

# OLI Overview and Status

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Landsat Science Team Meeting

7/15/08



**Ball Aerospace  
& Technologies Corp.**

**Agility to innovate,  
Strength to deliver**



## Outline



- Instrument Overview
- Subsystem Status
- Preliminary Data
- Conclusion

# Instrument Overview

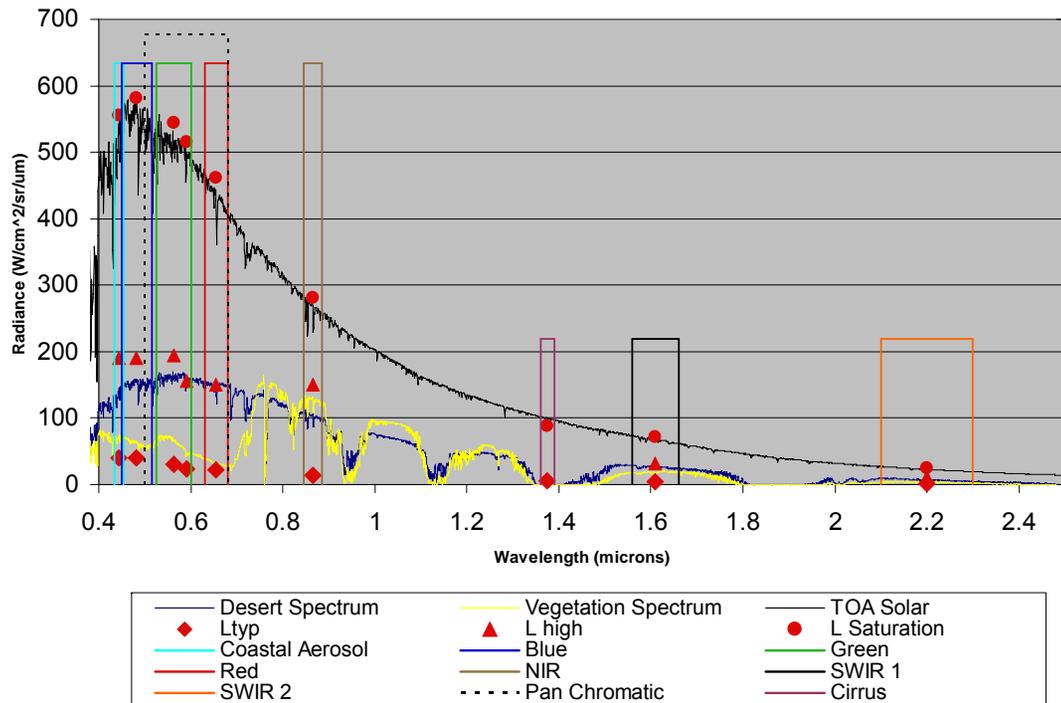




# OLI Maintains Landsat Legacy



- Landsat Continuity Mission demands
  - Accurate spectral and spatial information
  - Frequent synoptic earth views
  - NIST calibrated over time
  - Precise geo-referenced data



- Key instrument parameters

- Cross-track FOV 185 km
- S/C altitude 705 km
- Geodetic accuracy\*
  - ◆ Absolute 65 m
  - ◆ Relative 25 m
- Geometric accuracy\*\*
  - ◆ Absolute 12 m

Band Name	Band (nm)	Bandwidth (nm)	GSD (m)	SNR
Coastal/Aerosol	443	20	30	130
Blue	482	65	30	130
Green	562	75	30	100
Red	655	50	30	90
NIR	865	40	30	90
SWIR 1	1610	100	30	100
SWIR 2	2200	200	30	100
PAN	590	180	15	80
Cirrus	1375	30	30	50

Visible/NIR

SWIR

\*No terrain compensation

\*\*w/ terrain compensation



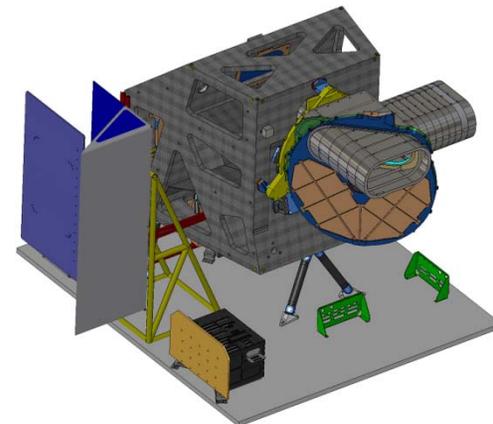
# Driving Performance Requirements



- Radiometric
  - Signal-to-noise radiometric stability (16-day, 60 sec, 5 year)
  - Pixel-to-pixel uniformity
  - Absolute radiometric accuracy
    - ❖ Absolute radiance – 5%, absolute reflectance – 3%
- Spectral
  - Spectral band edges and center wavelength tolerance
  - Integrated out-of-band (OOB) response (<2%)
  - Spectral uniformity (FWHM) ( $\pm 3\%$ )
- Spatial
  - Edge response
  - Aliasing
  - Light rejection and internal scattering
  - Ghosting
- Geometric
  - Band-to-band co-registration (4.5 m)
  - Absolute geodetic accuracy (65 m)

OLI Band and SNR Specs

#	Minimum Lower Band Edge (nm)	Maximum Upper Band Edge (nm)	SNR at LTypical	SNR at LHigh
1	433	453	130	290
2	450	515	130	360
3	525	600	100	390
4	630	680	90	340
5	845	885	90	460
6	1560	1660	100	540
7	2100	2300	100	510
8	500	680	80	230
9	1360	1390	50	N/A

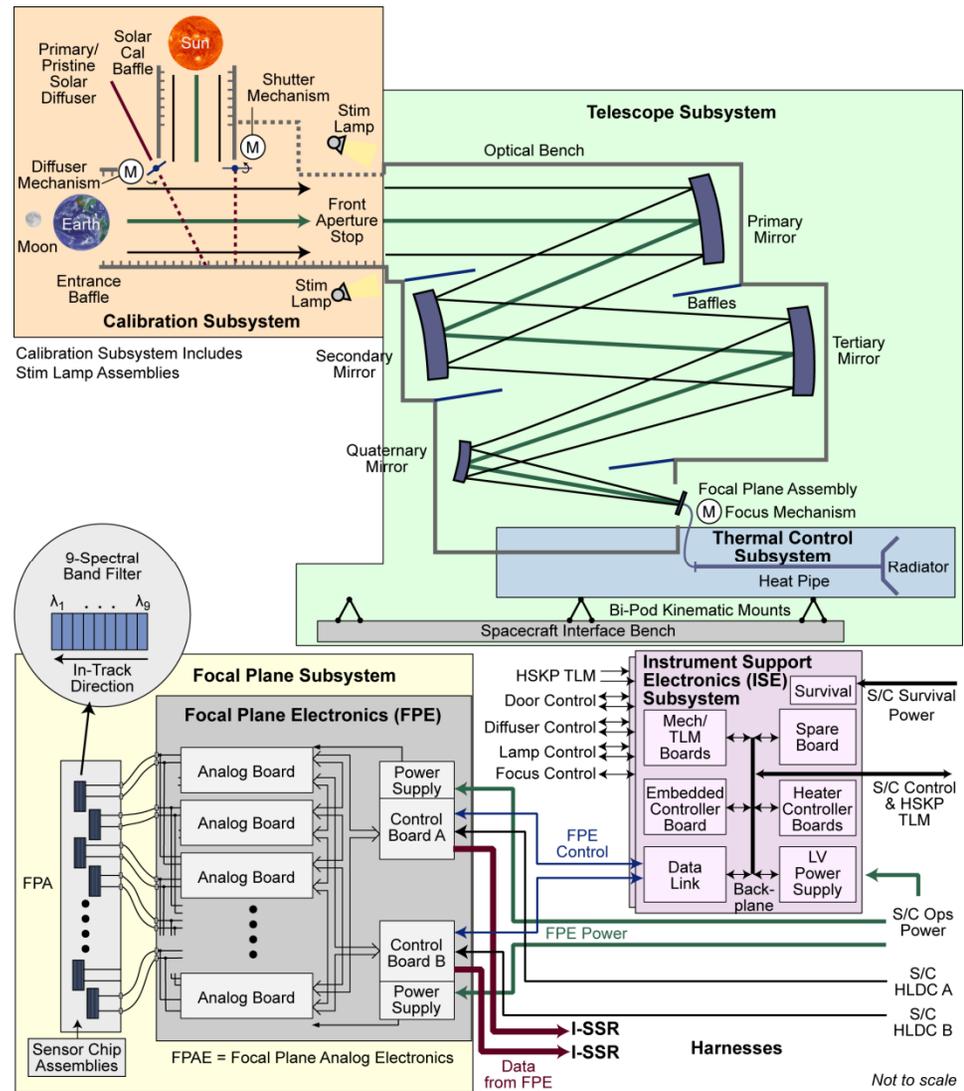
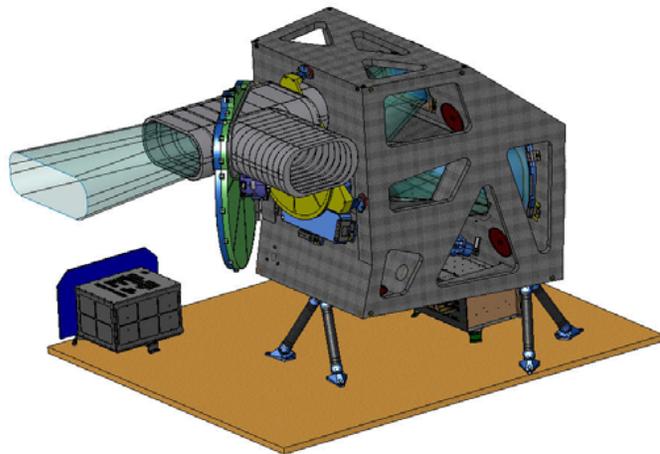




