Abstract Submitted
for the DPP09 Meeting of
The American Physical Society

Catalytic Role of Zero-Frequency Zonal Modes in Saturation by Damped Eigenmodes P.W. TERRY, D.R. HATCH, University of Wisconsin-Madison, W.M. NEVINS, LLNL, F. JENKO, IPP-Garching — Recent gyrokinetic simulations suggest that the effect of zonal flows on turbulence is catalytic, enabling energy to reach damped-eigenmode energy sinks in the wavenumber range of the instability. We investigate this issue, looking generically at three-wave coupling with a variety of analysis techniques. Using parametric instability analysis to study the excitation of general eigenmodes that are not linearly unstable, we find that energy transfer to damped-eigenmode energy sinks is sensitive to heavy reductions by phase mixing. Phase mixing is avoided if energy first goes to a set of catalytic modes and then to damped eigenmodes. The catalytic modes must have a zonal wavenumber (e.g., k_y=0), the linear wave frequency must be zero, but they do not have to be a flow or involve a flow, i.e., flow is not an essential aspect of the avoidance of phase mixing. Projections of ITG turbulence onto a linear-eigenmode basis indicate both the excitation of many virtually undamped, non flow-like k_y=o modes, and robustly damped $k_y \neq 0$ eigenmodes in the instability region.

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Date submitted: 02 Sep 2009