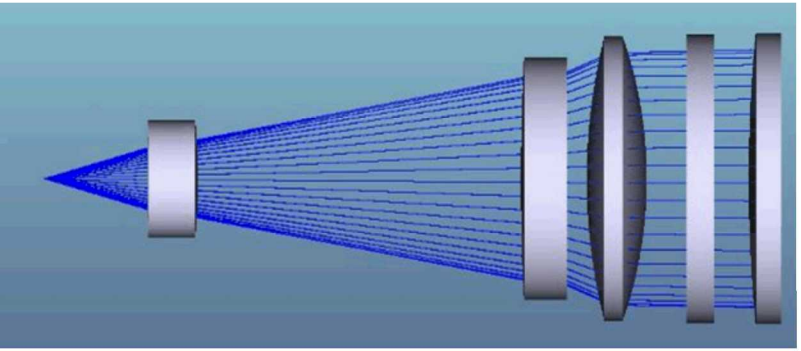
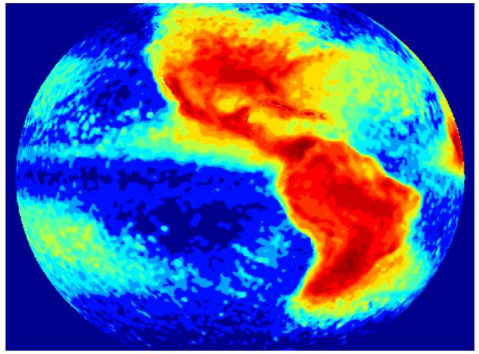
SAND2020-9521C





RROE Mission Capability

SENSER Science Meeting

9/15/20

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RROE is a High Speed Imaging Sensor Prototype

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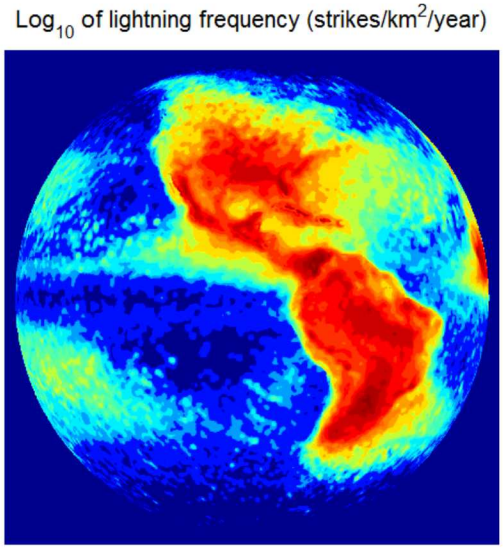
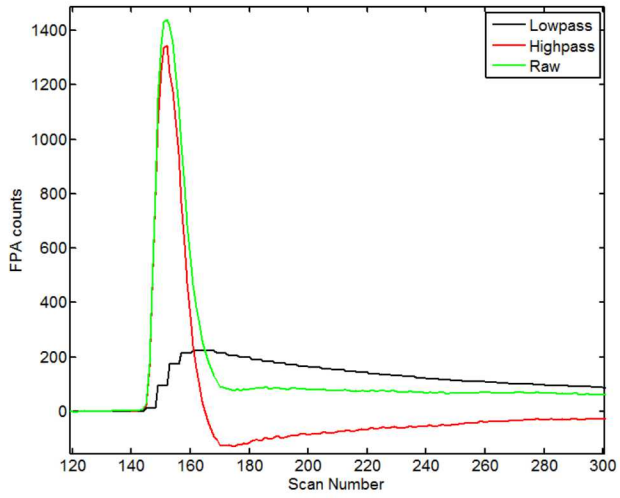
- Broadband visible lens/FPA
- Diffraction grating produces spectral information for bright point sources
- RROE does not have full earth coverage (~450kmX450km instantaneous coverage)
- Fast steering mirror can direct the FOV to cover most of the visible earth from GEO
- Nadir pointing geo-location uncertainty should be ~7km
- Time stamp accuracy on the order of 10µs

- 12 month on-orbit experiment
- Flying on STP-Sat6 with several other experiments and an operational payload
- Current launch date 1/21/2021 (subject to change)
- Geo-synchronous orbit, 112W
- 6GB/day downlink allocation

