VIIRS FU-1 Pre-launch Calibration and Characterization

NPP Instrument Calibration Support Team/Element (NICST/E)

VIIRS/MODIS Science Teams Meeting
Hilton BWI Airport
May 15, 2008

References

- List of Ambient Phase I, II, and III Test Data
  - Test IDs and Names; Data Collected/Processed
- List of NICST Data Analysis Reports
  - Name: NICST_REPORT_YR_###q (q for quick report)
  - Subject and Date Released
- List of NICST Technical Memos
  - Name: NICST_MEMO_YR_###
  - Subject and Date Released

All NICST reports and memos are available from e-room

VIIRS Ambient Radiometric Calibration and Characterization (RC-01)

Objectives: characterize sensor radiometric response/gain, dynamic range, SNR/NEdT, and dual gain transition

RC-01 Part 1 for Thermal Emissive Bands
RC-01 Part 2 for Reflective Solar Bands
RC-01 Part 3 for DNB
RC-01 Part 4 for Dual Gain Transitions

STR-504, 506, and 508

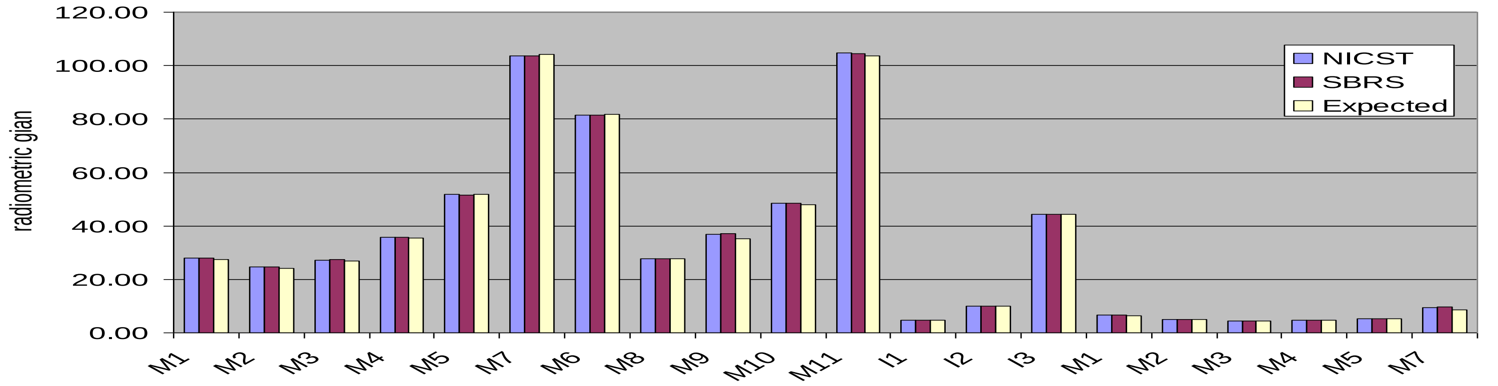
Radiometric Calibration Summary (RC-01)

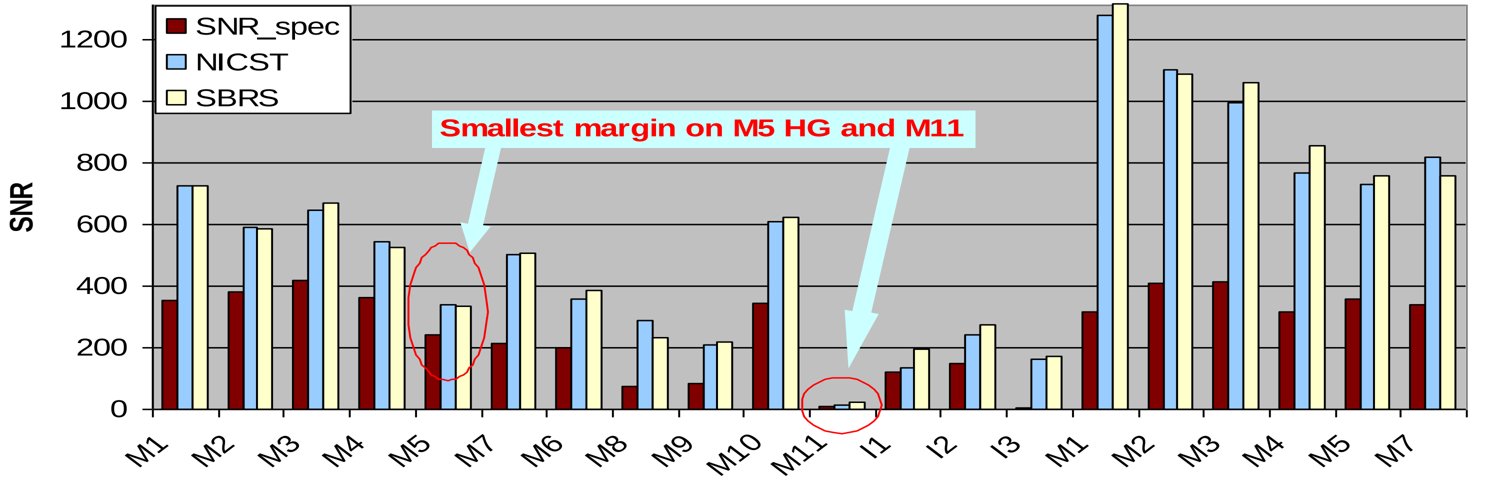
- All detectors meet the SNR/NEdT requirements (specified at typical radiance/temperature)
  - M12 D1 is out-of-family (OOF)
- Most spectral bands meet the dynamic range requirements
  - Exceptions: M8 (HG), M1 (LG), and M2 (LG)
- Most dual gain bands meet the gain switching requirements
  - Exception: M1 (HG to LG)

RC-1 provides initial ambient baseline performance information

RC-2 and RC-5 in TVAC will provide final verification of sensor performance

RSB Gains and SNR

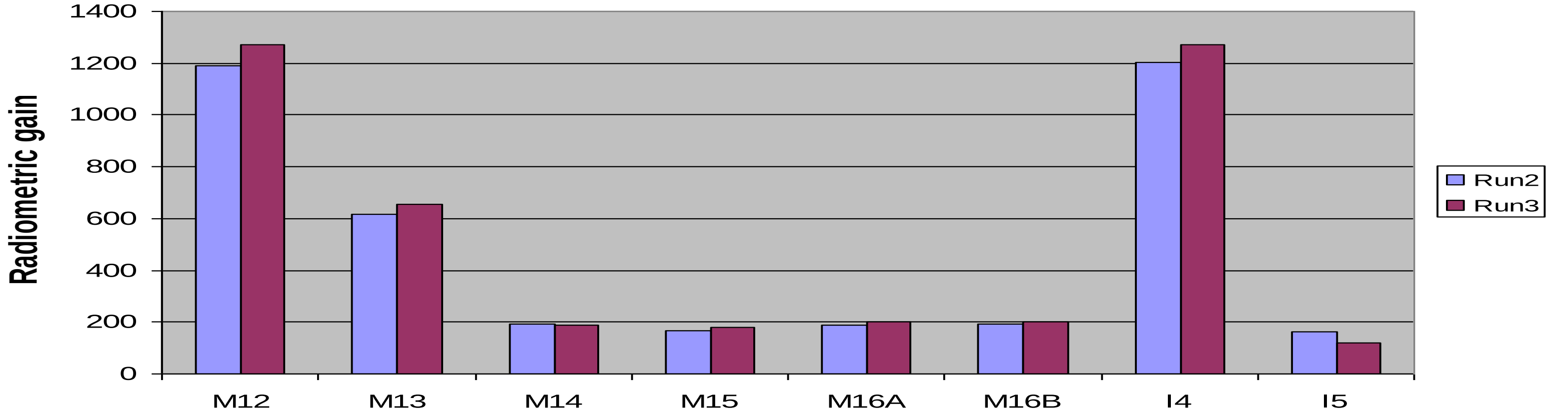


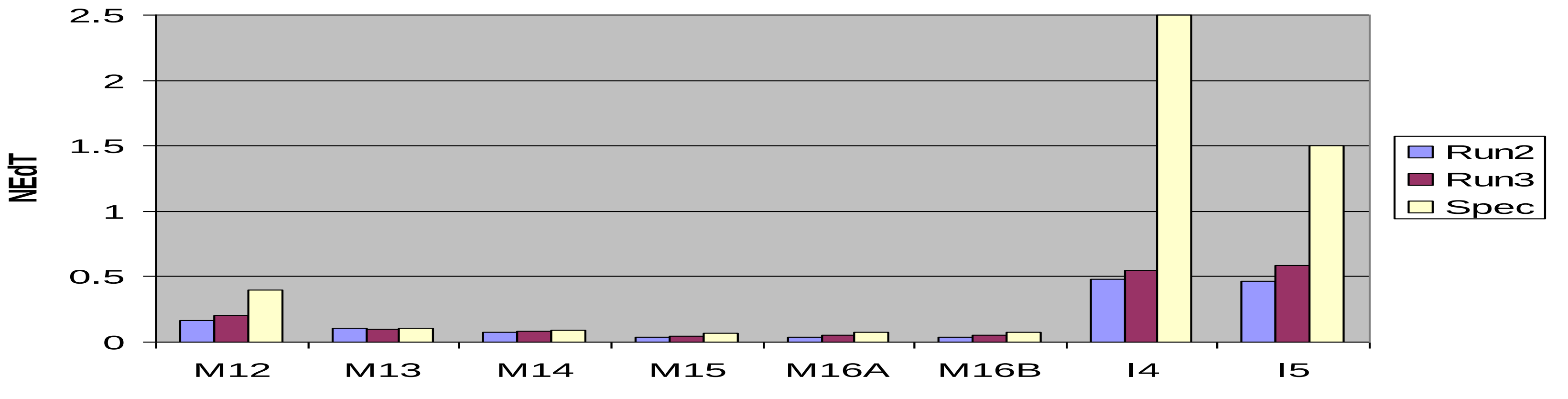


Measured SNR for all VIIRS RSB bands meet the specified requirements at Ltyp

(Expected values from Y23503; SBRS gains from Y23579)

TEB Gains and NEdT

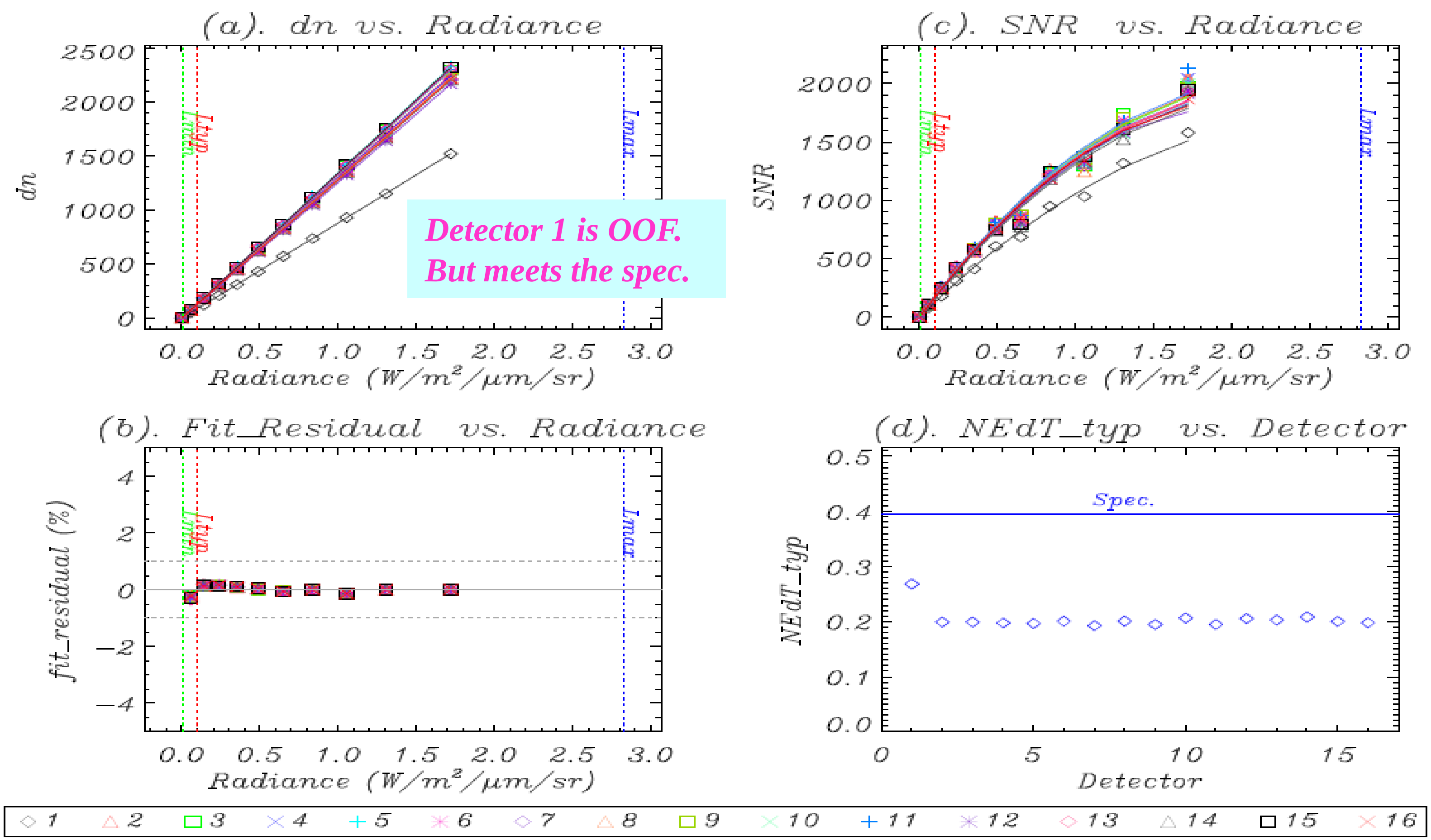




Run 2 CFPA set at 79.2K
Run 3 CFPA set at 81.6K

A few detectors failed SNR/NEdT in run3 (det. 2, 9, 16 of M14; det. 8 of M16A)

OOF Detector: M12 D1



Dynamic Range Compliance HAM A ASP A

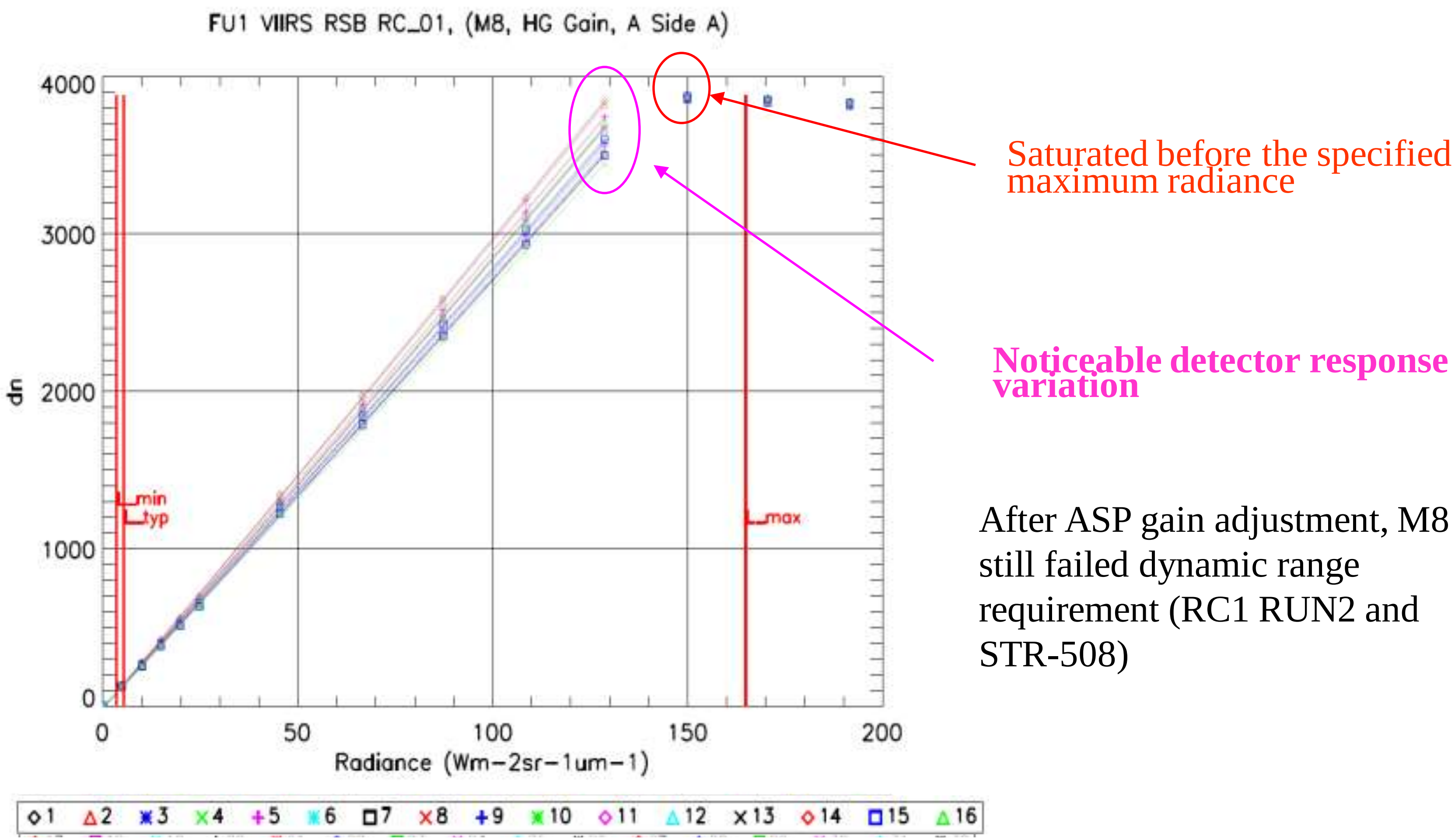
Gain state	Band	dn_sat/ dn_Lmax	dn_tran/ dn_Lmax
HG	M1	1.08	0.9
HG	M2	1.11	1.09
HG	M3	1.2	1.16
HG	M4	1.26	1.2
HG	M5	1.13	1.1
HG	M7	1.17	1.13
HG	M6	1.06	--
HG	M8	0.8	--
HG	M9	1.45	--
HG	M10	1.22	--
HG	M11	1.14	--
HG	I1	1	--
HG	I2	1	--
HG	I3	1.01	--
LG	M1	0.86	--
LG	M2	0.99	--
LG	M3	1.07	--
LG	M4	1.1	--
LG	M5	1.07	--
HG	M12	1.18	
HG	M13	1.47	
HG	I4	1	
HG	M14	3.67	
HG	M15	2.38	
HG	M16A	2.7	
HG	M16A	2.71	
HG	I5	5.54	
LG	M13	1.31	

from Y23656

SRV0465: RSB Dual Gain Band's High/Low gain transition within +20.0% to 0.0% of spec.

SRV0468: TEB Dual Gain Band's High/Low gain transition within +5.0K to 0.0K of spec. (M13: 343-348K)

M8 Did Not Meet Dynamic Range Requirement



After ASP gain adjustment, M8 still failed dynamic range requirement (RC1 RUN2 and STR-508)

Concerns (Ambient RC-01)

- SIS100 stability impact on radiometric calibration
- IFA filter leak: red leakage through M1 filter could be 16% of M1 RC-1 signal, causing the gain to be over estimated (from NGST)
- SWIR bands M8, M9 and M11 had relatively large detector gain variations
- Most dual gain bands had large noisy behavior at their gain transitions (to be verified from new test)

- Path forward: Better characterize SIS monitor and make sure it works

RC-1 provides initial ambient baseline performance information
RC-2 and RC-5 in TVAC will provide final verification of sensor performance

Response Versus Scan-angle (RVS) Characterization (FP-10)

Objectives: characterize RSB response versus scan angles (RVS); characterize TEB response versus scan angles (RVS)

FP-10 Part 1 for RSB
FP-10 Part 2 for TEB

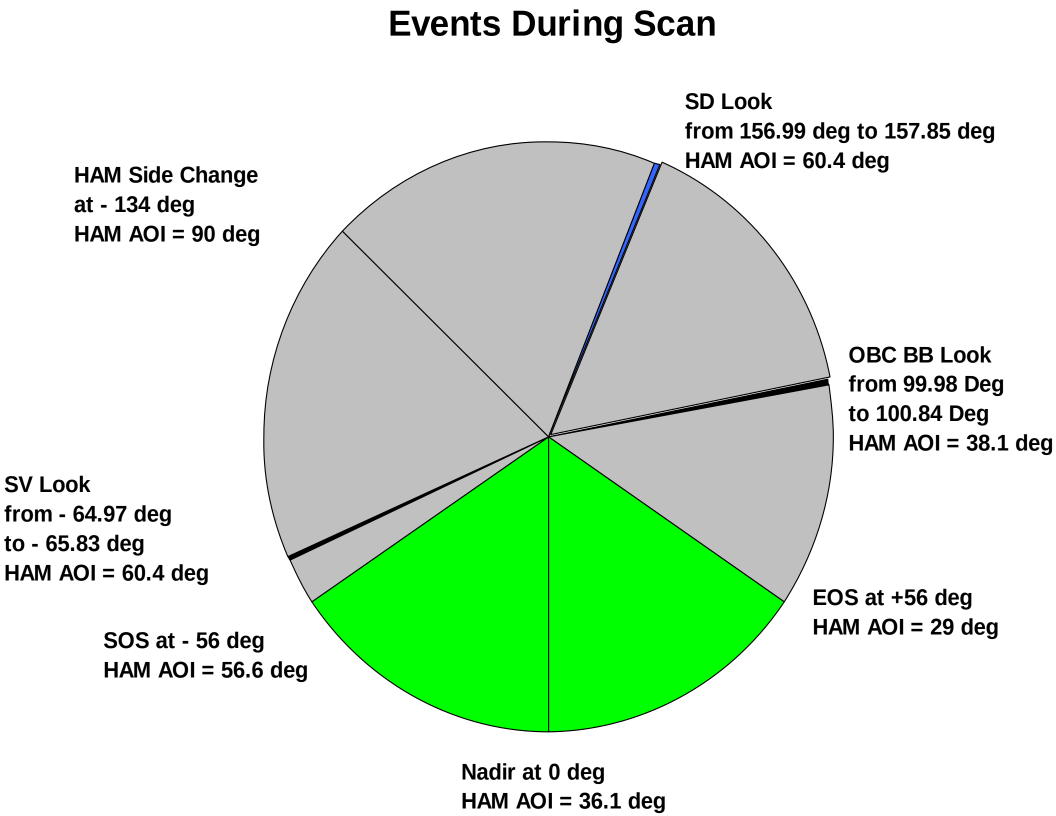
RVS Characterization Summary (FP-10)

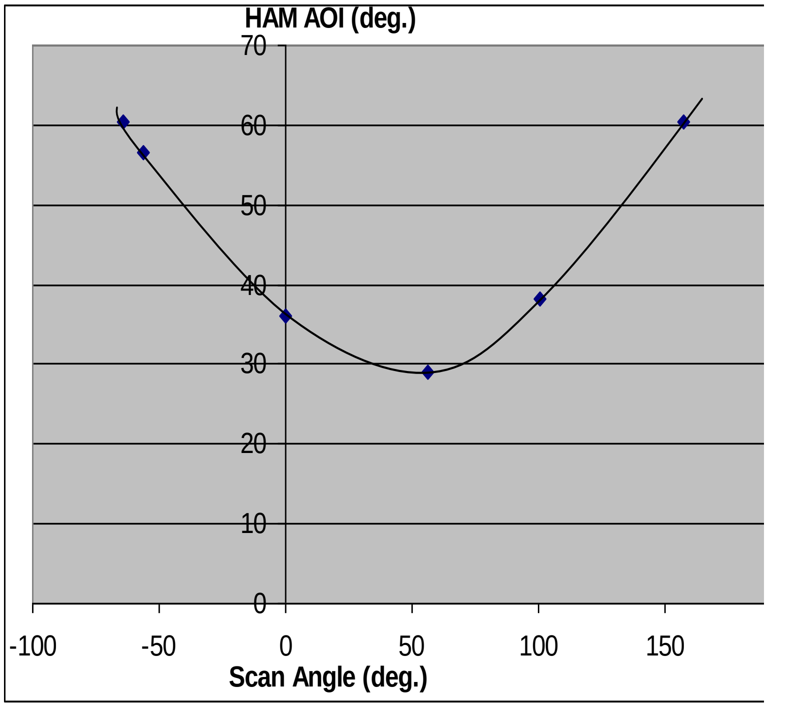
- RSB RVS characterization meet the requirements (agree with SBRS results)
- TEB RVS characterization meet the requirements (agree with SBRS results)

PVP 4.2.2.4.2 Characterize normalized RVS of RSB bands over full earth view scan to 0.3% or better (Pre-launch: 0.27%; change over life: 0.1%).

PVP 4.2.2.4.3 Characterize normalized RVS of TEB bands over full earth view scan to 0.2% (0.6% for M14) or better (Pre-launch 0.17% (0.57% for M14); change over life: 0.1%).

