Evidence for the Role of Velocity Shear on the L-H Transition in DIII–D*

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Recent measurements from the DIII–D tokamak indicate that shear in the group velocity of the edge density fluctuations is at least partly responsible for the 2–3× change in the H–mode power threshold, P_{th}, when the direction of the ion ∇B drift relative to the X–point location is reversed. Spatially resolved edge density fluctuation measurements show a change in the poloidal group velocity of the fluctuations when the ∇B drift direction was changed. High (low) shear in the poloidal velocity is associated with a low (high) P_{th}. A power scan shows that the velocity shear increases with the heating power. It is also observed that the poloidal group velocity can be larger than the $E_r \times B_T$ velocity near the plasma edge.

Comparisons at fixed heating power and density, but with opposite ∇B drift directions with respect to the X-point location, resulted in mid plane edge profiles of density and temperature, as well as amplitudes of density and potential fluctuations, that were nearly identical. This indicates that the specific values of mid plane edge temperature, beta, or their gradients are not playing key roles in determining P_{th}. Together, these results suggest that shear in the edge poloidal group velocity of the turbulence is important for obtaining H–mode and in determining P_{th}. These results also support the theory of shear flow stabilization of turbulence as the cause of the H-mode transport barrier.

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