Generation of Intermittent Ion Acoustic Waves in Whistler Turbulence: Particle-In-Cell Simulation

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Quasi-perpendicular collisionless shocks can be a cause of several microinstabilities which enhance ion acoustic waves, whistler waves, and etc. Cross-field currents associated with the shock transition region and reflected ions by the shock front are considered as energy sources of the wave enhancements. Recent observations found finite amplitude whistler waves propagating in directions highly oblique to the background magnetic field in the shock transition region. It is expected that nonlinear interactions of finite amplitude whistler waves develop into whistler turbulence and are dissipated through kinetic processes. Here we demonstrated by using a fully kinetic particle-in-cell simulation that nonlinear development of whistler turbulence enhances intermittent ion acoustic waves through ion/ion streaming instability. The instability is driven by interaction between two ion components in ion velocity space at local areas. Wavenumber of the ion acoustic waves is quasi-parallel to the background magnetic field, which is consistent with the waves observed in the shock transition region. The simulation results suggest that finite amplitude whistler turbulence can be an additional source of ion acoustic waves observed in interplanetary shocks and earth’ s bow shock. The positive roles of the enhancement process of ion acoustic waves by whistler turbulence in quasi-perpendicular collisionless shocks are discussed.

Keywords: whistler turbulence, ion acoustic wave, Collisionless shocks