VIIRS Scan Angles and AOI



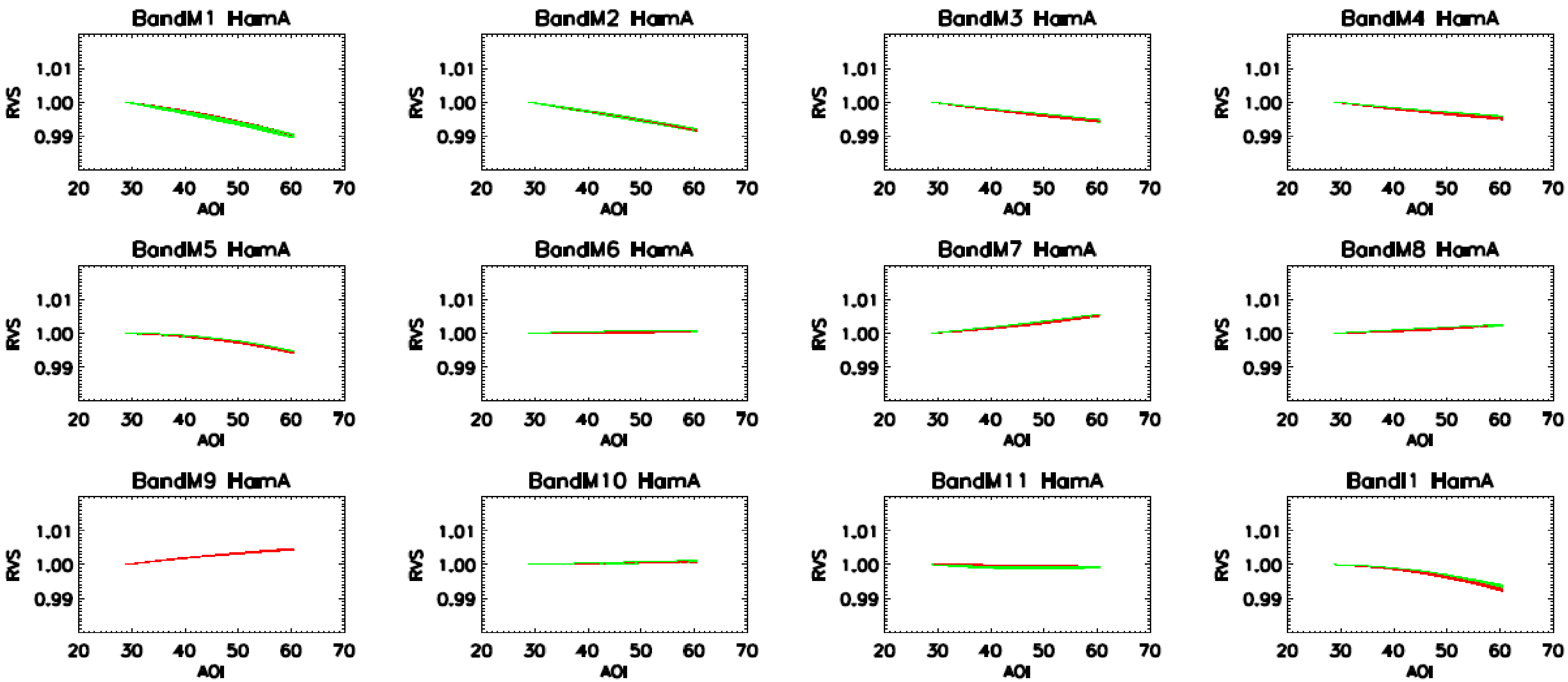


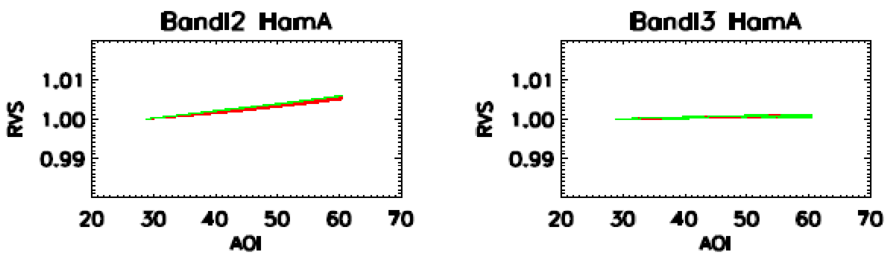
RVS Data Collection

- FP-10 Part 1
  - RSB bands: 12 discrete scan angles: -65.4^o, -55.5^o, -51^o, -45^o, -38^o, -30^o, -20^o, -8^o, 6^o, 22^o, 38^o, 55.5^o.
  - SIS100 radiance monitor data collected
  - Relative humidity and temperature monitored

- FP-10 Part 2
  - TEB bands: 12 distinct scan angles: -65.7^o, -60.6, -55.5^o, -51^o, -45^o, -38^o, -30^o, -20^o, -8^o, 6^o, 22^o, 35^o
  - CFPA controlled using BTC
  - LABB and OBC BB data collected

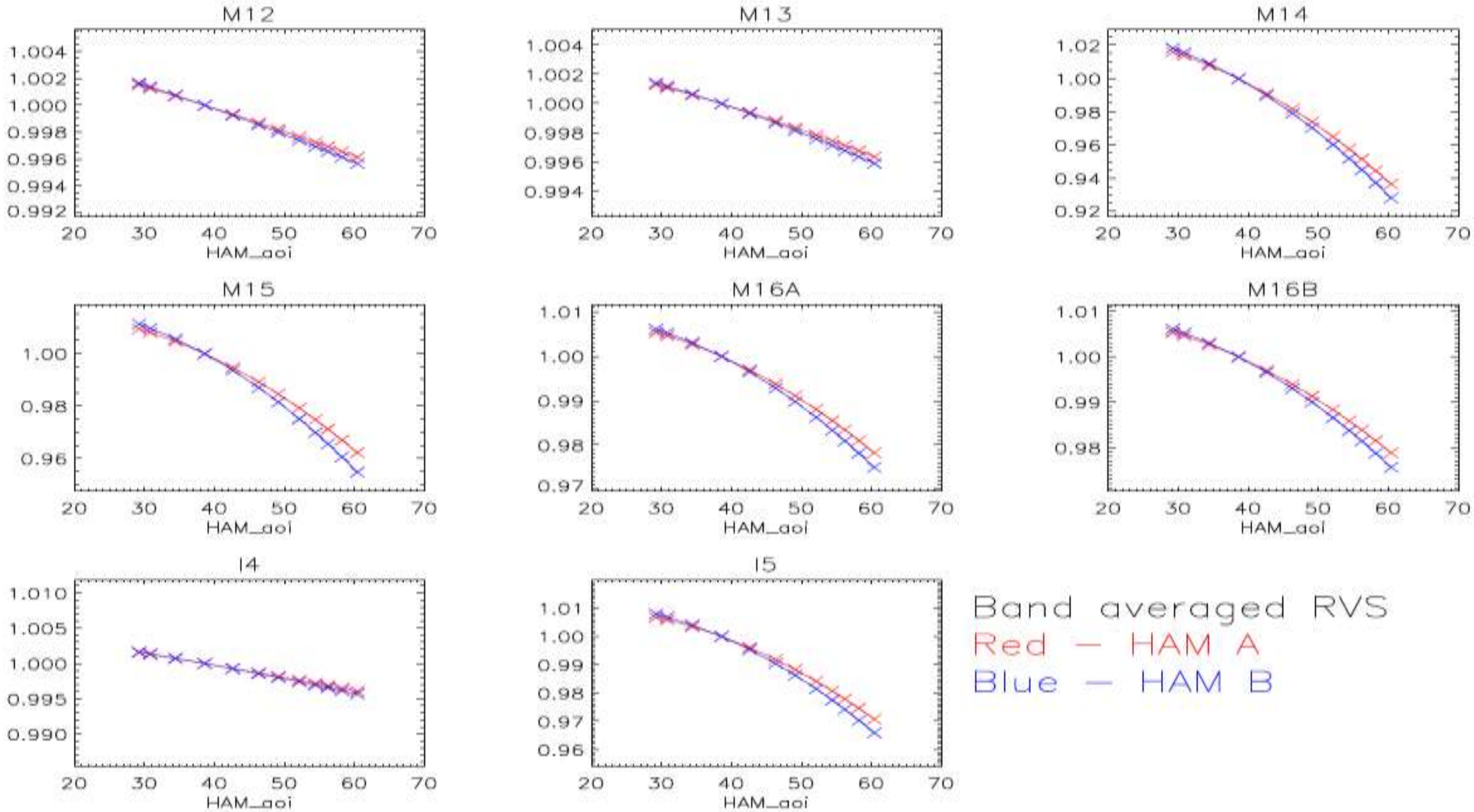
RSB RVS (for all detectors)



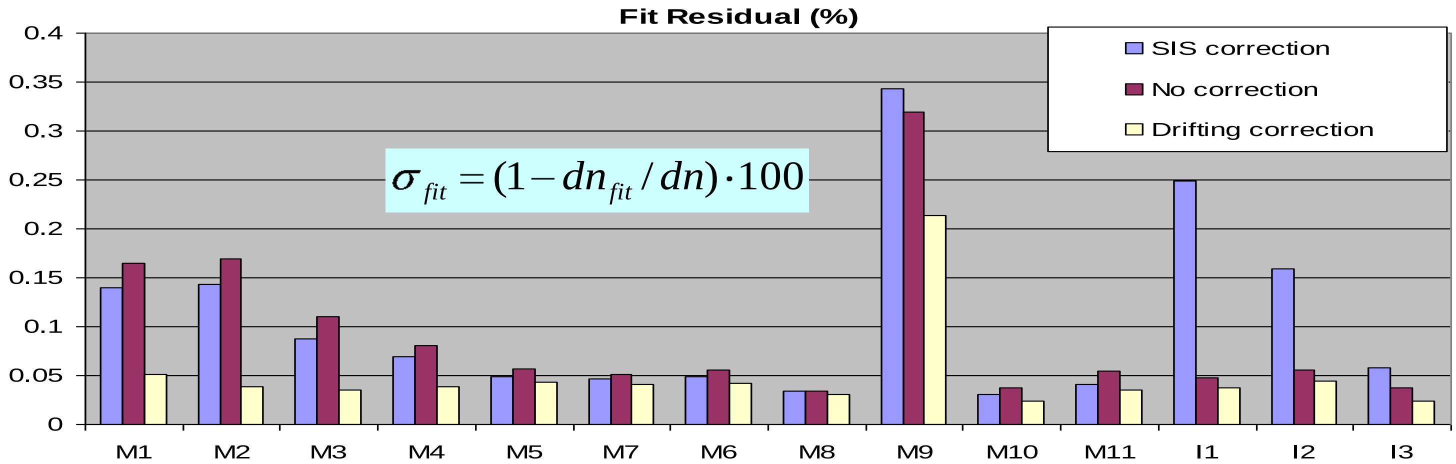


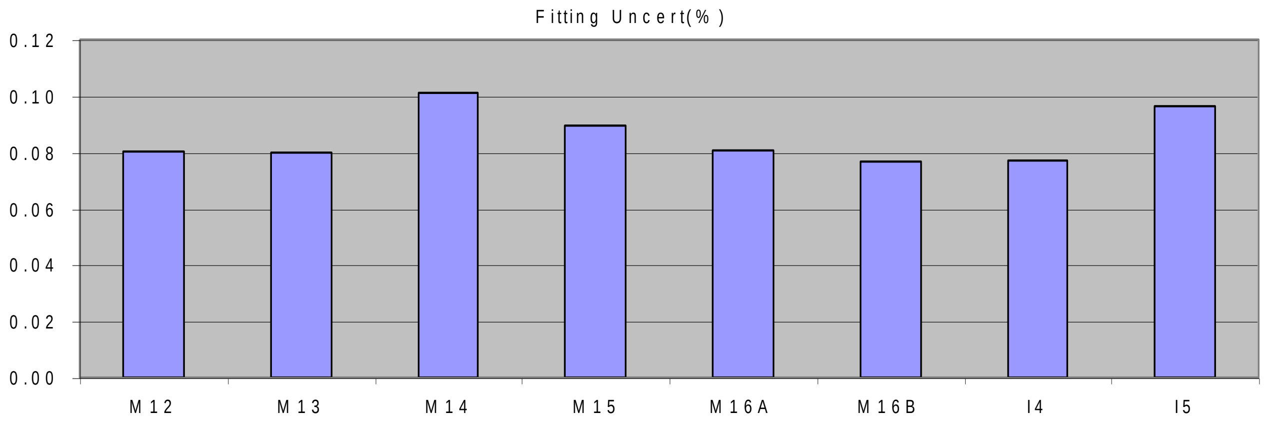
RVS results agree well to within 0.1%

TEB RVS (band averaged)



RSB and TEB RVS Uncertainty





RVS uncertainty included
(1) fitting residuals
(2) measurement errors

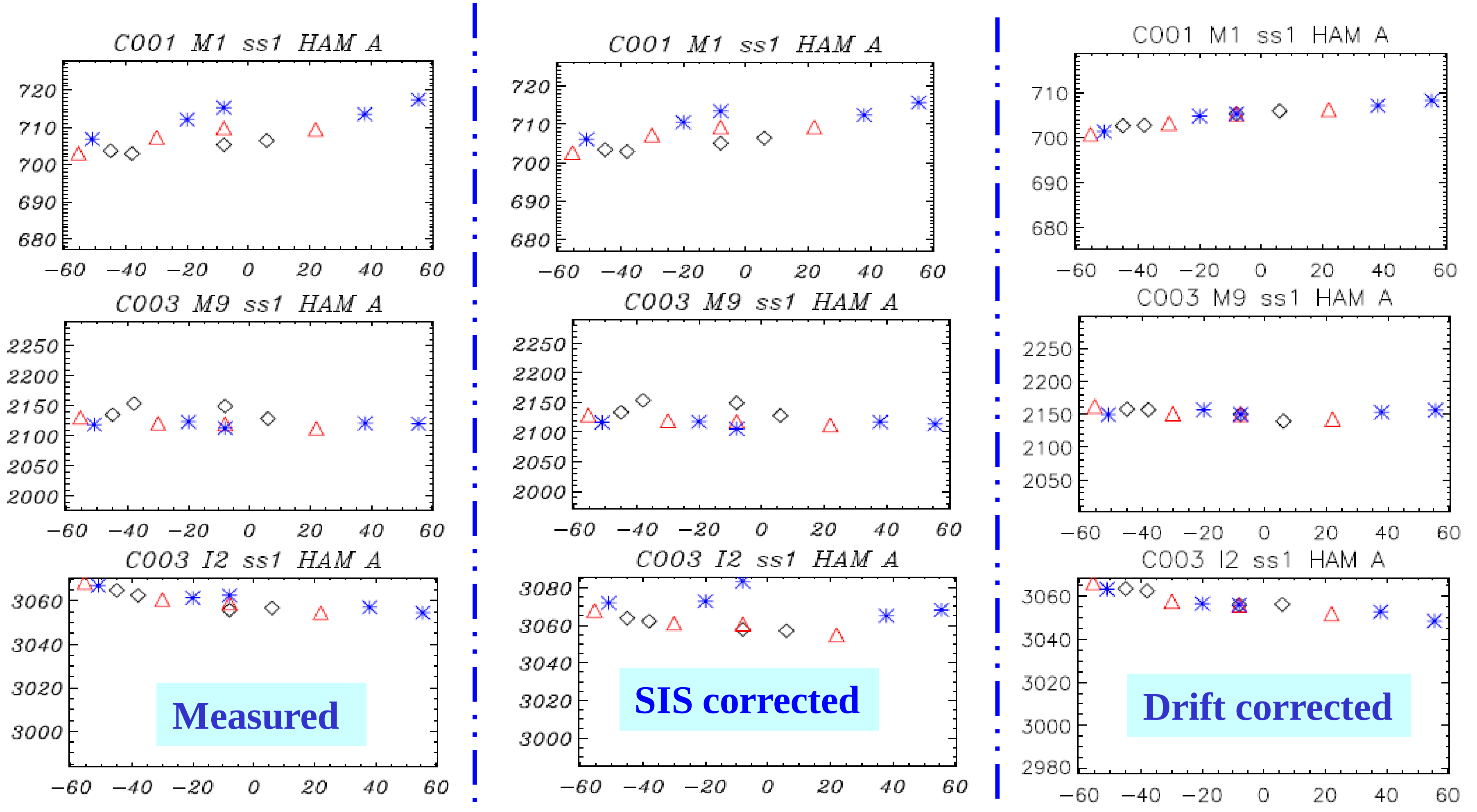
Both RSB and TEB RVS characterization meet the requirements
(consistent with SBRS analyses and results)

RVS Results and Issues

- SIS monitor approach was not satisfactory
  - **SIS stability and uncertainty are major concerns**
- Drifting correction approach works better for RSB RVS retrieval
  - Results agree well with SBRS using the same approach
  - Better understanding of SIS drifting mechanism and correction methodology needed
- Uncertainties of RSB and TEB RVS meet the requirements.
- HAM side difference is ~0.6% for M6-M7 and I2; ~0.4% for TEB bands
- Detector variation < 0.1% for RSB; and <0.4% for TEB

- Path forward:
  - FU1: verify RSB RVS with witness samples; re-evaluate TEB RVS uncertainty assessment
  - FU2: repeat measurements should be made at multiple scan angles.

SIS monitor correction vs drifting correction



Group 1 Group 2 Group 3

FU1 VIIRS Polarization Insensitivity for VisNIR Bands

FP-11, STR-545, and STR-554

- **Test Objectives**
  - Examine the insensitivity of the sensor to an input polarized light
  - Measure polarization insensitivity for every VISNIR band and detector at discrete scan positions
  - Characterize polarization insensitivity to uncertainty level (0.5%) specified in TP154640-103
- **Spec. for polarization factor:**
  3% for M1 and M7; 2.5% for all other VisNIR bands

Data Analysis Status of Polarization Insensitivity for VisNIR Bands

- Tests using PSA as polarized light source
  - Data: run1 and run 2
  - Data analyzed and polarization parameters derived
  - Strong effect of non-uniformity of light source and other noises
  - Algorithms developed to correct the effect of the PSA but they still depend on how well the PSA is characterized
- Tests using SIS with a polarizer sheet as polarized light source
  - Data: run2-STR-545 and run3-STR-554
  - Data analyzed and polarization parameters derived
  - No non-uniformity of the light source issue
  - The polarizer sheet might not provide perfect polarized light, waiting for SBRS' investigation

Algorithms for Polarization Insensitivity Data Analysis

- Fourier Analysis

$$dn(\alpha) = c_0 + \sum_{i=1}^{4} \left[c_i \cos(i\alpha) + d_i \sin(i\alpha) \right]$$

$$c_i = \frac{1}{\pi} \int_{-\pi}^{\pi} dn(\alpha) \cos(i\alpha) d\alpha$$

$$d_i = \frac{1}{\pi} \int_{-\pi}^{\pi} dn(\alpha) \sin(i\alpha) d\alpha$$

  - ➢ α is the polarization angle

- Only second order oscillation has information for the polarization effect
- Other order oscillations due to light source and other noise

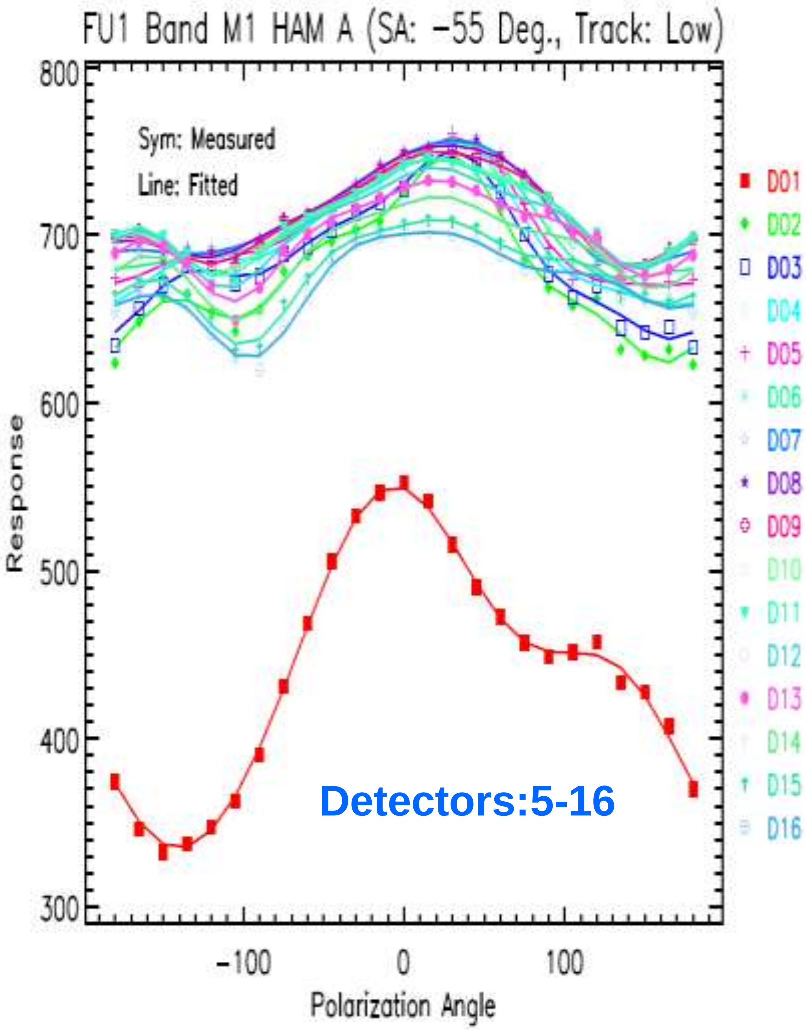
- Oscillation

$$dn(\alpha) = c_0 \left[1 + \sum_{i=1}^{4} a_i \cos(i\alpha + \beta_i) \right]$$

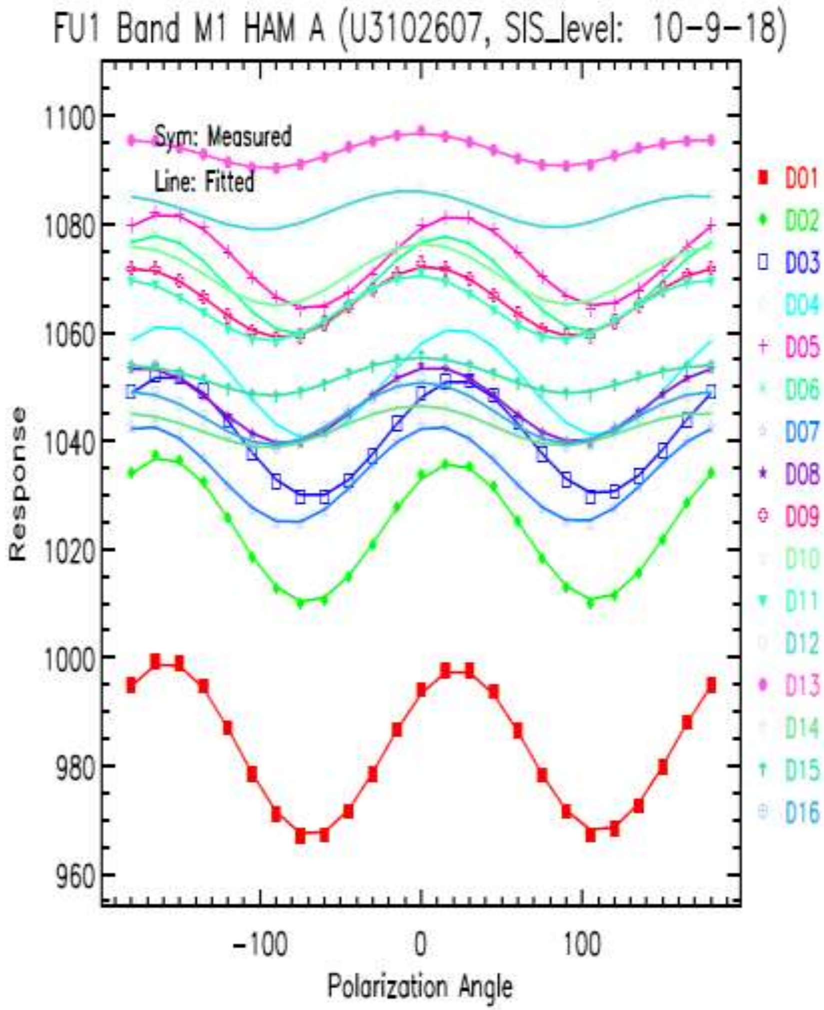
$$a_i = \sqrt{c_i^2 + d_i^2} / c_0, \quad \beta_i = a\tan(d_i, c_i)$$