# Baseline Design and Descriptive Block Diagram



- Pushbroom VIS/SWIR sensor
- Four mirror telescope with front aperture stop
- FPA consisting of 14 sensor chip assemblies, passively cooled



Not to scale  
A10978\_194Re



# Key Technical Parameter (KTP) Performance Summary



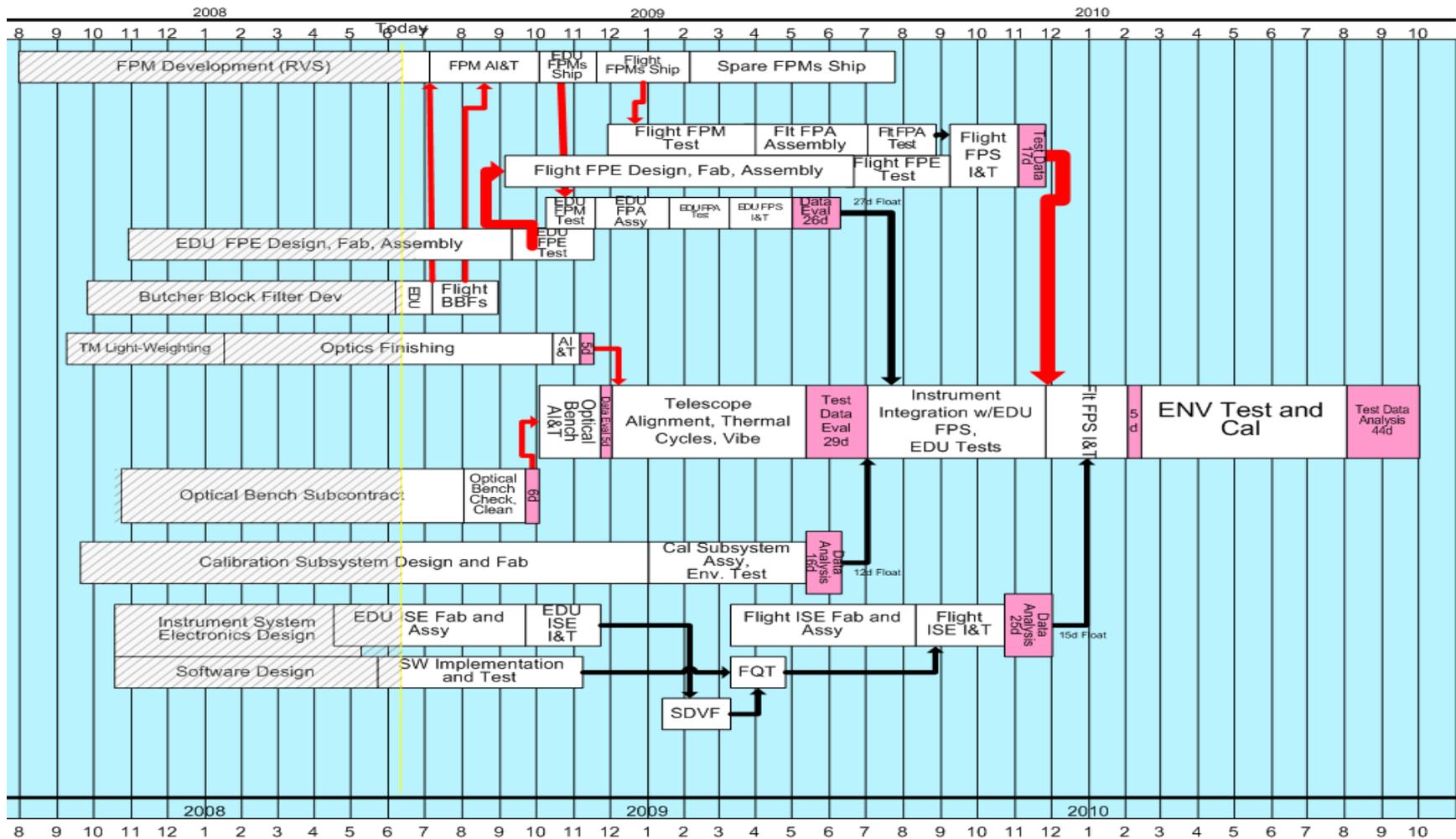
- Meeting all key requirements with margin

KTP	Reqd	Jul-08	Margin (%)	Units	Comments
Mass	375.0	274.6, 306.7	37,22	kg	CBE, Mature Mass
Peak Power (Imaging)	375	290.3, 309.3	43,15.6	W	CBE, Mature Power
Average Power (Imaging)	200	164.4,183.4	33,11	W	CBE, Mature Power
Data Rate	265	243.65	8.8	Mbps	Reqd. is NTE
SNR	130	59	-	%	Worst case margin at Ltyp (C/A band)
Edge Response Slope	0.027/m	5.5	-	%	Worst case margin (BLUE AT)
Abs. Rad. Accuracy	5.0	4.2	19	%	
Radiometric Stability	1.00	0.65	54	%	Worst band (C/A); Fixed defn
Pixel-to-Pixel Uniform.	0.25	0.2	15	%	Banding C/A Band
Absolute Geodetic Accuracy	65	51.12	27.2	m	
Band-to-Band Reg. Accuracy	4.5	4.39/4.37	2.4	m	AT/XT

- Mass and power are reported for both current best estimate (CBE) and “mature” values, which include Ball Aerospace growth factors
  - “Current Best Estimate” is the designer’s estimate
  - Mature mass / mature power reflects historical growth. i.e., it’s contingency
- Margin is low for coregistration simply due to an ‘allocation’ issue
  - Spacecraft predictions for attitude control exceed their requirements and have not been captured in the budgets yet



