JWST telescope integration and test progress

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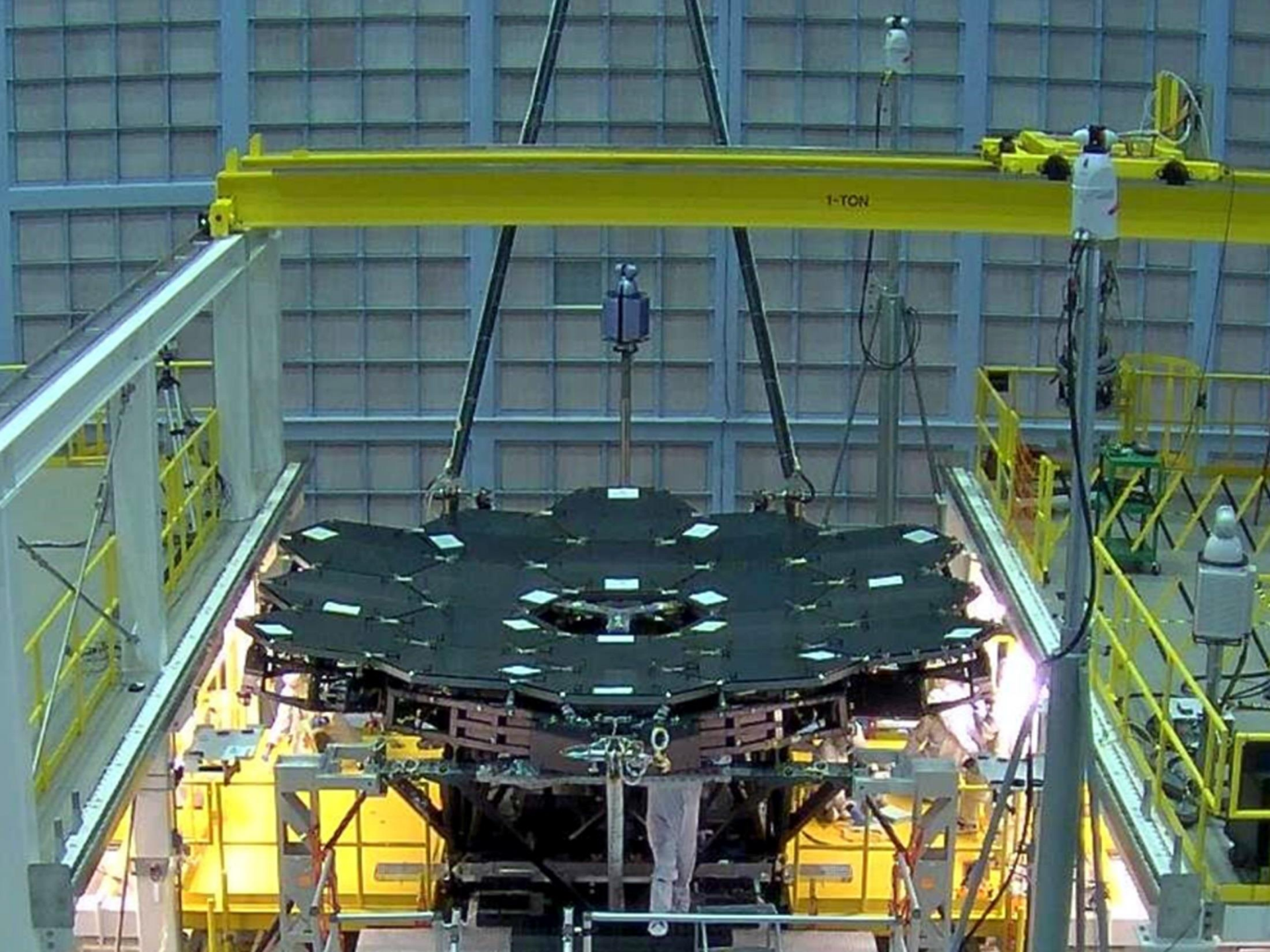
SPIE XXXX-XX

