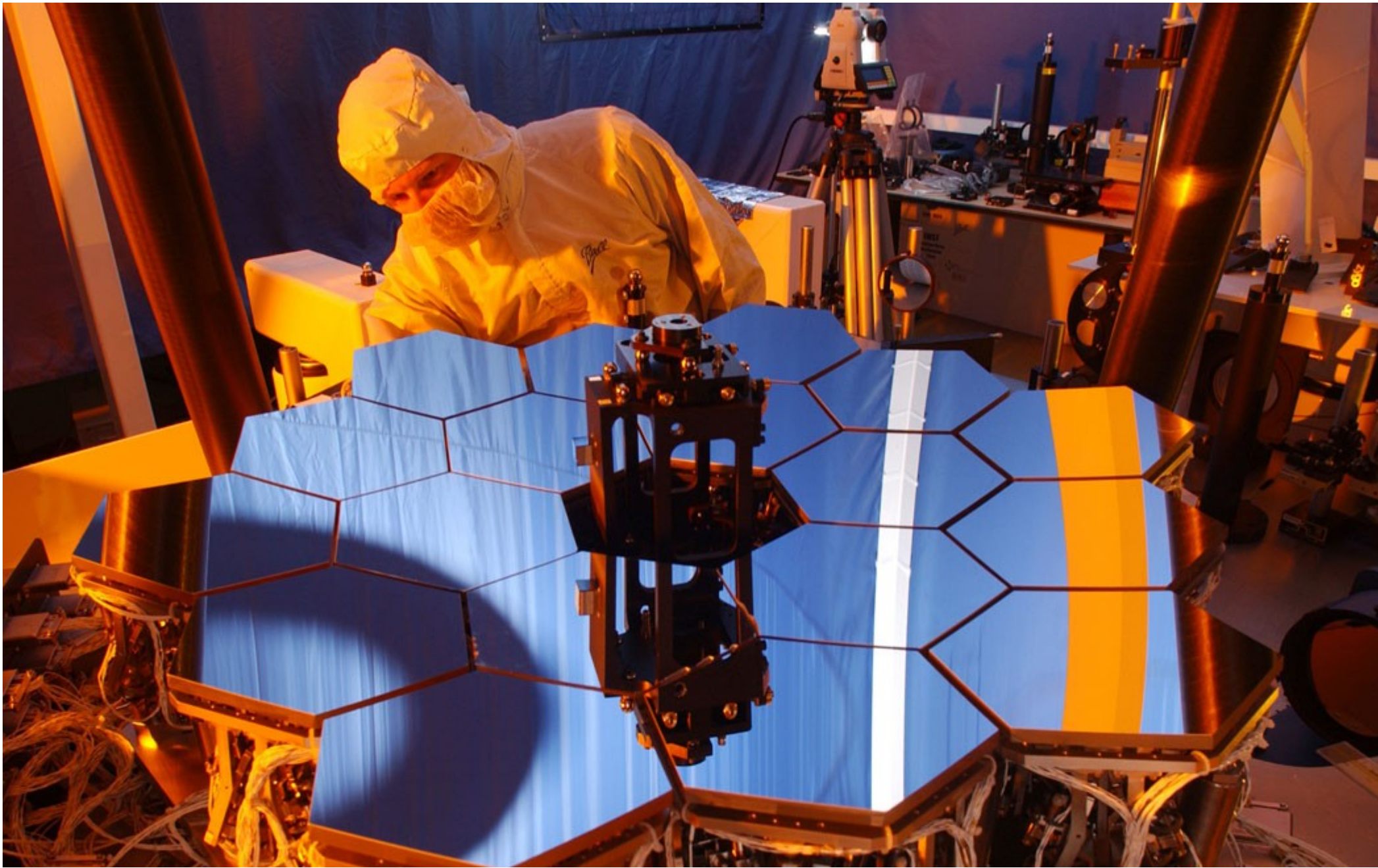
The James Webb Space Telescope



James E. Webb

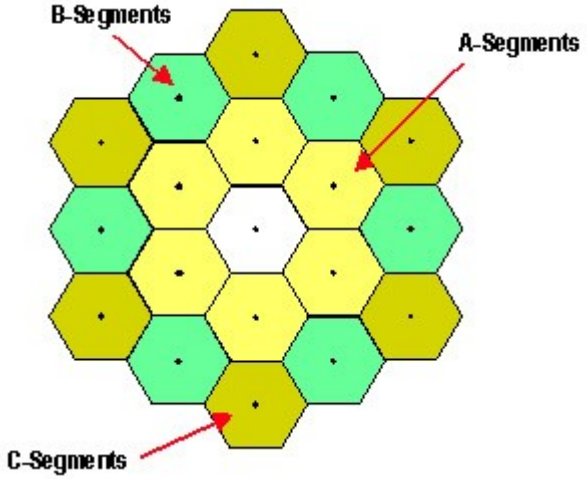
- Remember him?

