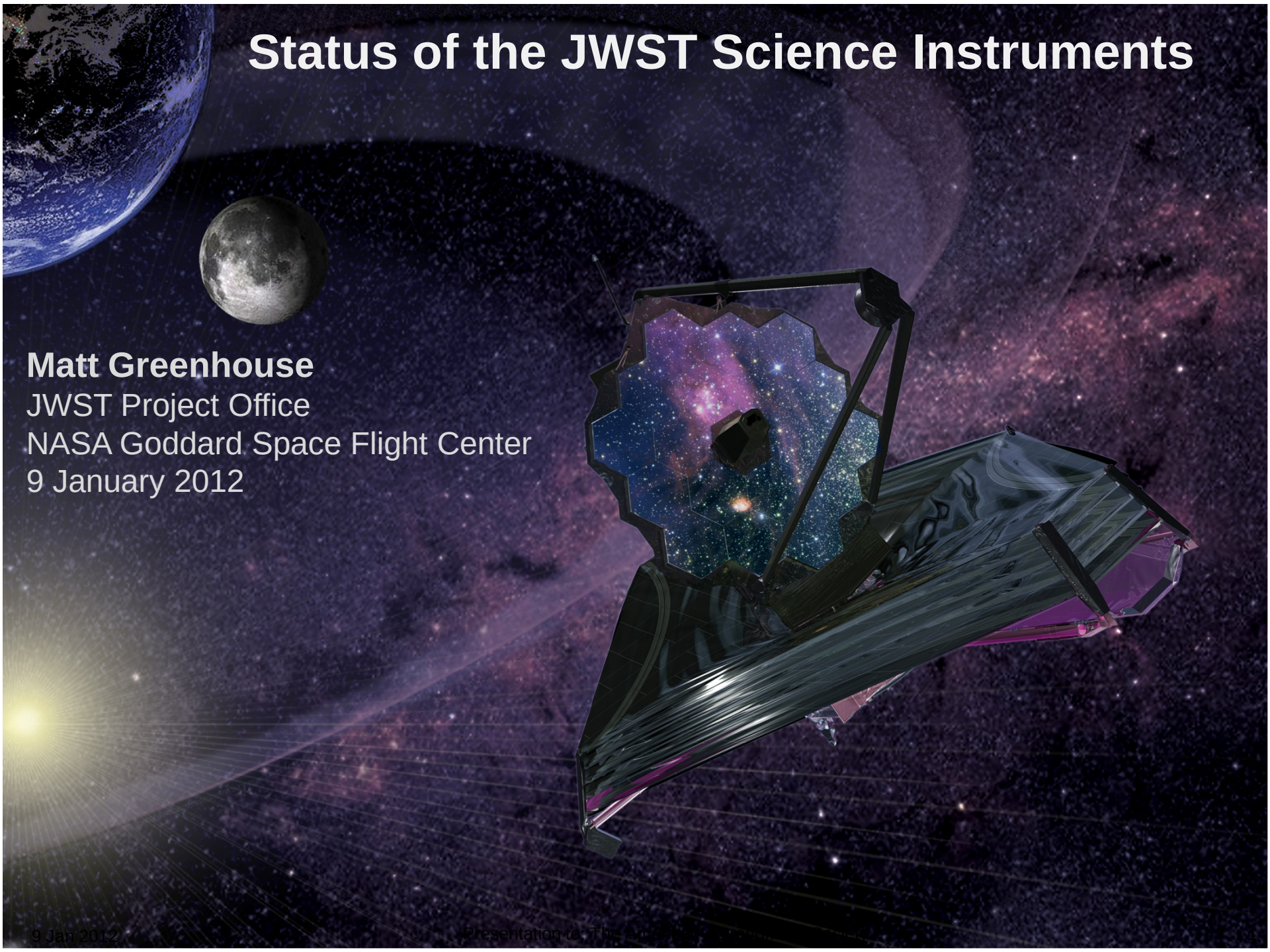
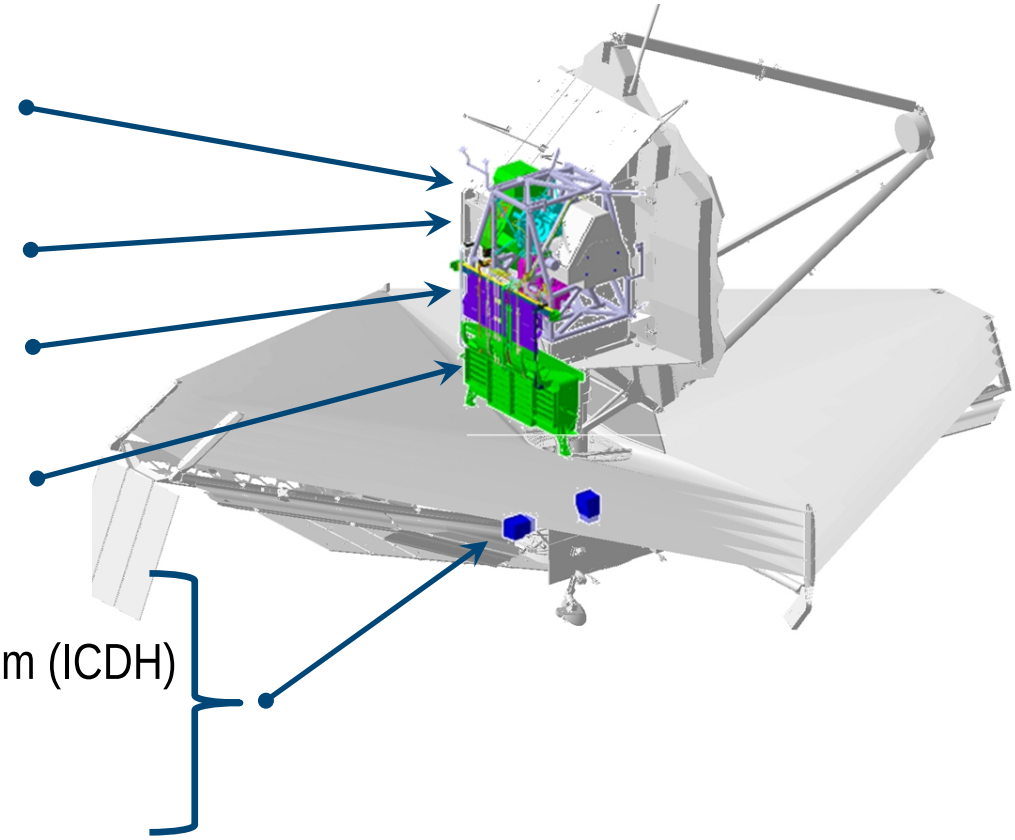
Status of the JWST Science Instruments



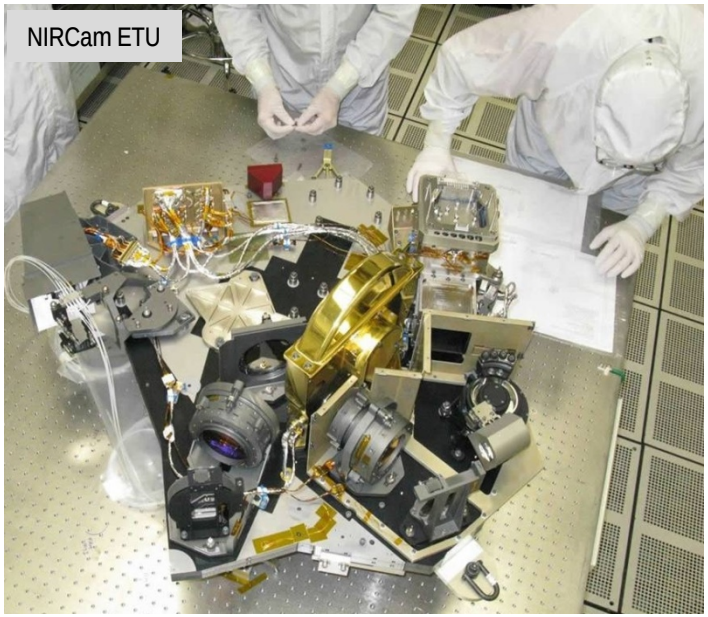
Matt Greenhouse
JWST Project Office
NASA Goddard Space Flight Center
9 January 2012

