Validating simulations of core tokamak turbulence: current status and future directions*

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Abstract. Validating predictive models of turbulent transport in magnetically confined plasmas requires comparisons of detailed fluctuation statistics, in addition to net energy flows. Using measurements from new and improved diagnostics on the DIII-D tokamak [Luxon J L 2002 *Nucl. Fusion* **42** 614], we have performed a series of comparisons against predictions from the GYRO code [Candy J and Waltz R E 2003 *J. Comp. Phys.* **186** 545]. The development and application of synthetic diagnostics that model the spatial sensitivities of a given experimental fluctuation diagnostic is essential for these comparisons. At $r/a = 0.56$, we find very good agreement between the predicted and measured energy fluxes and fluctuation power spectra. However, at $r/a = 0.8$ the simulations underpredict the energy flows by a factor of seven and fluctuation amplitudes by a factor of three, but successfully reproduce the shapes of the experimentally measured fluctuation power spectra. At both locations significant attenuation in the synthetic power spectra and fluctuation levels is observed relative to "unfiltered" levels. Additional results contrasting local and nonlocal simulation results and convergence in toroidal mode number spacing are presented.

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