Self-consistent interactions of the tearing mode and drift-wave microturbulence

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Small scale drift-wave microturbulence can significantly interact with larger scale magnetohydrodynamic (MHD) instabilities despite the extreme scale separation of the two phenomena. MHD instabilities such as the tearing mode can impact the evolution of drift-wave turbulence and vice-versa. It has recently been shown that ion temperature gradient (ITG) turbulence evolving in the presence of a static magnetic island can lead to a localization and poloidal asymmetry of the heat flux and turbulent resistivity that is dependent on the width of the imposed island[1]. In order to build upon this study we investigate the self-consistent interaction between Hasegawa-Wakatani drift-wave microturbulence and an unstable tearing mode. In our newly developed TURBO code, we time advance a three field model that describes the coupled nonlinear evolution of density, vorticity, and magnetic flux driven by equilibrium profiles for the magnetic flux and density with prescribed stability properties and turbulent drives. With an imposed static island, a poloidal asymmetry in the density flux is found, analogous to the results in Ref. 1. We then examine the influence of the turbulent drives on the stability of the tearing mode and quantify the energy transport via a turbulent resistivity. Last, we investigate the quasilinear evolution to saturation of magnetic islands as well as the turbulent dynamics in a fully self-consistent model and discuss the connections to the results in Ref. 1 and related work with imposed static islands in turbulence.

[1] O. Izacard et al., Phys. Plasmas 23, 022304 (2016)

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