Abstract Submitted
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Identification of new turbulence contributions to plasma transport in NSTX W.X. WANG, Princeton University Plasma Physics Lab., S. ETHIER, Y. YEN, S. KAYE, J. CHEN, PPPL, Z. LU, UCSD, E. STARTSEV, PPPL — Nonlinear global gyrokinetic simulations critical for addressing highly distinct turbulence and transport physics in spherical tokamaks (ST) such as NSTX have led to new insights. The drift wave Kelvin-Helmholtz instability, driven by strong shear flow, was found to be unstable in NSTX L-mode plasmas. The mode is characterized by finite $k_{//}$ and broader k_θ than for the ITG mode. While the strong rotation shear leads to a reduction in the lowest-k turbulence, the remaining low-k fluctuations can produce a significant ion thermal transport comparable to experimental levels in the outer core region. Low-k fluctuations in L-mode also produce significant toroidal momentum flux, including a large anti-gradient residual stress mainly due to zonal flow shear induced symmetry breaking. Another new, important turbulence source identified in NSTX is the dissipative trapped electron mode (DTEM), which is believed to play little role in the core of conventional tokamaks. Due to the high trapped electron fraction in NSTX, long wavelength DTEMs peaking around $k_\theta \rho_s \sim 0.1$ are destabilized by collisions with steep electron temperature and density gradients achieved there. The DTEM survives the strong ExB shear associated with the toroidal rotation. The grad-n driven DTEM is found to produce significant particle, ion energy and toroidal momentum transport in agreement with experimental levels in NSTX H-modes. The grad-Te driven DTEM may potentially produce a large heat flux contributing to the highly anomalous electron thermal transport, and possibly contribute to the strong increase of confinement in NSTX with decreasing collisionality. This work was supported by U.S. DOE Contract DE-AC02-09CH11466.

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