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H-mode Pedestal Evolution in ELMy and ELM-free discharges in NSTX[1]

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Most tokamaks operate in ELMy H-mode, since ELM-free regimes typically have narrow and transient operational windows. In contrast, in NSTX, sustained ELM-free regimes are routinely accessed with a wide operating window by evaporating lithium onto the divertor plates between discharges [1]. In this work, we use this widened operating window to investigate the governing physics of the pedestal density, temperature, and pressure profiles. As part of the FY11 DoE multi-facility Joint Research Target, we contrast the pedestal structure evolution, transport, and fluctuations in ELMy and ELM-free regimes, building on previous studies [2]. Counter to intuition, the pedestal pressure width and height are found to be larger in ELM-free than ELMy discharges. During the inter-ELM phase in ELMy discharges, the pedestal pressure height saturates early in the ELM cycle and the maximum pressure gradient is clamped around 20% of the ELM cycle, similar in part to DIII-D observations [3]. Meanwhile the pedestal width continues to expand until the onset of ELMs [4]. The inter-ELM edge fluctuations, using BES and reflectometer measurements in the pedestal region, show a decrease of the fluctuations just prior to the onset of the ELM. This reduction of edge fluctuations is sustained when transitioning to ELM-free regimes. In the ELM-free discharges, the electron density pedestal width and height grow slowly with time, while the electron pedestal temperature appears clamped; hence, the pedestal pressure also grows slowly, evolving to a favorable parabolic-shaped profile. Nevertheless, peeling-ballooning theory appears to set an upper limit to the pressure gradients in both ELM-free and ELMy discharges.

[1] H. Kugel, et al. Phys. of Plasmas **15** (2008) 056118
[2] J. Canik, et al., Phys. of Plamas **18** (2011) 056118
[3] R. Groebner, et al. Nucl. Fusion **4** (2009) 064002
[4] A. Diallo, et al. Nucl. Fusion **50** (2011) *at press*

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