# OLI One-Page Schedule

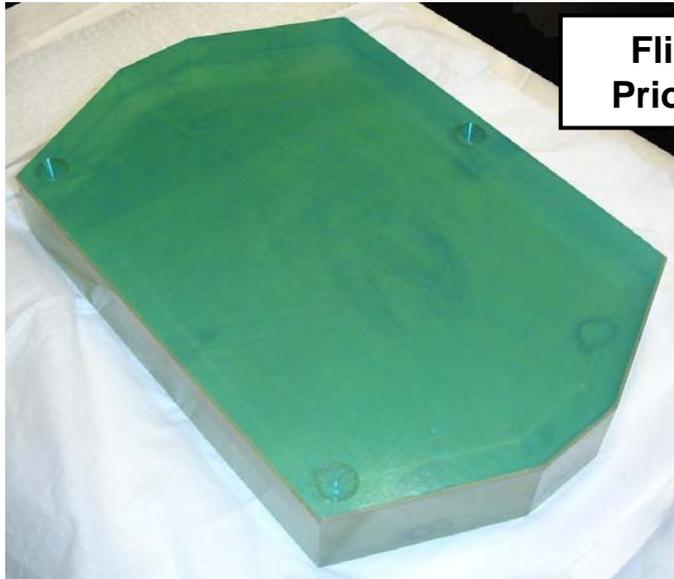


# Subsystem Status

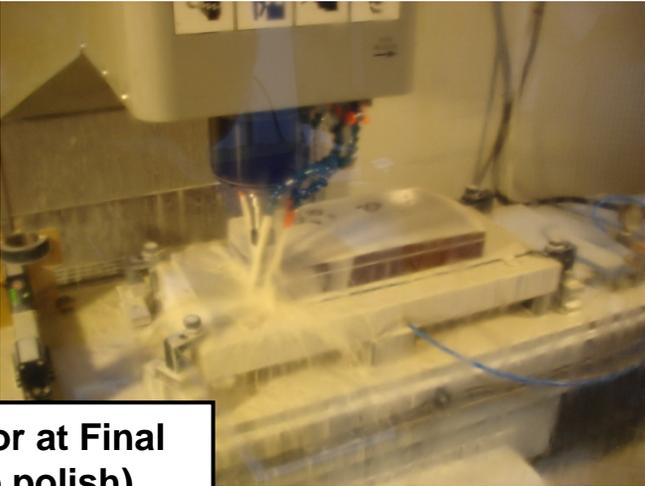




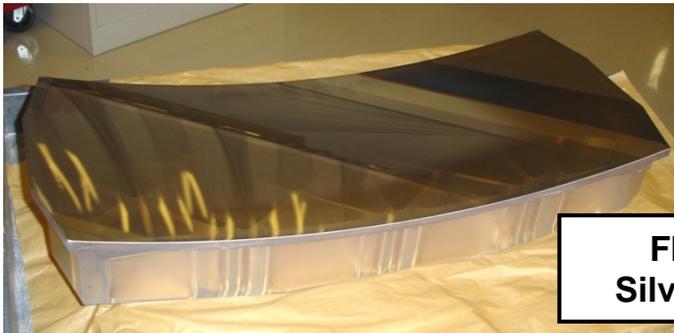
# Flight Optics Are in Final Polishing Operations at Tinsley



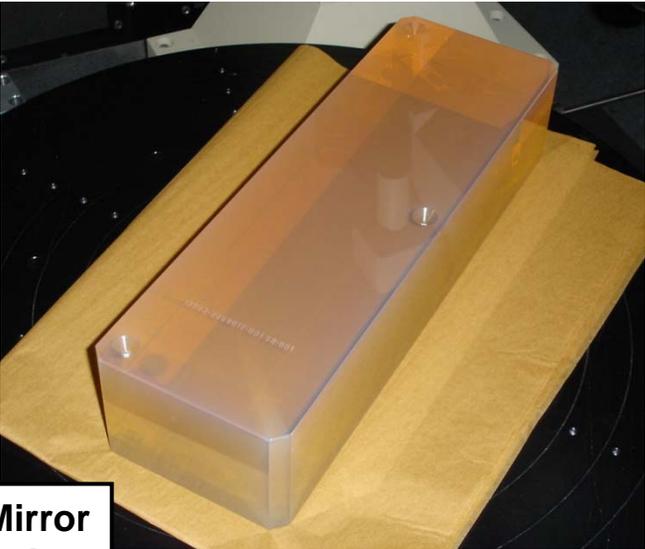
**Flight Primary Mirror  
Prior to Final Polishing**



**Flight Secondary Mirror at Final  
Edging (now in edge polish)**



**Flight Tertiary Mirror  
Silvered for WFE Testing**



**Flight Quaternary Mirror  
After Aspheric Shaping**



## Main Bench Assembly Takes Shape



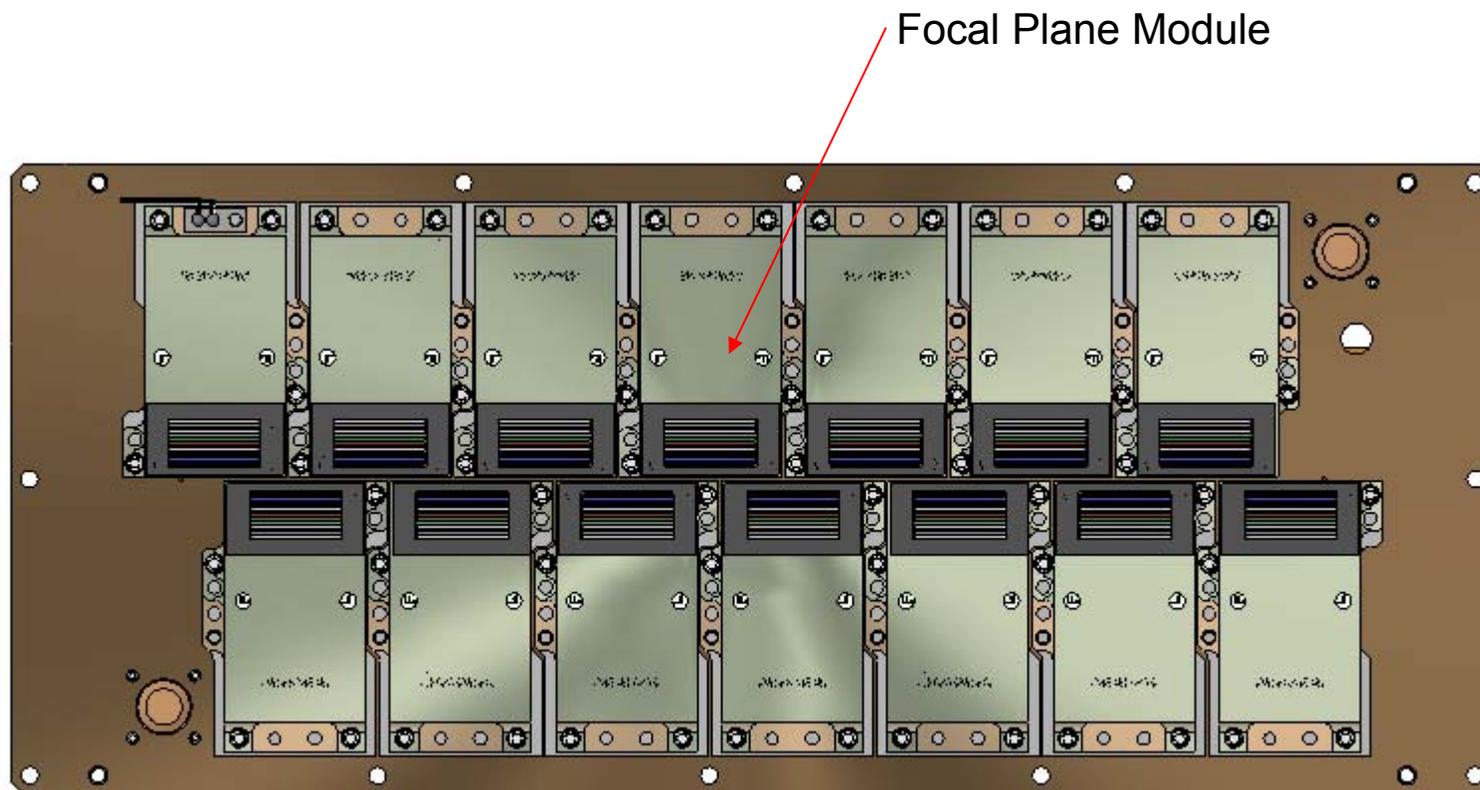
**ATK technicians bond FPA bulkhead into bottom bulkhead as main bench assembly takes shape**



## Focal Plane Consists of 14 Modules

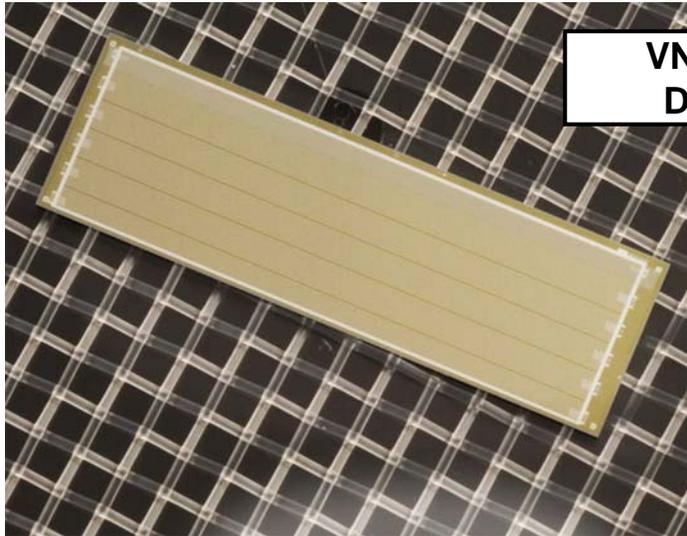


- Each Module contains Silicon and HgCdTe detectors mounted on a single readout chip (ROIC)
  - Spectral Filters above the detectors provide separation into bands

