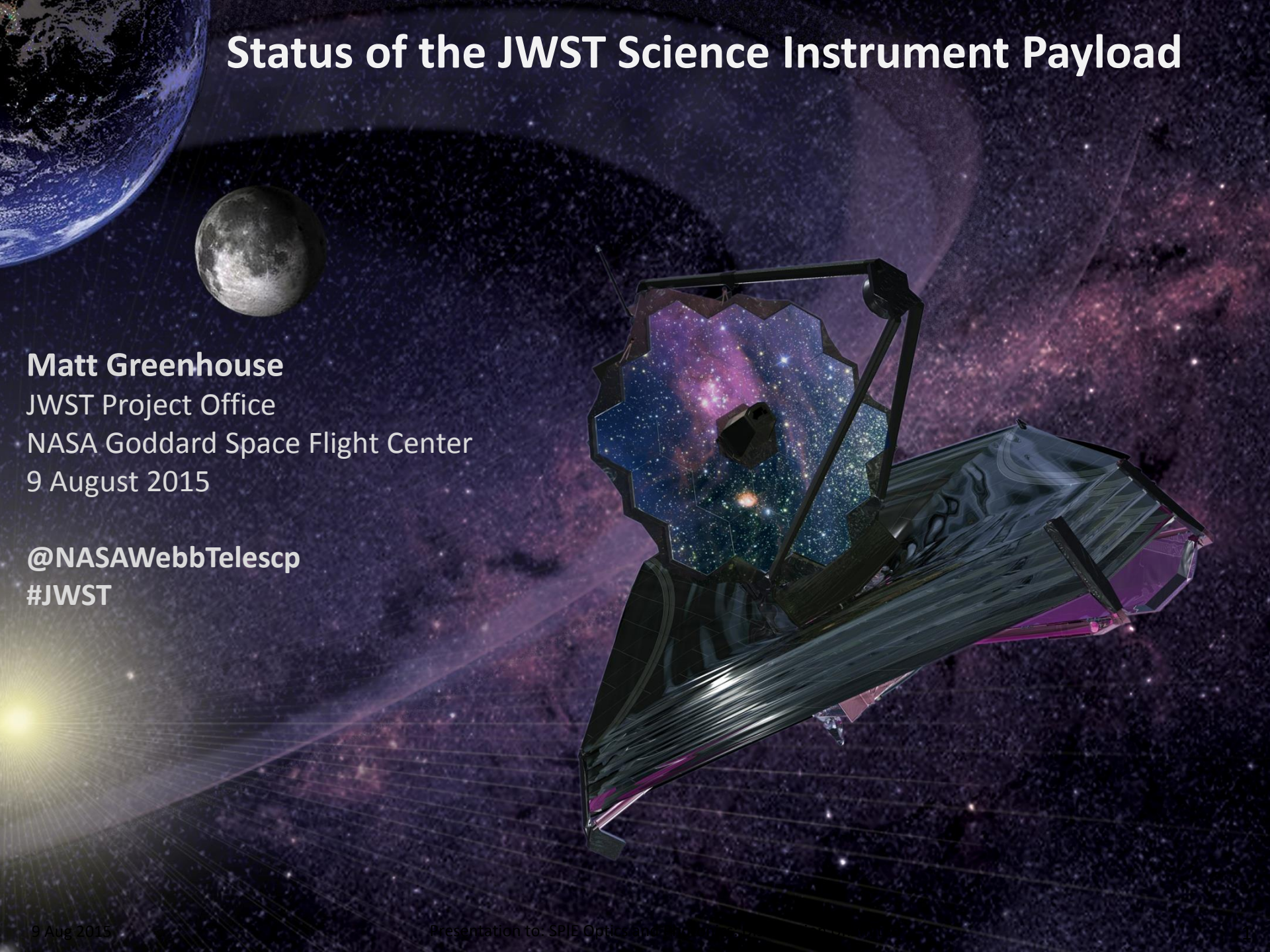
Status of the JWST Science Instrument Payload

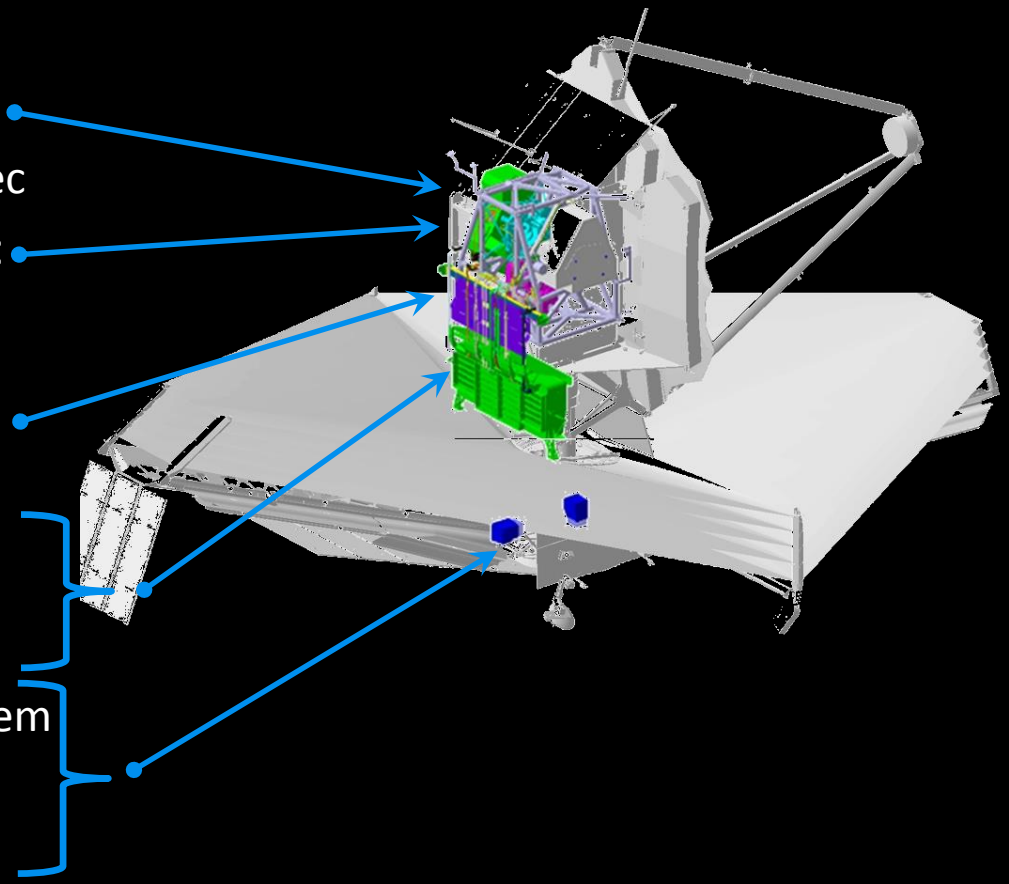


Matt Greenhouse
JWST Project Office
NASA Goddard Space Flight Center
9 August 2015

