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IONIC NEUTRON CONTENT ANALYZER:  
SYSTEM DESIGN OF A STUDENT BUILT 3U CUBESAT

**Abstract**

The Ionic Neutron Content Analyzer (INCA) spacecraft is a student built 3U cubesat designed and built by the New Mexico State University NanoSat Lab. INCA's mission is to demonstrate the functionality of a new Scintillator - Silicon Photomultiplier (SiPM) based neutron detector designed by NASA's Goddard Space Flight Center. The detector will provide science return by measuring neutron flux in Low Earth Orbit over time and a range of latitudes. This work provides technical details on the design of the INCA spacecraft to aid future cubesat missions. This paper presents INCA's subsystems including: the architecture and design of the communication system, including software and hardware for both the satellite and its ground station; the design of mission software, which includes both the flight software and ground station architecture; the derivation of the prediction and update steps of the kalman filter used for attitude determination; design and simulation of the spin-stabilized attitude control system utilizing only magnetorquers for actuation; an overview of the design and testing of INCA's thermal, vibrational, and structural properties. The paper concludes with a discussion of lessons learned from the assembly

and integration of the INCA spacecraft. Additionally provided is a link to select portions of the described software developed by the INCA team.