Dependence of Edge Turbulence Dynamics and the LH Power Threshold on Toroidal Rotation

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The power threshold required to induce a transition from L-mode to H-mode plasmas is found to depend strongly on the injected neutral beam torque. This phenomenon occurs with the ion grad-B drift direction towards or away from the dominant X-point. Turbulence characteristics (poloidal flow, correlation lengths, decorrelation times) are simultaneously measured over a 2D region in the edge of the plasma ($0.85 < r/a < 1.0$) using the recently upgraded, wider-field, high-sensitivity Beam Emission Spectroscopy system. Injected torque is varied from the co-current to balanced and counter-current directions utilizing the recently implemented counter neutral beam injection capability on DIII-D. Plasmas with the ion grad-B drift away from the X-point, known to have a higher LH power threshold than those with the ion grad-B drift towards the X-point, show the strongest LH power threshold dependence on injected torque. With all beam torque injected in the co-current direction, these plasmas exhibit a relatively high LH power threshold (near 4-6 MW). This power threshold is reduced to 2-3 MW near zero injected torque, and is further reduced to < 2 MW with counter-current injected torque. Plasmas with the ion grad-B drift towards the X-point showed a qualitatively similar, though less dramatic, dependence of the LH power threshold. 2D turbulence measurements with BES show an increasing poloidal flow shear as the LH transition is approached. The turbulence decorrelation rates are found to vary with plasma rotation. Detailed characterization of the LH power threshold and edge turbulence characteristics approaching the transition are presented.

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