GDB flux-driven turbulence simulations of the IWL Alcator C-Mod L-mode boundary plasma compared with experiment and stochastic model

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Prior to predicting confinement regime transitions in tokamaks one may need an accurate description of L-mode profiles and turbulence properties. These features determine the heat-flux width upon which wall integrity depends, a topic of major interest for research aid to ITER. To this end our work uses the Global Drift Ballooning (GDB) model [1] to simulate the Alcator C-Mod edge and contributes support for its use in studying critical edge phenomena in current and future tokamaks. We carried out 3D electromagnetic flux-driven two-fluid turbulence simulations of inner wall limited (IWL) C-Mod shots spanning closed and open flux surfaces [2]. These simulations are compared with gas puff imaging (GPI) and mirror Langmuir probe (MLP) data, as well as the stochastic fluctuation model [3], examining global features and statistical properties of turbulent dynamics. GDB reproduces important qualitative aspects of the C-Mod edge regarding global density and temperature profiles, within reasonable margins, and though the turbulence statistics of the simulated turbulence follow similar quantitative trends questions remain about the model's difficulty in exactly predicting quantities like the autocorrelation time. A proposed breakpoint in the near SOL pressure and the posited separation between drift and ballooning dynamics it represents are examined. This experimental-stochastic comparison helps us assess the reliability of GDB as a physics and a predictive tool for other studies.

[1] B. Zhu, et al., submitted to Comp. Phys. Comm. (2017)

[2] M. Francisquez, et al., Nucl. Fusion 57 (2017) 116049

[3] O. E. Garcia, et al., Phys. Plasmas 23 (2016) 052308