Paper ID: 53280
student

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

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THE RAADSAT MISSION FOR STUDYING TERRESTRIAL GAMMA-RAY FLASHES

Abstract

We present the RAAD (Rapid Acquisition Atmospheric Detector) 3U CubeSat, a mission designed to study Terrestrial Gamma-ray Flashes (TGFs). TGFs are sudden bursts of gamma-ray radiation occurring on microsecond timescales, which are triggered by lightning or thunderstorms and channeled into outer space. Previous detectors used to study TGFs were limited by large deadtimes, low time resolution, and poorly calibrated sensitivity at lower energies due to their not being pointed at Earth. The instrumentation proposed for this mission is an efficient gamma-ray detector in the 10 keV − 2000 keV range with small deadtime and high time resolution (both ∼100 ns), good spectral resolution , and microsecond absolute timing for correlation with lightning data. The mission will have a total effective area at low energies of $\sim$ 40 cm^2 . The immediate scientific goals are to explore the average atmospheric cut-off at low energies, search for a 511 keV electron-positron annhilation line, and search for microsecond structure in the lightcurves of the brightest bursts. It is also designed to make a direct, real world comparison of the performance of two fast crystal types (Cerium Bromide and Lanthanum Bromo Chloride) and two types of light readout sensors (standard photomultiplier tubes and Silicon Multi-Pixel Photon Counters) for future missions involving larger crystal arrays or multiple satellites. Here we will present the science specifications of the mission and its detectors, as well as simulated science products. The RAAD mission is the winner of the Mini-satellite competition held by the UAE Space Agency in 2018, and is expected to be fully developed and launched by JAXA for deployment from the ISS by 2020.