ELM Dynamics in the SOL of the DIII–D Tokamak*

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High temporal and spatial resolution measurements in the boundary of the DIII-D tokamak show that edge localized modes (ELMs) are produced in the low field side, are poloidally localized and are composed of fast bursts of hot, dense plasma on a background of less dense, colder plasma (~5×10^{18} m^{-3}, 50 eV) possibly created by the bursts themselves. The ELMs travel radially in the scrape-off layer (SOL), starting at the separatrix at ~450 m/s, and slow down to ~150 m/s near the wall, convecting particles and energy to the SOL and walls. Modeling of ELMs should, therefore, reflect this convective nature. The temperature and density in the ELM plasma are initially very similar to those at the top of the density pedestal but decay with radius in the SOL. The temperature decay length (~1.2–1.5 cm) is much shorter than the density decay length (~3–8 cm), which in turn decreases with increasing pedestal (and SOL) density. The local particle and energy flux at the wall during the bursts are 10%–50% (~$1–2\times10^{21}$ m^{-2} s^{-1}) and 1%–2% (~20–30 kW/m^2) respectively of the LCFS average fluxes, indicating that particles are transported radially much more efficiently that heat. The ELM heat pulse is not a single pulse, as modeled until now, but a series of strong, short bursts. The ELM plasma density and temperature increase linearly with pedesta; density up to a Greenwald fraction of ~0.6, and then decrease, producing a divertor-benign ELM regime at high Greenwald fractions.

*Work supported by the U.S. Department of Energy under DE-FG03-95ER54294, DE-FG02-89ER53297, DE-FC02-04ER54698, DE-FG03-95ER54309, W-7405-ENG-48, DE-FG03-01ER54615, and DE-AC04-94AL85000.