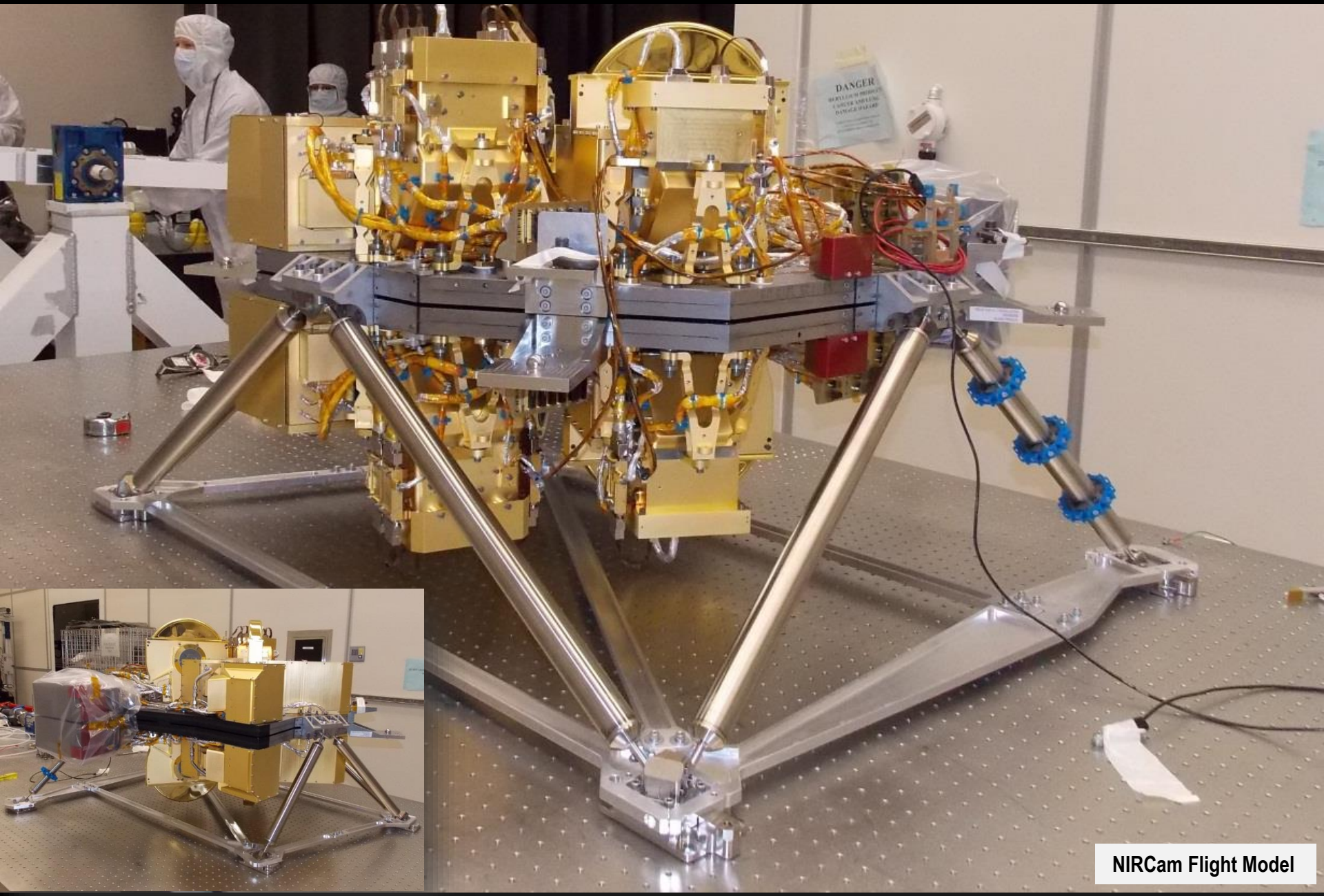
@NASAWebbTelescp
#JWST

The Integrated Science Instrument Module (ISIM) is the science instrument payload of the JWST

- **ISIM is one of three elements that together make up the JWST space vehicle**
  - Approximately 1.4 metric tons, ~20% of JWST by mass
  - Currently in integration and test and on schedule for delivery during Feb 2016
- **The ISIM system consists of:**
  - Five sensors (4 science)
    - MIRI, NIRISS, FGS, NIRCam, NIRSpec
  - Nine instrument support systems:
    - Optical metering structure system
    - Electrical Harness System
    - Harness Radiator System
    - ISIM electronics compartment
    - ISIM Remote Services Unit
    - Cryogenic Thermal Control System
    - Command and Data Handling System
    - Flight Software System
    - Operations Scripts System

