ_q. The parallel connection length is particularly relevant to MAST-U where it can vary by a factor three. Midplane Thomson scattering (TS) measurements of the electron temperature and density fall off lengths allow approximation of the heat flux width at the midplane using either sheath or conduction limited models of the SOL. Surprisingly, the results suggest that the sheath limited approximation gives the best agreement between the IR and TS heat flux widths, independent of the regime; a full study will be performed in this work to investigate this result. The best regression for the spreading parameter, S, showed a strong negative dependence on the poloidal magnetic field, as has been seen in ASDEX Upgrade [4]. A comparison of double and single null plasmas will be presented to investigate the dependence of S on magnetic configuration.

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[3] T. Eich et al., Nucl. Fusion 53 (2013) 093031

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