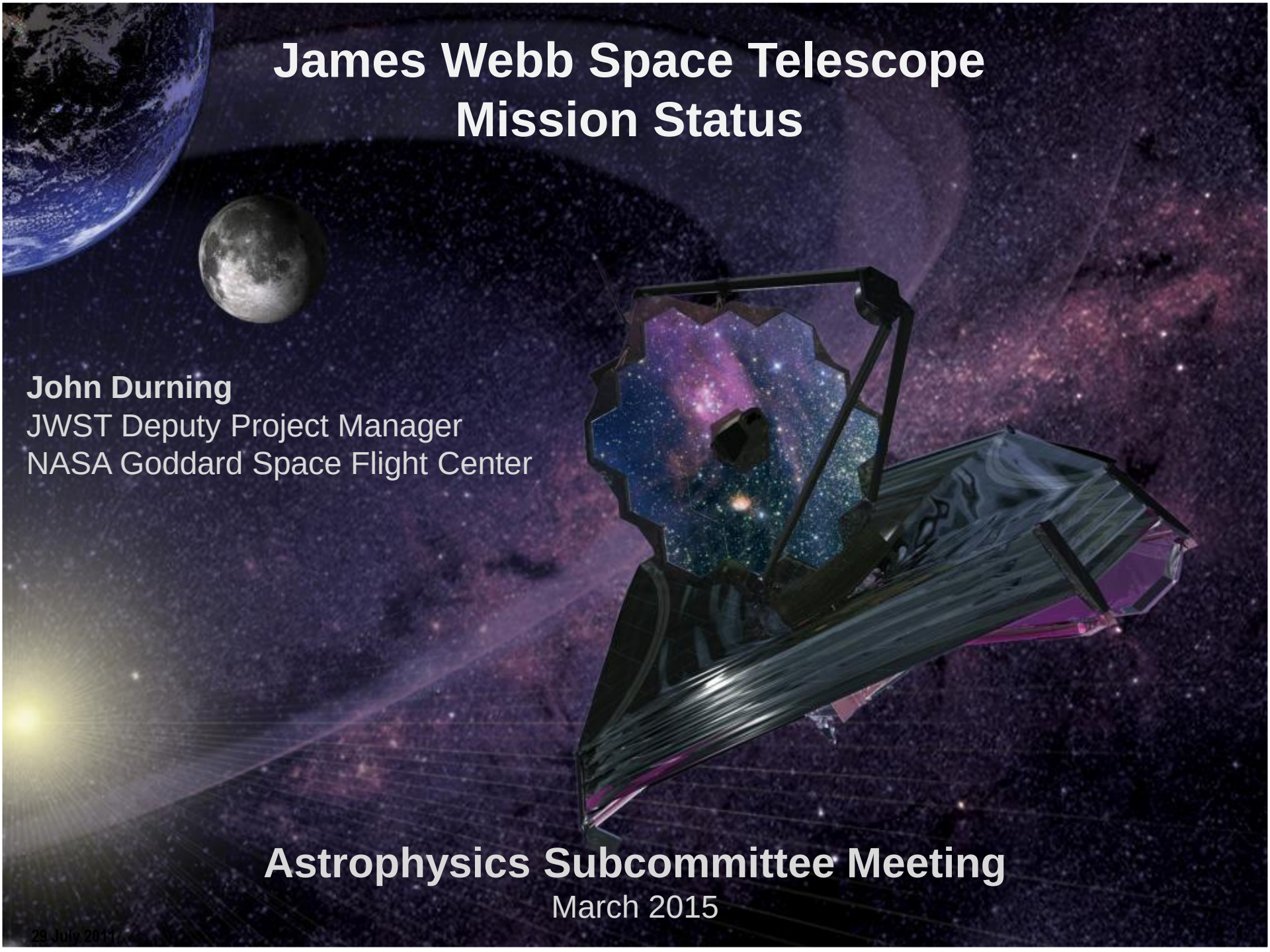
James Webb Space Telescope
Mission Status



