2nd Asia-Pacific Conference on Plasma Physics, 12-17,11.2018, Kanazawa, Japan

Experimental Observation of High-k Turbulence Evolution across L-H Transition in NSTX

Y. Ren[1], R.E. Bell[1], W. Guttenfelder[1], S.M. Kaye[1], B.P. LeBlanc[1], E. Mazzucato[1], S. Zwenben[1], K.C. Lee[2], C.W. Domier[3], D.R. Smith[4], H. Yuh[5] and the NSTX-U Team

[1] Princeton Plasma Physics Laboratory, Princeton University, Princeton, NJ 08543

[2] National Fusion Research Institute, Daejeon, 305-806

[3]University of California at Davis, Davis, CA 95616

[4]University of Wisconsin-Madison, Madison, WI, 53706

[5] Nova Photonics, Inc., Princeton, NJ 08540

e-mail (speaker): yren@pppl.gov

High-k (electron-scale) turbulence has been found to be an important candidate for electron thermal transport in NSTX not only in the core region [1], but also in the H-mode pedestal region [2]. In order to fully understand L-H transition physics in NSTX, it is important to understand the role of high-k turbulence in L-H transition. Here we report observations of high-k turbulence evolution across L-H transition for the first time for NSTX. The high-k turbulence measurement (for $3 \lesssim k_\perp \rho_s \lesssim 13$) was carried out using a collective microwave scattering system [3] in NBI-heated NSTX plasmas with I_p=0.9/1.1 MA, B_T=5.5 kG and NBI heating power of 2-6 MW. The measurement was made at r/a≈0.71-0.89 and is at smaller radius than the location of the edge transport barrier in the H-mode phase (r/a $\gtrsim$ 0.89). It is observed that the evolution of high-k turbulence across L-H transition can be classified into four phases. There is a quasi-steady-state phase for the high-k turbulence before L-H transition. After the transition, there is an intermittent phase (lasting for ~15 ms) where the average high-k fluctuation power gradually decreases with intermittent large relative variation (on ~0.5- 1 ms time scale) in high-k fluctuation power. After the intermittent phase, there is a high-k quiescent phase where high-k turbulence is significantly suppressed. A recovery phase is seen after the quiescent phase, where high-k fluctuation power starts to gradually increase. It is found that the suppression of the high-k turbulence is more significant at lower wavenumbers, namely $k_\perp \rho_s \lesssim$8-9. The overall suppression of high-k turbulence is found to be consistent with the decrease in maximum ETG linear growth rate from gyrokinetic stability analysis using measured equilibrium profiles and suggests ETG play an important role in driving thermal transport. In addition, low-k turbulence measurements, i.e. Beam Emission Spectroscopy and Gas Puff Imaging, will also be discussed.

[1] Y. Ren et al., Nucl. Fusion 53, 083007 (2013)

[2] J.M. Canik et al., Nucl. Fusion 53, 113016 (2013)

[3] D. R. Smith et al., Rev. Sci. Instrum. 79, 123501 (2008)