

Particle scattering in decaying magnetosonic-whistler mode turbulence

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Solar wind turbulence contains fluctuations with a broad range of frequency and wavenumber. Nonlinear cascade process in the solar wind turbulence transports fluctuation energy from MHD to ion/electron kinetic scales. At the kinetic scales, kinetic Alfvén and whistler mode waves are observed at kinetic scales where the MHD approximation is broken, which are expected to be cascaded from shear Alfvén and/or magnetosonic waves at the MHD scale. Turbulent fluctuations at kinetic scales can interact with ions and electrons, which cause particle acceleration and heating through dissipation of the fluctuations.

In this study we focus on ion and electron scattering through the forward cascade of magnetosonic/whistler mode turbulence. Two-dimensional particle-in-cell simulation demonstrates nonlinear development of magnetosonic-whistler turbulence at scales larger than ion kinetic scales. It is shown that anisotropic magnetosonic-whistler turbulence cascades to smaller scales following dispersion relation of highly-oblique propagating whistler mode waves, which involves intermittent large-amplitude magnetosonic waves. The magnetosonic waves scatter ions and electrons in the directions perpendicular and parallel to the background magnetic field respectively. Our simulation suggests that ions and electrons in magnetosonic-whistler mode turbulence are accelerated/heated by not only Landau and cyclotron resonance at electron kinetic scales but also nonlinear fluctuations generated at sub-ion kinetic scales.

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