John Durning
JWST Deputy Project Manager
NASA Goddard Space Flight Center

Astrophysics Subcommittee Meeting

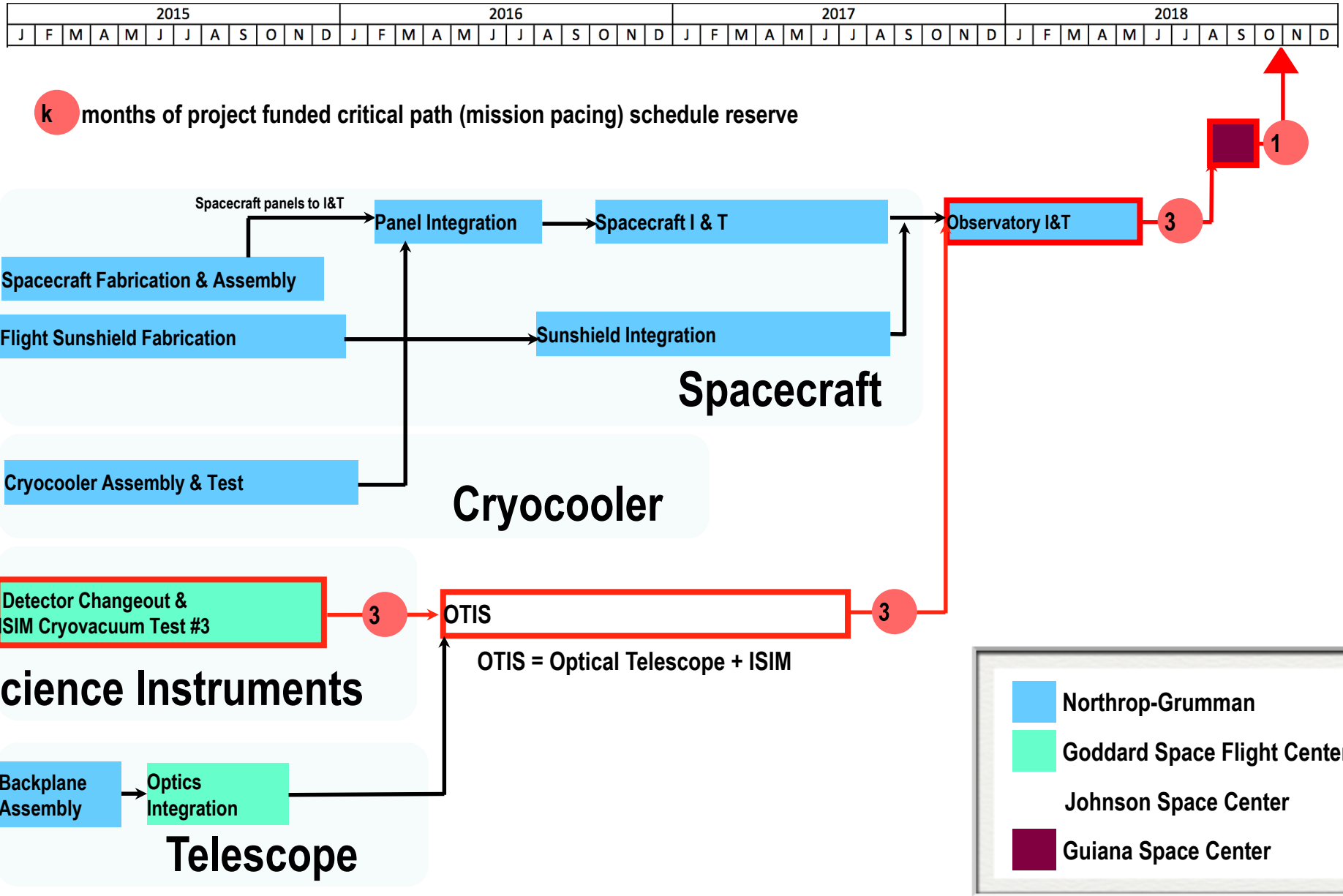
March 2015

Agenda

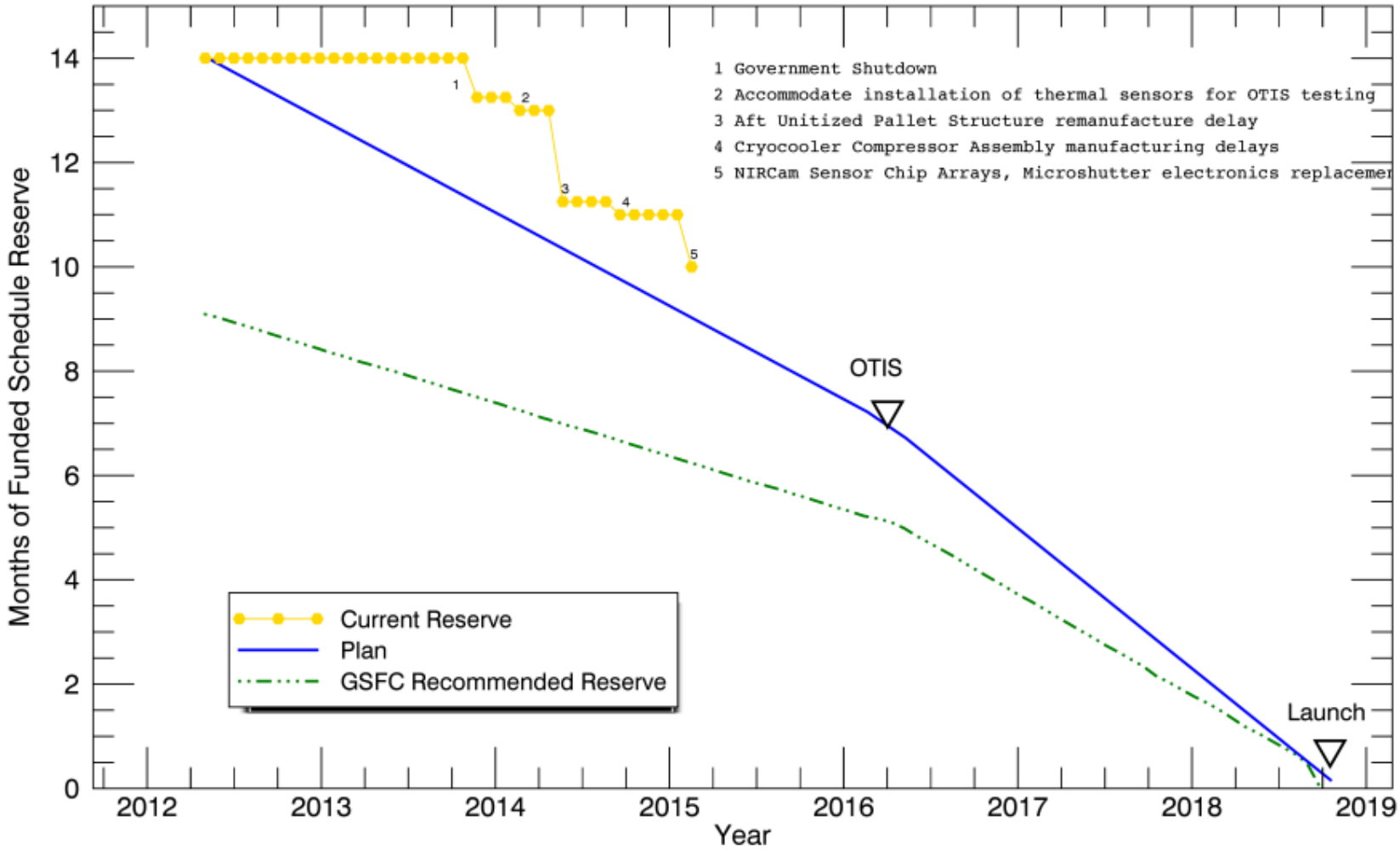
- Schedule
- Mission Status
- Issues/Concerns
- Closing Remarks

SCHEDULE STATUS

Simplified Schedule



Project Funded Schedule Reserve



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Milestone Performance

- Since the September 2011 replan JWST reports high-level milestones monthly to numerous stakeholders

	Total Milestones	Total Milestones Completed	Number Completed Early	Number Completed Late	Deferred to Next Year
FY2011	21	21	6	3	0
FY2012	37	34	16	2	3
FY2013	41	38	20	5	3
FY2014 ❖	36	23	10	8	11
FY2015	48	23	15	3*	0

***Late milestones have been or are forecast to complete within the year. Deferred milestones are not included in the number-completed-late tally.**

❖ Milestone accounting in FY2014 was complicated by the government shutdown and multicomponent milestones

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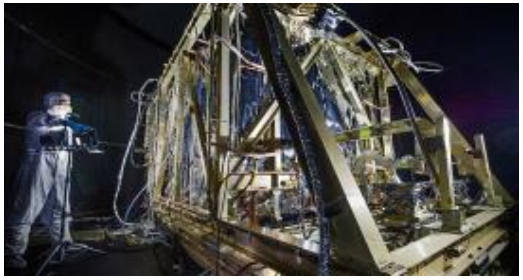
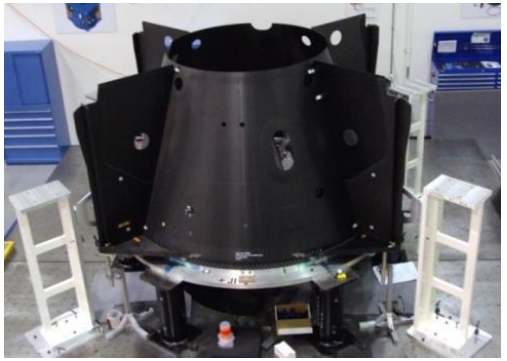
MISSION STATUS

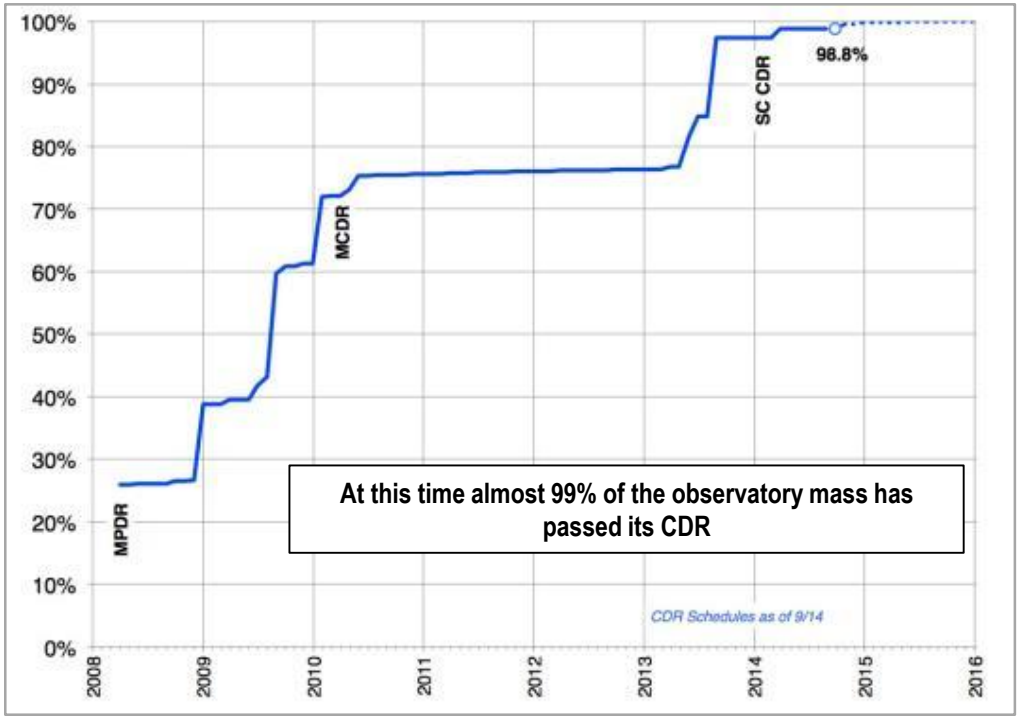
Overall Mission Status

JWST Is In Fabrication and I&T



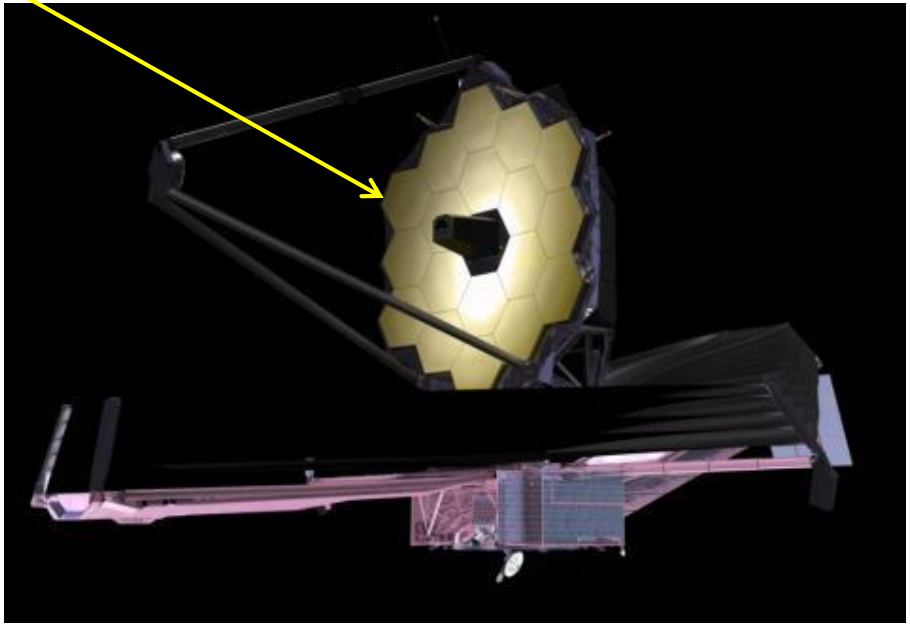


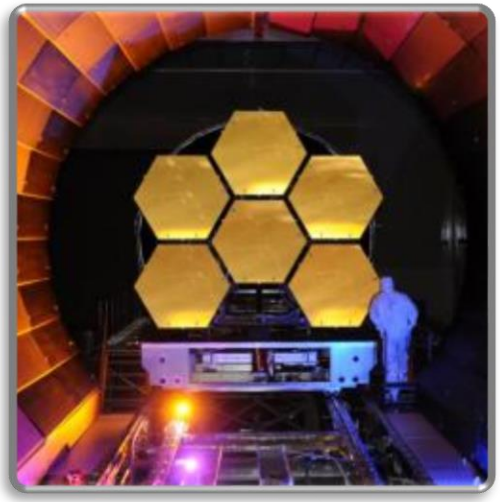
Flight Hardware Percentage of Mass Past CDR



