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Experimental Study of Parametric Dependence of Electron-gyro Scale Turbulence on NSTX

YANG REN, PPPL

Electron-gyro scale turbulence, e.g. driven by Electron Temperature Gradient (ETG), has been proposed as a potential candidate for driving anomalous electron thermal transport in toroidal confinement devices. However, experimental studies of ETG turbulence are still in the early stages. In order to characterize electron-gyro scale turbulence and clarify its role in transport, experiments were carried out to study its parametric dependence on the National Spherical Torus eXperiment (NSTX), using a unique microwave scattering diagnostic which measures the radial wavenumber spectrum with high radial localization. Here, we present the first direct experimental demonstration of density gradient stabilization of electron-gyro scale turbulence. The experimental observation is in quantitative agreement with linear numerical simulations and supports the conclusion that the observed density fluctuations are driven by ETG. Furthermore, it is observed that longer wavelength modes, with normalized perpendicular wavenumber less than 10 (normalized using ion gyro-radius with electron temperature), are most stabilized by density gradient, and the stabilization is accompanied by about a factor of 2 decrease in the plasma effective thermal diffusivity, suggesting ETG turbulence may play a role in driving anomalous transport. Motivated by the observed strong inverse dependence of NSTX confinement time on electron collisionality, a study of the collisionality dependence of the electron-gyro scale turbulence was also carried out. The measured wavenumber spectral power was found to decrease as collisionality increased by more than a factor of two, with electron gyroradius, electron beta and q_{95} kept approximately constant. This result suggests that ETG may not be the only mechanism driving anomalous transport. Comparisons with non-linear gyrokinetic simulations will also be presented.