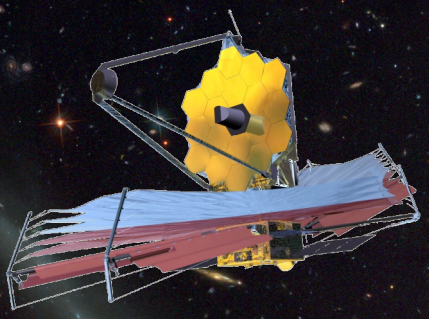
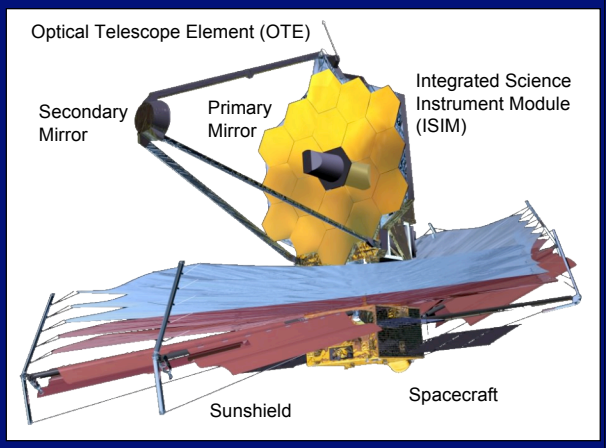
The James Webb Space Telescope



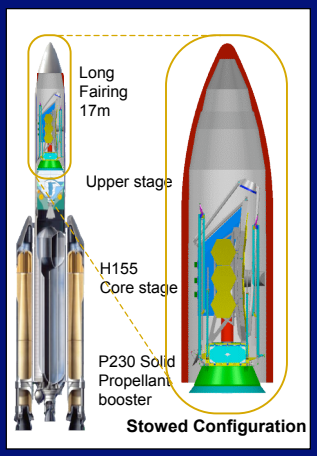
Jonathan P. Gardner
NASA's Goddard Space Flight Center

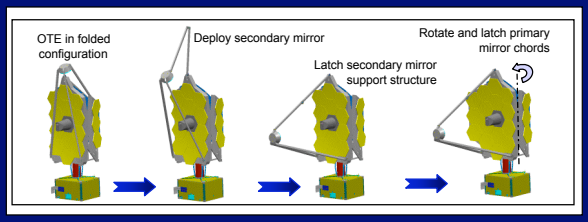
James Webb Space Telescope

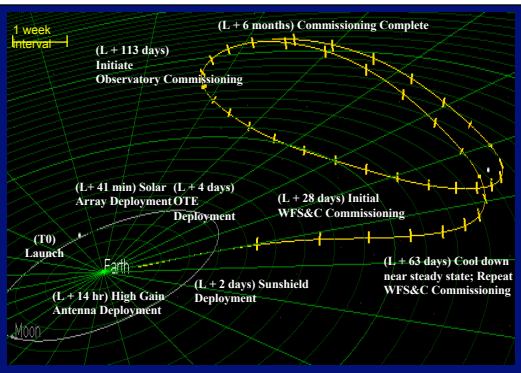
- 6.6m Telescope
- Launch in 2013 to L2.
- Successor to Hubble & Spitzer.
- Demonstrator of deployed optics.
- Passively cooled to 50K.
- Named for 2nd NASA Administrator
- NASA + ESA + CSA
- Lead: Goddard Space Flight Center
- Prime: Northrop Grumman Space Technology
- Operations: STScI



