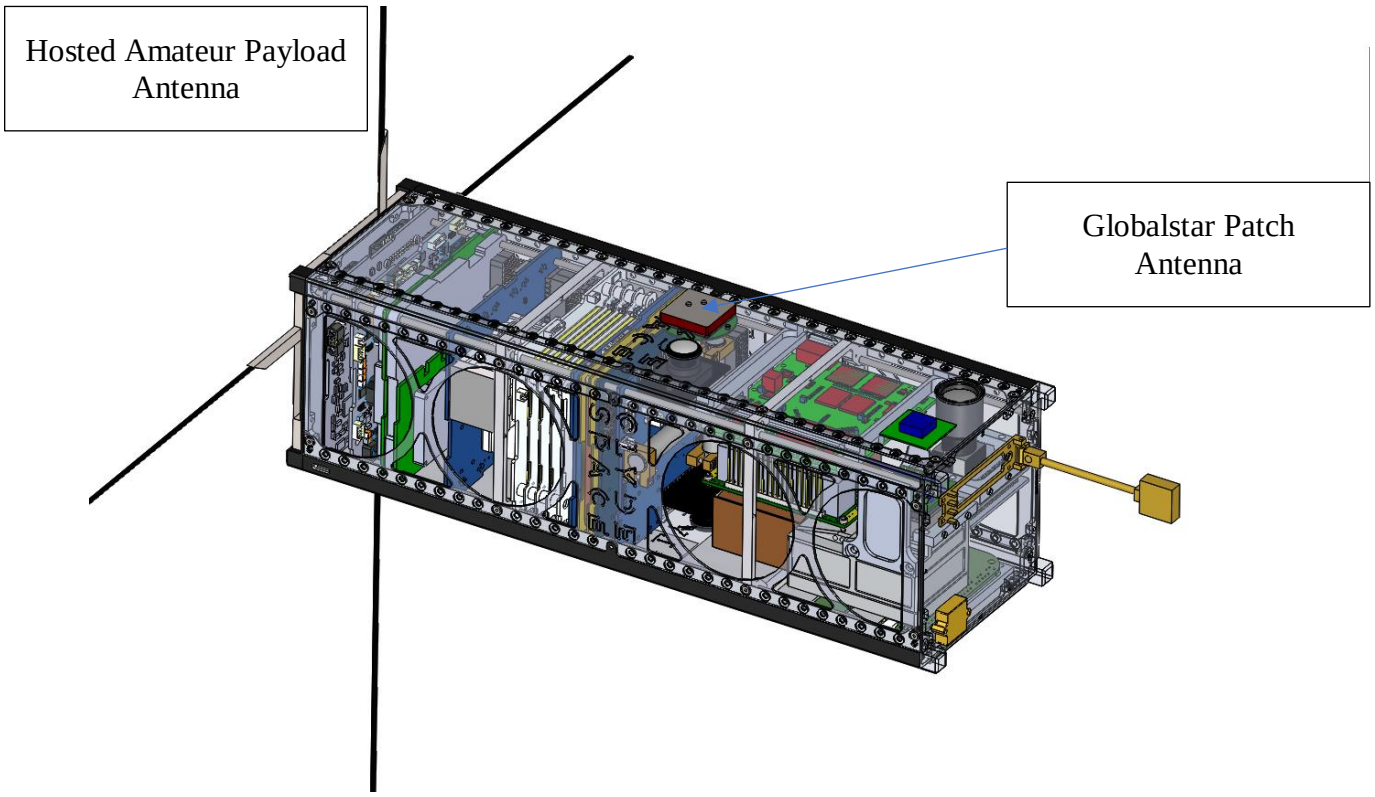
Neutron-1 Satellite Technical Description

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

The satellite will be launched as part of the ELaNa CubeSat launch program, on the ELaNa 35 ISS re-supply mission, carried as cargo aboard the Space X-21 – Falcon 9, from August 5, 2020. It will be deployed from the ISS during the fourth quarter 2020, into a circular orbit at 400 km, on an inclination from the equator of 51.6 degrees. Operation by the University will cease after 6 months of operation, at which time ownership of the cubesat will be transferred to the Kauai Community College Radio Club, who will operate the spacecraft to support amateur transponder service, and amateur access to neutron flux data. See the Communications Plan document for details. 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:

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Attitude Determination and Control Subsystem (ADCS): 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, ADCS computer and 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 telemetry 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. Adjusting 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.

Communications Subsystem (COMM): The spacecraft uses a duplex radio communicating via the Globalstar constellation, for all commands up and telemetry down..

Propulsion Subsystem: No propulsion subsystem is included.

Experiment Payload Subsystem: Neutron detectors developed at Arizona State University will detect thermal neutrons and epi-thermal neutrons. The detectors will count neutron strikes. The spacecraft will record location and time for each strike.

Hosted Amateur Transponder: The cubesat will host an amateur transponder provided by the Kauai Community College Amateur Radio Club. This consists of an ISIS radio and ISIS dipole antenna. The transponder will provide amateur message relaying, and will be operated by the Radio Club under Part 97 rules. See the Communications Plan document for details.