Progress in Implementation of the Portable Remote Imaging Spectrometer (PRISM) Coastal Ocean Sensor.

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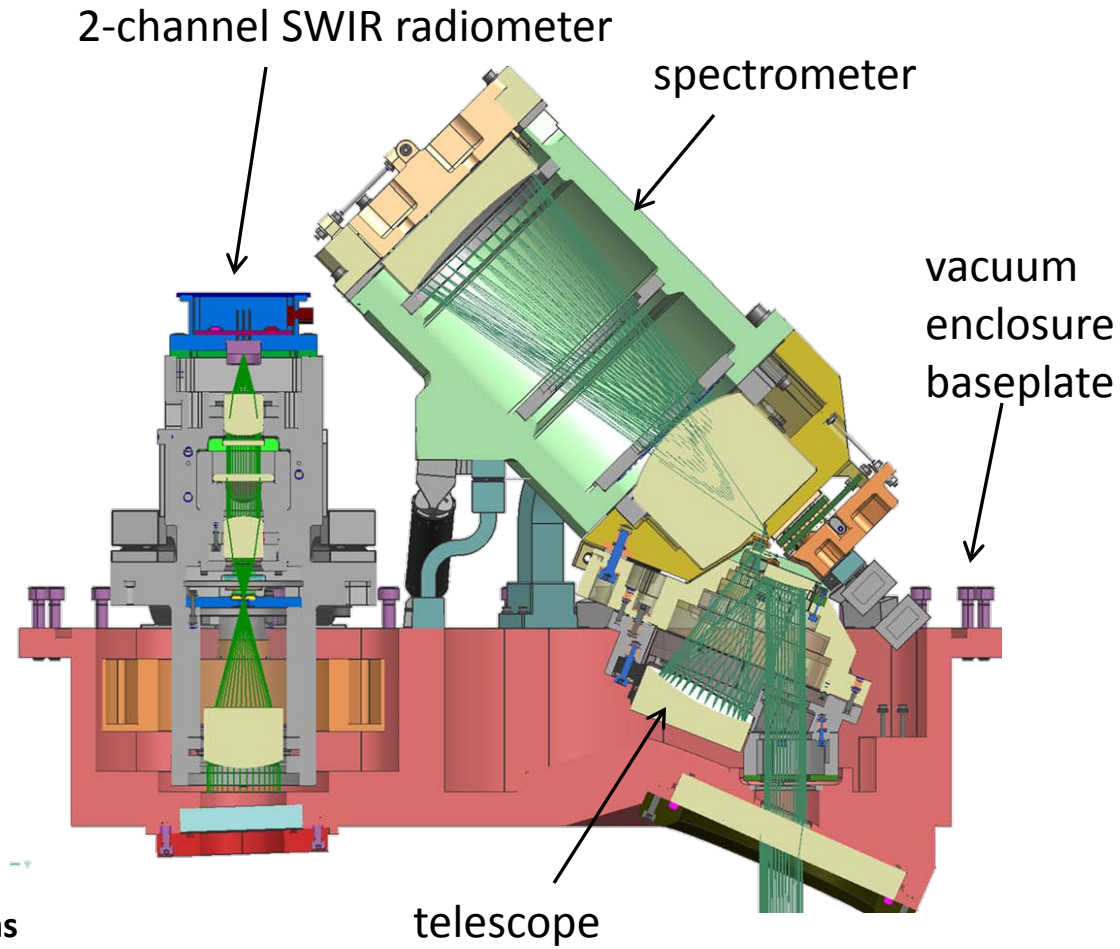
Instrument overview

- Simple and robust airborne pushbroom imaging spectrometer
- 350-1050 nm with extra channels at 1240 and 1610 nm, 33^0 FOV
- Specially designed for the challenges of airborne coastal ocean remote sensing:
  - high dynamic range
  - high SNR for dark water targets
  - high uniformity
  - low polarization sensitivity
  - UV and IR channels



- First flight: 2012
- NASA facility instrument
- Adaptable to multiple airborne platforms

Instrument specifications

PRISM is two instruments integrated into one assembly:
A pushbroom imaging spectrometer and a 2-band spot radiometer ("SWIR channel")

Spectrometer specifications

Spectral	**Range**	**350-1050 nm**
	Sampling	**2.85nm**
Spatial	**Field of view**	**33 deg**
	Instantaneous FOV	**0.95 mrad**
	Spatial swath	**610 pixels**
	Spatial resolution	**0.3 – 20 m**
Radiometric	**Range**	**0 to 75% R**
	SNR	**2000 @450 nm (relative to AVIRIS benchmark)**
	Polarization variation:	**< 2%**
Uniformity	**Spectral cross-track uniformity**	**>95% (straightness and parallelism of monochromatic slit image)**
	Spectral IFOV mixing uniformity	**>95%(straightness and parallelism of point source spectral image)**

