R006-15
B 会場 ： 11/27 　AM1（9:15-10:45）
9:30〜9:45:00

MMS 衛星によって得られたフォアショック構造内でのホイッスラーモード波動の観測的証拠

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Observational evidence of nonlinear growth of whistler-mode waves in foreshock structures obtained by the MMS spacecraft

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To demonstrate observational evidence of nonlinear wave growth, we present an electron distribution function exhibiting significant nongyrotropy near the cyclotron resonance velocity during a whistler-mode wave event in a foreshock structure. This nongyrotropic electron distribution function is predicted by a nonlinear wave-particle interaction theory for coherent large-amplitude waves [e.g., Omura, EPS, 2021]. An electron phase space hole is generated in the distribution functions due to the phase trapping motion of cyclotron resonant electrons around the resonance velocity in the presence of an appropriate magnitude of inhomogeneity. Electrons with such a nongyrotropic distribution function exchange energy and momentum efficiently with whistler-mode waves. The Magnetospheric Multiscale (MMS) spacecraft observed whistler-mode waves in a foreshock structure, which is called the Short Large-Amplitude Magnetic field Structures (SLAMS). By applying the method of wave-particle interaction analyzer (WPIA) to data obtained with the Fast Plasma Investigation Dual Electron Spectrometer (FPI-DES) and the search-coil magnetometer (SCM), we identified an electron phase space hole, which was suitable for wave growth; the hole appeared at an appropriate gyro phase angle relative to the whistler-mode wave magnetic field only near the cyclotron resonance velocity. The gradient of the magnetic field intensity along the magnetic field line during the time intervals was suitable for wave growth due to the phase trapping motion of resonant electrons. A loss cone of heated electrons escaping from the high-pressure part of the foreshock structure played an important role in generating temperature anisotropy for wave growth. When such a distribution function encounters a gradient of magnetic field intensity with an appropriate magnitude, whistler-mode waves grow rapidly due to the nonlinear growth mechanism. Because fluctuations in magnetic field intensity exist in foreshock structures, it is probably common for electrons to encounter such a magnetic field gradient, and there must be many opportunities for nonlinear whistler-mode wave growth in foreshock structures.