Quasi-coherent modes and electron-driven turbulence

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Frequency spectra of fluctuations can show experimentally several kind of components such as coherent modes which oscillate at a well-defined frequency, or broad-band fluctuations which are considered as the signature of turbulence. This work investigates Quasi-Coherent (QC) modes which have characteristics in between coherent and broad-band fluctuations [1–3]. QC modes are observed at around 30-120 kHz in fluctuation spectra obtained by reflectometry, and their normalized scale was estimated to $0.02 < k_\perp \rho_i < 0.4$. They are poloidal ballooned on the Low Field Side (LFS) midplane and can be observed from the plasma core up to the edge. As micro-instabilities such as Ion Temperature Gradient (ITG) and Trapped Electron Mode (TEM) have similar characteristics, their possible link with QC modes is investigated.

Modifications of fluctuation spectra were observed in previous studies dedicated to ITG and TEM [4–6] but their correlation with transitions of turbulence regimes remains unclear. The present experimental observations and gyrokinetic simulations show a correlation between onset of QC modes and prediction of TEM. In Ohmic discharges of TEXTOR and Tore Supra, QC modes appear in the Linear Ohmic Confinement (LOC) regime only. QC modes onset is also observed during Electron Cyclotron Resonance Heating (ECRH) in a Tore Supra region where turbulence was expected to be TEM dominated by diffusion measurements [7]. For both LOC and ECRH regimes, linear gyrokinetic simulations predict that TEM are the most unstable modes when QC modes appear in fluctuation spectra. Rotation of density fluctuations measured on the top of TEXTOR suggest that QC modes have a phase velocity ~ 300 m/s higher in the electron diamagnetic direction than lower frequency fluctuations, consistent with the role of electrons in the onset of QC modes.

[1] A. Krämer-Flecken, *et al.* Nuclear Fusion **44** (2004).
[2] V. Vershkov, *et al.* Nuclear Fusion **45** (2005).
[3] H. Arnichand, *et al.* submitted to Nuclear Fusion (2014).
[4] A. E. White, *et al.* Physics of Plasma **17** (2010).
[5] J. E. Rice, *et al.* Phys. Rev. Lett. **107**, 265001 (2011).
[6] C. Sung, *et al.* Nuclear Fusion **53(8)**, 083010 (2013).
[7] D. Villegas, *et al.* Phys. Rev. Lett. **105** (2010).