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Turbulent Spreading of Energy in Hasegawa Wakatani Model O.D. GURCAN, P.H. DIAMOND, University of California, San Diego, T.S. HAHM, P.P.P.L. — It is well known that the Hasegawa-Wakatani system, which describes the evolution of drift waves, including the effects of non-adiabatic electron response, "nonlinearly" conserves energy. Here we discuss the problem of spatial spreading of energy, and conclude that the energy is conserved locally, if electron response is adiabatic. If zonal flows are included (for the case of adiabatic electron response), the spreading rate of total energy, depends on zonal flow damping, rather than the zonal flow amplitude. This derivation is based on a Poynting type theorem $\partial_t [\varepsilon + \varepsilon_{ZF}] + \nabla \cdot (v_r[\varepsilon + \varepsilon_{ZF}])$, which imply that the zonal flows spread along with the turbulence rather than "lead" in the spreading process. For the hydrodynamic limit (which naturally includes the zonal or other types of large scale flows) we derived closed form expressions for the nonlinear, spatial energy flux, using a two-scale version of weak turbulence theory. This is a rigorous derivation, which includes all possible resonant triad interactions. We conclude that the spreading of internal energy is stronger, for the hydrodynamical limit. This is not in contradiction with the fact that the large scale structures (not necessarily zonal flows) may be important in turbulence spreading. In fact the dual cascade resulting in large scale flows, but small scale density fluctuations, maybe considered most effective in spreading the density fluctuations.

> Ozgur Gurcan University of California, San Diego

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