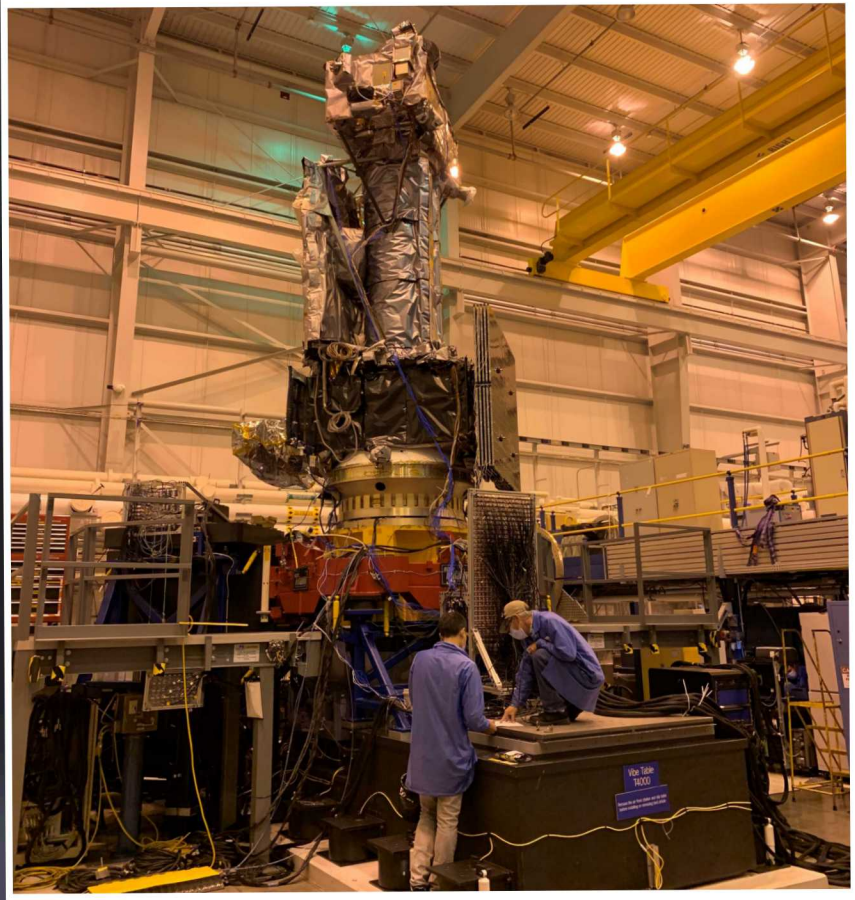
Mission Objectives and Experiment Requirements

- **Experiment Objectives**
  - Study the frequency and distribution of lightning
  - Capture a large database of many lightning signals
- **Data collection capability/plans**
  - 24/7 autonomous operation made possible by scheduled commanding and memory buffers on the payload
  - Requesting 30 “campaigns” during which near real time commanding and data downlink is available
  - Data latency outside campaigns may be ~2-4h