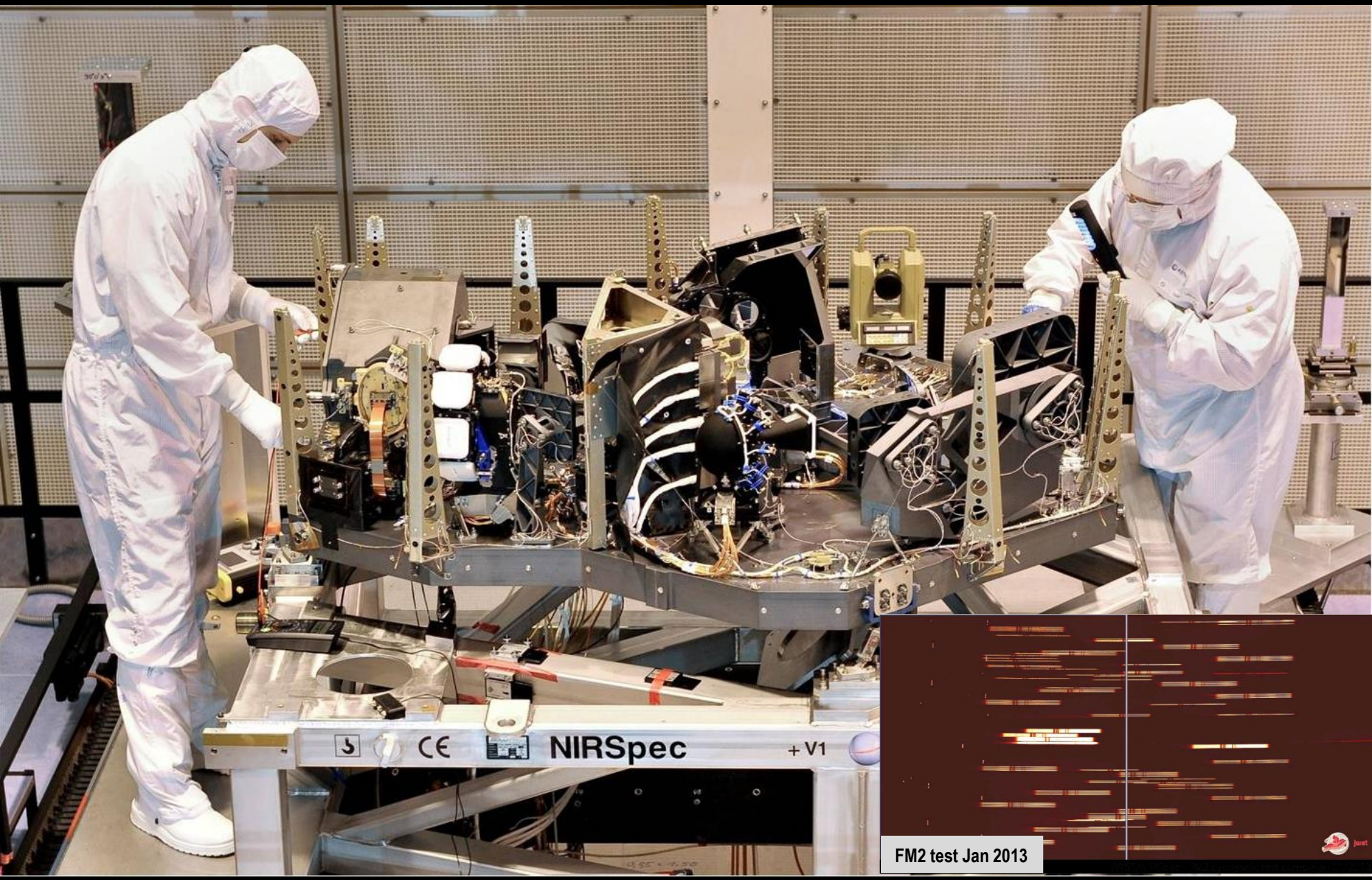


The NIRCam will image the earliest epoch of galaxy formation



NIRCam Flight Model

NIRSpec can obtain spectra of 100 compact galaxies simultaneously



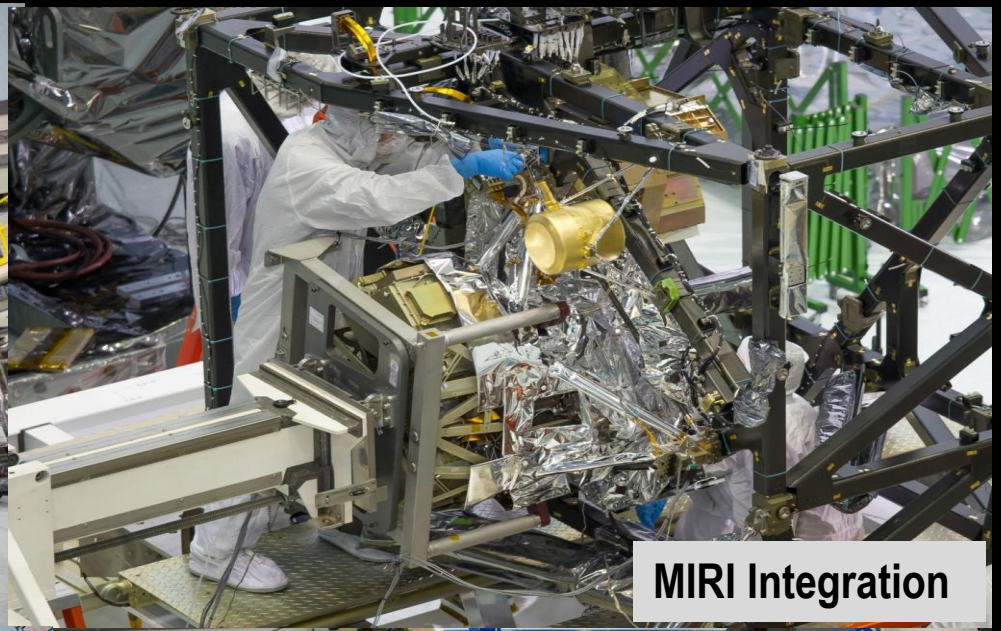
FM2 test Jan 2013

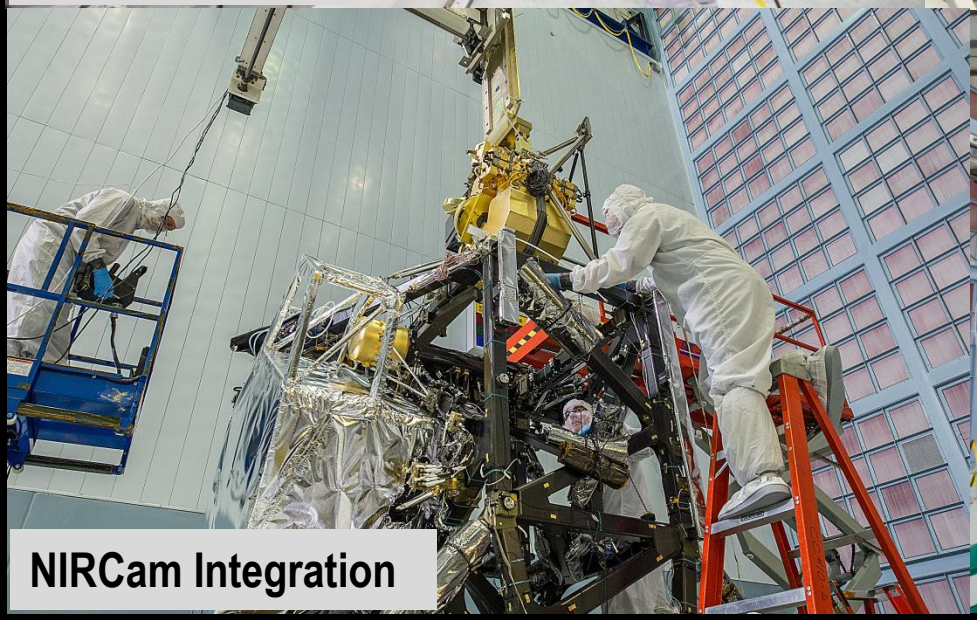
MIRI will provide the first high resolution imagery of the mid-infrared universe

