Abstract for an Invited Paper
for the DPP04 Meeting of
The American Physical Society

First Observation of Low, Intermediate and High k Turbulence in DIII-D and Comparison With Gyrokinetic Predictions[1]

W.A. PEEBLES, University of California, Los Angeles[2]

Understanding anomalous transport is important from both basic plasma science and fusion energy perspectives. Validation of turbulence-based transport predictions would increase confidence as next-step devices emerge, and could lead to transport control, optimization of pressure profiles and improved fusion performance. Long wavelength turbulence in the form of ion temperature gradient (ITG) driven modes is generally thought responsible for anomalous ion transport. In contrast, electron thermal transport is predicted to result from shorter wavelength trapped electron (TEM) and electron temperature gradient (ETG) driven modes, which have not previously been routinely measured. To address this issue, DIII-D recently upgraded measurement capability and obtained, for the first time, turbulence data over a broad spectral range ($0 < k\rho_s < 10$). Upgraded far-infrared scattering together with BES and PCI have been utilized to monitor low (0-1 cm^{-1}) and intermediate ($\sim 15\ cm^{-1}$) wavenumbers, whereas microwave backscattering has been developed to identify high k ($\sim 40\ cm^{-1}$) turbulence where ETG modes are created. High-k data display broad frequency spectra, whereas intermediate and low-k spectra are proportionally narrower. Calculations using the GKS linear stability code established that ETG, ITG and TEM modes were all unstable in these plasmas with frequency spectra consistent with experimental data. Nonlinear gyrokinetic calculations have been initiated to provide detailed comparison with experimental data, and experiments to unravel the roles of different turbulent spectral regions are underway.

[1]Supported by US DOE DE-FG02-01ER54615 and General Atomics SC-JP3337-01.
[2]In collaboration with the DIII-D Team: General Atomics, ORISE, ORNL, PPPL, MIT UNM, UMd, UW-Madison.