2fp Radiation in GEOTAIL Observations and Numerical Simulations

2fp Radiation in GEOTAIL Observations and Numerical Simulations

 # 笠羽 康正 [1], 大村 善治 [2]
Yasumasa Kasaba [1], Yoshiharu Omura [2]

[1] 富山県大・工・電子情報, [2] 京大・超高層
[1] Toyama Prefectural Univ., [2] RASC, Kyoto Univ.

地球電子フォアショックで生成される2fp radiationについて、衛星観測と数値実験による研究成果を総括する。
衛星観測の総括は以下の通りである。(a)2fp電波源はバウショック近傍に穴を有する。(b)2fp電波活動は太陽風エネルギー流量と正の相関を有する。(c)2fp電波活動は太陽風磁場方向と相関する。但し、金星における相関とは異なる。
数値実験では、2次元電磁粒子シミュレーションにおいて、様々な条件で2fp電波放射の生成を確認した。本講演では、上記から示唆される2fp電波の生成機構を総括したい。

We present a summary of our study on 2fp radiation generated in the Earth's electron foreshock through spacecraft observations and numerical simulations. Some features on the 2fp radio source, its geometry and the generation process will be reported. We hope to summarize the comparison between the 2fp radiation in real space and that in the computer space.

Observational data are provided by Plasma Wave Instrument (PWI) aboard the GEOTAIL spacecraft. We execute some statistical analyses of 2fp radiation and related plasma waves and particles around the foreshock region: the bifurcation phenomena of 2fp radiation associated with solar wind density jump, the direction finding of 2fp radiation, and the spatial distributions of plasma waves and energetic particles in the terrestrial foreshock [1][2].We suggest some features on the 2fp radio source:
(a)The 2fp radio source centroid locates generally at a distance of 10-40 RE from the contact point of the interplanetary magnetic field (IMF) line tangent to the bow shock. It agrees to the gradual decrease of foreshock activities in the region distant from the contact point.
(b)The 2fp radio source seems to have a hole around the contact point. It should be due to the lack of its emissivity or the existence of its directivity.
(c)The 2fp radiation and foreshock activities are positively correlated to the solar wind kinetic energy flux. We also suggest that the activity of 2fp radiation is correlated to the 2nd-4th power of the Langmuir wave activity.
(d)The foreshock activity is also correlated to the IMF direction. But it is not as same manner as the observations around Venus [3].

In this work we use the electromagnetic particle-in-cell code, KEMPO, developed in Radio Atmospheric Science Center, Kyoto University. We investigate the thin electron beam interaction in the 1- and 2-dimensonal system based on the conditions in the foreshock [4]. In 1-D periodic systems, electrostatic 2fp waves are generated on `beam mode' at k = 2kL (2kL: the wave number of beam-excited Langmuir wave). Amplitude of this wave is usually about 40 dB of that of beam-excited Langmuir wave. We do not find electromagnetic 2fp waves in all conditions. In 2-D periodic systems, electrostatic 2fp waves are also found at k = 2kL in the same manner as in 1-D systems.
We also find electromagnetic 2fp waves at k = 2/c. The growth of electromagnetic wave is independent of electrostatic 2fp waves but correlated to the product of beam-excited and back-scattered Langmuir waves. We also find that electromagnetic 2fp wave is weak in the system without ion. It due to the weakness of back-scattering of Langmuir waves by ions. We will also report a directivity in electromagnetic 2fp waves which is still in investigation.

[1] Y. Kasaba et al., Advanced Space Research, vol. 20, no. 5, pp. 699-702, 1997.
[2] Y. Kasaba et al., J. Geophys. Res., submitted, 1999.
[3] G.K. Crawford et al., J. Geophys. Res., vol. 103, No. A6, pp. 11985-12003, 1998.
[4] Y. Kasaba, Ph. D. thesis, Kyoto Univ., Kyoto, Japan, 1997.