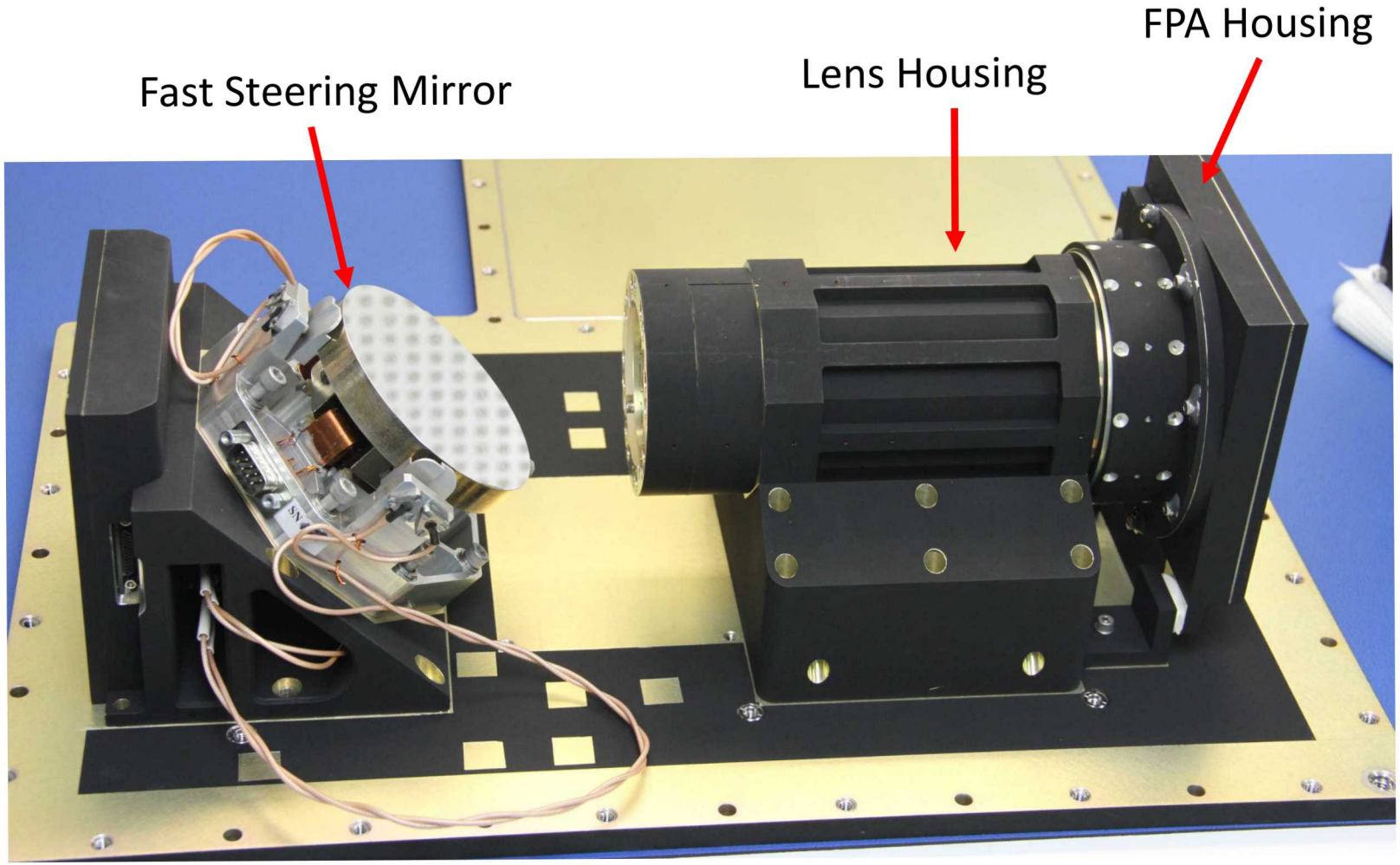


RROE is Integrated on STP-Sat6

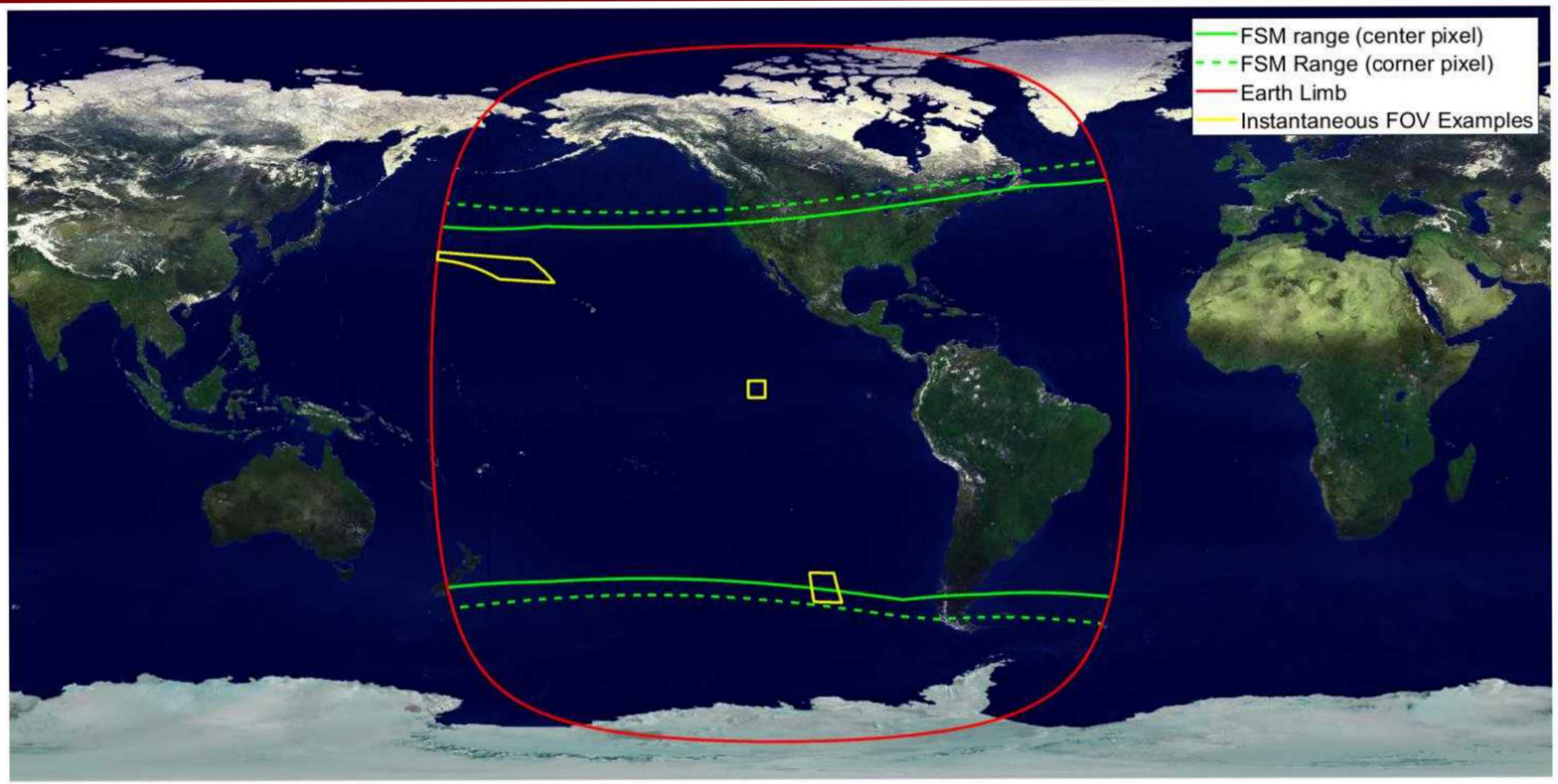


Currently undergoing environmental testing

RROE Optical Assembly

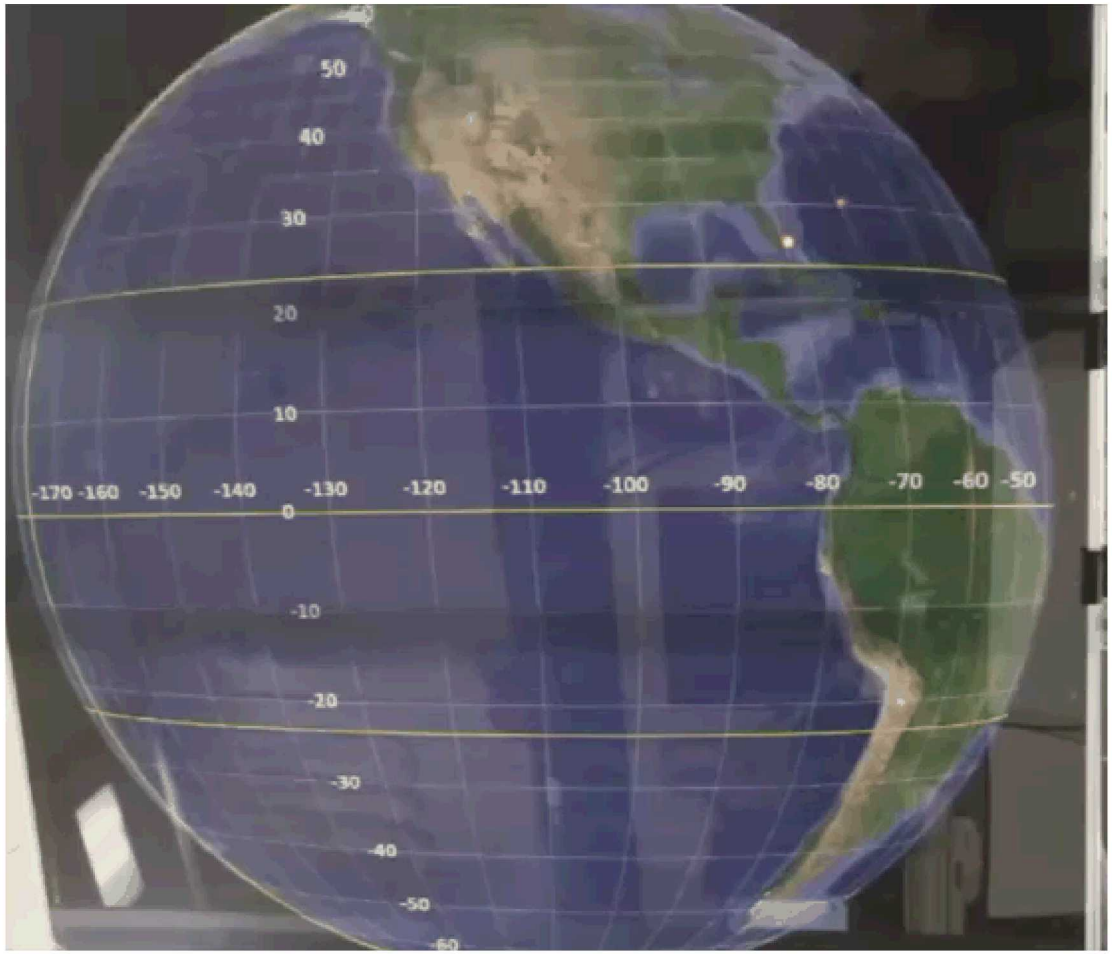


Steering Mirror Coverage



- Steering mirror does not have the range to reach the limb in the N/S direction
- The satellite is capable of body steering to allow RROE to reach high latitude regions. This has impacts to the SV and other payloads, so use will be limited.