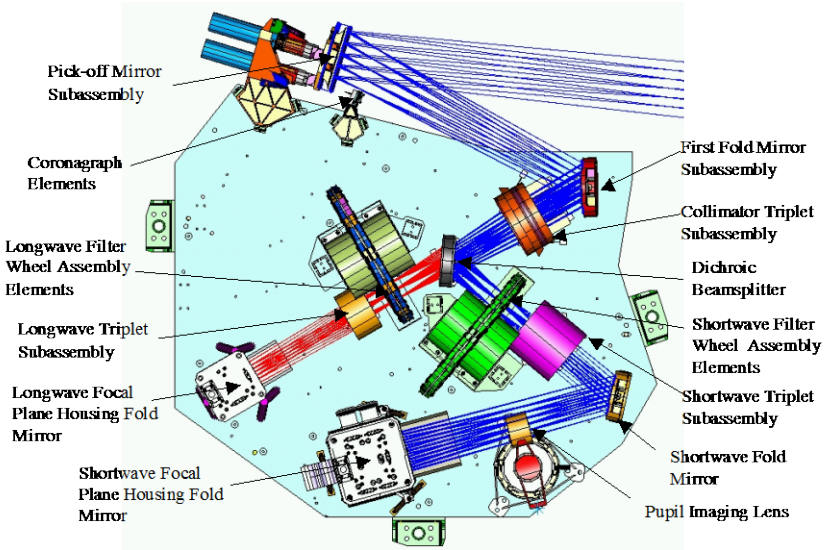
ISIM is the science instrument payload of the JWST

- ISIM is one of three elements that together make up the JWST space vehicle
  - Approximately 1.4 metric tons, ~20% of JWST by mass
  - Completed CDR during 2009
- The ISIM system consists of:
  - Four science instruments
  - Nine instrument support systems:
    - Optical metering structure system
    - Electrical Harness System
    - Harness Radiator System
    - ISIM electronics compartment (IEC)
    - ISIM Remote Services Unit (IRSU)
    - Cryogenic Thermal Control System
    - Command and Data Handling System (ICDH)
    - Flight Software System
    - Operations Scripts System



NIRCam will provide the deepest near-infrared images ever and will identify primeval galaxy targets for the NIRSpec

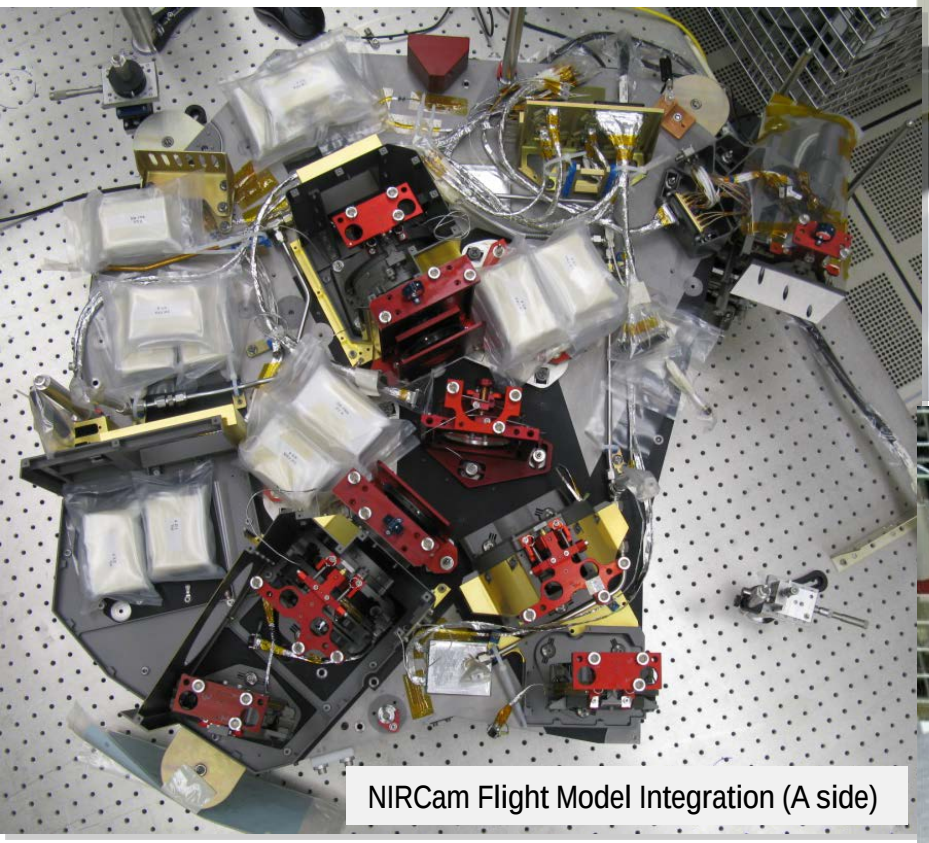




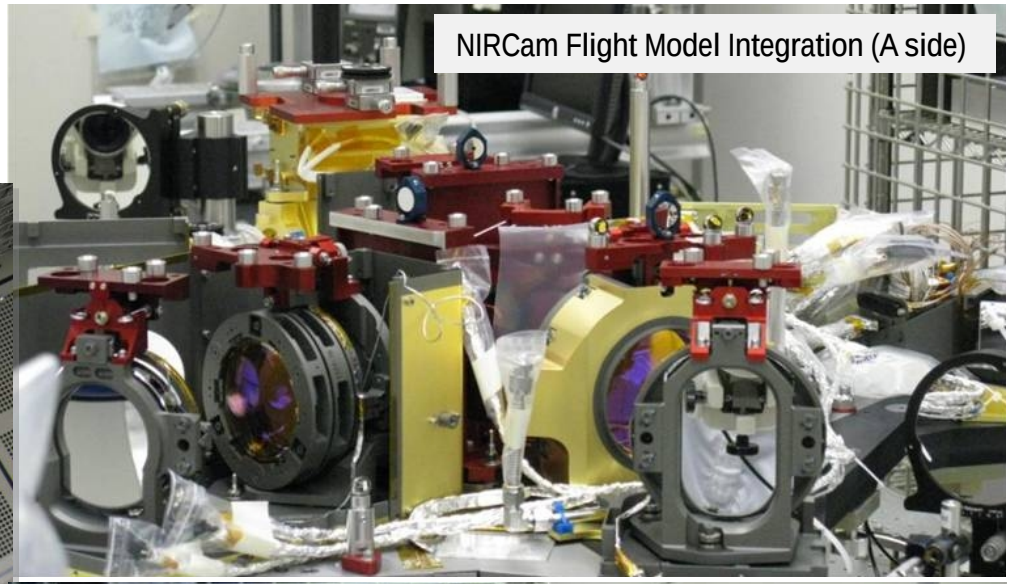
- Developed by the University of Arizona with Lockheed Martin ATC
  - Operating wavelength: 0.6 – 5.0 microns
  - Spectral resolution: 4, 10, 100 (filters + grism), coronagraph
  - Field of view: 2.2 x 4.4 arc minutes
  - Angular resolution (1 pixel): 32 mas < 2.3 microns, 65 mas > 2.4 microns, coronagraph
  - Detector type: HgCdTe, 2048 x 2048 pixel format, 10 detectors, 40 K passive cooling
  - Refractive optics, Beryllium structure
- Supports OTE wavefront sensing

NIRCam is on schedule for delivery during 2012

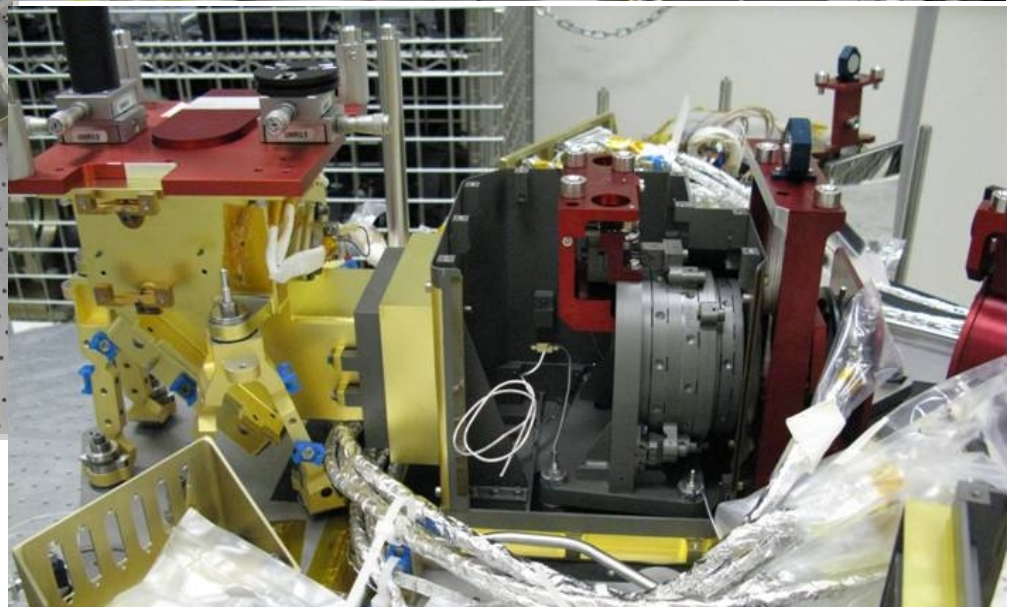
Flight model cryo-vacuum testing begins during March



