ELMs and Electron Transport in NSTX

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In the National Spherical Torus Experiment (NSTX), ‘Giant’ ELMs can occur resulting in a loss of plasma stored energy of up to 30%, and are accompanied by a cold pulse that causes a global decrease in the electron temperature profile. Estimates of the electron thermal transport during the propagation of the cold pulse from the edge to the core show a large enhancement over the underlying cross-field thermal diffusivity, χ_e, of up to several 10’s of m /s. Following the ELM, short wavelength fluctuations increase in the plasma edge and core, corresponding to an increase in the electron temperature gradient from the propagating cold pulse. Fast electron temperature measurements indicate that the normalized electron temperature scale length, R/L_{Te}, reaches the threshold value for instability predicted by a fit to linear stability calculations. This is observed on time scales that match the growth of the high-k fluctuations in the plasma core, indicating that the enhanced χ_e and energy loss from the ‘Giant’ ELM appear to be related to critical gradient physics and the destabilization of electron temperature gradient modes. These observations contrast with the more typical Type I ELM, which has a reduced energy loss of 4-10%, an absence of corresponding high-k fluctuations, and a slower perturbed transport on the order of the underlying steady state transport.