Status of and plans for validation of turbulence simulation against LAPD data

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An overview of efforts to validate turbulence simulation codes using the Large Plasma Device (LAPD) will be presented. LAPD plasmas are produced by discharge using a large-area emissive cathode and have the following typical plasma parameters: $n_e \sim 10^{12}\text{cm}^{-3}$, $T_e \sim 5\text{eV}$, $T_i \lesssim 1\text{eV}$, $400 < B < 2000\text{G}$, plasma length $L \sim 17\text{m}$, plasma radius $a \sim 30\text{cm}$, plasma pulse length $\tau \sim 10 - 20\text{ms}$. Broadband turbulence is observed in the edge of LAPD, the character of which is consistent with resistive drift (drift-Alfvén) waves and flow driven modes (Kelvin-Helmholtz and rotational interchange). The length of LAPD allows for cross-field transport to compete with parallel losses and the radial density profile outside of the plasma source is established by turbulent transport consistent with Bohm diffusion. LAPD plasmas are being modeled using the 3D Braginskii fluid turbulence codes BOUT and BOUT++, providing the opportunity to validate these codes in a plasma where detailed measurements via probes are possible. The codes have been modified to handle the cylindrical geometry of LAPD and have been verified against analytic calculations for pressure-gradient and flow driven instabilities[1]. Initial nonlinear simulations revealed good qualitative and semi-quantitative agreement with measured fluctuation characteristics[2]. Recent work with BOUT++ has focused on convergence studies, flow generation, and saturation mechanisms for instabilities in LAPD.

[1] P. Popovich, M. V. Umansky, T. A. Carter, and B. Friedman, Phys. Plasmas 17, 102107 (2010)

[2] P. Popovich, M. V. Umansky, T. A. Carter, and B. Friedman, Phys. Plasmas 17, 122312 (2010)