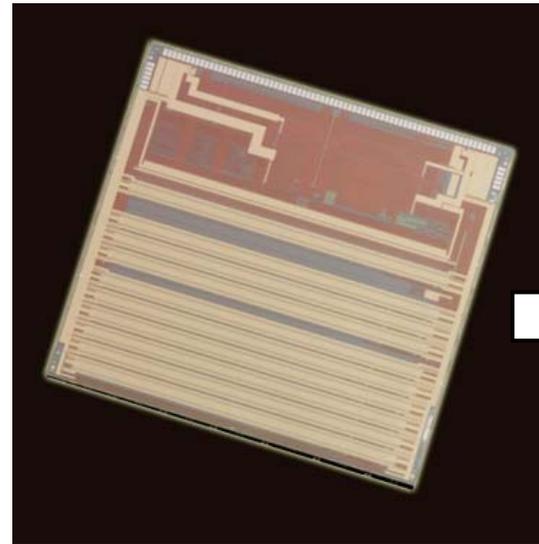




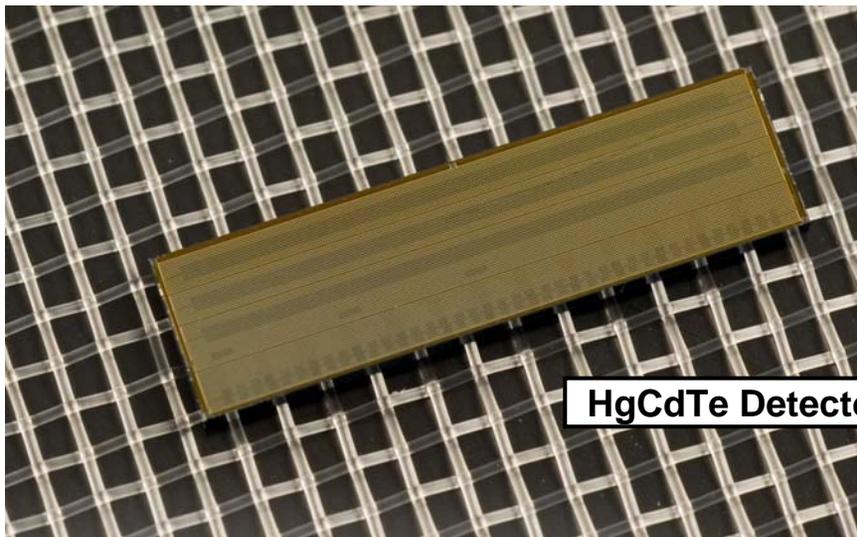
# Engineering Model Focal Plane Hardware Looks Good



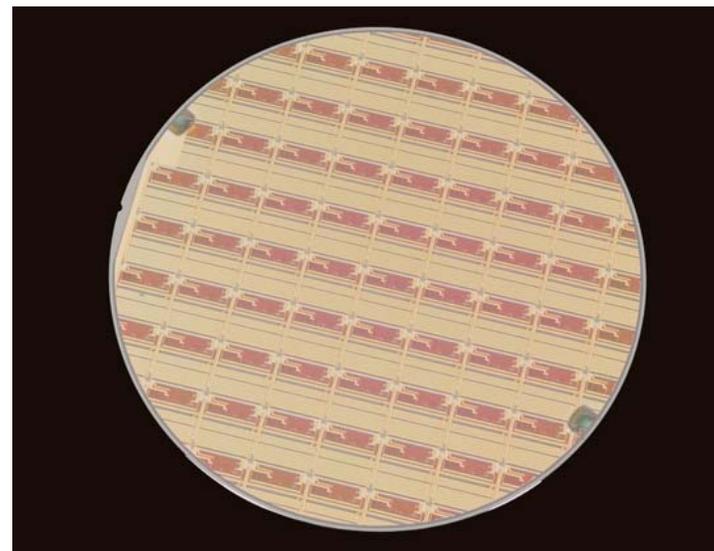
**VNIR Si PIN  
Detectors**



**ROICs**

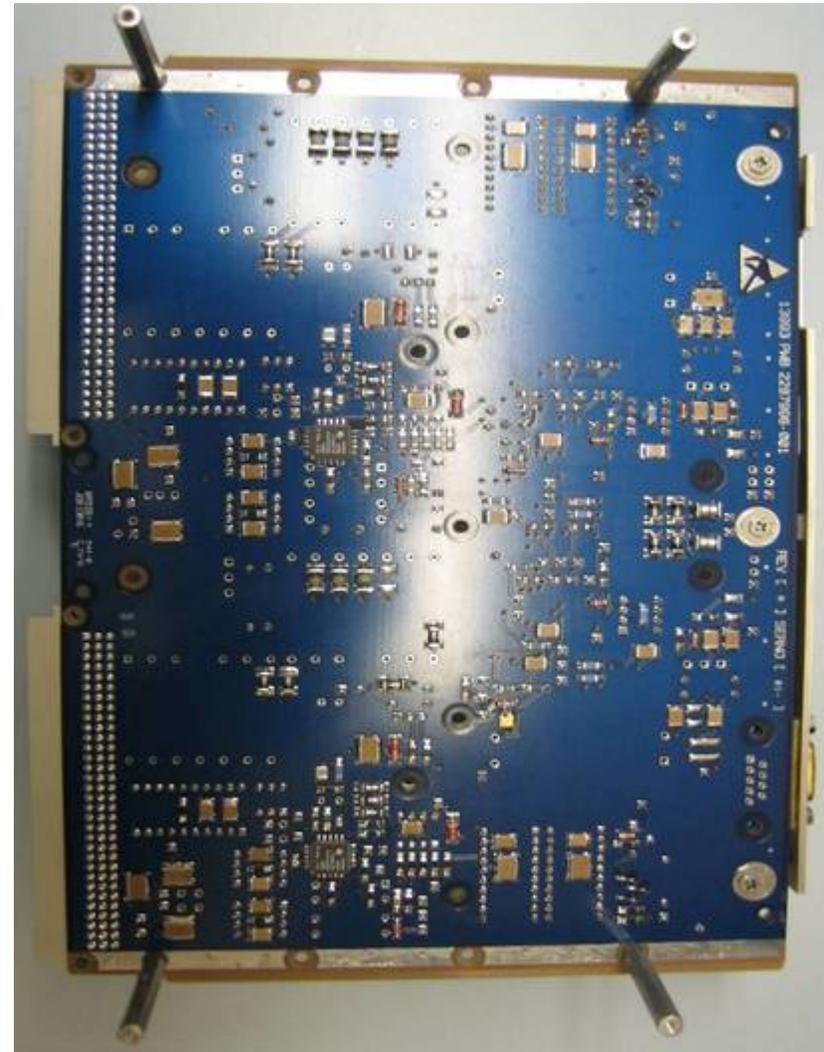


**HgCdTe Detectors**





# Engineering Unit Electronics Boards Are Being Populated

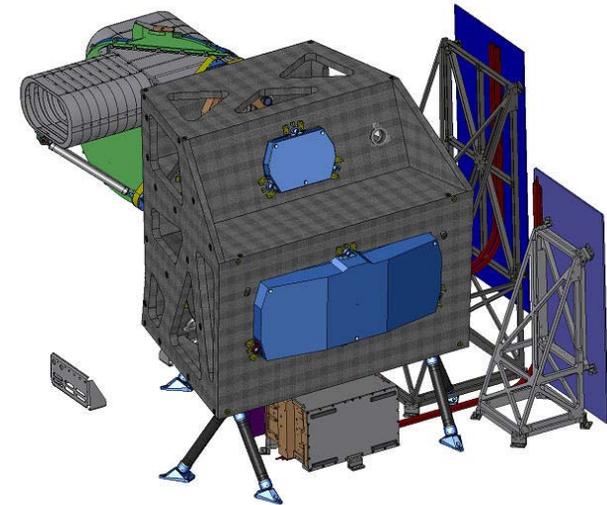
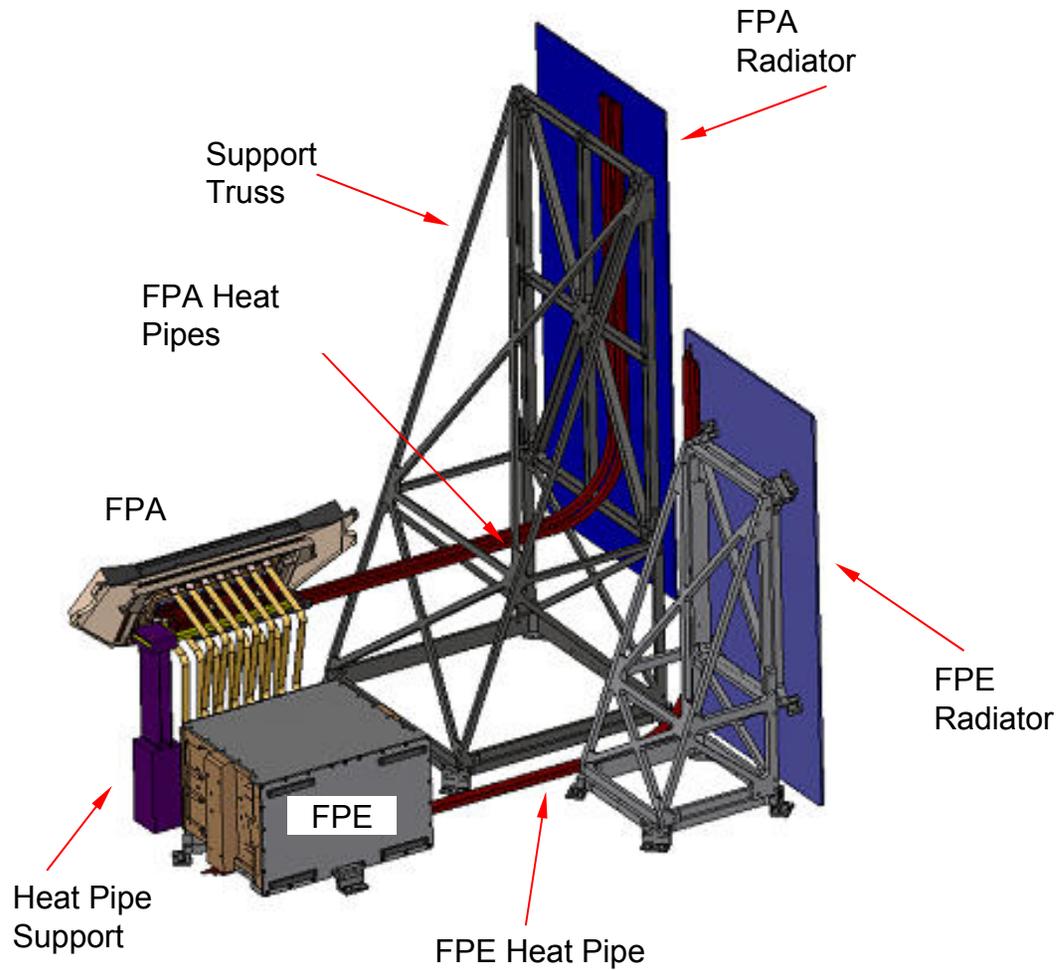




