Sounding rocket experiment to study the thermal electron heating in the Sq current focus

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A large number of sounding rockets have been launched to study the upper atmosphere and ionosphere from Uchinoura Space Center in Kagoshima for more than 30 years. Electron temperature is one of the most frequently observed parameters of the ionospheric plasma from the sounding rocket. As a result of statistical study of the obtained data, it was reported that the electron temperature increases by about several hundreds K at the altitude of 100-105 km with respect to the background temperature when the measurements are made at 11:00 LT in winter. Subsequent study indicates that such a temperature increase is closely related to the existence of the Sq current focus, and therefore the temperature increase becomes larger when the rocket passes through the center of the current system.

In order to elucidate a mechanism to cause the electron temperature increase, in other words, electron heating, the sounding rocket experiment was conducted in Uchinoura Space Center on January 16, 2007. The rocket was launched at 11:20 JST after identifying that the Sq current was approaching to the planned rocket trajectory. A total of eight instruments were installed on this sounding rocket; 1)Suprathermal electron analyzer, 2)Langmuir probe, 3)Fixed bias probe, 4) Electron temperature probe, 5)Electric field detector, 6)Magnetometer, 7)Sun sensor, 8)Horizon sensor. A purpose of the instruments from 1) to 6) is to make a direct measurement of the plasma, electric and magnetic field in the lower ionosphere, while the rest of the instruments aim at giving the rocket attitude.

A preliminary analysis of the data obtained from the rocket flight represents that the electron temperature was significantly increased by about 500-600 K at the altitude of 97-101 km with respect to the background temperature. Data from the Fixed Bias Probe suggest that a strong perturbation in the electron density is observed to exist above 97 km altitude, which is the lower boundary of the high electron temperatures. It is noticeable that both the electric field and magnetic field data have characteristic variation in the same altitude region as the electron temperature increase was observed, suggesting a possible connection between the thermal electron heating and variation of the electric and/or magnetic field.