Measured Response

PSA

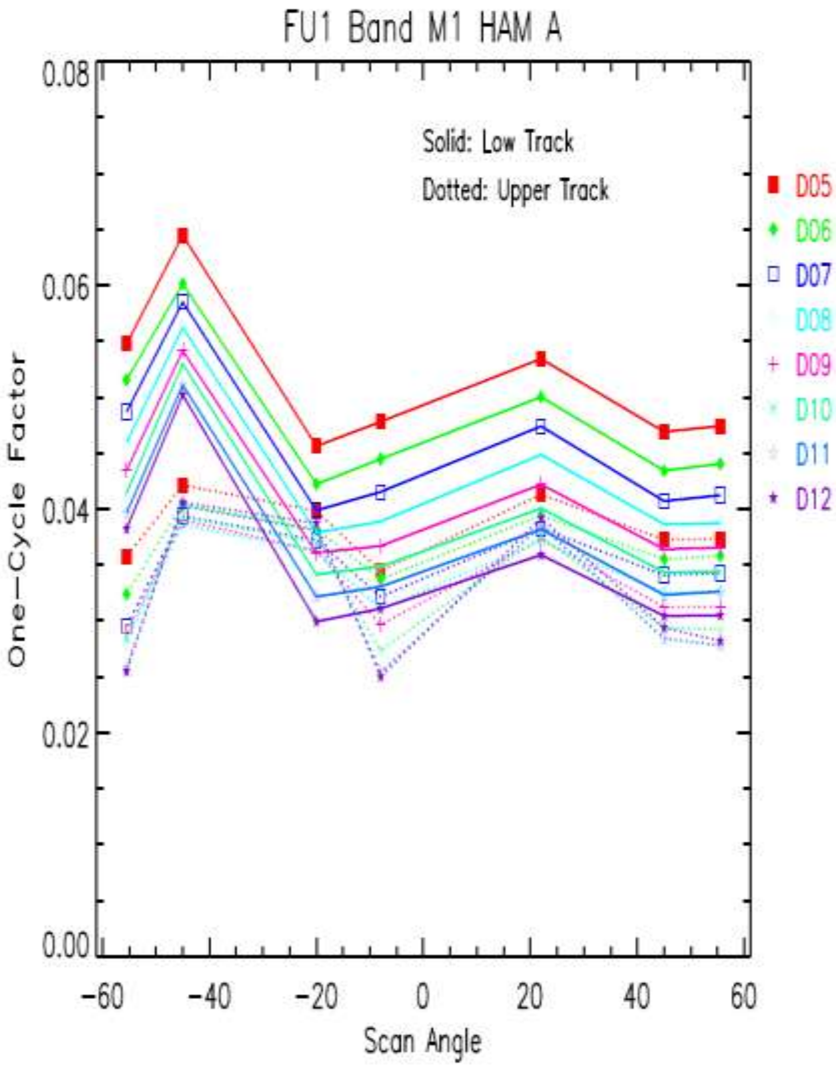


SIS with polarizer sheet

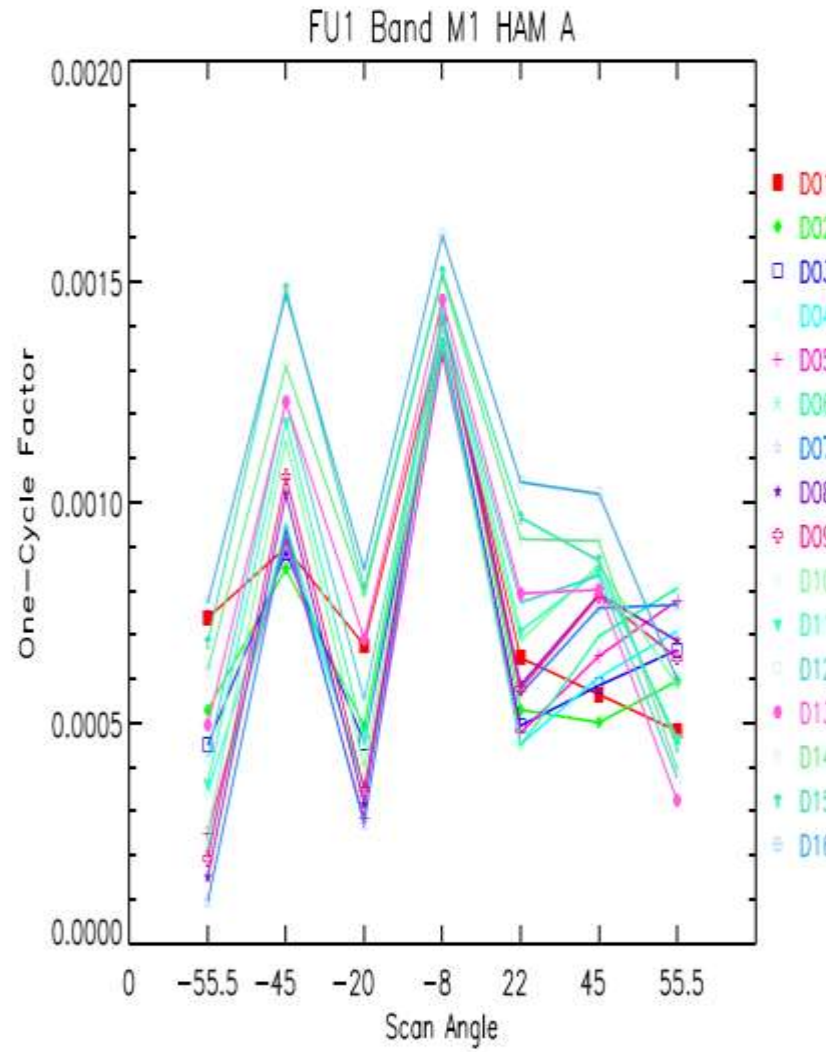


Amplitude of One-cycle Oscillation

PSA

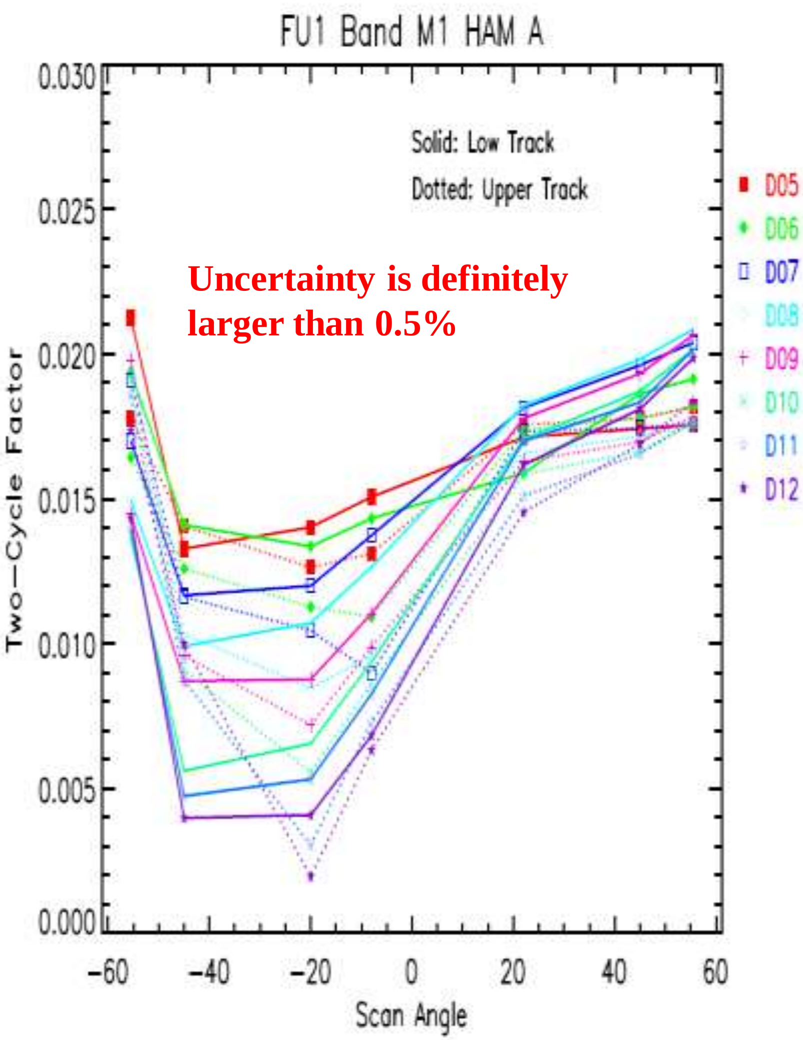


SIS with polarizer sheet

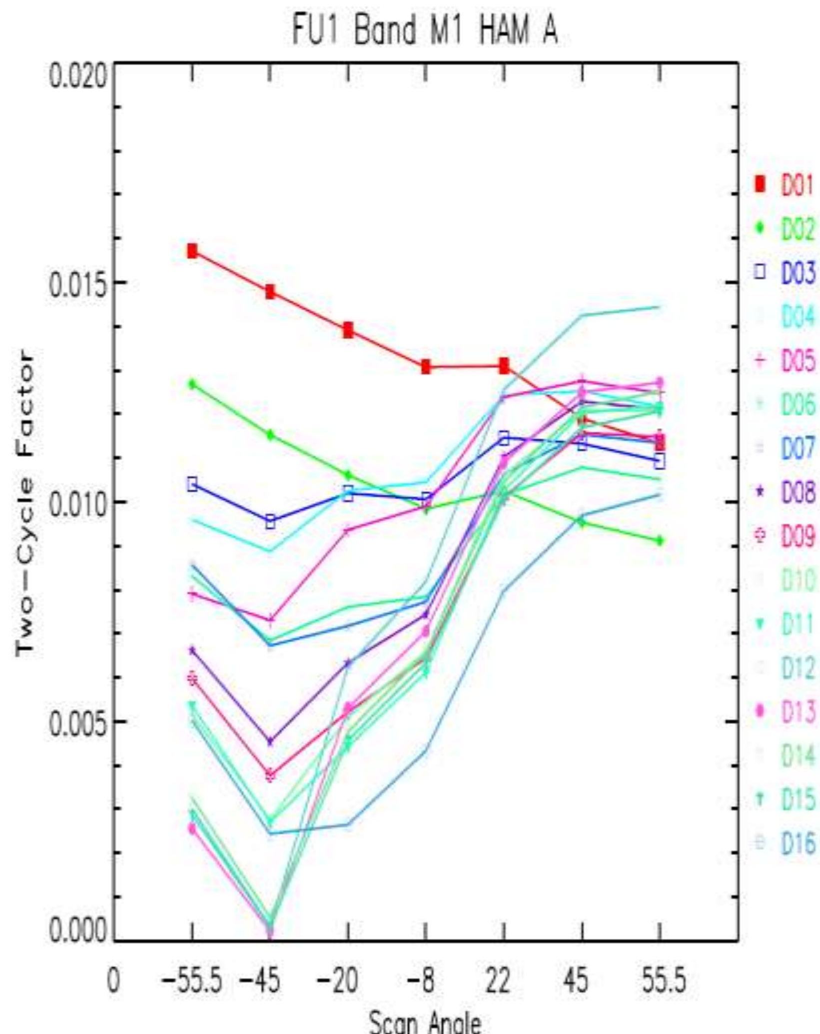


Polarization Factor

PSA

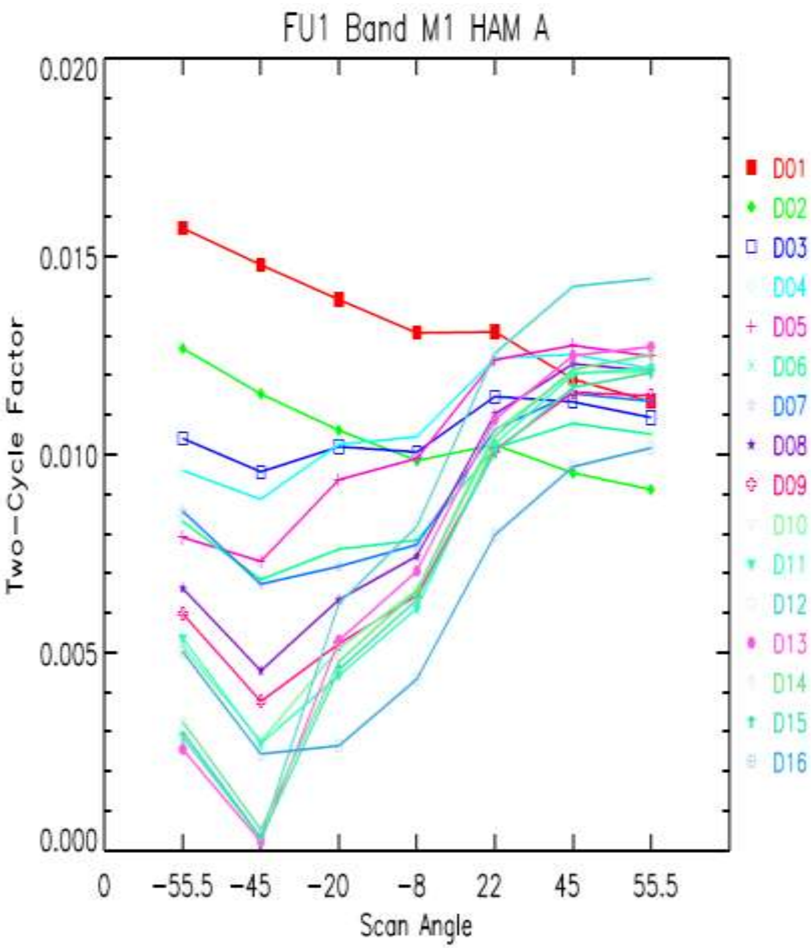


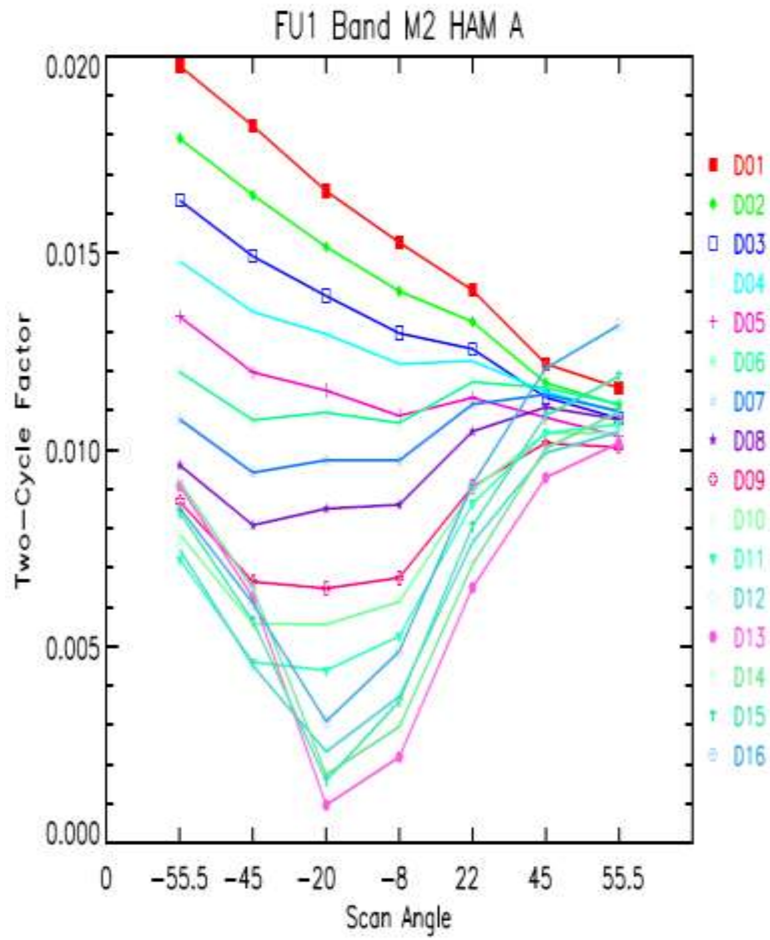
SIS with polarizer sheet



Polarization Factor

SIS with polarizer sheet

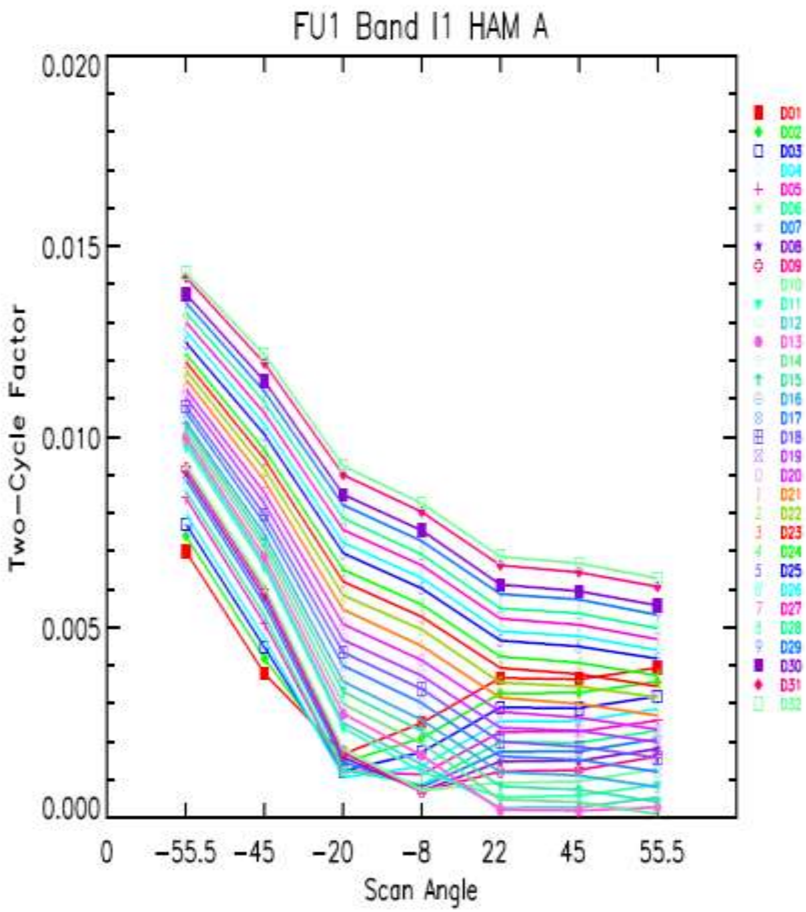


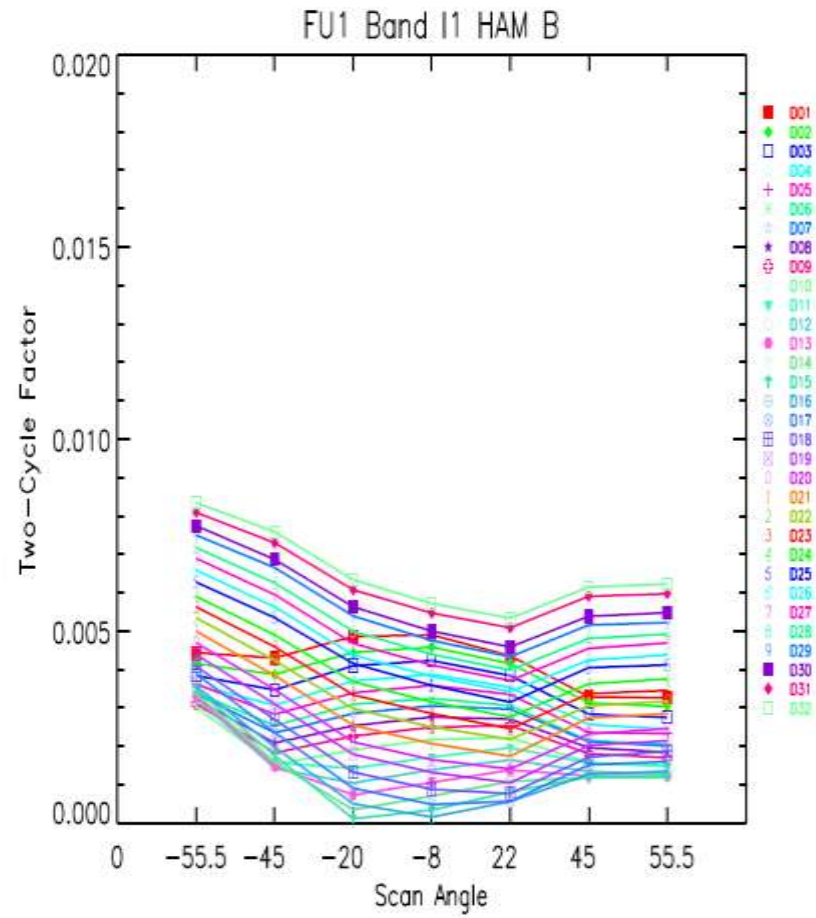


Polarization factors of band M1 (412 nm) are smaller than of band M2 (445 nm). This is probably due to the non-fully polarization of light for band M1, an issue being currently investigated by SBRS.

Polarization Factor

SIS with polarizer sheet

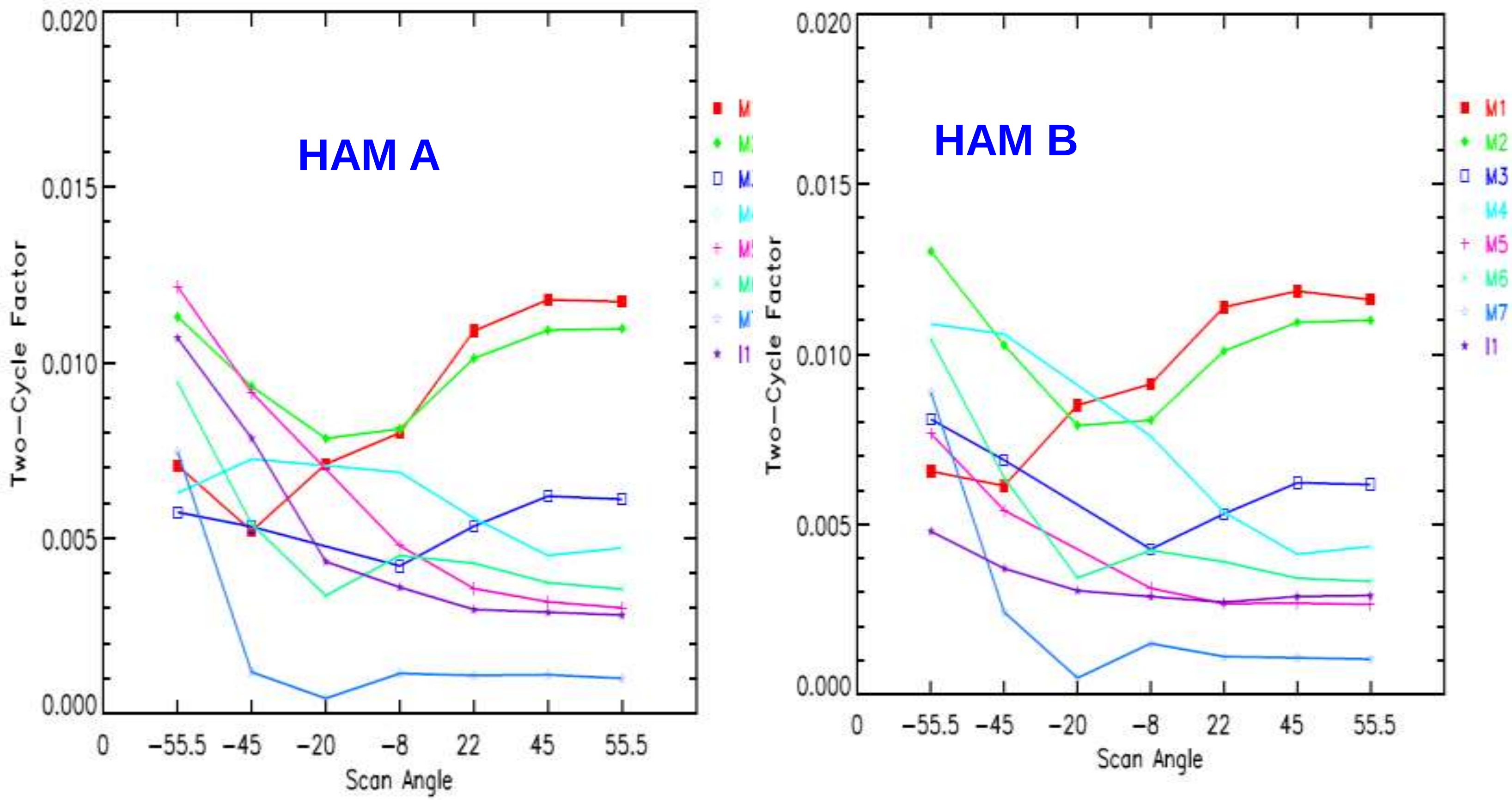




For band I1 (640 nm), the polarization factors are quite different for the two mirror sides at small AOI. The differences between the two mirror sides also observed for polarization factors of bands M4 (555 nm) and M5 (670 nm). This phenomena were also observed in the polarization factors derived from the tests using the PSA to provide polarized light source.

Polarization Factor

SIS with polarizer sheet



Detector averaged polarization factor

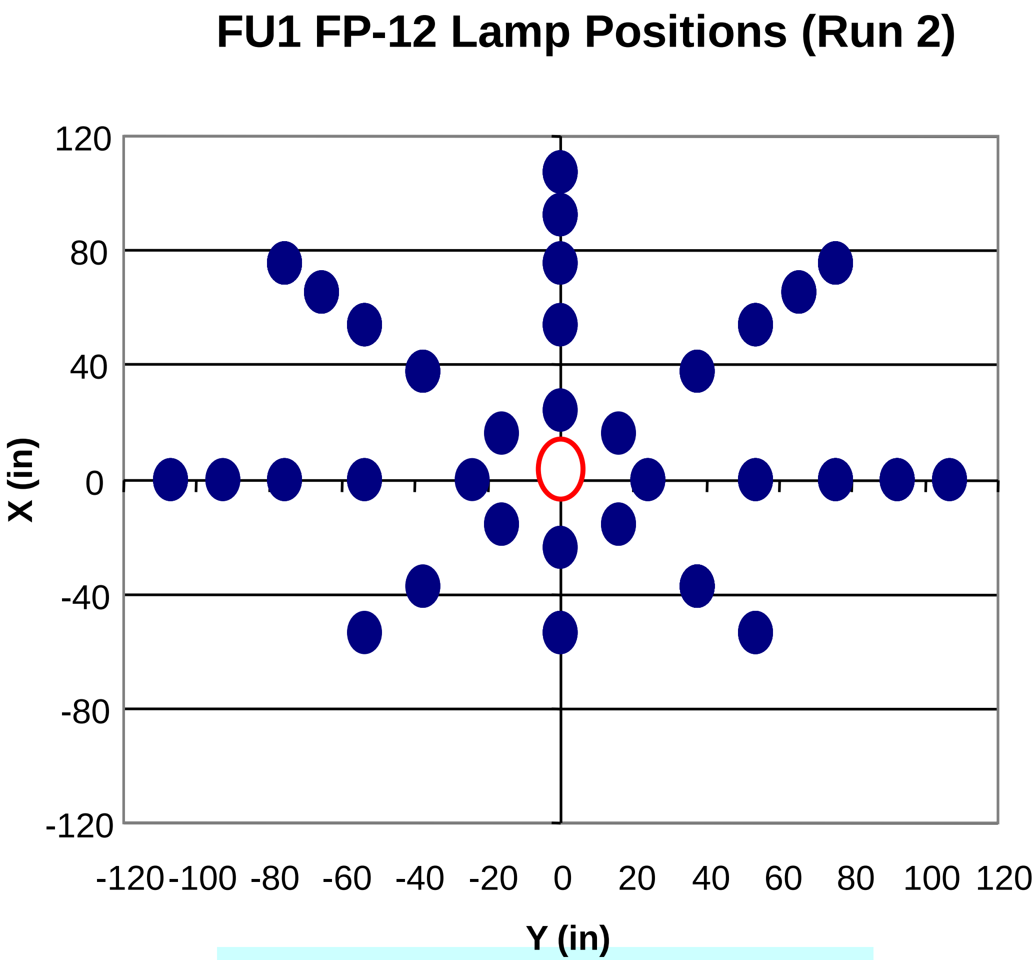
Summary

• All FU1 VIIRS polarization insensitivity test data (both with FP-11 and SIS with a polarizer sheet as light source) for VisNIR Bands are analyzed and the polarization parameters are derived from the measured data.
• The derived polarization factors from all tests satisfy the VIIRS specification for the polarization factor.
• The derived polarization factors are sensitive to detectors and also mirror side for a couple of bands.
• The polarization parameters derived from the test using PSA to provide polarized light are significantly contaminated by effect of non-uniformity of the light source and other noise. The uncertainty of the derived polarization factors are larger than the specification for the uncertainty level.
• The light provided by the SIS with a polarizer sheet might not be a fully polarized light. But the effect of the non-perfect polarized light on the derived parameters need to be corrected. The uncertainty level of the derived polarization factors can not be assessed without the characterization of the polarization degree of the polarizer sheets used in the tests.

FP-12: RSB Stray-Light Rejection (SLR)

- The irradiance from earth and/or cloud albedo outside the sensor FOV will be the main source of stray light, and sensor rejection of this light should be demonstrated prior to launch
- FP-12 test simulated stray light source comparable to the on orbit condition
- Test data was used for evaluation of temporal SLR performance against the specification
- The original specification SRV0065 requires that stray light causes less than 1% change in response when sensor viewing an earth scene of typical radiance

FP-12 Lamp Position at Nadir



The lamp was placed behind ABC

- A 1000w studio lamp was placed 120in away to provide uniform illumination over a solid angle cone
- Telescope was locked at three different scan angles: EOS (w/ cooled CFPA), Nadir (w/o BTC) and SV
- At each scan angle, the ABC was aligned with sensor FOV to provide a dark view
- At each lamp position, the measurement was done with the lamp off, on and off
- Sensor responses from all positions were summed and scaled to compensate for the spectral difference between earth albedo and the lamp.

