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STSAT-1 observations of the polar region

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STSAT-1 is the fourth satellite developed by Korea Advanced Institute of Science and Technology (KAIST), following the two 50 kg-size KITSATs and 100 kg-size KITSAT-3. The development of these microsatellites is part of the efforts at KAIST to promote space education as they were built with involvement of graduate students and relatively inexpensive parts were used. The purpose of the first three satellites was to establish satellite technology at KAIST while the main focus shifted to space science in the case of STSAT-1. STSAT-1, a three-axis stabilized satellite, was launched on September 27, 2003 into a sun-synchronous polar orbit at 685 km altitude and operated until May 2005. The main scientific mission of STSAT-1 was astrophysical observation while geophysical observations were also made when they did not interfere with scheduled astrophysics observations. The main scientific payload was an imaging spectrograph, capable of measuring far ultraviolet (FUV) emission lines from 90.0 to 115.0 nm (S-band) and 134.0 to 171.5 nm (L-band) with 0.15-0.2 nm and 0.25-0.3 nm spectral resolutions, respectively. The payload was primarily used for the observation of Galactic hot gas through sky survey mode operations. Geophysical observations of the spectrograph were usually made during eclipses when the geomagnetic conditions were not severe to protect the instrument. The spectrograph was directed toward the ground during geophysical observations so that it naturally observed auroras and nighttime airglows in the nadir direction. Over the polar region, precipitating electrons were simultaneously measured using the Electrostatic Analyzer (ESA) and Solid State Telescope (SST), whose energy ranges were 100 eV - 20 keV and 170 keV - 360 keV, respectively, on board the same spacecraft. For the auroral observations, the satellite was further maneuvered so that the designated one of the satellite's three axes became aligned with the local geomagnetic field line so that the ESA could provide pitch angle information of the precipitating electrons. With such a configuration, one of the SST's two telescopes was aligned along the geomagnetic field line and the other perpendicular to it. I would like to discuss some of the results obtained from this operation of STSAT-1 over the polar region. For example, electron microbursts were detected by SST at magnetic latitudes corresponding to the outer radiation belt zone. The observations showed that the microbursts occurred very fast with the time scale of less than 50 msec, much faster than the proposed pitch angle diffusion time scales. Furthermore, the energy dispersion showed that higher energy electron precipitation occurred at lower L values, indicating that precipitation might be related to the magnetic moment scattering in the geomagnetic tail. In another example, the auroral spectrum will be compared with the ESA spectrum of precipitating electrons measured simultaneously. It will be shown that the auroral FUV spectrum for inverted-V events has significant energy dependence with the long wavelength region of the L-band increasing faster than the short wavelength region with increasing peak electron energy.

Keywords: FUV obervation, aurora, microburst