- Oversaw the Apollo program
- Applied systems engineering to all aspects of R&D
- Manned flight the focus of his NASA, but science was not forgotten

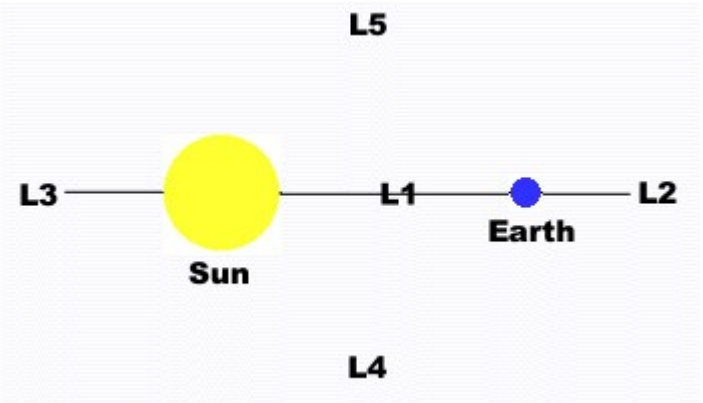
Why Webb?

"It is fitting that Hubble's successor be named in honor of James Webb. Thanks to his efforts, we got our first glimpses at the dramatic landscape of outer space. He took our nation on its first voyages of exploration, turning our imagination into reality. Indeed, he laid the foundations at NASA for one of the most successful periods of astronomical discovery."

-- Sean O'Keefe, former NASA Administrator



Details



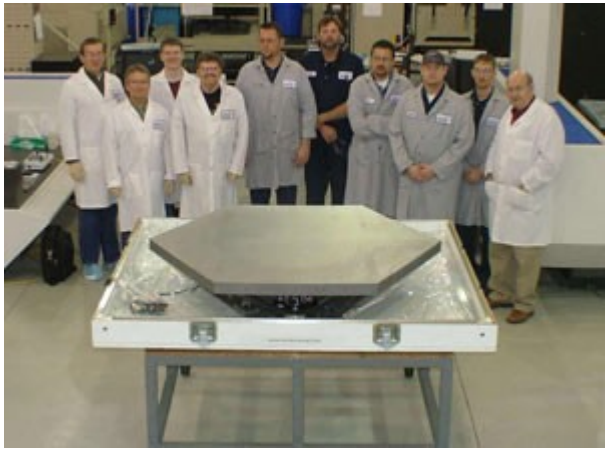
- IR Telescope with 6.5m primary mirror
- Primary mirror is made of 18 1.3m diameter, hexagonal Beryllium mirrors.
- Collaboration with NASA, Canadian Space Agency, and the ESA
- Orbits at L2, where it will have a stable orbit and be shielded from the Earth's, Moon's, and Sun's IR.

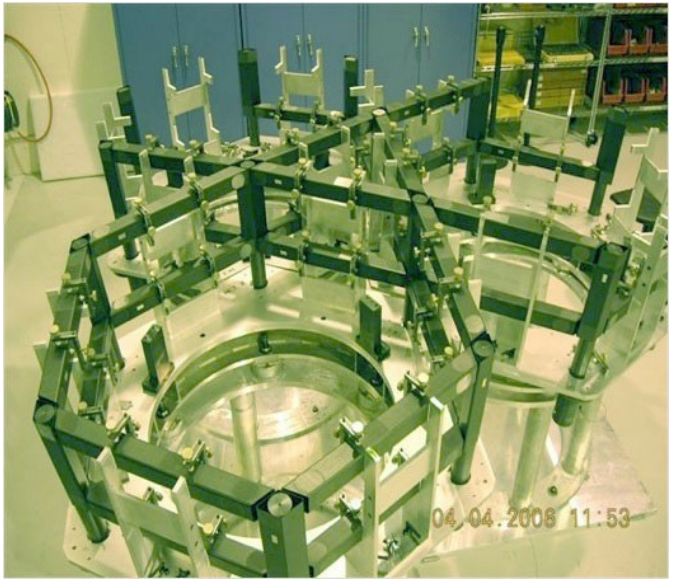
JWST's Launch

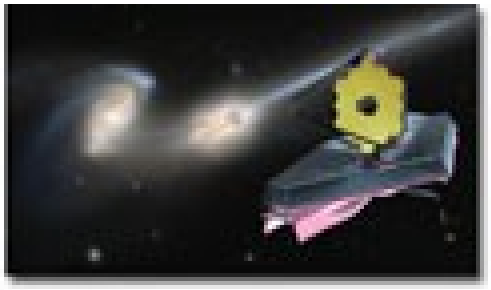
The Vision for Space Exploration

It's not just for astronauts

- Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about the destinations for human exploration
- Conduct advanced telescope searches for Earth-like planets and habitable environments around other stars