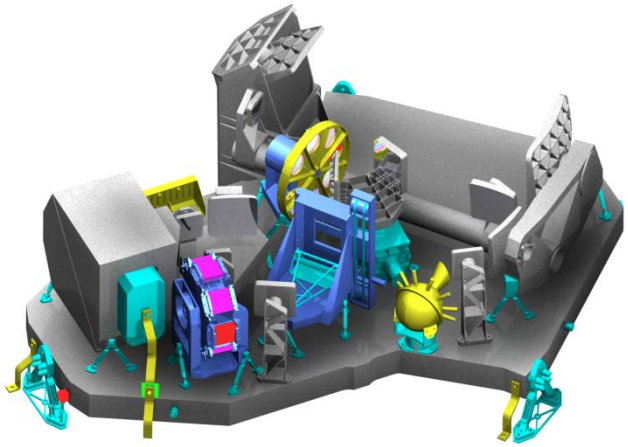
NIRCam Flight Model Integration (A side)

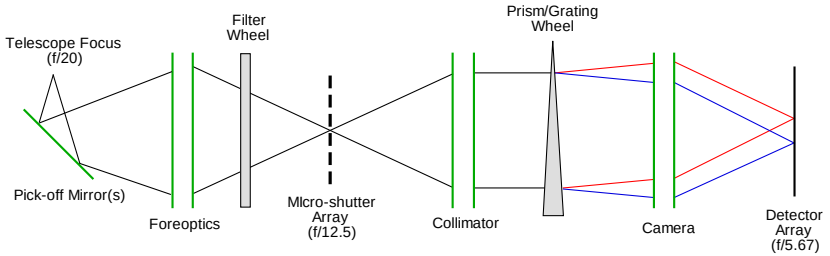


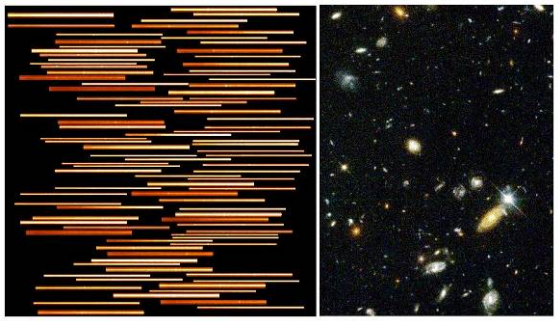
NIRCam Flight Model Integration (A side)