# Thermal Control Design



## +X UP ORIENTATION



Design integrated  
onto instrument



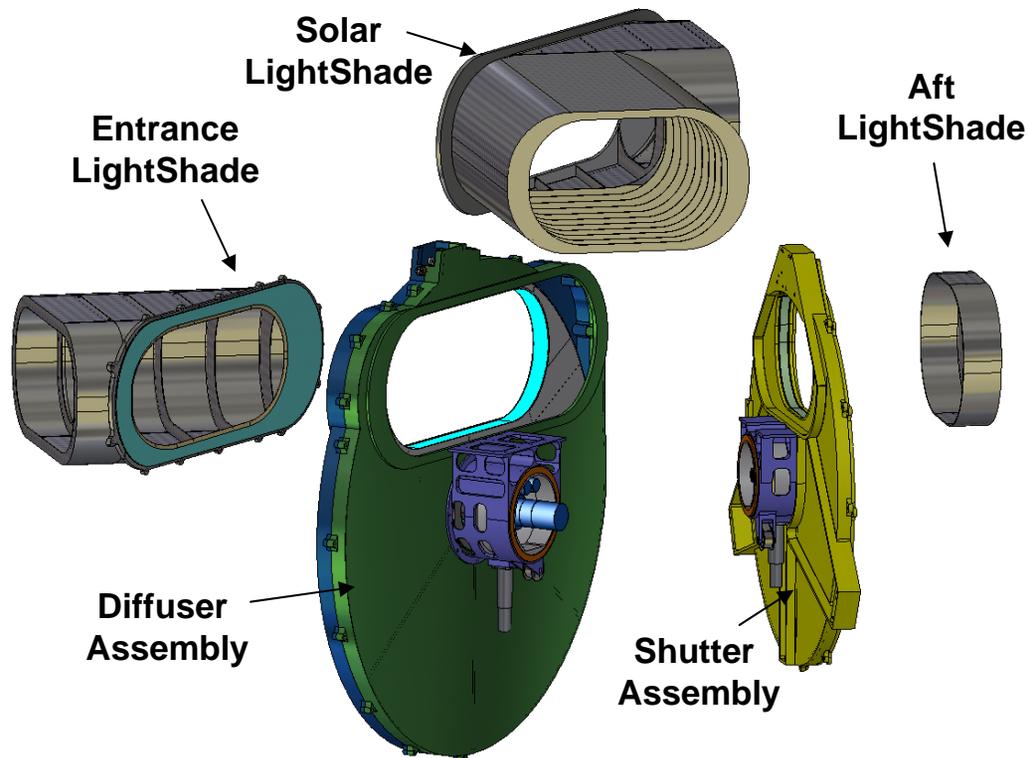
# Calibration Detailed Design Underway



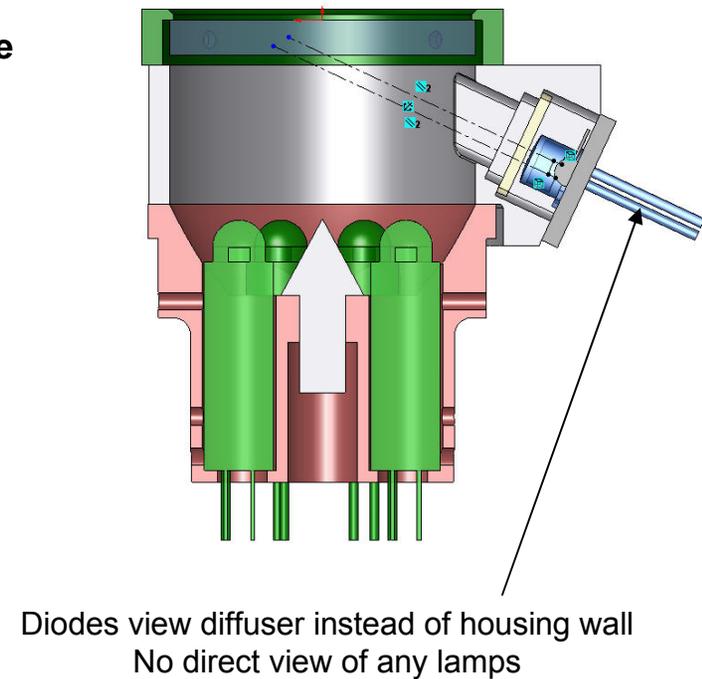
- Calibration Subassembly Consists of Five Subassemblies

- 3 LightShade Assemblies
- 1 Diffuser Assembly
- 1 Shutter Assembly

- Stim Lamp Assemblies redesigned to increase emitted light and optimize monitoring diode position



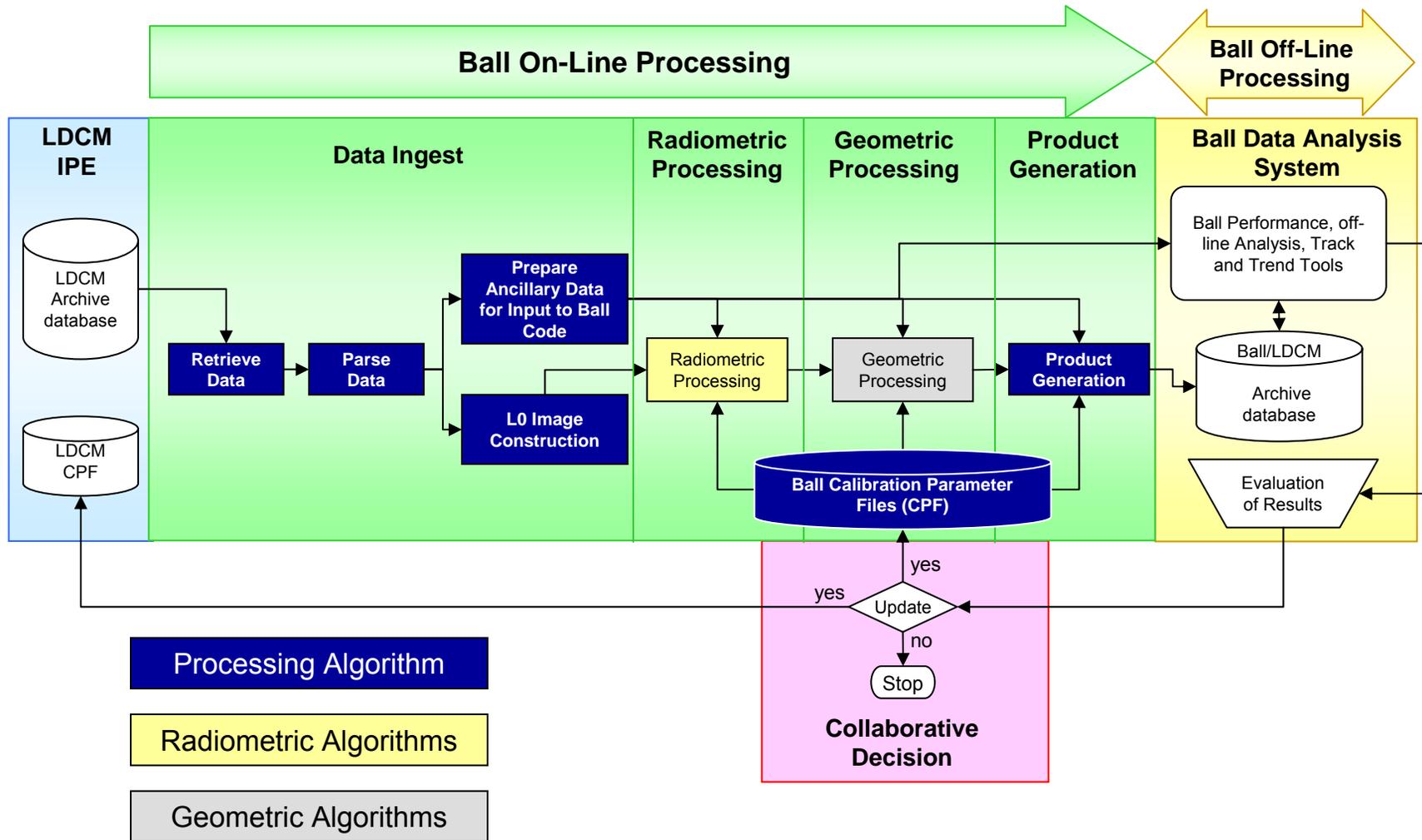
Exploded View of Calibration Subassembly



