

Characteristics of Electrostatic quasi-monochromatic wave in the downstream region of the bow shock: Geotail observation

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Several kinds of intense plasma waves are observed in the downstream region of the earth's bow shock. They are mainly classified into the Broadband Electrostatic Noise (BEN), Electrostatic quasi-monochromatic (EQM) wave, Langmuir wave and Magnetic Noise Burst (MNB). They are believed to be generated by electron beams, which are accelerated in the transition region such as bow shock transition region or dayside reconnection. However, detailed features and generation mechanisms on plasma waves are still unclear, because the downstream region of the bow shock is very turbulent region and observed plasma wave features change very quickly.

We focus on the EQM wave in the present paper, because generation mechanism, energy source and wave mode of this wave are not well known. The EQM wave is the purely electrostatic wave propagating in the parallel direction to the ambient magnetic field, because the EQM wave is not accompanied with the magnetic component. Frequency range of the EQM waves are from 500Hz to few kHz. In this region, the electron plasma frequency is in the range of 10 kHz to 50 kHz, and ion plasma frequency is several hundred Hz. Therefore, the observed EQM wave frequencies are between electron plasma frequency and ion plasma frequency. One of the interesting natures of the EQM wave is its frequency range, because there dose not exist the normal mode of electrostatic waves propagating parallel to the ambient magnetic field in this frequency range.

Observation of the EQM waves has a good correlation with the electron beam-like component that velocities are from 2000km/s to 3000km/s. We assume that the electron beam-like component is accelerated in the bow shock, because it is directed to the downstream direction away from the bow shock. This electron beam-like component makes asymmetric electron velocity distribution. We assume that this electron velocity distribution destabilizes the ion acoustic instability. In this region, solar wind bulk velocity is approximately 300km/s, and this velocity is enough to shift the frequency of the ion acoustic wave to 1 kHz due to the Doppler shift. As a result of analysis, frequency changes of the EQM waves are correlated with the solar wind bulk velocity parallel to the ambient magnetic field. Therefore the EQM wave is affected by the Doppler shift effect. For these reasons, the most plausible candidate as the plasma wave mode of the EQM waves is the Doppler-shifted ion acoustic wave.

The Geotail crosses the bow shock two times a week on its orbit since November 1994. Therefore there exist plenty of datasets. In order to make clear the generation point of EQM wave, we are due to do discussion about analyses such as comparison of intensity of EQM wave and distance from observation point to bow shock with the use of datasets of Geotail.