June 2016

OTIS AI&T Status

- **Telescope Test Activities**
  - Optical Telescope Element (OTE) and OTE/ISIM (OTIS) integration will occur at GSFC in the large SSDIF clean room
  - Most of OTE Optical Ground Support Equipment (OGSE) has been completed and was used for Pathfinder integration operations
- **Pathfinder OGSE Test Program**
  - A series of three cryo tests planned prior to the flight that increase in complexity and designed to cover all aspects of the flight test program
    - CCT – Chamber Commissioning with the OGSE installed - Complete
    - OGSE#1 – Center of Curvature and Dynamic Testing - Complete
    - OGSE#2 – Half Pass and Pass and a Half Testing
    - Thermal Pathfinder (TPF) – OTIS Thermal Simulation
- **Optical Telescope Element (OTE) Integration**
  - Optical integration of the flight OTE scheduled for Fall 2015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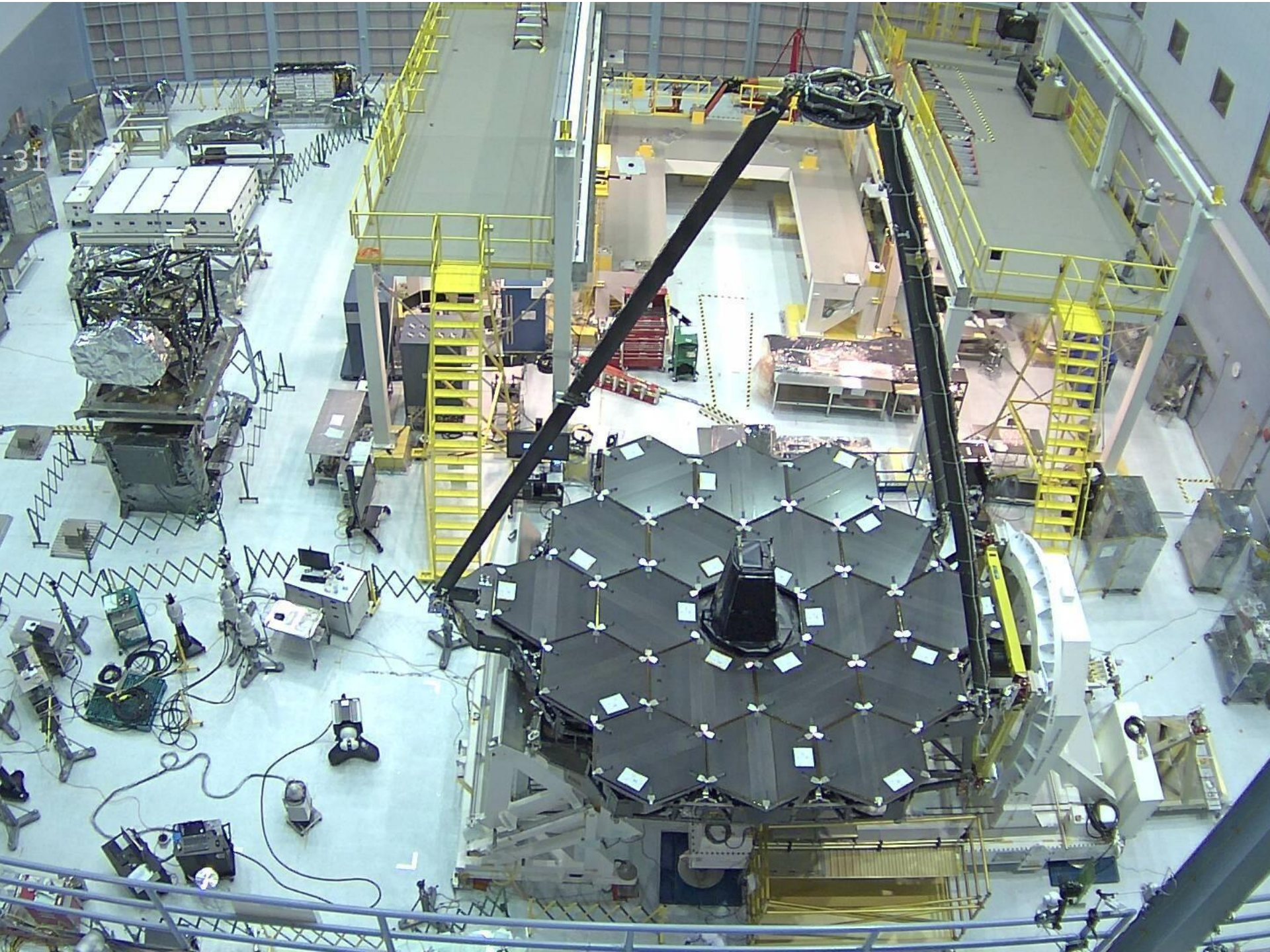
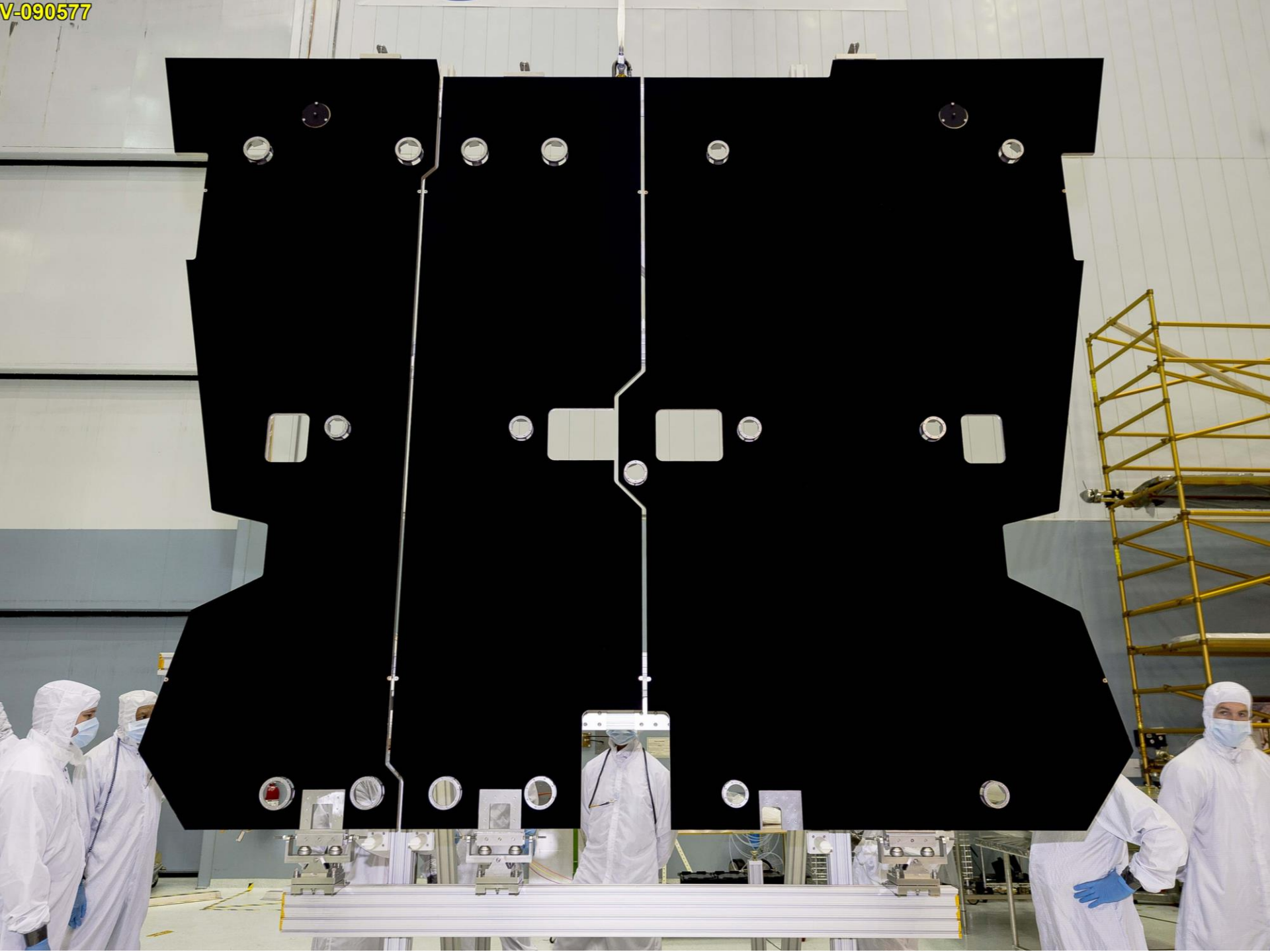
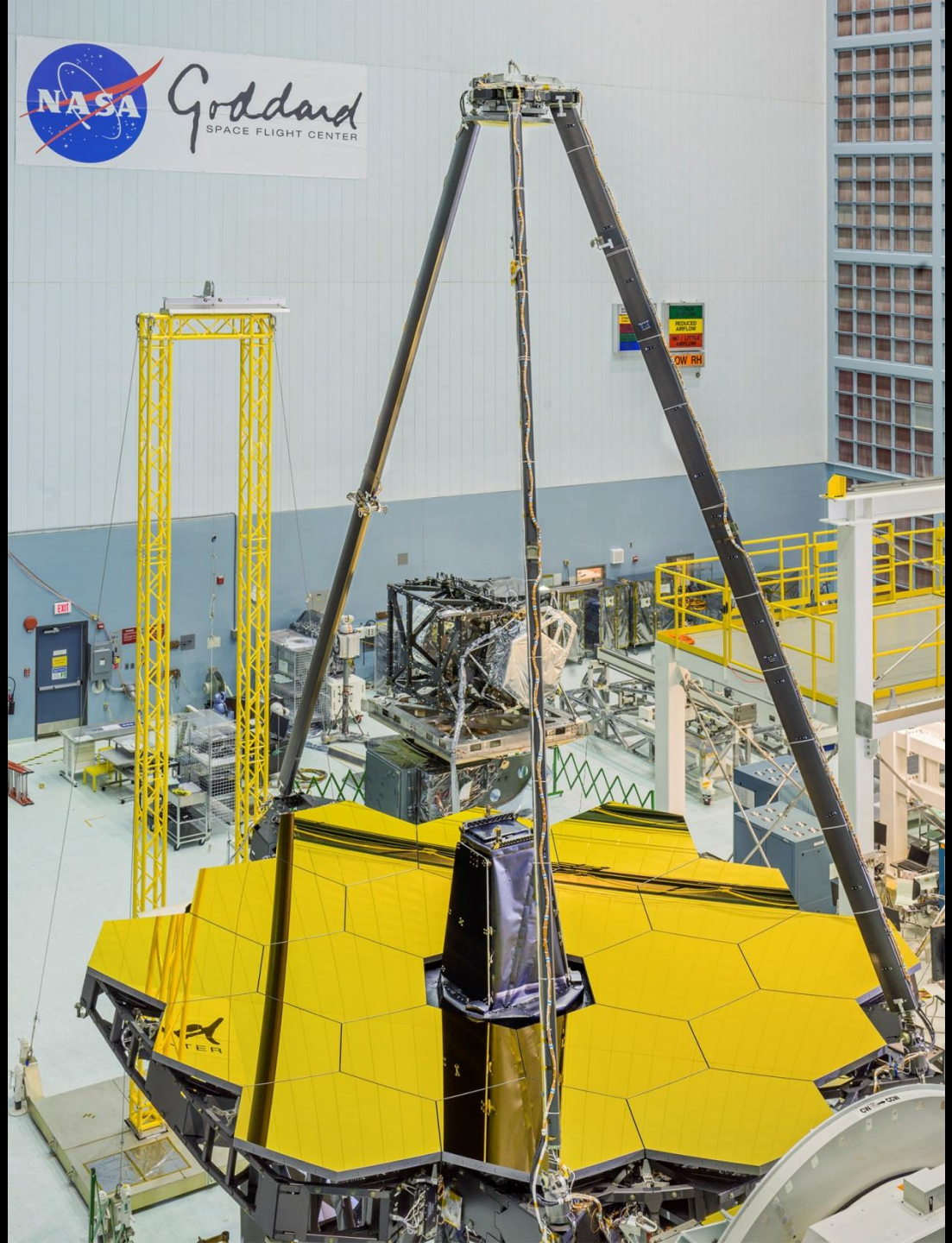
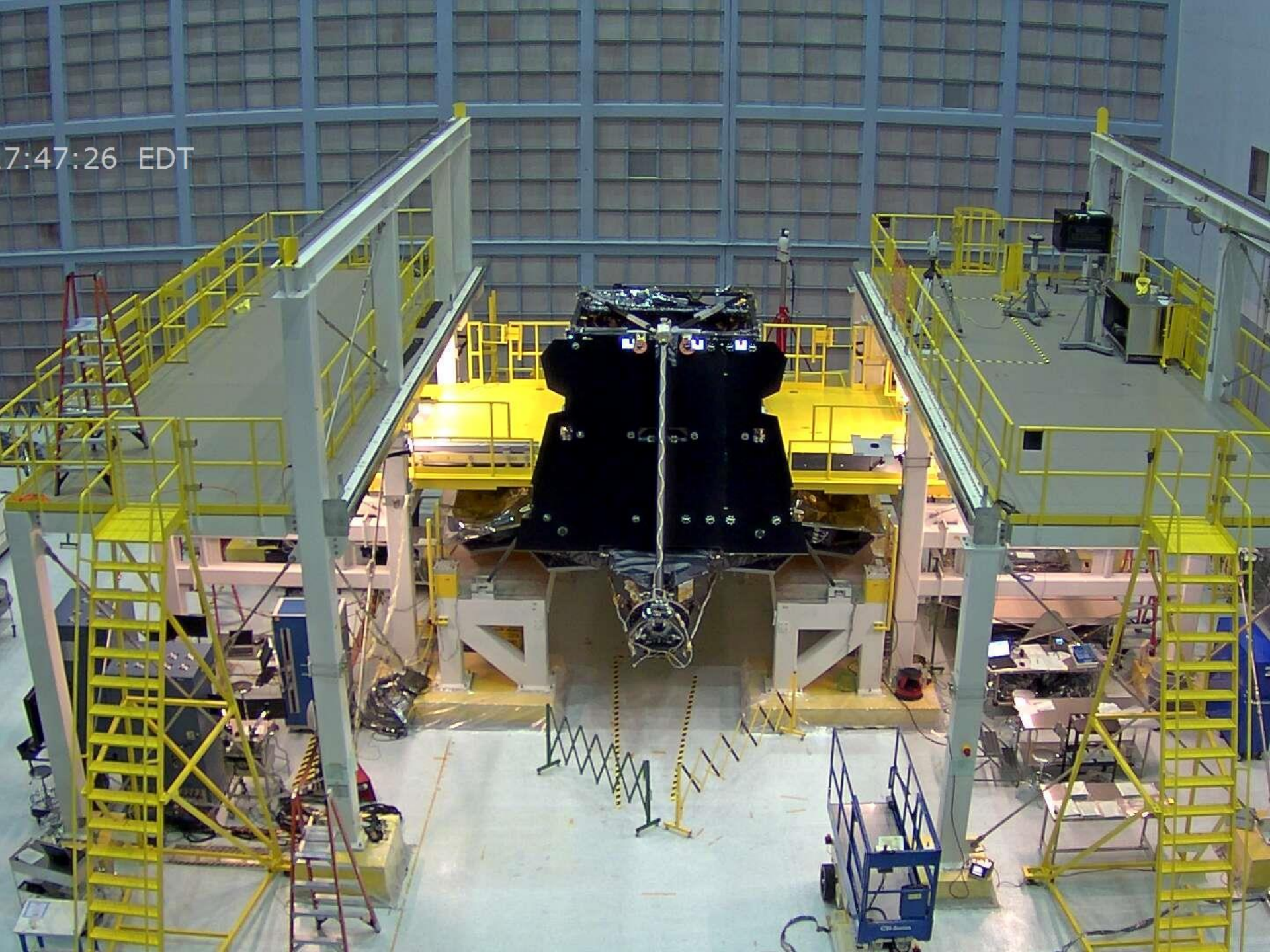
JACK 4
MINIMUM FORK LENGTH 150 in
FORK HERE
GTL 3220