Instrument specifications

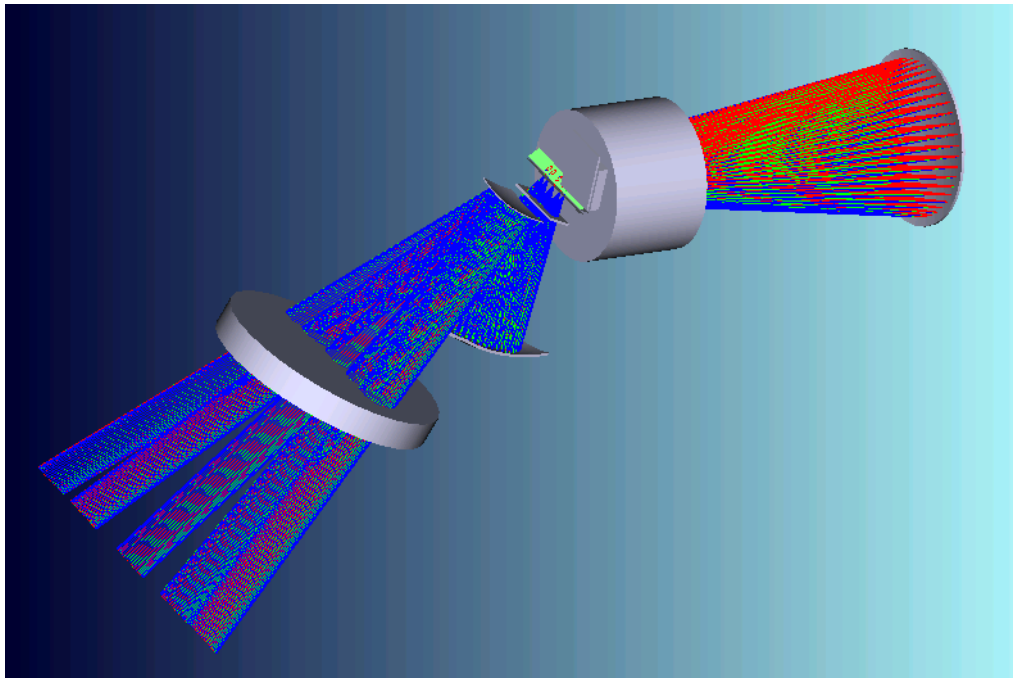
SWIR channel specifications

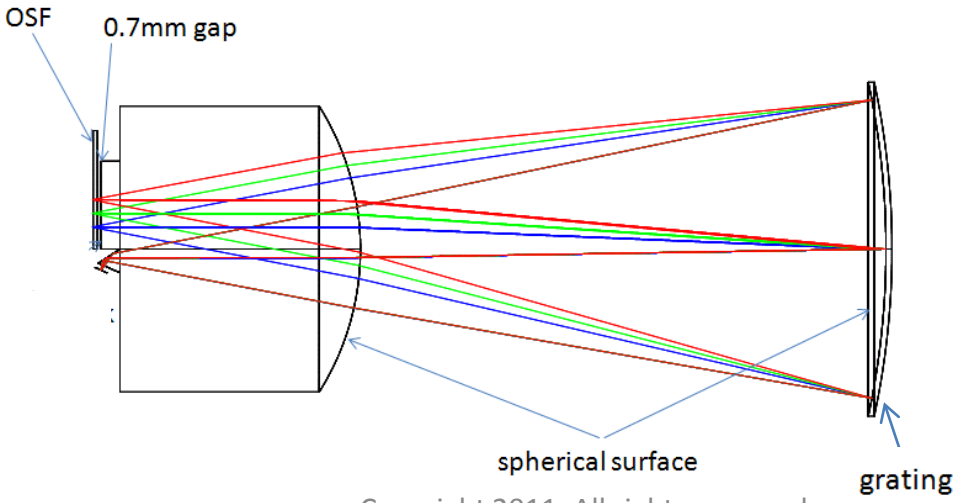
Spectral	**Channel 1 center**	**1240 nm**
	Ch1. bandwidth	**20 nm**
	Channel 2 center	**1610 nm**
	Ch. 2 bandwidth	**60 nm**
Spatial	**FOV/IFOV**	**2x2 PRISM pixels +/-0.1**
Radiometric	**SNR**	**350 @ 0 R, 23 km visibility**

PRISM schedule

SWIR Optomechanical assembly	Oct. 2010
Telescope optomechanical assembly	Oct. 2010
FPA delivery	Nov. 2010
Spectrometer optomechanical assembly	Apr. 2011
Electronics assembly and test	Sep. 2011
Integration into vacuum vessel	Dec. 2011
Ground calibration	Mar. 2012
First calibration flight	Apr. 2012
Science flights	Jun. 2012
Delivery	Sep. 2012

