Reduced-model (SOLT) simulations of an EDA H-mode shot at C-Mod†

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Reduced-model scrape-off layer turbulence (SOLT) simulations of an Enhanced D-Alpha (EDA) H-mode observed at C-Mod were conducted with the goal of understanding observed variations in scrape-off-layer (SOL) width. *On the core-side of the separatrix*, reference density and temperature profiles of the simulations are aligned with those observed in the experiment, and a mean poloidal flow is specified. The amplitude of this flow is used to control the level of turbulence in the simulations. *In a neighborhood of the separatrix, and in the SOL*, radial profiles evolve by self-consistent SOLT dynamics. The flow parameter is tuned to reproduce the observed flux of thermal energy across the separatrix, at which point experimental and simulation SOL widths are compared. In particular, the role of the competition between sheath- and collisional-limited parallel heat fluxes in determining the SOL width is studied. SOL width decreases with increasing input power and with increasing separatrix temperature in both the experiment and the simulation, consistent with the strong temperature dependence of the parallel heat flux in balance with the perpendicular transport by turbulence and blobs.

In terms of physics content and geometry, the SOLT model is relatively simple. Yet, applied to an EDA H-mode, it yields a persistent quasi-coherent mode (QCM) that dominates the turbulence and bears considerable resemblance to the QCM observed in C-Mod EDA operation. The SOLT QCM consists of nonlinearly-saturated wave-fronts located just inside the separatrix that are convected poloidally by the mean flow, occasionally emitting blobs into the SOL. The wavelength of the SOLT QCM is comparable to that observed in C-Mod. The mode frequency is dominated by Doppler shift in the "birth zone," yielding nearly linear ω-k dispersion. Linear analysis suggests connections with drift-interchange and Kelvin-Helmholtz instabilities that are present in the SOLT model.

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