Study of edge turbulence and L-H transitions in NSTX Ohmic plasmas

Santanu Banerjee[1], A. Diallo[2] and S. J. Zweben[2]

[1] *Institute for Plasma Research, Bhat, Gandhinagar 382428, Gujarat, India*
[2] *Princeton Plasma Physics Laboratory, Princeton NJ 08540 USA*

Lead-author e-mail: sbanerje@ipr.res.in

An important goal in fusion research, of late, is to develop a predictive understanding of the transition from L-mode to H-mode. In the new paradigm of drift waveï zonal flow turbulence [1-2], it has been emphasized that a significant portion of the available free energy from the gradients (∇n and ∇T) can be deposited in the zonal flows. Such models, however, need rigorous experimental validation for efficient operation of future fusion devices like ITER and beyond. Hence, the turbulence at the plasma edge needs to be analyzed in high spatial and temporal resolutions simultaneously. Characteristics of the turbulence in the edge and scrape-off-layer (SOL) of Ohmic plasmas in NSTX are studied in this work using data from the gas puff imaging diagnostic (GPI) [3]. Two dimensional turbulence velocity fields are derived from imaging velocimetry based on orthogonal dynamic programming (ODP) algorithm [4]. From the time dependent traces of the turbulence poloidal velocity (v_Z) across the L-H transition, it is apparent that the increase in v_Z precedes the fall in D_α signal and RMS fluctuation level. Hence, it is possible that the poloidal flow has initiated prior to the L-H transition. Further, a new ~40 kHz coherent mode is found in Ohmic L-mode plasmas for the first time in NSTX. Dynamics of the turbulence-zonal flow system across the L-H transition and statistical features of the blob dominated transport in L-mode plasmas will be reported.

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