R005-P06
ポスター 3 ：11/6　AM1/AM2 （9:00-12:30）

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Lower hybrid resonance (LHR) frequency measurements in the ionosphere by SS-520-3 NEI/PWM

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The lower hybrid resonance (LHR) frequency in the ionosphere has been measured by NEI/PWM (Number density of Electron measurement by Impedance probe/Plasma Wave Monitor) onboard the Sounding Rocket SS-520-3. SS-520-3 was launched from Svalbard on Nov. 4, 2021 to perform observations of the ion acceleration and heating processes in the cusp region. The NEI/PWM was successfully operated during the flight and background electron number density and plasma wave spectrogram along the rocket trajectory were obtained. In addition, NEI/PWM was designed to measure the probe capacitance Cp not only in a frequency range around upper hybrid resonance (UHR) frequency (0.1 to 20 MHz) but also in a frequency range around LHR frequency (5 to 11 kHz) in order to estimate ion composition in the ionosphere.

As shown by Balmain [1964], the impedance of short dipole antenna in a plasma around UHR frequency can be derived using the dielectric tensor with terms of electron. The probe impedance in a plasma around LHR frequency also can be derived using the dielectric tensor with terms of electron and ion. It is expected that a pair of minimum and maximum is once found around LHR frequency in each frequency sweep of the probe capacitance measurement. In the observation, such frequency profile was found only when the probe is in the wake. In addition, the frequency profile was found multiple times in one frequency sweep. They were beyond our expectations.

We consider that they are explained as follows: On the basis of the probe capacitance model mentioned above, the frequency profile of the probe capacitance at LHR becomes unclear when the electron collision frequency is higher than 300 Hz. The electron collision frequency depends on the electron temperature and ion number density [Nicolet, 1953]. If assuming that the electron temperature is 1500 K [Kitamura et al., 2011], and ion number density is $4x10^5$ /cc (from electron number density measured by NEI) around the apex of SS-520-3, the electron collision frequency is estimated as 350 Hz. In the wake, the electron temperature is higher and the ion number density is lower than those outside of the wake, and the frequency profile at LHR is unclear. If the ion number in the wake is $2x10^5$ /cc, the electron collision frequency is less than 170 Hz and the frequency profile at LHR becomes clear. Since the ion thermal velocity (~0.9 km/s) is less than the velocity of the rocket (3 km/s), it is considered that the ion wake with a length of 0.9 m is formed and fluttered. It would be why the frequency profile are found multiple times in one frequency sweep. If we can consider that they are frequency profiles around LHR frequency, the LHR frequency at an altitude around 700 km is estimated as 7 to 9 kHz, which suggests ion composition with O+ of 90% and H+ of 10 %.