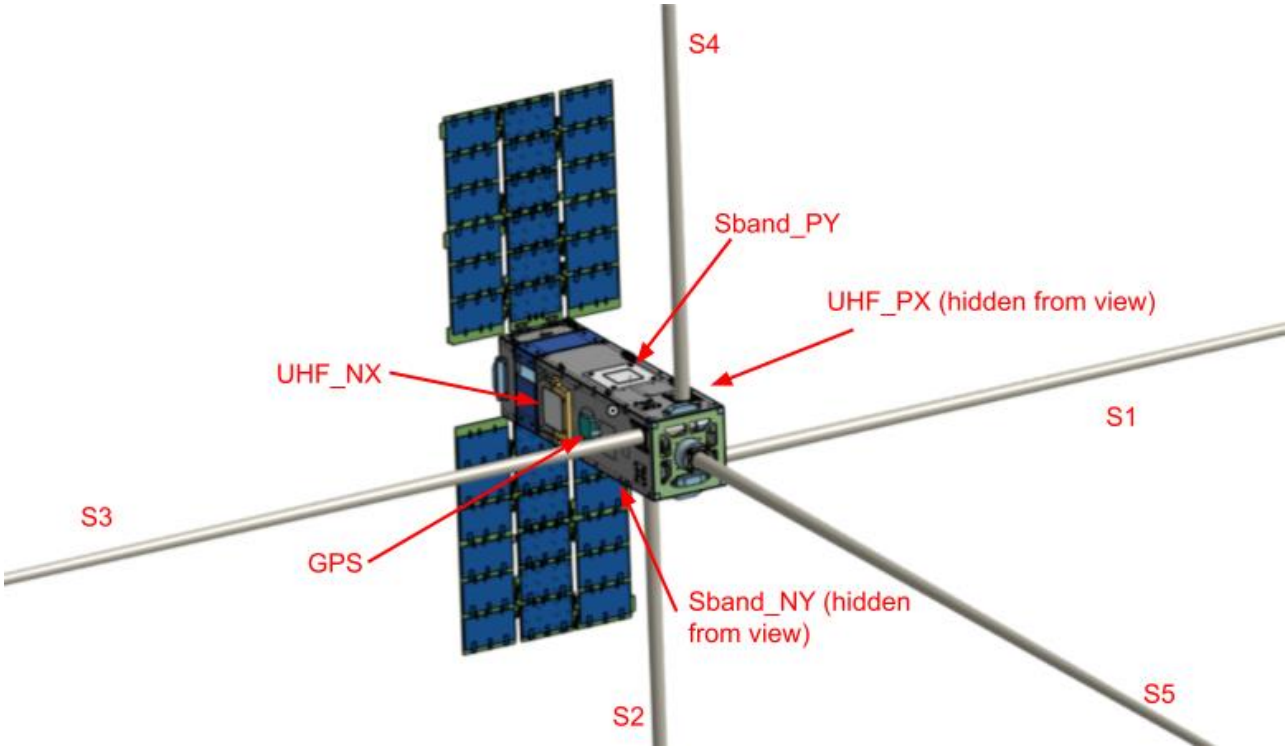
CURIE A and B Satellite Technical Description

The overall goal of the CURIE mission, is to use radio interferometry to study radio burst emissions from solar eruptive events such as flares and coronal mass ejections (CMEs) in the inner heliosphere, providing observations important for our understanding of the heliospheric space weather environment.

Two satellites, CURIE A and CURIE B, will be launched aboard VCLS Demo 2 Astra, No Earlier Than December 1, 2021. They will be inserted into a circular orbit at 500 km, on an inclination from the equator of 41 degrees. Transmission will begin 45 minutes after deploy from the launch vehicle, and cease upon deorbiting.

Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs 6 to 21 months after launch, depending on solar activity and obtained orbit altitude. Each spacecraft has the dimensions of 3 stacked 10 cm X 10 cm X 10 cm CubeSat modules (giving an approximate overall dimension of 10 cm X 10 cm X 30 cm for each). The total mass is about 10 Kg. See the Orbital Debris Assessment Report for details.

