HuskySat-1 Satellite Technical Description

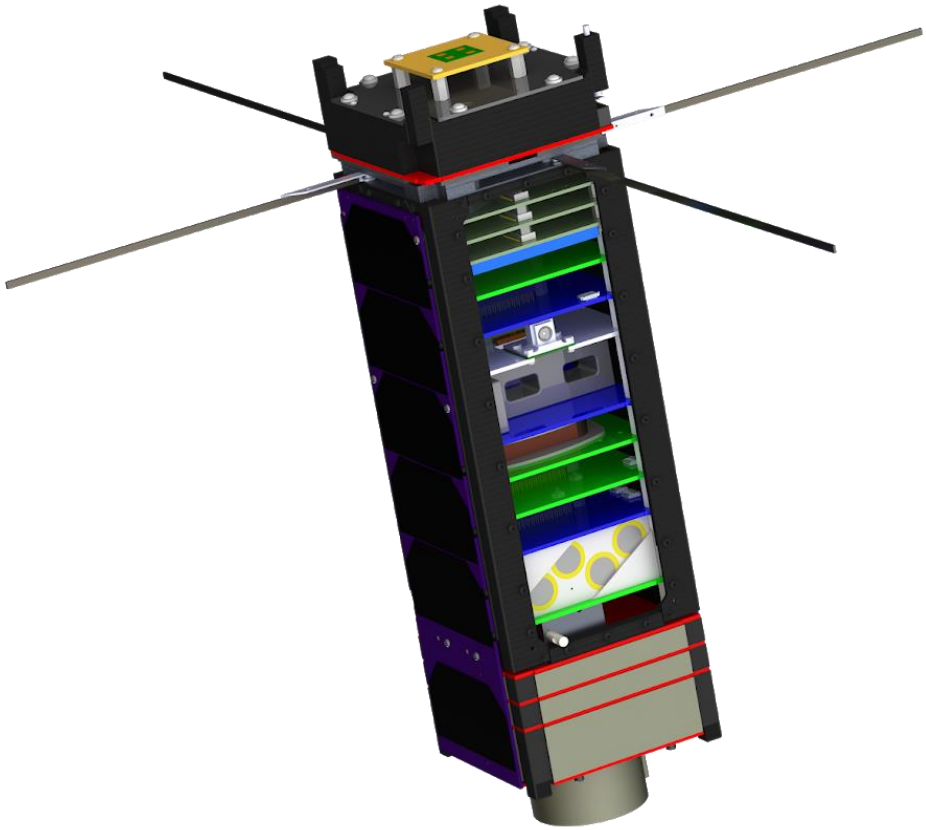
The overall goal of the University of Washington HuskySat-1 mission is to demonstrate an experimental K-band downlink, and a pulsed plasma propulsion system.

The satellite will be launched as a secondary payload aboard the NG-12 launch of the Cygnus ISS Resupply Capsule, from the Mid-Atlantic Regional Spaceport, on Oct 19th, 2019. After Cygnus leaves the ISS, it will boost to a circular orbit in the range of 455-500 km, on an inclination from the equator of 51.6 degrees, where the HuskySat-1 will be deployed,

Deploy and transmission start will be no earlier than November 1, 2019. Transmission will cease ~3 months after first transmission. At this time ownership of the satellite will be transferred to AMSAT, who may choose to repurpose it for Amateur operation after appropriate licenses have been obtained by them. Atmospheric friction is expected to slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs about 3.5 years 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 modules with a “tuna can” extension on one end (giving an overall dimension of 10 cm X 10 cm X 30 cm.) The total mass is about 3.2 Kg.

Figure 1 HuskySat-1 Overview



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The satellite contains the following systems:

Attitude and Determination and Control System (ADCS): The ADCS system determines tumble rate and orientation using an IMU (ST LSM6DSM), three magnetometers (Honeywell HMC 5983), and a sun sensor (nanoSSOC D60). The orientation can be altered through the use of in-house designed and built 3-axis magnetorquers.

Command and Data Handling (CDH) Subsystem: Command and data handling on the HuskySat is distributed across multiple MSP430 microprocessors, and utilizes a CAN bus to pass information between each subsystem.

Electrical Power Subsystem (EPS): The EPS is comprised of 3 side panels with Azur Space GmbH 3G30A photovoltaic cells going to a power generation board which controls charging, balancing, and heating the 6.6V 2.2 A-hr battery system. The batteries are COTS A123 APR18650m1B cells in a 2s2p configuration. From the battery pack, a power distribution board with over-current protection switches power to individual subsystems.

UHF/VHF Communication Subsystem: The comms transceiver will support a VHF uplink, and UHF downlink, using an ISIS 2-dipole antenna. It communicates with the ground station on the UW campus.

Structure Subsystem: The structure is fabricated from 7000 aluminum with stainless steel fasteners.

Propulsion Subsystem Payload: The propulsion system is a pulsed plasma thruster (PPT) utilizing a solid sulfur fuel. Each pulse has an energy of 10 J, and it can fire at maximum frequency of once per 4 seconds. The system will only engage by direct command from the ground station and fire a single pulse in response to each command. Each pulse provides an approximate impulse on the order of 500 μNsec, providing a delta V of about $\leq$0.00016 m/s, per pulse. The maximum possible total number of pulses over a 3 month period would be less than 1000, likely much less. The total delta V imparted, if all 1000 pulses had the maximum cumulative effect, would be less than 0.2 m/s. See the separate exhibit, "HuskySat-1 Pulsed Plasma Thruster Effects on the Satellite Orbit", for a more detailed description and assessment.

K-band Communication System Payload: The experimental communication system operates at 24 GHz for downlink only with a patch array antenna on the +Z surface of the CubeSat. It transmits to the receive only ground station at the UW campus.

Camera Payload: Raisbeck Aviation High School student interns designed and built a camera payload that is flying on HuskySat-1. The camera will capture a 92x64 pixel still image, with a ~550km swath width.