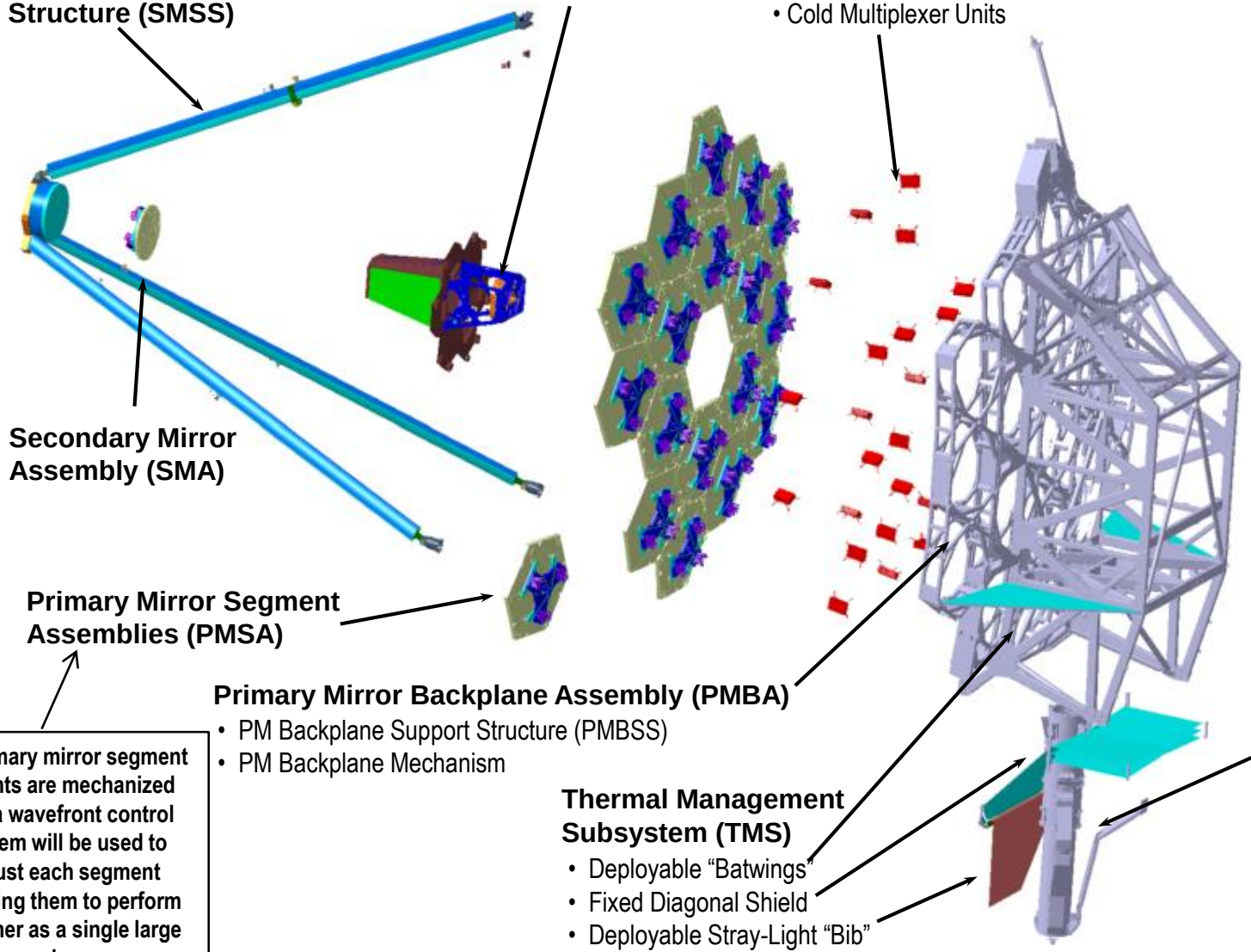
Telescope

- **Optical Telescope Element (OTE)**
- Sun Shield
- Integrated Science Instrument Module (ISIM)
- Spacecraft
- Ground System





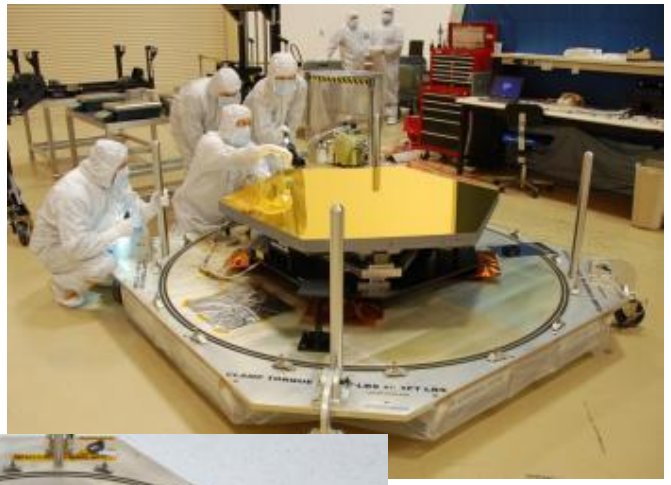
Telescope Architecture Overview



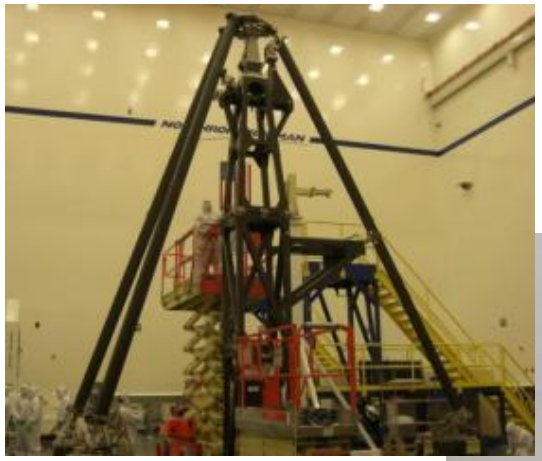
18 primary mirror segment mounts are mechanized and a wavefront control system will be used to adjust each segment enabling them to perform together as a single large mirror

Mirror Status

Flight telescope build begins - August 2015

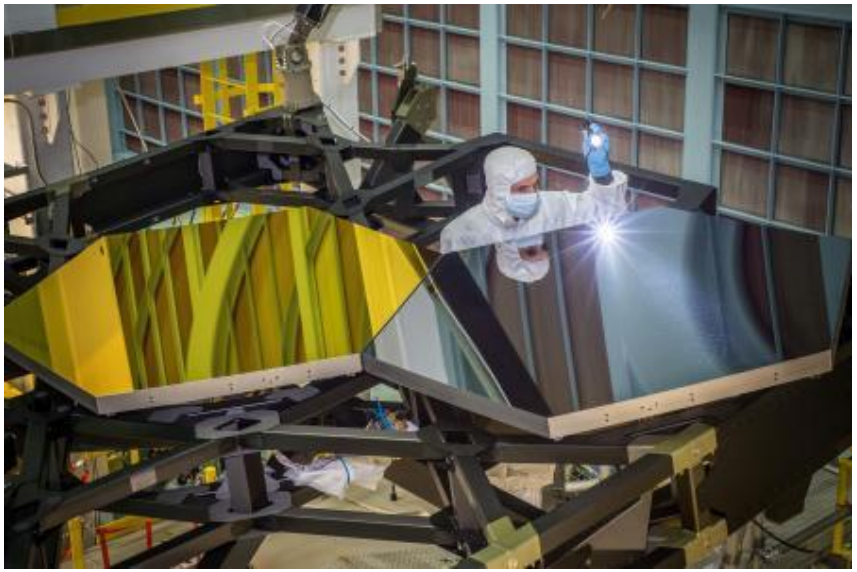


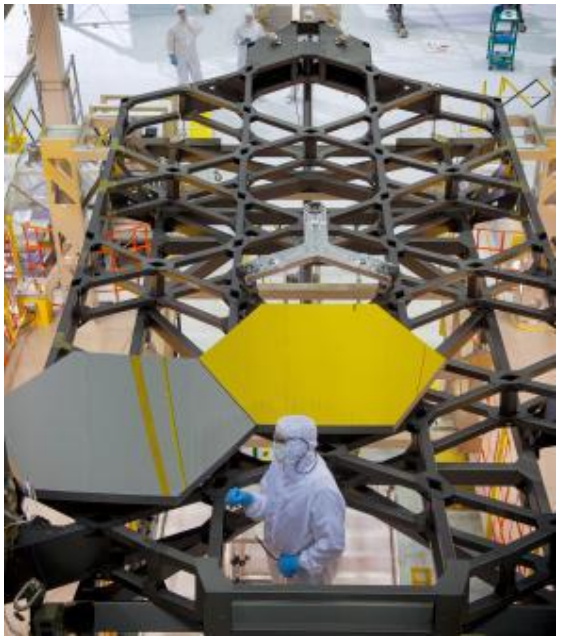
Backplane Support Frame, Center Section & Wings