V-090577


DESIGN AIRFLOW
REDUCED AIRFLOW
NO / LITTLE AIRFLOW
LOW RH


NASA
Goddard
SPACE FLIGHT CENTER
REDUCED AIRFLOW
EXIT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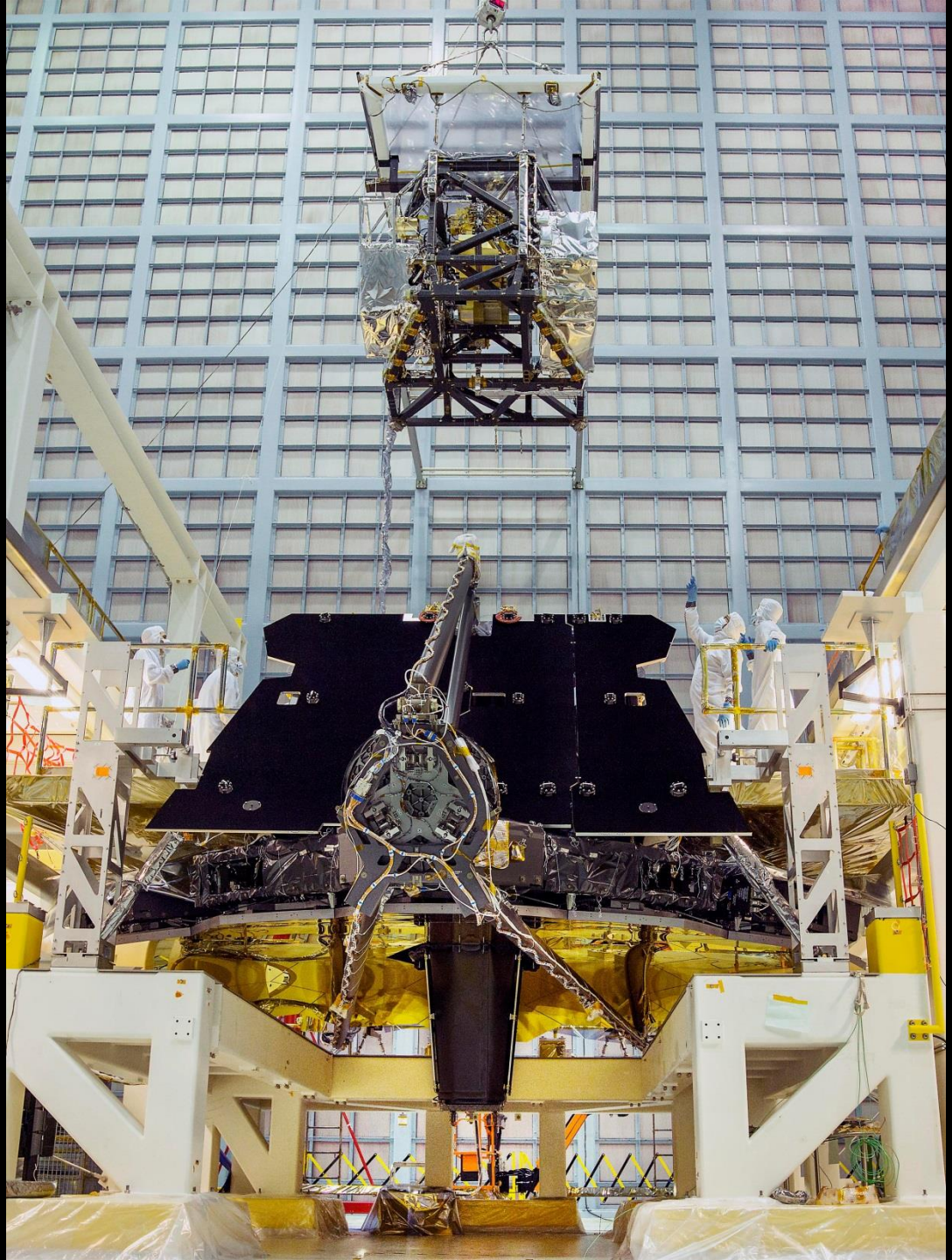


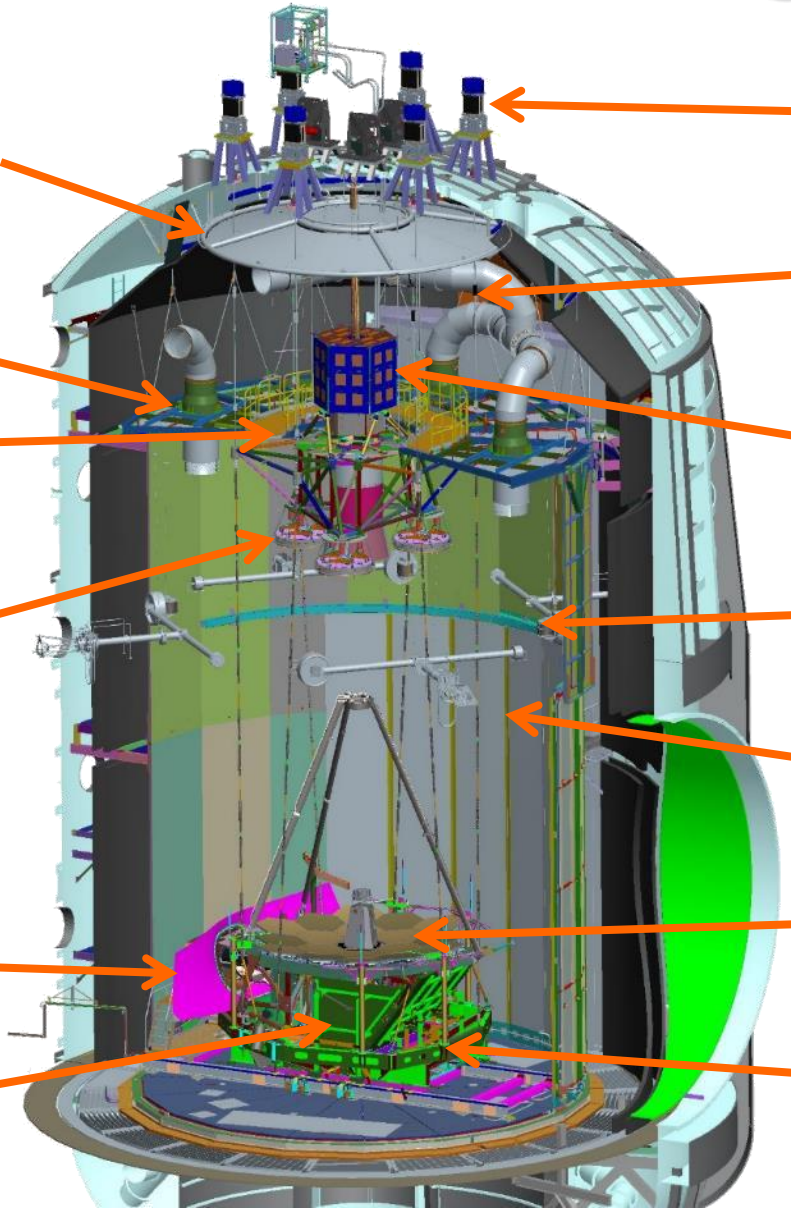
JSC Optical GSE

- **Work continues at JSC to prepare for the OTIS cryo test**

- **First series of tests were optical based tests**
  - Check out of the optical ground support equipment
  - Increasing complexity for the optical equipment

- **Excellent optical results with many lessons learned**

JSC Test Configuration



LN2 Outer Shroud

GHe Shroud

Upper Support Frame (USF)

Three, 1.5m Auto-Collimating Flats) (ACF)

Space Vehicle Thermal Simulator (SVTS) – Ready for Thermal PF

Deep Space Edge Radiation Sinks (DSERS)

Isolators (6 units)

Downrods (6 units)

Center of Curvature Optical Assembly (COCOA)

PG Systems (4 units)

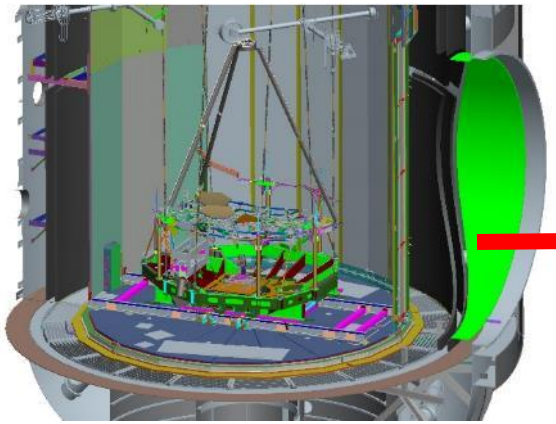
Telescope Rods (6 units)