MIRI flight model

FGS can sense pointing to 1 millionth degree precision
NIRISS enables moderate contrast imagery at an inner working angle of 0.5l/D

Sensor systems being integrated into science instrument module





Instrument module at 100% integration in preparation for CV-3 test

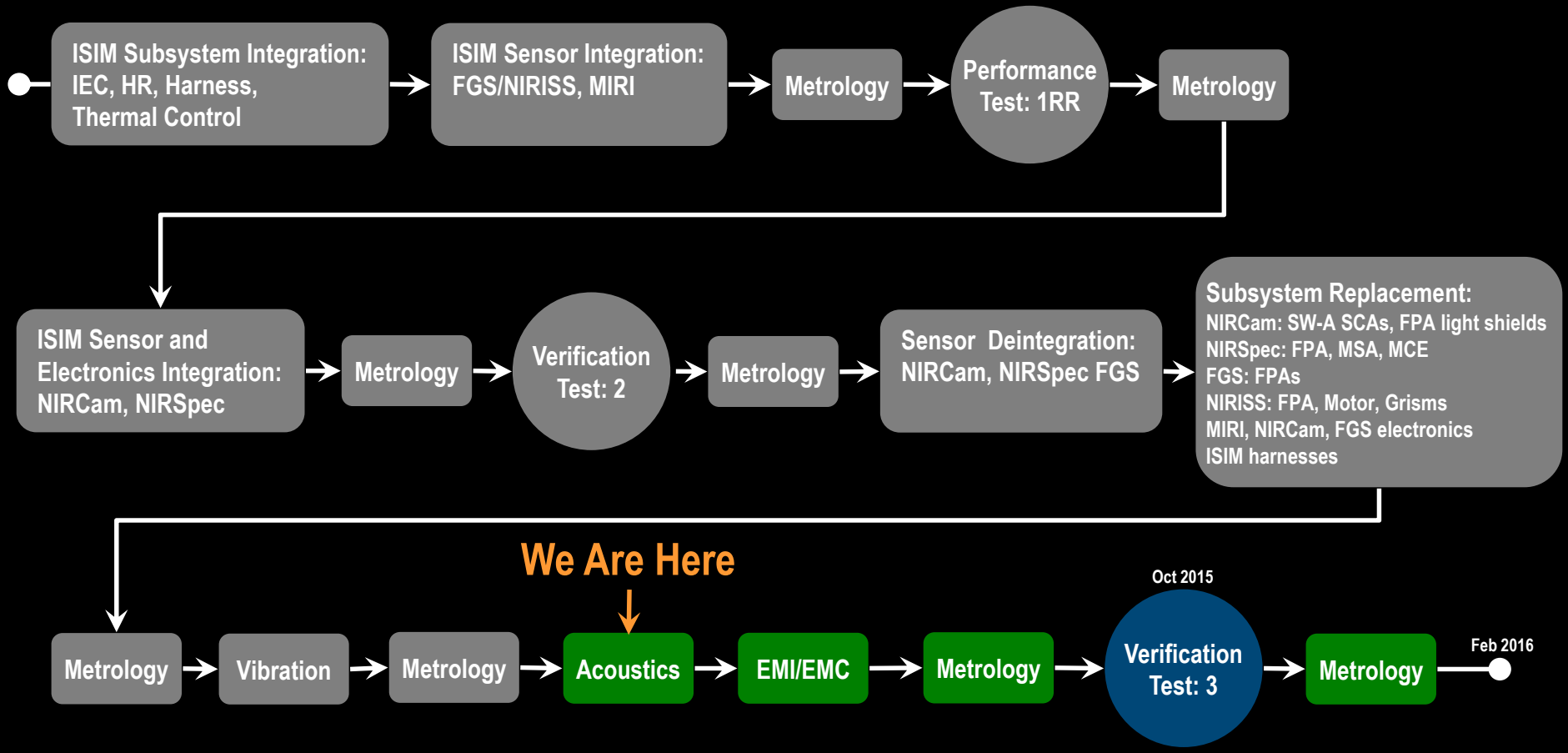
Making sure that it all works:

- **ISIM is on track for delivery to OTIS I&T during Feb 2016**
  - ~2 months slack to OTIS need date
  - Post CV-2 reintegration activities complete

Ambient Temp Test Environment

Cryogenic Vacuum Test Environment

Completed Activity



MIRI rework has been completed (partial list below)

Optical Assembly

- The spectrometer thermal blanket was replaced with a less used one.
- The OM Strain Array harness wires were cut and their connectors (red tag items) were removed. This was used for integration only.
- CCC was moved into Launch Lock position in preparation for the ISIM Prime vibration test.
- MIRI thermal shield was removed for access.
- The MIRI OA was not removed from ISIM.

Electronics

- FPE Signal Chain Electronics (SCE) boards have been redesigned and have a new FPGA architecture. PDU board grounding has also been changed. New boards were built and installed in the FPE.
  - Fixed high (10%) incidence of corrupted science data seen during instrument-level testing.
  - Fixed several significant reliability issues on the SCE boards

Harness Issues

- Focal plane harness sections on the ISIM Structure and the Harness Radiator were removed, CT scanned, continuity tested
  - Prompted by a cable problem from the same manufacturer.

