

Validation of Nonlinear Simulations of Core Tokamak Turbulence: Current Status and Future Directions^{*}

C. Holland

University of California-San Diego, 9500 Gilman Drive, La Jolla, California 92093

The process of verifying and validating transport and turbulence models is now recognized as an essential component for building and quantifying our confidence in these models. A particularly important part of the validation process for simulations of plasma turbulence is to compare code predictions against experimental measurements of fluctuations at multiple levels of the so-called “primacy hierarchy,” ranging from cross-phases and bicoherences to power spectra to heat and particle fluxes. In this talk, I will present an overview of the current status of research in this area, primarily using recent work [1] modeling a steady DIII-D L-mode discharge with the GYRO code as a case study. Highlighted topics will include assessing the success of “fixed-gradient” local and non-local simulations in reproducing experimental fluctuation measurements, the importance of using synthetic diagnostics in these comparisons, and the impact of statistical and systematic uncertainties in both the data input into the code (e.g. profiles and geometry) as well as in code output. I will then present some thoughts on future directions for improving the success of these models. In particular, I will discuss the need for (and limitations of) fixed-flux rather than fixed-gradient simulations. The issues of core-edge coupling and development of validation metrics will also be examined as necessary future topics of investigation. Finally, I will propose some experimental measurements, which would significantly advance the validation of these codes.

- [1] A.E. White, et al., “Measurements of Core Electron Temperature and Density Fluctuations in DIII-D and Comparison to Nonlinear Gyrokinetic Simulations,” submitted to Phys. Plasmas (2007).

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