Shear Flow and Turbulence Suppression in Limit Cycle Oscillations Preceding the L-H Transition*

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The L- to H-mode transition has been associated with the development of a localized **E×B** shear layer inside the separatrix. Recently, transient "H-mode-like" phases with reduced turbulence have been observed in NSTX preceding the L-H transition [1]. In ASDEX-U, a periodic modulation and an increase of the GAM (Geodesic Acoustic Mode) amplitude has been observed just prior to the L-H transition in low density plasmas [2]. New diagnostic capabilities at DIII-D, including an eight channel Doppler Backscattering (DBS) system and a five channel DBS system separated 180° toroidally, have allowed us to investigate the formation dynamics of the H-mode shear layer with high time (<10 μs) and spatial resolution (<1 cm). We present initial measurements of flow and turbulence evolution across the L-H transition, in particular during so-called dithering transitions.

In these transitions, an oscillating **E×B** flow in the electron diamagnetic direction develops in a narrow radial layer ~15 ms before the final L-H transition, while just inboard of this layer the **E×B** flow in the ion diamagnetic direction (associated with beam-driven toroidal co-rotation) is periodically enhanced. The oscillating flow is toroidally/poloidally correlated, consistent with a Zonal Flow feature at a frequency of ~2 kHz (much below the expected local GAM frequency). Turbulence suppression in a narrow radial layer ($\Delta r < 2$ cm) coincides with times of maximum flow shear. The radial correlation of flow and density turbulence across the shear layer and the correlation between time-dependent flow shear and turbulence envelope is examined. The "final" L-H transition following these oscillations is characterized by the development of a mean flow/shear layer and sustained turbulence suppression. The time evolution of shear flow and turbulence during a non-dithering transition will also be addressed.

[1] S.J. Zweben et al., Phys. Plasmas **17**, 102502 (2010)
[2] G.D. Conway et al., "Behaviour of mean and oscillating ExB plasma flows and turbulence interactions during confinement mode transitions," Proc. 23rd IAEA Fusion Energy Conf., Daejeon, Republic of Korea, 2010, paper EX/7-1.

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