Diodes view diffuser instead of housing wall  
No direct view of any lamps



# Ball Aerospace Algorithms Cover Both On-line and Off-line Processing

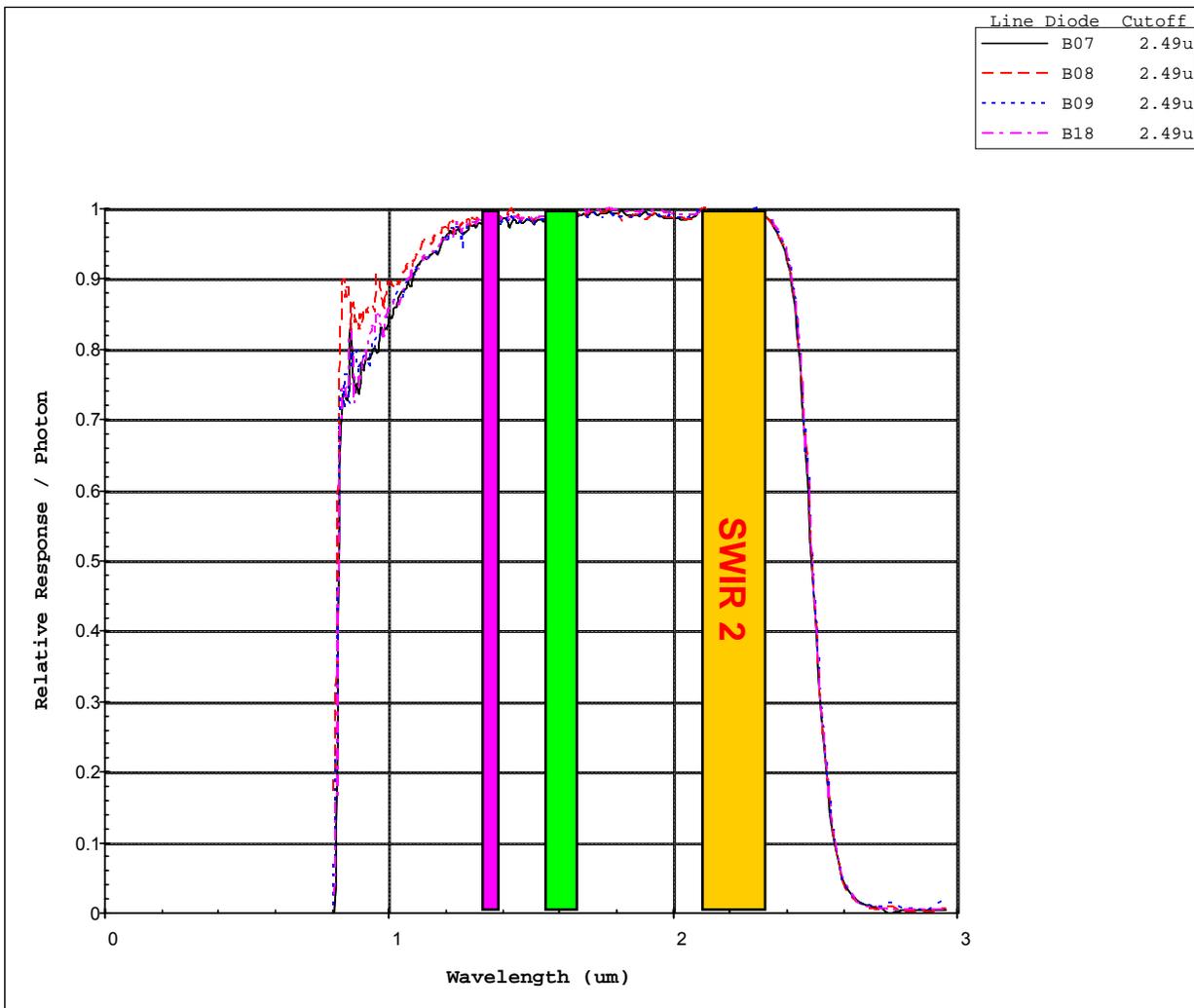


# Preliminary Data





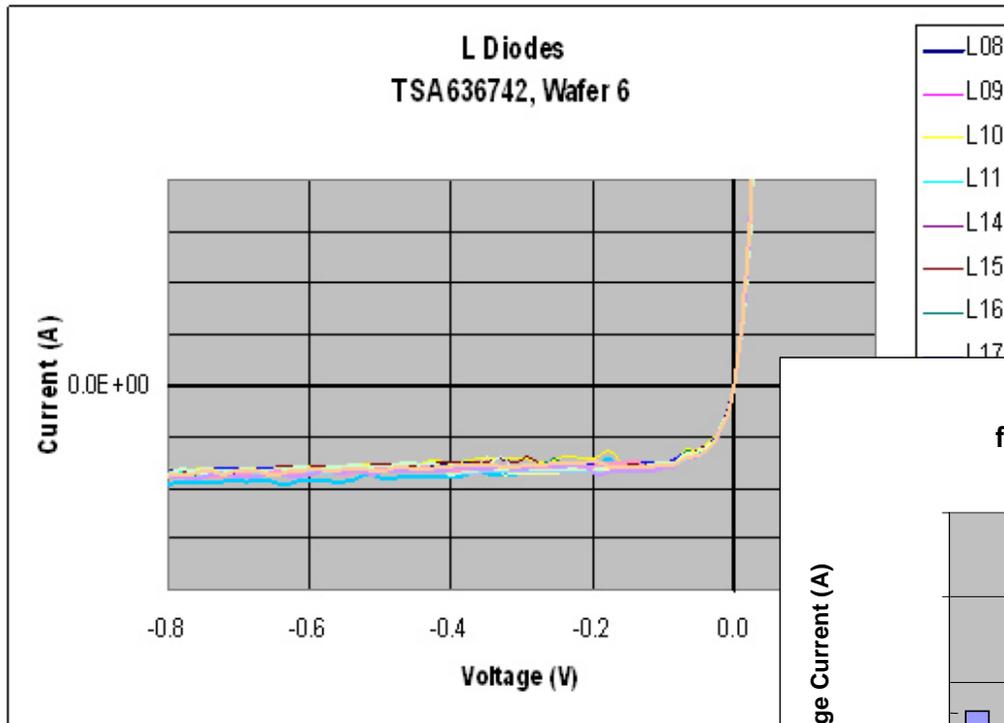
# HgCdTe SWIR Pilot Lot Material Meets Specifications for Quantum Efficiency



