Scaling of edge turbulence properties and implications for the SOL width

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Turbulence and plasma parameter data from a comprehensive edge database for NSTX is examined and interpreted based on theoretical estimates. In particular, quantities of interest for assessing the role of turbulent transport on the midplane scrape-off layer heat flux width are studied. Considering a combination of Ohmic, L mode and H mode discharges, the length and time scales of the turbulence are found to be consistent with drift-resistive ballooning modes, driven at least in part by curvature, and possibly affected by sheared flows. The data yields estimates for the binormal wavenumber k_y and a characteristic turbulence rate ν_{turb}. Dimensionless combinations derived from the data are $k_y\rho_s$, ν_{turb}/ω_*, ν_{turb}/γ_{mhd} and two other dimensionless parameters $C_\lambda = (\gamma_{mhd}/V_y')^{2/3}$ and f_{pm}. The latter two should, based on theoretical considerations, characterize the importance of sheared flows and the saturation level relative to the mixing length (profile modification) estimate. Assuming resistive ballooning mode turbulence is the dominant transport mechanism for spreading the heat flux channel, a rough expression for the normalized turbulent perpendicular heat flux, and hence the SOL heat flux width, λ_q can be derived in terms of these dimensionless parameters, assuming only the preceding drift-interchange character of the turbulence and classical parallel transport. Quantitative estimates for λ_q using this approximate result are comparable to the minimum measured values of λ_q in NSTX. Thus, while it cannot be claimed that turbulence physics dominates λ_q in NSTX, the present results suggest that it is not negligible, at least for discharges with high plasma current.

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