Enhancement of kinetic scale electrostatic fluctuations in decaying whistler turbulence: Particle-In-Cell simulations

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Solar wind observations show that larger cascade rates of turbulence lead to steeper power-law magnetic spectra at kinetic scales. This suggests that larger fluctuation amplitudes at kinetic scales lead to some nonlinear properties more efficiently. Our previous research showed that the modified two stream instability in a monochromatic finite amplitude whistler wave contributes the nonlinear dissipation of the wave at kinetic scales. This result suggests that kinetic instabilities can enhance the dissipation at electron and ion scales. The wave driven instability occurs with larger wave amplitudes more efficiently, so this process could be a contributor for the steep power-law spectrum at kinetic scales. Here two-dimensional electromagnetic particle-in-cell simulations in magnetized, homogeneous, collisionless electron-ion plasma demonstrate the forward cascade of whistler turbulence at ion scales. The simulation show that whistler turbulence cascades into electron scales, and show a spectrum break around the scale of the electron inertial length. Around the scale related to the break point, electrostatic fluctuations appear at several points intermittently. The electrostatic fluctuations are expected to be driven by ion acoustic instability driven by localized electric current in whistler turbulence. We will discuss the instability driven dissipation of whistler turbulence at kinetic scales and heating of both electrons and ions.

Keywords: plasma turbulence, whistler wave, Particle-In-Cell simulation

