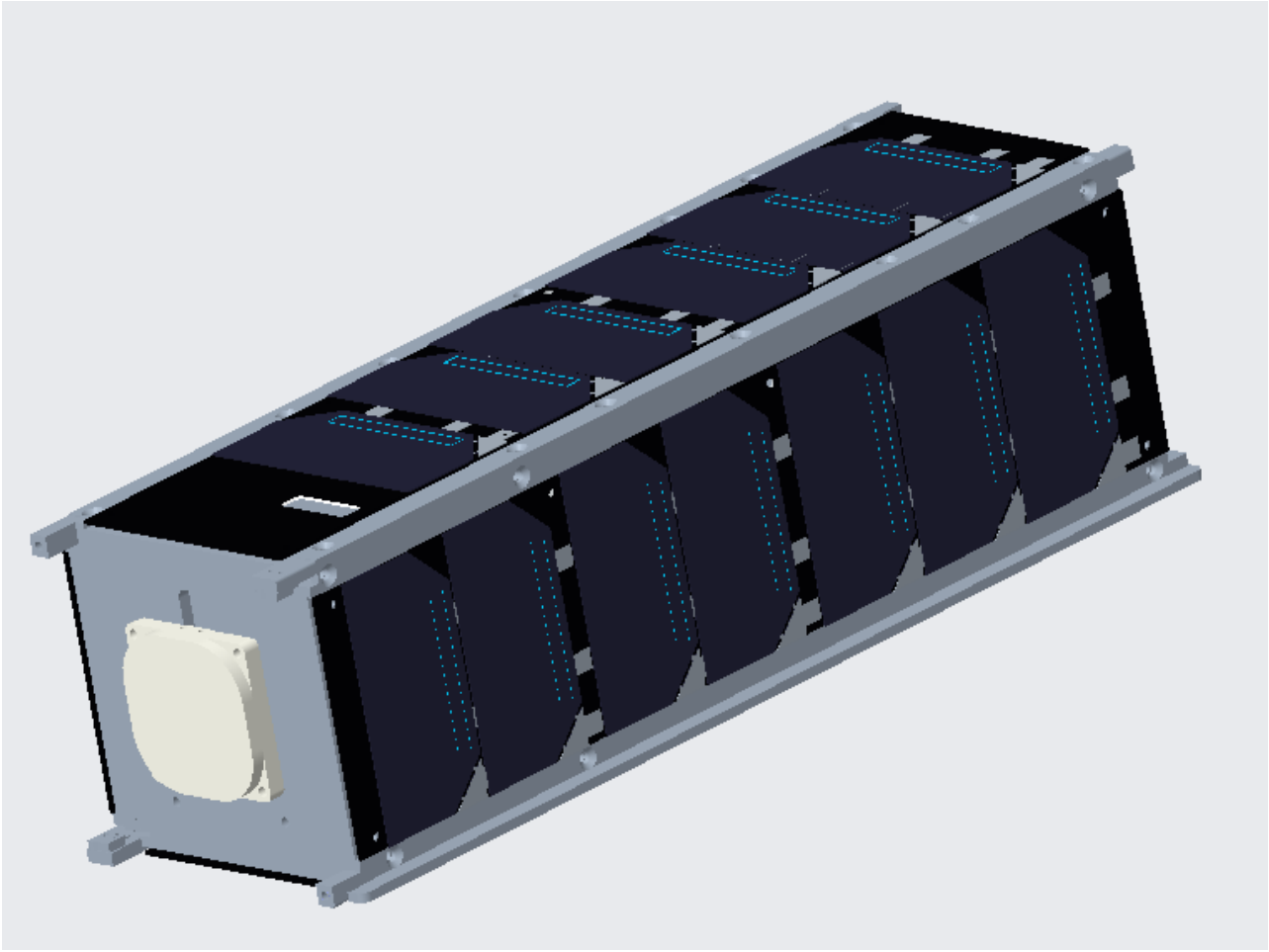
# SASSI2 Technical Description

The overall goal of the Student Aerothermal Spectrometer Satellite of Illinois and Indiana (SASSI2) is to collect atmospheric data relevant to its shock wave as it flies through the upper atmosphere.

