Simulations of electron-scale turbulence in NSTX pedestals*

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An extensive analysis of the linear microstability of the pedestal in the National Spherical Torus Experiment (NSTX) has been previously performed [1], exploring the observed impact that lithium deposition onto the plasma-facing components has on the pedestal structure. These studies found that the pedestal was marginally stable to electron temperature gradient (ETG) modes without lithium, but strongly unstable with lithium. This led to the conjecture that ETG may play a role in the observed stiffness of the edge electron temperature profile even as the neutral fueling and plasma density decrease as lithium is applied [2], thought to be critical to the observed stabilization of edge-localized modes [3].

Nonlinear ETG simulations have been performed for these cases using the GS2 code [4]. Results indicate that the ETG could indeed play a significant role in the pedestal power balance for these cases. With lithium, simulations show that ETG turbulence drives several hundred kW of electron heat flux, which is within a factor of two of the experimental level. Further, with a modest increase of the T_e gradient (~20%), ETG can provide the entirety of the electron heat flux. Without lithium, on the other hand, very little heat flux is found in electron-scale simulations, with negligible transport compared to experiment. These studies have also been extended to more highly shaped plasmas. 2D plasma/neutral modeling has been performed that shows similar trends in the recycling profiles and edge transport characteristics to the previously reported results at low triangularity [1]. Linear analysis again shows that ETG modes are unstable in the pedestal region, with higher growth rates in cases with lithium [5]. Results of nonlinear simulations for these high triangularity discharges will be presented. *Research supported by the US Department of Energy, Contracts DE-AC05-00OR22725, DE-AC02-09CH11466.

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