Edge Currents and Stability in DIII–D*

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Understanding the stability and performance limits of the pedestal region in magnetically confined toroidal plasmas requires an accurate knowledge of the plasma current in this region. Using the Zeeman effect in an injected 30 keV lithium beam [1], we have measured the currents in the edge of the DIII-D tokamak for various confinement modes. For the high confinement cases, where substantial pedestal pressure gradients exist, we find large [~MA/m^2], localized [$\Delta R \sim$ 1-2 cm] currents in the pedestal region which are consistent with calculations of edge bootstrap current using the measured pedestal plasma profiles in the NCLASS bootstrap model [2]. Using free boundary equilibrium solvers such as CORSICA [3] and EFIT [4] we have generated self-consistent reconstructions that include the measured j_{EDGE}. These equilibria may then be used in conjunction with the ELITE magnetohydrodynamic (MHD) stability code [5] to assess the linear stability of the edge to peeling/ballooning modes. These results are then compared to the measured edge localized mode (ELM) onset conditions. The apparent consistency of the measured j_{EDGE} with neoclassical predictions occurs despite the violation of one of the fundamental tenets of the theory, namely that the pressure gradient scale length be large compared to the ion orbit size [6].

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