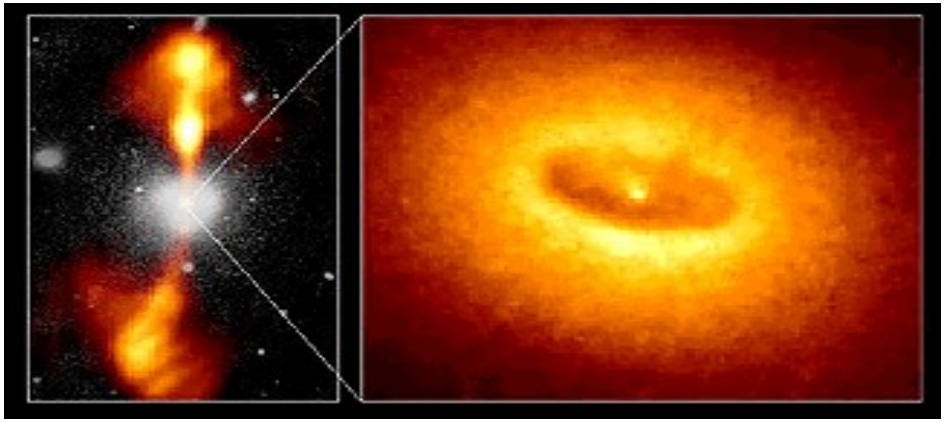




JWST Science Goals

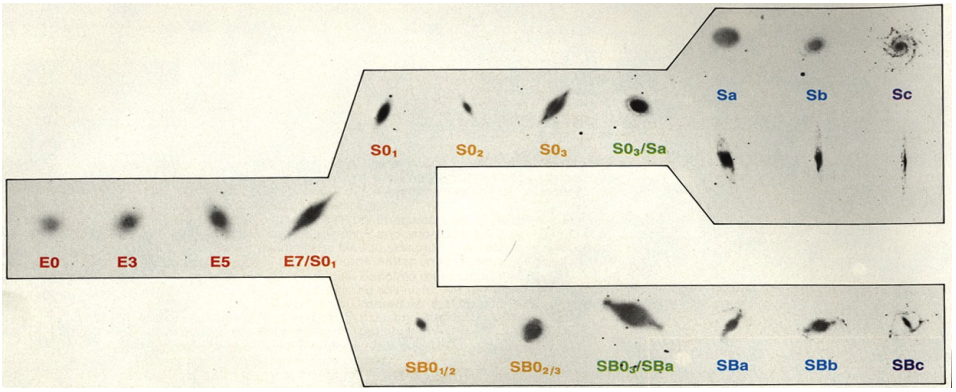
- Will look at every era of our universe
- Four main science objectives
  - The End of the Dark Ages: First Light and Reionization
  - Assembly of Galaxies
  - The Birth of Stars and Protoplanetary Systems
  - Planetary Systems and the Origins of Life

The End of the Dark Ages: First Light and Reionization



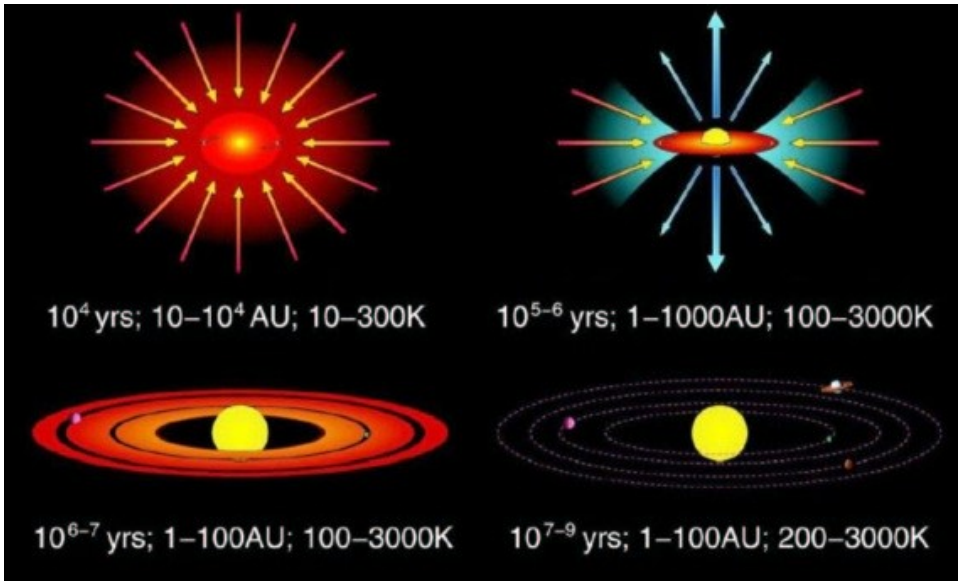
- Identify the first bright objects in the universe
- Identify the first galaxies
- When did reionization happen?
- What caused reionization?

Assembly of Galaxies



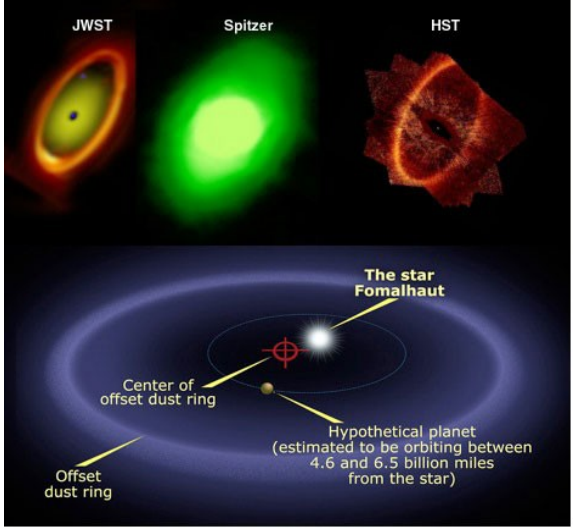
- Determine the evolution of galaxies, dark matter, stars, gas, metals, active galactic nuclei, spiral arms, and other physical structures
- How did the first galaxies form?
- Why are there different types of galaxies?
- What types of stars were in the first galaxies?
- What is the relation between galaxies and their central black holes?

The Birth of Stars and Protoplanetary Systems



- Focus on the birth and development of stars, and the birth of planetary systems.
- How do young neighboring stars interact with each other?
- Why are hot Jupiters so common?