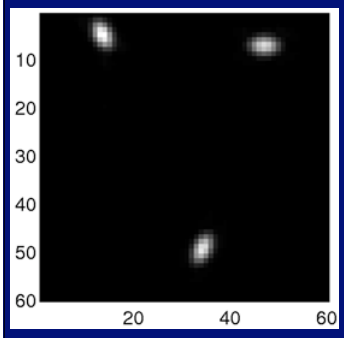
Launch, Deployment and Orbit





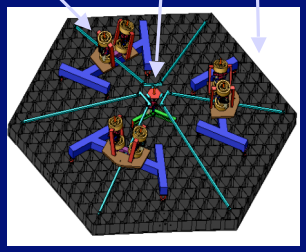


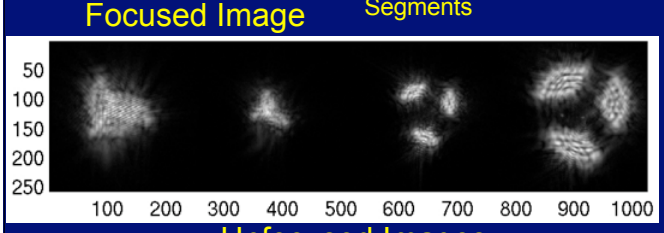
Mirror Segment Control



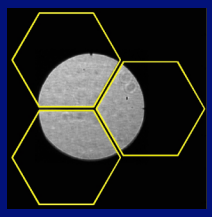
Focused Image

Testbed Mirror with 3 Segments

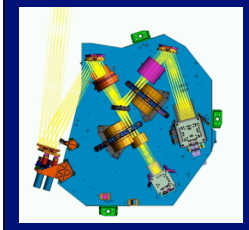




Unfocused Images



NIRCam



Arizona: Marcia Rieke PI

Lockheed-Martin & Rockwell

MIRI

George Rieke & Gillian Wright

JPL and European Consortium

Instrumentation

- NIRCam, 0.6 to 5.0 micron:
  - 2.3 x 4.5 arcmin FOV
  - Broad & narrow-band imaging
- NIRSpec, 0.6 to 5.0 micron
  - 3.4 x 3.4 arcmin FOV
  - Micro-shutter, IFU, slits
  - R~100, 1000, 3000
- TFI, 1.6 to 4.8 micron
  - 2.2 x 2.2 arcmin FOV
  - R~100 narrow-band imaging

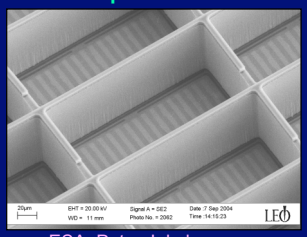
MIRI, 5.0 to 27.0 micron

- 1.4 x 1.9 arcmin FOV imaging
- 3 arcsec IFU at R~3000

Coronagraphy

- NIRCam, TFI & MIRI

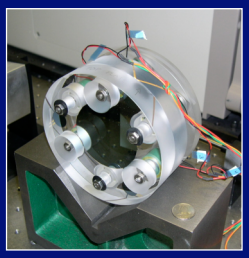
NIRSpec



ESA: Peter Jakobsen

EADS Astrium & GSFC

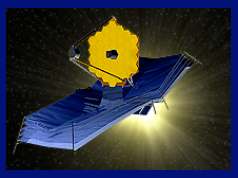
TFI



CSA: Rene Doyon

COM DEV

Operations



JWST at L2

Ka

S

DSN

THE ASTROPHYSICAL JOURNAL

- STScI has been designated as Science Operations Center
- GO, Legacy/Treasury and GTO programs similar to HST

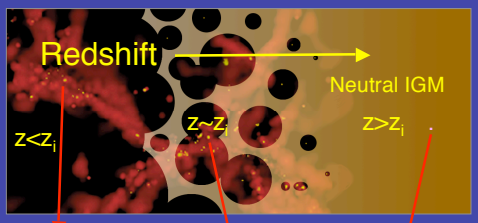
Astronomer

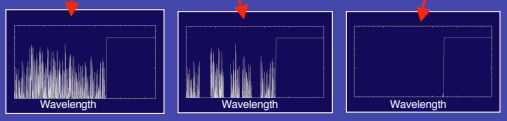
STScI

TAC

End of the dark ages: first light and reionization

- What are the first galaxies?
- When did reionization occur?
  - Complicated history?
- What sources caused reionization?





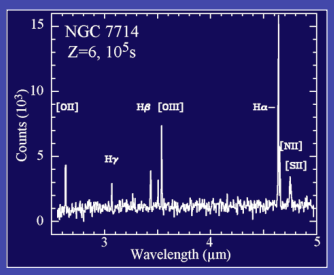
Lyman Forest Absorption | **Patchy Absorption** | **Black Gunn-Peterson trough**

- Ultra-Deep NIR survey (1.4 nJy), spectroscopic & Mid-IR confirmation.
- QSO spectra: Ly-α forest
- Galaxy spectra: Balmer lines (2×10^{-19} ergs/cm^2/sec)

The assembly of galaxies

- Where and when did the Hubble Sequence form?
- How did the heavy elements form?
- Can we test hierarchical formation and global scaling relations?
- What about ULIRGs and AGN?