All Flight Backplane Components are at NGAS in Integration

Telescope Pathfinder – Risk Reduction

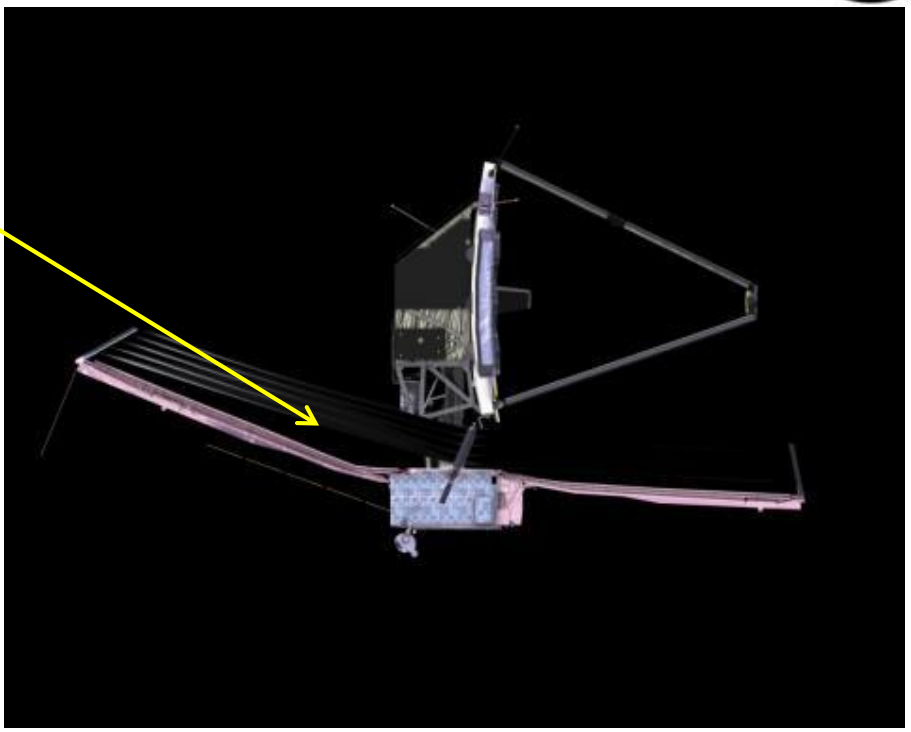


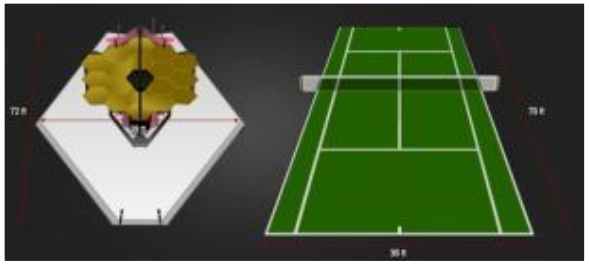


JWST Pathfinder is a partial telescope that will be used to practice our processes and procures on to get ready for the flight hardware.

Sunshield

- Optical Telescope Element (OTE)
- **Sun Shield**
- Integrated Science Instrument Module (ISIM)
- Spacecraft
- Ground System





Sunshield Testing

Engineering Test Highlights

- **Integration Verification Article (IVA) full-scale deployment test completed**
  - Key risk reduction test, successfully demonstrated membrane deployment design
  - Currently incorporating lessons learned and upgrading test facility for 2nd scheduled deployment test

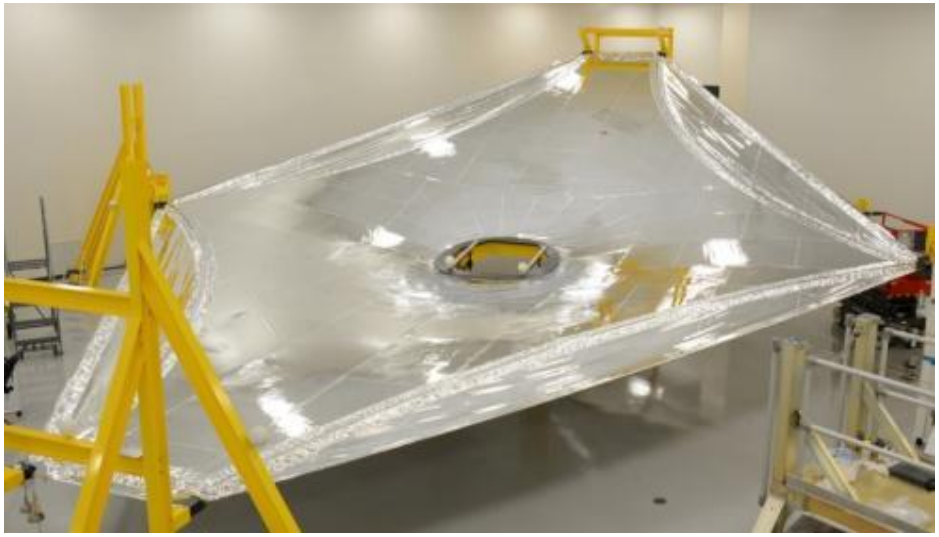
Sunshield Highlights – Membranes

Flight Manufacturing In Progress

Flight Membrane Manufacturing:

- **Flight Layer 3**
  - Fabrication is now complete and ready for shipment to NGAS
- **Flight Layer 4**
  - Fabrication underway, ~75% complete
- **Flight Layer 5**
  - Fabrication underway, ~50% complete
- **Flight Layer 1 & 2**
  - Ready for fabrication to begin

Flight Layer 4 shape testing:
Above: Installation
Below: Test configuration

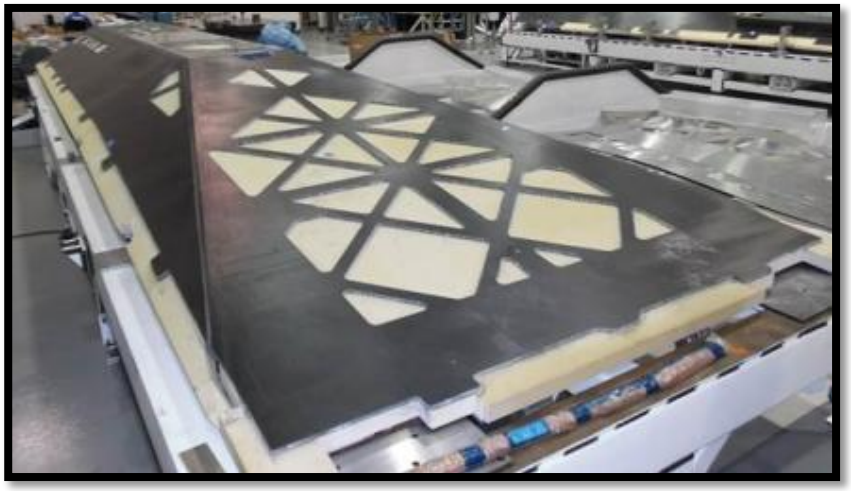


Sunshield Highlights – Structure

Manufacturing Going Well

<u>Flight Structure Manufacturing</u>:

- **Aft and Fwd Unitized Pallet Structure (UPS)**
  - Manufacturing in progress
- **Mid-Boom Assy (MBA) tube final machining and bonding operations are in process (see photo)**
- **Many other parts are complete and in process**

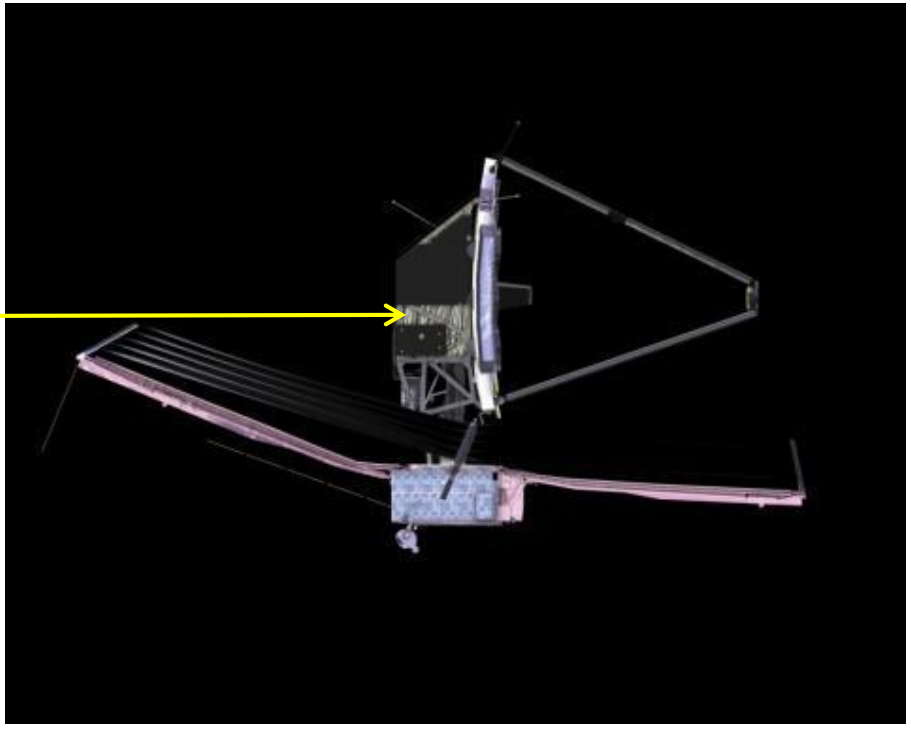


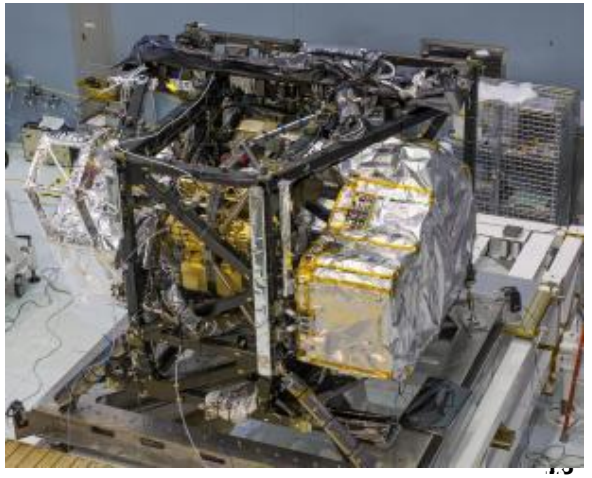
Aft Flight UPS

Flight Mid-Boom tube machining

Integrated Science Instrument Module

- Optical Telescope Element (OTE)
- Sun Shield
- **Integrated Science Instrument Module (ISIM)**
- Spacecraft
- Ground System

