TRYAD: A Pair of CubeSats to Observe Terrestrial Gamma-ray Flash Beams

Michael S. Briggs[1], Pete Jenke[1], J. M. Wersinger[2], and Mike Fogle[2]

[1] The Center for Space Plasma and Aeronomic Research (CSPAR), The University of Alabama in Huntsville , http://www.uah.edu/cspar

[2] The Department of Physics, Auburn University

The Terrestrial RaYs Analysis and Detection (TRYAD) mission is designed to measure the beam profiles and tilts of Terrestrial Gamma-ray Flashes (TGFs) using a pair of CubeSats separated by several hundred kilometers in low Earth orbit. With the existing gamma-ray instruments flying in unrelated orbits, virtually all Terrestrial Gamma-ray Flashes (TGFs) have been observed by a single instrument so that there is substantial degeneracy in modeling TGF beams. The TRYAD mission will sample the gamma-ray beam at two locations. Additionally, for many TGFs the source location will be determined using networks of ground-based very low frequency (VLF) radio receivers, such as the World Wide Lightning Location Network (WWLLN) and the Earth Networks Total Lightning Location Network (ENTLN). With gamma-ray measurements at two positions of known location relative to the TGF source, we will be able to distinguish between narrow and wide beams, which will diagnose between models for the production of TGFs. The primary test is the ratio of the observed gamma-ray numbers: relatively similar numbers of gamma-rays measured by the two CubeSats would favor a wide beam, while a much higher number observed by the TRYAD CubeSat closer to the source than by the farther CubeSat would favor a narrow beam.

Control of satellite separation is essential to the TRYAD mission. Separation control is achieved by using ionospheric differential drag on the two satellites. Fast (i.e., short pulse-width) scintillators are necessary so that deadtime or pulse pileup does not distort the comparison of the gamma-ray flux. To obtain large detector area at low cost, the TRYAD gamma-ray detectors use lead-doped plastic scintillator. To reduce the instrument volume, the scintillation light is measured with Silicon Photomultipliers (SiPMs) rather than with Photomultiplier Tubes.