PRISM optical design



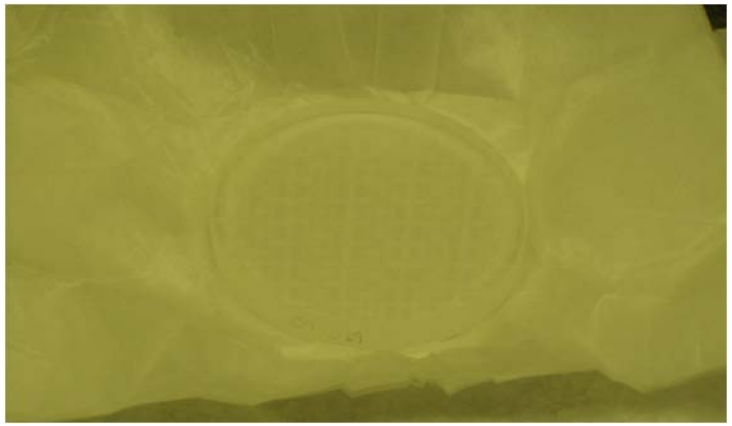


telescope

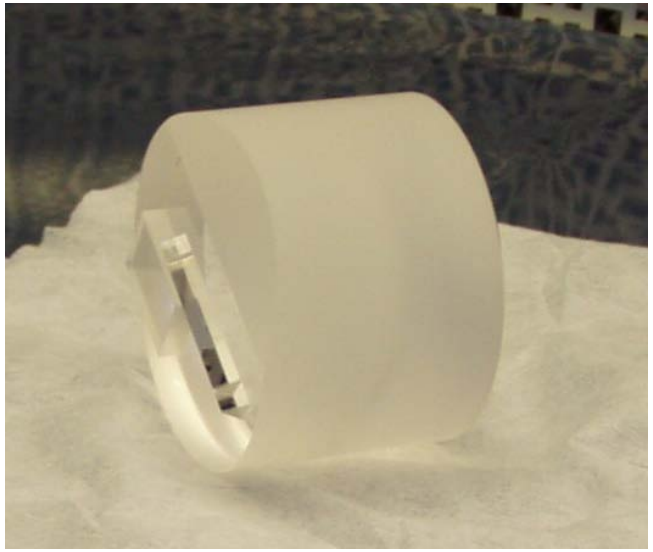
spectrometer

Optical components

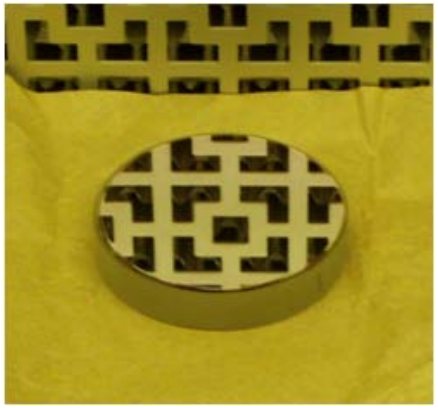
Telescope mirrors



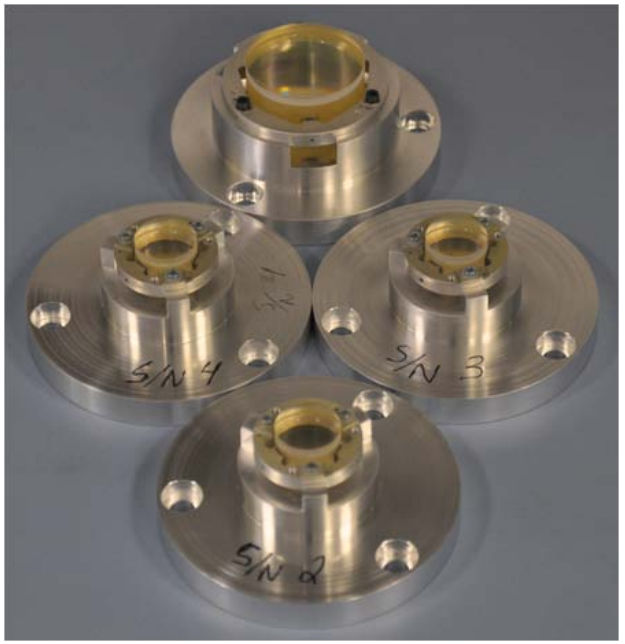
window



Silica block and TIR prism

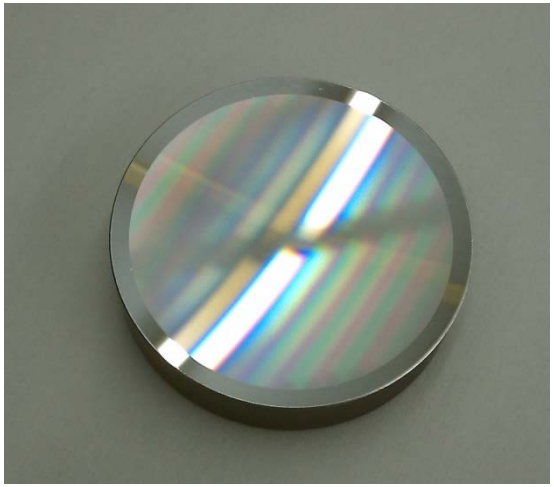


SWIR window

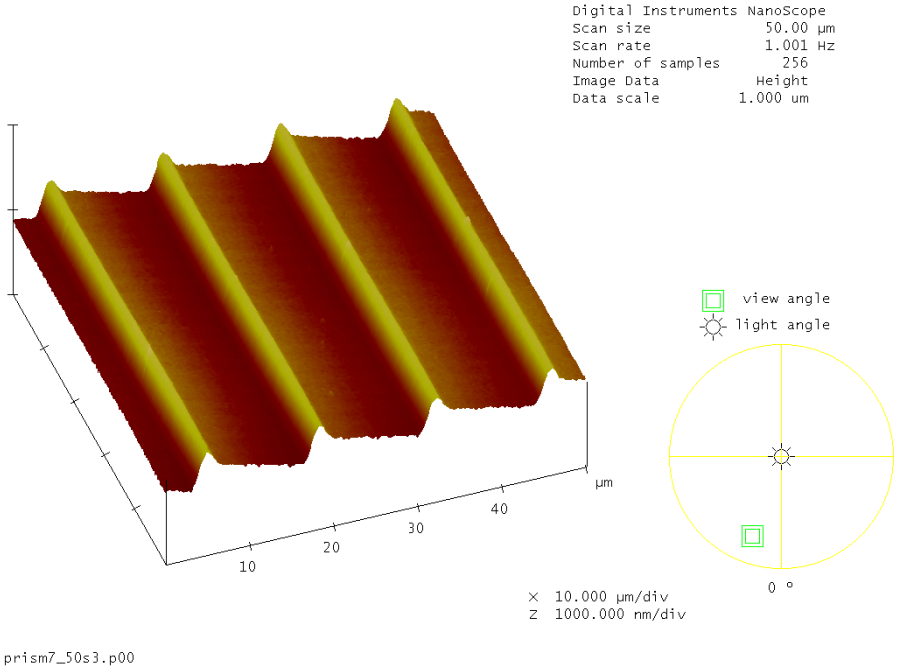


