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ATISE: MISSION CONCEPT FOR AURORAL AND PARTICLE MONITORING WITH A 12U CUBESAT

Abstract

Auroral monitoring is a strong challenge for space weather since they are directly linked to the precipitation of low energies' particles (E<50keV). One of the most difficult tasks is reconstructing the particle precipitation map into the atmosphere in the auroral regions. Existing ionospheric simulations like Glow or Transsolo allow such reconstructions. They however suffer from strong unreliability mainly due to uncertainties on the emissions processes and cross-sections. The Japanese satellite REIMEI, launched in 2012, strongly improves this problem since it was joining an auroral imager: Multi-spectral Auroral Camera (MAC) and two-particle detectors: Electron/Ion energy Spectrum Analyzer (ESA/ISA). This permits the measurement of the auroral emissions and the particle fluxes at the top of the atmosphere simultaneously which can be related if the particle detector is on the same magnetic field line as the auroral instrument. However, MAC has different filters of 428 nm, 558 nm, and 670 nm with a width of 2.47nm, 1.68nm, and 35.95nm respectively. Such measurements can cause bias in the auroral intensity due to the reflection of the moon and the reflection of the aurora itself, on the ground or the clouds.

To solve these issues, we propose a two-steps strategy. First, to design a space mission named the Auroral Thermosphere and Ionosphere Spectrometer Experiment (ATISE) which uses a spectrometer instead of imagers in addition to a particle detector. Second, to develop a second satellite for cross-observations of the auroras at the limb.

ATISE is a 12U CubeSat consisting of a 6U spectrometer including a 1nm of spectral resolution Fizeau interferometer, 1U for the particle detector, and 5U for the satellite subsystems. Several demonstration campaigns of the spectrometer have been performed in Norway to first prove the feasibility of the spectrometer concept within 6U.

This paper explains the CubeSat mission concept, the possible performances for auroral and particle precipitation monitoring, and the difficulties of such a project.