Cross-phase measurements of turbulent density and electron temperature fluctuations for transport model validation in fusion plasmas

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Detailed, quantitative comparisons between turbulent transport models and experiments are needed to develop predictive capability for ITER and other future burning plasma experiments. In recent years, advances in turbulent fluctuation diagnostics at fusion devices around the world have opened up new opportunities for stringent tests of nonlinear gyrokinetic simulations. In parallel, simulation capability has evolved, enabling the use of high-fidelity transport models in predictive experimental design. One emerging measurement is the cross-phase angle between electron density and electron temperature fluctuations. This measurement can be made with a coupled reflectometer-radiometer system, such as the n-T phase system currently in use on AUG [1], and systems used at W7-AS [2] and DIII-D [3]. In past work the measured n-T phase in the core plasma at DIII-D was consistent with predictions from linear and nonlinear simulations [3]. Nonlinear GENE simulations for AUG predict that the n-T phases increase with radial position, and are similar for plasmas with and without ECRH [6]. These predictions can be tested in the future with the new n-T phase system at AUG. Preliminary data from the edge and pedestal region using the new n-T phase system at AUG is presented. This poster will also review measurements of phase angles in fusion plasmas, i.e. [2,3,4,5], with an emphasis on using these measurements for validation of turbulent transport models and on using predictions from gyrokinetic simulations and reduced models to guide experimental design.

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