Edge localized mode dynamics and transport in the scrape-of layer 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 (~20 to 40 μs long) of hot, dense plasma on a background of less dense, colder plasma ($\sim 5\times10^{18}$ m^{-3}, 50 eV) possibly created by the bursts themselves. The ELMs travel radially in the scrapeoff 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. The temperature and density in the ELM plasma initially correspond to those at the top of the density pedestal but quickly decay with radius in the SOL. The temperature decay length (~1.2 to 1.5 cm) is much shorter than the density decay length (~3 to 8 cm), and the latter decreases with increasing pedestal (and SOL) density. The local particle and energy flux at the midplane wall during the bursts are 10% to 50% (~1 to 2×10^{21} m^{-2} s^{-1}) and 1% to 2 % (~20 to 30 kW/m^2) respectively of the LCFS average fluxes, indicating that particles are transported radially much more efficiently than heat. Evidence is presented suggesting toroidal rotation of the ELM plasma in the SOL. The ELM plasma density and temperature increase linearly with discharge/pedestal density up to a Greenwald fraction of ~0.6, and then decrease resulting in more benign (grassier) ELMs.