Summary of FP-12 Results

- After the initial run, the test data indicated that most of M-bands did not meet the original requirement, and an EFR was generated to formally track the non-compliance results
- The run 2 results show that bands M2-M7, and M11 do not meet the original requirement, but meet the proposed requirement RDW053A

- Path Forward: evaluation and approval of waiver request

Waiver of SRV0065 –W053

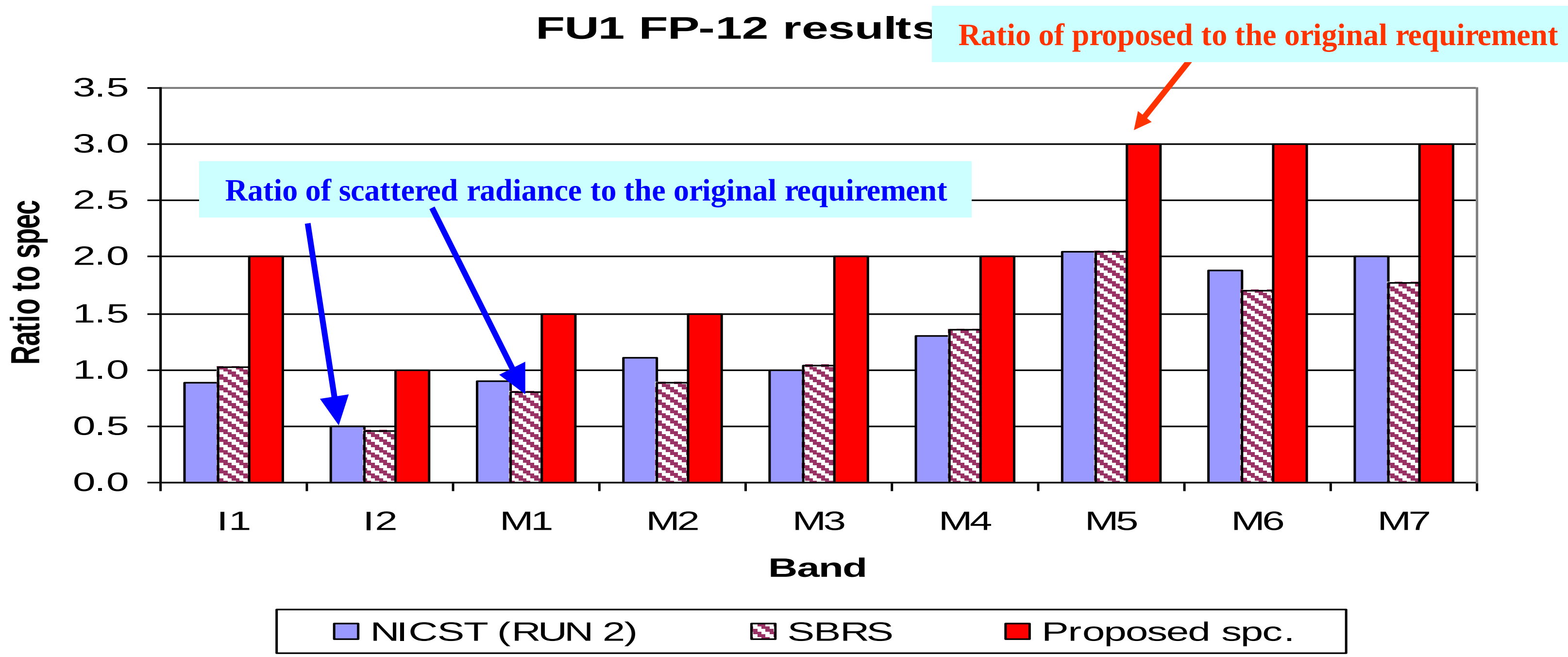
Band (wavelength,	Initial % L_{-typ}	W053 % L_{-typ}	W053A % % L_{-typ}
M1 (412)	1	3	1.5
M2 (445)	1	3	1.5
M3 (488)	1	3	2
M4 (555)	1	3	2
M5 (672)	1	3	3
M6 (746)	1	3	3
M7 (865)	1	3	3
M8 (1240)	1	3	1.35
M9 (1378)	1	3	1.2
M10 (1610)	1	3	1
M11 (2250)	1	10	10
I1 (640)	1	3	2
I2 (865)	1	3	1
I3 (1610)	1	3	1

- It is said that based on heritage mirror roughness knowledge, the predicted results showed non-compliance for VisNIR.

- For M8, M9 and M11, the SLR requirement makes SNR at Ltyp more stringent than the sensor SNR specification.

- Previous RDWs w053 was based on the initial modeling, a less matures models. RDWs w053A was proposed

Preliminary Results



Bands	NICST (EOL)	Proposed spec change
M8	1.248	1.351
M9	1.007	1.205
M10	0.837	1
M11	**9.38**	**10**
I1	1.079	2
I2	0.6	1
I3	0.166	1

- Ratio stands scattered radiance to the original spec.
- Bands with the ratio >1.0 are non-compliant

M11 has the largest scattering response

Summary of Near Field Response (NFR)

- FP-14 test was conducted with a single vertical slit scanning across IFA w/wo ND, and bandpass filters were used for VisNIR
- The objective is to estimate the ability of the sensor to measure the radiance from one region the earth scene which differs from the adjacent regions. An example
  - a bright cloud scanned by the sensor might introduce scattered radiation that would corrupt the radiometric measurements of an adjoining dark region
- The processed test data w/ selected collects are the same as the Raytheon
- The preliminary results of the data analysis indicate that at least bands M4, M12, M13 and M16 are non-compliant
- The largest margin between the existing specification and the measured data is found in TEB band M12 > 750%
- Ghosting signals are found in TEB which makes it difficult to assess the NFR.

FP-14 Test Overview

- **FP-14 – NFR for all spectral bands**

  Dynamic crosstalk artifacts are found in many VisNIR collected without BPF. Ghosting artifacts are found in TEB

- **STR541 – Emissive Band Filtering**

  An extended test for TEB to use bandpass filter to generate a narrow width light. Unfortunately, the artifacts were still presented, though the SNR was improved. The second run was conducted with the lamp level as high as possible to maximize SNR. This data is used in the FP-14 analysis.

- **STR546 – Aperture Blocking**

  To confirm the source of artifacts was within VIIRS and not a result of the test setting. Measurements were made with the aperture open, left half blocked, right half blocked and fully blocked. Unfortunately the results didn't give a sufficient explanation.

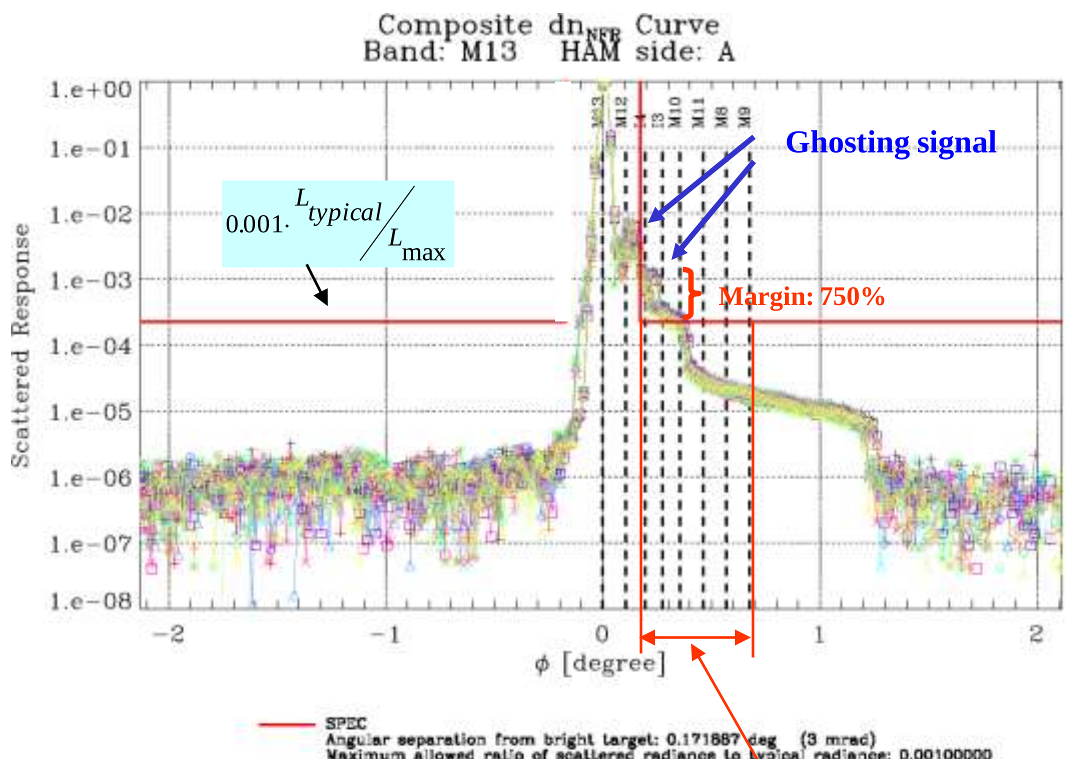
- **STR547 – TMC Source with Slit & Single Point Reticles**

  To confirm that the ScMA was not the source of the artifacts. The results still exhibited the artifacts. Requested by Eric Johnson, a few sets of data were collected with the single point reticle positioned over detectors 2, 8, 9 & 13 individually. The data allows to derive a more representative PSF to generate a scan & track response for the ScMA data. NGST used this data alone with FP-14 to derived ghost coefficients.

- **EFR3326**

  Engineering Failure Report 3326 was opened to track the investigation of artifacts in the FP-14 data.

Ghosting signal in STR-541



- Artifact signal of ~0.2% (FP-14: 0.5%) is seen on the detector when the slit is scanned across the IFA
- Artifact is angularly dependent in scan direction
- Ghosting is confirmed from the Dewar by a 2D-modeling

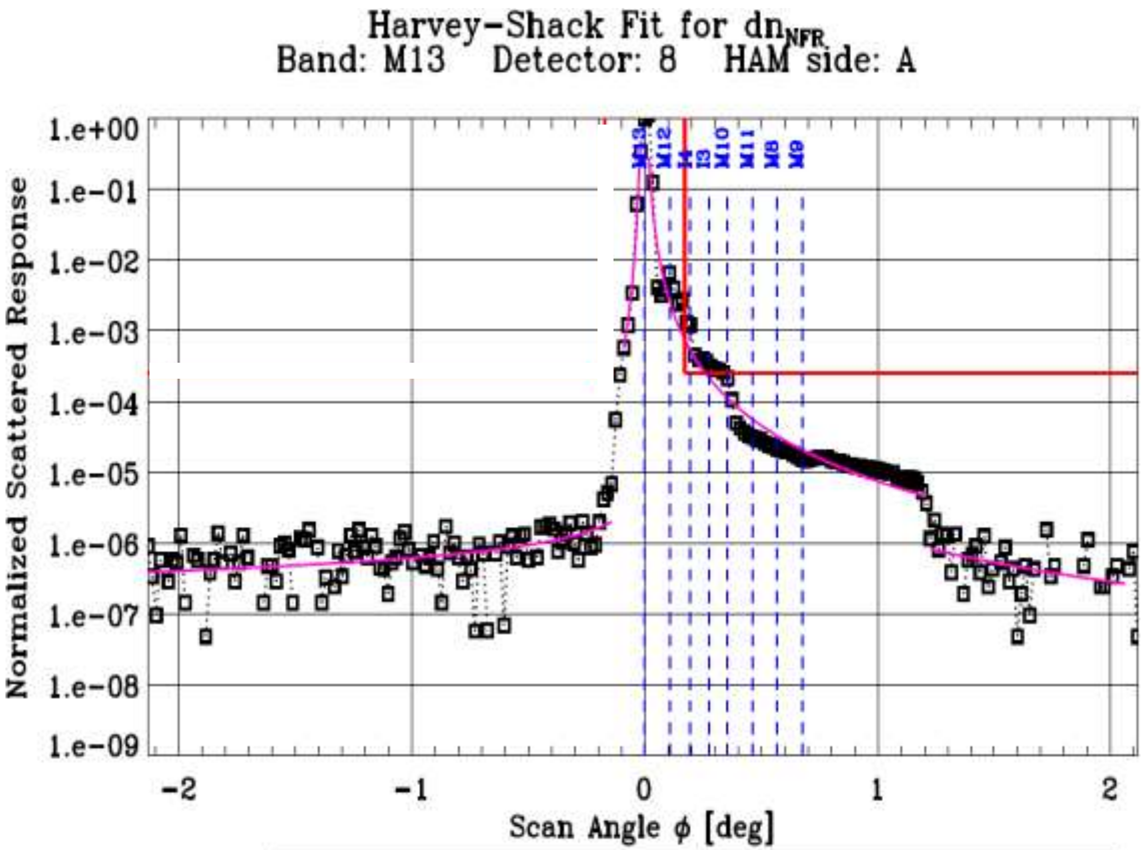
Initial spec. limits 0.1% of scattered response onto a detector from a bright target at 3 millirad away

Scattered response: dn/dn_max

Ø: angular distance in degree

The ghosting is observed in bands M12-M13, and M15-M16

M13 Analyzed Result (Preliminary)

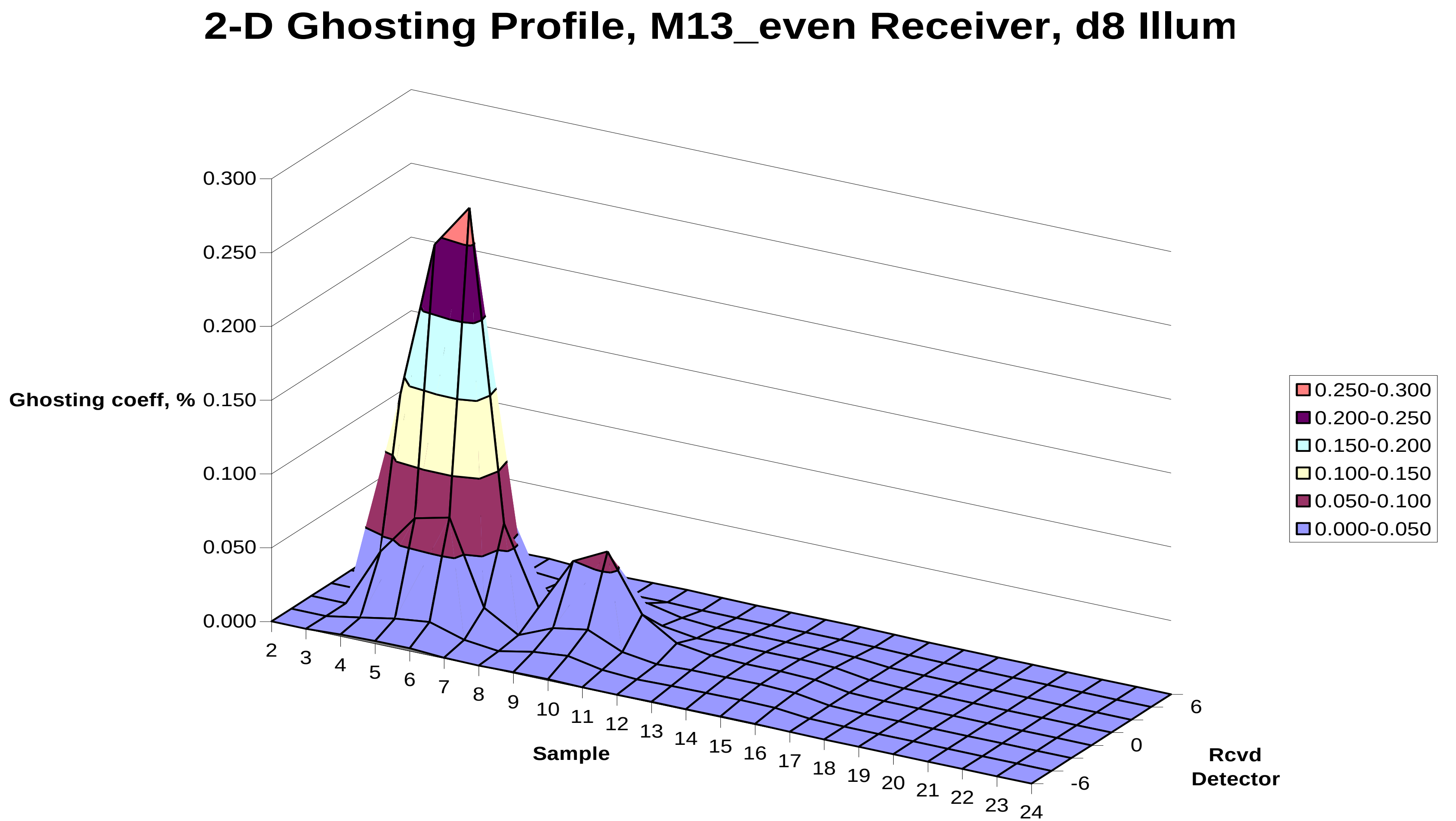


dn_{NFR}	···□···
dn_{HS}	——

	A_{outer}	M_{outer}	A_{inner}	M_{inner}
Left Side	2.45E−06	−6.04E−01	8.79E−08	−4.19E+00
Right Side	5.05E−06	−2.16E+00	2.97E−05	−2.61E+00

- Two sets of test data, one saturated and one unsaturated, are stitched together to generate the relative response for each detector.
- The stitched data are used to verify and refine NFR H-S models, which are used to evaluate the sensor performance.

NGST 2D Ghosting from FP-14 and STR-547



Waiver w004

New columns

Band	Angular separation from Bright Target (millirad)	Maximum allowed ratio of scattered Radiance to typical Radiance	L_{typ} (W/m2/Sr/mr) and T_{typ} (K)		L_{brt} (W/m2/Sr/mr) and T_{brt} (K)	
			High Gain	Low Gain	High Gain	Low Gain
M1	6	0.01	44.9	155	155	251
M2	6	0.01	40	146	154	161
M3	6	0.01	32	123	129	561
M4	6	0.01	21	90	261	508
M5	~~12~~ 6	0.02	10	68	223	443
M6	6	0.02	9.6		30.6	
M7	~~12~~ 6	0.02	6.4	33.4	153	255
M8	6	0.01	5.4		97.5	
M9	N/A	N/A	N/A		NA	
M10	~~N/A~~ 6	??	7.3		44.5	
M11	6	0.01	0.12		7.73	
M12	3	0.001	270 K		321 K	
M13	3	0.001	300 K	380 K	335 K	411 K
M14	N/A	N/A	N/A		NA	
M15	3	0.001	300 K		303K	
M16	3	0.001	300 K		302K	
DNB	N/A	N/A	N/A		NA	
I1	~~6~~ N/A	~~0.01~~ N/A	N/A		NA	
I2	~~6~~ N/A	~~0.01~~ N/A	N/A		NA	
I3	~~6~~ N/A	~~0.01~~ N/A	N/A		NA	
I4	N/A	N/A	N/A		NA	
I5	N/A	N/A	N/A		NA	

- It is said that requirement is too stringent for a few bands, since the large contrast ratio between Lmax and Ltyp never occur in the same earth scene.
- New requirements is under developing. To date no mutually agreeable changes have ever been identified.

NGST EFR 3326 Investigation Ghosting impact on SDR

- ERF 3326 Conclusions
  - Root cause is known-reflection and rejected light comes from Dewar window
  - NGST SDR sesults suggest no substantial impact in Emissive band SDR SST
  - NGST impact on assessment of EDRs VIIRS Cloud Mask and Aerosols are in progress

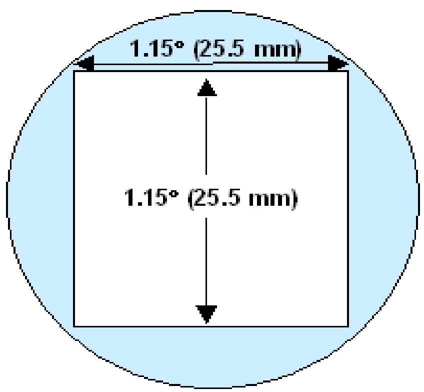
- Path Forward
  - NGST investigate VIIRS Cloud Mask and Aerosols EDR
  - Need independent verification of artifact Ghosting is a small impact to SST EDR

VIIRS FU1 Crosstalk

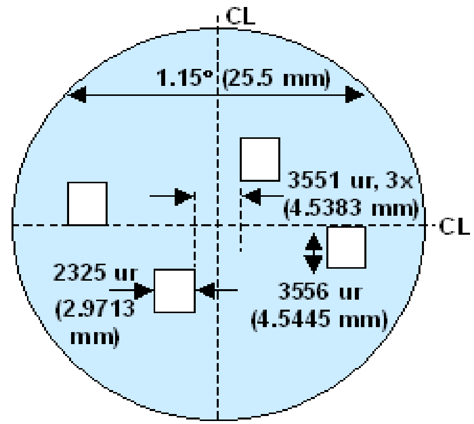
- **STR Crosstalk**
  - FPA and In-band crosstalk: STR351, STR352, STR358, STR359, STR405 and STR406
  - Crosstalk survey tests to investigate the presents xtalk artificial after rework of ASPs and VNIR FPA
  - Provided preliminary assessment of crosstalk mechanisms
    - Optical Crosstalk/Filter Leakage for VisNIR
    - In-band dynamic xtalk for all spectral bands

- **FP13 Crosstalk**
  - Measure the crosstalk signal under both static and dynamically scanning conditions
  - Part 1 uses the Three Mirror Collimator (TMC) and Part 2 uses the Scatter Measurement Assembly (ScMA) to cover the low gain region of the VisNIR dual gain bands.
  - Include both polychromatic illuminations
  - Verify compliance with crosstalk requirements for all spectral bands.

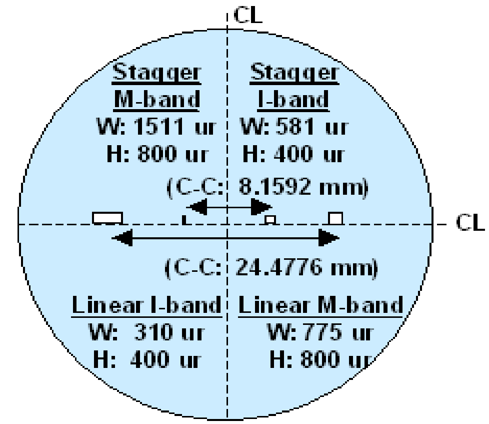
FP13 Reticle Spatial Patterns



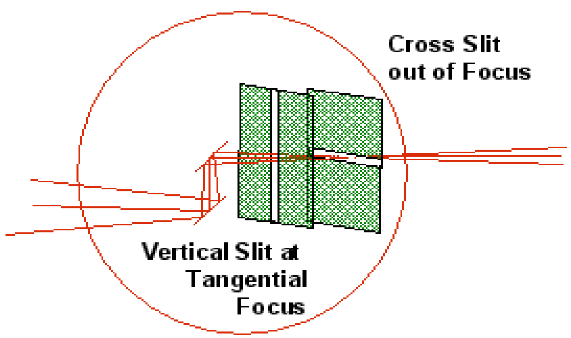
TMC Reticle:
Open/Knife Edges



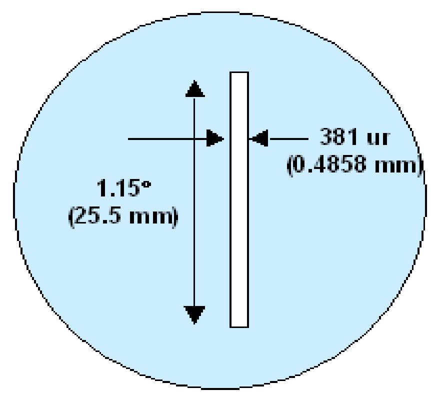
TMC Reticle: 4
Rectangular Openings



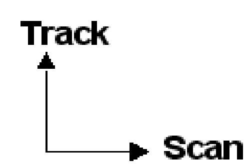
TMC Reticle: Individual Openings
(overlay mask used to obscure all
but single opening selected to
match sender size)



ScMA Reticles: Single
Sender Configuration



TMC Reticle: Single Vertical Slit
(P/N 227536 w overlay mask to
obscure all but single slit opening)



STR Crosstalk Overview

STR No.	Objectives	FPAs Tested			Elect. Side	Test Implementation					Similar Existing STR
		VN	SM	LW		Source	Reticle	Spectrum	Rad Level	Scan/Static	
351	Evaluate VisNIR band-band crosstalk artifacts (electrical, optical).	X			A	TMC	Single Vertical Slit	BP Filters matching VisNIR bands, SSF, and Broad (no BP filters)	Multiple	Scanning	396/320
359	Evaluate SMLWIR band-band and in-band crosstalk artifacts (electrical, optical).		X	X	A	TMC	Single Vertical Slit	BP Filters matching SMLWIR bands, SSF, and Broad (no BP filters)	Multiple	Scanning	396
358	Evaluate significant VisNIR band-band crosstalk artifacts (electrical, optical).	X			A	TMC	Vertical KE	BP Filters matching VisNIR bands, SSF, and Broad (no BP filters)	Multiple	Scanning	397
405	Evaluate SMLWIR band-band and in-band crosstalk artifacts (electrical, optical).		X	X	A	TMC	Vertical KE	BP Filters matching SMLWIR bands, SSF, and Broad (no BP filters)	Multiple	Scanning	397
352	Evaluate In-band X-talk	X	X	X	A & B	TMC	Horizontal KE, 1 orientation - bright to dark illumination at several track positions	Broad (no BP filters)	Multiple	Scanning	430
406	Evaluate VisNIR IFA filter Leakage (OOB)	X			A	TMC	Wide Vertical Slit (static) covering single IFA filter block	OOB Filters (bandpass located between VisNIR Bands)	Maximum Setting	Scanning & Static positioning on VisNIR band centers	320

