Varying the pre-discharge lithium wall coatings to alter the characteristics of the ELM-free H-mode pedestal in NSTX[[1]](#footnote-1)\*

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The different types of high confinement (H-mode) discharges, both with and without edge-localized modes (ELMs), are usually described in the literature as singular states, despite variability within each type. ELM-free H-modes often have the highest H-factors, but have not attracted extensive study because of their continual temporal evolution with impurity accumulation. Despite their evolution, there is a sense in the literature that the “best-performing” ELM-free states can be broadly characterized as a singular enhancement of Type I ELMy H-mode.

Recent experiments with gradually increasing lithium wall coatings on graphite plasma facing components in the National Spherical Torus Experiment (NSTX) showed pre-discharge lithium deposition had nearly continuous relationships with various plasma profile and discharge characteristics [1,2]. It starts at the wall: lithium has a strong affinity for hydrogenic species, leading to decreased recycling and reduced core fueling. Coupled with a resilient edge temperature gradient and improved confinement inside the pedestal top[3], the edge density and pressure gradients became wider. These changes led to improved edge stability, suppressing edge-localized modes (ELMs). In this paper, we show that the pedestal parameters continued to improve with additional lithium, *even after ELMs were completely suppressed*. This result implies a new knob for controlling the pedestal structure in high confinement discharges, for tests of models of pedestal structure. Here we present the evolution of the ELM-free H-mode pedestal with variable pre-discharge evaporation, showing a general improvement of the ELM-free pedestals with increasing lithium. For example, the electron density profile H-mode pedestal half-width from standard hyperbolic tangent fitting increased from about 7% to 10%; comparable increases were obtained for the electron pressure profile widths. The evolution of these ELM-free pedestals will be compared with peeling-ballooning calculations, which show robust stability to edge modes, and initial kinetic-ballooning mode calculations.

[1] D.P. Boyle, et al., Plasma Phys. Controlled Fusion **53** (2011) 105011

[2] R. Maingi, et al., Phys. Rev. Lett. **107** (2011) 145004

[3] J.M. Canik, et. al., Phys. Plasmas **18** (2011) 056118

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