DPP13-2013-000604

Abstract for an Invited Paper
for the DPP13 Meeting of
the American Physical Society

ELM Suppression and Pedestal Structure in I-Mode Plasmas[1]

JOHN WALK, MIT Plasma Science and Fusion Center

The I-mode regime is characterized by the formation of a temperature pedestal and enhanced energy confinement (H_{98} up to 1.2), without an accompanying density pedestal or drop in particle transport. Unlike ELMy H-modes, I-mode operation appears to have naturally-occurring suppression of large ELMs in addition to its highly favorable scalings of pedestal structure (and therefore overall performance). Instead, continuous Weakly Coherent Modes help to regulate density. Extensive study of the ELMy H-mode has led to the development of the EPED model, which utilizes calculations of coupled peeling-ballooning MHD modes and kinetic-ballooning mode (KBM) stability limits to predict the pedestal structure preceding an ELM crash. We apply similar tools to the structure and ELM stability of I-mode pedestals. Peeling-ballooning MHD calculations are completed using the ELITE code, showing I-mode pedestals to be generally MHD-stable. Under certain conditions, intermittent ELMs are observed in I-mode at reduced field, typically triggered by sawtooth crashes; modification of the temperature pedestal (and therefore the pressure profile stability) by sawtooth heat pulses is being examined in ELITE. Modeled stability to KBM turbulence in I-mode and ELMy H-mode suggests that typical I-modes are stable against KBM turbulence. Measured I-mode pedestals are significantly wider (more stable) than the width scaling with the square root of poloidal beta characteristic of the KBM-limited pedestals in ELMy H-mode. Finally, we explore scalings of pedestal structure with engineering parameters compared to ELMy H-modes on C-Mod. In particular, we focus on scalings of the pressure pedestal with heating power (and its relation to the favorable scaling of confinement with power in I-mode) and on relationships between heat flux and pedestal temperature gradients.

[1]This work is supported by DOE agreement DE-FC02-99ER54512. Theory work at General Atomics is supported by DOE agreement DE-FG02-99ER54309.