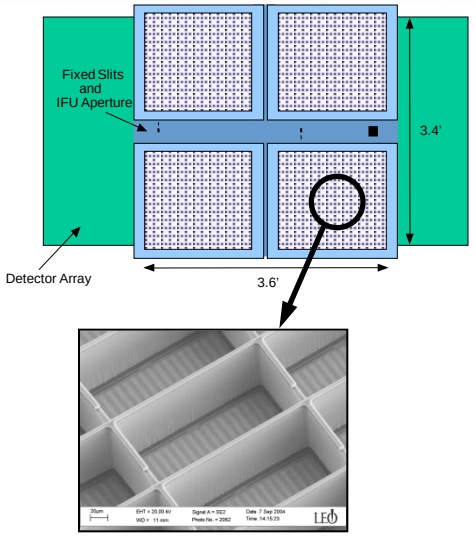


The NIRSpec will acquire spectra of up to 100 galaxies in a single exposure



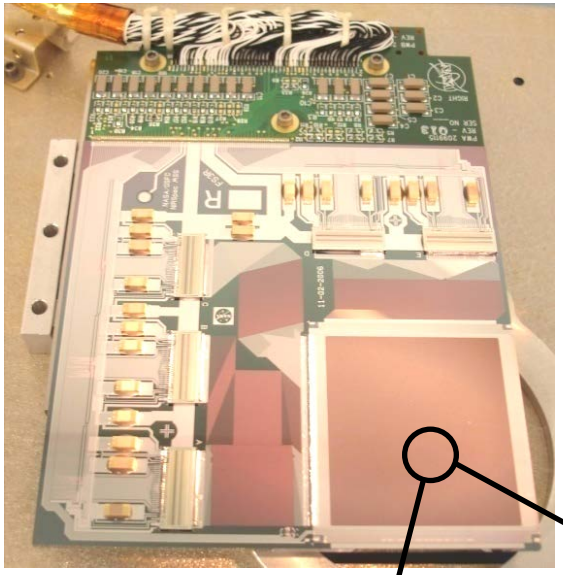


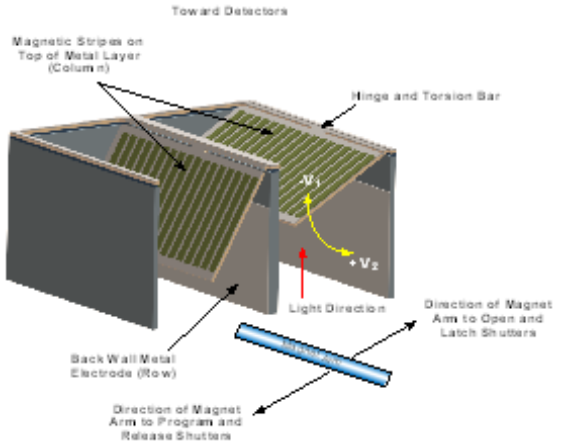


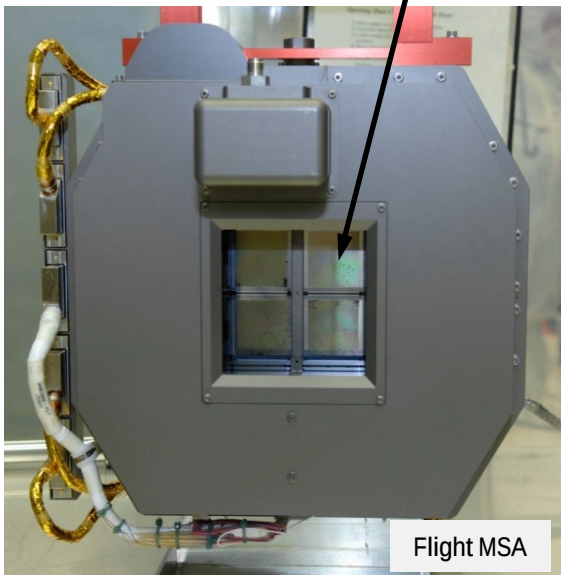


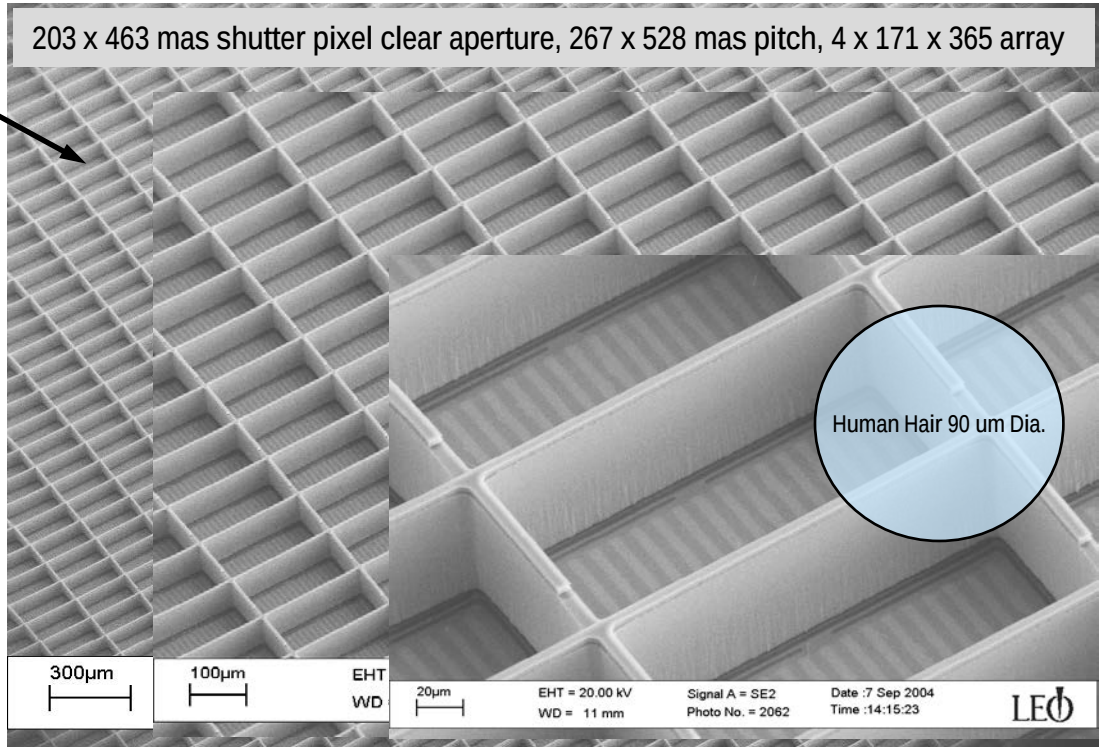
- Developed by the European Space Technology Center (ESTEC) with Astrium GmbH and Goddard Space Flight Ctr
  - Operating wavelength: 0.6 – 5.0 microns
  - Spectral resolution: 100, 1000, 3000
  - Field of view: 3.4 x 3.4 arc minutes
    - Aperture control:
      - Programmable micro-shutters, 250,000 pixels
      - Fixed long slits & transit spectroscopy aperture
      - Image slicer (IFU) 3x3 arc sec
  - Detector type: HgCdTe, 2048 x 2048 format, 2 detectors, 37 K passive cooling
  - Reflective optics, SiC structure and optics

Aperture control: 250,000 programmable micro-shutters System at TRL-8 and delivered to ESA June 2010



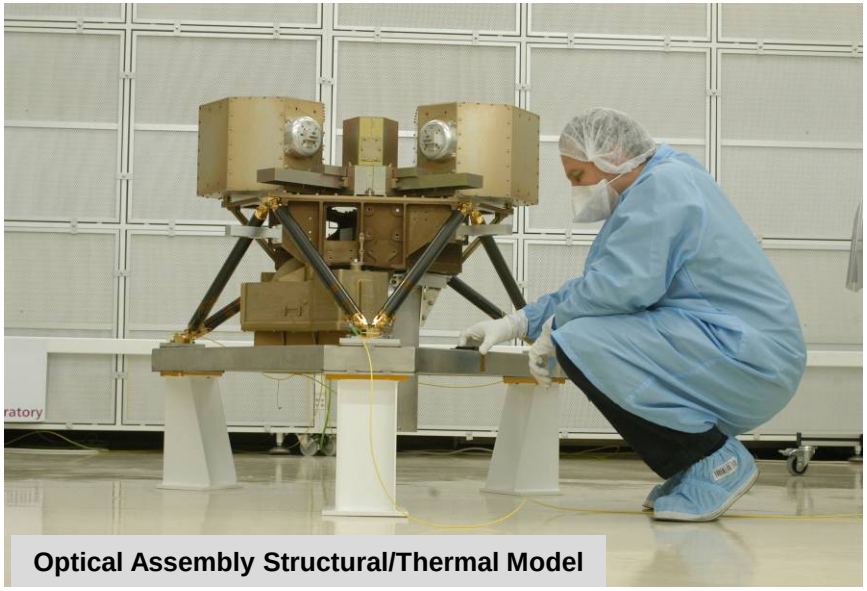


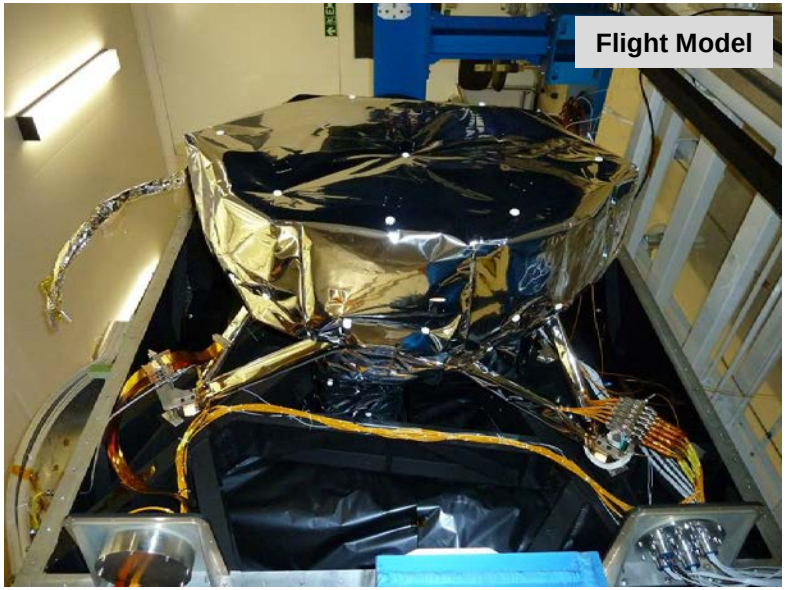




NIRSpec delivery expected during 2012

The MIRI instrument will detect key discriminators that distinguish the earliest state of galaxy evolution from more evolved objects


Optical Assembly Structural/Thermal Model



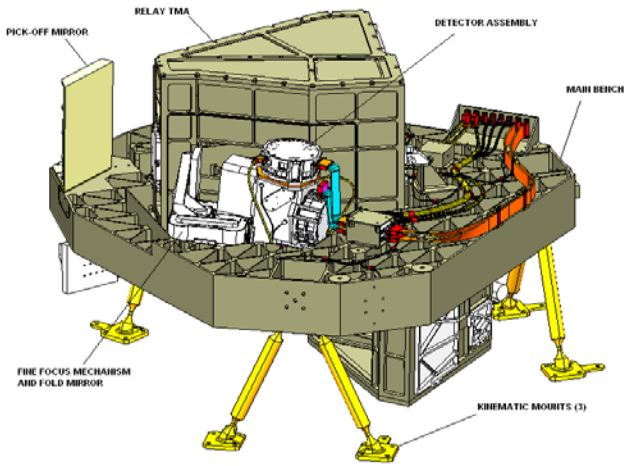
- Developed by a European Consortium and JPL
  - Operating wavelength: 5 - 29 microns
  - Spectral resolution: 5, 100, 2000
  - Broad-band imagery: 1.9 x 1.4 arc minutes FOV
  - Coronagraphic imagery
  - Spectroscopy:
    - R100 long slit spectroscopy 5 x 0.2 arc sec
    - R2000 spectroscopy 3.5 x 3.5 and 7 x 7 arc sec FOV integral field units
  - Detector type: Si:As, 1024 x 1024 pixel format, 3 detectors, 7 K cryo-cooler
  - Reflective optics, Aluminum structure and optics

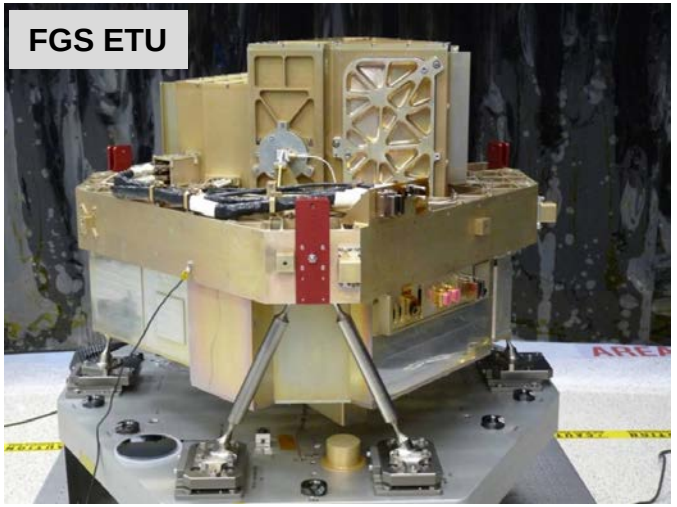
Flight unit cryo-vacuum testing completed during July 2011

MIRI is on schedule for delivery during 2012

Flight MIRI on test fixture

The FGS-Guider and -NIRSS provide imagery for telescope pointing control & spectroscopy for Ly-α galaxy surveys and extra-solar planet transits