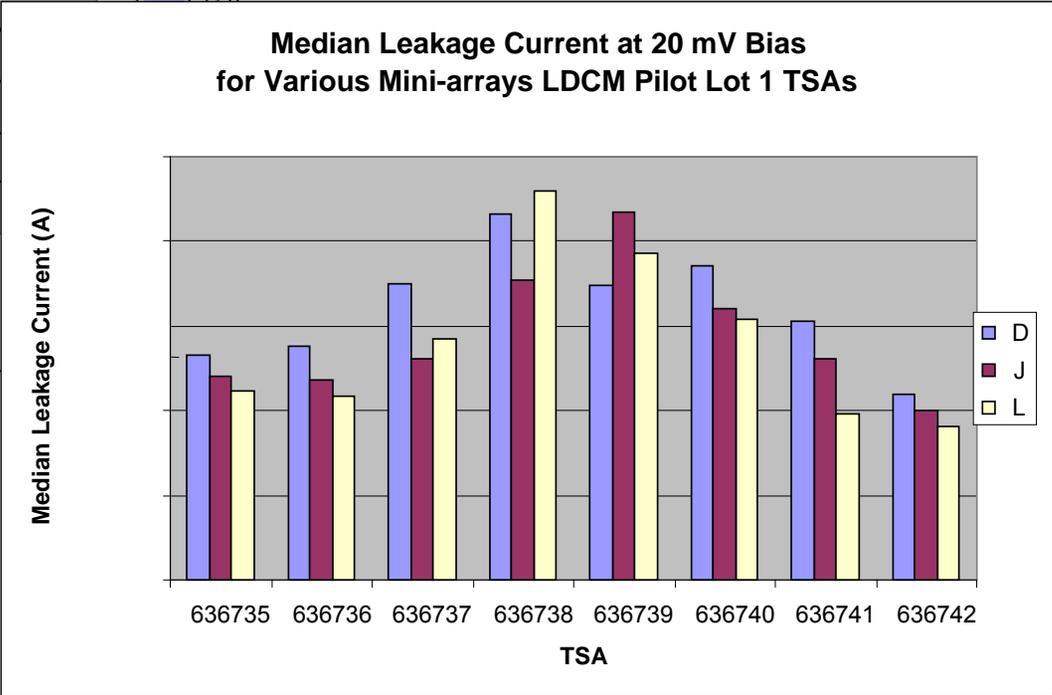
- Cutoff wavelength is high enough that we'll have good response in the SWIR
  - Good QE
  - Good spectral flatness



# HgCdTe SWIR Material Exhibits Low Dark Current and Excellent Dark Current Uniformity



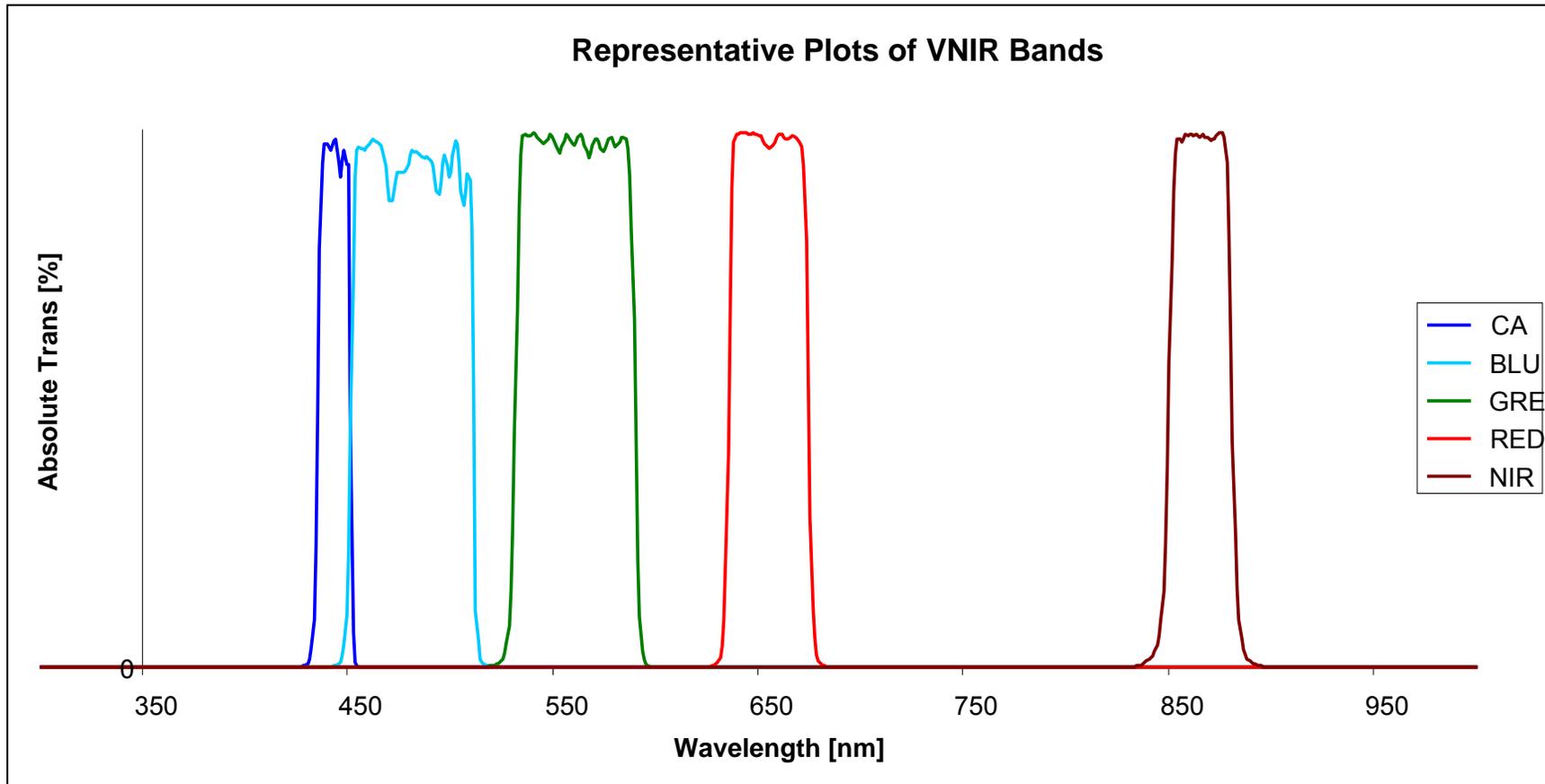
**Measurement Data on Pilot Lot Test Structures**



**Lower is better; values show meet dark current requirements**



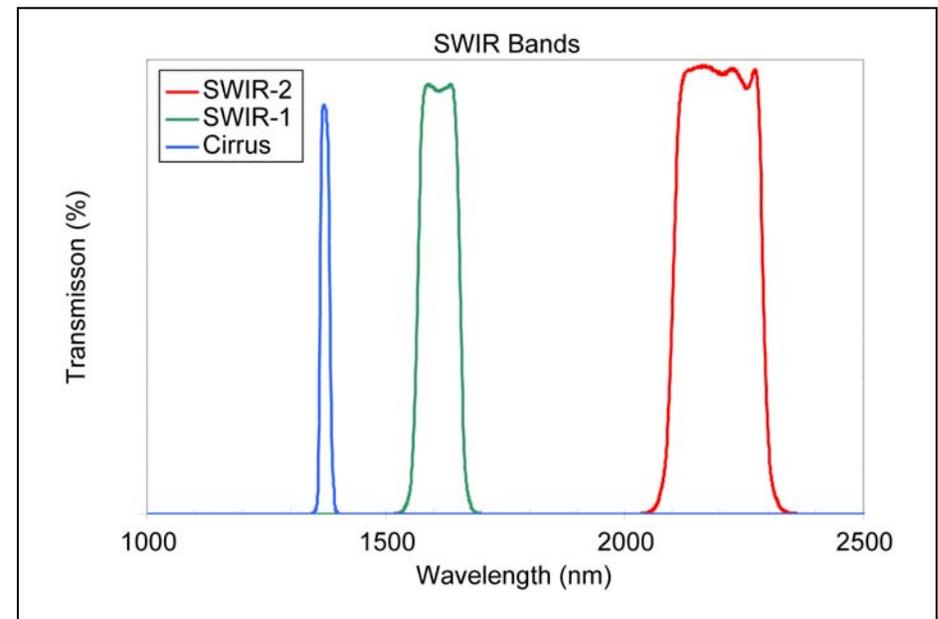
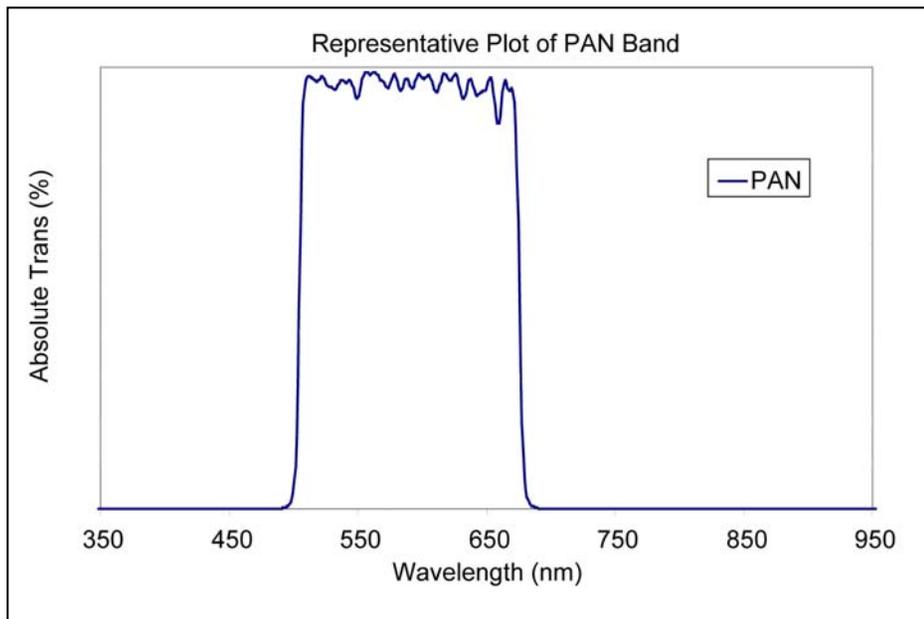
# First Pass Spectral Filters Show VNIR In-Band Spectral Response Is Well Behaved