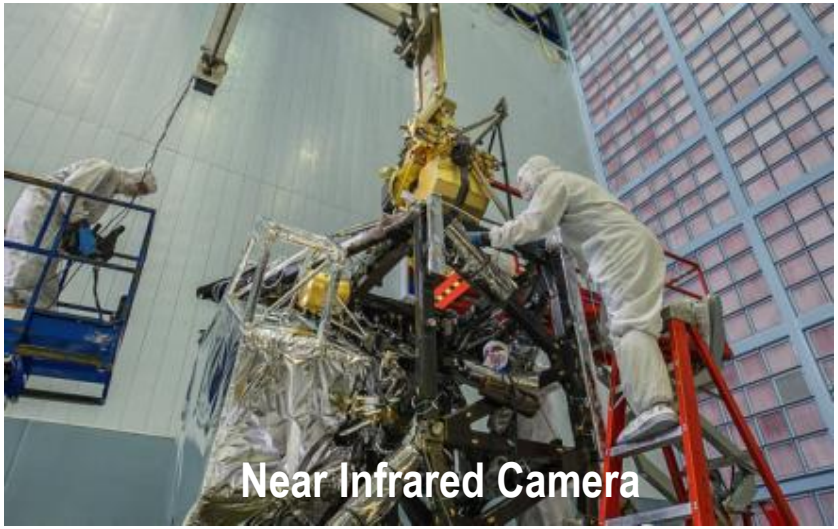


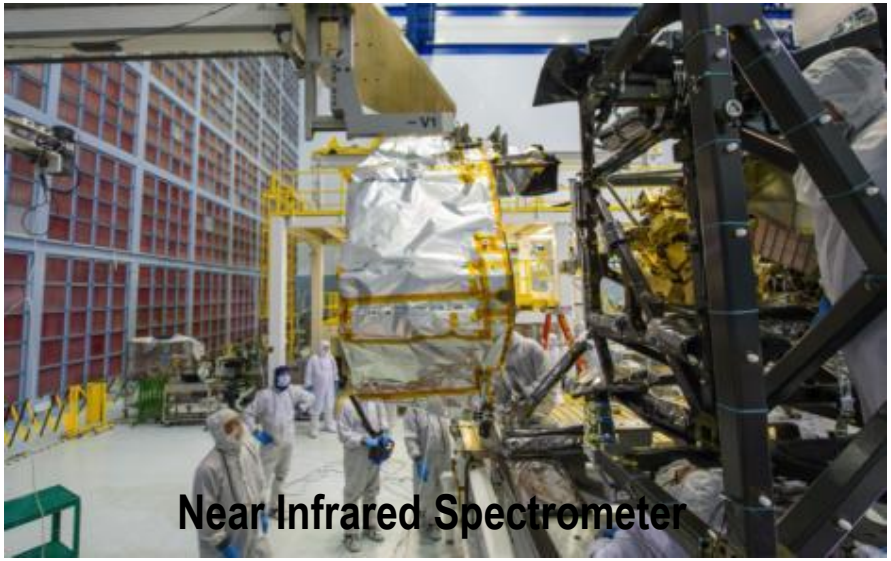


All Instruments Delivered and Were Integrated


Fine Guidance Sensor


Mid-Infrared Instrument


Near Infrared Camera


Near Infrared Spectrometer

Key Aspects of the ISIM I&T Program

ISIM cryo-vac testing is occurring in three phases, with ambient testing and buildup to the final flight configuration in between

✓ **2013: CryoVac1-RR ("Risk Reduction") – Successfully Conducted**

Flight MIRI, FGS/NIRISS; validate the array of test support equipment and overall performance of the test setup (thermal, jitter, stray light); dry-run procedures/analyses, train personnel

✓ Installed flight NIRCam, NIRSpec

✓ **2014: CryoVac2 – Successfully Conducted**

First full-up ISIM verification test with all four flight instruments

100+ people supporting **2,800 consecutive hours of testing**

Extremely flexible test flow and Simple and effective decision model led to 100% of all minimum requirements completed and 95% all other objectives approximately 2 weeks early

De-integrate instruments, replace near-IR detectors, re-integrate; carry out ISIM-level vibration, acoustics, EMI/EMC tests – **In Process**

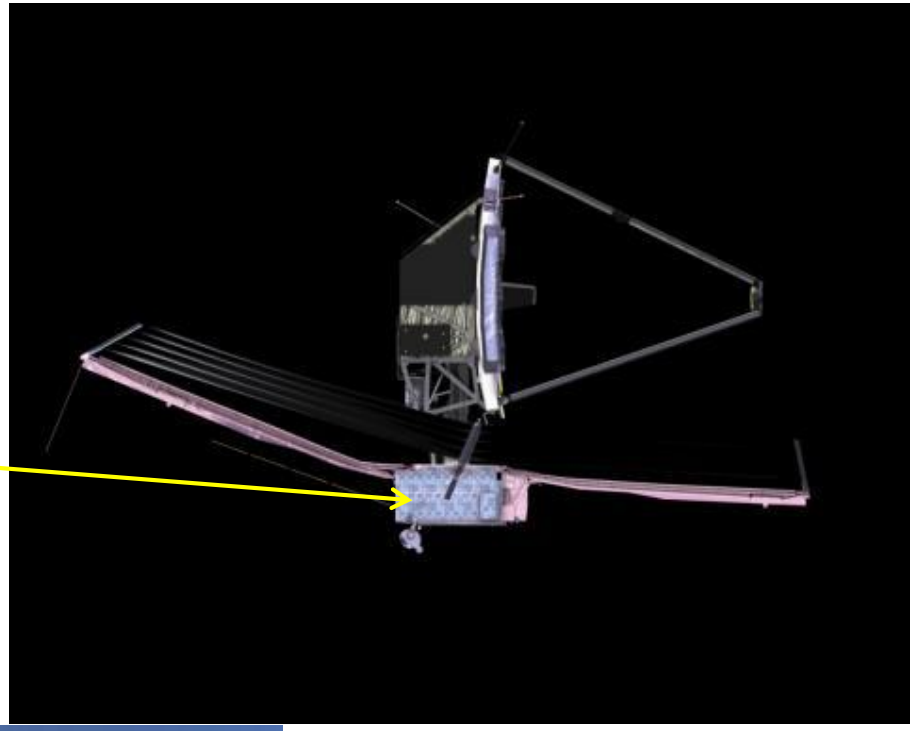
2015: CryoVac3 – Sep. 2015 Start

Final "run for the record" ISIM verification with all flight systems

ISIM Delivery – January 2015

Spacecraft

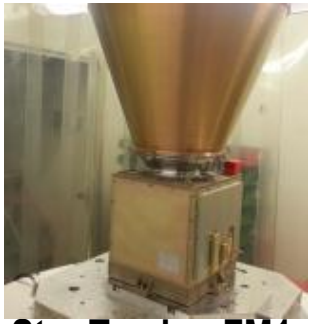
- Optical Telescope Element (OTE)
- Sun Shield
- Integrated Science Instrument Module (ISIM)
- **Spacecraft**
- Ground System



Spacecraft Status

Fabrication, Assembly, and Component Level Testing in process in preparations for Spacecraft I&T

Engineering Qualification Models
Flight Hardware Components
Component Flight Testing



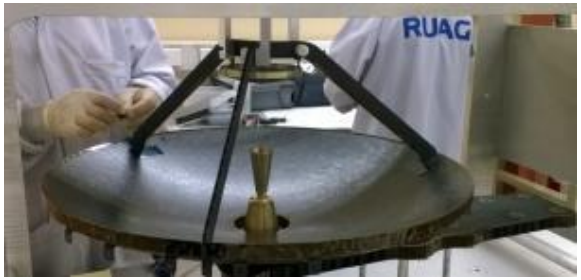
Star Tracker FM1

Solar Panel

Equip Panel

Reaction Wheel EQM

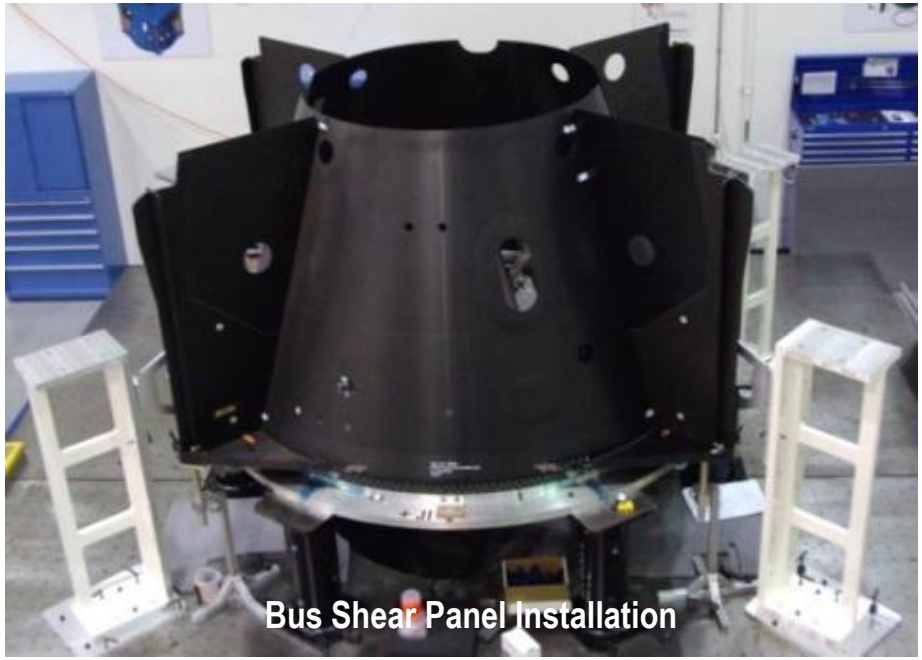
+J3 Panel (with Inserts)