FGS rework items have been completed (partial list below)

Optical Assembly

- Replaced 3 detector FPAs due to the detector degradation issue
- Replaced 2 gearmotors on the Dual Wheel
- Replaced the GR700 grism on the Dual Wheel
- Replaced the GR150 grism that had a substrate failure during CV2
- Inspected the second GR150 grism for delamination: No delamination observed

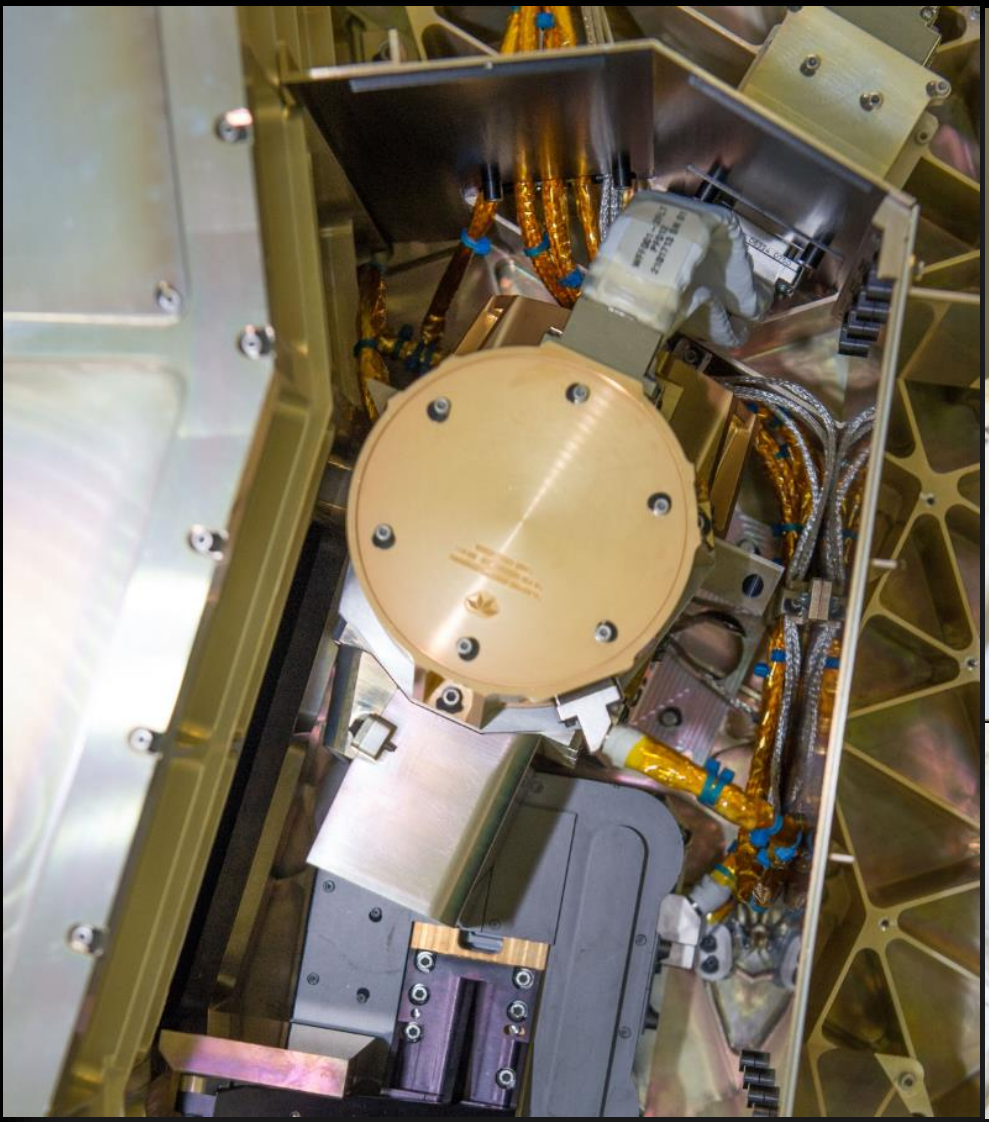
Electronics

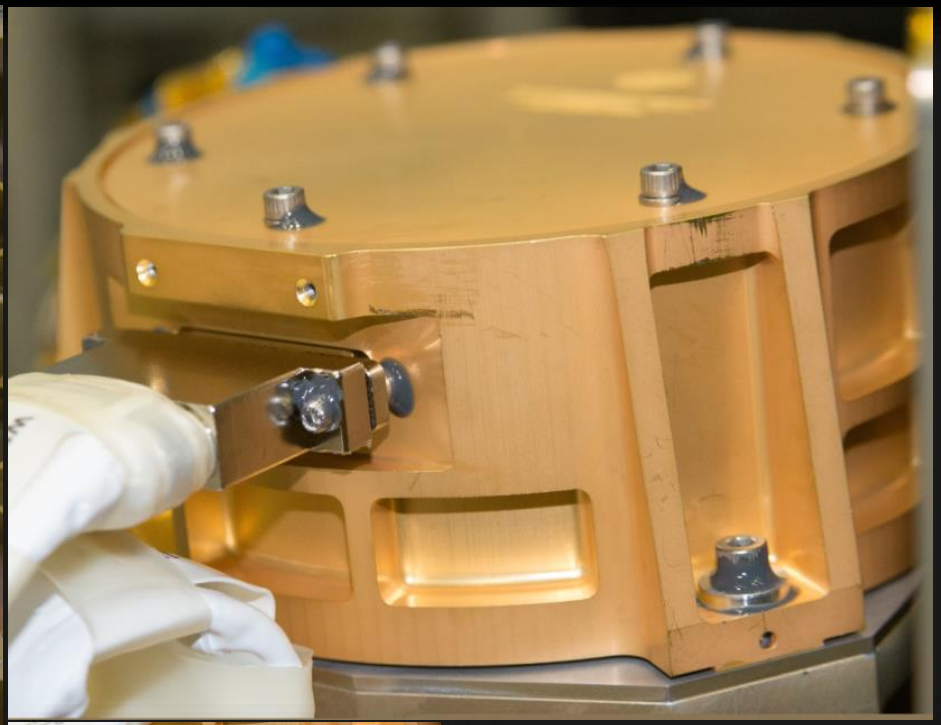
- Replaced Sensor Chip Electronics (SCE) boards