OTIS

Hardpoint/Offloader Support Structure (HOSS)

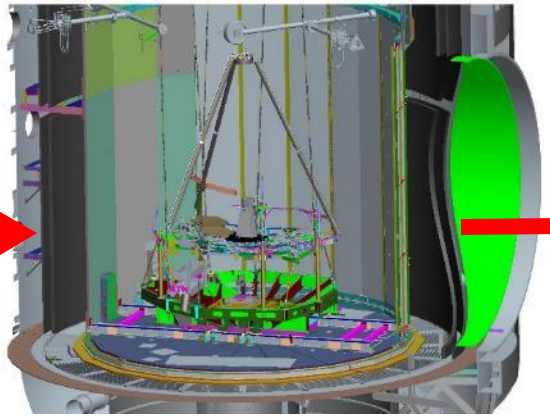
OGSE Test Program

OGSE-1 Complete



- Checkout Optical GSE that has not seen cryo before: CoC test, Hanging Config, Photogrammetry
- No flight hardware except flight spare PMSA/SMA
- Dynamics and Thermal Distortion portion of PF Augmentation occur here

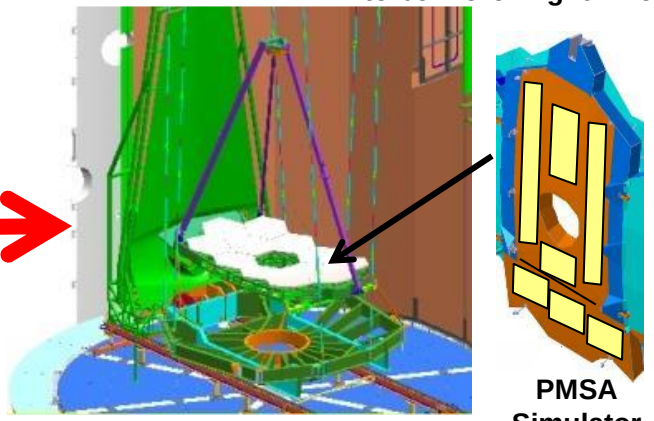
OGSE-2 Complete



- Checkout Pass and a half test with flight AOS and GSE source plate system
- Uses BIA camera as SI simulator

