

# Turbulent Transport and Blob Models

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A convergence of results from experiments, simulations, and theory has led to a new picture of turbulent transport in the edge and SOL. The turbulence in this region is large amplitude ( $\delta n/n \sim 1$ ) and highly nonlinear; the resulting transport is intermittent in space and time, and has non-Gaussian statistics. The observed transport is consistent with the radial propagation of coherent plasma structures (“blobs”). These structures are created by nonlinear saturation of the underlying turbulence in the edge and near SOL, and propagate to the wall due to charge polarization and resulting  $\mathbf{E} \times \mathbf{B}$  drift, which is driven in tokamaks mainly by the toroidal curvature. The original theory [1] describing ballistic blob propagation in the far SOL has been generalized [2] to include parameter regimes appropriate in the blob creation zone. Theory and simulations show that increasing the collisionality  $\Lambda = (v_{ei} L_{\parallel} / \rho_s \Omega_e)$  leads to electrical and thermal disconnection of the blobs from the axial boundaries (analogous to strong ballooning) and more rapid transport. An interesting application of this effect is the (convective) density limit observed on the C-Mod tokamak [3,4].

This talk will review the basic concepts of the blob model and summarize recent developments in theory and computer simulations. The parameter space controlling SOL transport will be described and a simple correspondence given between the scaling of the growth rate  $\gamma$  of the linear instability and that of the blob velocity  $v_x$  corresponding to the nonlinear saturation of the instability. Analytic and simulation results will be described from a 2-region 2D simulation model [5] which gives a reduced description of 3D turbulence.

<sup>1</sup> S. I. Krasheninnikov, Phys. Lett. A **283**, 368 (2001); D. A. D'Ippolito, J. R. Myra, and S. I. Krasheninnikov, Phys. Plasmas **9**, 222 (2002).

<sup>2</sup> J. R. Myra and D. A. D'Ippolito, Phys. Plasmas **12**, 092511 (2005).

<sup>3</sup> B. LaBombard et al., Phys. Plasmas **8**, 2107 (2001); B. LaBombard et al., Nucl. Fusion **45**, 1658 (2005).

<sup>4</sup> D. A. D'Ippolito and J. R. Myra, LRC Report LRC-06-107 (2006).

<sup>5</sup> D. A. Russell, D. A. D'Ippolito, and J. R. Myra, Bull. APS **50**, 84 (2005), paper CP1 45.