Turbulent Transport and the Scrape-off-Layer Width*

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Understanding the physical processes that control the radial width of the scrape-off-layer (SOL) is a key issue for the tokamak and spherical torus concepts. It is well known that future devices may be constrained by the power flux impacting material surfaces. Moreover, the particle flux influences fueling through recycling. In this paper we report on recent progress in theory, simulation and the comparison of these with data on the characteristics of the SOL.

The SOL width is set by a competition between cross-field and parallel transport. Cross-field transport fluxes are governed by turbulence-induced $E \times B$ convection, which can result in a quasi-diffusive contribution near the last closed surface (LCS) and in the formation of blob-filaments which produce strong convective transport in the SOL. [1] Heuristic estimates for the radial blob velocity in various regimes of the edge parameter space are combined with similar classical estimates for the parallel heat and particle flux to gain insight on the scaling of the SOL width. [2]

A more detailed description of SOL turbulence at the outer midplane is obtained from the 2D SOLT (scape-off-layer turbulence) code [3]. The code models the evolution of vorticity, density, temperature and zonal fluid momentum in the outboard midplane of a tokamak, and contains a reduced description of the electron drift wave, interchange instabilities and sheath physics. Curvature- and grad-B-driven charge separation enable blob transport of strong fluctuations ($\delta n/n \sim 1$) from the edge into the SOL. The parallel physics is modeled by closure schemes which depend upon the regime. Blob formation and its impact on the SOL width are investigated. It is shown that imposed zonal flows regulate the flow of particles and power across the LCS and hence the SOL profiles of n and T.

Finally, we compare the SOLT simulations with data from NSTX. Gas-puff imaging (GPI) diagnostics near the NSTX midplane [4] are compared with synthetic GPI diagnostics from the SOLT simulations to address the character of the turbulence. Probe measurments of the n and T profiles in the SOL are compared with the simulations. Ideas for improvement of the models and for additional information from the experiments are discussed.

[1] S. I. Krasheninnikov, D. A. D'Ippolito and J. R. Myra, J. Plasma Physics **74**, 679 (2008).
[2] see also S.J. Zweben et al., this conference.
[3] D. A. Russell, J. R. Myra, and D. A. D'Ippolito, Phys. Plasmas **14**, 102307 (2007).
[4] see also R. J. Maqueda et al., this conference.

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