Analyzed Data Checklist

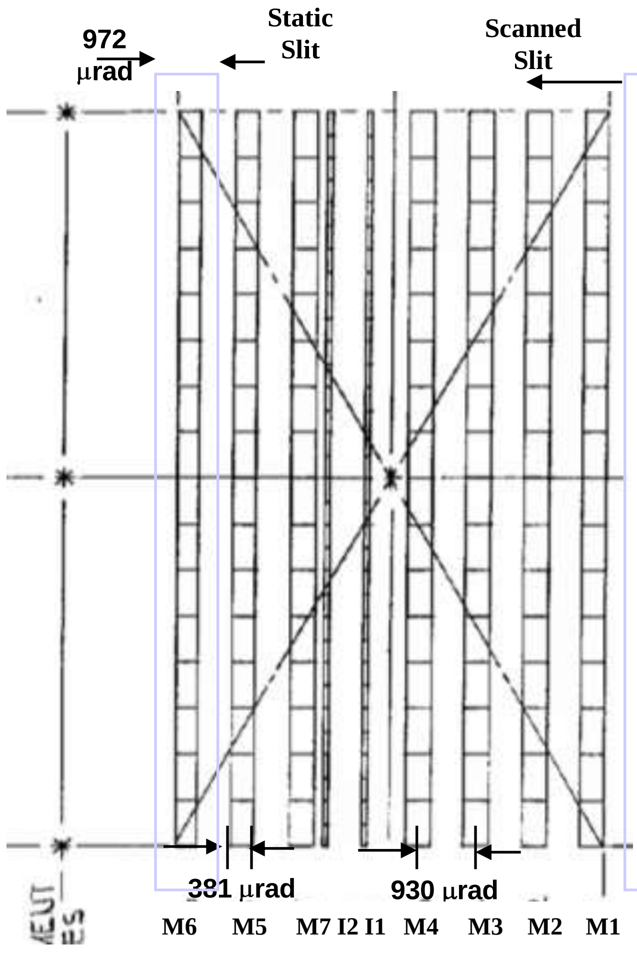
- Completed STR351, STR352, STR358, STR359, and STR406 crosstalk analysis
- Completed FP-13 point-to-point static and dynamic crosstalk analysis for all spectral bands
- Identified crosstalk root cause, as well as the major send detectors
- Derived and delivered static point-to-point crosstalk influence coefficients for all VIIRS spectral bands in dn, radiance, and CNR spaces for cases of:
  - For HG --> HG
  - For LG --> HG
  - Fixed LG --> Fixed LG
- Results comparison between similar tests are in progress

Summary of STR Optical Crosstalk

- Significant optical crosstalk is evident from
  - M1, M3 and I1 into M4
  - M4 into M5
- High optical crosstalk is associated with TMC BPF blocking sides, as well as IFA filter leak
- Filter orientation recommendation for FP-13 after STR-406 was made by NGST on Sept 26, 2007
- Optical crosstalk/leak is measurable for receiver bands M1, M2, M4, M5 and M6 at difference spectral ranges
  - M1: 770-830nm
  - M2: 370-390nm
  - M4: 428-432, 460-470 and 700-720 nm
  - M5: 460-470, 570-585, and 770-830nm
  - M6: 370-390, 460-470, 500-520nm
- Compared with STR-443 data (component level), STR-406 (system level) shows improvement in spectral range >700nm
- Optical crosstalk map was derived and released

STR 406 Optical Crosstalk Overview

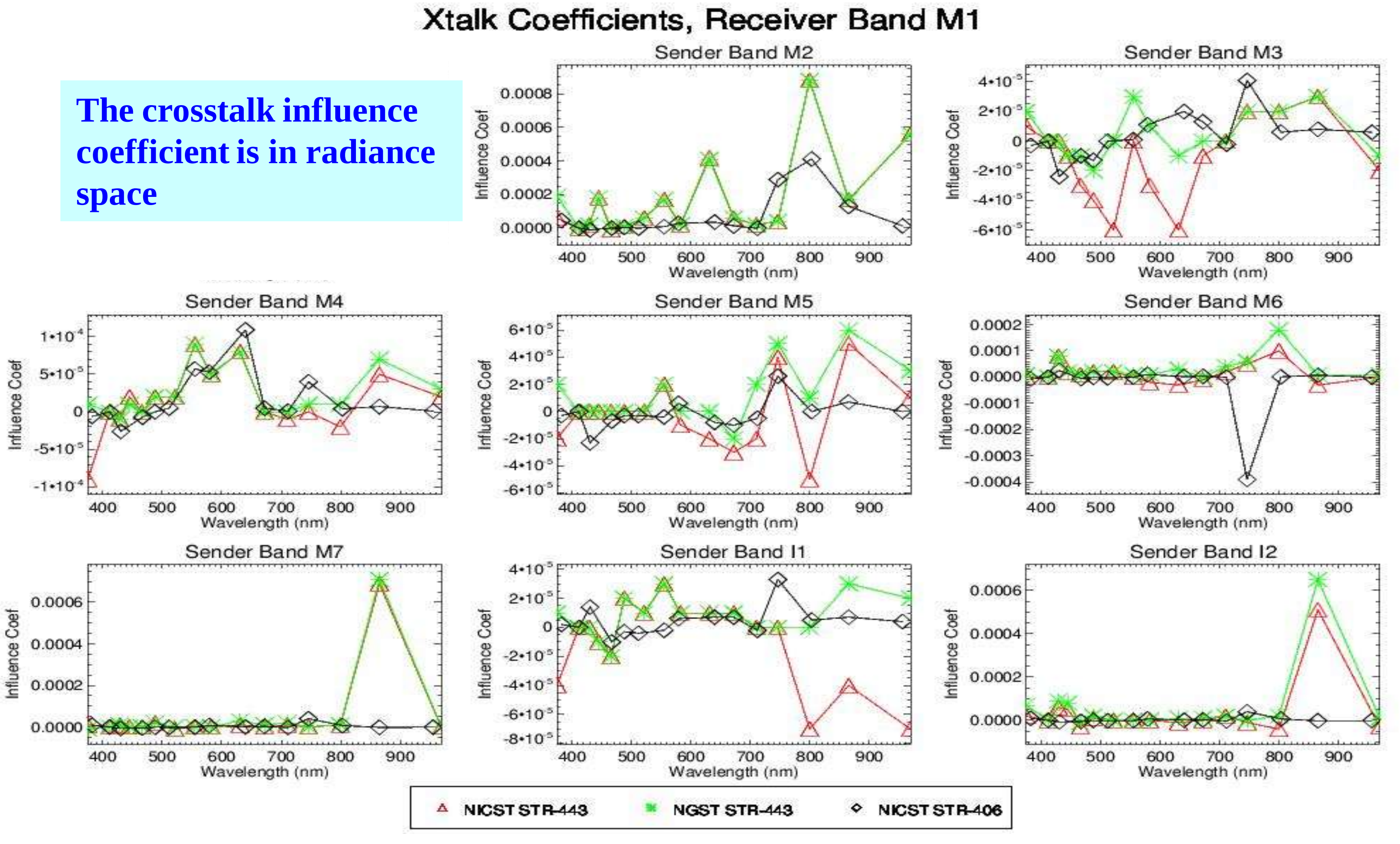
UAID	Filter used	Collects
3101194	No filter	8
	82.45 nm)	8
3101196	M1 BP filter	8
3101197	OOB filter (430.54 nm)	8
3101198	M3 BP filter	8
3101199	OOB filter (466.94 nm)	8
8 3101200		
3101201	OOB filter (511.86 nm)	8
3101202	I1 BP filter	8
3101203	OOB filter (579.05 nm)	8
3101204	M5 BP filter	8
3101205	OOB filter (711.62 nm)	8
3101206	M6 BP filter	8
3101207	OOB filter (802.85 nm)	8
3101208	I2/M7 BP filter	8
3101209	OOB filter (955.58 nm)	8



- Objective: Evaluate optical leakage through VisNIR IFA slit illumination using The TMC
- 8 OOB spectral filters and 7 VisNIR BPF were used
- ~972 microradian slit width (approx 2.5 M-Band IFOV)
- TMC SIS is at 23,000 (max)

FU1 Optical Crosstalk

The crosstalk influence coefficient is in radiance space



Dynamic Crosstalk Tests

STR w/ KE Reticle

STR358: vertical KE for VNIR
STR405: vertical KE for SMWIR & LWIR
STR352: horizontal KE

- **Illumination of lower number detectors**
- **Obscuration of higher number detectors**
- **6 track positions of horizontal knife edge**

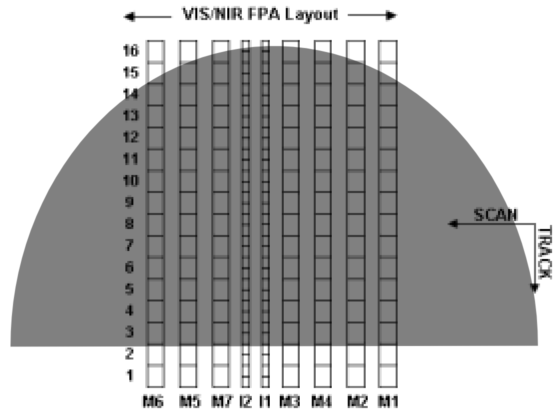
Single Slit Reticle

TR359: 5 TMC BB Levels for SMWIR and LWIR, 9 BP filters: M8, M9, M10/I3, M12, M13, M14, I4 and I5;
STR351: 5 TMC SIS Levels, 7 VNIR BP filters: M1, M3, M4-M7/I2, and I1
FP-13: three TMC SIS source levels 4000, 4500, and 25000 fl

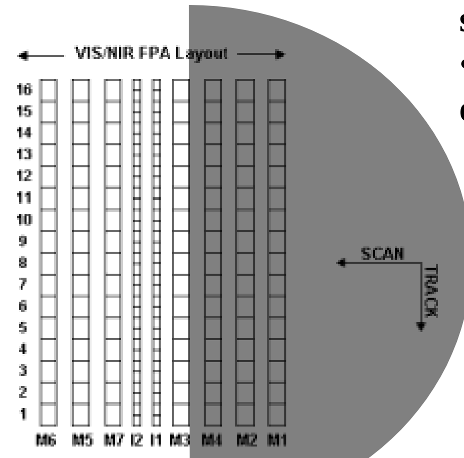
FP-13 w/ Open Reticle

Highest TMC source level for VisNIR bands

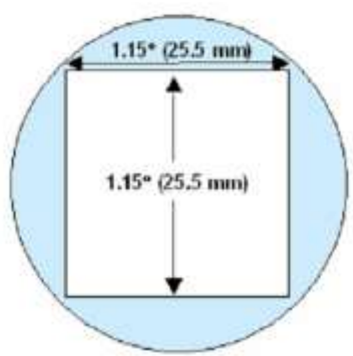
- **Dynamically scanned**
- **256 scans each collect**



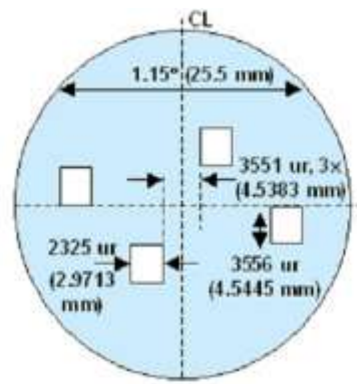
Horizontal Knife Edge



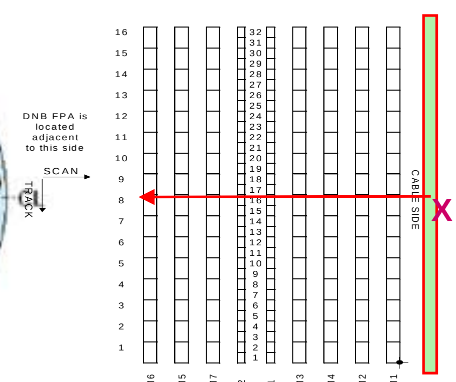
Vertical KE Orientations



TMC Reticle: Open/Knife Edges



TMC Reticle: 4 Rectangular Openings



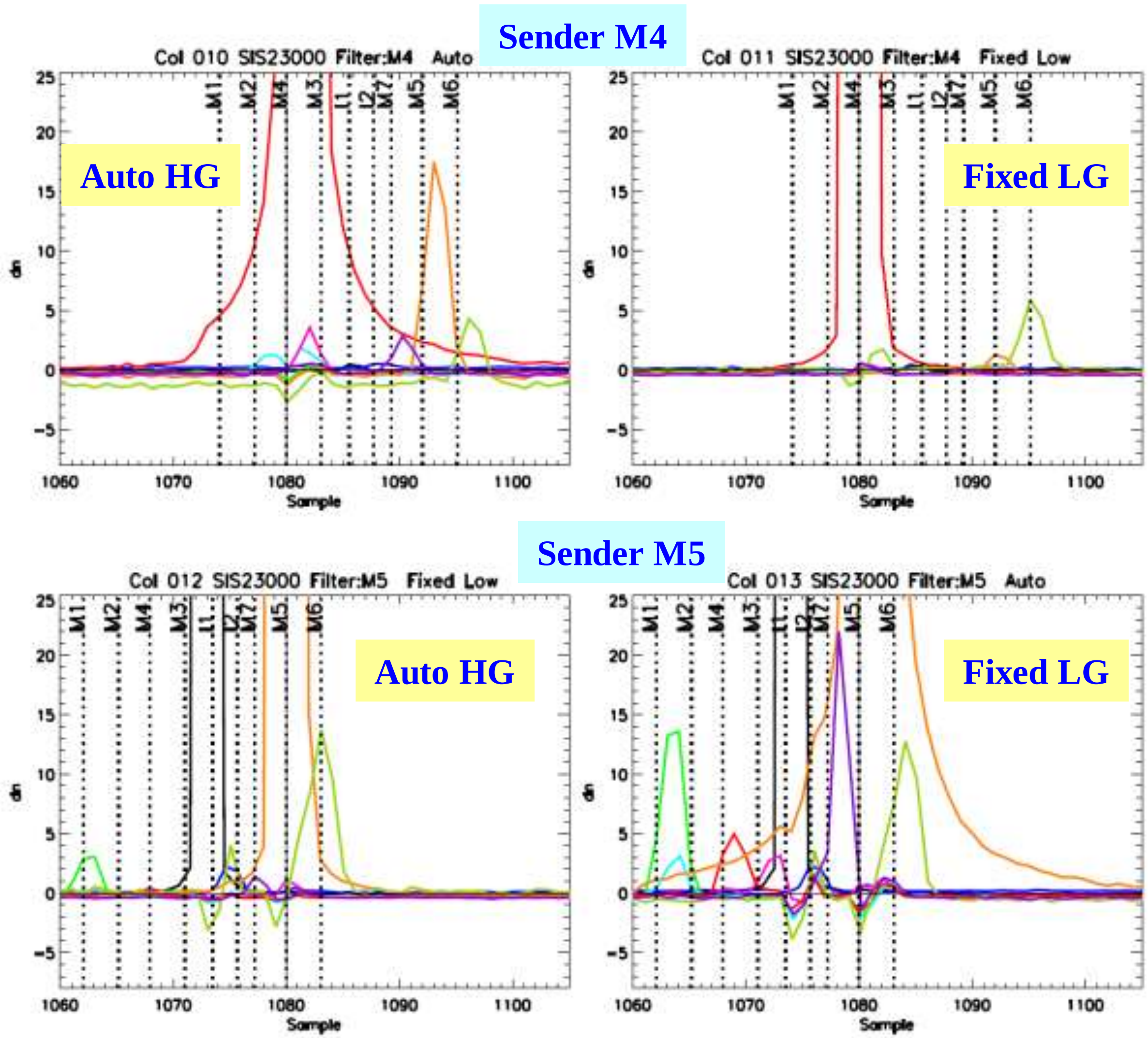
Single vertical slit

Preliminary Summary of Dynamic Crosstalk

Generally in radiance space:

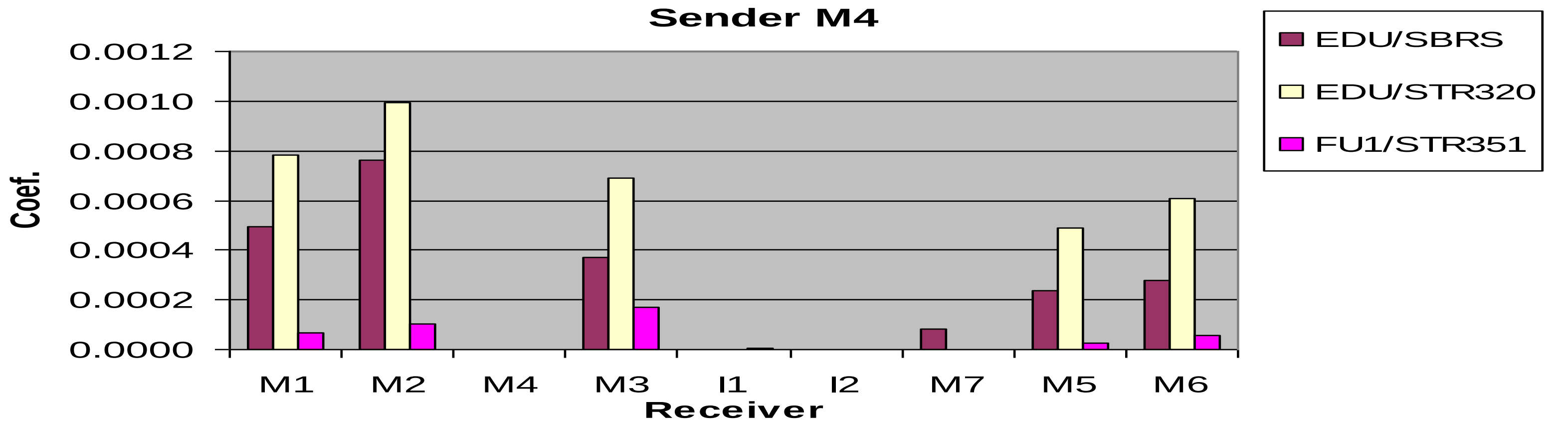
- Improvement is made in dynamic crosstalk in FU1 compared with EDU data after bond wire additions
- Dynamic crosstalk are observed only in VisNIR when sender bands are M4, M5, I1, and I2/M7
- Dynamic crosstalk in radiance space is impacted by gain state. Low gain has smaller coefficients.
- Dynamic crosstalk is proportional/linear to the source level
- Detector variations and I-band sub-sample difference are measurable

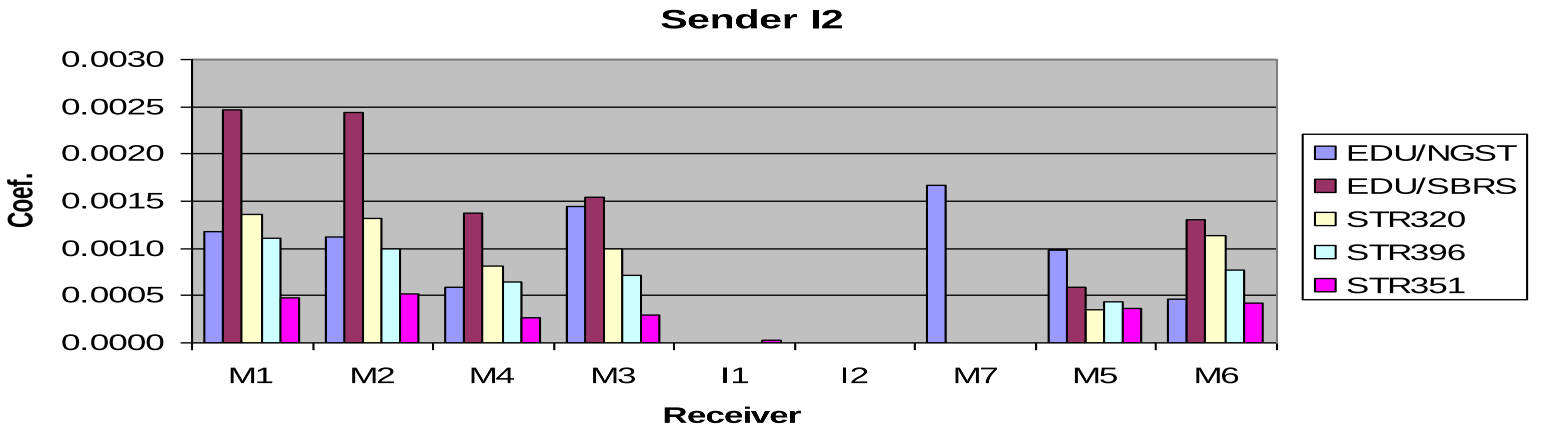
Dynamic Crosstalk Signal from STR-351



- TMC SIS level 23000 fl
- De-register dn vs. sample number for the middle detector
- Low gain has lower dynamic crosstalk than that of the auto HG
- Dynamic crosstalk is evident
- Optical crosstalk is also observed in receiver bands M1 and M5-M7

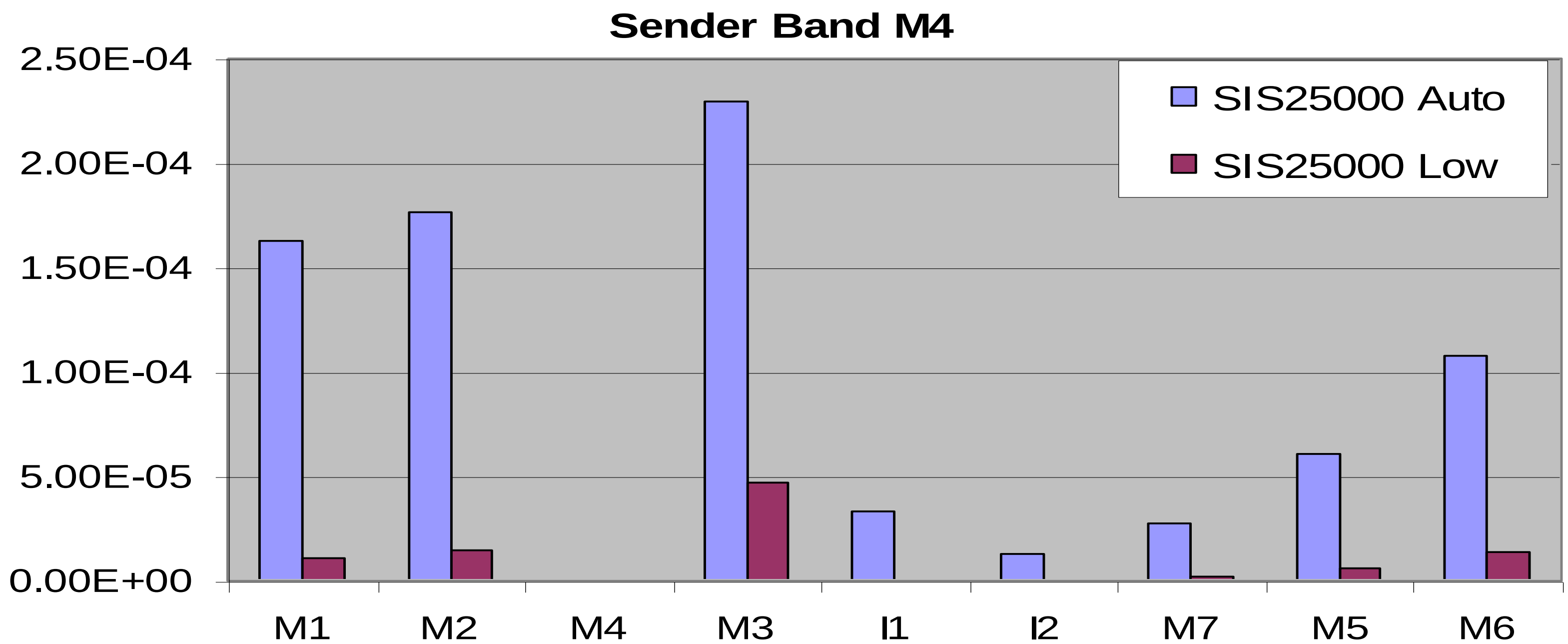
Dynamic Crosstalk in Radiance (Preliminary)





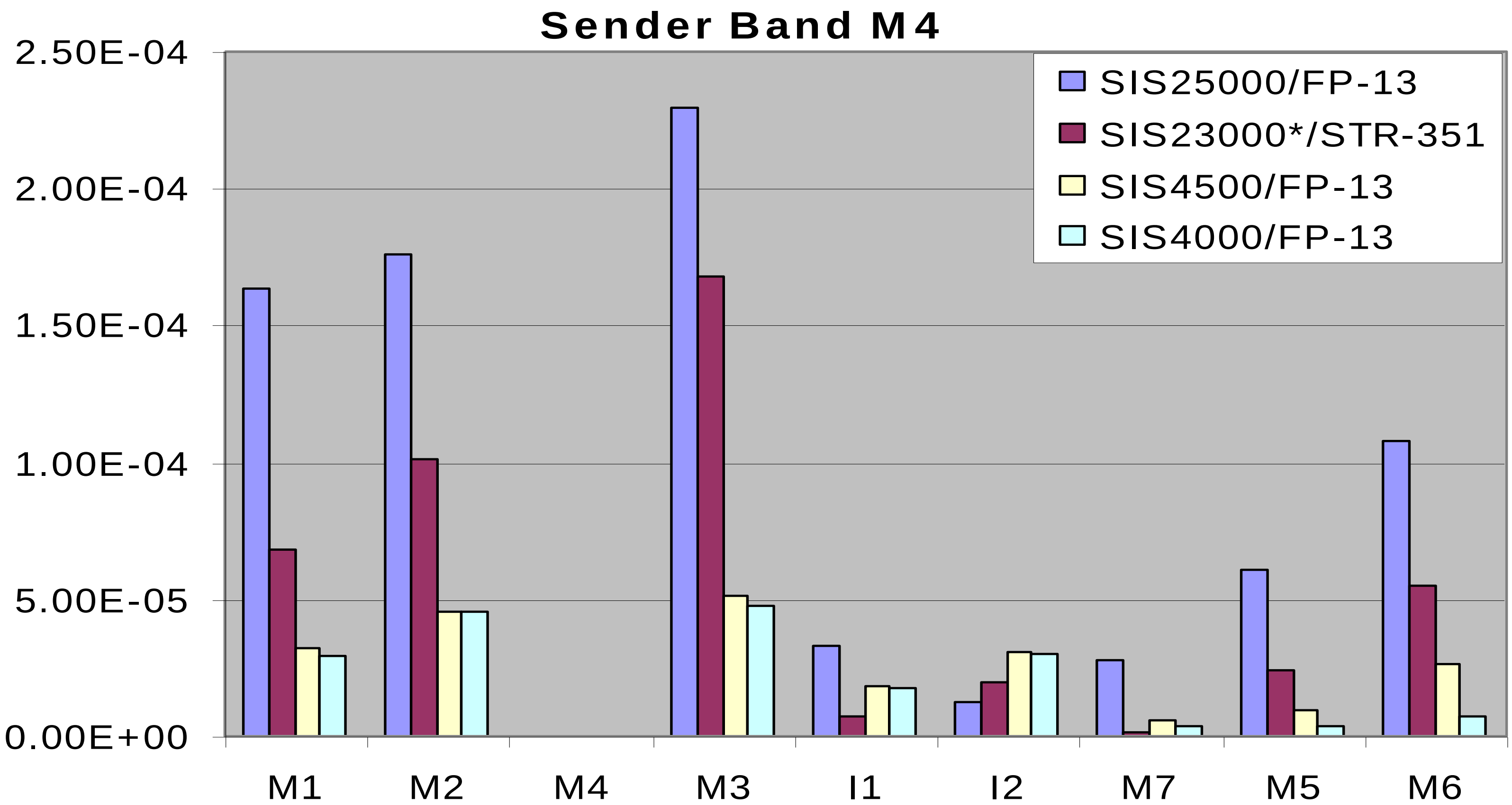
- Improvement was made in dynamic crosstalk after bond wire additions
- In general, FU1 has smaller dynamic crosstalk than EDU

