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Suppressing Electron Turbulence and Triggering Internal Transport Barriers with Reversed Magnetic Shear in the National Spherical Torus Experiment

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Observations in the National Spherical Torus Experiment (NSTX)[1] have found electron temperature gradients that greatly exceed the linear threshold for the onset for electron temperature gradient-driven (ETG) turbulence. These discharges, deemed electron internal transport barriers (e-ITBs), coincide with a reversal in the shear of the magnetic field and with a reduction in electron-scale density fluctuations, qualitatively consistent with earlier gyrokinetic predictions.[2] To investigate this phenomenon further, we numerically model electron turbulence in NSTX reversed-shear plasmas using the gyrokinetic turbulence code GYRO.[3] These first-of-a-kind nonlinear gyrokinetic simulations of NSTX e-ITBs confirm that reversing the magnetic shear can allow the plasma to reach electron temperature gradients well beyond the critical gradient for the linear onset of instability. This effect is very strong, with the nonlinear threshold for significant transport approaching three times the linear critical gradient in some cases, in contrast with moderate shear cases, which can drive significant ETG turbulence at much lower gradients. In addition to the experimental implications of this upshifted nonlinear critical gradient, we explore the behavior of ETG turbulence during reversed shear discharges. This work is supported by the SciDAC Center for the Study of Plasma Microturbulence, DOE Contract DE-AC02-09CH11466, and used the resources of NCCS at ORNL and NERSC at LBNL.

[1]M. Ono et al., Nucl. Fusion **40**, 557 (2000).
[2]H. Y. Yuh et al., Phys. Rev. Lett. **106**, 055003 (2011); F. Jenko and W. Dorland, Phys. Rev. Lett **89**, 225001 (2002)
[3]J. Candy and R. E. Waltz, J. Comput. Phys. **186**, 545 (2003).