

What is FIREBIRD?

FIREBIRD (Focused Investigations of Relativistic Burst Intensity, Range and Dynamics) is an NSF funded CubeSat specifically designed to study electron microbursts. Microbursts are short-lived (~100ms) bursts of electron precipitation from the Earth’s radiation belts to the atmosphere. Each FIREBIRD mission (launched December 2013, and January 2015, respectively) consisted of a pair of CubeSats which slowly separated over the course of the mission to measure bursts at a variety of spatial scale sizes.

FIRE Instrument

FIRE uses a pair of 1500um thick solid state silicon detectors on each spacecraft. These detectors are identical, with the exception of a collimator that surrounds one detector to change the geometric factor and acceptance angle. These detectors were acquired as surplus from a NOAA mission.

An additional enabling technology for FIRE was the DAPPER, an Aerospace developed chip for NASA’s MMS mission which handles both detectors simultaneously in a low-noise and low-power environment.

Digital Interface

In addition to being the interface between FIRE and BIRD, the digital board is also responsible for converting the pulse widths produced by the DAPPER into counts in the defined energy bins at the appropriate timing (200 keV to >1 MeV at 18.75ms time resolution). These values are customizable which aids in calibration.

Calibration and Flight

Calibration consisted of both bench-top testing with beta and gamma sources (at left), running at the highest energy resolution possible (~10 keV). This was used to set the digital fence-posts that defined the 6 energy channels from 200 keV to >1 MeV used in flight. At right is an example of on-orbit measurements from Flight Unit 3 during the St. Patrick’s day storm in 2015. Both detectors measure microbursts across a large energy range and the different geometric factors both ensure sufficient counts and mitigate saturation issues.