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Linear Gyrokinetic Calculations of Microturbulence in H-mode on NSTX

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Gyrokinetic simulations of plasma turbulence with the massively parallel code GS2 [1,2] are being carried out to examine a low aspect ratio, H-mode experiment which exhibits unusual transport behavior, within flux tube geometry. NSTX is a low aspect ratio, high beta experiment to study transport and turbulence with additional diagnostic capability for fluctuations and q profile expected in future years. The q profiles for these simulations appear to be reversed in the plasma center. These initial simulations of NSTX are focussed on an H-mode experiment with resilient electron temperature profiles, in the presence of increasing density and decreasing ion temperature, to examine the role of critical temperature gradients and the existence of marginal stability.

Simulations have been carried out for three radii, at two times during the pulse. Linearly converged eigenmodes are found with eigenfunctions from $k_\theta \rho_i$ = 0.1 to 80, extending from the ITG-TEM to the ETG range of frequencies. Initial simulations show that during the evolution of the discharge the dominant instabilities outside the core-region are ETG modes. ITG modes are either stabilized by plasma conditions of magnetic geometry and profiles, or by the large ExB shearing rates computed from plasma rotation. In the plasma core, in agreement with the observed remarkably good plasma confinement, both ETG and ITG modes are stable. Microtearing modes are found near the half-radius, but would be likely stabilized by ExB shearing. Resilient electron temperature profiles then may be connected with ETG modes as the plasma is far above marginal stability for these modes outside the half-radius. The experiment is characterized by acceptably low values of ρ^*, from 0.031 at r/a=0.25 to 0.0064 at r/a=0.80. While the criterion of $\rho^* \ll 1$ required for GS2 calculations holds, there are additional effects such as ρ^* stabilization by which profile effects mix different wavelengths, as will be examined with GYRO[3,4].

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