26th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Space Science Missions (2)

Author: Dr. Miguel Nunes
University of Hawaii and Manoa, United States, manunes@hawaii.edu

NEUTRON-1 MISSION: LOW EARTH ORBIT NEUTRON FLUX DETECTION

Abstract

The NEUTRON-1 mission is scheduled to launch on ELaNa 25 during the Fall of 2019. The 3U CubeSat will measure low energy neutron flux in Low Earth Orbit (LEO) in an effort to gather new science data. It is being developed by the Hawaii Space Flight Laboratory (HSFL) at the University of Hawaii at Manoa (UHM), and its associated community colleges. The science payload was developed by Arizona State University (ASU).

Neutrons in LEO have three major sources: production in the atmosphere via Galactic Cosmic Radiation (GCR) and Earth's radiation belt, production in the spacecraft by the same radiation, and direct emission from the Sun during large Solar Particle Events (SPE). The overall science goal of the NEUTRON-1 mission is to measure the time dynamics of low energy Earth albedo neutron flux as a function of solar activity level, time, and space coordinates of the CubeSat. To achieve this goal, we use a pair of small neutron detectors developed by ASU for the upcoming LunaH-Map mission. The measurements will focus on low energy secondary neutrons, one of the components of the LEO neutron environment. Maps of secondary low energy neutron abundances will be derived from the data as a function of latitude, longitude, and time as a basis for further modeling.

Data gathered by the neutron detectors will contribute to understanding the complex relationship between Earth and Sun through mapping neutron abundances in LEO. In combination with data obtained by other spacecraft and ground-based measurement stations, we will evaluate the variability of secondary neutron production in the atmosphere and GCR as a function of solar variability. Special attention is given to unusual neutron abundances in relation to solar flares, solar particle events, and disturbances of the Earth's magnetic field. We will also evaluate our neutron data for potential application in space weather characterization and radiation safety.

In addition, this mission presents an excellent opportunity to establish flight heritage and demonstrate the technological capabilities of the NASA EPSCoR funded Comprehensive Open-architecture Solution for Mission Operations Systems (COSMOS, http://cosmos-project.org). COSMOS is an open source set of tools that is being developed at HSFL as a flexible general purpose solution for this and future SmallSat missions. It is intended to enable/facilitate SmallSat mission operations at universities with limited budgets and short schedules.