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Zonal Flows from Parametric Decays in ITG Turbulence and the Internal Gravity Wave Paradigm KEN UZAWA, TOMOHIKO WATANABE, HIDEO SUGAMA, NORIYOSHI NAKAJIMA, National Institute for Fusion Science, WENDELL HORTON, Institute for Fusion Studies — The problem of ITG turbulence in a torus is closely related in mathematical structure to the problem of nonlinear internal gravity waves (IGW). The torus has an effective gravity g=c_s^2 cosθ/R which points away from the center of the torus with major radius R. The angle θ is taken as zero on the outside of the torus where the plasma is unstably stratified in mass density ρ with the buoyancy frequency ω_g^2= -g dlnρ/dr <0 or unstable whereas the inside of the torus where cosθ= -1 the stratification is stable with ω_g^2= -gdlnρ/dr >0. Alfven waves couple the two regions producing the well known ideal beta limit or Tryon limit on stable plasma MHD motions. For drift waves the motions are much smaller scale and thus the local plasma remains stable on the inside and unstable on the outside. We have derived a dispersion relation, which is fourth order algebraic equation with respect to the complex frequency of zonal flow, and find that the conditions for the parametric decay of finite amplitude ITG or IGW into zonal flow modes. We use the pseudo-spectral drift wave code to test the conditions and find how much the energy spreads from a narrow unstable wave packet into a broad spectrum of stable and unstable modes. Work partially supported by the U. S. Department of Energy, National Science Foundation, and the Ministry of Education in Japan.

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