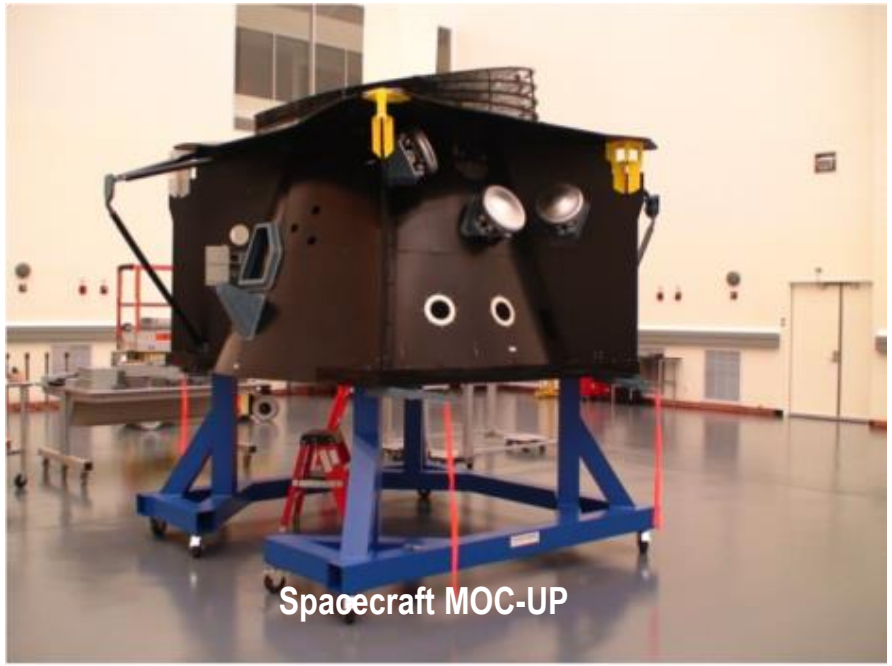
High Gain Antenna

Command and Telemetry Processor

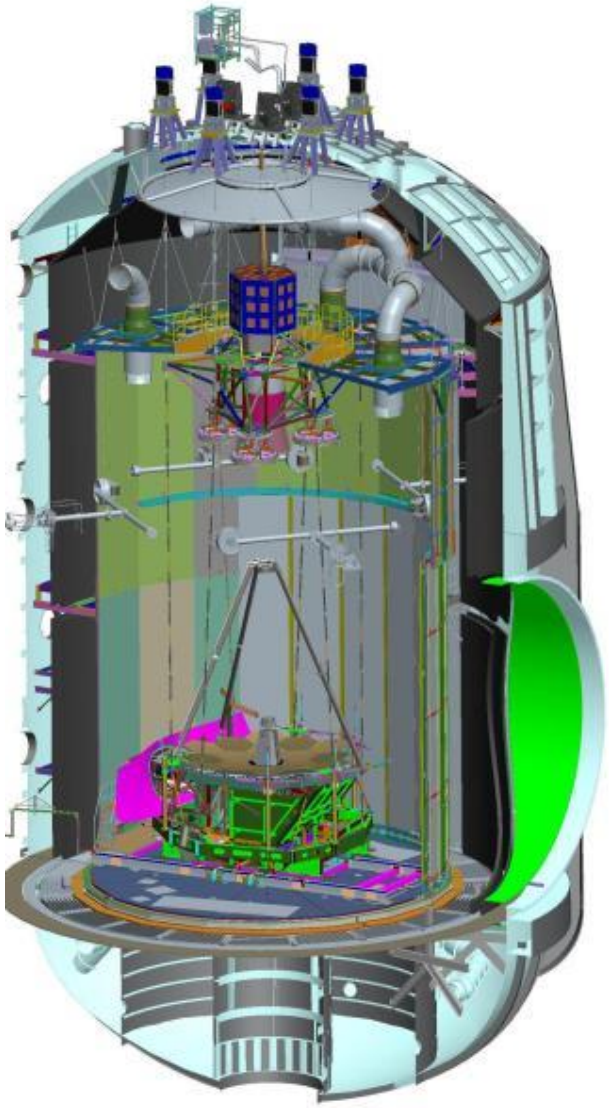
Spacecraft Status



Bus Shear Panel Installation



Spacecraft MOC-UP



OTIS TESTING

What Is OTIS

Optical Telescope Element and Integrated Science Instrument Model

Integrate Flight ISIM (Begin Obs. I&T)
- Integrate Flight ISIM
- Integrate Flight IEC
- Integrate Radiators
- Complete TMS install

Pre-Env. Test
- COCI
- Alignment Metrology
- Electrical Functional

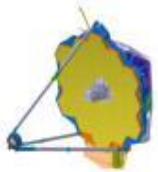
Acoustic & Sine-Vibe Tests

Post Env. Test
- Electrical Functional
- 1st Motion Checks
- COCI

Ship to JSC/ CryoVac Prep
- Electrical Functional
- SMSS Walkout
- Wing & DTA Deployment
- Configure OTE for cryovac test

Observatory (OTIS) Cryo Optical Test
- Verifies OTE-ISIM Alignment
- Cross check optical and thermal performance

Prep/Ship To NGAS Observatory I&T
- Obs. Level: CST, EMC,
- Acoustic, Shock Vibe, Deployment

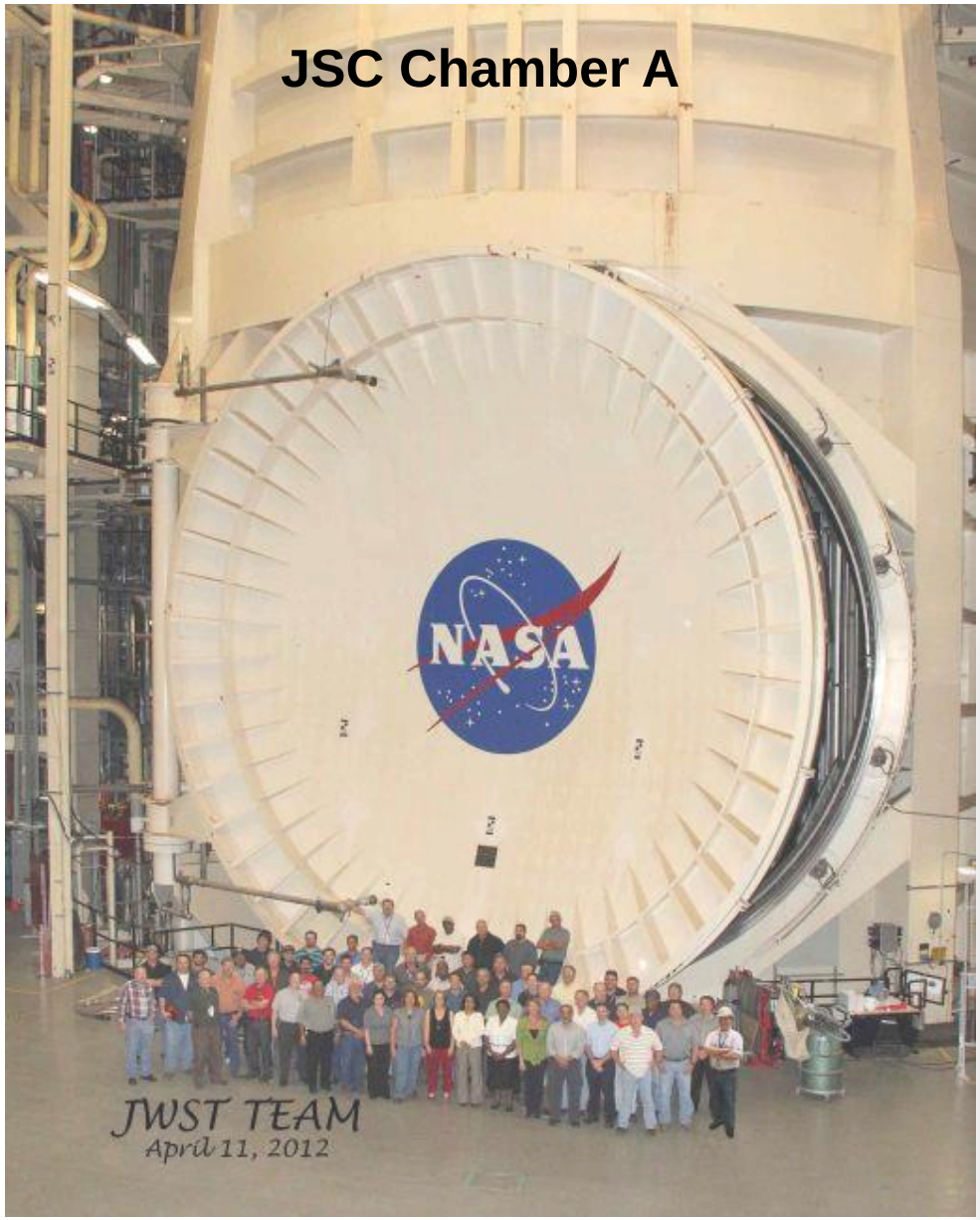


OTIS Testing

- **Pre-OTIS Testing**
  - Three Risk Reduction tests prior to OTIS Testing will be conducted with Telescope Pathfinder and Optical Ground Support Equipment, each building upon the other

- **Flight OTIS Test**
  - Verify Instrument to Telescope Alignment
  - Complete all Optical Telescope Element Cryo Verification
  - Thermal Balance Tests
    - Check OTIS system thermal workmanship and provide data to validate the OTIS thermal model for use in flight temperature predictions