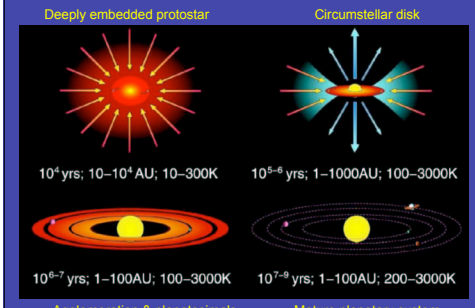
Galaxies in GOODS Field



- Wide-area imaging survey
- R=1000 spectra of 1000s of galaxies at $1 < z < 6$
- Targeted observations of ULIRGs and AGN

Birth of stars and protoplanetary systems

- How do clouds collapse?
- How does environment affect star-formation?
  - Vice-versa?
- What is the low-mass IMF?

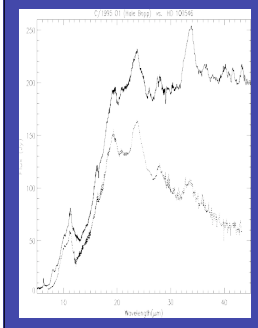


The Eagle Nebula
as seen in the infrared

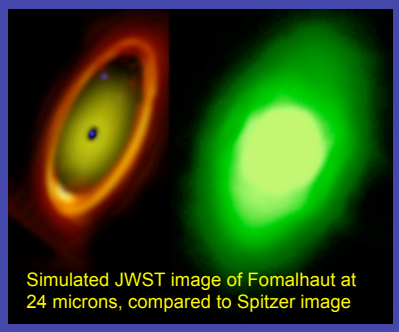
- Imaging of molecular clouds
- Survey "elephant trunks"
- Survey star-forming clusters

Planetary systems and the origins of life

- How do planets form?
- How are circumstellar disks like our Solar System?
- How are habitable zones established?



Spectrum of HD100546
compared to Hale-Bopp
Malfait et al 1998



Simulated JWST image of Fomalhaut at
24 microns, compared to Spitzer image

- Extra-solar giant planets
  - Coronagraphy
- Spectra of circumstellar disks, comets and KBOs
- Spectra of icy bodies in outer Solar System

What can Great Observatories do for JWST?

- Find a z>10 quasar
  - Needed for reionization studies
  - May be in existing surveys, may need ultra-wide Spitzer
- Complete the existing galaxy surveys
  - Complete full wavelength coverage (X-ray to radio) on:
    - UDF, GOODS, COSMOS, Lockman Hole, EGS, etc.
- Homogeneous datasets on nearby galaxies, galactic and Solar System objects
  - Has the TAC process left gaps in well-selected samples and datasets?

He Shroud Installation at MSFC X-Ray Calibration Facility (XRCF)

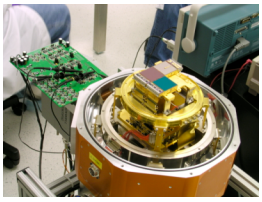
JWST Segment Test
NASA/MSFC - XRCF

WFSC achieves Two Milestones

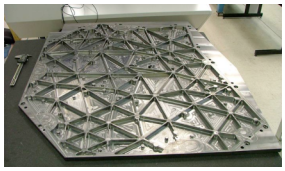
Dispersed Hartmann Sensor demonstrated on Keck telescope

