Edge Stability Studies at high $\langle j_{edge}/B \rangle$ in the PEGASUS Toroidal Experiment

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Large-scale, coherent, high-m filamentary edge instabilities are routinely observed under conditions of high edge current density in the PEGASUS Toroidal Experiment. These instabilities exhibit properties strikingly similar to Edge Localized Mode observations in large, high-performance advanced tokamak plasmas. In particular, the filaments are observed via high-speed imaging and local magnetic field fluctuation measurements to have low- to intermediate-*n*, large poloidal coherence lengths (over the majority of the poloidal cross-section), to rotate in the poloidal direction, and to explosively detach from the plasma edge region and propagate radially outward. Local edge measurements with scanning magnetic and electrostatic probes indicate these ELM-like structures have both magnetic and electrostatic turbulence properties. A coherent electromagnetic signature is particularly evident in the 100-200 kHz spectral range. This signature vanishes rapidly with distance from the last closed flux surface, consistent with a MHD origin and high *m*. These ELM-like structures may be explained by peeling-ballooning stability theory. The extremely low-**B** ($B_{t,0} \leq 0.1$ T at $R_0 = .45$ m) and high edge current density ($j_{edge} \approx 100$ kA/m^2) present in PEGASUS leads to high peeling instability drive, proportional to $\langle j_{edge}/B \rangle$, that is comparable to that achieved in H-mode operation on larger experiments. It is thus reasonable to expect peeling modes in PEGASUS, although the large relative $\langle j_{edge}/B \rangle$ is due to the naturally very low magnetic field and strong dI_p/dt (≤ 50 MA/s) driving j_{edge} as opposed to the presence of a strong pressure gradient and bootstrap current in the edge. PEGASUS, as a very low-field ST, offers a unique opportunity to study detailed properties of peeling-ballooning instabilities, in that the edge current and pressure profiles can readily be measured in detail via insertable probes. To that end, a new magnetic probe array and a scanning Langmuir probe assembly are being installed on PEGASUS. They will provide measurements of $P_e(R,t)$, $B_z(R,t)$ with high spatial and temporal resolution for comparison to peeling-ballooning stability theory with direct experimental constraint on the both the edge current and pressure profiles in equilibrium reconstructions.

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