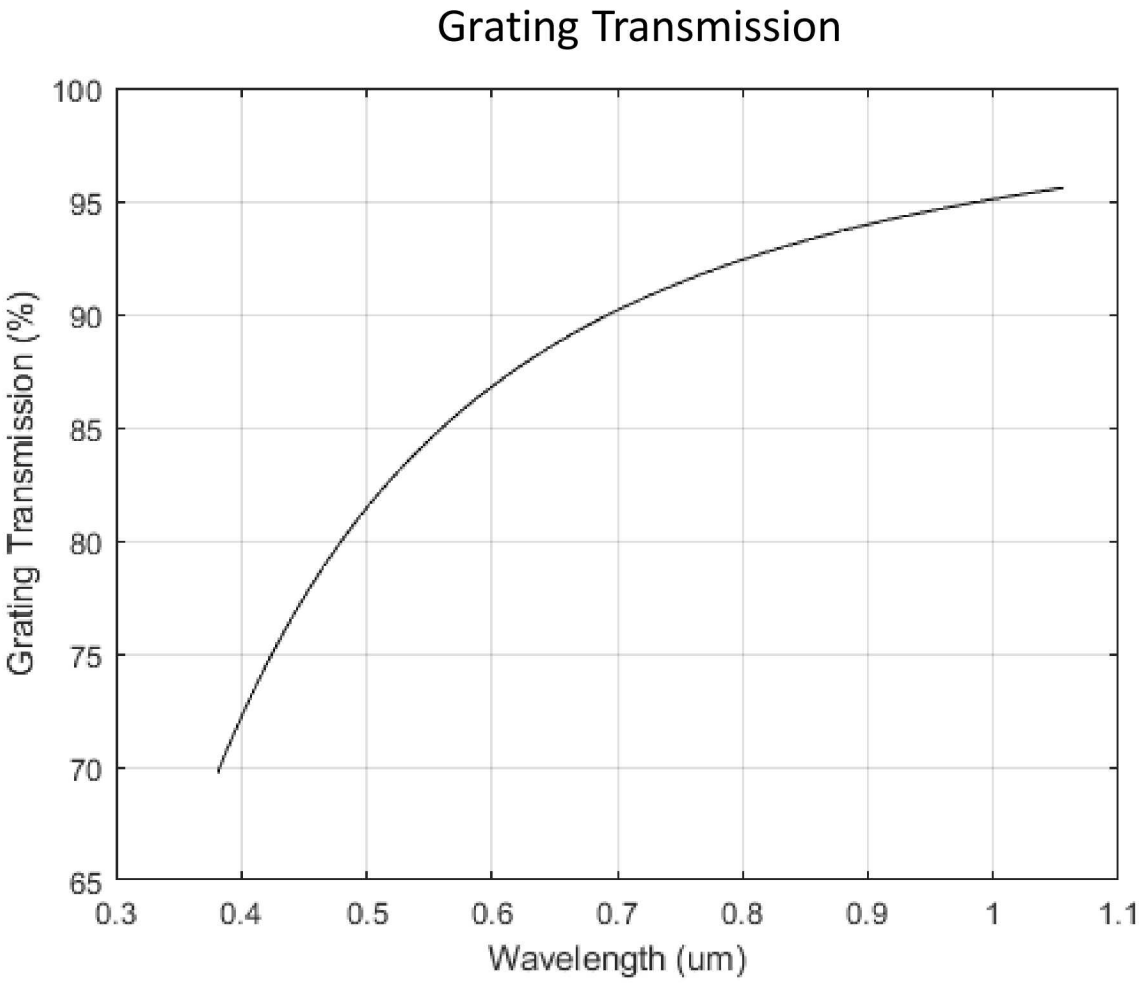
Ground Pointing Calibration and Mirror Lookup Table

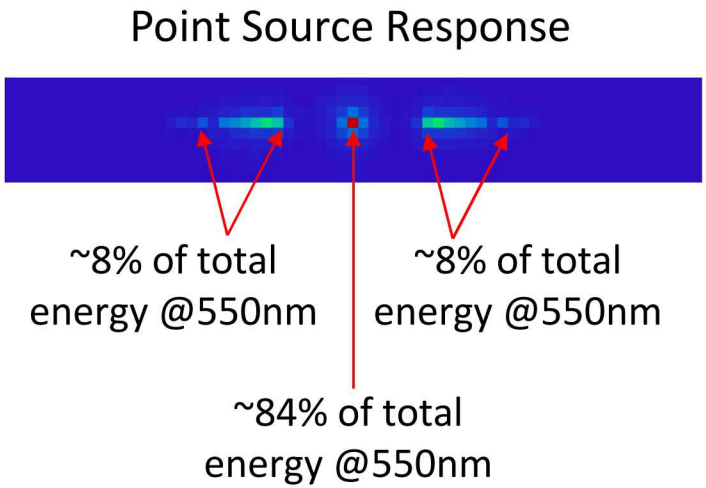


- Printed image of the earth was placed at the correct distance from RROE to match the angular extent from GEO
- Laser was aligned to optical axis and reflected off the steering mirror
- Steering mirror was pointed towards lat/long locations using a lookup table generated from steering mirror calibrations

Steering mirror is used only for position commanding, not for continuous motion or jitter control

