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Comparison of Turbulence Measurements From DIII-D L-mode and High Performance Plasmas to Turbulence Simulations and Models[1]

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Measured turbulence characteristics (correlation lengths, spectra, etc.) in L-mode and high performance plasmas in the DIII-D tokamak show many similarities with the characteristics determined from turbulence simulations. These comparisons have great potential for enhancing our understanding of turbulence and transport as well as benchmarking and testing of simulation results. Radial correlation lengths $\Delta r_{\tilde{n}}$ of density fluctuations from L-mode discharges are found to be numerically similar to either the ion poloidal gyroradius $\rho_{\theta,i}$ or 5-10 times the ion gyroradius ρ_i over the radial region $0.2 < r/a < 1.0$. Comparison of these correlation lengths to ITG gyrokinetic simulations (the UCLA-Univ. of Alberta, Canada UCAN code) show that without zonal flows simulation $\Delta r_{\tilde{n}}$ are very long, spanning much of the 65 cm minor radius. With zonal flows these decrease to near the measured values in both magnitude and radial behavior. An experiment was performed to determine whether the correlation lengths scale with the poloidal or the total gyroradius. The poloidal gyroradius was modified while keeping other plasma parameters fixed. Analysis shows that the experimentally determined $\Delta r_{\tilde{n}}$ do not scale as $\rho_{\theta,i}$ indicating a scaling proportional to ρ_i. Preliminary UCAN simulation results have large uncertainties but show no clear scaling with poloidal gyroradius. Of additional interest are correlation lengths from quiescent double barrier (QDB) discharges, where both experiment and simulation show a significant reduction below normal L-mode scalings consistent with reduced transport in these high performance plasmas.

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