Pedestal performance dependence upon plasma shape in DIII-D

A.W. Leonard 1), T.A. Casper 2), R.J. Groebner 1), T.H. Osborne 1), P.B. Snyder 1), and D.M. Thomas 1)

1) General Atomics, San Diego, California, USA

2) Lawrence Livermore National Laboratory, Livermore, California, USA

e-mail contact of main author: Leonard@fusion.gat.com

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Abstract. Higher moments of the plasma shape than triangularity are found to significantly affect the pedestal pressure and edge localized mode (ELM) characteristics in DIII-D. The shape dependence of the pedestal pressure was experimentally examined by varying the squareness in the proposed ITER configuration while holding the triangularity fixed. Over this scan the pedestal pressure increased by ~50% from highest squareness to lowest squareness. The variation of pedestal energy is found to be consistent with stability analysis of the measured profiles. The ELM energy also varied with the shape to maintain a nearly constant fraction of the pedestal energy. Stability analysis using model shapes and pressure profiles indicates that much of the advantage of high triangularity for high pedestal pressure can be achieved in lower triangularity shapes by optimizing squareness and/or the distance of the secondary upper separatrix from the primary separatrix. In high beta discharges an increase in pedestal pressure is observed with higher global stored energy. The greatest pedestal pressure increase is at low squareness due to an increase in both the pressure gradient stability limit and the width of the pedestal. The variation in pedestal pressure with squareness was also used to optimize "Hybrid" discharges in DIII-D where a lower pedestal pressure was required for improved overall

performance. In the “Hybrid” regime low squareness resulted in a high pedestal pressure with large infrequent ELMs that eventually triggered an internal 2/1 tearing mode that locked, resulting in a disruption. At higher squareness the pedestal pressure was reduced with smaller and more rapid ELMs, resulting in maintenance of a steady beneficial internal 3/2 tearing mode and good confinement. For all of the cases studied, an increase in pedestal width at low squareness appears to be a significant factor in the increase in total pedestal pressure.