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UNIVERSITY OF OSLO CENSSAT-1 MISSION CONCEPT

Abstract

The Centre for Space Sensors and Systems at the University of Oslo is designing and building a CubeSat mission to investigate the Earth's atmospheric response to space weather variations. The mission is currently in the concept definition phase. Energetic particles and the plasma around our planet affect the atmosphere, known responses include aurora and airglow phenomena, which are directly linked to solar particles and plasma density. Other effects are chemical; particle precipitation creates NOx and HOx species which again creates micro-ozone holes. The times scale and extent of these processes are currently not well constrained. Our mission aims to study the direct correlation between the impact of energetic particles, the local plasma parameters, and the atmospheric response.

To achieve this, we are planning to include three instruments; a Langmuir probe, a solar energetic particle (SEP) monitor, and a camera with a selection of bandpass filters. The Langmuir probe will provide high resolution electron and ion density measurements and temperature readings, informing on the local plasma environment. The SEP monitor consists of a segmented scintillator detector sensitive to gamma-ray and charged energetic particles, such as protons, and is also capable of detecting epithermal

to thermal neutrons. It is based on the CLUNGAS instrument which is being developed for resource mapping of the lunar surface. CENSSAT-1 will provide flight heritage to the instrument, while the spectrometer will provide sensitivity to SEPs, required to identify the impact of solar storms at Earth. The last instrument is an RGB camera, which will be equipped with bandpass filters centered on 439, 557.7 and 630 nm for aurora and airglow emission lines, as well as a filter to catch the long-wavelength wing of the Huggins ozone band at 330 nm. CENSSAT-1 will observe atmospheric emissions in limb and nadir modes, and acquire ozone vertical profiles in the mesosphere and upper stratosphere by stellar and solar occultations.

The mission will also conduct optimal attitude reorientation control experiments. Real-time optimization techniques, combined with performance improvements in radiation-hardened CPUs, have made the prospect of real-time optimal control in spacecraft systems possible. When implemented, this technique will reduce energy use, and allow for much more dynamic pointing strategies, opening up for additional science cases.

In this paper, we will present the science objectives and mission concept for CENSSAT-1, discuss the mission architecture and the chosen payloads.