UCLA

Plasma Physics Seminar

Physics & Astronomy Building (PAB) Room 3-330
Via Zoom: https://ucla.zoom.us/j/92785449357?pwd=SVBTSko3bTdEUW03dzQwNks1Q2lKZz09
Friday, October 6, 2023 at 12:30PM
Lunch will be served at 12:00PM

New Measurements of H-mode Core Density Fluctuation Wavenumber Spectra and Tests of Quasilinear Turbulence Modeling

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Abstract: Measurements of the density fluctuation wavenumber spectrum, δne(k), obtained with Doppler backscattering (DBS) in ECH-heated H-mode DIII-D plasmas, are reported and used to test predictions from the TGLF code. Remarkable agreement is found between DBS measurements and our novel synthetic DBS diagnostic using measured profiles. The back-scattered power spectrum, Ps(k), was directly measured with DBS over a broad wavenumber range, $0.5 \leq k \leq 16$ cm-1 in electron-heated H-mode plasmas possessing low collisionality (ν*e < 1), Te/Ti > 1, and zero injected torque – a regime expected to be relevant for future devices. Measurements reveal a nonuniform spectrum with weak decay (k^-0.6) at low wavenumbers increasing to rapid decay (k^-9.4) at high-k. Starting with the SCOTTY beam tracing code, a novel synthetic DBS diagnostic was developed that allows us to calculate the back-scattered power, Ps, using the TGLF model δne(k). TGLF predicts that R/LTe-driven modes (TEM/ETG) dominate the transport spectra in this plasma regime. Parameter scans with TGLF predict the Ps(k) spectrum is sensitive to small changes in R/LTe at low and intermediate-k. Interestingly, +10% R/LTe destabilizes electron modes near kθρs = 1.0, nonlinearly increasing electron thermal and particle fluxes. With +10% R/LTe, the synthetic DBS diagnostic predicts the formation of a peak near kθρs = 1.0 in the Ps(k) spectrum – which was not observed experimentally. These TGLF predictions, combined with DBS measurements, suggest the mid-radius of this plasma is in a state of mixed ion-electron turbulence. Our results, fluctuation wavenumber spectrum measurements and a novel synthetic diagnostic, allow for significantly improved tests of both reduced turbulence/transport models and nonlinear gyrokinetic simulations (currently underway).

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