Averaged Crosstalk Coefficient vs. Gain State



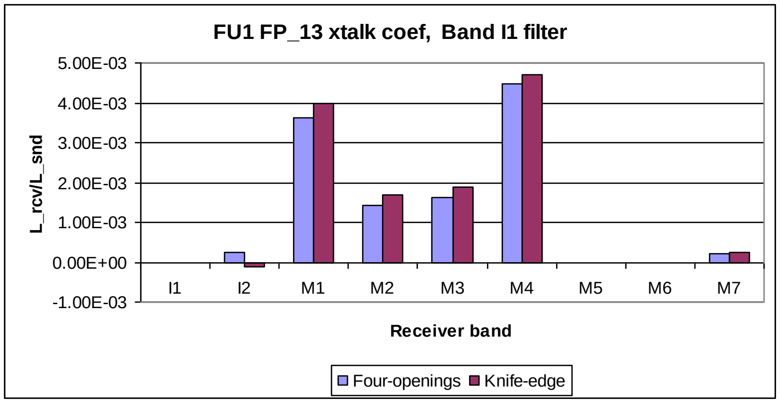
Auto HG has higher dynamic crosstalk coefficient than that of LG state

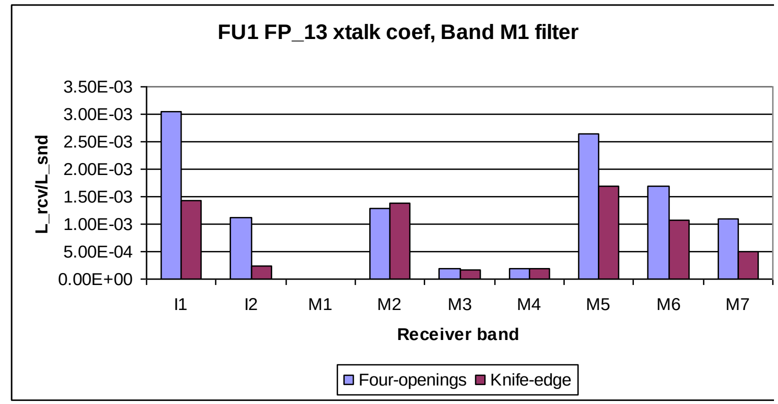
Crosstalk vs. SIS Level

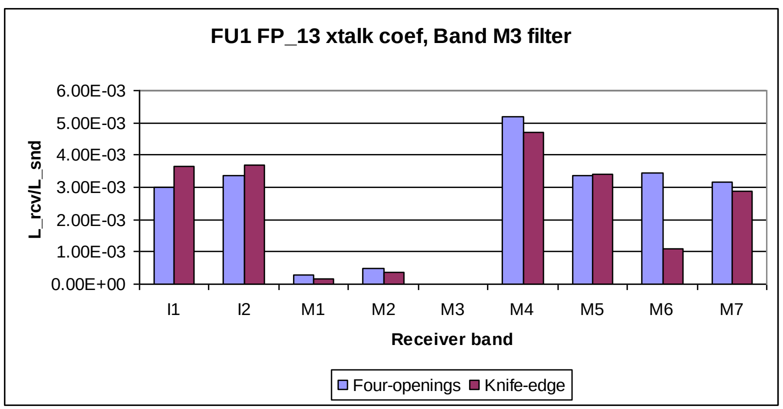


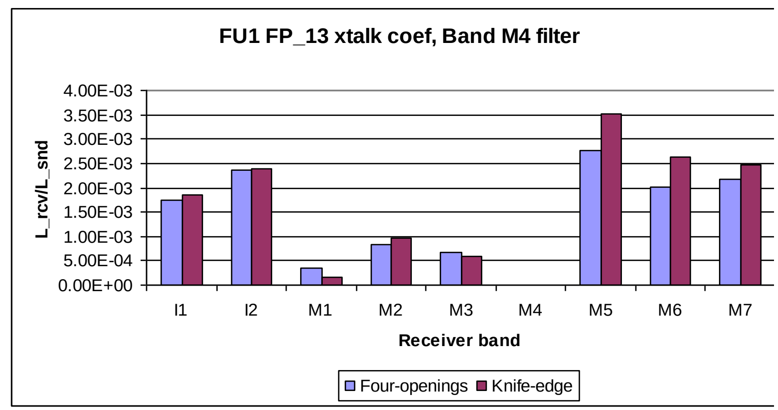
Amplitude of dynamic crosstalk in radiance ratio is proportional/linear to the source level

Optical Crosstalk coefficients
From FP-13 Four-opening and KE (1)









Optical crosstalk is also observed in dynamic tests

Electrical Static P-to-P Crosstalk from FP-13

- Part 1 uses the Three Mirror Collimator (TMC) and Part 2 uses the Scatter Measurement Assembly (ScMA) to cover the low gain region of the VisNIR dual gain bands.
- Verify sensor compliance with crosstalk requirements for all spectral bands.

Summary from P-to-P Static Crosstalk

VisNIR FPA:

- Dominant sender detectors are 3, 8, and 13 from MB and 5/6, 15/16, 25/26 from IB
- Significant readout crosstalk from ROIC are observed which is N MB-detector away from the sender detector in track direction (N= 0, 2, and ±10/11)
- For HG-->HG, high in-band optical scattering (in track direction) extended over ±5~ ± 8 adjacent MB detectors
- For LG-->HG and LG-->LG, optical scattering to adjacent bands (in scan direction) is the dominant effect
- LG-->HG exhibits higher electrical crosstalk in the dn ratio. This may associated with the gain bit transition from the ASP board
- Sub-sample differences are measurable
- Limited source levels didn't provide evidence of crosstalk linearity. The FP-15/FP-16 tests are appropriate tests for the linearity investigation

LWIR FPA:

- No measurable readout crosstalk
- No measurable dominant sender detectors

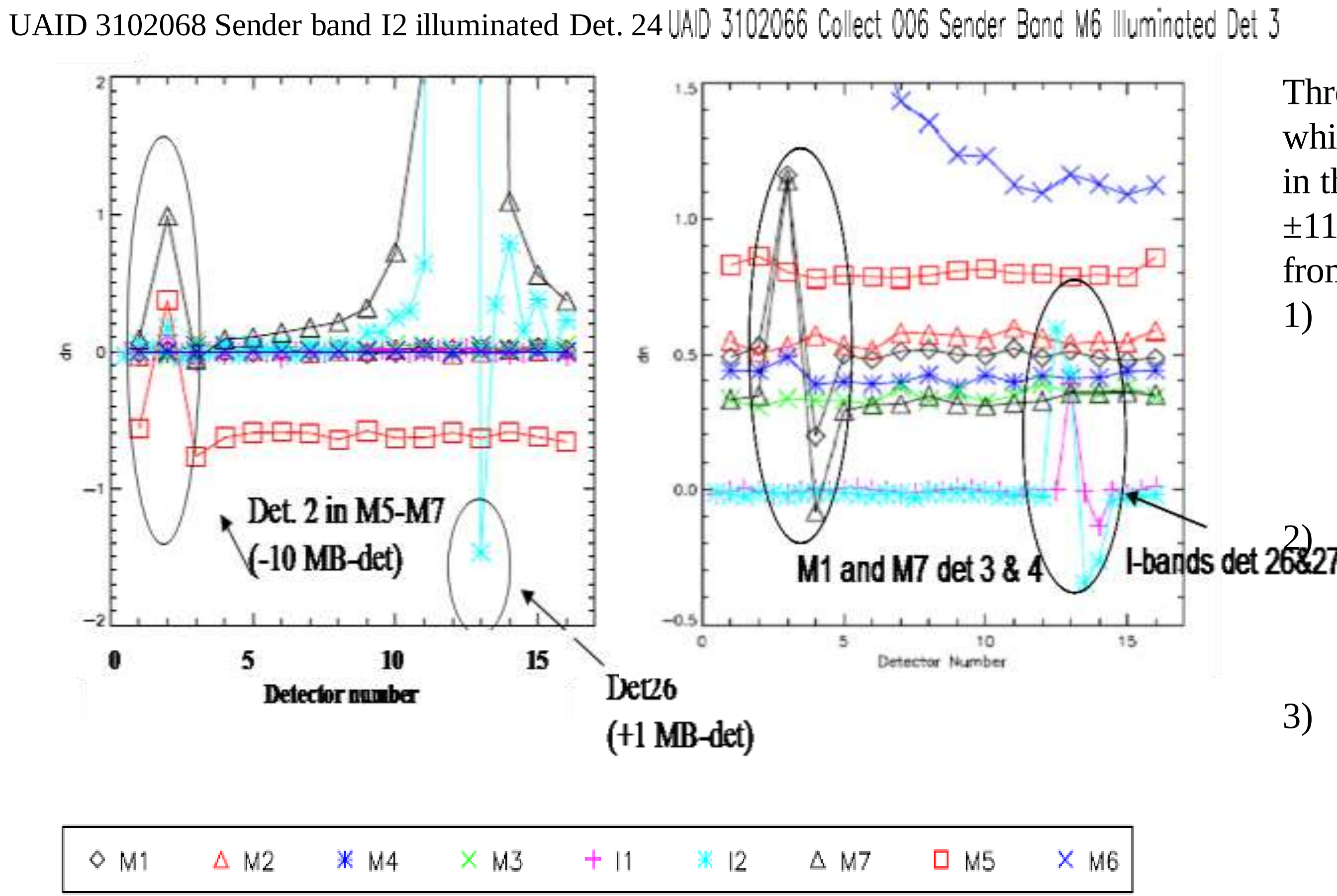
S/MWIR FPA:

- Relatively small but noticeable readout crosstalk which is N MB detector away from the sender detector (N= 0, 1, ±10)
- Relatively small but noticeable dominant detectors are 8 and 13
- Odd, even detectors and sub-sample differences are measurable

Summary of Out of Spec. Bands/Detectors

- Current P-to-P crosstalk testing has both electrical and optical components
- Optical artifacts in the test set up are leading to high uncertainties in the electric crosstalk measurements
- Given a severe sensor specification, many receiver detectors in all spectral bands are not compliant
- For most of bands, majority of out of spec detectors (P-to-P) have crosstalk to Noise Ratio (CNR) less than 1.
- However, crosstalk should be summed over all senders, which leads to CNR values much higher that the spec. of 0.5NEdL.
- A completed comprehensive crosstalk influence tables can be found in the eRoom: https://collab2.st.northropgrumman.com/eRoom/PayloadSensors/VIIRS/0_8452F

Readout Crosstalk from ROIC



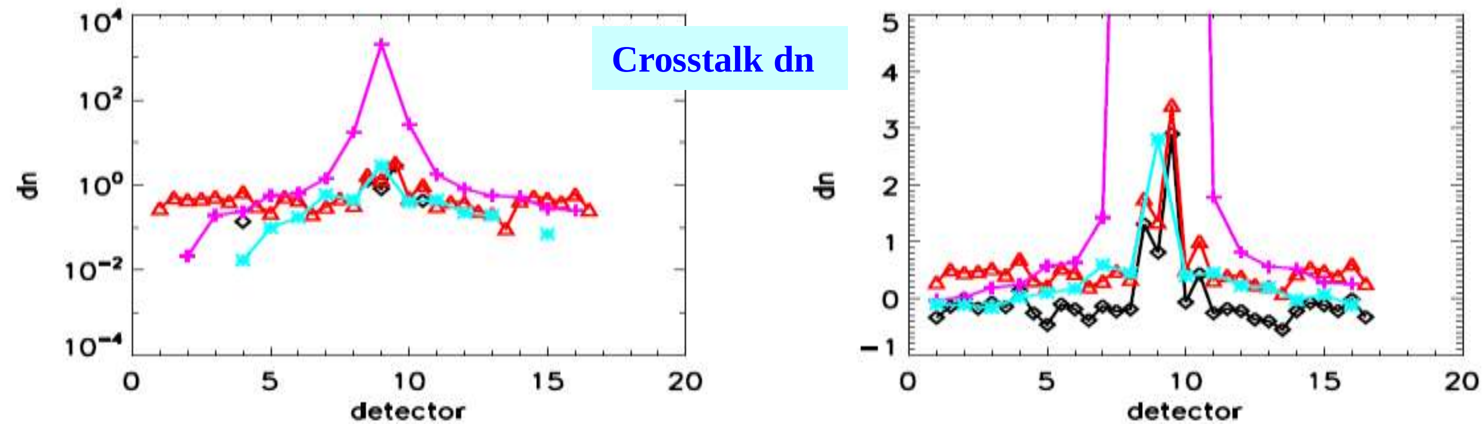
Three types of ROIC crosstalk, which are preferentially located in the track field at 0, 2, ±10 and ±11 M-band detectors away from the sender detector:

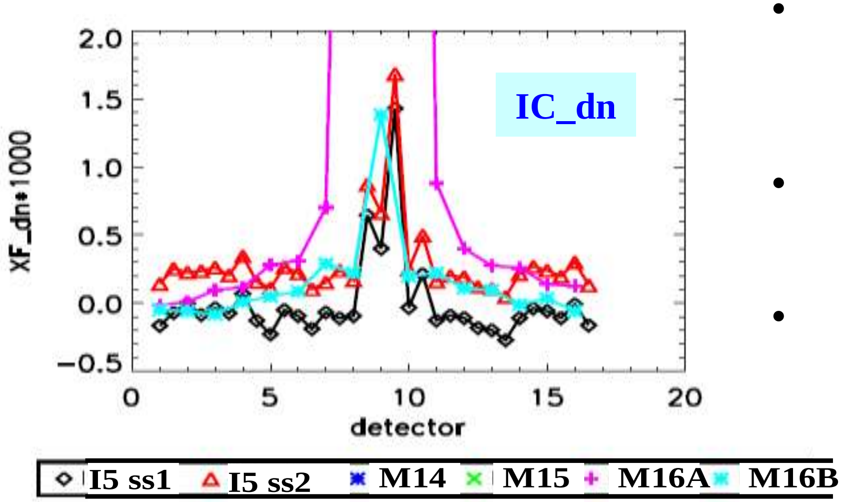
1) a negative dip response usually less than 1.5dn and is associated with sender band in-band pixels
2) a positive anomalous signal peak which is associated with cross-band pixels
3) a pair of positive & negative or negative & positive anomalous signal peaks which also occurs for cross-band pixels.

dn vs. detector number

Adjacent band and In-band optical artifacts

U3102155 Collect 18: Illuminated Band M16A, Detecter 9





- Effect of optical artifact associated with adjacent bands which have significant or completed spectral overlap is exclude (M16 and I5)
- In-band crosstalk along track direction is contaminated by optical artifacts of scattering and illumination spillover
- Crosstalk between adjacent bands is also dominated by optical artifacts.

Crosstalk Assessment

- Crosstalk influence coefficients are derived in dn, radiance and noise (crosstalk to noise ratio) spaces

$$IC\_dn = \frac{dn_{REC}(i)}{dn_{SND}(j)}$$

$$IC\_L = \frac{\Delta L_{REC}(i)}{\Delta L_{SND}(j)} = \frac{g_{SND}(j)}{g_{REC}(i)} \frac{dn_{REC}(i)}{dn_{SND}(j)}$$

$$CNR = \left[\frac{L_{MAX}(j) g_{SND}(j)}{2}\right]\left[\frac{dn_{REC}(i)}{dn_{SND}(j)}\right]\left[\frac{\sqrt{3}}{\sigma_{REC-DARK}(i)}\right]$$

- Verification is made between the sensor crosstalk compliance against the requirement SRV0631 to the 0.2% Ltyp or 0.5 noise:

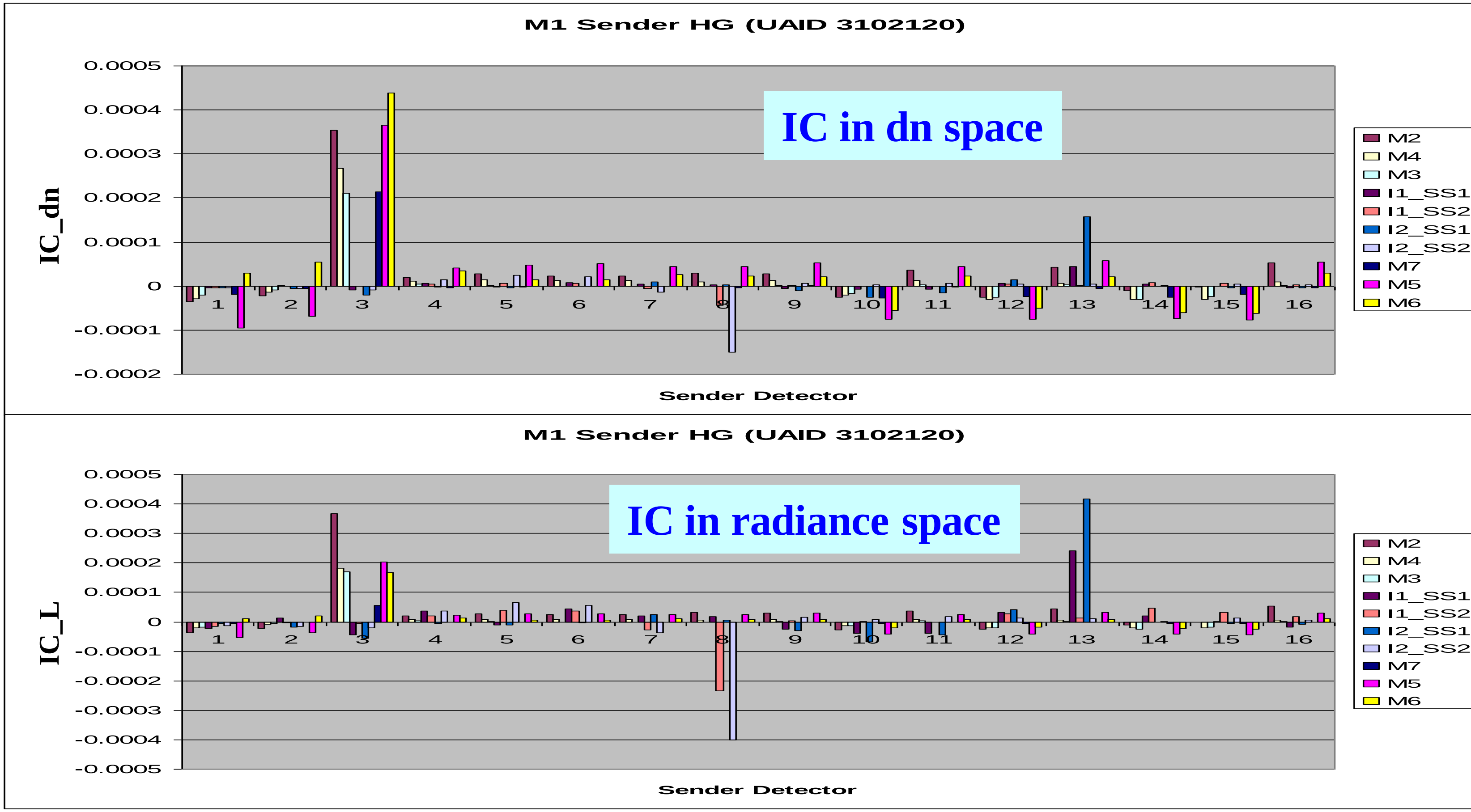
$$PVP_{Spec} = L_{MAX}\, g_{SND}\left[\frac{dn_{REC}}{dn_{SND}}\right]\left[\frac{\sqrt{3}}{0.5 \cdot \sigma_{REC-DARK}}\right]$$

$$PVP_{Spec} = L_{MAX}\left[\frac{g_{SND}}{g_{REC}} \frac{dn_{REC}}{dn_{SND}}\right]\left[\frac{1}{0.002 L_{TYP}}\right]$$

dn_{SND}: dn of the sender detector
dn_{REC}:dn of the receiver detector
g_{SND}: radiometric gain of the sender detector
$g_{REC:}$ radiometric gain of the receiver detector
L_{MAX}: the maximum radiance for the sender band
$\sigma_{REC-DARK}$: standard deviation of the receiver detector for the shutter closed scans only.

$\sqrt{3}$ is only for diagnostic mode and apply for single gain bands

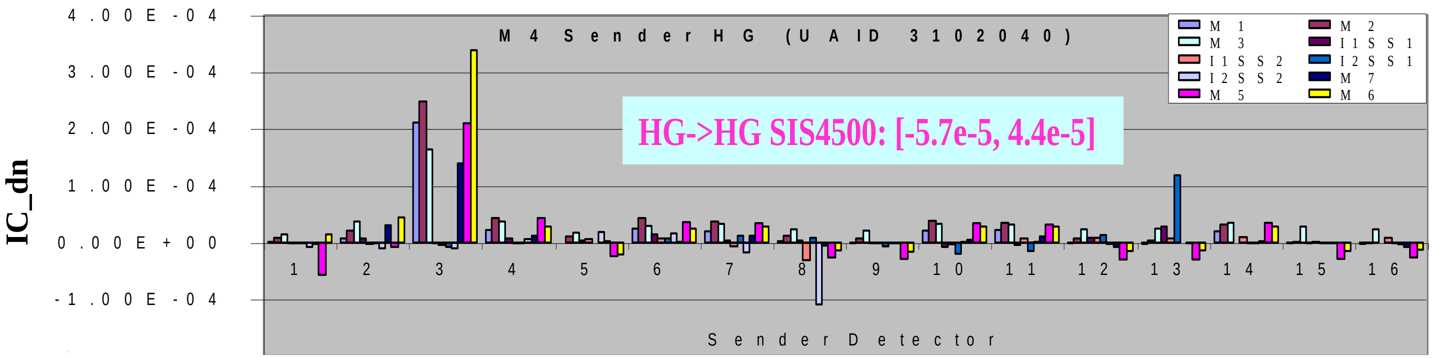
Major Crosstalk Sender Det. in Band M1

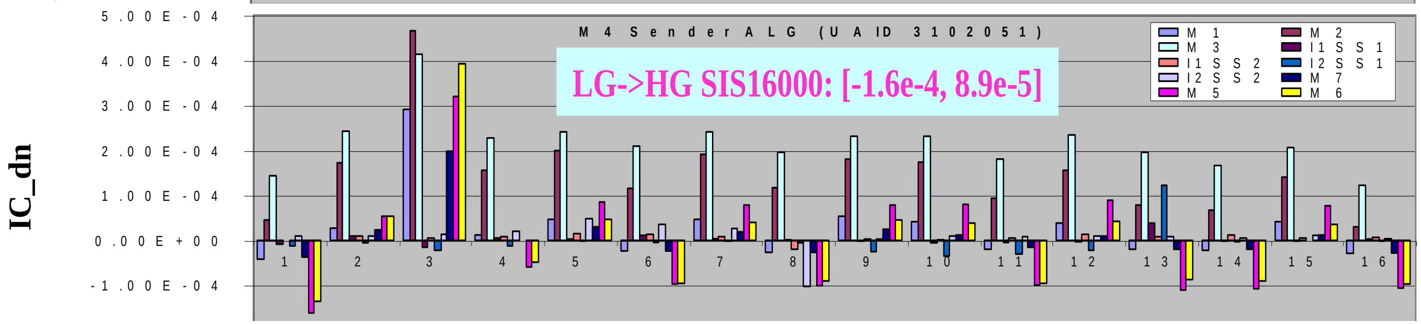


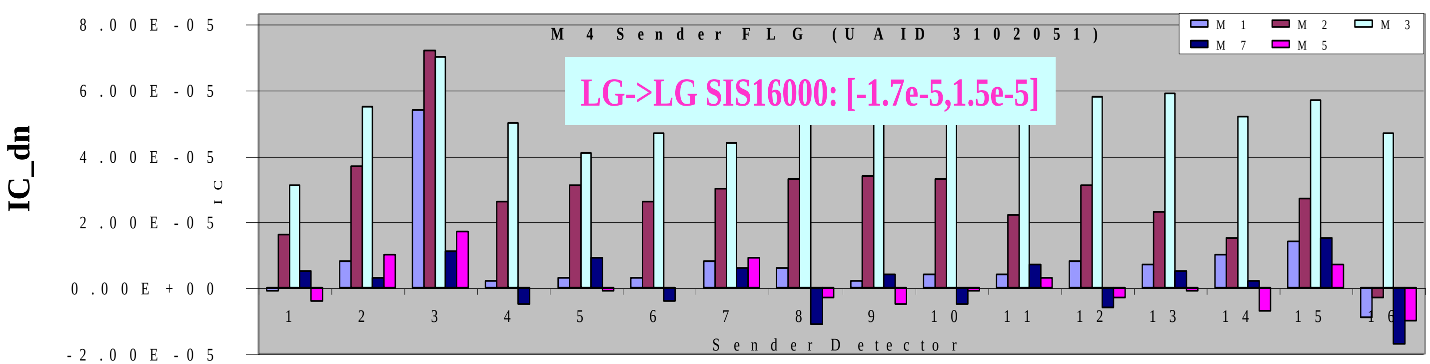
Dominant detectors: M-band detectors: 3, 8, and 13
I-band detectors: 5,6, 15,16 and 15,16

The identified dominant sender detectors from dn and radiance space are consistent

