FOR ABSTRACT SUBMISSION

Paper Title

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

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Abstract Text: Enter the abstract in one continuous paragraph (maximum 2400 characters including spaces); text exceeding the space limit will be truncated. Do not use mathematical characters or expressions, Greek or other symbols, and superscripts or subscripts. The size of the text box cannot be exceeded.

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.