***Data is from first of three lots that will be used to select flight filters***



# Pan and SWIR Spectral Response Is Excellent



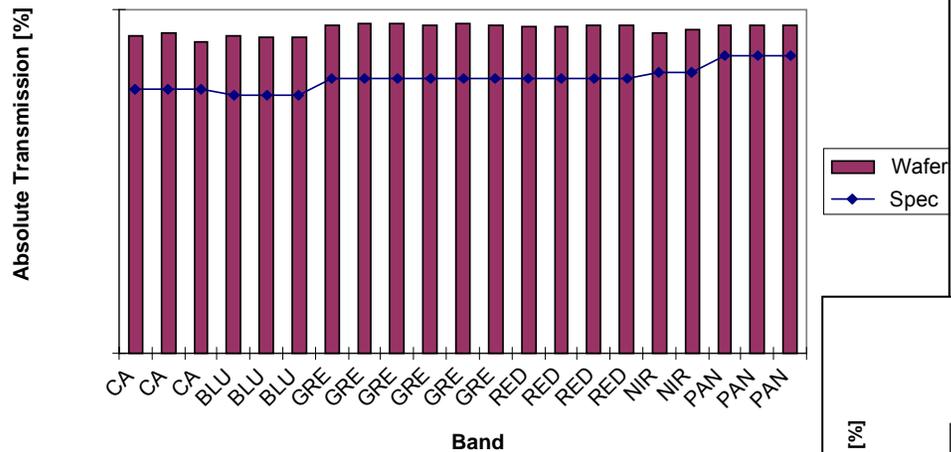
***Data is from first of three lots that will be used to select flight filters***



# Spectral Transmission Exceeds Requirements For All Wafers

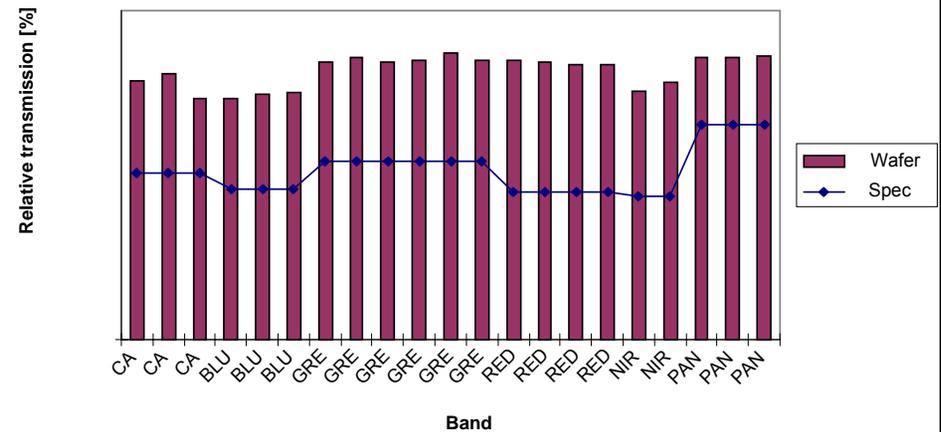


Average Transmission Between 50% Points  
(Spec 3.2.6)



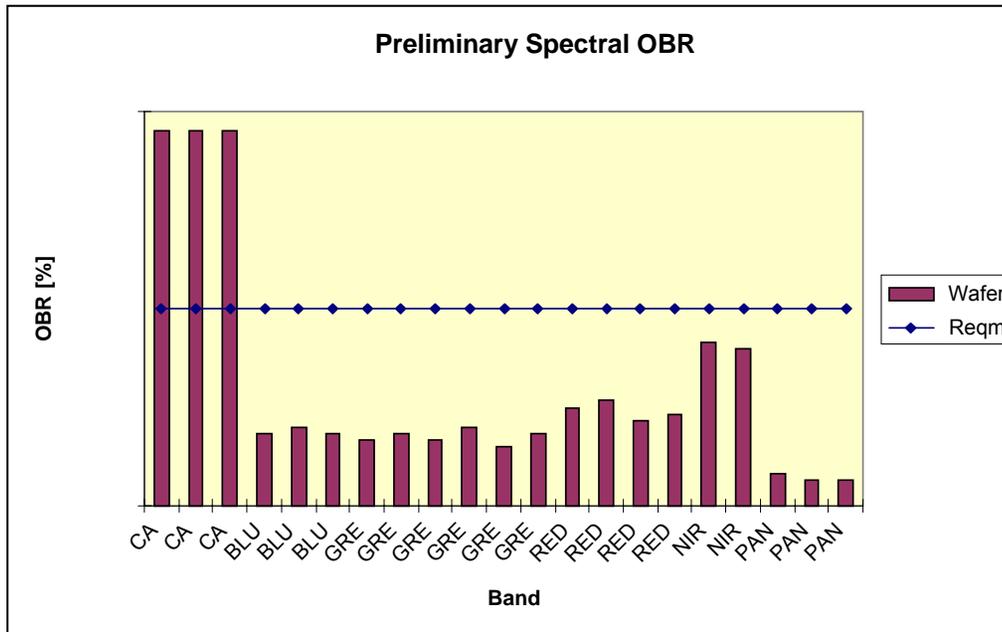
**Greater than spec is good**

Average Relative to Peak Response  
(Spec 3.2.7.1 Spectral Flatness)





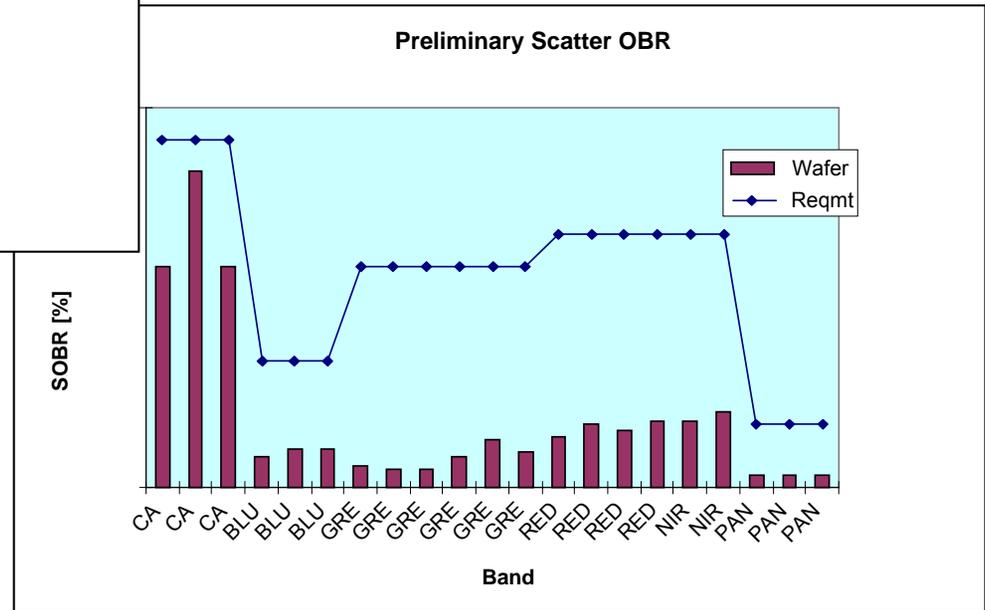
# Spectral and Scatter Out-of-Band Response Meet EDU and Most Flight Requirements



Initial results indicated we don't have the "VIIRS filter problem."

**Less than spec is good**

**CA spectral OBR being addressed in Lots 2 and 3**



# Summary





## Summary



- OLI is on schedule
- Requirements and Design are stable
- Hardware's starting to roll in
- Preliminary data from focal planes and filters is all positive