Contribution ID: **87** Type: **Poster**

TH/P4-19: Drift-based Model for Power Scrape-off Width in Low-Gas-Puff H-mode Plasmas: Theory and Implications

Wednesday, 10 October 2012 14:00 (4h 45m)

A heuristic model for the plasma scrape-off width in low-gas-puff tokamak H-mode plasmas is introduced. Grad B and curvature drifts into the scrape-off layer (SOL) are balanced against near-sonic parallel flows out of the SOL, to the divertor plates. These assumptions result in an estimated SOL width of order the poloidal gyroradius. It is next assumed that anomalous perpendicular electron thermal diffusivity is the dominant source of heat flux across the separatrix, investing the SOL width, derived above, with heat from the main plasma. The separatrix temperature is then calculated based on a two-point model balancing power input to the SOL with Spitzer–Härm parallel thermal conduction losses to the divertor. This results in a heuristic closed-form prediction for the power scrape-off width that is in quantitative agreement both in absolute magnitude and in scaling with recent experimental data. The applicability of the Spitzer-Härm model to this regime can be questioned at the lowest densities, where the presence of a sheath can raise the divertor target electron temperature. A more general two-point model including a finite ratio of divertor target to upstream electron temperature shows only a 5% effect on the SOL width with target temperature = 75% of upstream, so this effect is likely negligible in experimentally relevant regimes. To achieve the near-sonic flows measured experimentally, and assumed in this model, sets requirements on the ratio of upstream to total SOL particle sources relative to the square-root of the ratio of target to upstream temperature. As a result very high recycling regimes may allow significantly wider power fluxes. The Pfisch-Schlüter model for equilibrium flows has been modified to allow near-sonic flows, appropriate for gradient scale lengths of order the poloidal gyroradius. This results in a new quadrupole flow pattern that amplifies the usual P-S flows at the outer midplane, while reducing them at the inner. The strong parallel flows and plasma charging implied by this model suggest a mechanism for H-mode transition, consistent with the observation that LSN divertors have lower power threshold and the JT-60 divertor did not accommodate H-mode. These results suggest that ITER may need to operate at least transiently in the low SOL regime presented here in order to achieve H-mode transition.

Country or International Organization of Primary Author

USA

Primary author: Mr GOLDSTON, Robert (Princeton Plasma Physics Laboratory)

Presenter: Mr GOLDSTON, Robert (Princeton Plasma Physics Laboratory)

Session Classification: Poster: P4

Track Classification: THD - Magnetic Confinement Theory and Modelling: Plasma–material interactions; divertors, limiters, scrape-off layer (SOL)