Transport-scale interaction of Alfvén eigenmodes and microturbulence

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Previous work found that turbulence can redistribute energetic particles in phase space [1], but this ignored the important effect of toroidicity-induced Alfvén eigenmodes (TAEs). To date, no mechanism has been found by which drift wave turbulence directly affects the saturation of unstable TAEs [2]. Instead, TAEs saturate by redistributing the energetic particles which drive them. Therefore, a nontrivial interaction between microturbulence and TAEs, as mediated by energetic particle transport, has been found [3]. In this work, we present a model where turbulence and TAEs evolve independently on the fast timescale, but interact through the redistribution of energetic particles on the slow timescale. Turbulent diffusion coefficients are found from nonlinear gyrokinetic simulations and we use a quasilinear diffusion model for TAEs [4]. We demonstrate under what conditions TAEs interact with turbulence, which of these transport mechanisms is dominant, and compare to other models of TAE saturation.

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[2] Bass and Waltz. "Gyrokinetic simulations of mesoscale energetic particle-drive Aflvénic turbulent transport embedded in microturbulence." *Physics of Plasmas* **17**:112319 (2010)

[3] Duarte, et al. "Prediction of nonlinear evolution character of energetic-particle-driven instabilities." *Nuclear Fusion* **57**:054001 (2017)

[4] Berk, et al. "Line broaded quasi-linear burst model." *Nuclear Fusion* **35**:1661 (1995)