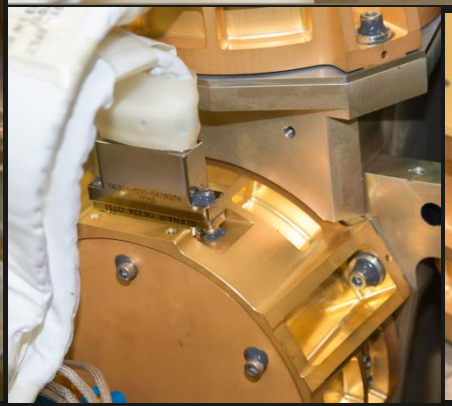
Harness

- Harness supports and clamps installed to fix a routing issue

New FPAs were installed into Guider 1 and 2





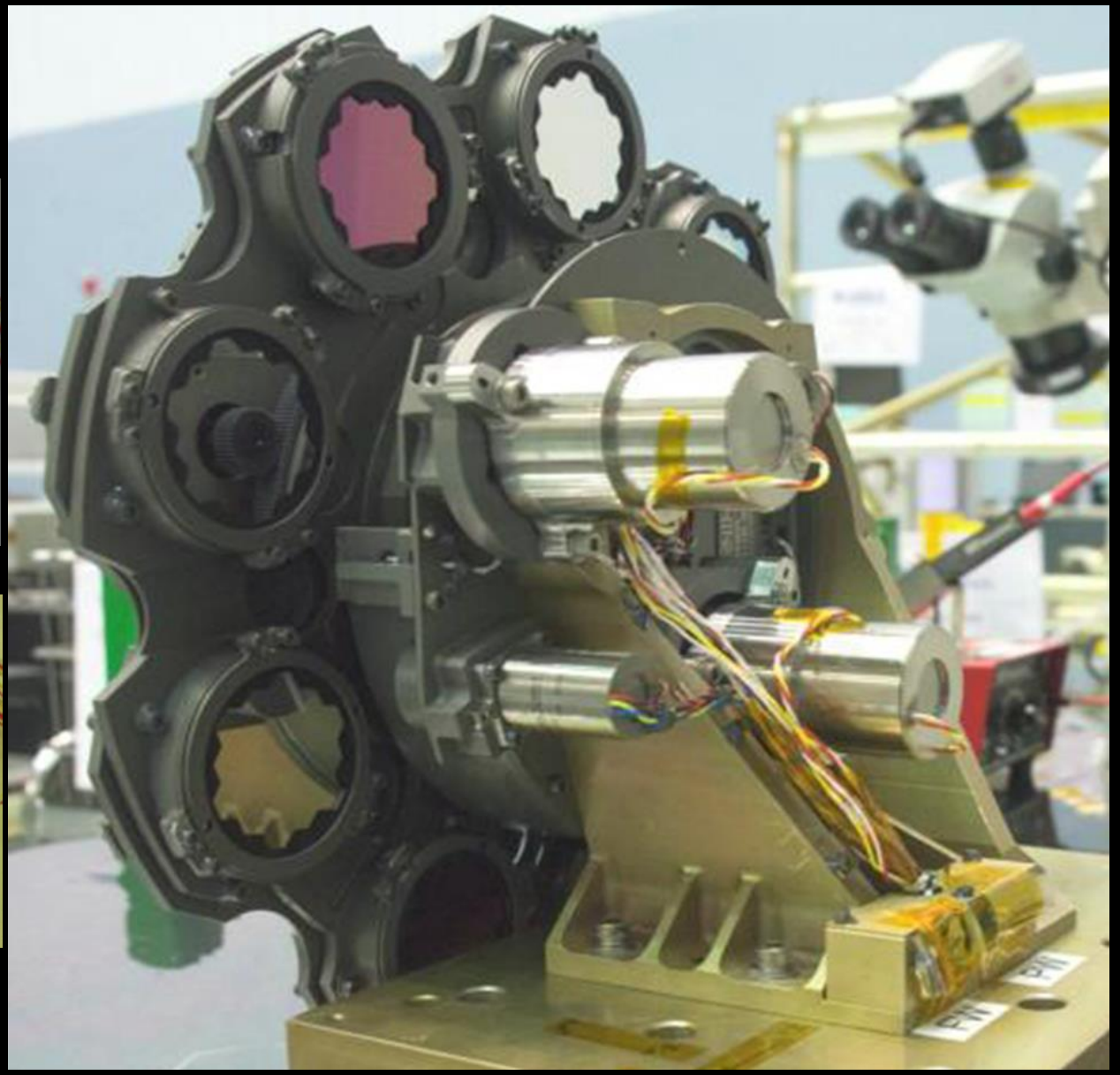


A new FPA was installed into NIRISS

FGS gear motors were redesigned to improve operational lifetime

Filter Wheel Gear Motor

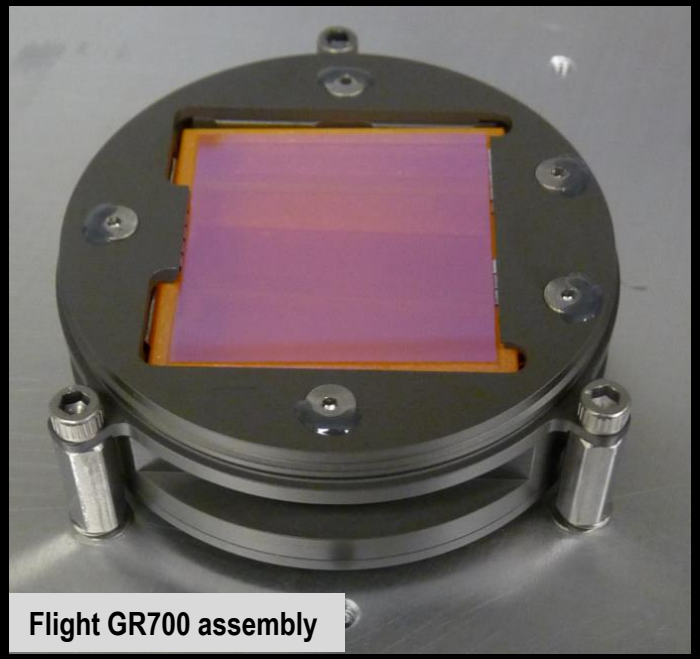
Pupil Wheel Gear Motor



The GR700 (exoplanet) grism mount was redesigned to improve stray light performance

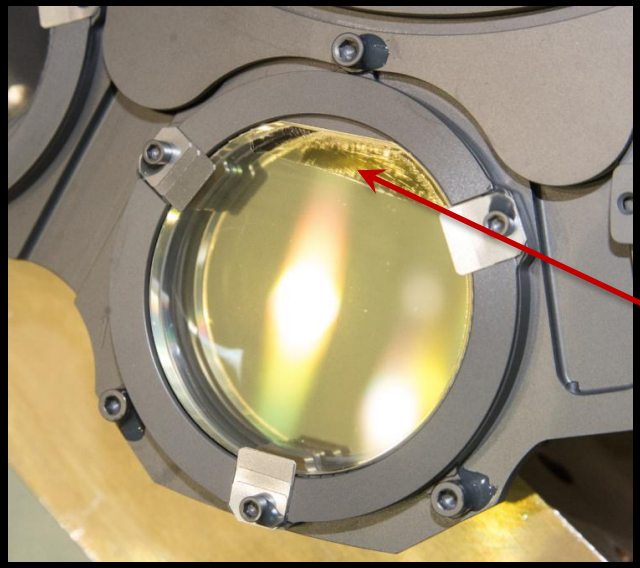
GR700 showed ghosting in CV2

- Eliminated by 90 deg rotation of the grism
  - Required redesign of the mount assembly
  - Spare grism was installed in this new mount
    - Spare has better grove profile than prior flight unit resulting in significant increase in throughput
- New grism assembly underwent environmental testing before reinstallation