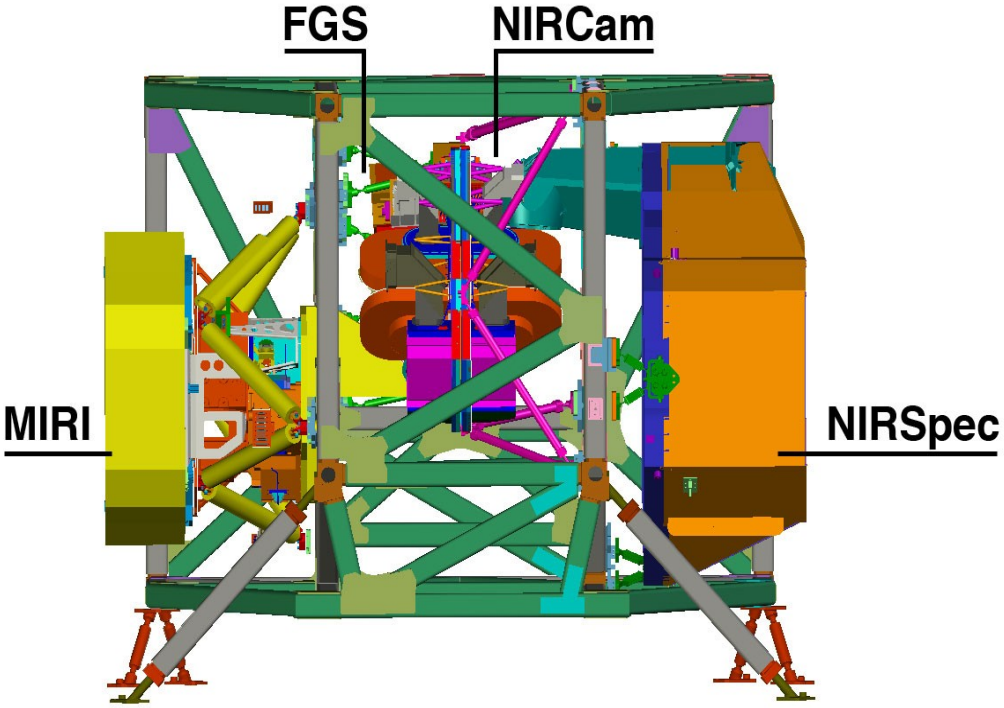
Planetary Systems and the Origins of Life



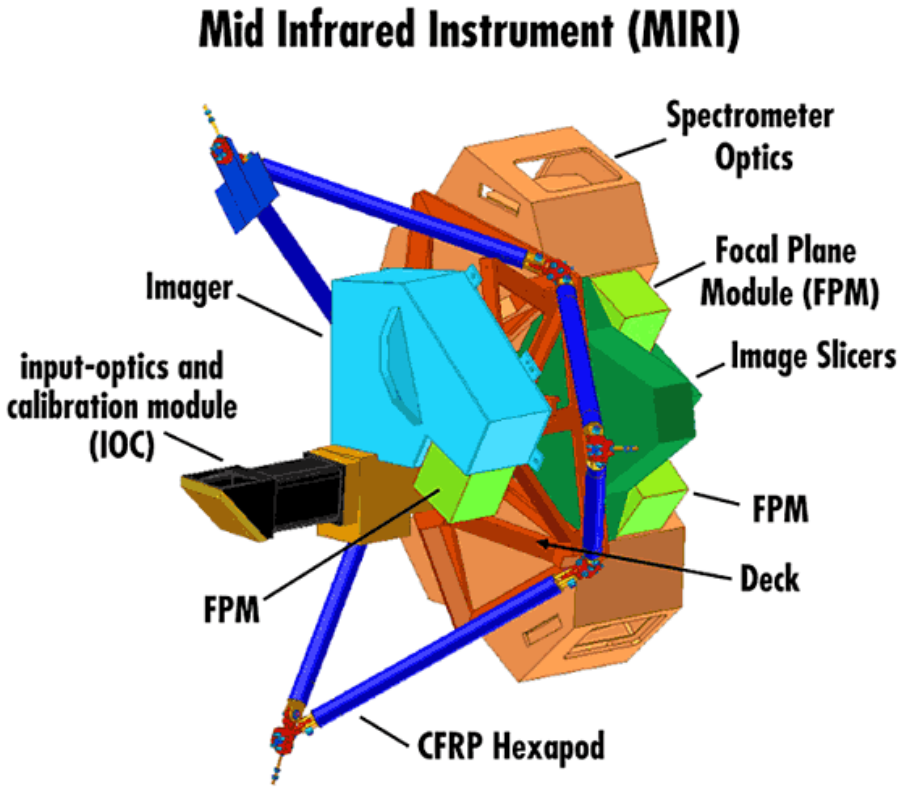
- Study systems with chemical and physical characteristics suitable for life, including our own
- How are the building blocks of planets formed?
- Hope to image an extrasolar planet with JWST
- Identify and study comets and other far-away objects in our own system

Integrated Science Instrument Module

- 4 main science instruments plus cryogenics system, guidance software, etc
  - Mid-Infrared Instrument
  - Near Infrared Camera
  - Near Infrared Spectrograph
  - Fine Guidance Sensor