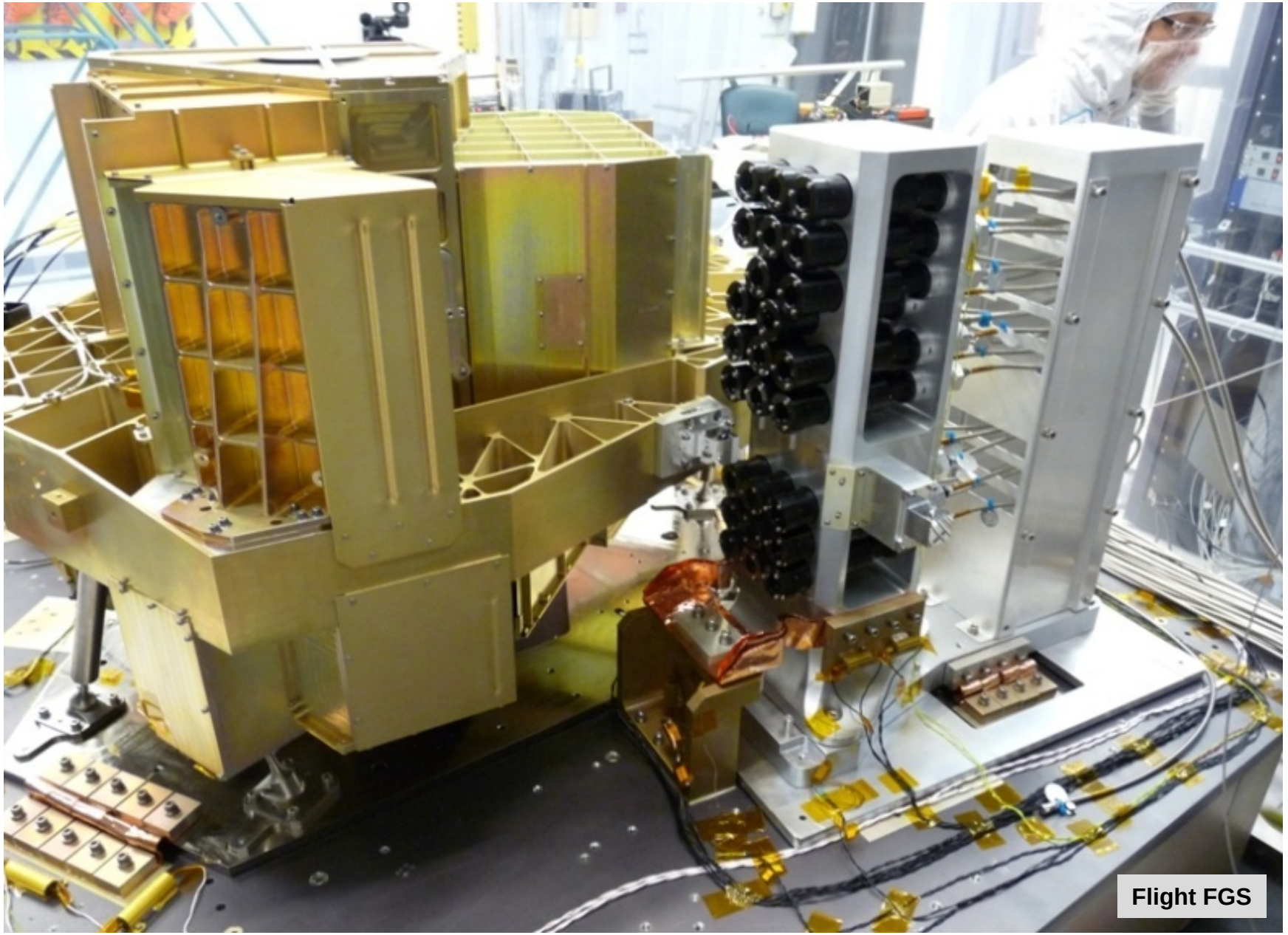




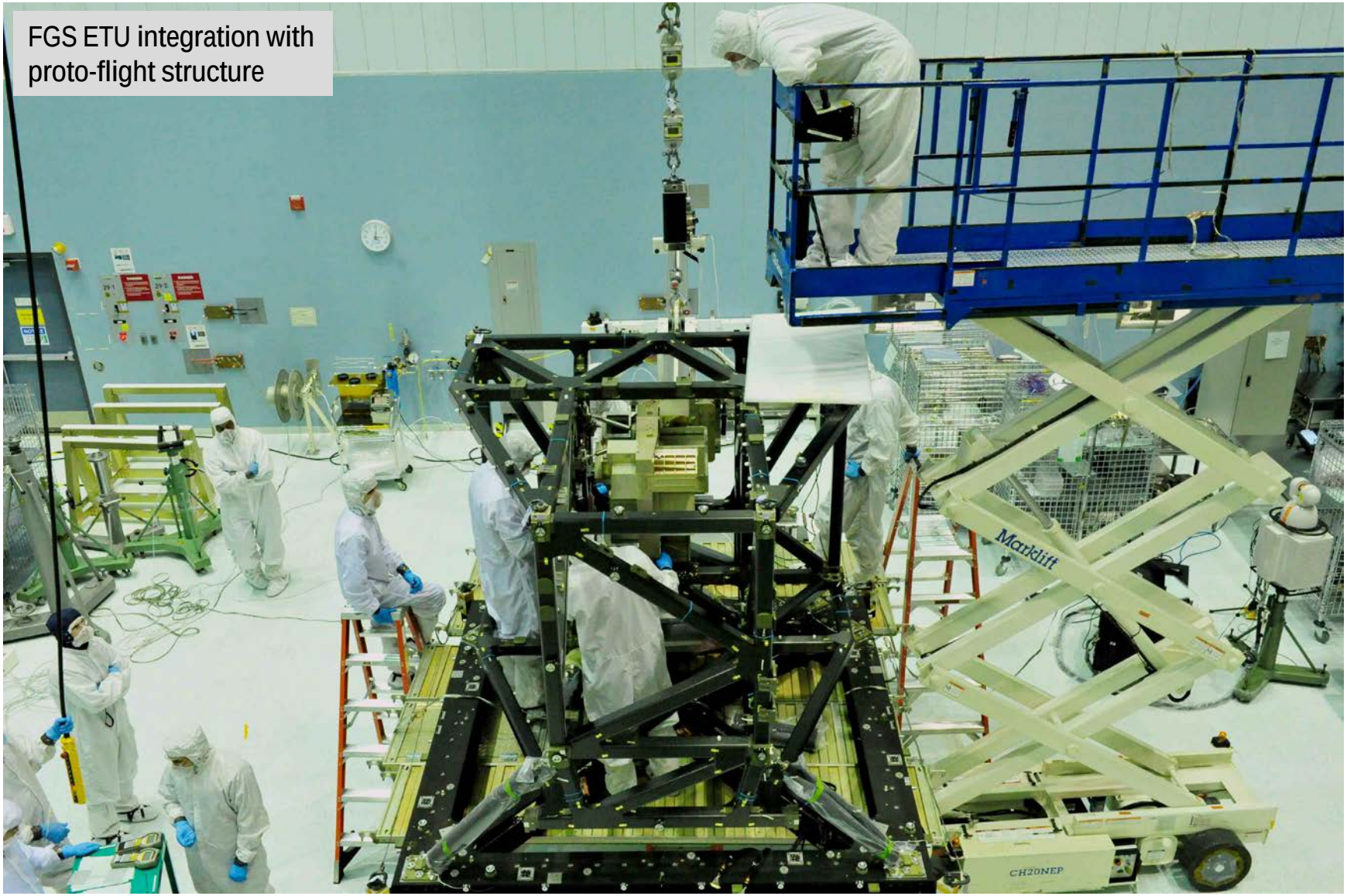
- Developed by the Canadian Space Agency with ComDev
  - Broad-band guider (0.6 – 5 microns)
  - Field of view: 2.3 x 2.3 arc minutes
  - Science imagery:
    - Slitless spectroscopic imagery (grism)
      - R ~ 150, 0.8 – 2.25 microns optimized for Ly alpha galaxy surveys
      - R ~ 700, 0.7 – 2.5 microns optimized for exoplanet transit spectroscopy
    - Sparse aperture interferometric imaging (7 aperture NRM) 3.8, 4.3, and 4.8 microns
  - Angular resolution (1 pixel): 68 mas
  - Detector type: HgCdTe, 2048 x 2048 pixel format, 3 detectors
  - Reflective optics, Aluminum structure and optics

