THE MARTIAN PLASMA WAVE EXPERIMENT:

EXPECTATIONS FOR NOZOMI

H. Matsumoto[(1)], Y. Kasaba[(2)], T. Okada[(3)], K. Hashimoto[(1)], I. Nagano[(4)], S. Yagitani[(4)], T. Ono[(5)], H. Hayakawa[(2)]

(1) Kyoto Univ., RASC, Uji, Kyoto, 611-0011, Japan,

Email: matsumot@kurasc.kyoto-u.ac.jp

(2) ISAS, Sagamihara, Kanagawa, 229-8510, Japan

Email: kasaba@stp.isas.ac.jp

(3) Toyama Pref. Univ., Kosugi, Toyama, 939-0398, Japan

(4) Kanazawa Univ., Kanazawa, Ishikawa, 920-8667, Japan

(5) Tohoku Univ., Sendai, Miyagi, 980-8578, Japan

Background

In January 2004, The NOZOMI spacecraft will be placed into an ecliptic orbit around Mars with a periapsis altitude of 150km and an apoapsis of 15RM. The plasma wave analyzer (PWA) aboard NOZOMI will give us various information on Martian plasma waves. The PWA covers from DC to 37kHz by a low frequency plasma wave analyzer (LFA) and from 20kHz to 5MHz by a plasma wave and sounder experiment (PWS). In this paper, we introduce current status and expectation of NOZOMI plasma wave investigation (mainly LFA). Since NOZOMI is now planning collaborations with Mars Exploler project, we welcome the interest of European scientists.

Instrumentation

The PWA uses two orthogonal electric dipole wire antennas (50 m tip-to-tip) in the spacecraft spin plane.
[LFA] The LFA measures plasma waves, DC electric fields, and the spacecraft potential in three frequency bands; H(10Hz-32kHz), M(10Hz-1kHz), and L(DC-40Hz). These signals are converted to spectra and waveforms by the onboard frequency analyzer (OFA) and the waveform capture (WFC). The OFA uses a dipole antenna in band-H and both in band-M. The WFC uses a dipole antenna for 10msec x 128 in 100kHz-sample(H), both for 13 min in 2.56kHz-sample(M), and Ey in 128Hz sample(L). [1]
[PWS] The PWS instrument consists of; (1) the topside sounder for the Martian ionosphere within the density range from $10^{2\text{-}6}$/cc, (2) the passive receiver for observation of natural plasma waves and radio waves in the frequency range from 20 kHz to 5 MHz, (3) the impedance probe for measuring the in-situ electron density, and (4) an altimeter for the measurement of the spacecraft altitude and land shape of the Martian surface. [2]

Passive Wave Observations: Expectation

Based on the results of Phobos-2 mission and the past measurements around Earth and Venus, we are expecting following topics around the Mars:
a) The macroscopic plasma environment: Global mapping of electron density and wave activity will be executed from the ionosphere to solar wind. We will also observe plasma structures and electric fields in the nightside tail-like region. The plasma density measurement will provide the information on the cold plasma outflow from the upper ionosphere found by Phobos-2.
b) The microscopic plasma processes: We will investigate the plasma waves at the boundary regions and upper ionosphere in order to study the wave-particle interactions between the solar wind and the Mars. The contribution to the mass-loading process at the planetopause is one of the most important topics. It is also expected to observe plasma waves related to the particle acceleration in the auroral-like region found in Venus nightside ionosphere. We will also confirm the interaction of the charged dust torus around Phobos.
c) Generation and propagation of electromagnetic waves: We expect to find the impulsive radiations from the dust storm or lightning in the atmosphere. The crustal magnetic field up to 400 nT (found by MGS) would make the whistler-mode waves to propagate through the ionosphere. We also expect to find radiations from the planetopause (nonthermal continuum) and the foreshock (2fp radiation) . They will tell the real-time plasma density in the source.

References

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