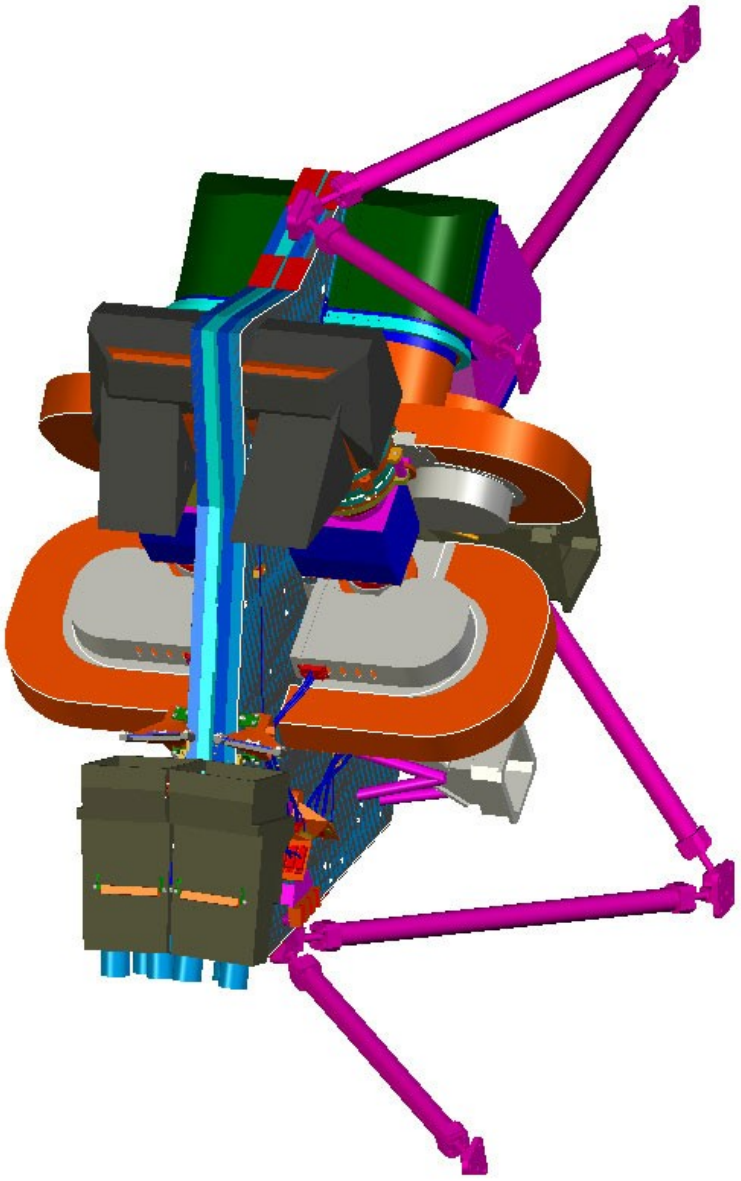


Mid-Infrared Instrument



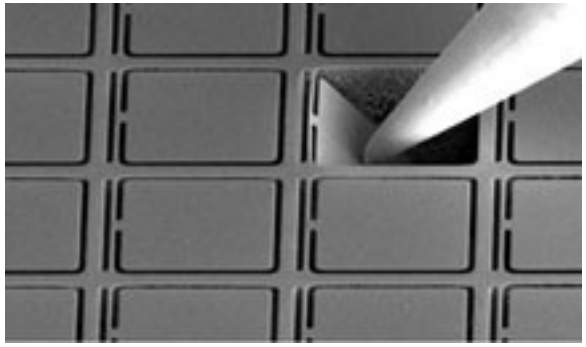
- ESA and NASA JPL
- 5-27 microns
- Broad and narrow band imaging, as well as two types of coronagraphy and slit spectroscopy
- Useful for multiple studies

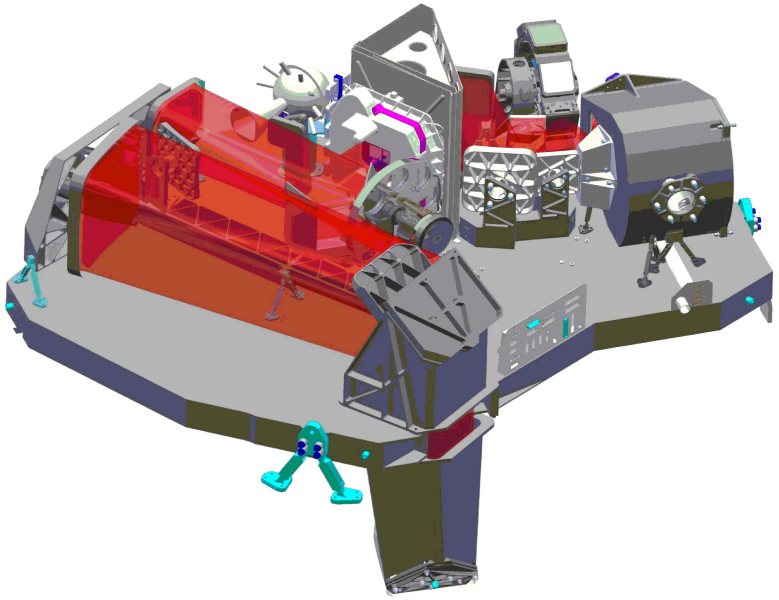
Near-Infrared Camera



- University of Arizona
- .6 – 5 microns
- Broad and intermediate band, wavefront sensing
- Mapping dark matter, supernovae lightcurves, much more.

