

## Electron hybrid simulations of impedance measurements in the ionospheric plasma

# Tomonori Suzuki[1]; Takayuki Ono[2]; Yuto Katoh[3]; Jyunpei Uemoto[4]; Atsushi Kumamoto[5]; Masahide Iizima[6]

[1] Dep. of Geophys, Graduate School of Sci., Tohoku Univ.; [2] Department of Astronomy and Geophysics, Tohoku Univ.; [3] Grad. Sch. Sci, Tohoku Univ.; [4] NICT; [5] Planet. Plasma Atmos. Res. Cent., Tohoku Univ.; [6] Shukutoku

In-situ plasma diagnostics are essential for evolutions of the space plasma physics. Impedance probe, which is a kind of RF probe, was developed as a powerful tool to measure absolute values of the electron number density. The frequency spectrum of the probe impedance allows us to derive the electron density from the upper hybrid resonance (UHR) frequency. Over the past half a century, impedance probes have been installed on many sounding rockets and satellites to measure the electron density in the ionosphere and magnetosphere.

The antenna impedance reflects various physical quantities of the plasma as well as the electron density. We confirmed in our previous studies that the sheath capacitance is a useful parameter to the plasma diagnoses. Moreover, based on impedance measurements in plasma chamber, we suggested that sheath effects are essential to interpret resonances in thermal magnetized plasma [Suzuki et al, in press]. We also study the method of the derivation of electron-neutral collision frequencies in the ionospheric plasma from the impedance measurement.

Recently numerical experiments play an important role in understanding the characteristics of the antenna impedance in plasmas. The electron-neutral collision frequencies in the lower ionosphere have been studied by Plasma-Fluid Finite-Difference Time Domain (PF-FDTD) simulations [Ward et al., 2005; Spencer et al., 2008]. However, the ion sheath surrounding the probe has not been included in PF-FDTD simulations. Since the sheath capacitance significantly modifies the probe impedance at the frequency range lower than the UHR frequency, it is necessary to take into account the effect of the sheath in evaluating the probe impedance.

In the present study we investigate the impedance of a probe immersed in a plasma including effects of the collision and the ion sheath via electron hybrid code. The electron hybrid code treats cold electrons as fluid, and hot electrons as particles [Katoh, 2003]. We have compared the observed probe impedance in the ionosphere with simulations. In this presentation, we report on the present state of the simulations and future prospects.