Abstract Submitted
for the APR06 Meeting of
The American Physical Society

Nonlinear Energy Transfer in Ion Temperature Gradient Turbulence[1] W.X. WANG, T.S. HAHM, W.W. LEE, G. REWOLDT, W.M. TANG, Princeton Plasma Physics Lab. — Nonlinear energy couplings in ion temperature gradient (ITG) turbulence are studied by global gyrokinetic particle simulation of shaped toroidal plasmas based on DIII-D geometry. It is observed that the average toroidal mode number is rapidly down-shifted by 2/3 along the $m/n \sim q$ surface, coincidently occurring during the turbulence saturation process. This indicates that the ITG saturation is strongly correlated with nonlinear energy transfer to longer-wavelength modes. The nonlinear toroidal coupling is considered as a dominant channel for the energy transfer to low-n modes, and simultaneously, to strongly damped high-n modes, resulting in the overall spectrum down-shift. Our numerical experiments suggest that the zonal flows can drive turbulence. However, the associated energy coupling is very weak. In contrast, the zonal flows are shown to extract a large amount of energy from turbulence components during their generation process. This, in part, represents turbulent transport reduction by zonal flows. In addition, zonal flows also affect the nonlinear energy coupling process in k-space by transferring turbulence energy faster and more efficiently from unstable modes to stable modes, compared to the case without zonal flows. This is compared to the corresponding effect of an applied equilibrium radial electric field determined by the neoclassical dynamics.

[1]Work supported by U.S. Department of Energy and SciDAC GPSC.

W. X. Wang
Princeton Plasma Physics Lab.

Date submitted: 18 Jan 2006 Electronic form version 1.4