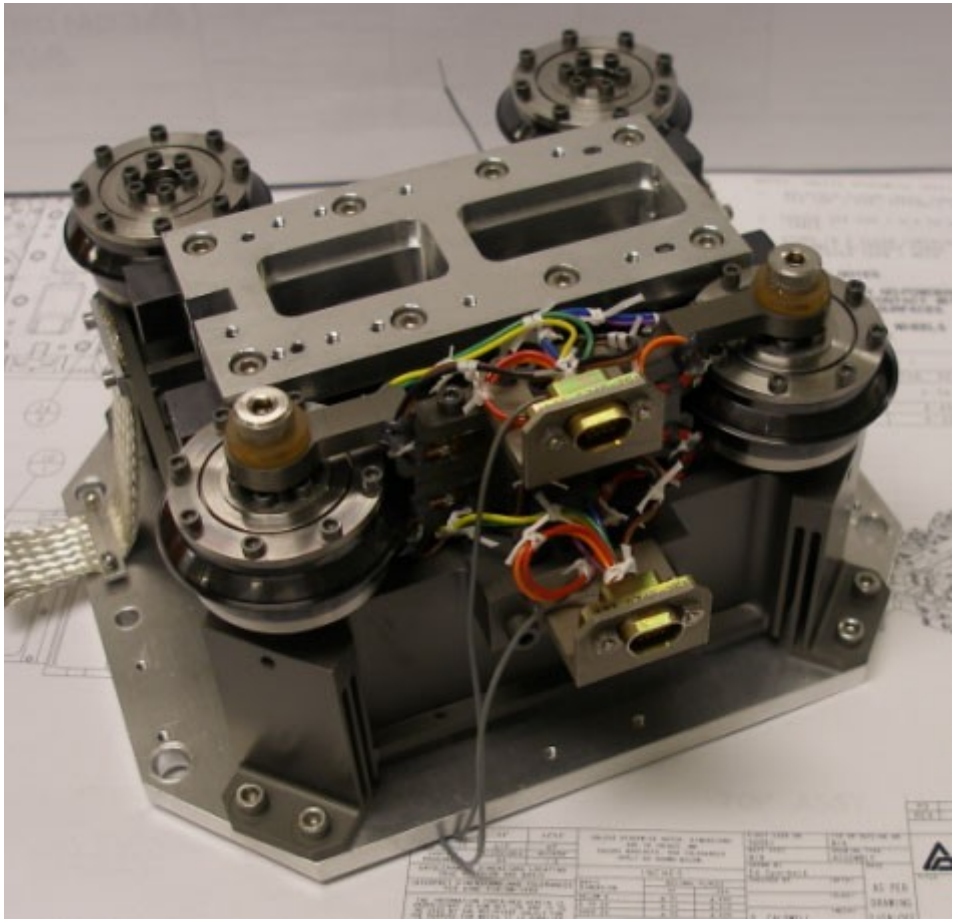
Near-Infrared Spectrograph





- ESA and NASA
- .5 – 6 microns
- 3 modes
  - Long slit
  - Multi-object
  - Low resolution prism