Pathfinder Thermal

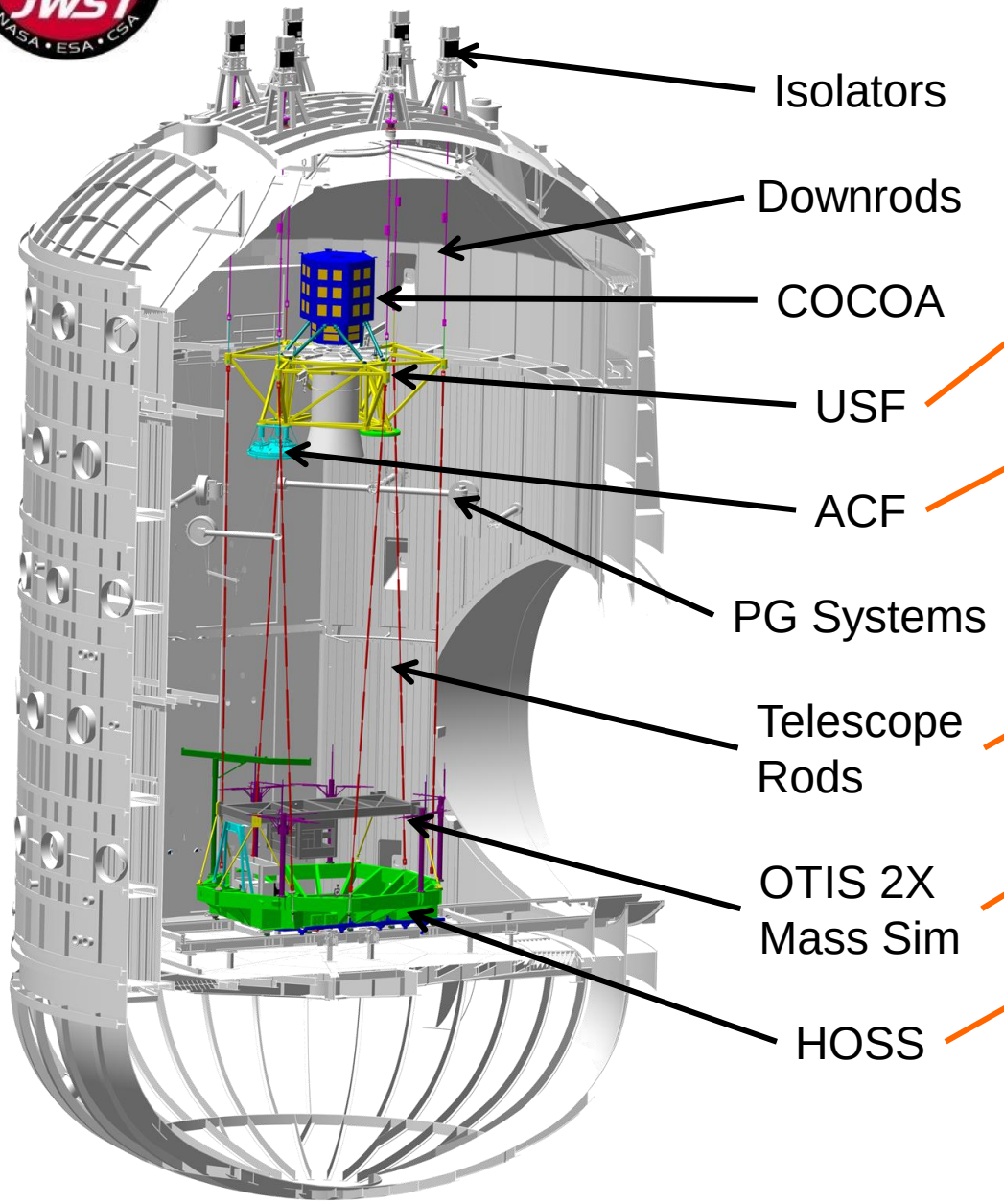
PF Updated to be more Flight Like

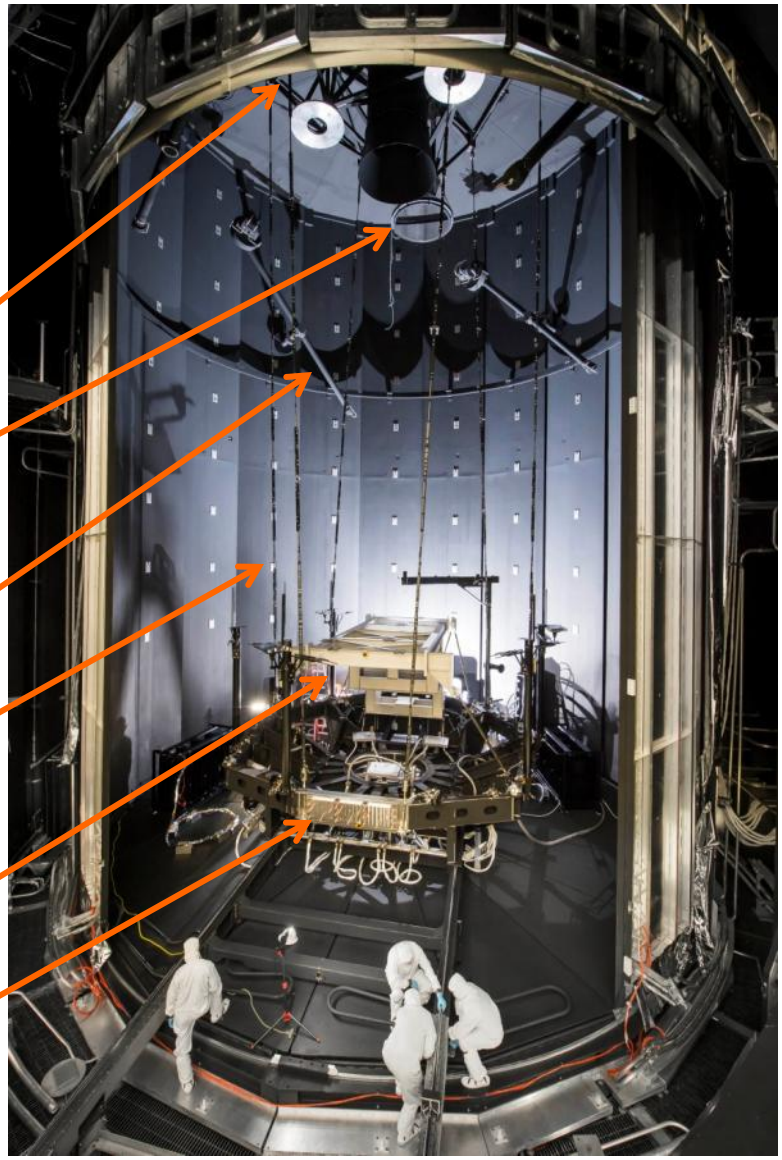


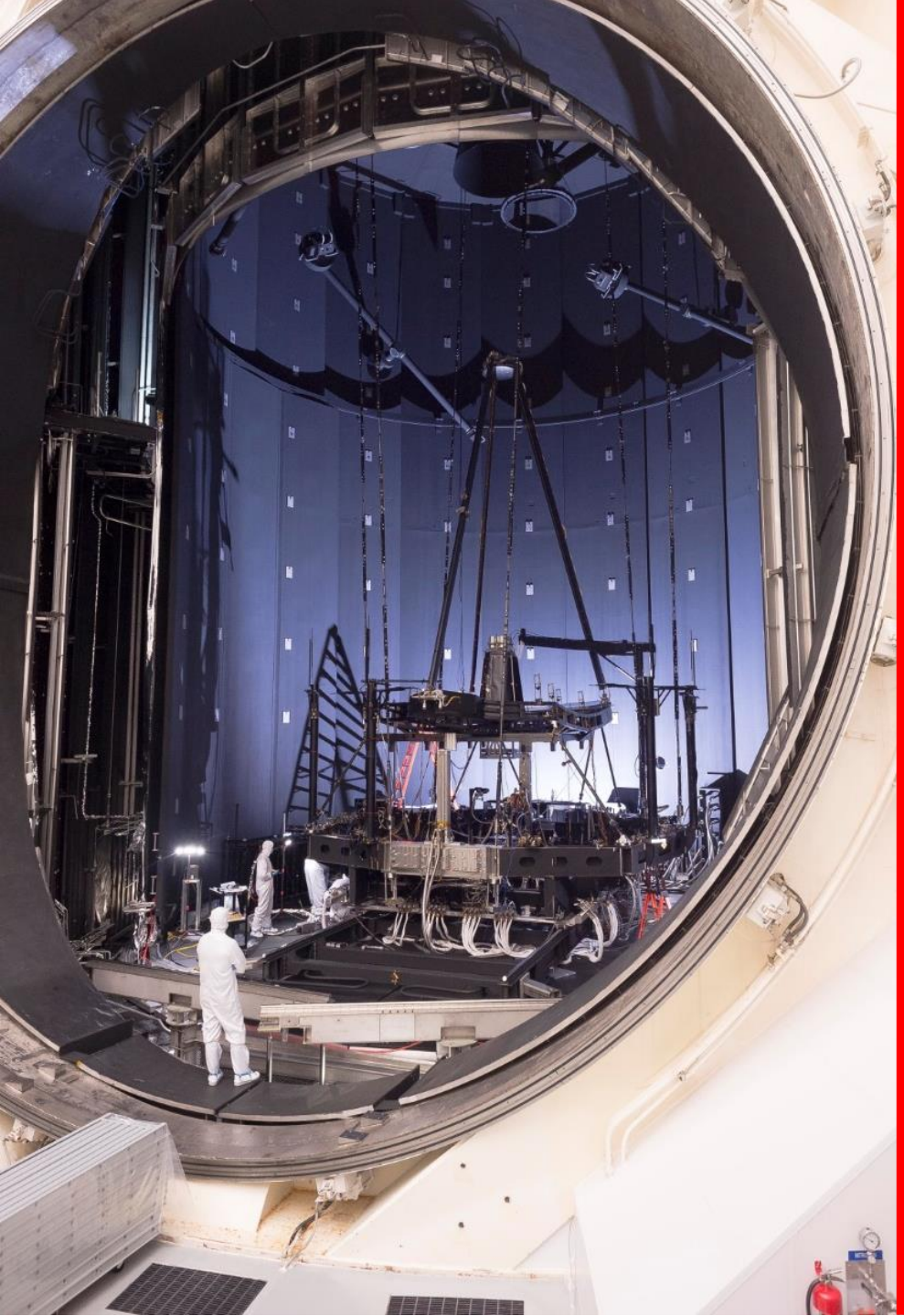
PMSA Simulator

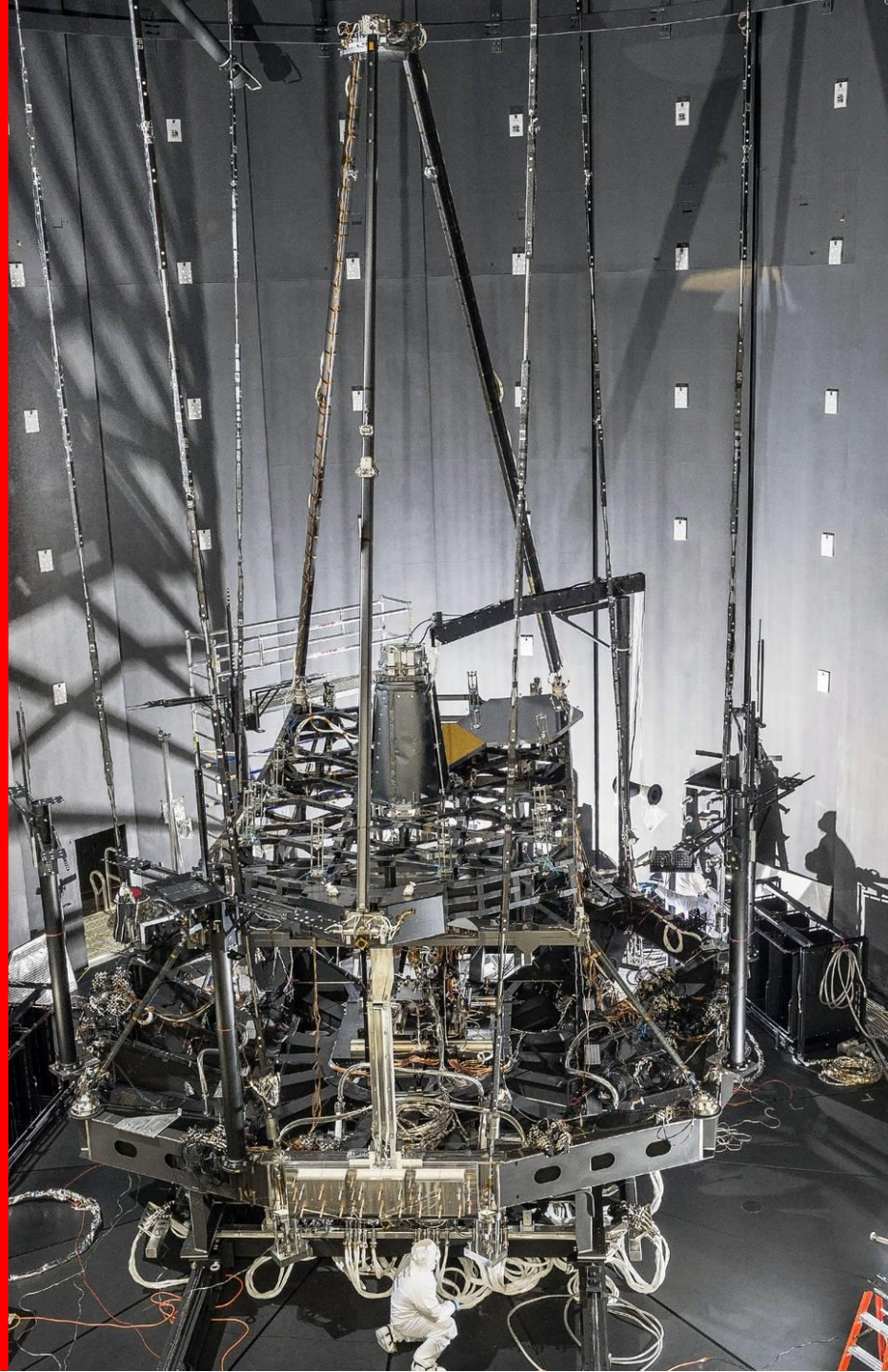
- Thermal GSE Checkout (includes SVTS)
- Dry run cooldown and warmup
- Will allow risk reduction of some OTE Thermal Balance (design validation off the critical path)

Chamber Configuration for CCT









Range of Motion

- Range of COCOA and ACF actuation systems

COCOA	V1 (mm)	V2 (mm)	V3 (mm)	RV1 (urad)	RV2 (urad)	RV3 (urad)
Range	+/- 24.6	+/- 32	+/- 32	N/A	+/-5.6	+/-5.6
Cryo Position (margin)	-7.4 (70%)	7.2 (76%)	0.4 (98%)	-0.6	0.5 (92%)	-0.5 (90%)

ACF	Decenter (mm)	Tilt (mrad)
Range	N/A	10.8
Cryo Position (margin)	N/A	0.15 (99%)

Photogrammetry Accuracy

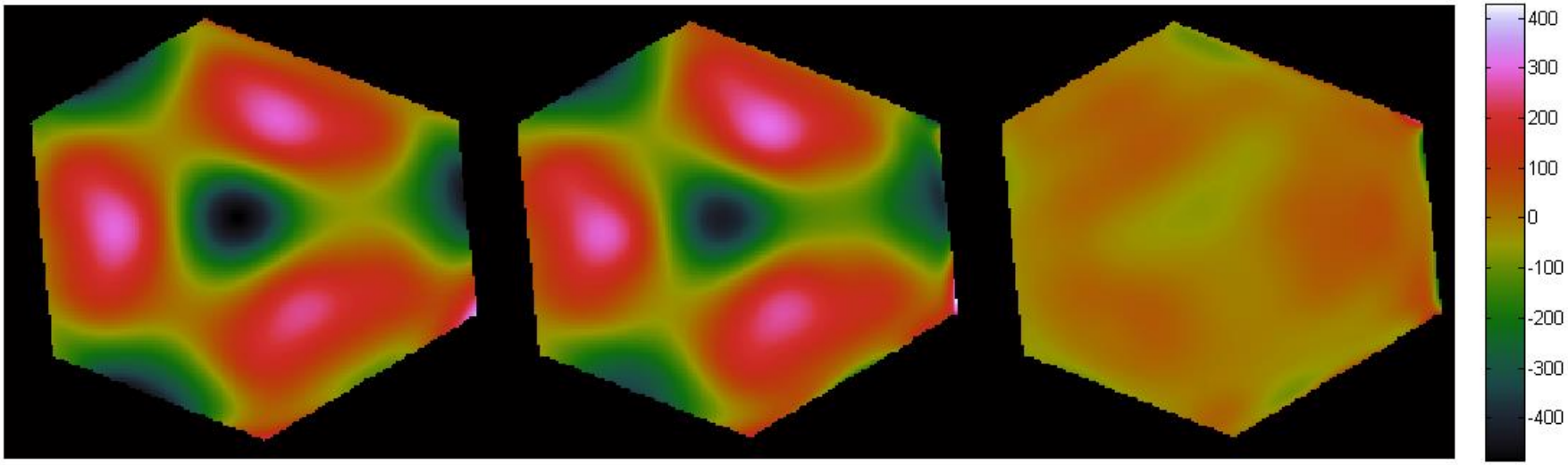
Hardware Component	Measurement Direction	Requirement	Measured Value	Margin
PM to AOS	Piston	0.1mm	0.04mm	62%
	Decenter	0.1mm	0.08mm	16%
	Tilt	0.15mrad	0.09mrad	40%
	Clocking	1.0mrad	0.31mrad	69%
SM to AOS	Piston	0.15mm	0.08mm	43%
	Decenter	1.25mm	0.65mm	48%
	Tilt	0.335mrad	0.27mrad	24%

