# CHARACTERISTICS OF WIRE ANTENNAS FOR VLF ELECTRIC FIELD IN THE MAGNETIZED PLASMA

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## INTRODUCTION

Characteristics of a wire antenna used for the electric field observation in the magnetized space plasma could be different from those in free space because of the plasma sheath surrounding the antenna. We need to know the antenna characteristics (antenna impedance and effective length) in the magnetized plasma to calibrate the observed data and obtain the absolute intensity of the electric field.

In our previous antenna study, we have estimated the effective length from the ratio of the open voltage induced at the antenna terminal to the electric field theoretically calculated from Maxwell's equations using the observed plasma density and geomagnetic field. We have estimated the effective lengths of antennas onboard the Akebono satellites. The estimated effective lengths of the two wire antennas are nearly equal to those in free space. However, we see a small variation depending on the satellite spin angle.

## IMPEDANCE MEASUREMENT

The effective length was estimated by assuming that the antenna impedance is constant. However the antenna impedance might be fluctuated caused by the satellite spin.

The impedance of the antennas onboard GEOTAIL has been measured by Tsutsui et al. by using the calibration function onboard GEOTAIL[1]. They have found that the impedance depend mainly on the ambient electron density and the satellite spin. The impedance of wire antennas onboard Akebono has been measured by Hashimoto et al., where the results also depends on the electron density and the satellite spin[2]. For the GEOTAIL case, the dependence of the impedance measurement on the satellite spin is caused by the fluctuation of the photoelectron emissions from the satellite body and the antenna surfaces. On the other hand, for the Akebono case, the photoelectrons do not play an important role because the spin axis of Akebono always points to the sun.

In this study, we checked the dependence on satellite spin angle of the antenna impedance onboard the Akebono satellite. The Vector Impedance Probe (VIP) onboard the Akebono satellite measures the impedance of the wire antenna by observing the response from the ac voltage signals applied to the antenna. We checked measurement result by 10 kHz signals, and the capacitance components of the antenna impedance were 300 - 400 pF, and the resistance components were 400 k - 1 MΩ. Again, one of the result depended on the angle between the satellite traveling direction and the antenna.

## CONCLUSIONS

The dependence of the antenna impedance might be caused by the ambient plasma wake formed by the plasma flow and/or the satellite movement. In the plasma wake, the potential and the plasma density distribution are locally reformed, thereby the change of the antenna impedance is synchronized with the satellite spin. However the fluctuation of estimated effective length is unexplained by only this fluctuation of antenna impedance, so we have to take account of other parameters.

## REFERENCES

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