Dual-gain band crosstalk

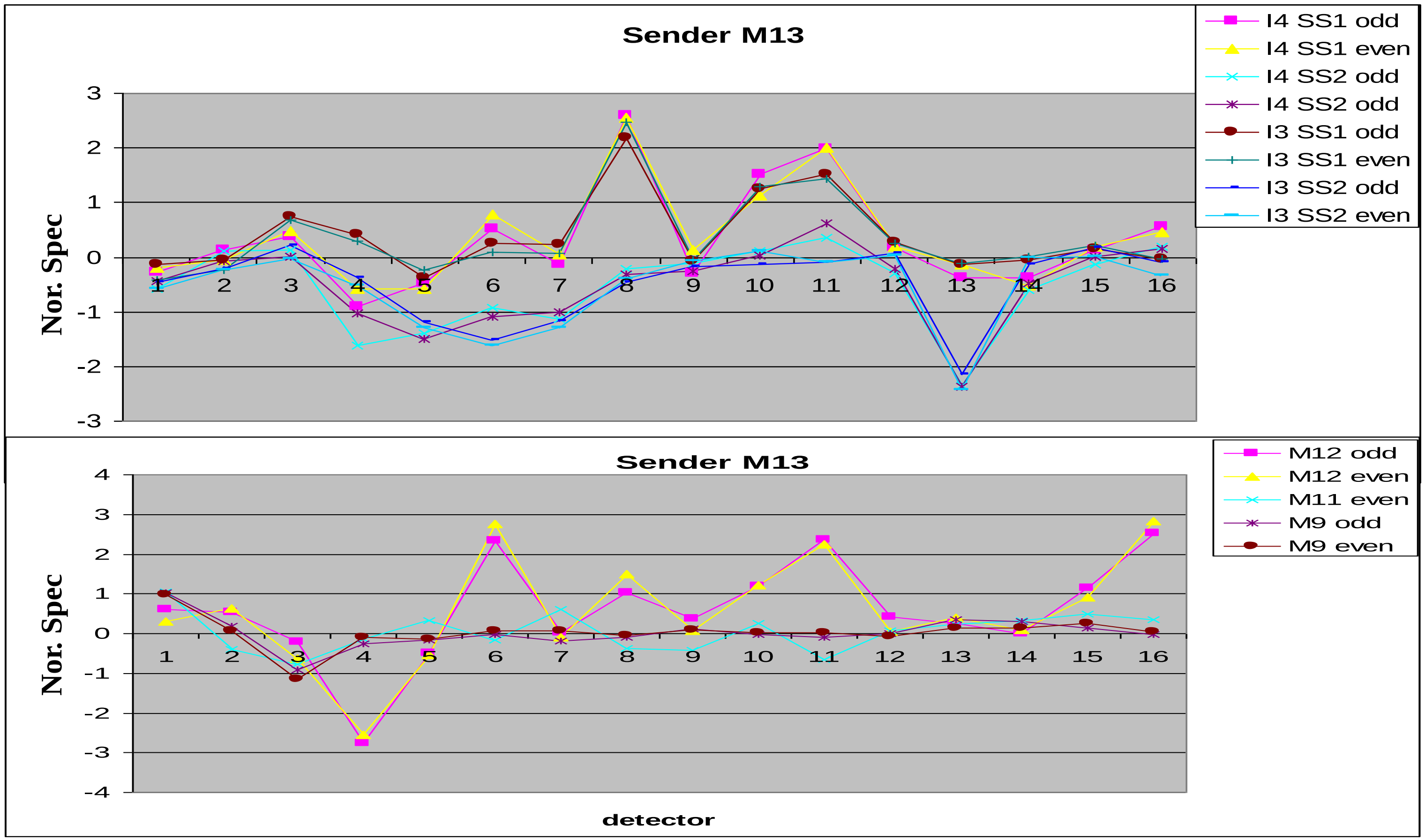






- When sender is in LG state, optical scattering/artifacts to adjacent bands are dominant
- Fixed LG has the smallest crosstalk influence coefficient

Identifying Out of Spec. detector



Detectors with Normalized spec. >1.0 do not meet baseline requirement

Path forward

- NGST and NASA continue to assess crosstalk impact on FU1 SDR/EDR
- NASA science community recommends insertion of re-manufactured IFA in FU1 at the earliest opportunity
- NASA science community recommended hardware ROIC rework but probably not possible for FU1

Backup References

Ambient phase I&II Data Check List

Test ID	Test Name	No. of UAIDs	No. of Collects	Data Size GB	Processed
FP-1	Blackbody function, DC restore	67	67	8.3	5.8
FP-10	RVS	131	329	41.9	41.9
FP-11	Polarization sensitivity	67	1254	20.0	20.0
FP-12	Stray-light rejection	28	583	20.1	20.1
FP-13	Xtalk	118	2488	323.1	323.1
FP-14	NFR	87	261	60.0	60.0
FP-4	BBR	122	354	70.1	64.1
FP-5	Pointing/scan angle	11	64	9.1	
FP-6	MTF/HSR	58	149	49.6	
FP-8	Power profile	22	48	13.6	
FP-9	Sensor modes	70	93	5.0	
RC-1	Radiometric	287	1638	107.0	107.0
SI-2	Focal Plane integration	25	121	3.0	
SI-4	Command/Telemetry verification	13	29	3.5	
SI-5	Ecal	14	77	1.1	0.1
SI-6	Noise	20	252	26.8	6.5
STR-351	VNIR xtalk Veritcal slit	1	27	1.4	1.4
STR-352	In-band xtalk hor. Knife-edge	5	60	42.4	42.4
STR-354	dual-gain switching	1		1.4	
STR-356	Polarization	7		2.4	
STR-358	VNIR xtalk Vertical knife-edge	1	41	1.7	1.7
STR-359	SWIR B-to-B in-band xtalk slit	3	25	15.0	15.0
STR-405	SWIR B-to-B inband xtalk knife-edge	1	23	1.4	1.4
STR-406	xtalk static	1	55	5.2	5.2
STR-500	RVS	5	21	4.2	
STR-502	VNIR optical xtalk filter character	5	19	9.1	
STR-520	VNIR xtalk	5	32	9.0	
STR-530	PSA investigation	13		11.0	
STR-528	Polarization	1	13	4.7	4.7
STR-545	Polarization	12	25	4.7	4.7
STR-536	Polarization	12	374	4.7	
STR-541	NFR	7	48	10.2	10.2
STR-504	Radiometric calibration	6	32	3.1	3.1
STR-506	Radiometric calibration	1	11	0.5	0.5
STR-508	Radiometric calibration	1	7	0.7	0.7

>800 GB data has been Processed

Ambient phase III Data Check List

Test ID	Name	# of UAIDs	# of Collects	Size (gb)	processed	note
SI-2	Focal Plane Integration	2	17	0.75		
SI-4	Command & Telemetry Verifciation	2	6	1		
SI-5	Electronics Self Test	2	16	2.1		
SI-6	Noise	2	11	2.5	2.5	
FP-8	Power Profile	9	141	1.9		
FP-15	Relative Spectral Response	6	9	1.3		dry run
FP-16	Relative Spectral Response	24	109	3.5		dry run
RC-5	RC Thermal Bands	9	18	1.2		dry run
STR-537	VIIRS Data Throughput	2	2	0.02		
STR-553	DNB CV Noise Investigation	6	18	4.2		
STR-554	Polarization Characterization	140	1417	355.6	30	some are dry run
STR-559	Maximum Bandwidth testing	6	6	0.02		
STR-565	Vertical Scan of SIS 100	5	72	8.3		
STR-573	VIIRS Data Throughput	7	7	0.07		
E System Test		8	12	0.05		

>32.5 GB data has been Processed

Released Data Analysis Reports During Phase I Test

NICST_REPORT_07_007q	A quick report to the white-noise for the test of FU-1 SI-6 pt 1.1	07/12/07
NICST_REPORT_07_008q	Preliminary Results of VIIRS FU1 Dynamic crosstalk in SMWIR and LWIR Fro	07/15/07
NICST_REPORT_07_009q	Preliminary analysis of FU1 VIIRS Ambient SI-5 Electronics Self Test	07/17/07
NICST_REPORT_07_010q	Preliminary Results of VIIRS FU1 Dynamic crosstalk in SWMIR/LWIR From S	07/19/07
NICST_REPORT_07_011q	Preliminary Results of VIIRS FU1 Dynamic crosstalk in VisNIR From STR-351	07/19/07
NICST_REPORT_07_012q	FU1 Ambient I Test Data Processing Report SI-6 Part 1.1 and Part 2 (baseline	07/20/07
NICST_REPORT_07_013q	Preliminary Results of VIIRS FU1 Dynamic crosstalk in VNIR bands from STR	07/23/07
NICST_REPORT_07_014q	FU1 VIIRS Line Spread Function along Scan for Image Bands From FP-6 2.3	07/26/07
NICST_REPORT_07_015q	Preliminary Results of VIIRS FU1 along Scan BBR From FP-4 Part 2	07/26/07
NICST_REPORT_07_016q	FU1 Ambient I Test Data Processing Report from STR 406 (static part)	07/26/07
NICST_REPORT_07_017q	Preliminary Results of VIIRS FU1 RC-01 pt. 2 for RSB bands (Electronic Side	07/28/07
NICST_REPORT_07_018q	VNIR CTIA Saturation Investigation From STR504 and RC-1 Part 2	08/01/07
NICST_REPORT_07_019q	Preliminary Results of VIIRS FU1 STR-352 in-band xtalk using a horizontal kn	08/06/07
NICST_REPORT_07_020q	FU1 Ambient I Test Data Processing Report FP - 1 Part 1	08/08/07
NICST_REPORT_07_021q	Preliminary Results of VIIRS FU1 band M8 Dynamic Range From STR-508	08/09/07
NICST_REPORT_07_022	crosstalk comparison from STR-443 and STR-406	08/09/07
NICST_REPORT_07_023q	M1-M3 Saturation Investigation From STR506	08/10/07
NICST_REPORT_07_024q	FU1 Ambient I Test Data Processing Report SI-6 Part 1.1 (baseline, run 2)	08/10/07
NICST_REPORT_07_025q	FU1 Ambient I Test Data Processing Report RC - 1 Part 1	08/15/07
NICST_REPORT_07_026q	Preliminary Results of VIIRS FU1 RC-01 pt. 2 run2 for RSB bands (Electronic	08/18/07
NICST_REPORT_07_027q	Preliminary Results of VIIRS FU1 RC-01 pt. 2 run2 for electronic Side B and its comparison with side A	08/18/07
NICST_REPORT_07_028q	VIIRS FU1 RC-01 pt. 2 run2 Measurement for RSB bands Electronic Side B	08/21/07
NICST_REPORT_07_029q	FU1 Ambient I Test Report from SI-6 Part 1.1 (baseline, run 3)	08/28/07
NICST_REPORT_07_030q	Preliminary Results of VIIRS FU1 RC-01 pt.1 run 2	08/28/07
NICST_REPORT_07_031q	Preliminary Report on FP-4 Side A Run 3	08/28/07
NICST_REPORT_07_032q	Preliminary Report on FU1 RC-01 Part 4	09/10/07

Released Data Analysis Reports During Phase II Test

NICST_REPORT_07_033q	Preliminary Report on FU1 VIIRS Polarization Insensitivity Analysis	09/11/07
NICST_REPORT_07_034q	Dynamic crosstalk comparison (between EDU & FU1 and FU1 component & sensor level)	09/16/07
NICST_REPORT_07_035q	Preliminary Report on RSB RVS Characterization	09/26/07
NICST_REPORT_07_036q	Preliminary Report on FU1 VIIRS Polarization Insensitivity Analysis (upper &lower track)	09/27/07
NICST_REPORT_07_037q	Summary of FU1 STRs crosstalk	09/08/07
NICST_REPORT_07_038q	Summary Report on Polarization Insensitivity Analysis	09/20/07
NICST_REPORT_07_039q	Preliminary Results of VIIRS FU1 dynamic xtalk in VisNIR xtalk using Single Slit Scanning with BPF M4 from FP-13	10/04/07
NICST_REPORT_07_040q	FU1 FP-13 four-rectangular opening xtalk tests (M4 filter only)	10/05/07
NICST_REPORT_07_041q	Preliminary analysis of TEB RVS from FP-10 part 2	10/09/07
NICST_REPORT_07_042q	Preliminary Report on FU1 VIIRS Polarization Insensitivity Analysis (with PSA correction)	10/10/07
NICST_REPORT_07_043q	RSB RVS Characterization With SIS Monitor Data Correction	10/10/07
NICST_REPORT_07_044q	Preliminary Results of VIIRS FU1 static point-to-point xtalk in VisNIR using BPF M4 from FP-13	10/11/07
NICST_REPORT_07_045q	Preliminary results of FU1 FP-13 knife-edge xtalk tests (M4 filter only)	10/12/07
NICST_REPORT_07_046q	Preliminary Results of VIIRS FU1 static point-to-point xtalk in VisNIR using BPF I1 from FP-13	10/17/07
NICST_REPORT_07_047q	Preliminary Results of VIIRS FU1 static point-to-point xtalk in VisNIR using BPF M7 from FP-13	10/19/07
NICST_REPORT_07_048q	FU1 FP-13 four-rectangular opening xtalk tests for VisNIR bands	10/23/07
NICST_REPORT_07_049q	FU1 FP-13 knife-edge xtalk tests data analysis for VNIR bands	10/26/07
NICST_REPORT_07_050q	Preliminary Results of VIIRS FU1 Static Xtalk in VisNIR with BPFs M1, M2, M3, M5, M6 and I2 Fro	11/11/07
NICST_REPORT_07_051q	FU1 Ambient Test Data Processing Report RC - 1 Part 1 (run 3)	11/15/07
NICST_REPORT_07_052q	Analysis Results of VIIRS FU1 Xtalk with VisNIR BPF From FP-13	11/15/07
NICST_REPORT_07_053q	FU1 FP-14 Near-Field Response (NFR) for VNIR bands	11/26/07
NICST_REPORT_07_054q	NICST Major Findings and Concerns From FP-13 VIIRS FU1 VisNIR Static Point-to-Point Test	11/29/07
NICST_REPORT_07_055q	Summary of FU1 FP-14 with Bandpass Filter (BPF) for VisNIR Bands	11/29/07
NICST_REPORT_07_056q	Analysis of FU1 FP-12 stray-light rejection for VisNIR Bands	12/10/07
NICST_REPORT_07_057q	Analysis Results of VIIRS FU1 Xtalk with LWIR From FP-13 (static)	12/17/07
NICST_REPORT_07_058q	VIIRS FU1 Polarization Insensitivity Analysis from STR-545	12/19/07
NICST_REPORT_07_059	NICST Test Data Review from VIIRS FU1 Ambient Phase II Test	12/19/07
NICST_REPORT_07_060q	Analysis of TEB RVS from FP-10 part 2 updated	12/26/07
NICST_REPORT_07_061q	Analysis of FU1 FP-12 stray-light rejection for VisNIR Bands	12/28/07
NICST_REPORT_08_001	FU1 Ambient I Test Report from SI-6 Part 1.1 (baseline, run 3)	01/02/08
NICST_REPORT_08_002q	Analysis Results of VIIRS FU1 Xtalk with SMWIR From FP-13 (static)	01/06/08
NICST_REPORT_08_003q	VIIRS FU1 Polarization Alignment Analysis from STR-528	01/15/08

Released Data Analysis Memos (1)

Number	Subject	Date
NICST_MEMO_07_001	VIIR EDU VNIR Xtalk/Scatter Analysis using FP-16 part1 OOB RSRMeasurement Data	Jan. 2, 2007
NICST_MEMO_07_002	Data Analysis of VIIRS EDU TV RC-02 Test: Hot Plateau with Voltage 28V	Jan. 12, 2007
NICST_MEMO_07_003	Comparison of VIIRS EDU radiometric calibration at three temperature at three temperature pleateus for VNIR bands	Jan. 22, 2007
NICST_MEMO_07_004	VIIR EDU in-band RSR for the VNIR bands after SpMA source correction	Jan. 30, 2007
NICST_MEMO_07_005	VIIR EDU Dynamic crosstalk in VNIR bands from STR-320	Feb. 06, 2007
NICST_MEMO_07_006	Comparison of VIIRS EDU FP-16 xtalk results between NICST and NGST	Feb. 13, 2007
NICST_MEMO_07_007	VIIRS EDU static electronic xtalk comparison using FP-15 and FP-16 RSR measurement data sets	Feb. 20, 2007
NICST_MEMO_07_008	Preliminary Results for Crosstalk among FU1 VIS/NIR bands from VIIRS FU1 STR-397 Test	March 07, 2007
NICST_MEMO_07_009	VIIRS EDU VIS/NIR crosstalk analysis using ploychromatic illumination STR319 (static case)	March 12, 2007
NICST_MEMO_07_010	Analysis of VIIRS VisNIR crosstalk using coefficients derived from FP-16 tets data and radiance from MODIS scenes	March 16, 2007
NICST_MEMO_07_011	VIIRS FU1 Dynamic Crosstalk in the VNIR bands From STR-396	March 21, 2007
NICST_MEMO_07_012	Plateau	March 28, 2007
NICST_MEMO_07_013	Preliminary analysis of FU1 STR-430 xtalk test using a horizontal knife edge reticle	April 03 2007
NICST_MEMO_07_014	VIIRS FU1 Dynamic anomalies in the SMWIR and LWIR from STR-396	April 12 2007
NICST_MEMO_07_015	Variation in EDU TEB radiometric characterization due to satellite voltage change at TV Hot Plateau	April 19 2007
NICST_MEMO_07_016	Preliminary Results of VIIRS FU1 Calibration Data Reporting and DC Restore Verification (FP-1 part 2)	May 03 2007
NICST_MEMO_07_017	VIIRS FU1 dual gain noise artifacts (STR-431)	May 31 2007
NICST_MEMO_07_018	Alone-scan IFOV and MTF results for the VIIRS FU1 ambient test	June 13 2007
NICST_MEMO_07_019	VIIRS EDU TEB radiometric characterization change (RC-5 part 2) for the OBC BB temperature warm-up and cool-down tests at hot plateau	June 19 2007
NICST_MEMO_07_020	Summary of VIIRS EDU radiometric calibration for Reflective Solar Bands	June 26 2007
NICST_MEMO_07_021	Preliminary FU1 Detector Based Crosstalk Map from STR-443	July 3 2007
NICST_MEMO_07_022	VIIRS FU1 Spatial/Spectral Crosstalk Mapping for the VisNIR from STR443	July 5 2007
NICST_MEMO_07_023	Comparison of electrical x-talk coefficients from EDU FP-16, FP-15 and FU1 STR443	July 17 2007
NICST_MEMO_07_024	VIIRS FU1 along scan spectral band registration	July 24 2007
NICST_MEMO_07_025	Alone-scan IFOV and HSR results for the VIIRS FU1 Image bands	July 13 2007
NICST_MEMO_07_026	Preliminary analysis of VIIRS FU1 dynamic crosstalk in VisNIR bands from STR358	Sept. 17 2007
NICST_MEMO_07_027	VIIRS FU1 dynamic crosstalk in VisNIR bands from STR351	Oct. 02 2007
NICST_MEMO_07_028	VIIRS FU1 Dynamic crosstalk in the SMWIR and LWIR bands from STR-359	Oct. 09 2007
NICST_MEMO_07_029	Data Analysis Results for VIIRS FU1 FP-1 Part 1 (window determination)	Oct. 30 2007
NICST_MEMO_07_030	VIIRS FU1 Response Versus Scan Characterization for the RSB Bands from FP-10 part 1	Dec. 10 2007
NICST_MEMO_07_031	Data Analysis of VIIRS FU1 Near Field Response (NFR) from FP-14 for the Reflective Solar Bands (RSB)	Dec. 12 2007
NICST_MEMO_08_001	Preliminary analysis of VIIRS FU1 FP-13 four-opening reticle dynamic xtalk measurement for RSB	Jan. 11 2008

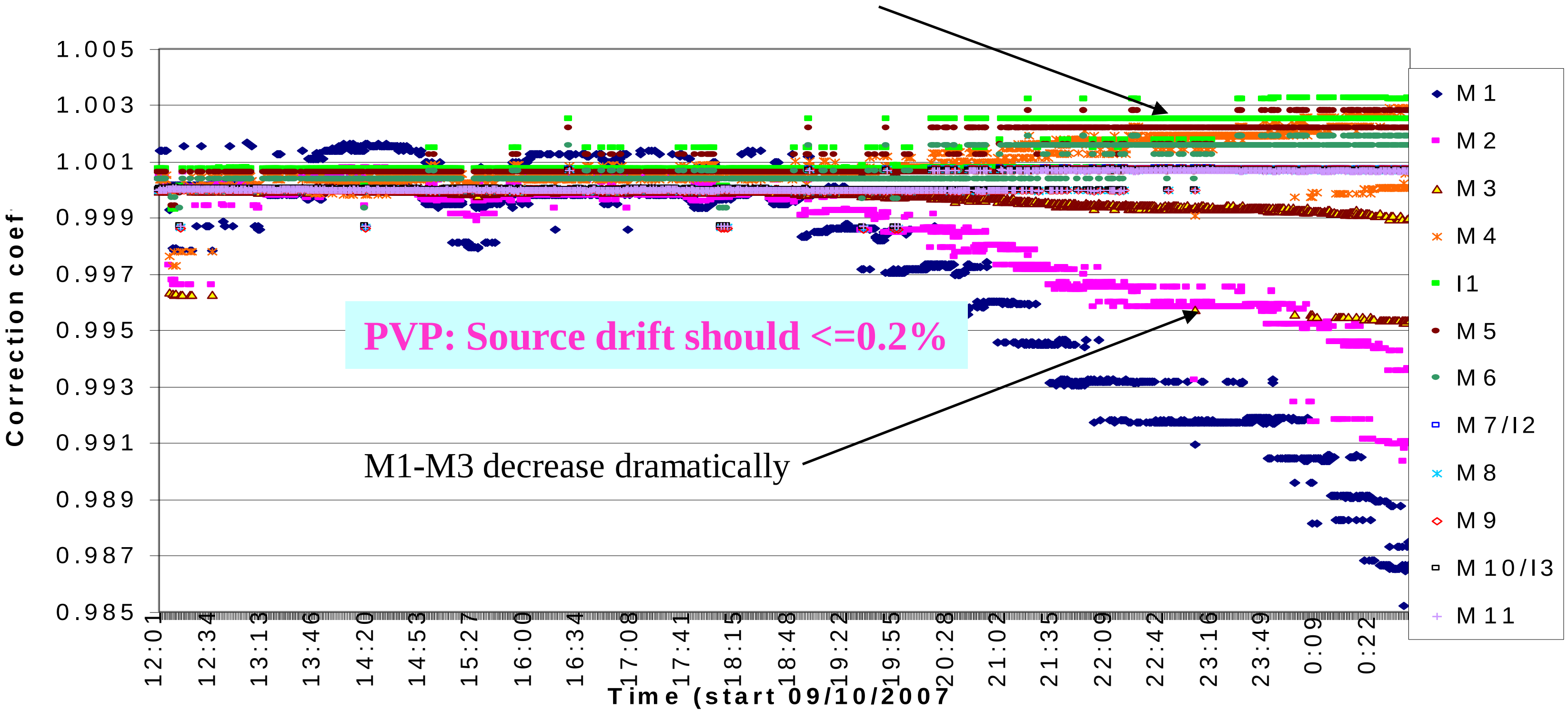
Released Data Analysis Memos (2)

YEAR 2008		
Number	Subject	Date
NICST_MEMO_08_001	Preliminary analysis of VIIRS FU1 FP-13 four-opening reticle dynamic xtalk measurement for RSB	January 11 2008
NICST_MEMO_08_002	Preliminary analysis of VIIRS FU1 FP-12 stray-light rejection measurement for VNIR bands	01/28/08
NICST_MEMO_08_003	VIIRS FU1 Detector Noise Calculation (SI-6 Part 1.1)	01/28/08
NICST_MEMO_08_004	Analysis of VIIRS FU1 FP-13 point-to-point crosstalk for SMWIR	02/12/08
NICST_MEMO_08_005	Preliminary analysis of VIIRS FU1 FP-13 knife-edge reticle dynamic xtalk measurement for VIS and NIR bands	02/25/08
NICST_MEMO_08_006	SIS monitor data and its impact on RSB RVS	02/28/08
NICST_MEMO_08_007	Drift corrected VIIRS FU1 Response Versus Scan (RVS) for the Reflective Solar Bands (RSB) from FP-10 Test	03/03/08
NICST_MEMO_08_008	Response vs. Scan Angle for VIIRS FU1 TEB (FP-10, part 2)	03/11/08
NICST_MEMO_08_009	VIIRS FU1 Polarization-Sensitivity FP-11 Test Data Analysis	03/11/08
NICST_MEMO_08_010	Analysis of VIIRS FU1 FP-13 point-to-point crosstalk for LWIR and SMWIR	03/18/2008
NICST_MEMO_08_011	Summary of VIIRS FU1 RSB radiometric calibration from RC01 and STR tests	03/20/08
NICST_MEMO_08_012	Analysis of VIIRS FU1 RSB radiometric dynamic range from RC-01 Part 2	03/24/08
NICST_MEMO_08_013	Analysis of VIIRS FU1 RSB radiometric sensitivity from RC-01 Part 2	04/01/08
NICST_MEMO_08_014	Study of VIIRS EDU TEB radiometric calibration and retrieval using different ranges and levels of calibration source radiance	04/02/08
NICST_MEMO_08_015	VIIRS FU1 FP-13 dynamic crosstalk, vertical slit for SMWIR and LWIR	04/07/08
NICST_MEMO_08_016	FU1 VisNIR static point-to-point crosstalk maps ffrom FP-13 ambient phase II test	04/11/08
NICST_MEMO_08_017	Summary of FU1 point-to-point static crosstalk from FP-13	04/21/08
NICST_MEMO_08_018	VIIRS FU1 dynamic crosstalk with a single slit from FP-13	04/29/08
NICST_MEMO_08_019	VIIRS FU1 band-to-band registration from ambeint phase II test	05/02/08

