

Electrostatic Waves near the Lower-Hybrid Frequency in the Electron Plasma Sheet Boundary Layer: Geotail Observations

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We observed electrostatic waves in the electron plasma sheet boundary layer of Earth's magnetotail by the Geotail spacecraft. Since, frequencies of these electrostatic waves are close to the lower-hybrid frequency and those electric field vectors are almost perpendicular to the ambient magnetic field, we conceive that these electrostatic waves are lower-hybrid waves. Electrostatic waves in the lower hybrid frequencies play important roles in acceleration and heating of particles and in the contribution of the overall dynamics of the magnetosphere. However, generation mechanism of lower-hybrid waves in the electron plasma sheet boundary layer is not clear.

Figure 1 shows typical examples of the lower-hybrid waves on January 11 1995 at the location of $X_{GSM} = 41.4R_E$, $Y_{GSM} = 1.6R_E$, $Z_{GSM} = -5.2R_E$. Upper and lower panel of Figure 1 shows a dynamic spectrum and a waveform of the electric field observed by the electric field detector (EFD) [1] onboard the Geotail spacecraft. The waves are observed near the lower-hybrid frequency shown as black solid line in upper panel of Figure 1. From our waveforms and electrons observations, observations of the lower-hybrid waves correlate with the existence of electron beams which are parallel to the ambient magnetic field. Figure 2 shows the reduced electron velocity distribution function by the low energy particle detectors (LEP) [2] onboard the Geotail spacecraft at 10:39:32.194 on January 11 1995, and shows electron enhancement correspond to the electron beam from -15,000 km/s to -25,000 km/s. On the contrary, observations of the lower-hybrid waves do not correlate with the plasma density or magnetic field gradients. Further, the existence of lower-hybrid waves correlates with existence of Langmuir waves. This result also leads to the presence of electron beams. Thus, we conceive that generations of the lower-hybrid waves are depend on the existence of the electron beams.

In the present paper, we show the wave features and discuss the generation mechanism of the lower-hybrid waves in the electron beam region of the plasma sheet boundary layer.

References

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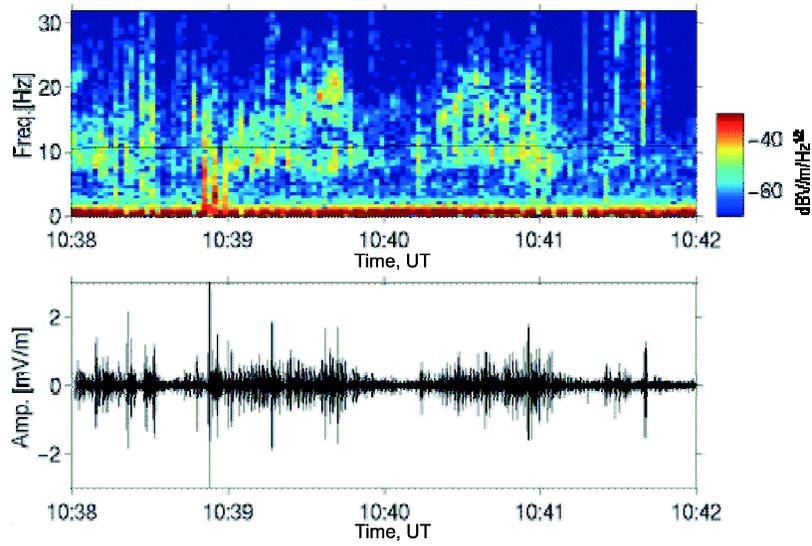


Figure 1. Dynamic spectrum (upper panel) and waveform (lower panel) of the electric field observed by the EFD onboard the Geotail spacecraft on January 11 1995.

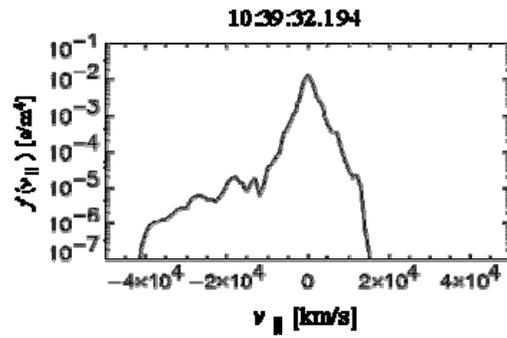


Figure 2. Reduced electron velocity distribution by the LEP onboard the Geotail spacecraft at 10:39:32.194 on January 11 1995.