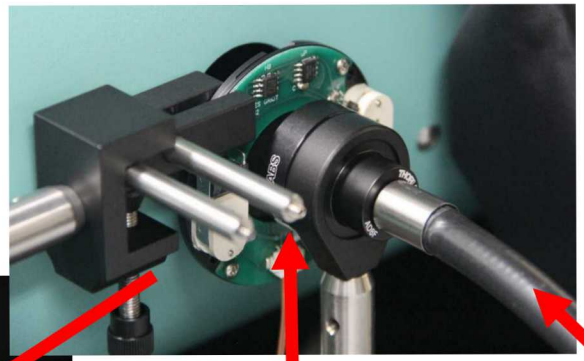
Grating Properties





Grating is fixed in the optical train – always in use

Sensitivity Measurement Configuration



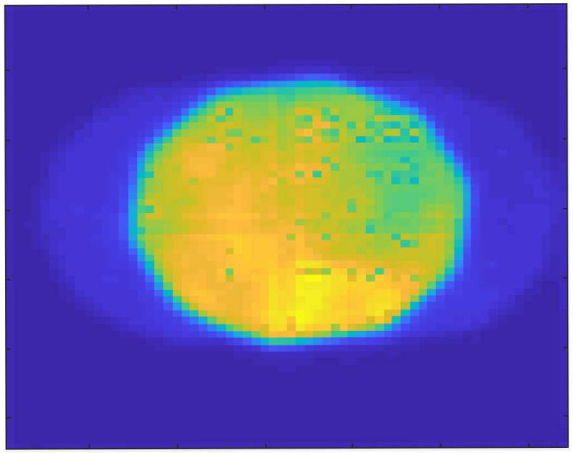
RROE

Collimator

Spectral Filter/Iris

Broadband
Light Source

FPA Frame

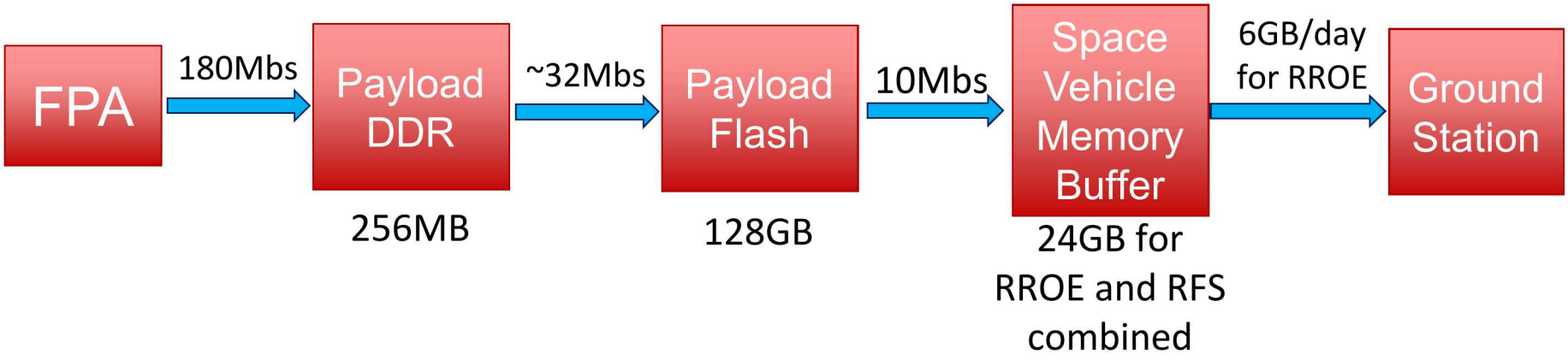


Sensitivity Measurement Results

	400nm	500nm	600nm	700nm	850nm
Measured Signal	28,012	28,996	31,239	35,316	33,536
Modeled Signal	27,265	29,518	31,610	36,201	41,330
% Diff	2.74	-1.77	-1.17	2.44	-18.86

