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Delayed Onset of Heat Flux by Resonance in Three-Wave Energy Transfer P.W. TERRY, P.Y. LI, University of Wisconsin - Madison, M.J. PUESCHEL, University of Texas at Austin, G.G. WHELAN, University of Wisconsin - Madison — A saturation theory for toroidal ITG turbulence based on zonal-flow-catalyzed transfer to stable modes successfully recovers scalings of the heat flux with the zonal flow damping rate and plasma beta observed in gyrokinetic simulations. Here the theory is extended to include the physics of the instability threshold in temperature gradient by retaining the appropriate magnetic drift effects in the fluid model. The theory has a quasilinear factor with a flux threshold at the linear value. However, a factor proportional to the inverse triplet correlation time makes the flux very small above this threshold when nonlinear energy transfer is nearly resonant. After a higher threshold in temperature gradient the flux begins to increase at a rate proportional to the gradient. Both features are qualitatively consistent with recent gyrokinetic observations, which show a smooth upturn in flux at the nonlinear threshold and no indication of bifurcation or tertiary instability. The separation of linear and nonlinear thresholds (Dimits shift) is governed by resonance broadening effects. When these arise from finite Larmor radius the shift is small, but it increases to realistic values if the resonance is broadened by nonlinear (eddy damping) effects. Supported by USDOE.

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