Wide Pedestal Quiescent H-mode Plasmas in DIII-D Tokamak

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A new quiescent H-mode (QH-mode) regime with enhanced pedestal without ELMs has been discovered in the DIII-D tokamak in ITER relevant low torque and collisionality [1, 2]. The regime was originally discovered in conventional QH-mode when the counter-Ip neutral beam torque drops to ~2Nm in balanced double null shape. Across the transition, the pedestal electron pressure increases by 60% and widens by 50% and the plasma confinement rises by 40%. It is referred to as 'wide-pedestal QH-mode' because the pedestal width exceeds the EPED-KBM limit. The onset of edge broadband MHD modes and micro-turbulence accompanied with a lower ExB shear in this region is a common feature of the wide-pedestal QH, instead of the edge harmonic oscillations (EHO). It is conjectured that the increased transport provided by these edge modes reduces the pedestal gradients resulting in an enhanced pedestal while still remaining below the ELM-limit.

The wide-pedestal QH-mode has been created and sustained in a range of shapes from slightly upper single null to lower single null, including the ITER similar shape and for a range of torques spanning the ITER equivalent range. Wide-pedestal QH has been initiated and sustained with net zero NBI torque throughout the discharge with good confinement and terminated only due to hardware constraints. Surprisingly, confinement improvement has been observed with core electron heating using ECH. Impurity transport is studied with Silicon and Aluminum injection using laser blow-off diagnostics.

The role of edge magnetic and density fluctuations in forming the wide pedestal is being studied. The broadband MHD is composed of two counter-propagating low-*k* branches while the intermediate-*k* density turbulence propagates in the electron-direction (lab frame) and oscillates periodically [3]. A flat spot is observed in the pedestal profiles of wide-pedestal QH-mode, especially that of the electron temperature. The location of the flat spot is close to the location of the peaking of the amplitudes of some of these edge modes.

[1] K.H. Burrell *et al*, Phys. Plasmas 23, 056103 (2016). [2] Xi Chen, *et al*, Nucl. Fusion **57**, 086008 (2017). [3] K. Barada, *et al*, accepted by Phys. Rev. Lett.

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