Backup RVS

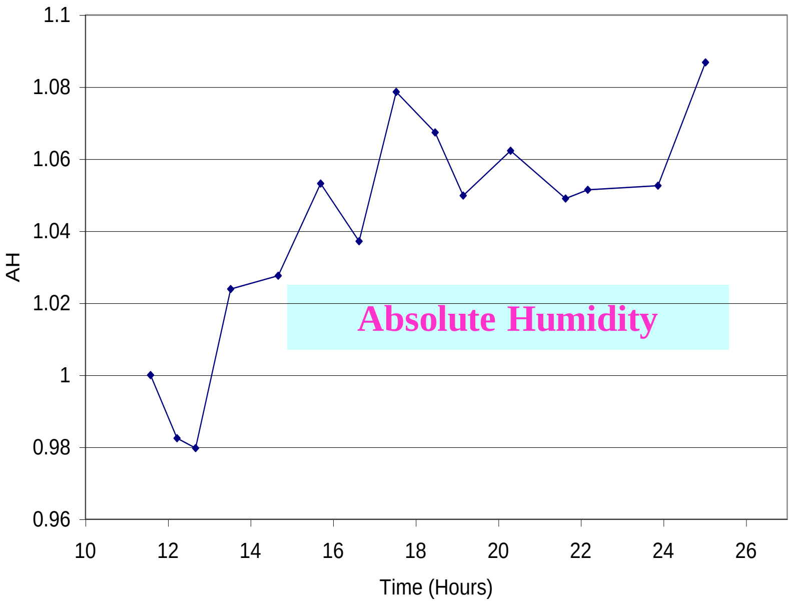
SIS Monitor Data

Anomalies in I1 and M5-M6

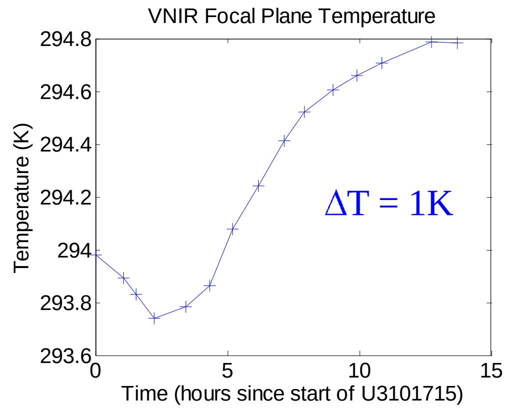


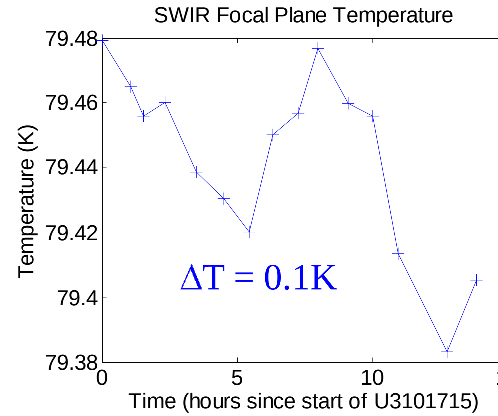
Compensation of variations in SIS-100 output for the same lamp configuration was expected
Compensation of dn variation was failed
Anomalies in SIS monitor data were not fully understood, especially drifting in the blue regions

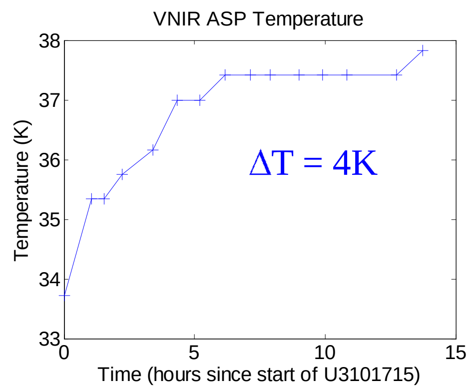
Test Environment Conditions

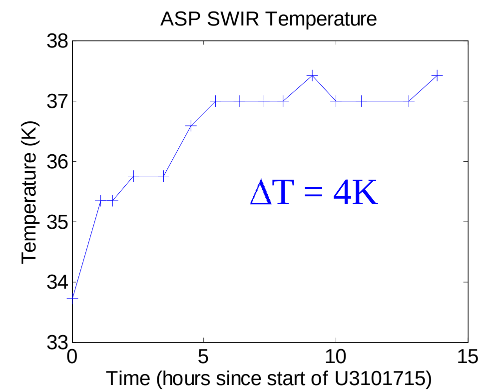


SBRS M9_RVS_Data_V2.xls (Nov.14 2007)





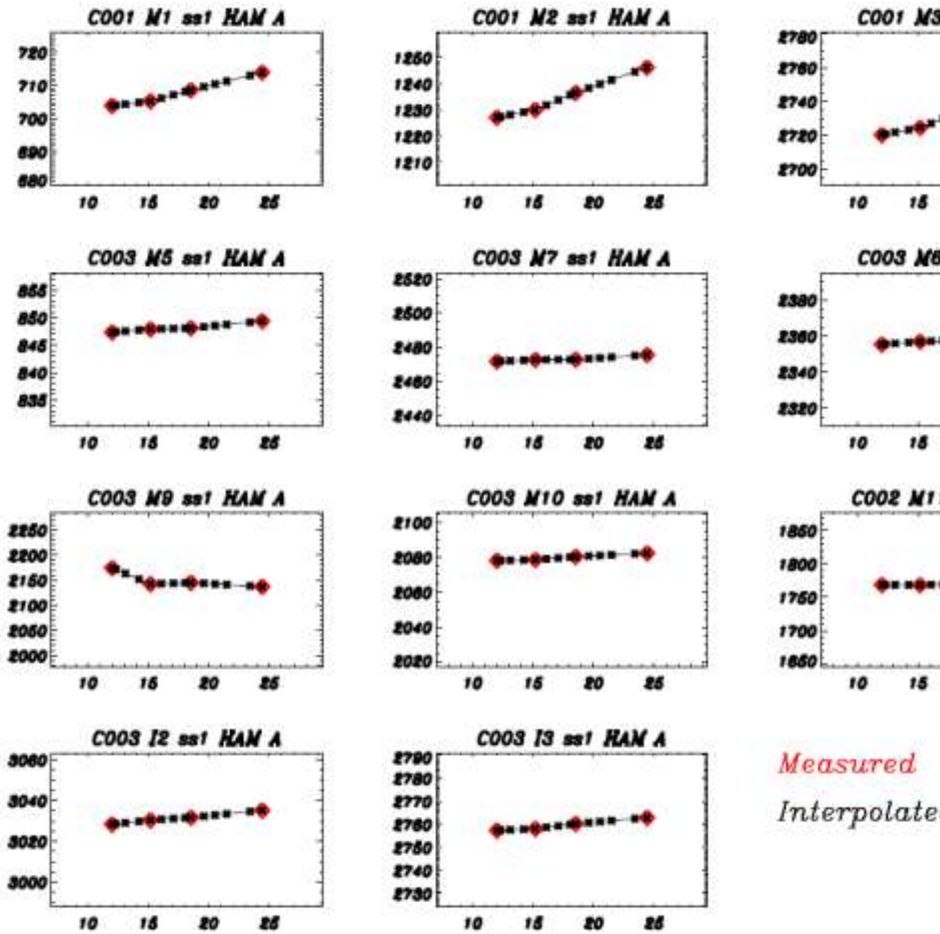




M9 variation > 1%, likely due to changes of relative humidity and temperature of test environment

* From Kameron Rausch

Response Drifting over Time (hour)



SBRS proposed approach for drifting correction

- # Four -8º repeated measurements were used
- # Quadratic interpolation between data collects for each band (exception: M9)
- # Sensor and/or source drifting?

PVP 4.2.2.4.2 : Sensor gain drafting is expected <=0.1%

M1-M3 drifted 1.1-1.6%

Backup Crosstalk

Backup Significant VisNIR Crosstalk Pairs

HG				
Sender	Receiver	Max out-of-spec	# Failing Spec	# CNR>1
M1	I1_S2,I2_S2, M6	-1.88	40	2
M2	I1	-1.34	5	0
M3	I1	-2.2	11	1
M4	I1_S2	-1.68	7	0
M5	I1,I2	-2.79	36	2
M6	M1,M2,I1,I2	-5.84	151	0
M7	M6,I1_S2	3.94	19	1
I1	M1-M7	-6.8	531	77
I2	M1-M6	-3.63	243	54

Auto LG				
Sender	Receiver	Max out-of-spec	# Failing Spec	# CNR>1
M1	I1_S2,I2_S2	1.28	36	0
M2	I1, M5	1.92	9	0
M3	M2,M4,I1_S1	-1.92	32	0
M4	M2,M3,M6,I1,I2	4.3	166	89
M5	M6,I1,I2	-11.39	504	33
M7	M1-M6,I1,I2	-4.72	393	28

Fixed LG				
Sender	Receiver	Max out-of-spec	# Failing Spec	# CNR>1
M1	I1,I2_S2	1.89	45	0
M2	I1,M5	1.98	59	0
M3	M2,M4,I1_S1	14.09	222	111
M4	M2,M3,M6,I1,I2	5.65	261	21
M5	M6,I1,I2	-12.76	1485	44
M7	M1,M2,M5,M6,I1,I	-6.75	297	29

- Most out of spec. detector pairs are the results of adjacent band optical artifacts
- Major sender detectors are M-band det. 3, 8, and 13; and I-band 5&6,15&16, and 25&26
- A completed and comprehensive crosstalk influence coefficient tables can be found in the eRoom

CNR>1: Crosstalk is the dominant effect over noise

Significant SMWIR and LWIR Crosstalk Pairs

Sender	Receiver	gain state	of Sender de	# of Receiver dets	max	avg	CNR>1
M13	M12	ALG	16	16	5.96	1.89	16
M13	I4 SS1	FLG	15	32	2.78	1.35	
M13	I4 SS2	FLG	12	24	2.46	1.36	
M13	I4 all	FLG	15	32	2.78	1.35	
M13	M12	FLG	16	16	23.85	3.13	16
I5 SS1	I5 SS1	1	9	6	1.66	0.50	
I5 SS1	I5 SS2	1	9	6	-1.69	0.50	
I5 SS2	I5 SS1	1	4	3	1.69	0.34	
I5 SS2	I5 SS2	1	6	4	-1.72	0.25	
I5 all	I5 all	1	11	8	-1.72	0.42	
M16A	I5 SS1	1	16	27	5.67	1.60	6
M16A	I5 SS2	1	16	32	6.67	2.01	10
M16A	I5 all	1	16	32	6.67	1.88	10
M16A	M16B	1	8	8	1.64	1.24	8
M16B	I5 SS1	1	7	4	-2.25	-0.69	
M16B	I5 SS2	1	14	31	3.14	1.14	
M16B	I5 all	1	16	31	3.14	1.01	
M16B	M16A	1	9	8	1.69	1.44	16
M15	I5 SS1	1	4	4	1.47	0.81	
M15	I5 SS2	1	6	6	1.41	0.56	
M15	I5 all	1	7	6	1.47	0.68	
M14	I5 SS1	1	6	3	-1.30	-0.06	
M14	I5 SS2	1	6	3	-1.33	-0.07	
M14	I5 all	1	6	3	-1.33	-0.06	

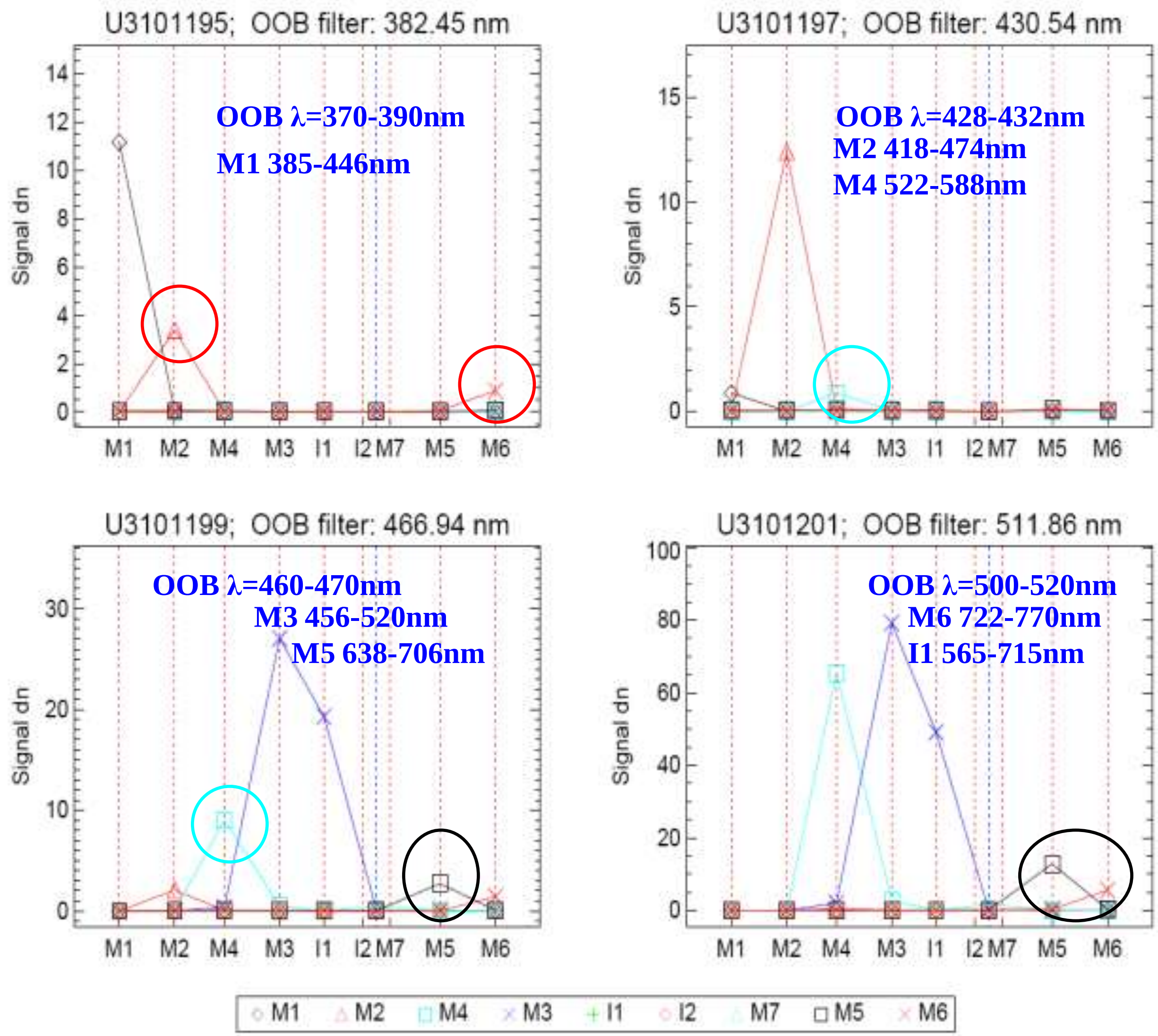
backup

HG				
Sender	Receiver	Max out-of-spec	# Failing Spec	# CNR>1
M1	I1_S2	-1.24	4	0
	I2_S2	-1.33	32	0
	M6	-1.88	4	2
M2	I1_S1	-1.34	4	0
	I1_S2	-1.08	1	0
M3	I1_S1	-1.86	7	0
	I1_S2	-2.2	4	1
M4	I1_S2	-1.68	7	0
M5	I1_S1	-2.79	13	1
	I1_S2	-2.45	11	1
	I2_S1	-1.74	7	0
	I2_S2	-1.21	5	0
M6	M1	2.47	29	0
	M2	1.21	16	0
	I1_S1	-5.22	11	0
	I1_S2	-5.84	15	0
	I2_S1	-3.79	22	0
	I2_S2	-4.65	58	0
M7	M6	-1.53	6	0
	I1_S2	3.94	13	1
I1	M1	-1.82	33	0
	M2	-1.84	34	0
	M3	-1.53	46	2
	M4	-1.58	36	0
	M5	-4.37	58	24
	M6	-6.8	39	49
	M7	-1.48	42	2
I2	M1	-1.4	32	0
	M2	-1.37	32	0
	M3	-1.2	32	0
	M4	-1.19	32	0
	M5	1.83	78	31
	M6	-3.63	37	23

Auto LG				
Sender	**Receiver**	**Max out-of-spec**	**# Failing Spec**	**# CNR>1**
M1	I1_S2	1.28	4	0
	I2_S2	-1.07	32	0
M2	I1_S1	1.19	5	0
	I1_S2	1.92	4	0
M3	I1_S1	-1.92	17	0
	I1_S2	1.84	10	0
	M6	-1.13	5	0
M4	M2	-3.72	71	33
	M3	4.3	54	56
	I1_S1	-2.35	17	0
	I1_S2	-2.77	24	0
M5	M6	1.87	41	32
	I1_S1	-11.39	159	1
	I1_S2	-6.01	160	0
	I2_S1	-5.51	109	0
	I2_S2	-3.76	35	0
M7	M1	-1.66	65	0
	M2	-1.92	64	0
	M3	-1.13	2	0
	M4	-1.04	10	0
	M5	-2.92	64	0
	M6	-4.28	69	28
	I1_S1	-4.5	23	0
	I1_S2	-4.72	22	0
	I2_S1	-4.43	40	0
	I2_S2	-4.17	34	0

Fixed LG				
Sender	Receiver	Max out-of-spec	# Failing Spec	# CNR>1
M1	I1_S1	1.85	6	0
	I1_S2	1.89	8	0
	I2_S2	-1.25	31	0
M2	I1_S1	1.98	18	0
	I1_S2	1.7	14	0
	M5	-1.97	27	0
M3	M2	1.5	22	0
	M4	14.09	175	111
	I1_S1	2.52	25	0
M4	M2	5.09	79	7
	M3	5.65	86	14
	M6	-1.64	4	0
	I1_S1	-2.91	30	0
	I1_S2	3.55	32	0
	I2_S1	-2.52	15	0
	I2_S2	-2.6	15	0
M5	M6	2.19	37	32
	I1_S1	-12.76	157	8
	I1_S2	-11.92	1182	13
	I2_S1	-6.61	70	1
	I2_S2	-5.15	39	0
M7	M1	-1.68	29	0
	M2	-2.29	32	0
	M5	3.59	38	0
	M6	-4.49	72	29
	I1_S1	-5.57	21	0
	I1_S2	-6.75	24	0
	I2_S1	-3.59	37	0
	I2_S2	-4.47	44	0

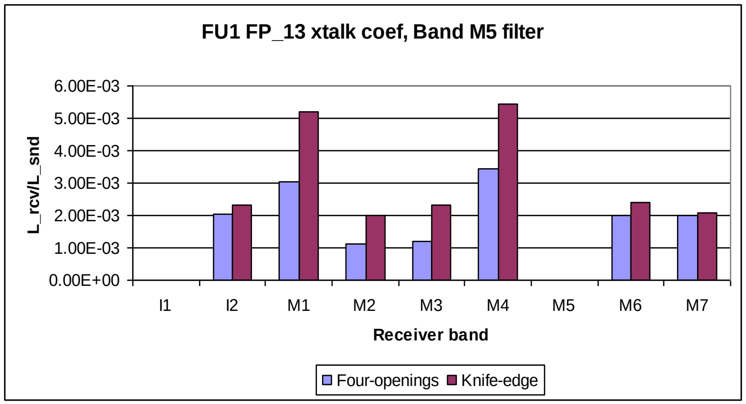
Results w/ OOB Filter

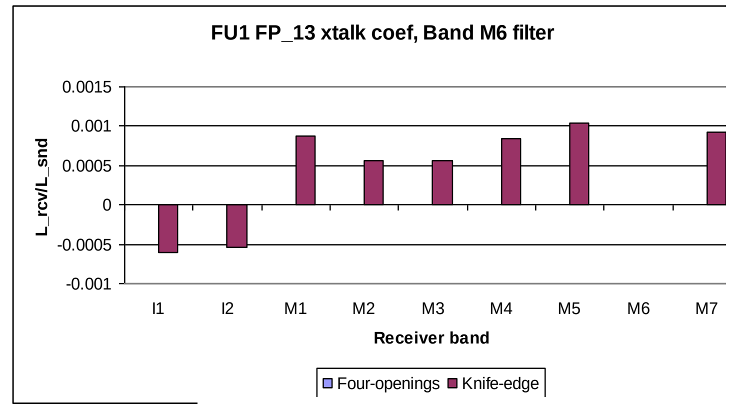


- Spectral overlap cause optical leak is not crosstalk
- Optical crosstalk is measurable for bands M1, M2, M4, M5 and M6

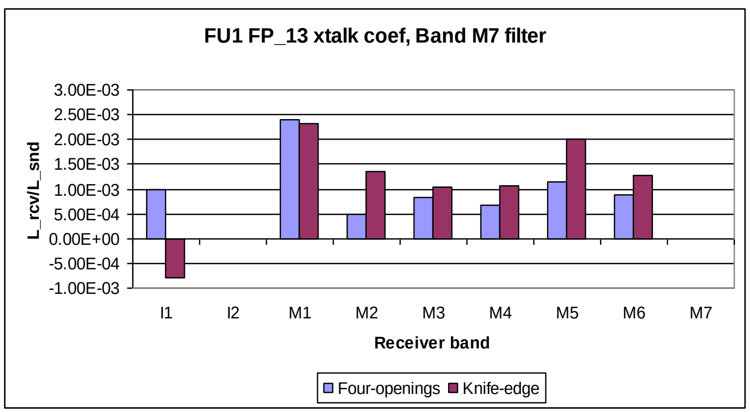
-M1: 770-830nm
-M2: 370-390nm
-M4: 428-432, 460-470 and 700-720 nm
-M5: 460-470, 570-585, and 770-830nm
-M6: 370-390, 460-470, 500-520nm

Comparison of Crosstalk coefficients between four-opening and KE (2)





M6 data from 4-openings may use substitute band



- Two set of crosstalk coefficients are on the same order
- The discrepancy may caused by different test configurations

TABLE 2: SRV0055 Dynamic Range Requirement (Wm-2sr-1mm-1)

SRV0055			Single Gain		Dual Gain			
					High Gain		Low Gain	
Band	Center Wavelength (nm)	Gain Type	[Lmin]	[Lmax]	[Lmin]	[Lmax]	[Lmin]	[Lmax]
M1	412	Dual	-	-	30	135	135	615
M2	445	Dual	-	-	26	127	127	687
M3	488	Dual	-	-	22	107	107	702
M4	555	Dual	-	-	12	78	78	667
M5	672	Dual	-	-	8.6	59	59	651
M6	746	Single	5.3	41.0	-	-	-	-
M7	865	Dual	-	-	3.4	29	29	349
M8	1240	Single	3.5	164.9	-	-	-	-
M9	1378	Single	0.6	77.1	-	-	-	-
M10	1610	Single	1.2	71.2	-	-	-	-
M11	2250	Single	0.12	31.8	-	-	-	-
I1	640	Single	5	718	-	-	-	-
I2	865	Single	10.3	349	-	-	-	-
I3	1610	Single	1.2	72.5	-	-	-	-

[Lmin]: Minimum radiance of the instrument specification(W/m2-sr-μm)

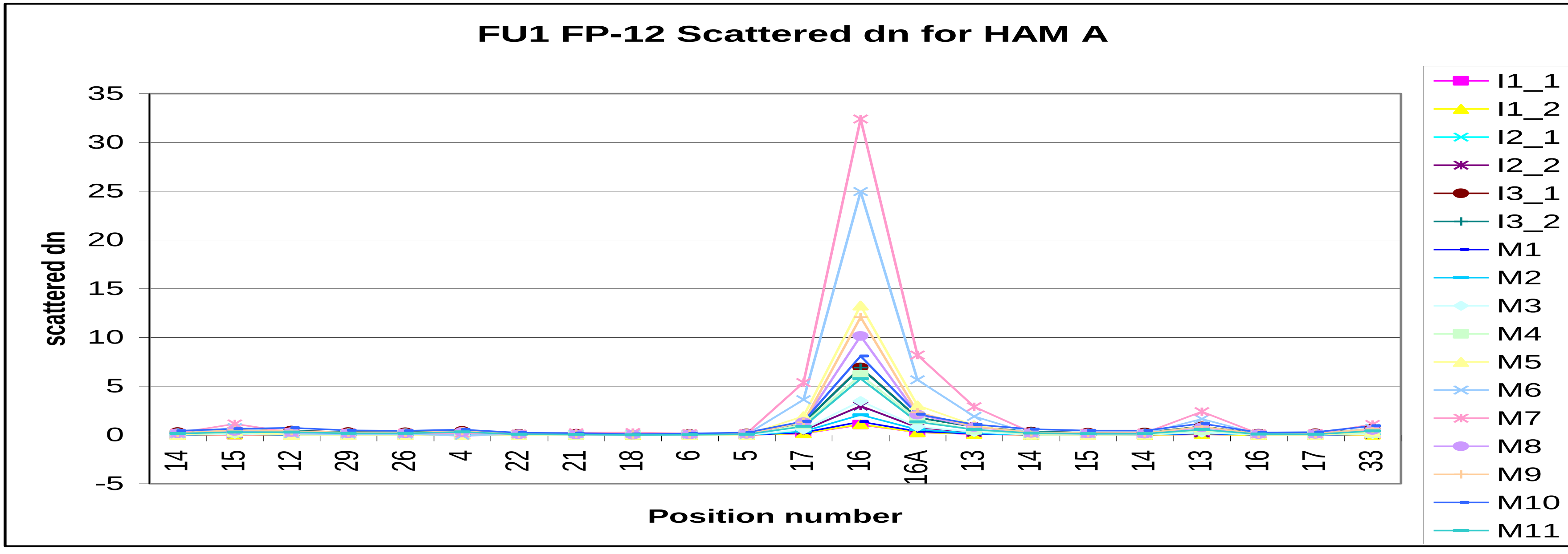
[Lmax]: Maximum radiance of the instrument specification (W/m2-sr-μm)

Sensitivity requirements for VIIRS Sensor reflective bands

			Single Gain		Dual Gain			
					High Gain		Low Gain	
Band	Center Wavelength (nm)	Gain Type	Ltyp	SNR	Ltyp	SNR	Ltyp	SNR
M1	412	Dual	-	-	44.9	352	155	316
M2	445	Dual	-	-	40	380	146	409
M3	488	Dual	-	-	32	416	123	414
M4	555	Dual	-	-	21	362	90	315
M5	672	Dual	-	-	10	242	68	360
M6	746	Single	9.6	199	-	-	-	-
M7	865	Dual	-	-	6.4	215	33.4	340
M8	1240	Single	5.4	74	-	-	-	-
M9	1378	Single	6	83	-	-	-	-
M10	1610	Single	7.3	342	-	-	-	-
M11	2250	Single	0.12	10	-	-	-	-
I1	640	Single	22	119	-	-	-	-
I2	865	Single	25	150	-	-	-	-
I3	1610	Single	7.3	6	-	-	-	-

The units of spectral radiance for Ltyp are wm-2sr-1mm-1.
The SNR column shows the minimum required (worst-case) SNR that applies at the end-of-scan. Elsewhere in the scan, aggregation will yield a larger SNR.
Within the same gain setting, at radiances larger than Ltyp, the SNR will be larger than what is specified in this table.

Backup: Band Averaged dn vs. Position in run 1



- The scattered radiance at position 16 takes about 54 - 63% of the sum of all positions for VNIR bands: caused NICST initial results is twice larger than the SBRS results
- Position 16 data was excluded after we learned a ABC baffle was remove and caused this anomaly. The updated results agree with the SBRS results