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ELM Characterization and Dynamics at Near-Unity A in the Pegasus ST

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Operation in the high confinement (H-mode) regime and mitigation of associated deleterious Edge Localized Mode (ELM) activity are necessary for the success of ITER and future reactors. H-mode studies at near-unity aspect ratio A can offer unique insights into these issues. Edge plasma parameters at low A permit unique measurements of the edge pedestal with high spatiotemporal resolution using probes. In particular, measurements of the current density profile J_edge of import to peeling-ballooning stability and its nonlinear dynamics during ELMs are presented. Two classes of ELMs have been identified to date by their proximity to P_LH and measured n spectra provided by a near-edge Mirnov coil array. Both ELM types produce propagating, field-aligned filaments and have multiple n measured during the crash. These observations are consistent with the presence of a spectrum of simultaneously unstable peeling-ballooning modes anticipated by theory and nonlinear ELM simulations. Small, Type III-like ELMs occur at P_OH ˜ P_LH with n <= 4. Large, Type-I-like ELMs occur with P_OH > P_LH and intermediate 5 < n < 15, similar to ELMs at A ˜ 1.3 in NSTX. The Type III n ranges are opposite that reported at high A, and Type I n are in the low range of those reported at high A. These differences presumably reflect the strong peeling mode drive ˜ J_edge/B present in the ST. The dominant n component of a large ELM grows exponentially, whereas other n are nonlinearly driven and damped prior to the crash. Access to small and large ELMs are demonstrated in Ohmic H-mode plasmas by varying the applied input power. J_edge(R,t) measurements have been obtained across single ELM events with sub-cm spatial and Alfvenic temporal resolution. Both ELM types feature the nonlinear generation of "current-hole"J_edge perturbations, similar to prior studies of nonlinear peeling mode dynamics in Pegasus. A Type I ELM is shown to additionally expel a current-carrying filament during the ELM crash. Initial experiments coupling small amounts of helical edge current injection to H-mode plasmas suggest suppression of Type III ELM activity and negligible macroscopic impact on the discharge. This occurs for injected currents I_inj <˜ 1 kA. Above I_inj >˜ 1 kA the 3D field perturbation degrades the edge sufficiently to exit H-mode.

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