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Energy Transfer and Saturation in Kinetic Turbulence[1] P.W. TERRY, M.J. PUESCHEL, G.G. WHELAN, Z. WILLIAMS, University of Wisconsin-Madison — Kinetic turbulence in magnetic confinement fusion devices saturates by transfer of energy both to large-scale damped modes and to small-scale perpendicular wavenumbers through interaction with large-scale zonal flows. The energy branching ratio between the perpendicular wavenumber cascade and large scale-stable modes is not well known for different values of collisionality, driving gradients, plasma beta, and other parameters, nor is there an understanding of saturation and its scalings that accounts for the key players in this physics. We describe efforts to understand the energetics of saturation across regimes that range from fluid to kinetic using a combination of analytic theory and gyrokinetic simulation with advanced diagnostics that include mode decomposition of spectral energy transfer and the scale-dependent ratio of spectral energy transfer to dissipation. From simulation, we analyze the damping of large scale zonal flows, the effect of stable modes in collisionless regimes, and the role of magnetic fluctuations at finite beta. From analytic theory we study scalings of turbulence and zonal flow saturation levels with collisionality and gradient drive.

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