Preliminary report of a sounding rocket experiment to elucidate electron heating in the Sq current focus
- Observations of thermal electron energy distribution -

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Sounding rocket observations in Japan suggest that the electron temperature profile occasionally exhibits the local increase by several hundred K at 100-110 km altitudes at 1100-1200 LT in winter. Detailed study of the temperature profiles indicates that such an increase is closely related to the existence of Sq current focus, because it becomes more significant when the measurement is made near the center of Sq focus. In order to understand a general feature and to investigate a generation mechanism of this unusual phenomena, a sounding rocket experiment was carried out.
In this experiment, “S-310-44” rocket equipped with a suite of five science instruments was launched from Uchinoura Space Center at 12:00 JST on January 16, 2016 after being convinced that the Sq current was approaching to the planned rocket trajectory. In this presentation, we will focus on the energy distribution of thermal electrons and electron temperature obtained from FLP (Fast Langmuir Probe) instrument onboard the rocket.
In the FLP instrument, a small AC voltage with a frequency of 2 kHz was superimposed on a triangular voltage bias with an amplitude of 3 V. It is possible to estimate energy distribution from the amplitude of the second harmonic component of 2 kHz in the probe current. Moreover, the electron temperature can be estimated from the electron energy distribution, when the energy distribution is considered to be *Maxwellian*. Another function of the FLP is to be able to provide a small-scale (< 1 m) electron density perturbation, which can be estimated from the electron saturation current provided by a fixed bias spherical probe installed on the rocket axis.
During this experiment, a group of Kyushu University has continuously measured the geomagnetic field on the ground to estimate exact position of Sq current focus, because it is required for the rocket trajectory to be close enough to the current focus. Their analysis about the magnetometer data suggests that *in-situ* observations of electrons, magnetic and electric fields were conducted in the distance of 200 to 300 km from the current focus.
The FLP successfully made its measurement during both upleg and downleg of the rocket flight. Observations of the energy distribution suggest that the electron temperature increased by about 200 K with respect to the background in the altitude range from 100 to 110 km. It is also significant that the observed energy distribution unlikely seems *Maxwellian* distribution and sometimes exhibits a possible existence of *non-Maxwellian* component in the high electron temperature region. Power spectrum analysis of the electron current by the fixed bias probe indicates that the amplitude in the frequency range of several hundred Hz increased at the E region altitude. In particular, it is remarkable that the strong electron density perturbation was observed in the broad frequency range at altitudes from 95 to 110 km. In this presentation, we give a report on the preliminary analysis of the thermal electron measurements in more detail.

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