Turbulence measurements and gyrokinetic validation at ASDEX Upgrade

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Quantitative comparison of gyrokinetic (GK) models of plasma turbulence to experimental measurements of fluctuating quantities is essential to provide stringent tests of the theory. Recently, the development in the fidelity of GK simulations, new experimental diagnostics and advanced synthetic diagnostics for qunatitative comparison, means that GK models can be tested more thoroughly than ever. At ASDEX Upgrade (AUG), using a recently developed 30 channel Correlation Electron Cyclotron Emission (CECE) radiometer, measurements of the fluctuation amplitude, $\delta T_{e\perp}$, radial correlation length, $L_r(T_e)$, and n_e-T_e cross-phase, $\alpha_{n_eT_e}$, have been obtained simultaneously in an L-mode plasma and are quantitatively compared to non-linear ion-scale GK simulations in an extensive validation study [1]. Additionally, eddy tilt angles have been measured for the first time at AUG using Radial Correlation Doppler Reflectometry and are found to be different for ITG and TEM dominated turbulence [2]. The results are interpreted through the use of extensive full wave simulations and compared directly to theoretical values. Doppler Reflectometry (DR) was recently used in the AUG core plasma to measure the electron density $k_\perp$ spectrum in the range $0.4 < k_\perp \rho_s < 3$ [3]. Discrepancies between O and X mode measurements are found to be explained by a combination of non-linear saturation at low-k and an enhanced power response at high-k [4]. O-mode results are in reasonable agreement with GK simulations. Furthermore, measurements of the eddy dissipation time and perpendicular correlation length of n_e fluctuations have been made using Poloidal Correlation Reflectometry [5] and compared to GK values. Experiments were recently performed to bring together as many simultaneous, spatially overlapping turbulence measurements as possible for quantitative comparisons to non-linear GK simulations. The measurements and progress in their quantitative comparison to GK simulations will be discussed.

References

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