Contribution ID: **294** Type: **Poster**

Scalings of Ion Temperature Gradient Turbulence and Transport

Thursday 25 October 2018 14:00 (20 minutes)

An analytic saturation theory for toroidal ion temperature gradient turbulence is derived from a well-known fluid model, providing the saturated levels of the unstable fluctuation, a nearly conjugate stable mode, and the zonal flow, along with their dependencies on the model parameters. The theory utilizes the eigenmode decomposition of the dynamical equations, applies statistical closure, and introduces an ordering expansion to isolate and analyze zonal-flow-catalyzed energy transfer. This is the dominant energy transfer channel, carrying energy from the instability, through a zonal flow to the dissipated stable mode via nearly resonant wavenumber triads. Solution of closed energy balance equations for the critical sources and sinks yields a turbulence level that is proportional to the ratio of the zonal flow damping rate and the inverse of the triplet correlation time of the zonal-flow catalyzed wavenumber triplet interaction. The zonal flow energy is proportional to the ratio of the growth rate and the inverse correlation time. The analytic solutions for saturation level and scalings are applied to the ion heat flux, showing that it has a factor given by the standard prediction of quasilinear theory, and correction factors that include the inverse of the triplet correlation time a reduction due to the stable mode. This form, which holds for both zero and finite plasma beta, is used to model the beta scan of modified cyclone-base-case gyrokinetic ITG turbulence in simulations with GENE. Standard quasilinear theory does not fall off sufficiently fast with beta to match the nonlinear flux. Inclusion of the correlation time factor, which increases strongly with beta at low perpendicular wavenumber, produces a modified quasilinear prediction
that agrees well with the nonlinear flux.

Country or International Organization

United States of America

Paper Number

TH/P6-19

Author: Prof. TERRY, Paul (University of Wisconsin-Madison)

Co-authors: Mr FABER, Benjamin (University of Wisconsin-Madison); HEGNA, Chris (University of WIsconsin-Madison); Mr WHELAN, Garth (University of Wisconsin-Madison); Dr PUESCHEL, M.J. (University of Texas at Austin); Mr LI, Ping-Yu (University of Wisconsin-Madison); Dr MIRNOV, Vladimir (University of Wisconsin - Madison)

Presenter: Prof. TERRY, Paul (University of Wisconsin-Madison)

Session Classification: P6 Posters