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SPACE QUALIFYING RAAD CUBESAT FOR THE STUDY OF TERRESTRIAL GAMMA-RAY
FLASHES AND OTHER SHORT TIMESCALE PHENOMENA**Abstract**

Presenting the RAAD instrument (Rapid Acquisition Atmospheric Detector), the payload of a 3U CubeSat. RAAD is composed of two detectors designed and optimized for studying Terrestrial Gamma-Ray Flashes (TGFs) through the use of two different types of scintillating crystals (Cerium Bromide and Lanthanum BromoChloride) coupled to S13361-6050AE-04 Hamamatsu Silicon Photomultipliers (SiPMs) and R11265-200 Photomultiplier Tubes (PMTs). Each detector consists of a 2 x 2 array of crystals and photosensors, each fitting into < 1U of a cubesat, and provides $\sim 20 \text{ cm}^2$ of effective area to photons < 200 keV and $\sim 10 \text{ cm}^2$ at 600 keV. The detector's unique combination of scintillating crystals and photosensors, along with a custom designed readout electronics, overcomes the deadtime and timing precision limitations as well as the low resolution at lower energies (< 50 keV) typical of previous missions that had tried to detect TGFs. The custom designed payload electronics provides the required spectroscopic and timing capabilities within the low power budget constraints (< 4 W in average) of the mission. We're aiming at the 20 keV – 3000 keV energy range, few hundreds ns time response and good energy resolution ($\sim 5\%$ @ 511 keV). We present the performed space qualification tests, the payload mechanics, its calibrations and pre-flight particle and signal simulations for the characterization of the expected response. We also show how such detectors could be deployed in a network of CubeSats to study TGFs and for multi-messenger astronomy. RAAD is the chosen payload for a 3U Cubesat that won the Mini-satellite competition held by the UAE Space Agency in 2018, which is expected to be launched in the first quarter of 2021 and deployed from the International Space Station.