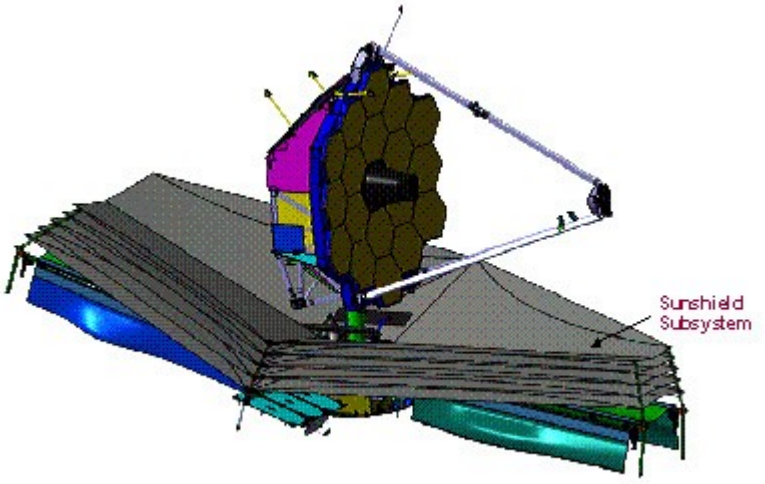
Fine Guidance Sensor



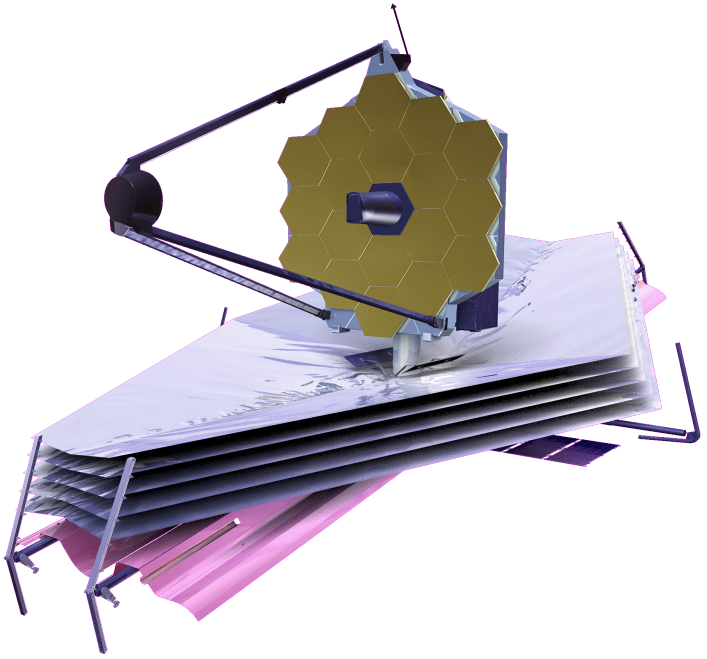
- CSA
- Support for the altitude control system
- Three main functions
  - Acquire target images
  - Acquire guide stars
  - Keep JWST stable

Sunshield

- JWST needs to be kept very cold to see very faint objects
- Sunshade protects JWST from its own systems and from the Sun
- Size of tennis court
- Keep JWST cooler than 50K



JWST and Hubble



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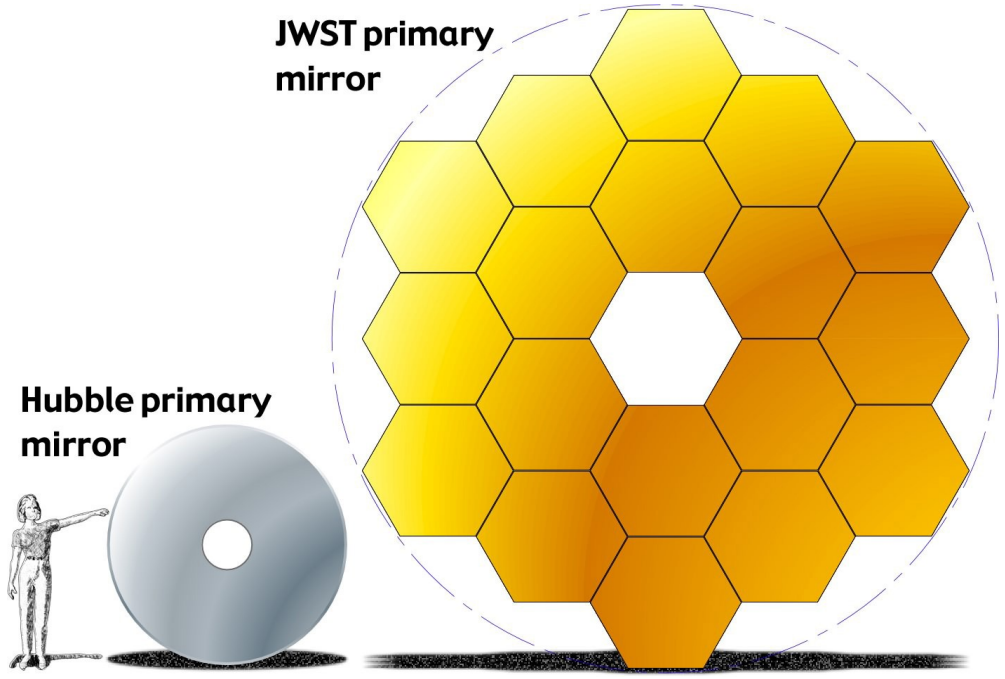
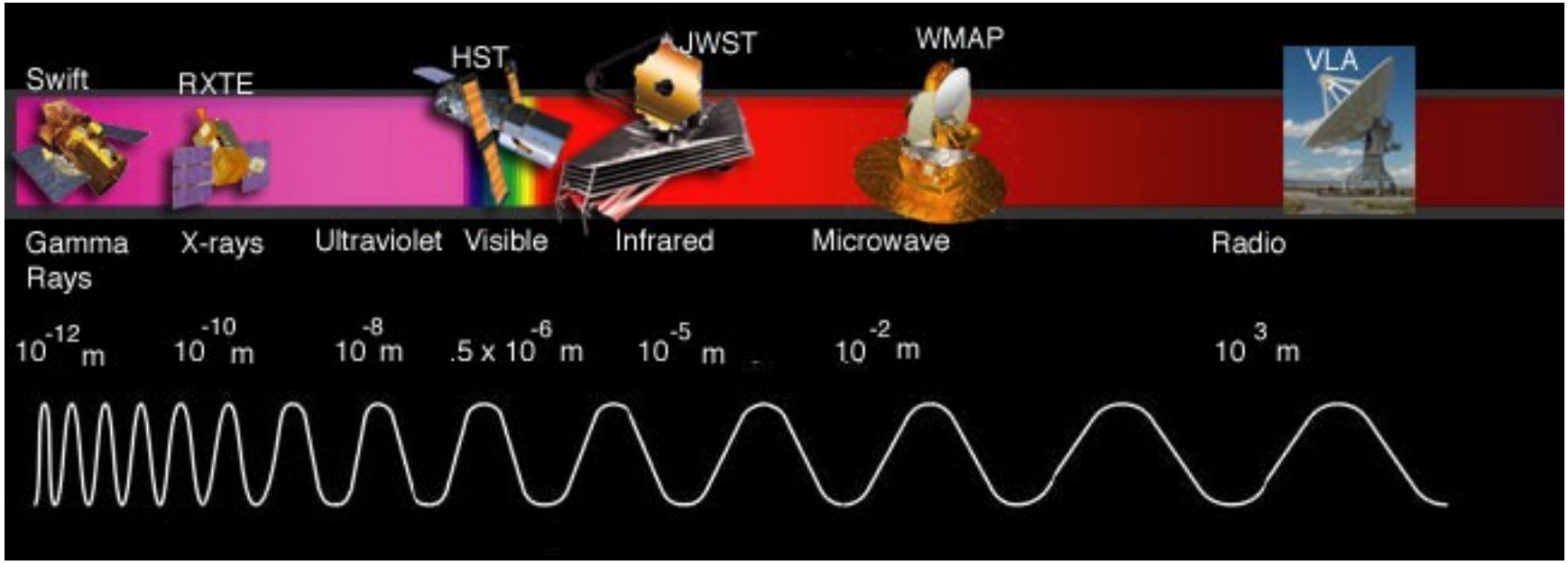
Sizes