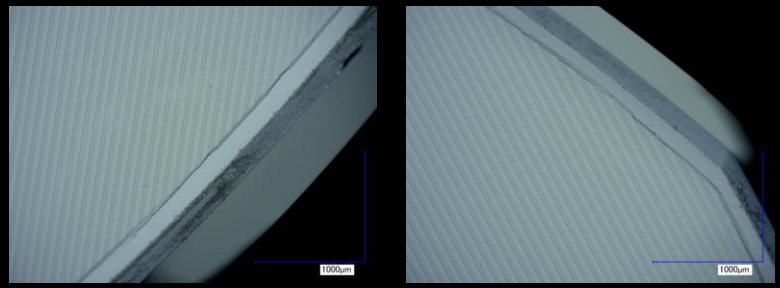
Flight GR700 assembly

The GR150 (Ly Alpha galaxy survey) grism was replaced



Prior (CV-2) grism

Replacement grism



Typical microscopy for critical flaw inspection

NIRCam rework has been completed (partial list below)

NIRCam Optical Assembly

- Debris was removed from a LW-A FPA connector which fixed a ground isolation short that was discovered prior to CV-2.
- Replaced 3 SCAs and on the SW-A FPA
  - The SW-A was successfully vibed at unit level prior to reintegration with the OA
- Replaced light shields on all FPAs
- Mod-A alignment cube was tested for stability to retire a flight safety concern

NIRCam Electronics

- Replaced FPE low voltage converter (LVC) Boards (with new DC-DC converters and over voltage protection)

Harness

- Cable modifications at ICE ICP-1 panels to update IRSU-monitored temp sensor pinouts (adapter was used in CV2)
- Replaced a harness that was too short
- Swapped connectors to achieve proper cross-strapping of the SpaceWire cables between IRSU and FPE-B

Replacing FPAs on NIRCam

NIRSpec rework items (partial list)

NIRSpec Optical Assembly

- Replaced Detector Subsystem: FPA, 2 ASICs, FPA-to-ASIC harnesses
- Replaced Microshutter Assembly with FM2
- Replaced Optical Bench Kinematic Mount Accelerometer
- Replaced the Optical Assembly Cover