Figure 1 CURIE Overview



CURIE A and B Satellite Technical Description

The satellite contains the following systems:

Guidance, Navigation and Control (GNC) Subsystem: The attitude control capability is provided by a Blue Canyon Technologies XACT unit providing full 3-axis stabilization, sub-degree fine-pointing capability and 1-3 minute timescale to achieve an arbitrary slew. The XACT unit is a self-contained unit with three reaction wheels, magnetometer, torque coils for momentum dumping and a star tracker. A GPS receiver is used for orbit station keeping knowledge. Additional hardware being flown for evaluation but not required for flight control include an additional magnetoresistive magnetometer and an inertial MEMS accelerometer.

The orbital control ability is provided by a cold gas propulsion system providing 1m/s total delta V per 3U cubesat. The propulsion system has been developed at the Space Sciences Laboratory at the University of California at Berkeley, and has these nominal specifications: 6Ns total impulse, 0.6mN burst bit, 3mN nominal thrust. The ACS control system is required to orient the spacecraft to direct the propulsion impulse. In nominal simulations 25% of the propellant is used in 12 months and thus ample reserves remain for an extended mission phase (up to 9 months), allowing formation flying and active collision avoidance for the full mission duration.

Command and Data Handling (CDH) Subsystem:

The CDH subsystem is contained in one printed circuit board: The On Board Computer Board (OBCB), which contains the flight FPGA and CPU, memory and relays for deployables. The OBCB interfaces to the rest of the subsystems in the satellite.

Communications Subsystem (COMMS):

The COMMS subsystem consists of three radio modules:

The TT&C radio is based on a commercial integrated transceiver module, with a RF front end tuned and filtered around a UHF frequency of 916 MHz. This transceiver is used for all commanding using CCSDS compliant AES-256 encryption standards, as well as downlink of basic spacecraft housekeeping state of health data. The UHF TT&C radio is using a splitter and dual patch Right Hand Circularly Polarized (RHCP) patch antennas mounted on the chassi.

An S-band transmitter channelized in the 2300-2400 MHz frequency range is used for the main science data downlink. The S-band transmitter is using a splitter and dual S-band patch antennas.

An experimental Software Defined Radio (SDR) is being flown but is not required for spacecraft operation. The SDR will mainly be used for evaluation as an S-band transceiver. The radio's analog front end is tuned to the same frequency band as the S-band transmitter.

Electrical Power Subsystem (EPS): The power generation and storage system comprises symmetric deployable trifold solar arrays built at the Space Sciences Lab utilizing space rated Spectrolab photovoltaic cells, an electric power supply (EPS) unit from Clyde Space (Starbuck Nano), which includes battery charge regulators (BCR) and switches, current limiters and power distribution modules (PCM) that delivers bus power to the reset of the spacecraft systems. The solar

arrays consist of six 3U panels each with 6 cells, providing a nominal total input power after deployment of 36 Watts. Additionally, the central panel is doubled sided such that power generation still occurs pre-deployment of the tri-fold solar arrays, albeit at a reduced rate (6 Watts). The lithium-ion battery (OPTIMUS-30) is purchased from Clyde Space with a capacity of 30Whrs.

Thermal Control Subsystem (TCS): The TCS controls hardware temperature through cold biasing of the thermal design, utilizing heaters to stabilize temperatures. Sensors are wired to the OBCB board, which hosts thermal control algorithms to control the heaters. The radio power amplifiers are heat sunk to the satellite chassi for heat dissipation.

Structure Subsystem: The structure is fabricated of Alu 6061-T6.

Propulsion Subsystem: Each 3U cubesat contains a cold gas thruster system comprising a single canister containing, at launch, 12g of CO2 at 850psi pressure, a motor to puncture the sealed canister in orbit after spacecraft separation and deployment, a valve, a regulator, harnessing and a nozzle aligned with the spacecraft -Z axis.

This comprises the only fluid and fluid systems on board the spacecraft.

Payload Subsystem: The science payload consists of five deployable 2.5m stacer antennas, low frequency (<100MHz) preamplifiers, analog processing board, digital controller and ADC sampling board, a low noise power supply and a chip scale atomic clock. The science radio instrument system constitutes a low noise radio receiver to measure the radio emissions in the 0-80 MHz frequency range, calculate Fourier components to downlink for further post-downlink interferometric correlation analysis. The science instrument and stacer antennas have no transmit capability and are not connected to the COMMS sub-system.