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Forward cascade of whistler turbulence at ion scales

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Two-dimensional electromagnetic particle-in-cell simulations in magnetized, homogeneous, collisionless electron-ion plasma demonstrate the forward cascade of whistler turbulence at ion scales. Saito et al. (2015, submitted) emphasized that the modified two-stream instability could contribute the dissipation of kinetic turbulence at ion scales, by demonstrating rapid damping of a monochromatic ion-scale whistler wave in two-dimensional particle-in-cell simulation. The instability is driven by the electric current fluctuation perpendicular to the mean magnetic field. Through the development of the instability, electrons and ions are scattered in the directions parallel and perpendicular to the mean magnetic field, respectively. We expect that the forward cascade of whistler turbulence and the dissipation related to the modified two-stream instability contribute plasma heating and have key role of variability of power-law index of magnetic spectrum at ion scale in solar wind. Solar wind observations show that larger cascade rates of turbulence lead to steeper power-law magnetic spectra. The instability driven dissipation could explain property of the magnetic spectra at ion scales. Discussion will focus on properties of whistler turbulence, such as the power-law index, wavenumber anisotropy, electron and ion heating, through the forward cascade of decaying whistler turbulence.

Keywords: kinetic turbulence, plasma heating, wave-particle interaction