Where Do We Cryo Optical Test OTIS



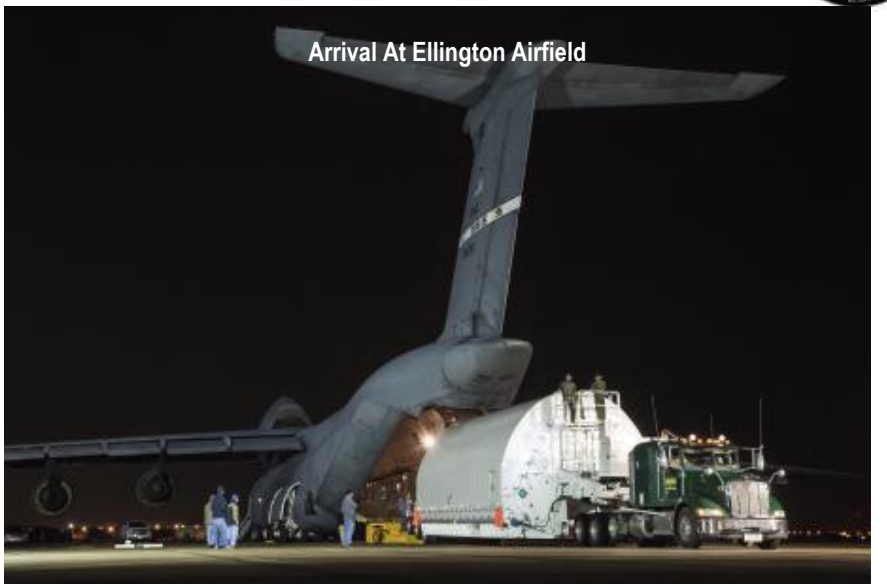
JSC Chamber A

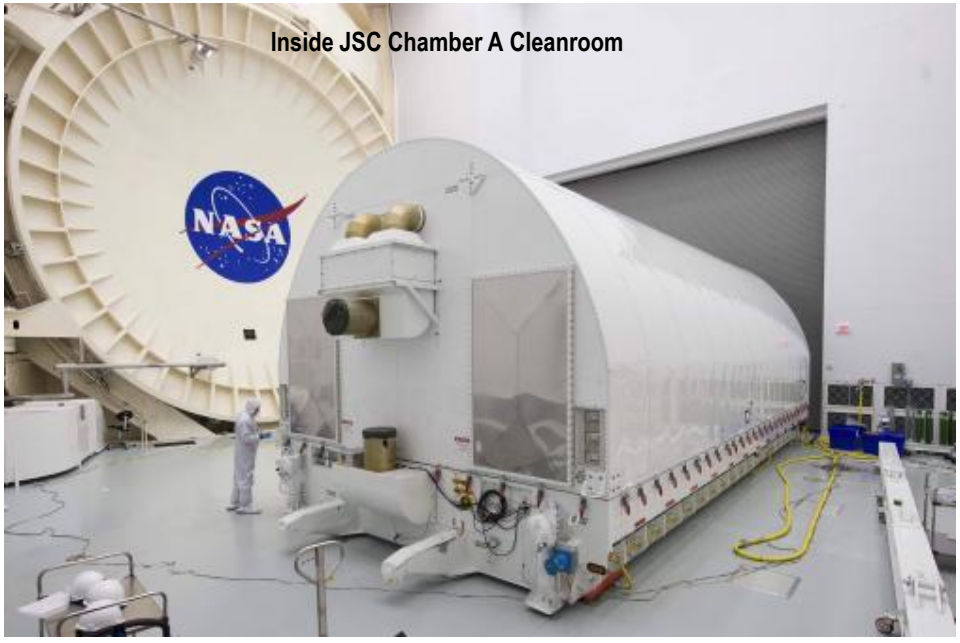
World's Largest CryoVac Chamber

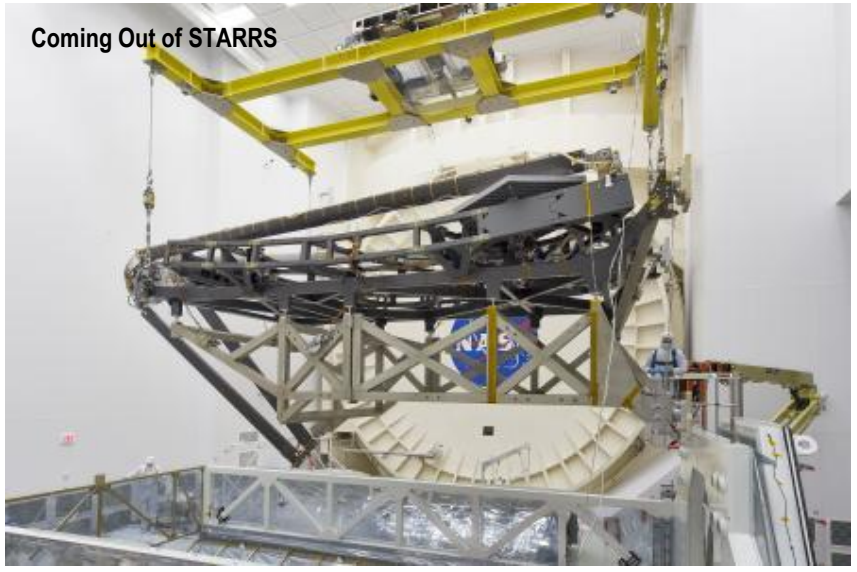
GSFC and JSC collaborated to provide a facility capable of testing OTIS in its challenging operational environment and built a cleanroom in front of it