- JWST
  - 22m long
  - 12m wide
  - 6.5m mirror
- HST
  - 13.2m long
  - 4.2m wide
  - 2.4m mirror

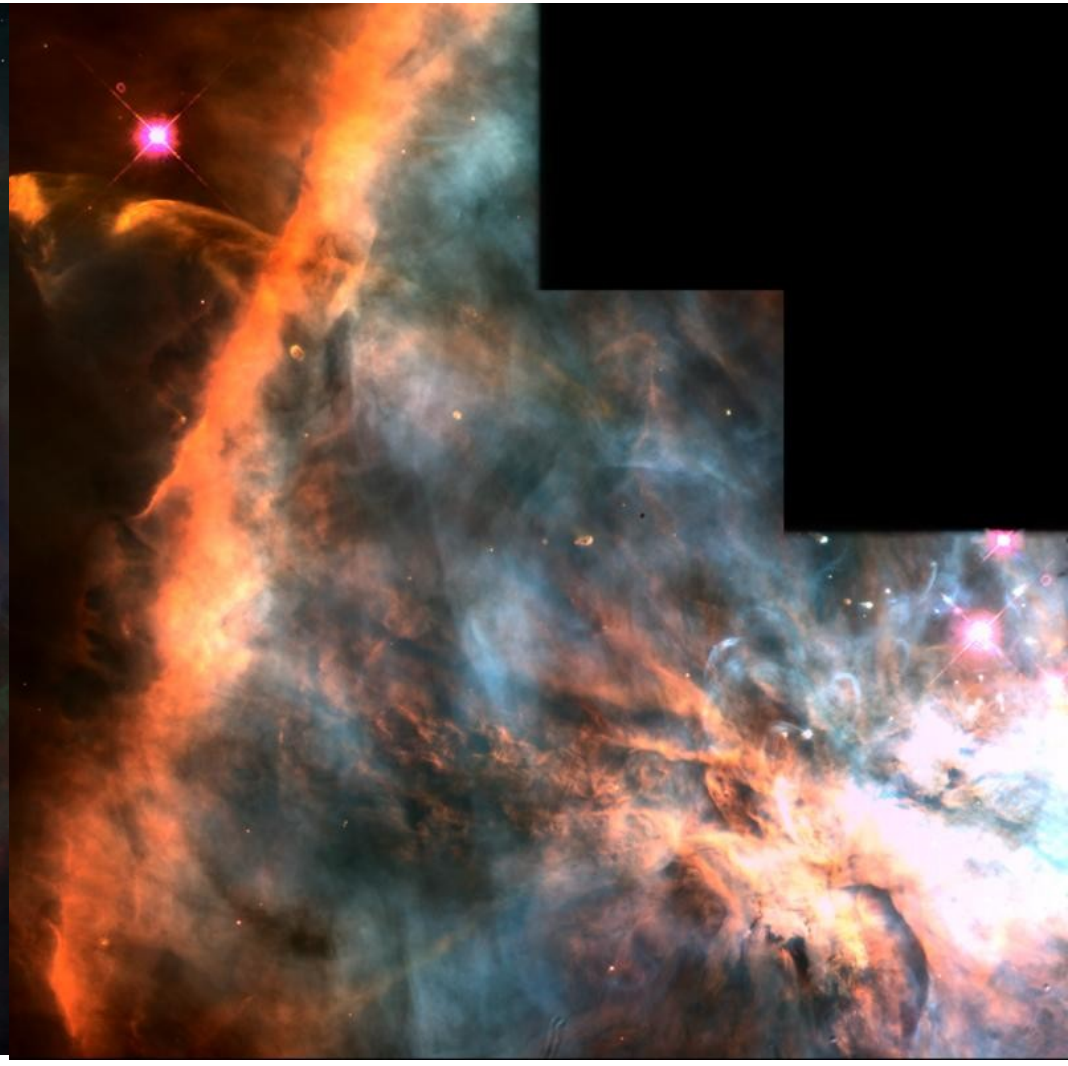


Wavelengths

- JWST
  - .6 – 28 microns
- HST
  - .8 – 2.5 microns



Orion through HST



Orion in IR

Citations

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- hubblesite.org
- http://chandra.harvard.edu/photo/2001/orion_mc
- http://www.stsci.edu/jwst/instruments/