The spacecraft will be launched as a secondary payload as part of the Cygnus NG-10E flight, from Wallops Flight Facility, November 17, 2018. The satellite will be deployed from the second stage after the primary payload detaches and continues to the ISS. SASSI2 will be inserted into an orbit with a 296-km altitude apogee and 189-km altitude perigee, at an inclination from the equator of 51.63 degrees. Transmission will begin no sooner than 46.5 minutes after deployment and cease upon de-orbit and disposal. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs approximately 11 days after launch. See the Orbital Debris Assessment Report for details.

The spacecraft is a single unit with the dimensions of 3 stacked 10 cm x 10 cm x 10 cm CubeSat units (giving an overall dimension of 10 cm X 10 cm X 30 cm.) The total mass is approximately 3.87 kg.

**Figure 1: CAD model of SASSI2 showing the patch antenna on the bottom plate.**



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The satellite contains the following systems:

**Guidance, Navigation and Control (GNC) Subsystem:** The GNC subsystem is a fully magnetic system utilizing 6 torque coils (2 aligned in each axis) for rate damping. SASSI2 relies on aerodynamic stability to keep the spacecraft pointed in the ram direction. Aerodynamic stability is provided by multiple steel ballast blocks near the front of the spacecraft that move the center of mass forward of the aerodynamic center of pressure. Spacecraft attitude is determined through a system of magnetometers and inertial measurement units (IMUs). Orbit determination is done via range and range-rate data generated by communication with the Globalstar network. All torque coils operate through the torque coil board, which is attached to the bottom plate.

**Command and Data Handling (CDH) Subsystem:** The CDH board and mounted daughter card handle all aspects of spacecraft control outside of the initial boot sequence upon deployment, which is handled by the power board. This includes operating all subsystem daemons, storing data, and monitoring spacecraft health and processor integrity.

**Electrical Power Subsystem (EPS)**: There are three primary components to the EPS on the spacecraft: power board, solar arrays, and battery pack. The power board, with guidance from CDH, directs power from the batteries to each subsystem as necessary. The power board performs current and voltage monitoring in battery charging and discharging as well, which is used as health data for the spacecraft. The solar arrays are comprised of four sets of triple junction GaAs cells. Expected power generation is 15 W outside of eclipse. The battery pack is composed of LG 18650 cells with a nominal capacity of 3400 mAh. The battery board handles cell balancing and includes overcharge protection autonomously.

**Thermal Control Subsystem (TCS):** The only form of thermal control is Kapton battery heaters. The heaters are monitored and controlled by the EPS.

**Structure Subsystem:** The structure is composed of aluminum and consists primarily of a front plate, middle plate, and back plate, connected with four corner rails. The rails are used as attachment points for the solar panel, spectrometer, radio, and ballast.

**Payload Subsystem:** The payload is separated into two assemblies. The first is the spectrometer assembly, which consists of a Flame spectrometer from Ocean Optics, fiber optic cable, lens, and sapphire window (which is mounted to the front plate). The second assembly consists of pressure sensors and a heat flux sensor, all of which are mounted on the front plate. Both payloads interface with the CDH system through payload boards attached to the middle plate.

**Propulsion Subsystem:** SASSI2 has no propulsion system.

**Communications Subsystem:** The communication system consists of a NearSpace Launch, Inc. Eyestar D2 transceiver communicating with the Globalstar network. A radio support board is used to control voltage and current being sent to the radio. The spacecraft uses a patch antenna on the outboard face of the bottom plate for communications. The attitude determination and control system (ADCS) monitors spacecraft orientation and confirms that the spacecraft is not pointed towards Earth's surface before and during all transmissions.