SWIR lenses

Diffraction grating

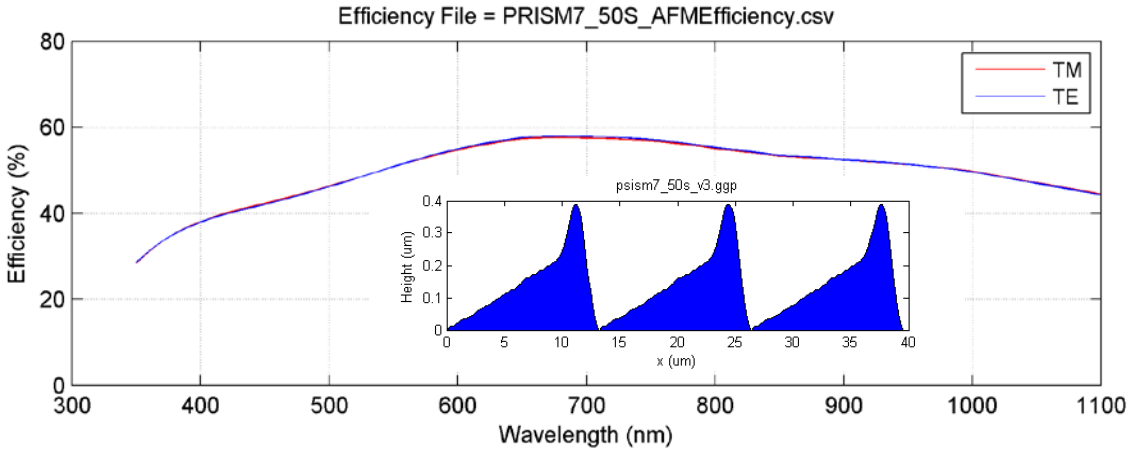


Concave E-beam grating
2.67” diameter

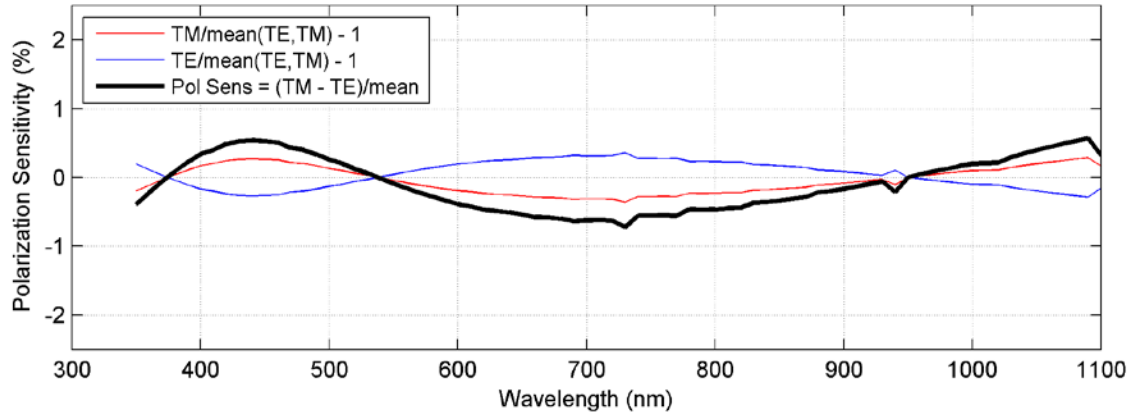


Measured groove profile with atomic force microscope

Diffraction grating

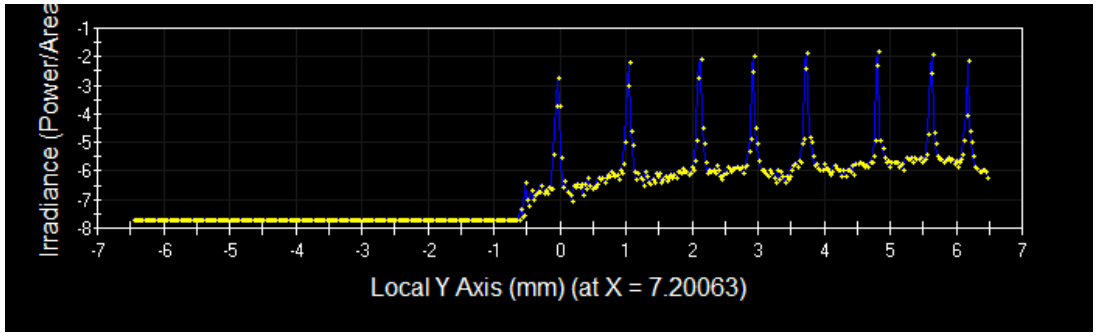


Broadband efficiency

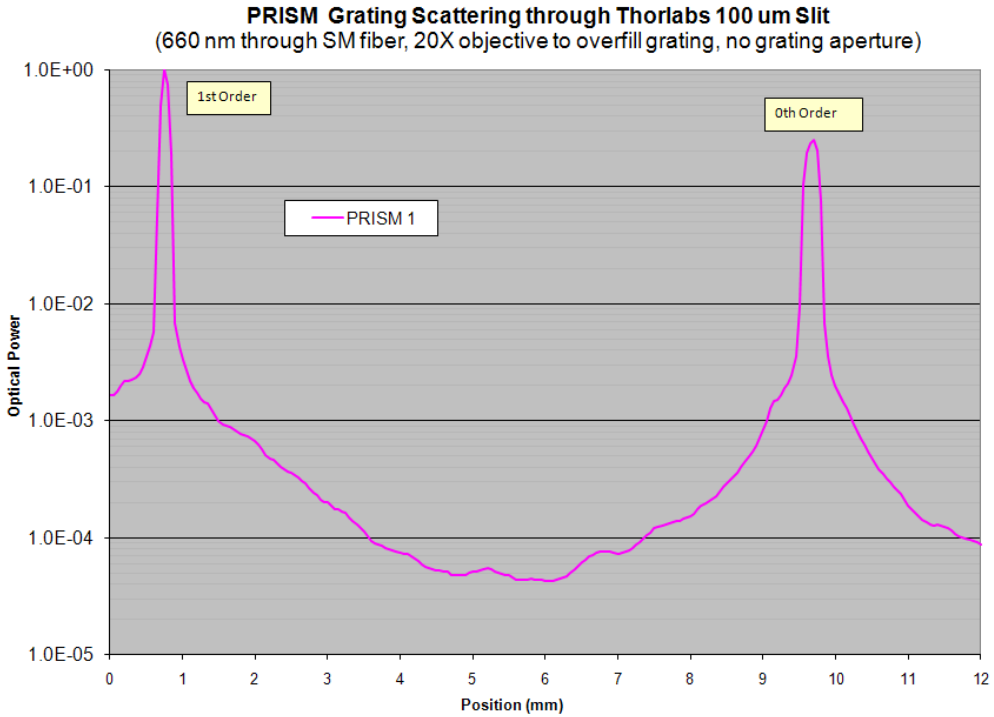


Polarization sensitivity below 1% meets specification.

