Studies of role of inter-ELM pedestal instabilities on pedestal structure and ELM onset in DIII-D

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Experiments have been performed on DIII-D to study the role of inter-ELM pedestal instabilities on both the pedestal structure and the onset of ELMs. In these experiments, we scanned the NBI torque, puffed gas in the edge as well as varied the edge ECH heating to study the impact of these actuators on the inter-ELM pedestal modes. We observe a transition from a regime dominated at the beginning of the inter-ELM period by a single mode located near q=5 which expands to a more balanced organization between this mode and two secondary modes located near the q=6 surface just before the ELM onset. These additional modes can couple energy from the pedestal into the separatrix, providing a channel for the expulsion of energy and particles in the form of an ELM. More specifically, a large majority of energy losses from the pedestal is thought to occur between ELMs [1]. The key players in this energy loss are instabilities localized in the pedestal such as kinetic ballooning modes (KBM), electron temperature gradient (ETG), microtearing modes (MTM), ion temperature gradient (ITG), etc. Many experiments have reported inter-ELM pedestal modes (JET[2], C-Mod[3], DIII-D[4], AUG[5], EAST[6], and HL-2A[7]) that are correlated with saturation of the pedestal gradients prior to the ELM onset. Recent gyrokinetic calculations (GENE) have identified the pedestal modes on DIII-D to be consistent with microtearing modes [9]. Here, we study the pedestal evolution between ELMs to investigate the ELM onset mechanism. In addition, we report on pedestal experiments where we extract the dynamics of the most dominant modes localized in the pedestal during multiple inter-ELM periods and the effects of the various actuators on these modes. This work was performed under US DoE contract DE-AC02-09CH11466, DE-FC02-04ER5469, DE-FG02-08ER54984 and DE-FC02-04ER54698.

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