Decaying Whistler Turbulence at Ion Scales: Particle-In-Cell simulation

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Solar wind observations show that a magnetic fluctuation spectrum has two spectral break points around 1Hz and a few tens of Hz in a spacecraft frame at 1AU. The spectrum becomes steeper at the break points in frequency. The Taylor hypothesis in the solar wind implies that these scales correspond to ion and electron inertial (or Larmor) scales. The hypothesis suggests that ion and electron kinetic properties have an important role to make the steeper spectra of the magnetic spectrum in the solar wind. Dissipation and/or dispersion properties of kinetic turbulence should be investigated in more details including kinetic properties of ions and electrons.

Two-dimensional electromagnetic particle-in-cell simulation in magnetized, homogeneous, collisionless electron-ion plasma has been done to demonstrate the forward cascade of decaying whistler turbulence at ion scales. Fluctuations with right-handed polarization at scales larger than ion inertial length are applied as an initial condition of the simulation, which satisfy a dispersion relation of whistler waves in cold-magnetized plasma. The particle-in-cell simulation, which includes full kinetic properties of electrons and ions in collisionless plasma, demonstrates turbulent cascade and dissipation of fluctuation energy self-consistently.

Discussion will focus on properties of decaying whistler turbulence at ion scales, such as the power-law index, wavenumber anisotropy, and plasma heating. Comparison of properties of whistler turbulence at ion scales with electron scales will also be discussed.