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EX/P7-01: Characterisation of Ion-scale Turbulence in MAST

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Ion thermal transport in spherical tokamaks is often observed to be close to the neo-classical level, which is consistent with the suppression of anomalous transport due to ion-scale turbulence by strong NBI-driven flow shear. In order to test this conjecture a 2D BES diagnostic has been implemented on MAST to image the low-k (< 1.6 cm^-1) density turbulence. Initial investigations have focused on characterization of the turbulence in L- and H-mode discharges. The BES data exhibits both broad-band turbulence as well as coherent, global MHD modes, which complicates the analysis. The poloidal motion of the fluctuations is found to be dominated by the local ExB drift, with smaller diamagnetic contributions in either the ion- or electron drift directions depending on the dominant branch of turbulence, e.g. ITG or TEM. Calculation of the spectral density S(f, k) using a maximum entropy technique allows the localised turbulence to be distinguished from the global modes. In the periphery of L-mode plasmas the dominant turbulence appears to propagate in the ion-diamagnetic irection relative to the local ExB velocity but weaker turbulence observed in H-mode propagates in the electron diamagnetic direction. The BES turbulence observations have been compared with synthetic data generated from non-linear, gyro-kinetic simulations performed using the ORB5 and GS2 codes. Initial comparisons, based on global ORB5 simulations both with and without sheared flow, reproduce some important characteristics of the turbulence, e.g. flow-shear preventing spreading of the turbulence from an unstable peripheral region into the plasma core, although significant differences are apparent, the observed turbulence exhibiting shorter 'eddy'lifetimes and correlation lengths in the outer regions and hence being 'stronger'than the simulated turbulence.

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