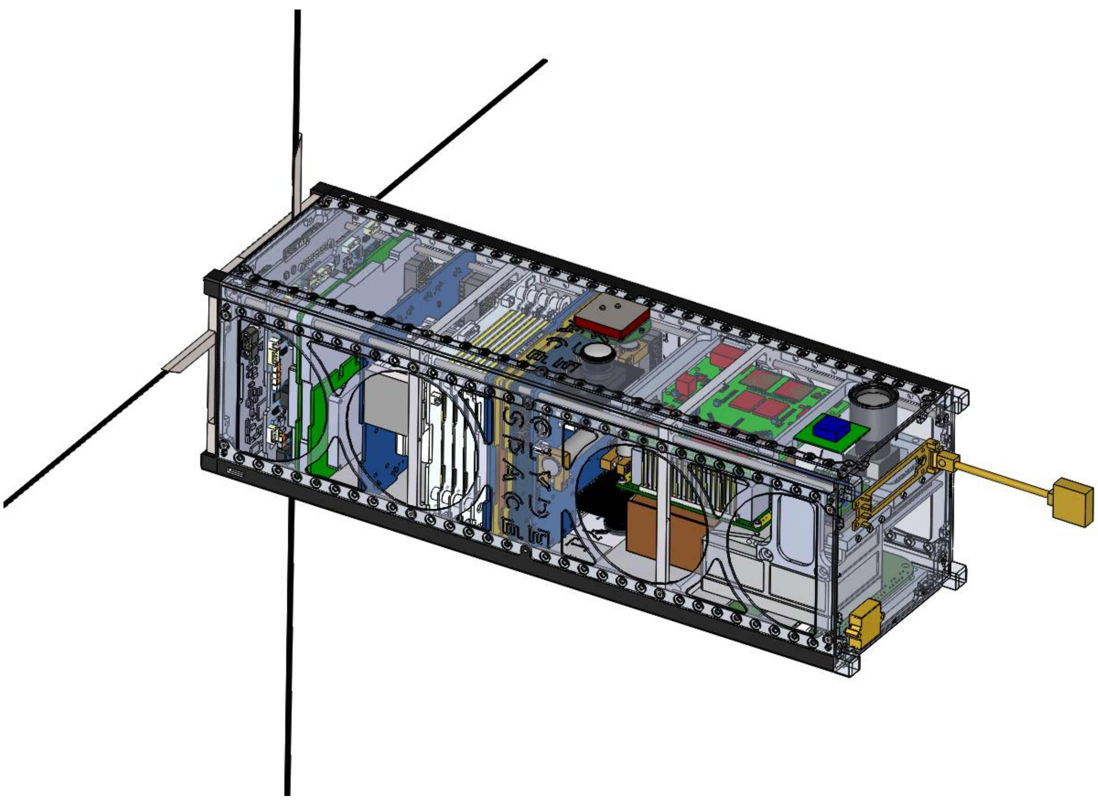
Neutron-1 Satellite Technical Description

The overall goal of the Neutron-1 mission, is to measure the time dynamics of low energy Earth albedo neutron fluxes as a function of solar activity level, time, and location. The spacecraft is developed by the Hawaii Space Flight Laboratory (HSFL) at the University of Hawaii, and the detector is developed by Arizona State University (ASU).

The satellite will be launched as part of the ELaNa CubeSat launches, on the NG-12 ISS re-supply mission, carried as cargo aboard the Antares launch vehicle, from Cape Canaveral, Florida (NET October 19, 2019). It will be deployed from the ISS during first quarter 2020, into a circular orbit at 400 km, on an inclination from the equator of 51.6 degrees. Operation will cease by October 19 2021. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting is expected to occur about 2 years after deploy. See the Orbital Debris Assessment Report for details.

The spacecraft is a 3U CubeSat with the overall dimensions of approximately of 10 cm X 10 cm X 30 cm. The total mass is about 6 Kg.

Figure 1 Neutron-1 Overview



The satellite contains the following subsystems:

<u>Attitude Determination and Control Subsystem (ADCS):</u> The ADCS is a pitch momentum bias system using three reaction wheels for momentum with 3 desaturation torque coils built into the structure to cancel environmental torques. The equipment also includes dual magnetometers, sun sensors, star tracker, and ADCS computer that comprise the critical components in this subsystem. Additional hardware being flown for enhanced flight control include a GPS receiver.

On-Board Computer Subsystem (OBCS): This critical subsystem has two parts: the On Board Computer (OBC) and the Integrated Spacecraft Computer (ISC). The OBC will interface with the payload and telecom subsystems. The ISC will interface with the EPS and ADCS subsystems. The OBC uses the Gumstix hardware. The OBC commands the payload, spacecraft modes of operation, and handles the telemetry to the ground station via the Telecom subsystem. ISC acts as a slave computer to the OBC and operates the power and attitude of the spacecraft. The OBCS will gather and format the spacecraft state of health data and payload instrument data.

Electrical Power Subsystem (EPS): The EPS is a direct energy transfer system using a solar array producing approximately 6W of orbit average power to charge the 40 W-hr battery system. The solar arrays utilize standard Emcore photovoltaic cells; the batteries are COTS Clydespace pack. The ISC board sends signals to the Power Switch Boards to control charging and load switching.

Thermal Control Subsystem (TCS): The TCS uses passive methods to stabilize hardware temperatures. The subsystem uses copper straps and waste heat from subsystems. The attitude of the spacecraft in relation to the sun is also used to warm the spacecraft as needed.

Structure and Mechanism Subsystem (S&M): The 3U structure is from Clydespace and is fabricated of aluminum. Rods are used to mount the stacked boards to the frame.

Telecom Subsystem (COMM): The spacecraft uses the software defined Gamalink radio with S and UHF band downlinks, and VHF uplink, communicating with the ground station in Hawaii. S-Band is for payload telemetry and UHF/VHF is for command and control. It will also use simplex and duplex radios communucating via the Globalstar constellation.

Propulsion Subsystem: No propulsion subsystem is included.

Payload Subsystem: The Arizona State University (ASU) neutron detectors will enable us to detect thermal neutrons and epi thermal neutrons. The detectors will count neutron hits. The spacecraft will record location and time for the hits.