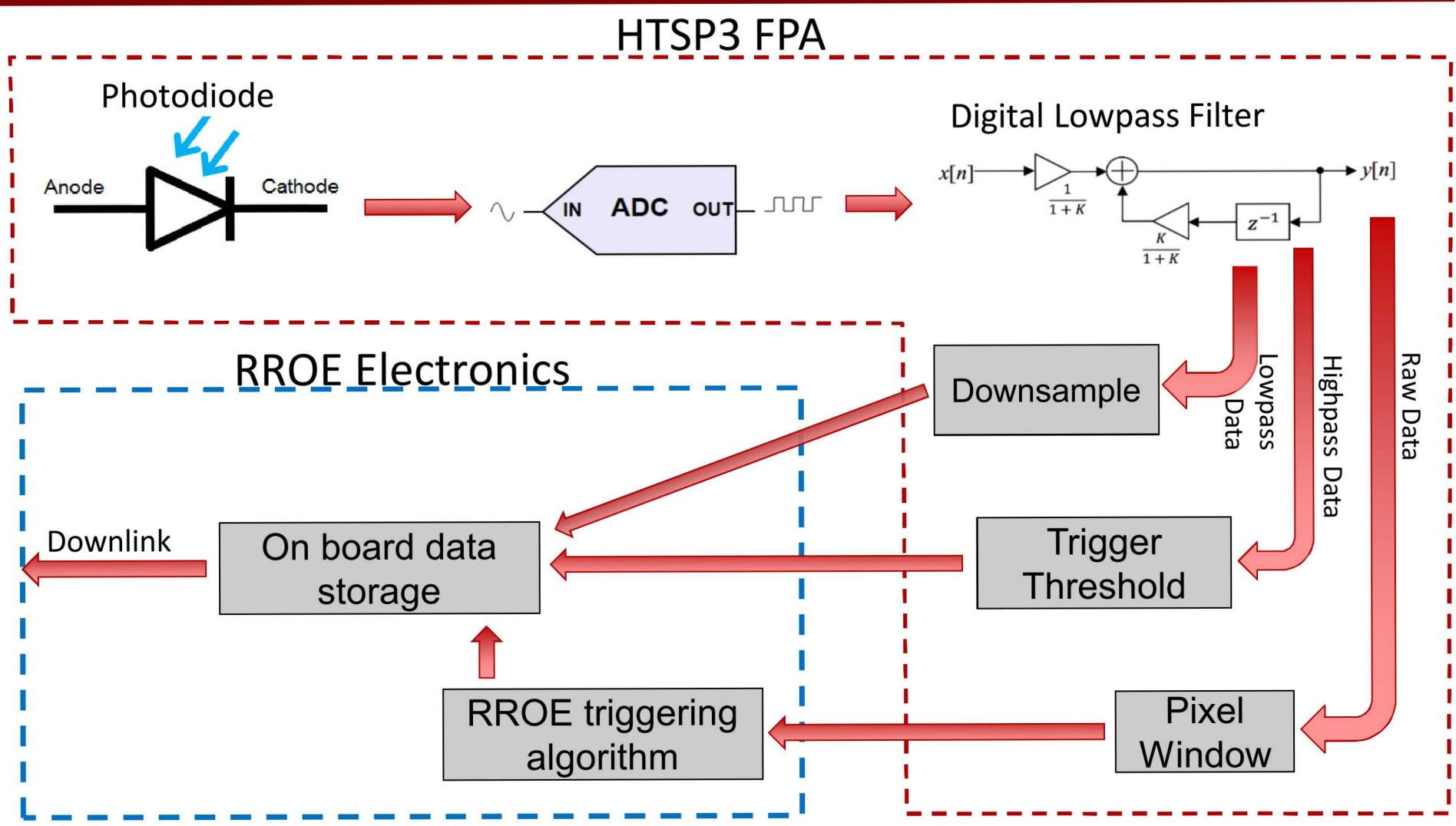
- Measured signal levels from RROE match very well to modeled values from 400-700nm. Comparison yielded more error at 850nm.

RROE Data Path to Ground



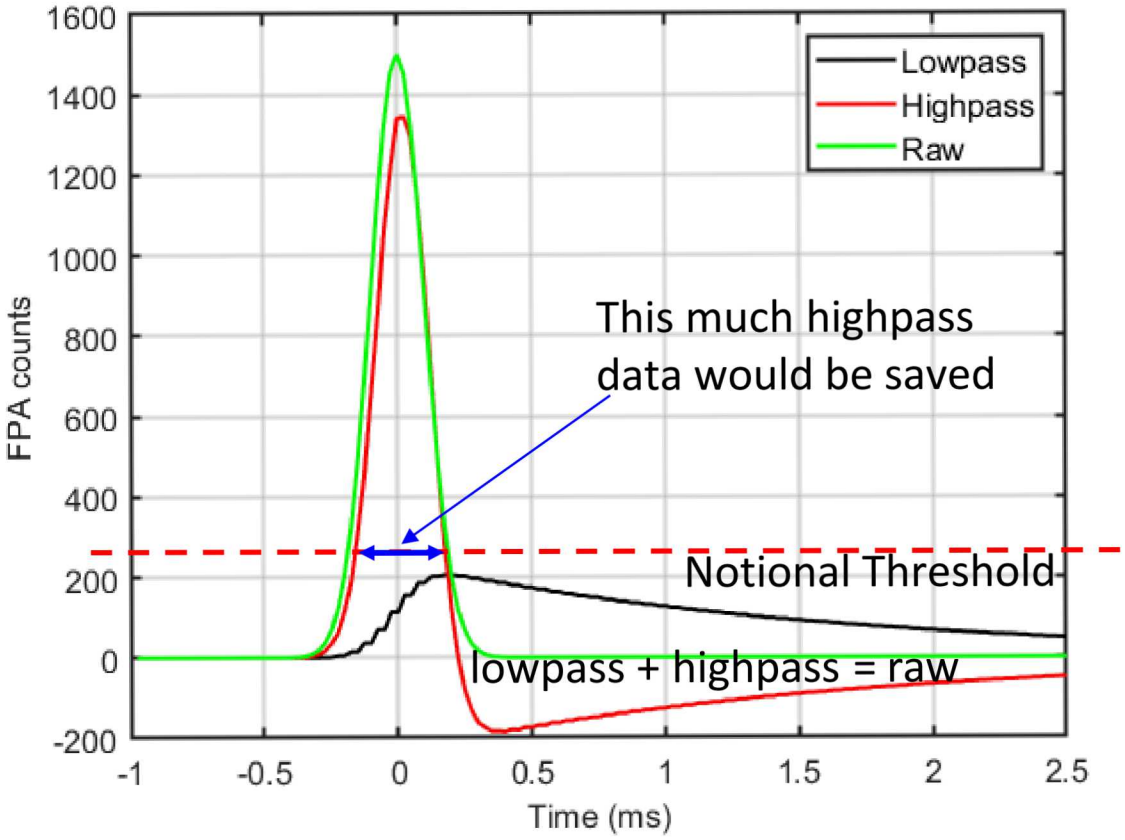
RROE has triggering features that will greatly condense the amount of data being saved compared to maximum continuous data rates

