Measurements of 2D Edge Turbulence Dynamics and Comparison with BOUT Simulations*

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Turbulence characteristics and dynamics near the plasma edge, separatrix, and scrape-off-layer regions are measured as a function of plasma rotation using 2D density fluctuation imaging measurements obtained with Beam Emission Spectroscopy on DIII-D. Time-varying turbulence flow properties are measured via application of 2D velocimetry techniques to extract the 2D velocity field of the turbulent eddy structures. This analysis provides measurements of the turbulence velocity field, $\vec{v}(r,\theta)$, which allows for determination of such parameters as equilibrium and time-varying poloidal flows, including zonal flows and Geodesic Acoustic Modes, as well as time-varying radial motion of eddies and the resulting turbulent particle flux. The derived 2D velocity field may furthermore allow for extraction of the Reynolds Stress that is thought to contribute to intrinsic poloidal rotation drive. Plasmas with core toroidal rotation in the co-current and near balanced directions and with the ion ∇B drift directed towards and away from the dominant X-point are examined during the L-mode phase leading up the L-H transition. Simulations of these plasmas with the BOUT code have been performed and similar analysis is applied. Statistical properties of the measured and simulated flow fields are compared. These plasmas are chosen for detailed examination because of significant differences in edge poloidal flows and radial electric fields, as well as large differences in the L-mode to H-mode transition power that have been observed with rotation and magnetic configuration. Characterizing variations of turbulence flows and understanding these observed differences should be of significant practical value for understanding the H-mode power threshold.

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