Typical PG Accuracies

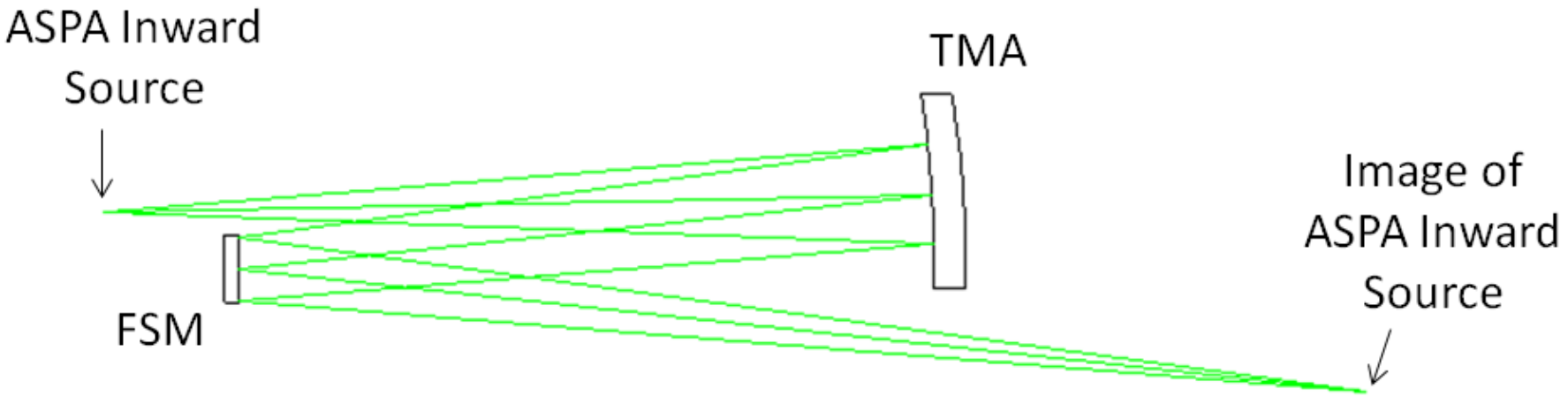
	2σ M1 (mm)	2σ M2 (mm)	2σ M3 (mm)
ACF	0.040	0.067	0.124
SM	0.034	0.020	0.058
ASPA Support Arm	0.047	0.021	0.022
ASPA	0.021	0.007	0.008
AOS Base	0.020	0.015	0.013
PM	0.023	0.010	0.014
Strut Base	0.116	0.024	0.053

PMSA Figure Error

Measured (165 nm-rms) ***Model Predict (161 nm-rms)*** ***Difference (31 nm-rms)***



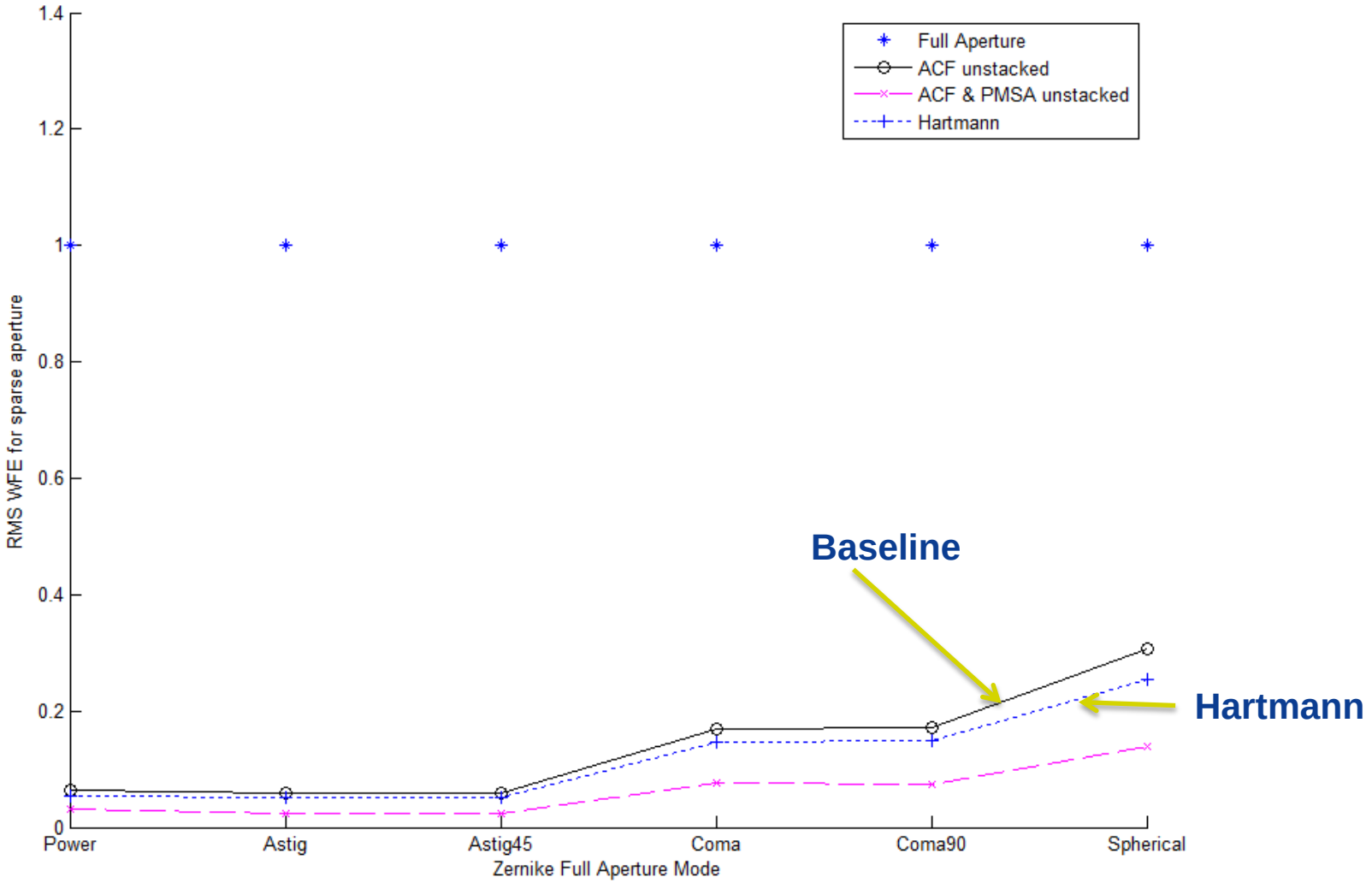
Inward Source Light Path



ASPA Image Location

Instrument FOV	ASPA Source Designation	Difference between Best Image Location and Predicted Location		
		dM1 (mm)	dM2 (mm)	dM3 (mm)
NIRCamB	I-1	0.987	0.137	-0.120
NIRCamB	I-3	0.578	0.055	-0.395
NIRCamB	I-4	0.792	0.168	0.127
NIRCamA	I-5	0.784	0.327	-0.151
NIRCamA	I-6	0.749	-0.176	-0.192
FGS1	I-7	0.579	0.030	-0.204
FGS1	I-8	0.531	0.013	-0.176
FGS1	I-9	0.167	0.099	-0.215
FGS2	I-11	0.946	0.060	-0.092
FGS2	I-13	0.870	0.069	-0.094
NIRISS	I-15	-0.129	0.051	-0.267
NIRISS	I-16	0.084	0.074	-0.188
MIRI	I-23	0.013	0.195	0.135
MIRI	I-24	-0.217	0.108	-0.385
NIRSPEC	I-25	0.265	0.102	-0.191
NIRSPEC	I-26	-0.035	0.094	-0.247
	Average	**0.435**	**0.088**	**-0.166**
	Standard Deviation	**0.410**	**0.103**	**0.144**
	Range	**1.204**	**0.503**	**0.530**