Stray light control



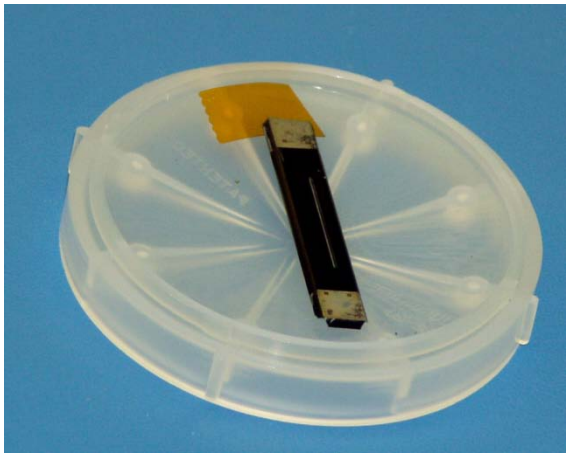
Modeled scatter background of system without grating scatter ~1E-4



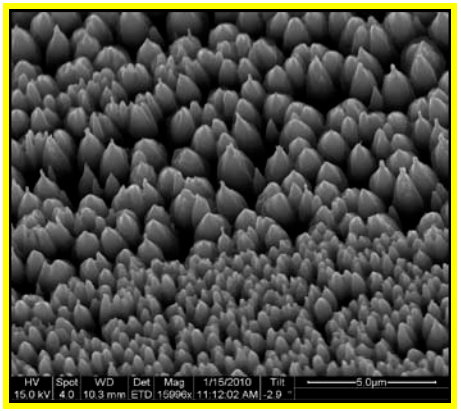
Measured scatter from grating stays well below 1E-3

Stray light control: Absorbing slit substrate

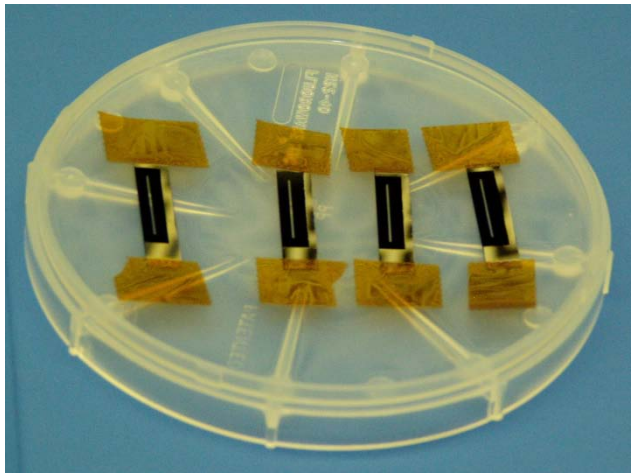
Absorbing slit substrate aids in stray light reduction
(R < 1% vs. gold coating)



Black Si slit delivered

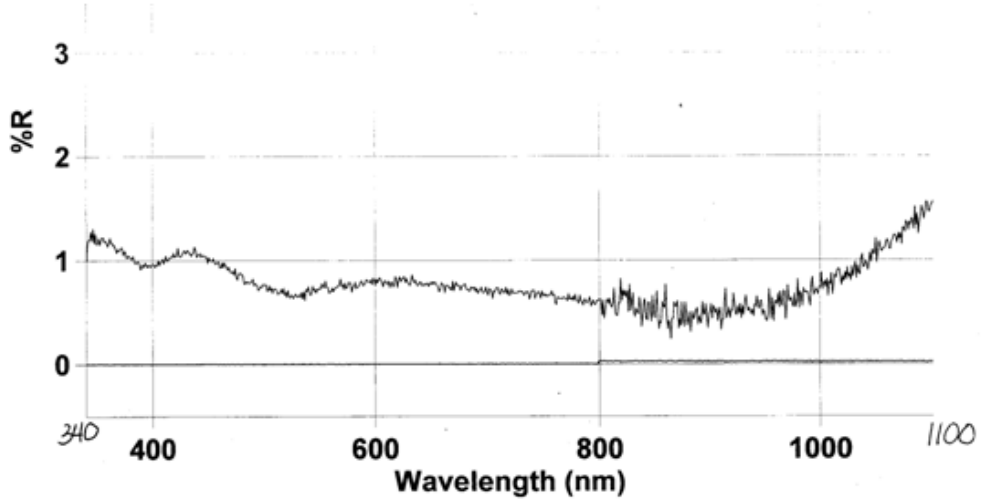


Absorbing subwavelength structure formed on Si



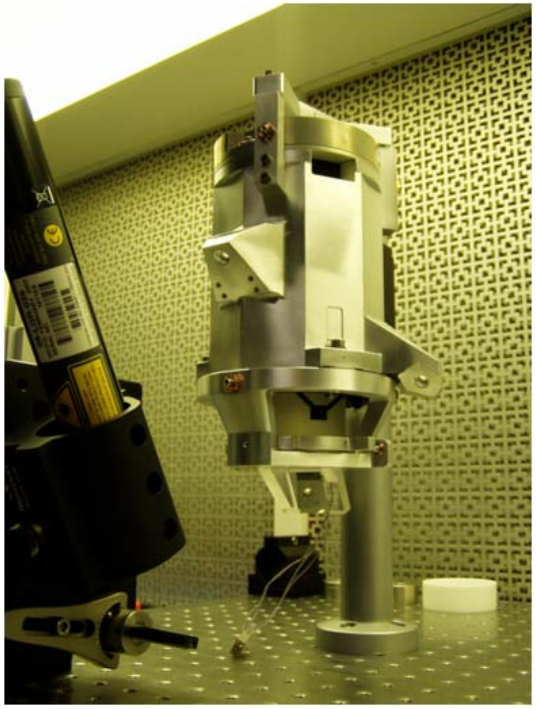
Black Si baffles for bonding to the Au-coated side of the slit

Stray light control



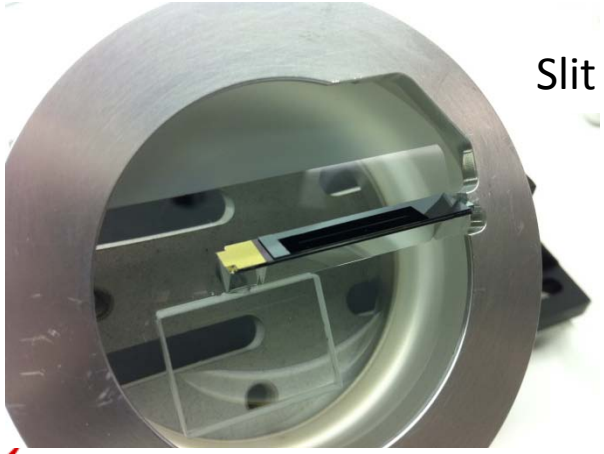
Measured A/R coating performance of delivered spectrometer optical parts exceeds specification (JML Optics).

