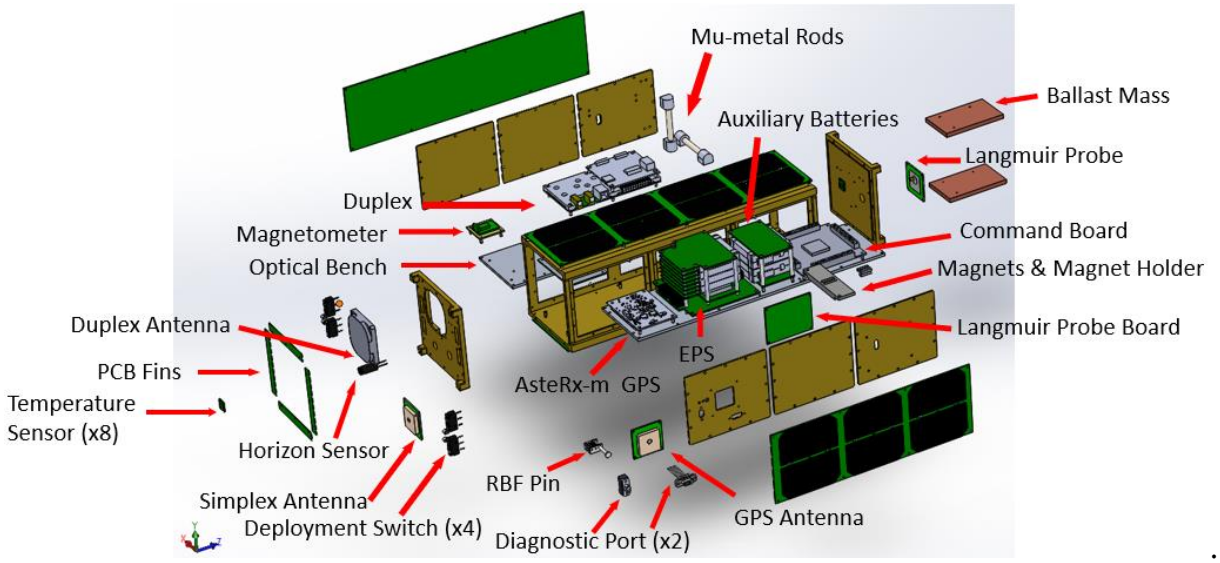
UNITE Satellite Technical Description

The goals of the UNITE CubeSat mission are to: measure plasma properties of the lower ionosphere using a Langmuir Plasma Probe, monitor its own internal and skin temperatures via a temperature sensor array for use in updating a thermal model of the spacecraft, and carefully track the CubeSat's orbital decay using data from an onboard GPS unit.

The satellite will launch November 21, 2018, on an Orbital ATK Antares II Cygnus ISS resupply mission. It will be deployed from the International Space Station via the NanoRacks CubeSat Deployer in early 2019. It will be inserted into a 400 km circular orbit, at an inclination of 51.6 degrees. Transmission will begin 50 minutes after deploy, and cease upon reentry. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs 1.2 years after deployment. See the Orbital Debris Assessment Report for details.

The spacecraft is a three unit CubeSat with the dimensions of 10 cm X 10 cm X 34 cm. The total mass is about 3.5 kg.

Figure 1 UNITE Overview



The satellite contains the following systems:

Command and Data Handling (C&DH) Subsystem: The C&DH will control the operating modes of the CubeSat, and interface with payload sensors and other subsystems, and transmit the data to the Communications Subsystem. The PIC24FJ256GA106 microprocessor interfaces with the temperature sensor array, magnetometer and Langmuir Plasma Probe.

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Attitude Determination Subsystem (ADS): The ADS determines CubeSat rotational rates using a Honeywell HMC2003 three-axis magnetometer. Once the spacecraft is stabilized, it will determine the attitude of the CubeSat.

Attitude Control Subsystem (ACS): The ACS ensures that the spacecraft becomes aerodynamically stabilized in the ram-direction to allow the Langmuir Plasma Probe to take optimal plasma measurements. It uses Mu-Metal rods to dampen rotational rates simultaneous with aerodynamic stabilization.

Communications Subsystem (COMM): The COMM transmits science and housekeeping data to the University of Southern Indiana (USI) mission operations via the Globalstar satellite constellation. Likewise, COMM will receive any commands sent by mission operations, and relay those commands to C&DH.

The Communications Subsystem consists of a simplex unit (integrated with the Electric Power Subsystem) which only transmits, and a duplex unit which both receives commands and transmits data. This makes possible virtually 24/7 communications with the UNITE CubeSat. The COMM subsystem was supplied by Near Space Launch (NSL).

Electrical Power Subsystem (EPS): The Electric Power Subsystem (EPS) will supply, manage and monitor power throughout the CubeSat. The EPS unit was purchased from NSL.

The EPS consists of 30 Spectrolab Ultra Triple Junction solar cells, custom made printed circuit boards to hold the solar cells, four Lithium-polymer batteries and a control module from NSL providing Maximum Power Point Tracking.

Mechanical Subsystem: The 3U structure, purchased from NSL, is 6061 anodized aluminum.

Payload Subsystem; The Langmuir Probe is the science payload. The objective of the Langmuir Plasma Probe is to conduct *in situ* measurements of electron density and electron temperature, as well as ion density in the lower ionosphere. It has a commanded voltage sweeping from -5 volts to +5 volts at 1 Hz, with higher sweep rates possible to probe possible sporadic E layers in the lower ionosphere.

Temperature Sensor Array Subsystem: The objective of the Temperature Sensor Array Subsystem is to provide temperature measurements at eight locations on or inside the UNITE 3U CubeSat. These temperature results will be used to refine a thermal model. The temperature sensors are AD590 integrated circuit sensors from Analog Devices. One sensor will be placed near each of the six CubeSat faces, one on the command board and one on the magnetometer.

Global Positioning System (GPS) Subsystem: The GPS will provide position, velocity and time data from which orbital elements can be determined in order to track orbital decay. The GPS unit is a Septentrio model AsteRx-m.

Propulsion Subsystem: No propulsion subsystem is included.