MiTEE Satellite Technical Description

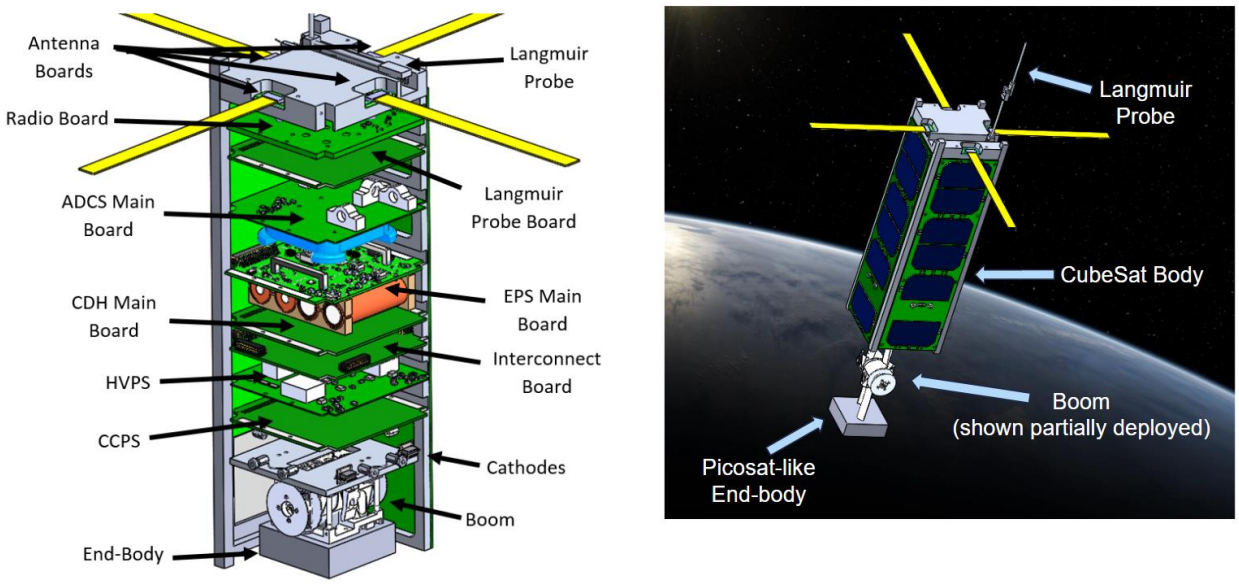
The overall goal of the MiTEE mission, is to test miniature electrodynamic tethers as a propulsion concept for small satellites.

MiTEE-1 will measure properties of ionospheric plasma and spacecraft charging in Low Earth Orbit with a flight-ready Langmuir Probe instrument designed for the ProSEDS mission. The spacecraft will also concurrently sweep the voltage of its picosat end-body and the electron emission current of its thermionic emitters in order to characterize the picosat's ability to collect electron current from the ionospheric plasma.

The satellite will be launched as a secondary payload aboard Virgin Galactic LauncherOne Vehicle, 1st December 2017. It will be inserted into a circular orbit at 500 km apogee and perigee, on an inclination from the equator of 90 degrees. Transmission will begin 1st December 2017, and cease 1st June 2018. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs 7.2 years after launch. See the Orbital Debris Assessment Report for details.

The spacecraft is a single unit with the dimensions of three stacked 10 cm X 10 cm X 10 cm CubeSat modules (giving an overall dimension of 10 cm X 10 cm X 33 cm). The total mass is about 4 kg.

Figure 1 MiTEE Overview



The satellite contains the following systems: CDH, Communications, EPS, OADCS, Structures, and Plasma Electrodynamics.

Command and Data Handling (CDH) Subsystem: The Command and Data Handling Subsystem is responsible for controlling the spacecraft, transitioning between different phases of the mission, executing requested tasks, and managing error. It employs a distributed architecture

that relies on multiple microprocessors to execute sub-system level tasks. The main processor queues and authenticates the uploaded commands, verifies the completion of tasks, maintains mission time and synchronization, and activates recovery options when needed. Sub-system level microprocessors receive the commands from the main microprocessor and control subsystem components to complete the requested action.

Communcations Subsystem: The communication system uses an AstroDev Lithium Li-2 transceiver and a 4 monopole antenna array to communicate with the ground station at the University of Michigan by UHF uplink and downlink. The system also transmits a 5 second duration status beacon every 30 seconds. The Communication system is responsible for the management of all outgoing and incoming signals and interfacing to the Data Handling subsystem.

Electrical Power Subsystem (EPS): The MiTEE-I Electrical Power System is composed of: solar panels, a battery, a battery regulation and power distribution section, a constant current power supply, and a dual polarity high voltage power supply. The power distribution section regulates charging of the battery with energy supplied by the satellite's solar panels, and provides regulated voltage supply rails of digital 3.3V, analog 3.3V, and 5V for the entire satellite, along with voltage supply rails for the Langmuir probe.

Orbits, Atitude Determination and Control (OADCS): The Orbits, Attitude Determination and Controls Subsystem is in charge of controlling the spacecraft attitude, and tracking its location. This subsystem includes magnetometers, an IMU, and magnetorquers, to detumble the satellite, and maintain attitude. In addition, it includes photodiodes and magnetometers, to sense orientation.

Structures Subsystem: The main structure is 3D printed aluminum with internal supports for PCBs, and a cap for mounting the antennas and Langmuir probe.

Plasma Electrodynamics Subsystem (PES): The PES controls and monitors the Langmuir probe, thermionic cathode, and current collection and emission measurements for the rest of the CubeSat.