Optomechanical assemblies

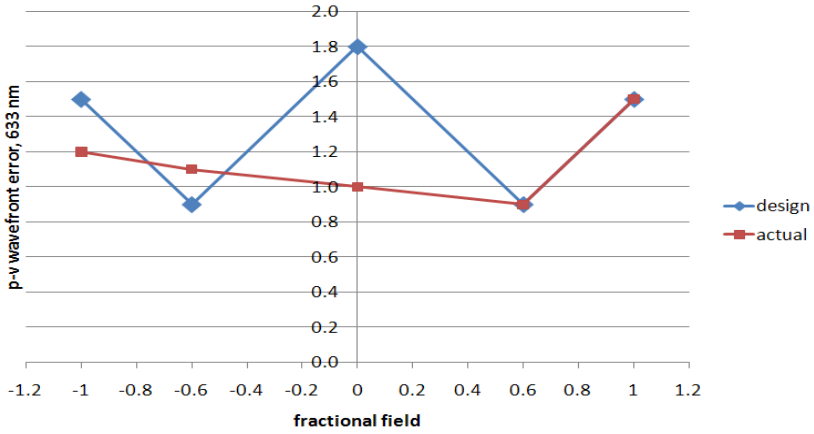


Spectrometer during alignment

SWIR telescope and relays

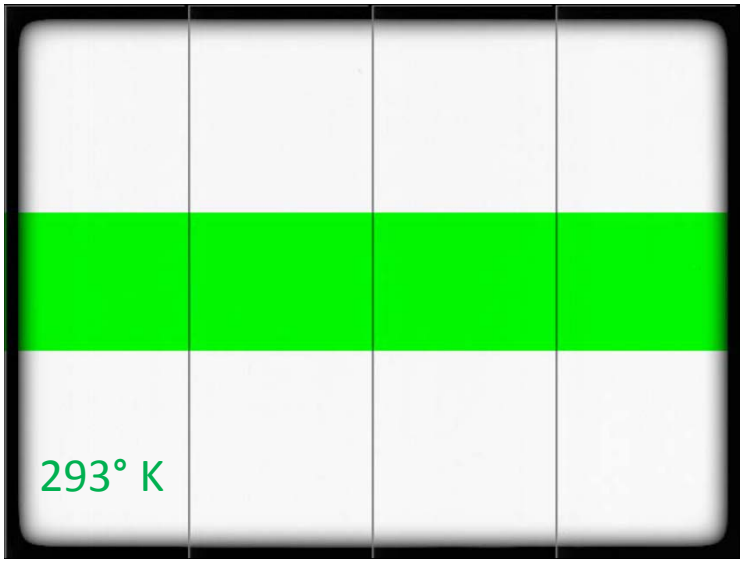


Slit assembly

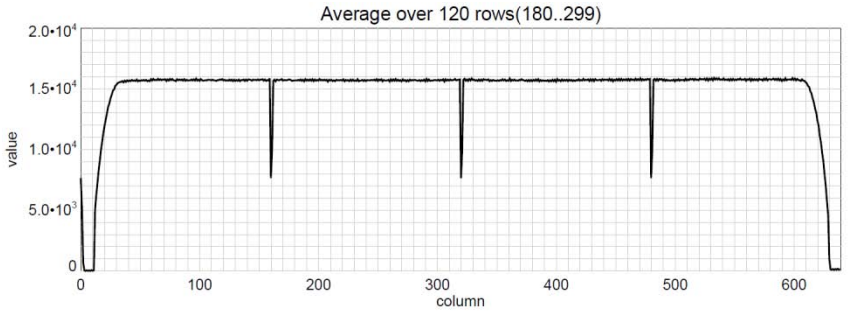


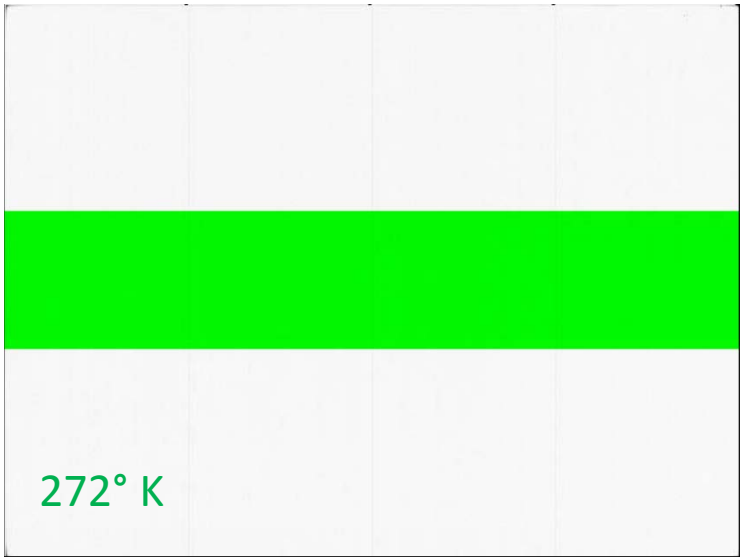
Telescope measured wavefront error

FPA / electronics characterization

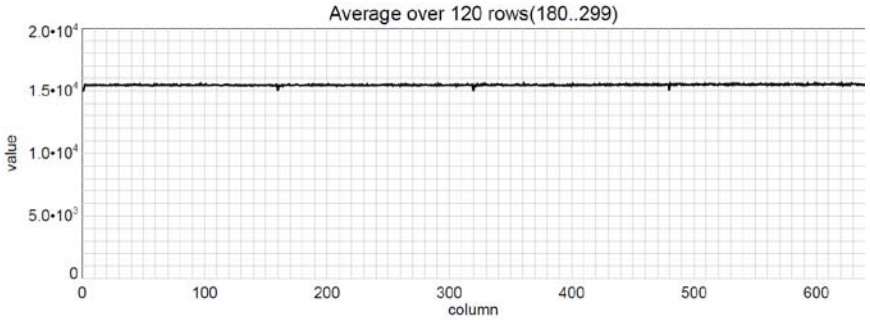


Dark subtracted flat field frame @ 293° K. Edge pixel dark current renders ~ 25 pixels around edges of the array unusable.

