

Plasma Boundary Studies Via “Wind-Tunnel” Approach

Researchers from the Alcator C-Mod tokamak at the Massachusetts Institute of Technology and from the DIII-D tokamak at General Atomics have used a “wind-tunnel” approach to study the confinement and stability conditions of the plasma boundary. These conditions are important because they play an important role in determining the confinement and stability of the entire plasma. However, it has been difficult to develop a understanding of how these conditions are determined and how they vary between machines.

The experiment tested basic plasma physics theory which predicts that similar plasma phenomena should be observed in the two machines if certain “dimensionless parameters” were matched, even though the machines have

significantly different sizes and magnetic field strengths. Such an experiment is analogous to the use of a wind tunnel to compare the aerodynamics of aircraft with very different physical sizes. When the dimensionless parameters were matched near the boundary, the edge plasmas in the two machines exhibited the same energy transport characteristics; they exhibited the “quasi-coherent mode”, a small-scale instability; and they were both found to be very near the threshold for the development of a large-scale edge instability (ELMs). Thus, the experimental results were consistent with the predictions of basic theory and show that the wind-tunnel approach, of using dimensionless parameters, is a very productive method to compare the results from different tokamaks

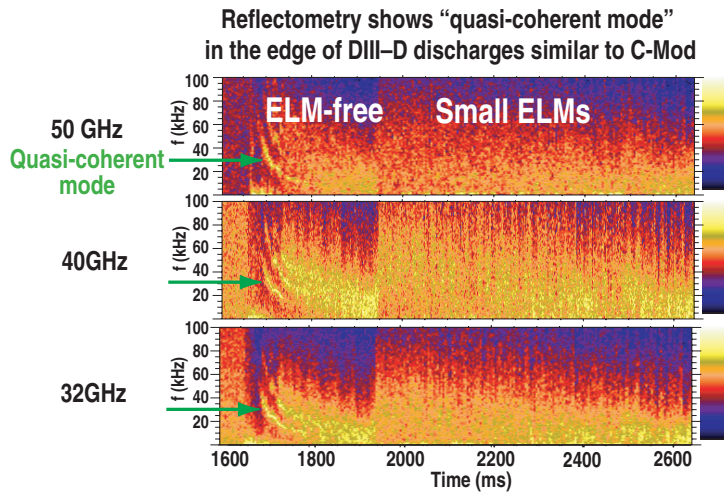


Fig. 1. Color contour plots of the density fluctuation power spectra versus time for homodyne reflectometry (UCLA) at 32, 40 and 50 GHz (corresponding to densities in the edge gradient region) showing the presence of a “quasi-coherent” mode in the DIII-D edge during the ELM-free phase.

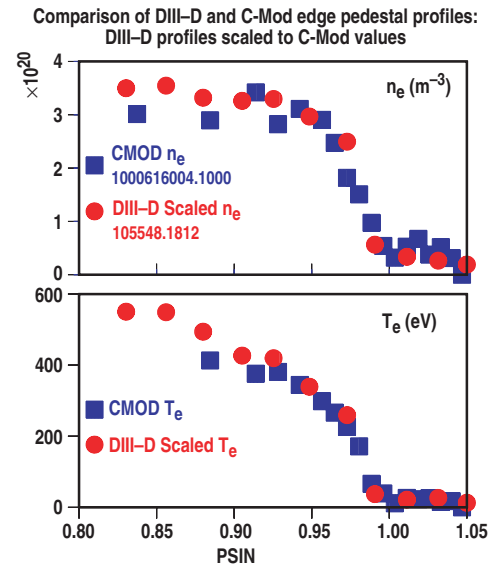


Fig. 2. Comparison of DIII-D and C-Mod edge pedestal profiles, showing the similarity between the DIII-D and C-Mod pedestals. The DIII-D profiles are scaled to C-Mod values.