Flight model cryo-vacuum testing currently underway

FGS is on schedule for delivery during 2012

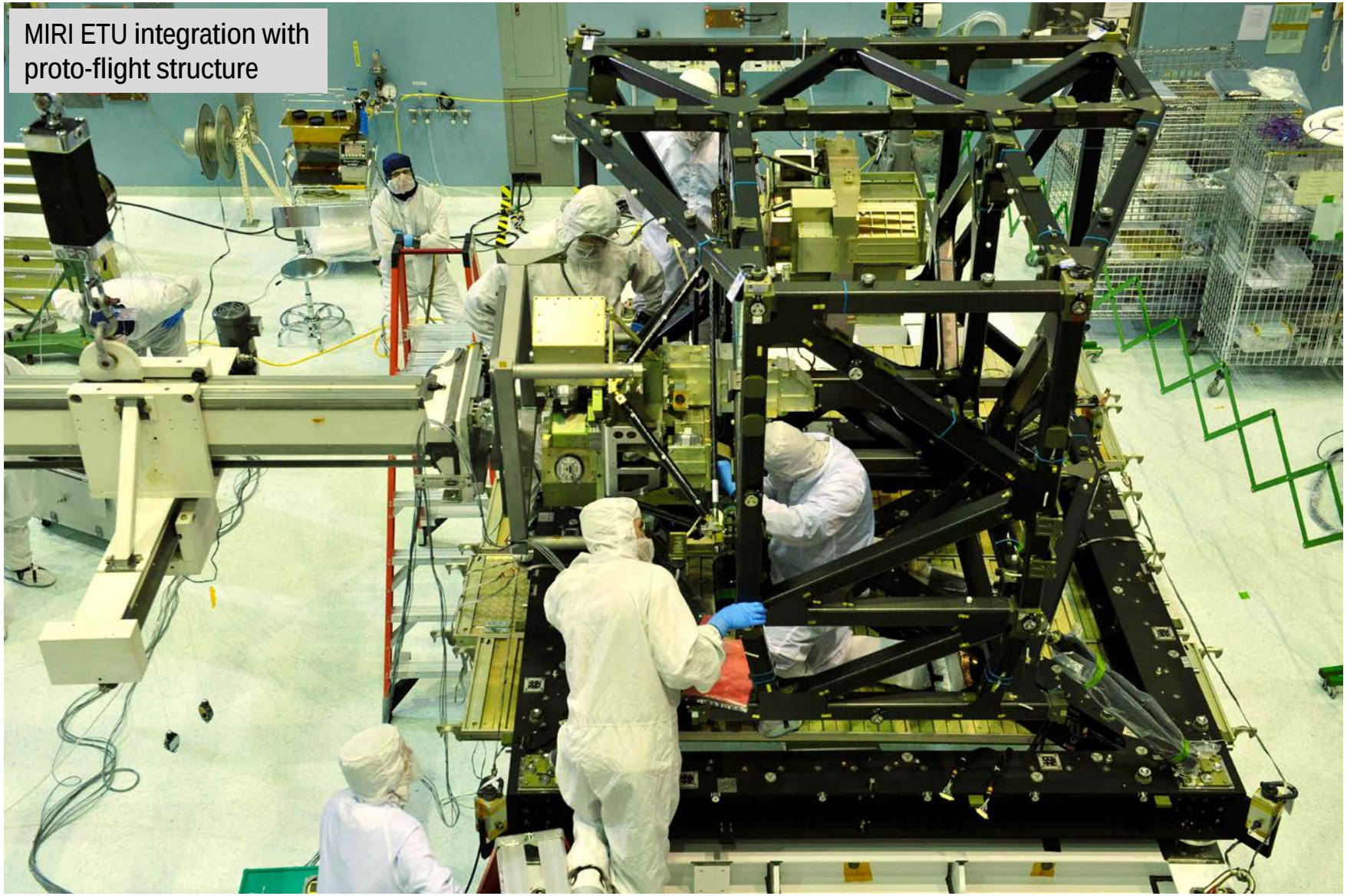


ETU SI integration with ISIM structure proceeding well



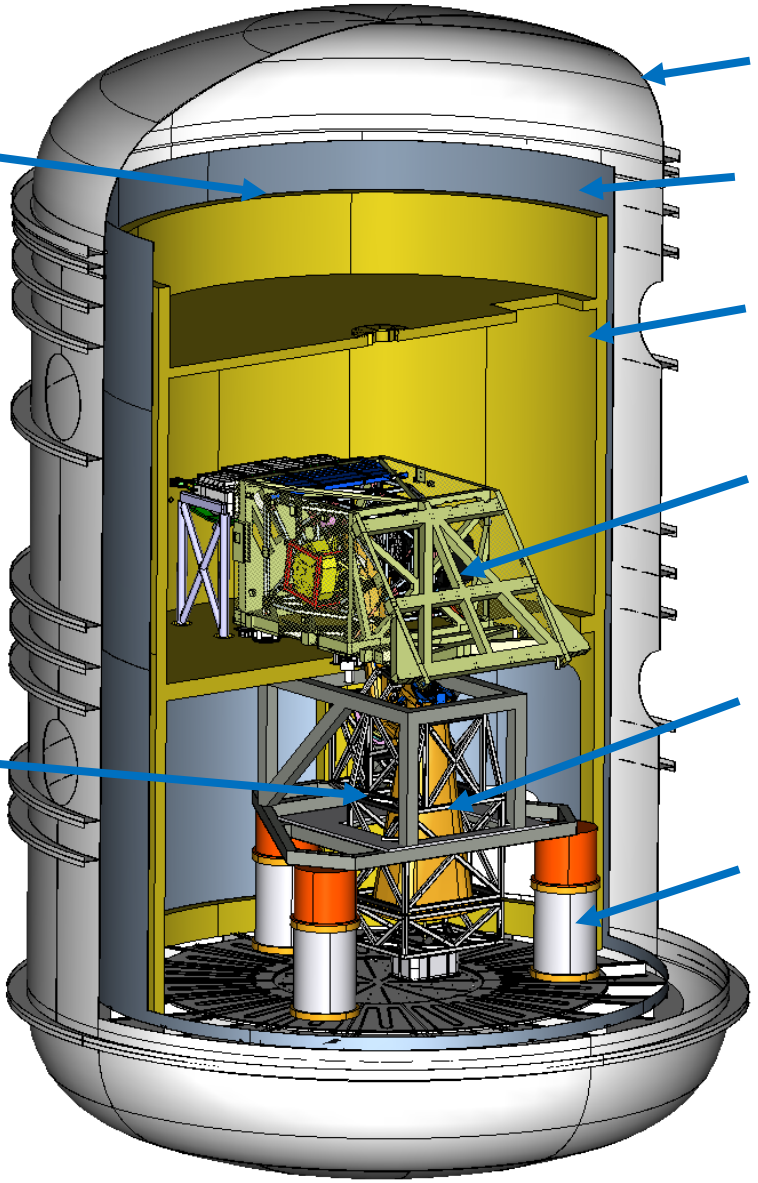
FGS ETU integration with proto-flight structure

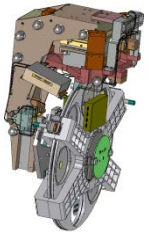
ETU SI integration with ISIM structure proceeding well



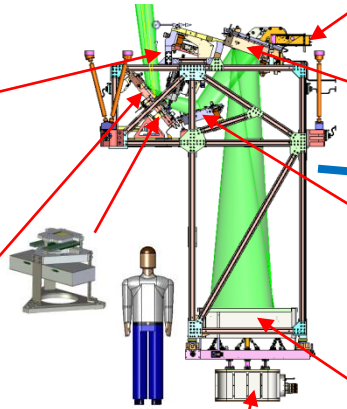
ISIM will be tested at ~35 K in the GSFC SES chamber using a cryogenic telescope simulator (OSIM)

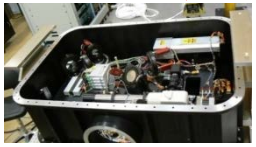
LHe shroud installation and test completed July 09