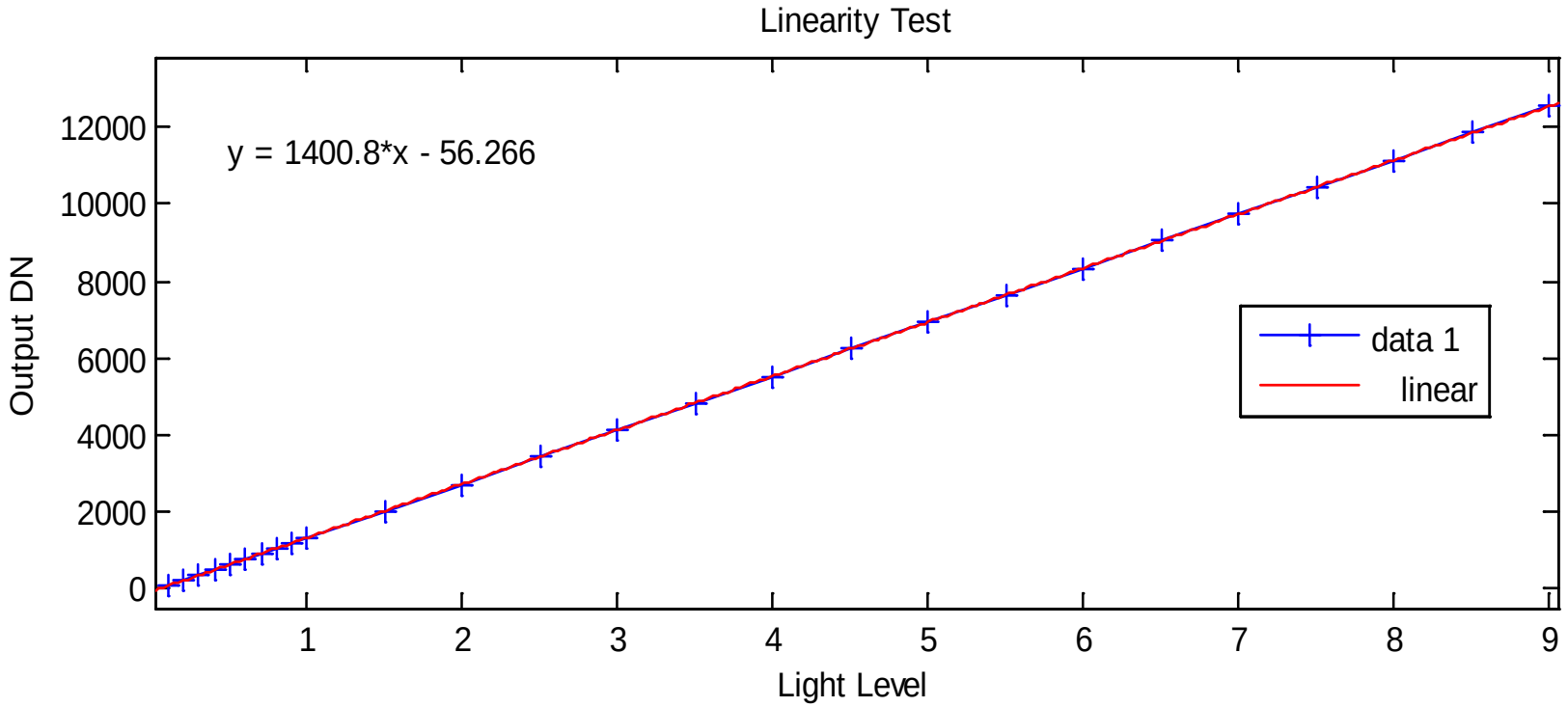




Dark subtracted flat field frame @ 272° K. Edge pixel dark current effects around the edges of the array is negligble.