Three Signal Paths Through FPA to RROE Electronics



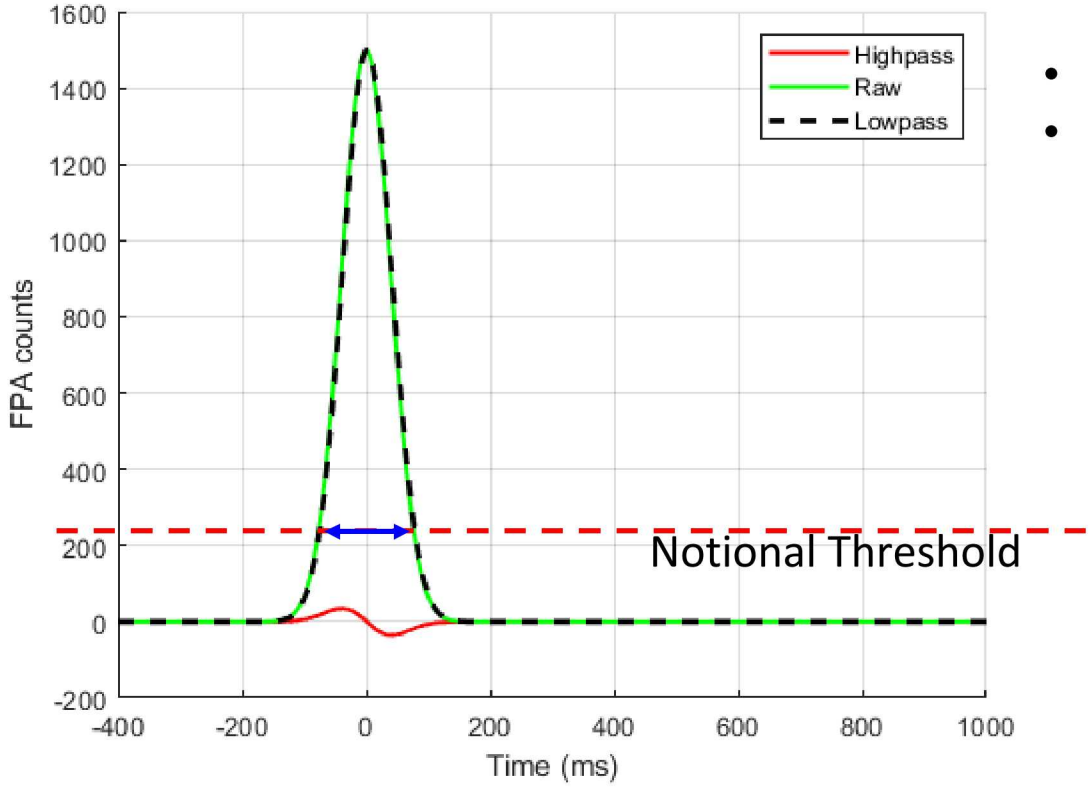
FPA can produce lowpass data simultaneously with highpass **OR** raw windowed data

Simulation of a Fast 0.5 ms Pulse Signal Through FPA



- Pulse width shown is ~0.5ms
- Most of a "fast changing signal" is in the highpass data

FPA Response to a Longer Duration 200 ms Signal



- 200ms pulse width
- Far less of the signal is represented in the highpass data

This signal would not be saved because the highpass signal does not cross the threshold

Data Collection Modes

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Mode	Data Type	Description
Raster scan	Highpass	• Grid of steering mirror locations on the earth (commandable) • Data are collected at each location for a set dwell time
Highpass	Highpass	• Set FPA in highpass triggered mode and save groupings of continuously triggered data into event records
Window	Raw	• Set window and use triggering algorithm implemented in RROE electronics (almost identical to the FPA high-pass algorithm)
Window-force	Raw	• Saves continuous window data without triggering starting at a set point in time for an adjustable duration

Selected software capabilities/commands cont.

Capability	Description
Threshold Tables	For both window and highpass modes each pixel can be assigned one of 4 discrete thresholds.
Pre/Post Cache	Ability to save frames before the first trigger occurs and after the last trigger
Persistence	Event record is started in window and highpass mode only after some number of consecutive frames with triggers occur.
Mirror lookup table	Table lookup of actual optical axis deflection as a function of mirror position command. Can be updated on orbit to account for any pointing error determined from ground calibrations.
Mirror Geo-Location Tables	Can store up to 64 tables of geo-locations that are cycled through in the raster scan collection mode

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THE END

Thank You!

Questions?