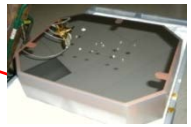


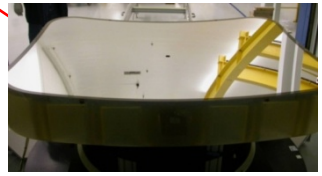
Fold Mirror 3 Tip/Tilt Gimbal Assembly





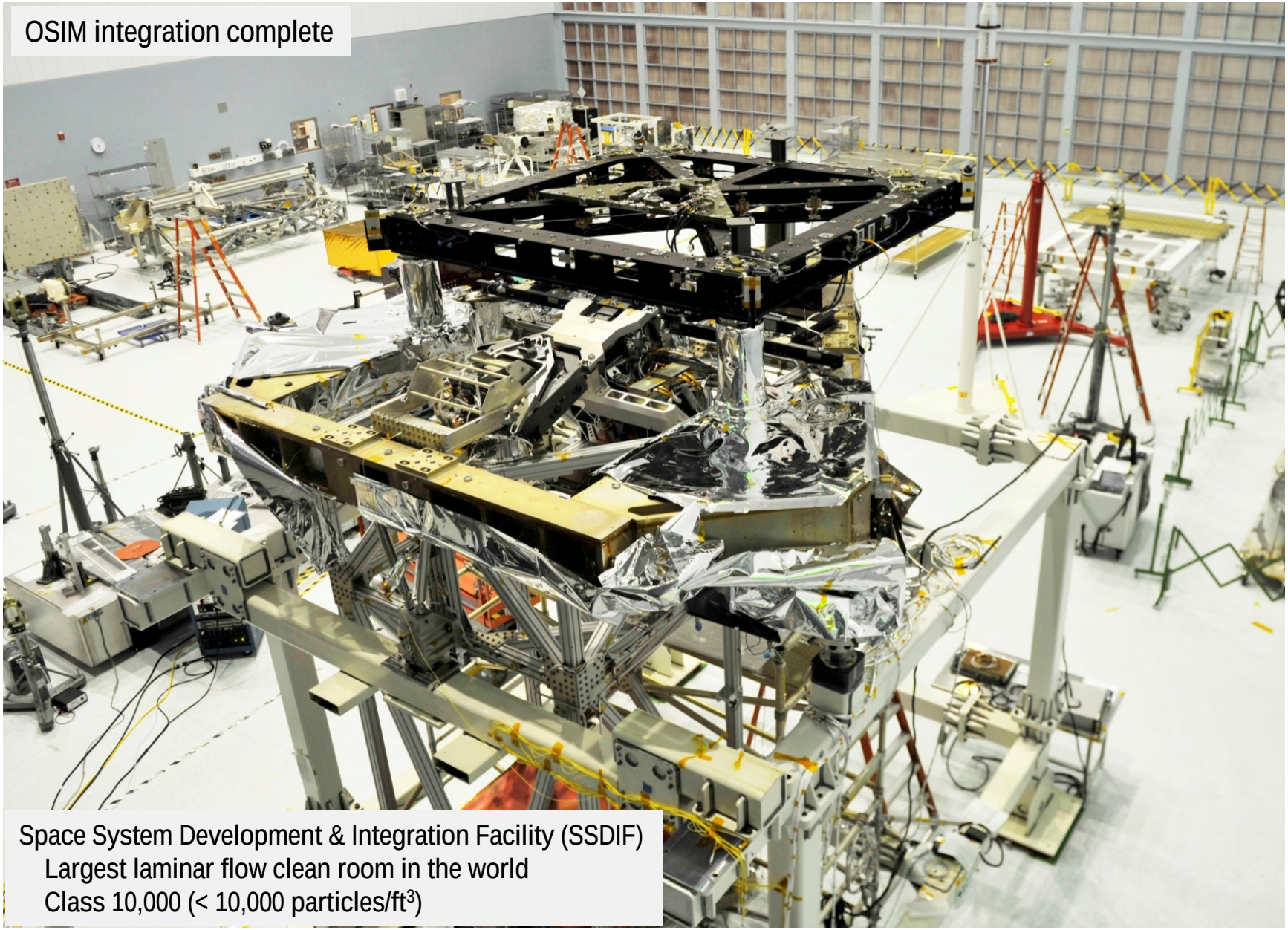
Alignment Diagnostic Module



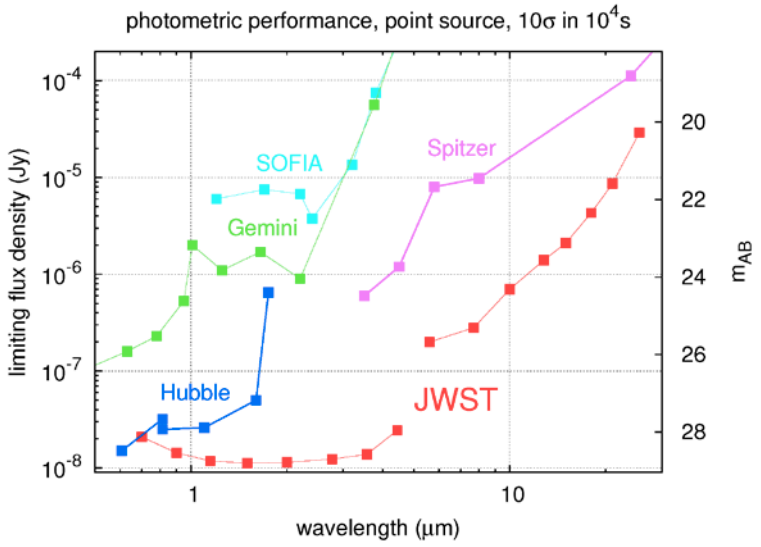


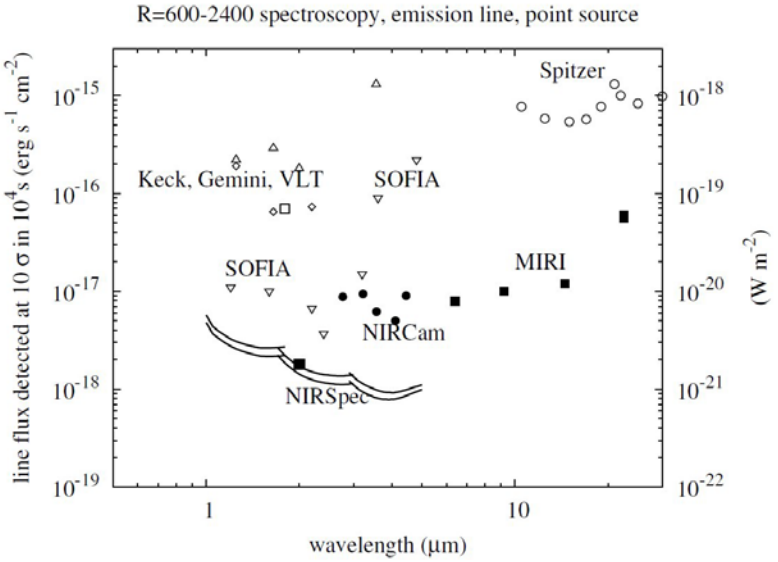
OSIM Primary Mirror

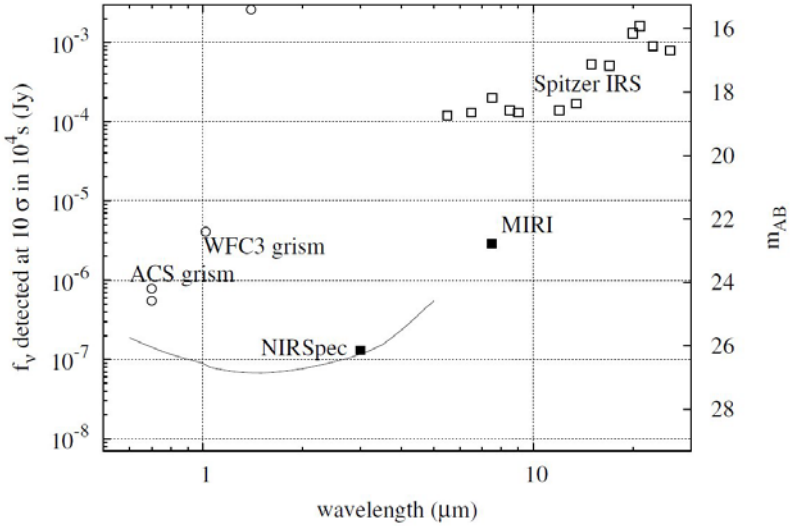
OSIM is on schedule for cryo-vac certification during 2012



The JWST will achieve unprecedented sensitivity over the 0.6 – 29 micron spectrum







