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Influence of Beta, Shape, and Rotation on the H-mode Pedestal Height in DIII-D[1]

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Recent experiments on DIII-D aimed at improving our understanding of the H-mode pedestal have shown that the observed pedestal gradient and pedestal width are sensitive to variations in plasma shape and global β but relatively insensitive to plasma rotation. These dependencies are critical to the extrapolation of present results to ITER due to the sensitivity of fusion performance on pedestal height. Using single parameter scans to isolate these effects, the pedestal pressure was observed to increase as either plasma shaping or global β was increased due to an increase in the width and the gradient of the pedestal pressure. In both cases, stability analysis indicated that the increased pressure gradient is consistent with peeling/ballooning theory. Stronger shaping increases the edge stability limit, allowing the pedestal pressure gradient to increase. At the same time, the pedestal width grows with the increasing pressure gradient until the MHD stability limit is reached and an ELM occurs. In the same manner, increased β improves the edge stability limit through increased Shafranov shift, with the pedestal gradient and width increasing. The increase in pedestal width at higher total pedestal pressure is correlated with a larger ion gyroradius as suggested by a number of theories. Gyroradius dependence will be examined with respect to previous results and scaling of the pedestal height to ITER. Increased toroidal rotation was observed to have minimal impact on the pedestal height even though core energy confinement improved. Increased toroidal rotation does not significantly change the stability limit, resulting in the pedestal width and gradient remaining unchanged. These results suggest that the improvement in core confinement as rotation increases is independent of pedestal performance.

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