Turbulent Radial Correlation Lengths in the DIII–D Tokamak*

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Measurements of the radial correlation length Δr of density fluctuations have been made on the DIII–D tokamak in ohmic and L–mode discharges. These measurements span the radial region $0.5 \le \rho \le 1$ and are found to scale approximately as $\rho_{\theta,s}$ or 5–8 ρ_s. Here $\rho_{\theta,s}$ is the poloidal ion Larmor radius calculated using the local electron temperature and the poloidal magnetic field while ρ_s is the same except calculated using the total magnetic field. Currently, the two scalings ($\rho_{\theta,s}$ or 5–8 ρ_s) are not distinguishable over the region measured due to error bars inherent in the various measurements. The data were obtained primarily from a heterodyne reflectometer system. Data from a lithium beam probe, Langmuir probes, and BES will also be presented. Comparisons to published analytic formulas for the turbulent radial correlation lengths have been carried out. The measurements are consistent with the magnitude and radial dependence predictions from both a slab and a neo-classical formulation of ion temperature gradient (ITG) driven turbulence as well as an electron drift wave turbulence prediction. Predictions from toroidal ITG and a different slab ITG model were found to be outside the error bars of these measurements. Note that most predictions can be brought into agreement by the use of an undetermined constant multiplier on the theoretical value. The significance and implications of these results will be discussed. In addition, a detailed comparison to a non-linear gyro-kinetic turbulence code has begun. This is the beginning of a broad comparison of turbulence and other parameters (correlation lengths to start, then spectra, fluctuation levels, etc. from various diagnostics as appropriate) to code predictions. The code is used to simulate the particular plasma based upon measured profiles such as T_i, n_e, q, etc. Particular attention is directed at using similar spatial, wavenumber, measurement location and numerical analysis techniques in the code as compared to experiment. The code predictions of Δr were similar in magnitude and radial dependence to the measurements. However, since this version of the code uses a circular plasma cross-section, these results are being checked against a fully shaped version of the code. These and other similar comparisons are believed to be important as they serve to test and benchmark theory and codes as well as to help identify the type(s) of turbulence involved.

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*Work supported by U.S. Department of Enery under Grant Nos. DE-FG03-86ER53225, DE-FG03-95ER54294, DE-FG03-96ER54373, and Contract No. DE-AC03-99ER54463.