See more at:
http://www.stsci.edu/jwst/science/sensitivity

Learn more at:

www.jwst.nasa.gov

http://webbtelescope.org/webb_telescope/progress_report/

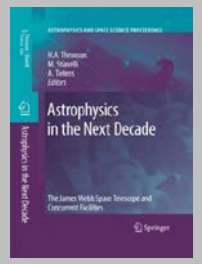
Watch the JWST being built at:

www.jwst.nasa.gov/webcam.html

Read about JWST science mission objectives at:

http://www.jwst.nasa.gov/science.html

http://www.stsci.edu/jwst/science/whitepapers/



Explore your science objectives with the JWST observing time estimator:

http://jwstetc.stsci.edu/etc/

Interact with the JWST Science Working Group:

http://www.jwst.nasa.gov/workinggroup.html

The End (of this presentation)

But

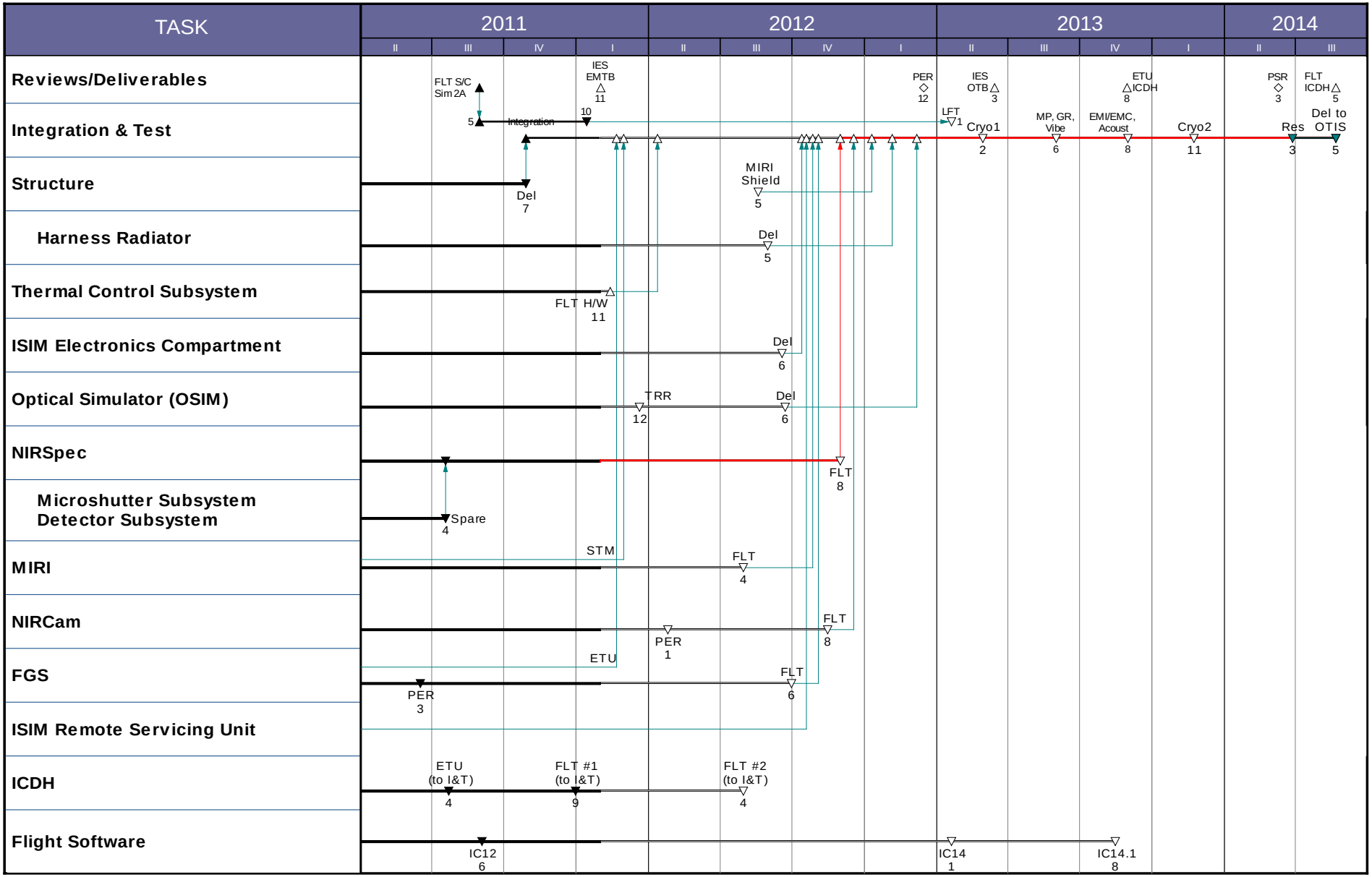
with JWST, we will see the beginning of *everything*

The first galaxies
The origins of galactic structure
The birth of stars
The creation of planets
and more
.
.
.

Supplemental Charts

ISIM MASTER SCHEDULE

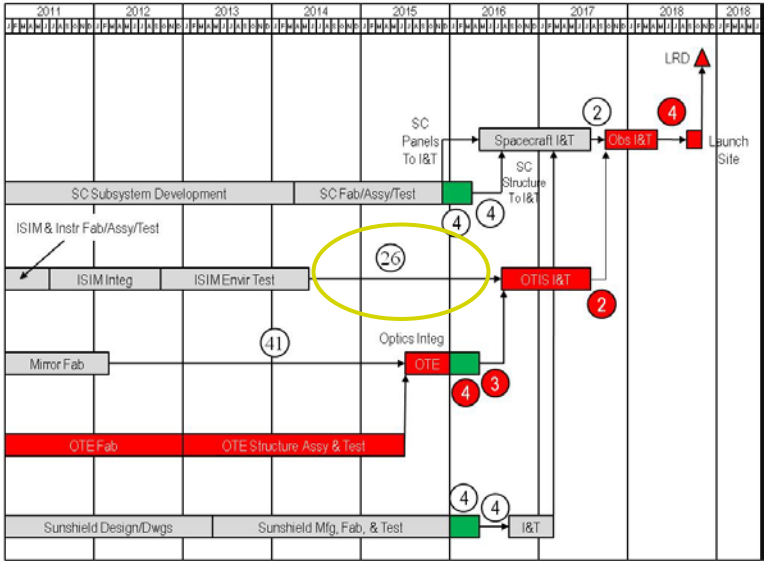
REV-K



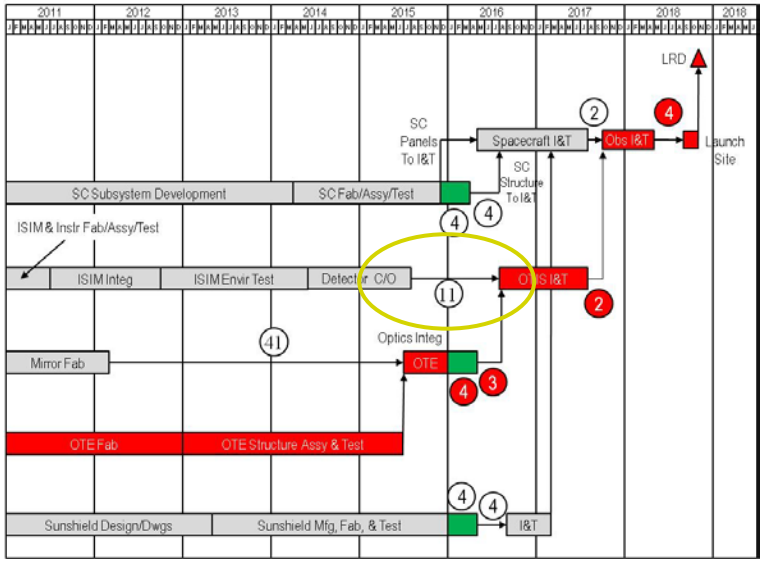
As of 10/31/11

Notional Detector Swap Out Schedule Impact

Schedule Reflecting Instrument Slips



Schedule Reflecting
Instrument Slips/Detector Swap Out



- Risks against remaining “notional” 11 mos. “schedule bath tub” include
  - Instruments are not yet delivered
  - New detectors delayed from Teledyne
  - Unexpected problems during ISIM integration
  - Complexity and scope of the ISIM cryo test program
  - Unexpected problems during detector change out and retest
  - Facility conflicts at GSFC with other projects

- Additionally, project working closely with NGAS to accelerate OTE schedule to provide more schedule flexibility during OTIS testing – makes maintaining the current near term ISIM testing a necessity