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Ion-Scale Turbulence Study in KSTAR L-Mode Plasmas

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In KSTAR L-mode discharges (B_t0 = 3–3.3 T and I_P = 600 kA) heated by ˜1.5 MW neutral beam injection (NBI), 200–400 kHz turbulent fluctuations were observed with a multichannel (4 radial and 16 poloidal) microwave imaging reflectometer system [1]. Linear gyrokinetic simulations with GYRO predicted that turbulence is most unstable at k_theta ˜ 3 /cm (k_theta rho_s ˜ 0.4) and the most unstable mode frequencies in the plasma frame (omega_0/2pi) are a few tens of km in the NBI L-mode discharges. The most unstable mode frequencies were shifted by equilibrium ExB flow velocities (U_ExB) and their frequencies in the laboratory frame, which are given by omega/2pi = (k_perp U_ExB + omega_0)/2pi [2], were consistent with the measurements. Turbulence in a discharge (#9010) was modeled with a nonlinear gyrokinetic code GTS and the result showed that the dominant wavenumber and apparent poloidal velocities of fluctuations were consistent with the GYRO simulation result and measurement. In order to study the measured turbulence structure scales and their dependence on the local equilibrium parameters, the temporal and spatial characteristic scales of the measured turbulence were evaluated with the cross correlation analysis and compared with equilibrium parameters relevant to the ion-scale turbulence. Work supported by the NRF of Korea under grant no. 2014M1A7A1A03029865 and the US DoE under grant no. DE-FG02-99ER54531.

[1] W. Lee et al, Nucl. Fusion 54, 023012 (2014).
[2] R. A. Koch and W. Tang, Phys. Fluids 21, 1236 (1978).

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