Two-fluid simulation of anisotropic Drift-Alfven turbulence

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Abstract

We present results from extensive numerical simulations of steady state Drift-Alfven turbulence in the presence of a strong guide field. We use a turbulence model based on equations originally derived by Hazeltine as an extension of the Reduced MHD model (RMHD). The model includes three dynamical fields, potential, magnetic flux, density and allows for the existence of a background density gradient that drives large scale electromagnetic drift-wave instabilities. Previous numerical simulations of this model have been mostly restricted to 2D or pseudo 2D simulations in the limit of vanishing $k_{\|}$, which restrict the turbulence cascade to the field-perpendicular plane. However, recent work in MHD turbulence have shown that the parallel dynamics can play a key role in anisotropic turbulent cascades. In this work we present fully 3D high resolution simulations of strong Drift-Alfven turbulence in a rectangular box that matches the anisotropy of the turbulence imposed by the guide field and allows one to capture the field-parallel dynamics. Simulations are used to investigate the spectrum of shear-Alfven turbulence at large scales and the transition to Kinetic Alfven turbulence near the ion sound radius scale.

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