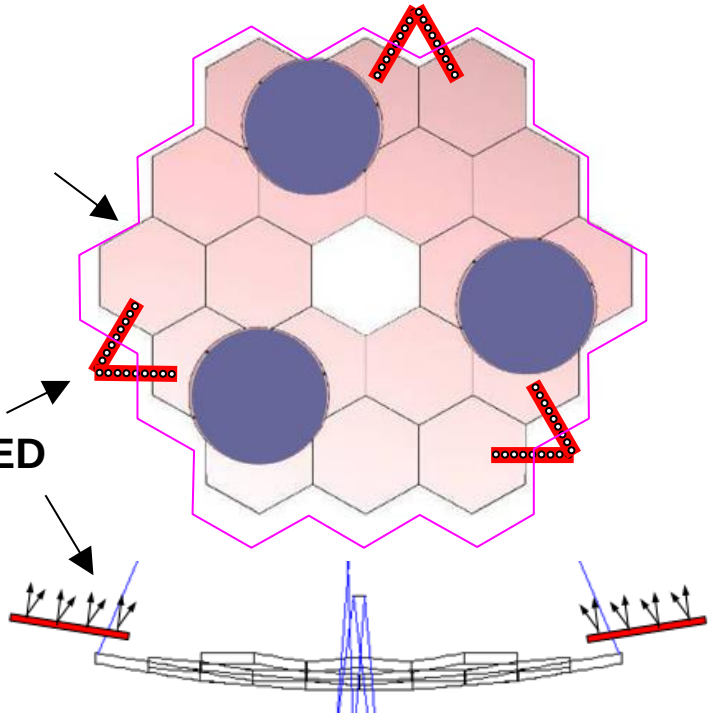
Hartmann Test Sensivity

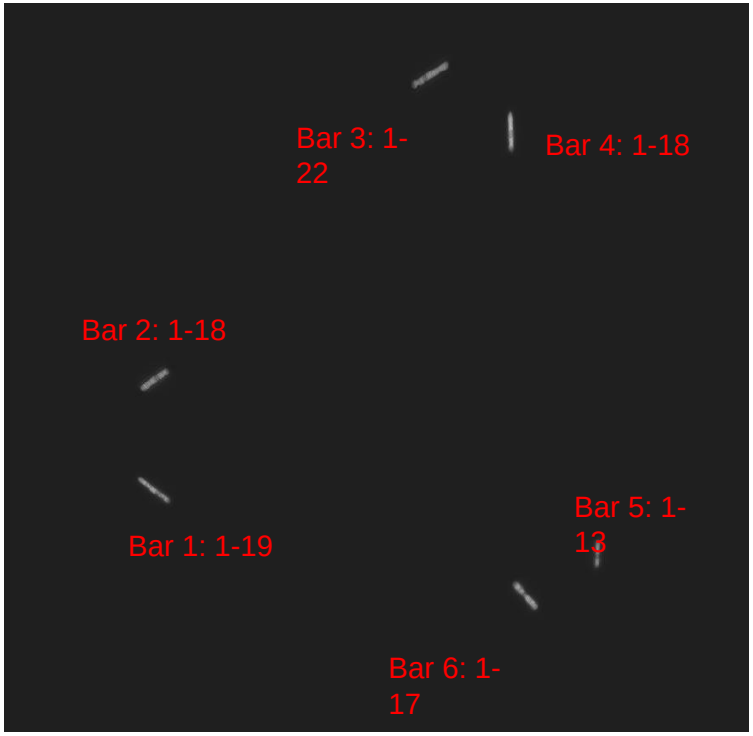


Fid Light Bar Performance

FSM Mask Projection

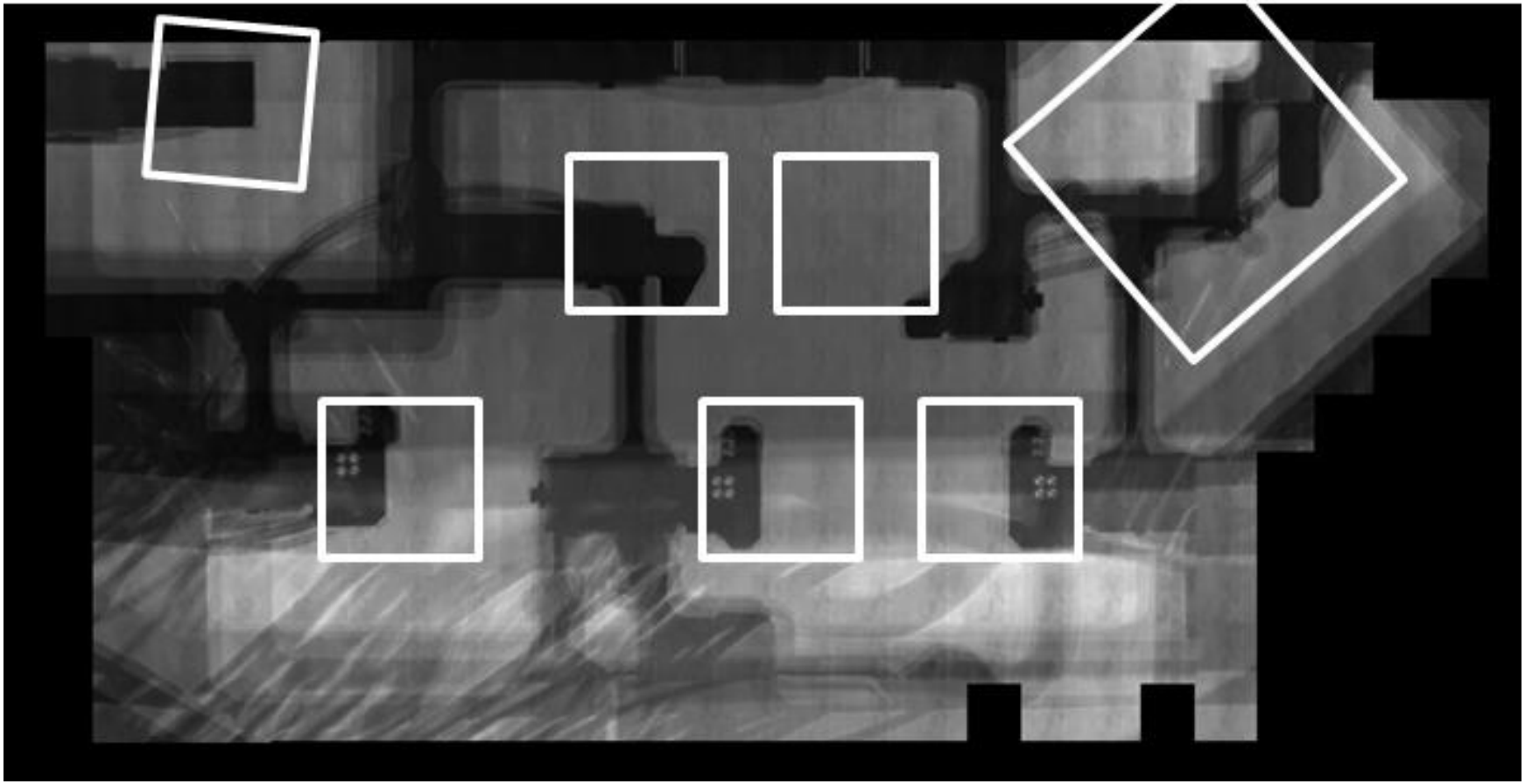
Linear LED Arrays





Bar	1	2	3	4	5	6
Nominal Last visible LED	20	18	21	17	13	16
Actual last visible LED	19	18	22	18	13	17