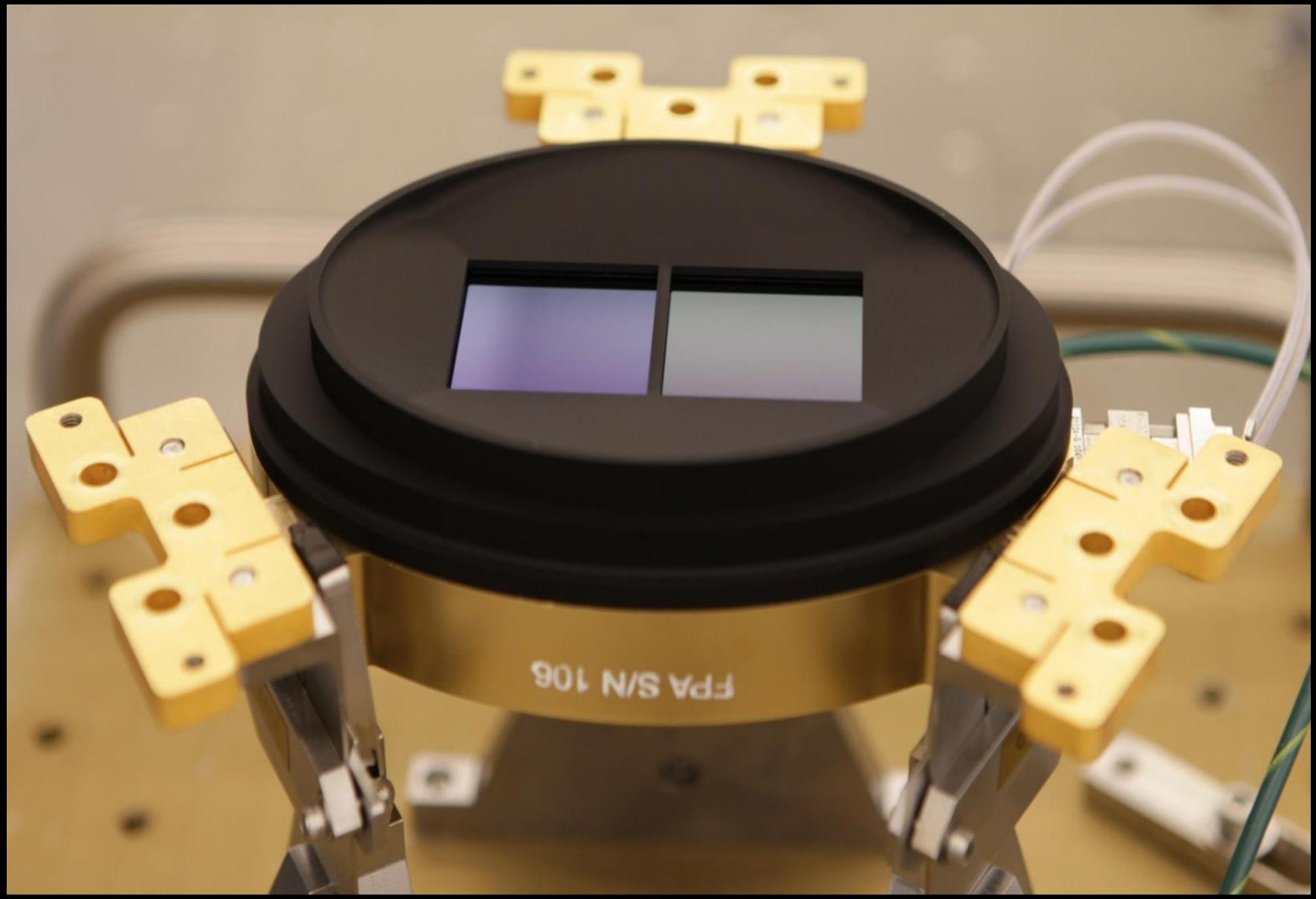
NIRSpec Electronics

- Replaced damaged boards and connectors in the MCE

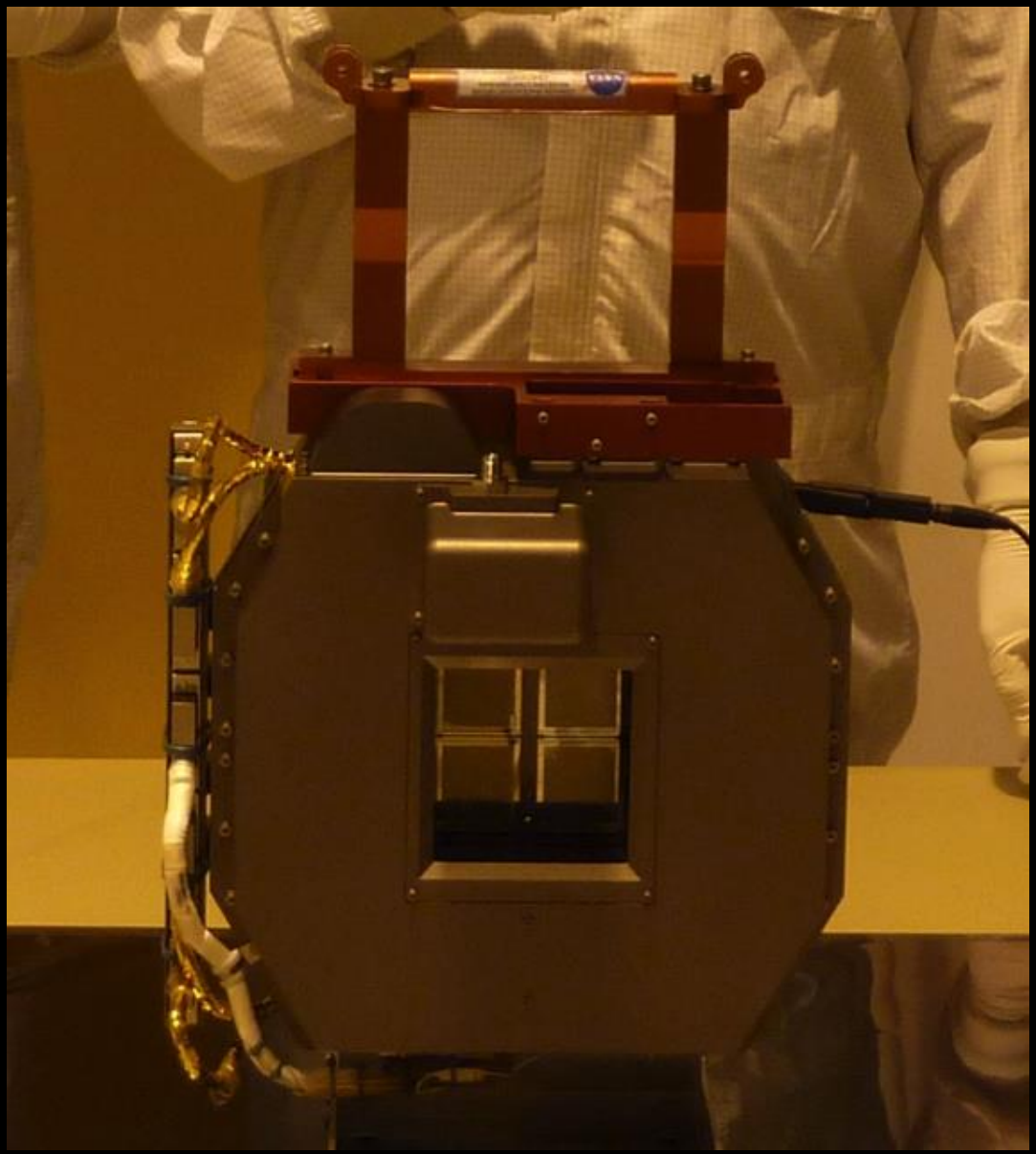
Harness

- Replaced a harnesses that had length and routing issues found when first integrated
- Replaced a harnesses that had design issues causing too high resistance on harness shields

New flight focal plane assembly including new ASICs and harness were installed



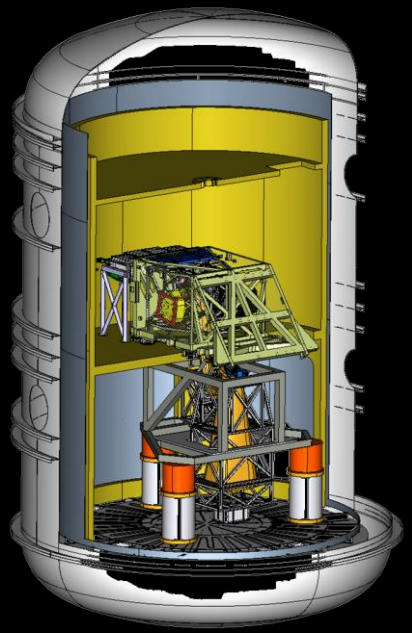
The MSA was replaced with Flight Model #2



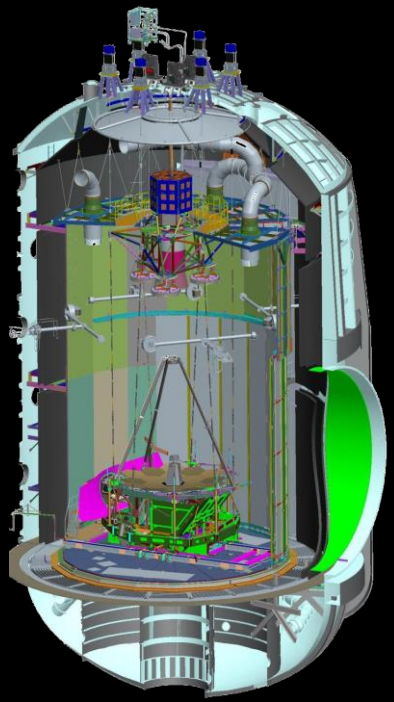
In Sum …

- **ISIM is on track for delivery to Observatory I&T during February 2016**
- **Schedule is not success oriented**
  - 2 months of slack to cover remaining 6 months of work
- **Challenging CV-3 test ahead**
  - Well understood facility and very experienced team to meet that challenge

Last element-level ISIM test begins during October 2015 in GSFC SES chamber



Observatory end-to-end optical test begins during December 2016 in JSC Chamber-A



Launch 2018 from Kourou Launch Center (French Guiana)