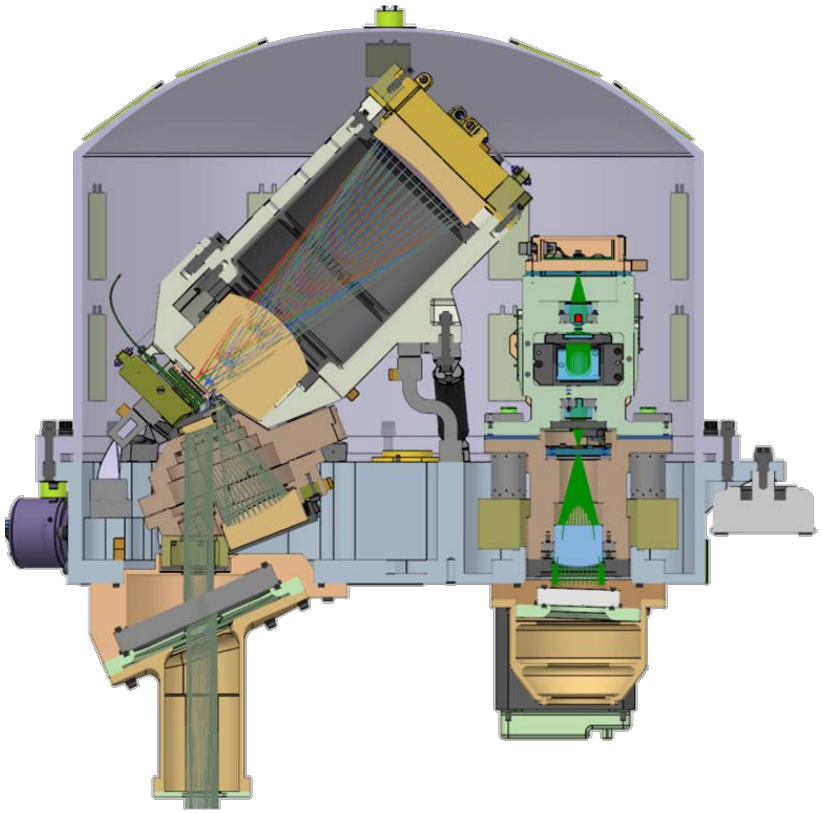


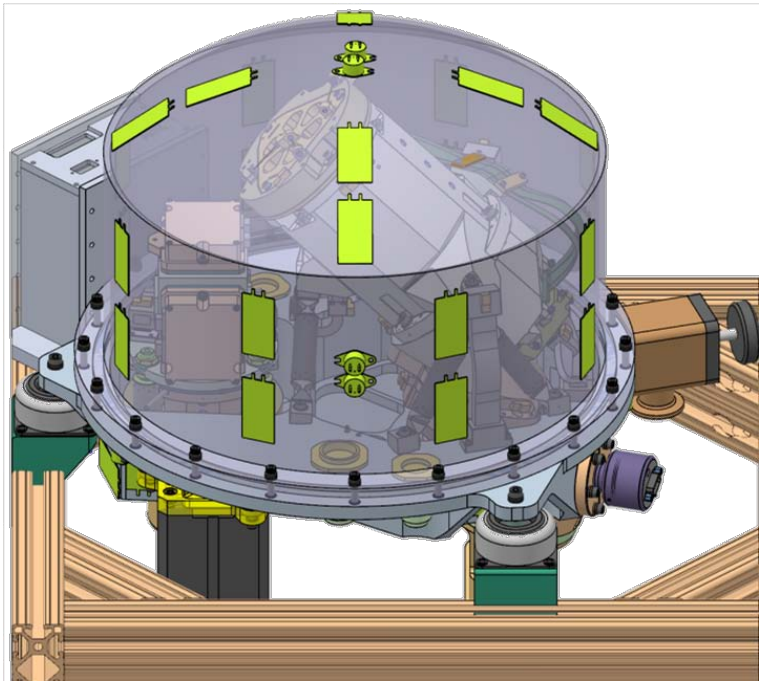
FPA / electronics characterization



Detector linearity test result. A small correction will be required to bring the response into the specified 99% linear range.

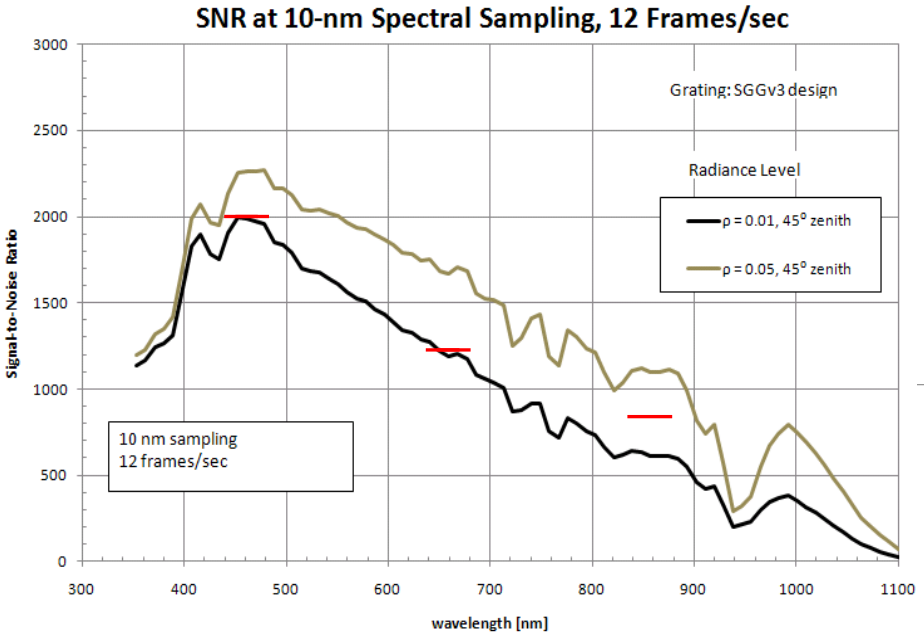
Vacuum enclosure design



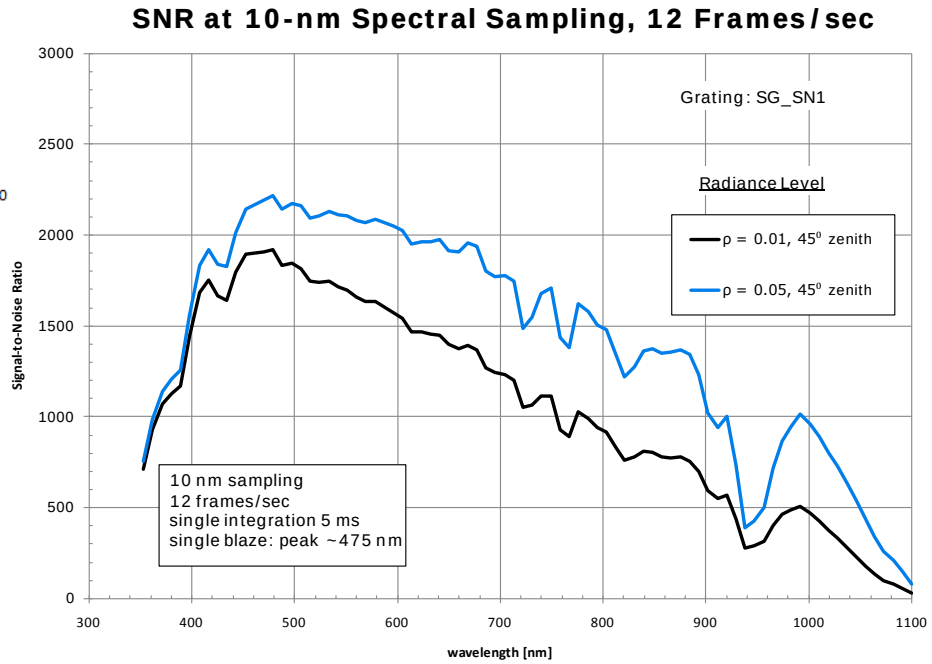


PRISM operates in a thermally controlled vacuum enclosure for additional stability in flight.

SNR model



Prediction at Design Review



Current Prediction

Conclusions

- PRISM development is proceeding on schedule and with few surprises
- Components meet their specifications
- Spectrometer assembly passed focus/light path geometry test
- Detector edge pixel dark current will necessitate a lower operating temperature but can be handled with existing control system.
- PRISM should be a valuable addition to NASA's coastal ocean monitoring tools, enabling high spatial and temporal resolution measurements.