Nonlinear Simulation of CSDX Including Sheath Physics

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The Controlled Shear Decorrelation Experiment (CSDX) linear plasma device provides a simple system for nonlinear studies of coupled drift-wave/zonal flow dynamics. A minimal model of 3D collisional drift-wave simulations with parallel sheath boundary conditions in CSDX reports change of physics in comparison to axially periodic simulation. The model evolves density, vorticity and electron temperature perturbations, incorporating axial sheath physics. Simulations carried out using BOUndary Turbulence (BOUT++) framework [1]. Equilibrium electron density and temperature profiles are taken from experimental measurements [2], and results show that simulation results has significant sensitivity to retaining the radial profile variation of plasma parameters. Previously, application of synthetic Langmuir probes to axially periodic simulation results revealed that electron temperature fluctuations are significant in interpretation of results [3], however in recent sheath-including simulations electron temperature fluctuations are significantly smaller than in the axially periodic case, yielding synthetic floating potential fluctuations more consistent with experimental observations. Moreover, onset of zonal flow via nonlinear energy transfer and Reynolds work has been studied, and effects of sheath dissipation has been discussed.

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[1] B. D. Dudson, et al., Comp. Phys. Comm. 180 (2009) 1467
[2] S. C. Thakur, et al., Physics of Plasmas 20, 012304 (2013)
[3] P. Vaezi, et al., APS DPP Conference Proceeding, DPP15-2015-001563 (2015)