Wavefront Sensing and control (WFSC) testbed completed

Instrument Hardware is on track

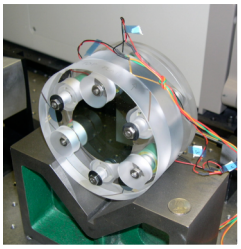


NIRCam Eng Model Detectors



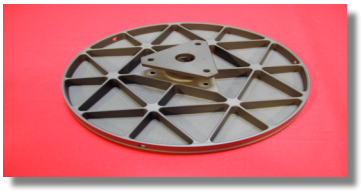
NIRCam ETU Optical Bench

NIRSpec Microshutter Array Flight Candidate

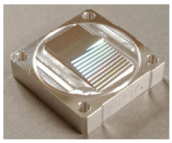


Tunable Filter
Prototype Etalon

MIRI Model



Prototype NIRSpec SiC Mirror

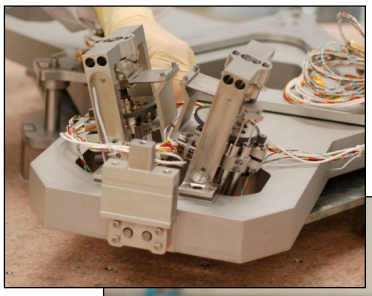


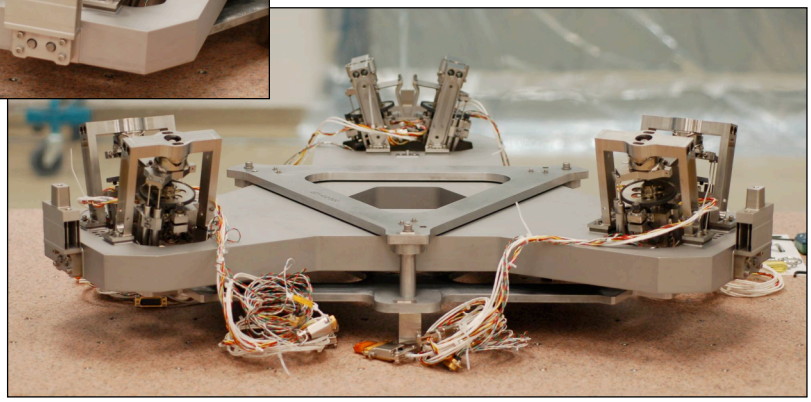
MIRI Prototype Image
Slicing Mirror

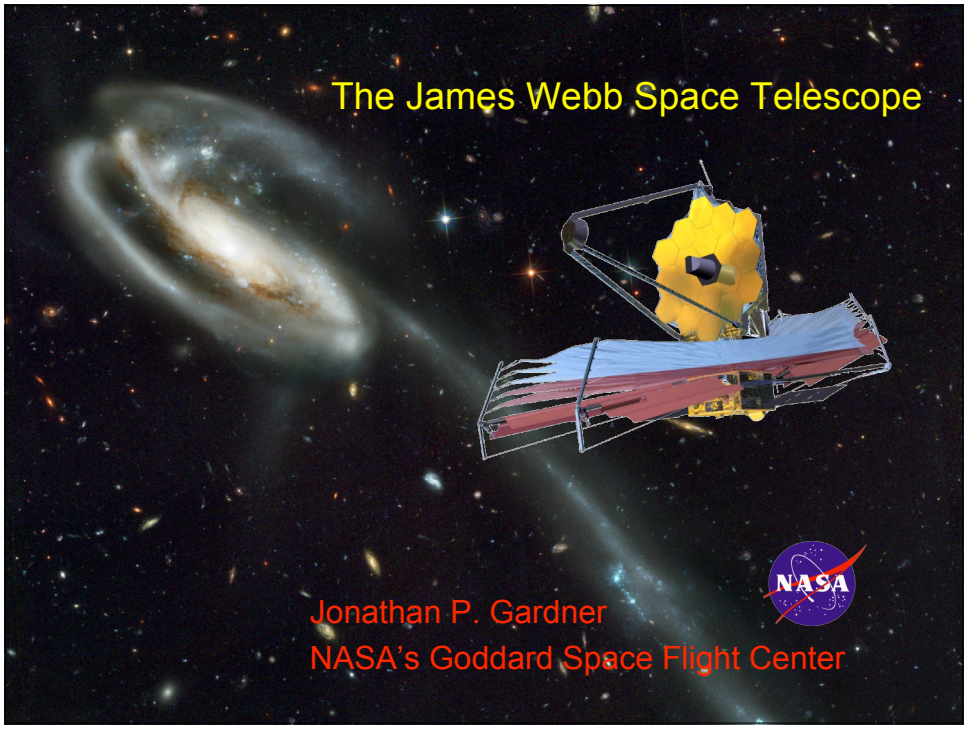
All Primary Mirror Segments Completed

Primary Mirror Segment Assembly Build-Up is Underway at Ball

Build-up of the first flight segment Hexapod to Delta Frame Assembly is underway and ahead of schedule at Ball; this assembly includes the actuators that can adjust the shape and position of each Primary Mirror segment



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