Chamber Commissioning Test

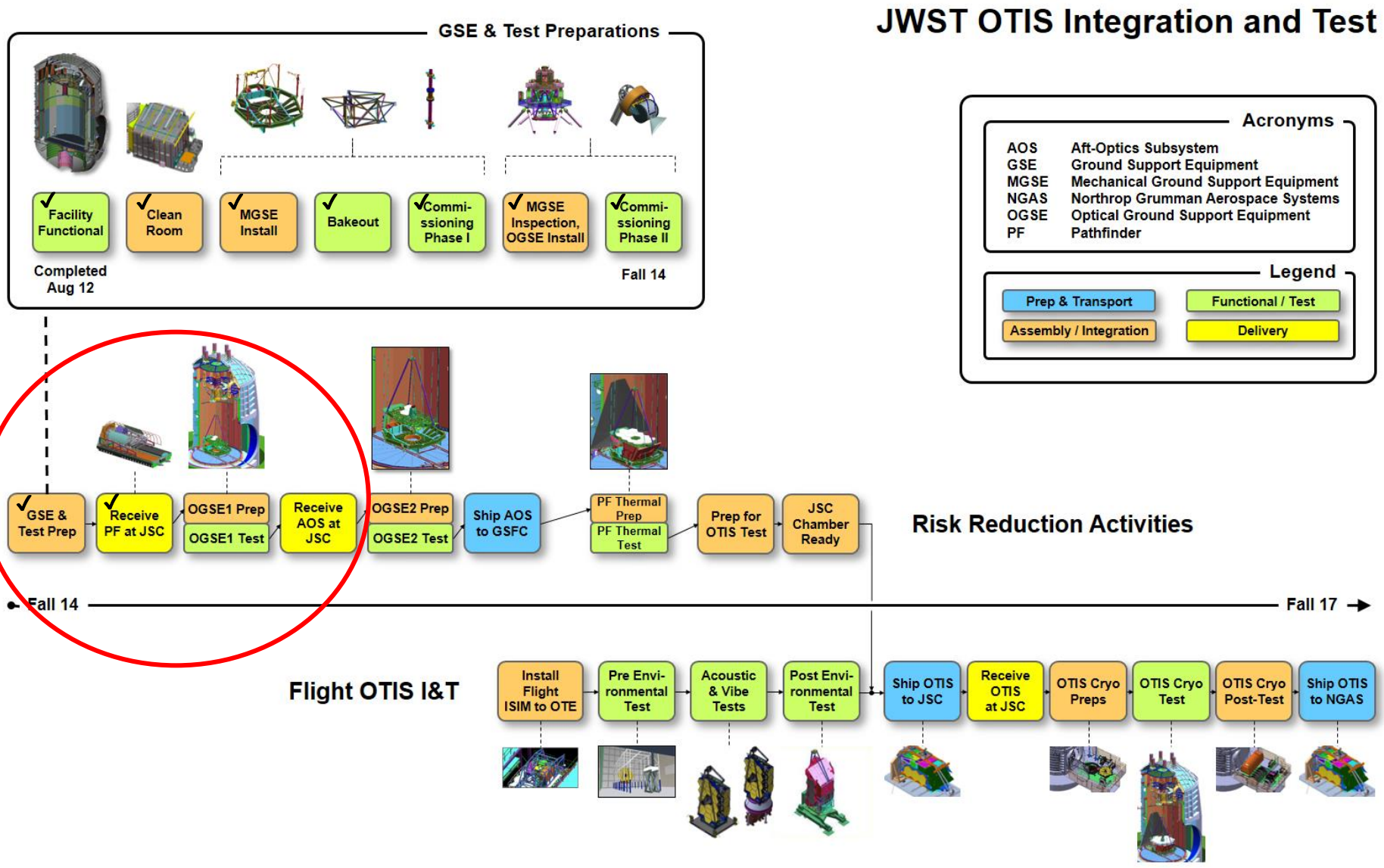
Telescope Pathfinder Arrives at JSC







Where Are We In OTIS Flow

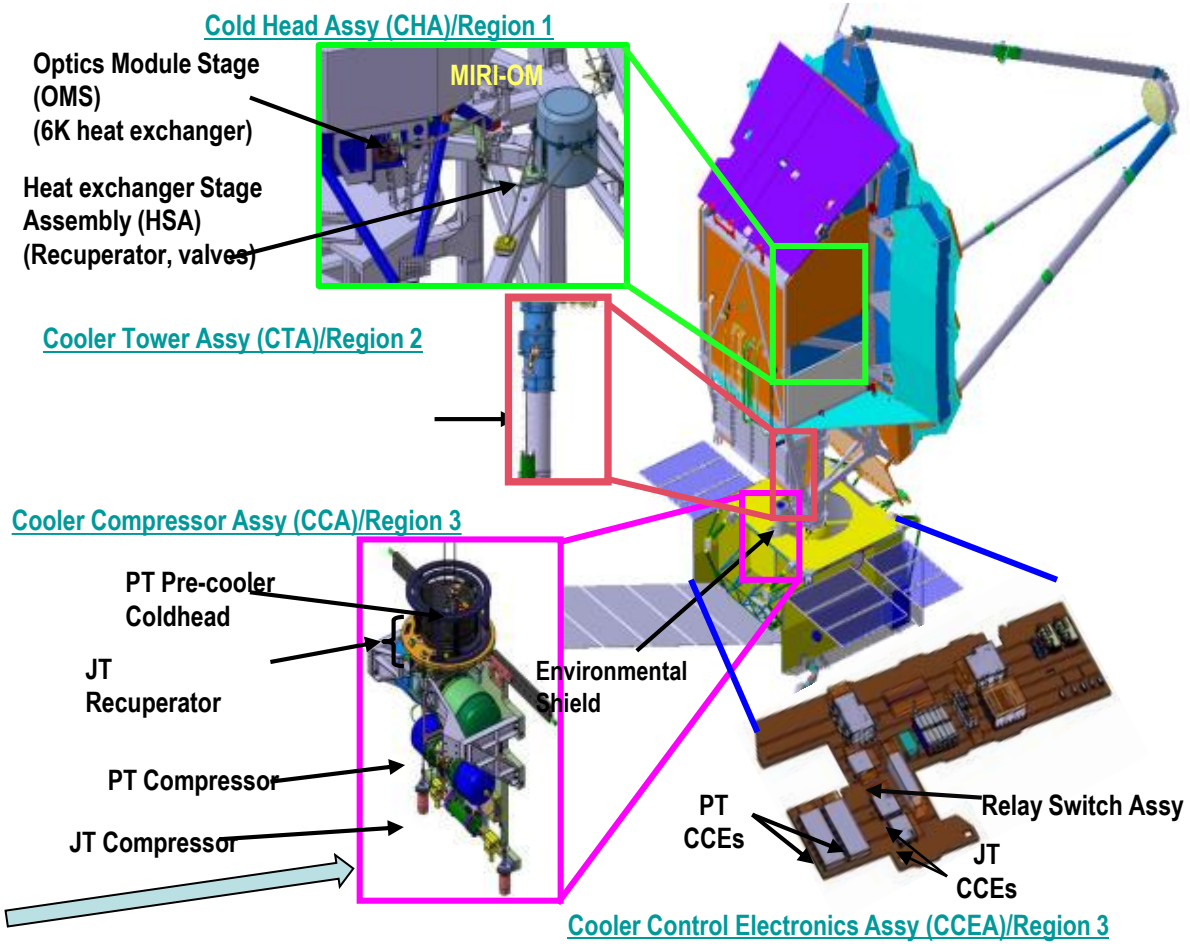


CONCERNS/ISSUES

- **Cryo-cooler delivery schedule**
- **NIRSpec Microshutter Control Electronics boards rebuilds**
- **NIRCam Sensor Chip Assembly masking and Electrostatic discharge event**
- **Non-Explosive Actuator Shock margin issue**
- **ISIM Heat Strap rework**

MIRI Cryo Cooler

- **Of the 3 may components of the Cryo-cooler, two have been delivered**
  - The remaining component, the compressor assembly, is undergoing final integration and testing now
  - Expect it to be delivered this summer to JPL for performance testing



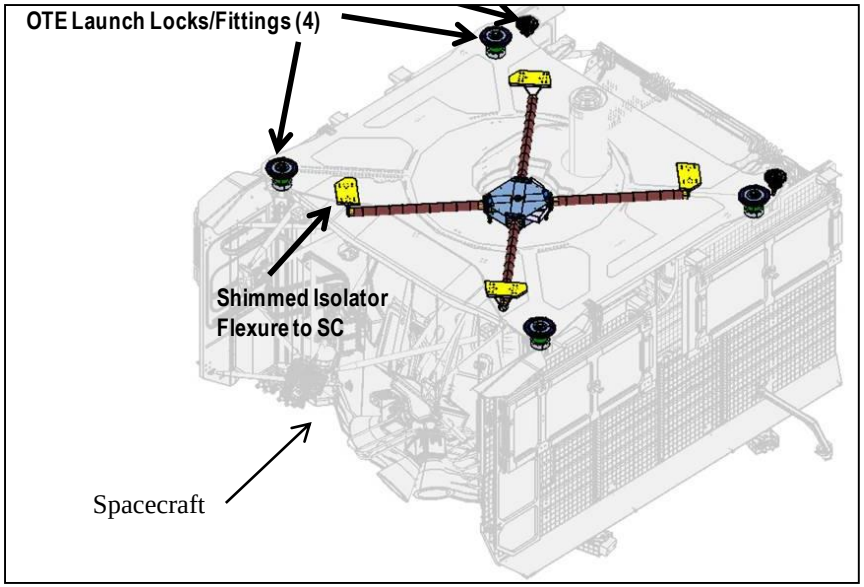
Assembly and test activity driving the schedule

Instrument Challenges

- **NIRSpec Microshutter Control Electronics**
  - During testing of the control electronics for the microshutter system a short was discovered on one of the electronic boards.
  - This board and an adjacent board needed to be remade and that work is underway and should be completed by the end of the month
- **NIRCam Detector system**
  - During testing of the detector system following the CV2 testing it was discovered that 2 of the 4 detector chips on one of the instrument channels had anomalous readings
  - Upon inspection it was determined that we needed to replace those detector units. That work is underway and should be completed by the end of the month.

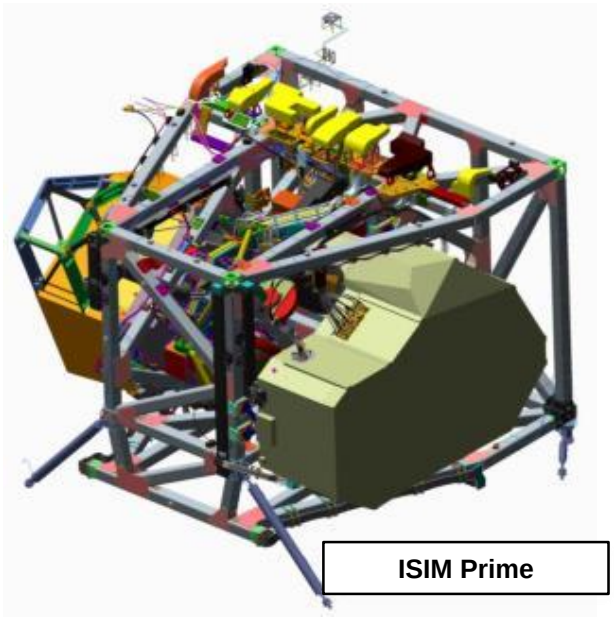
Non-Explosive Actuator Shock

- The Non-Explosive Actuator (NEA) used to separate the telescope from the space once in orbit is based on a heritage design – four are used
- During performance testing of this device is was discovered that the shock it creates was greater than expected – it exceeded requirements
- A design effort was undertaken to try and get the shock from this device reduced
- That design effort is nearing completion but has taken longer than planned should have test result in the next month

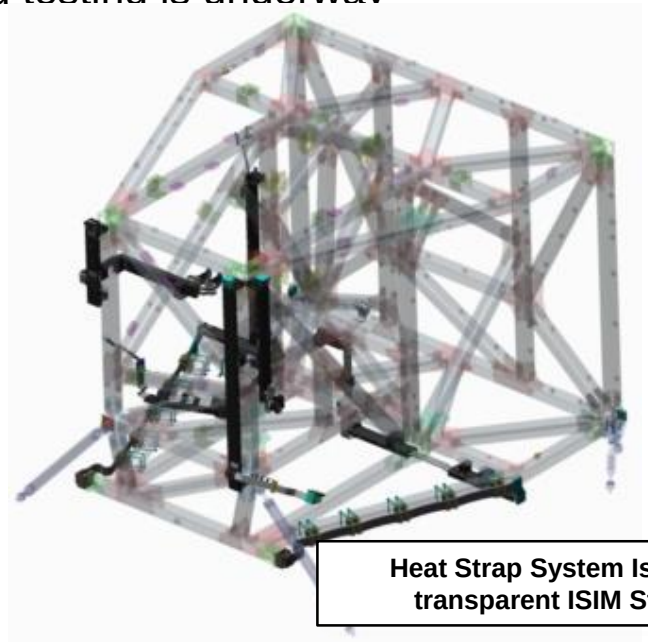


ISIM Heat Strap Attachment Robustness

- **Following a successful conclusion of CV2 activities it was noticed that one of the heat strap interface fasteners to the ISIM structure did not have the required preload.**
- **An inspection of the rest revealed that other fasteners also exhibited a similar relaxation of preload**
- **A review board was empanelled and an investigation undertaken**
  - It was determined there were some design flaws in the interface attachment plates that need to be addressed
  - Redesigns were made and re-fabrication and testing is underway



ISIM Prime



Heat Strap System Isolated on transparent ISIM Structure

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CLOSING REMARKS

JWST Is On Track For An October 2018 Launch