ELECTROSTATIC QUASI-MONOCHROMATIC WAVE IN THE DOWNSTREAM REGION OF THE BOW SHOCK: GEOTAIL OBSERVATION

Koichi Shin [(1)], Hiroshi Matsumoto [(1)], Hirotsugu Kojima [(1)], Toshifumi Mukai [(2)]

(1) Kyoto University, Radio Science Center for Space and Atmosphere Gokasho, Uji, Kyoto, 611-0011, Japan

(2) Institute of Space and Astronautical Science, 3-1-1 Yoshinodai, Sagamihara, Kanagawa, 229-8510, Japan

Several kinds of intense electrostatic 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 and Langmuir wave. They are believed to be generated by electron beams, which are accelerated in the transition region such as bow shock transition or dayside reconnection region. 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.

In order to understand the plasma wave features and their generation mechanisms, we analyze the Geotail plasma wave data in the down stream region of the bow shock and corresponding to the electron data. Since November 1994, the GEOTAIL crosses the bow shock two times a week on its orbit. Therefore there exist plenty of datasets, which are very suitable for the present analyses.

We focus on the EQM waves in this paper, because energy source and wave mode of this wave are not well known. There are frequency ranges from 500Hz to few kHz. 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. In this region, the electron plasma frequency is in the range of 10kHz to 50kHz, and ion plasma frequency is several hundred Hz. Therefore, the observed EQM wave frequency is between electron plasma frequency and ion plasma frequency. One of the interesting natures of the EQM waves is its frequency, because there does 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. The electron beam-like component makes asymmetric electron velocity distribution. We assume that this electron velocity distribution destabilizes the ion acoustic instability. Since 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.