Shadowgram Test

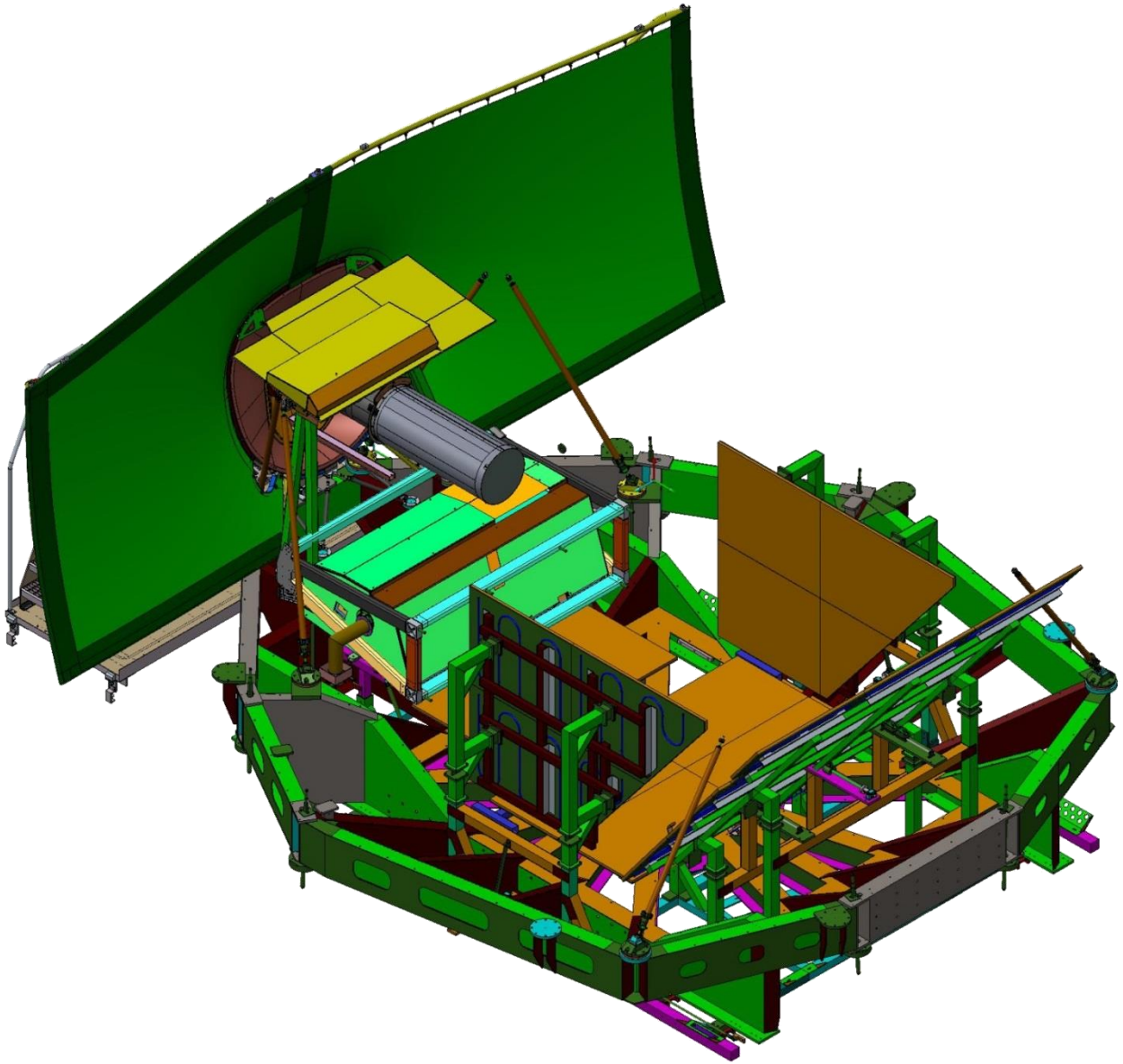


Thermal Pathfinder (TPF) Test

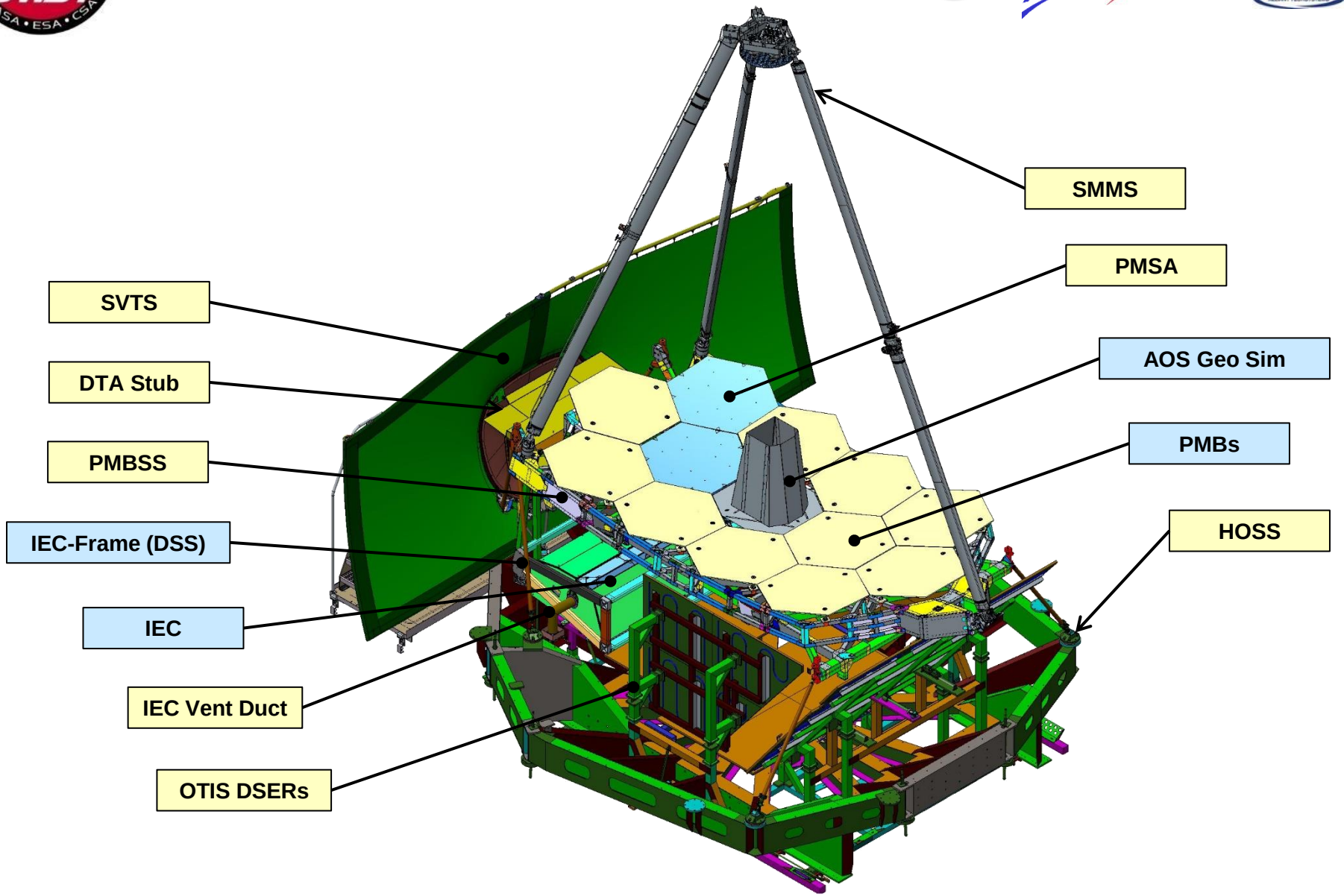
- **Final test prior to OTIS is thermally focused**
  - How does the system cool down with an OTIS simulator

- **Incorporation of all the thermal hardware**
  - DSERS
  - SVTS
  - Zero-Q heaters
  - Actively cooled ACF's due to "no He gas" for the OTIS test

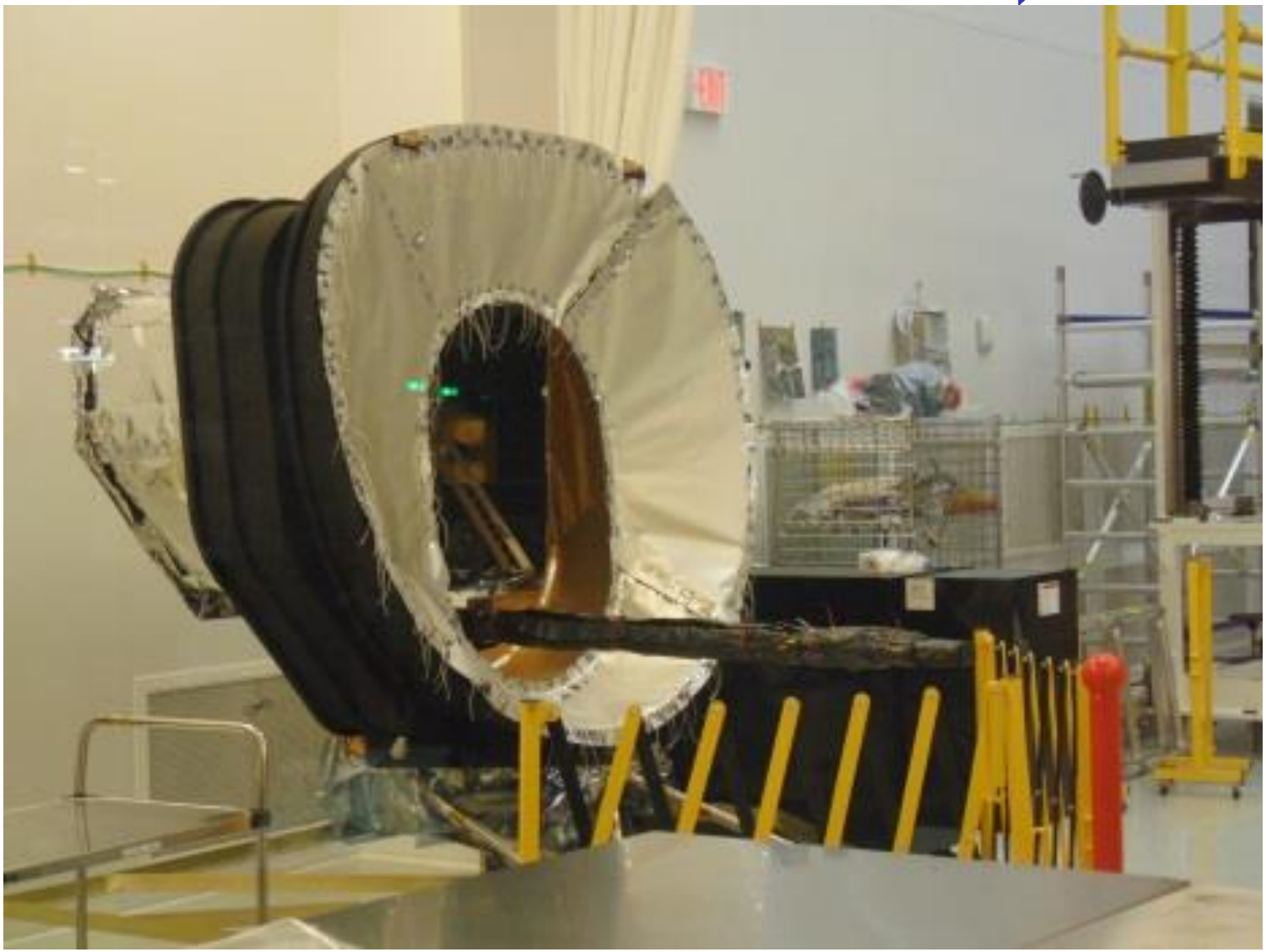
HOSS Thermal Configuration



TPF Pathfinder Configuration



SVTS Hub and Rim



Summary

- **The first of three Optical Ground Support Equipment and Thermal Tests is complete**

- **Test results have been excellent**
  - COCOA works as designed
    - The two PMSA's were phased
  - PG system is fully operational
  - Isolation system worked as designed
    - Short during cryo temperatures identified and will be corrected prior to OGSE#2

- **Pathfinder has been very important and enables the flight program**
  - Provides critical experience in preparation for the critical path flight program
  - Well worth the investment by the program