### The James Webb Space Telescope



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http://jwst.nasa.gov

Space Science Reviews, 2006, 123/4, 485

# James Webb Space Telescope



• 6.6m Telescope

- Successor to Hubble & Spitzer.
- Demonstrator of deployed optics.
- 4 instruments: 0.6 to 28.5 µm
- Passively cooled to < 50 K.
- Named for 2<sup>nd</sup> NASA Administrator





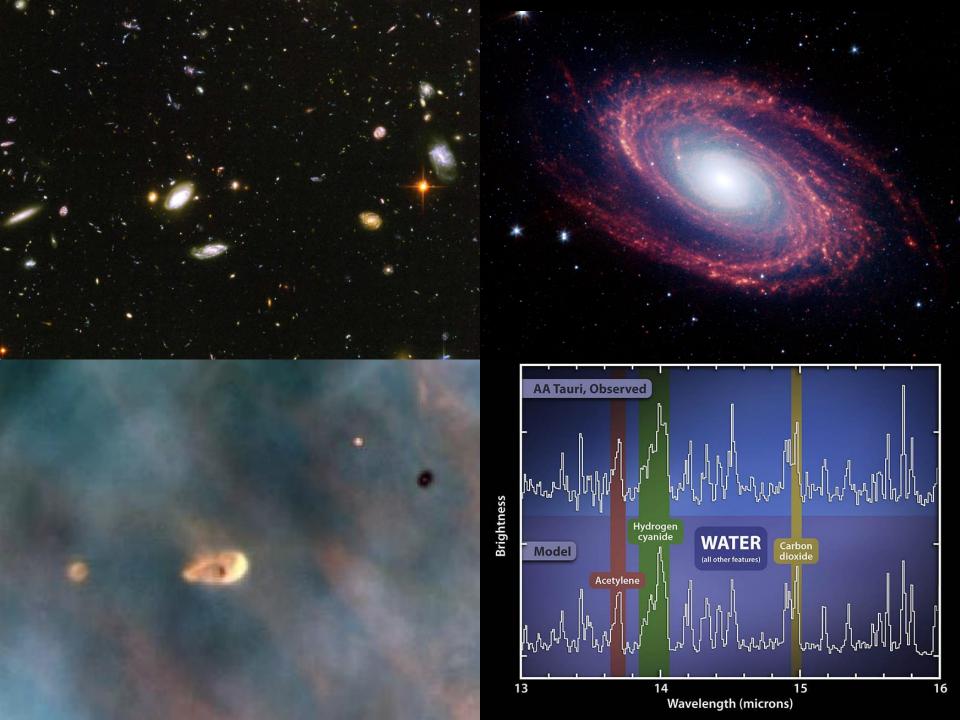
Integrated Science Instrument Module (ISIM) **Primary Mirror** 

Secondary Mirror

Spacecraft Bus

**5 Layer Sunshield** 

- Complementary: 30m, ALMA, WFIRST, LSST
- NASA + ESA + CSA: 14 countries
- Lead: Goddard Space Flight Center
- Prime: Northrop Grumman
  - **Operations: STScl**
- Senior Project Scientist: Nobel Laureate John Mather
- Launch date: October 2018



# NIRCam

NIRCam: Imaging 0.6 – 5.0 µm Broad, med & narrow 10 sq. arcmin FOV 65 mas resolution Coronagraphy

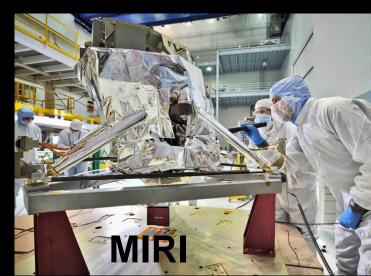
FGS/NIRISS: Guiding Slitless spectroscopy (R~150) Exoplanet transits (R~750) Non-redundant mask



MIRI: 5 – 28.5 µm 2 sq. arcmin FOV IFU R~3000 Coronagraphy

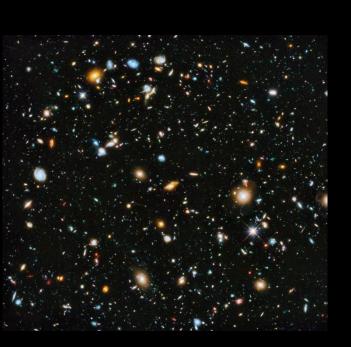


NIRSpec: Multi-object: 10 sq. arcmin IFU: 3x3 arcsec R~100, R~1000, R~3000



Model-Dependent Rule of Thumb: Deep NIR Surveys

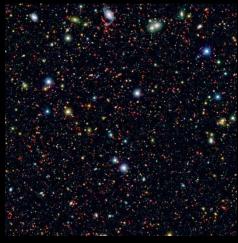
- Ultra-deep, deep and deep-wide imaging surveys:
  - JWST will do at z~12 what HST is doing at z~6
  - JWST will do at z~17 what HST is doing at z~9



UDF

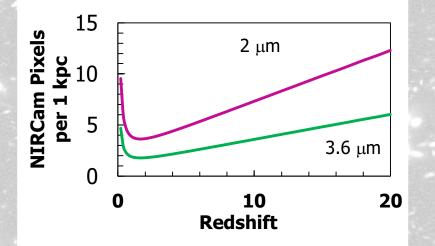






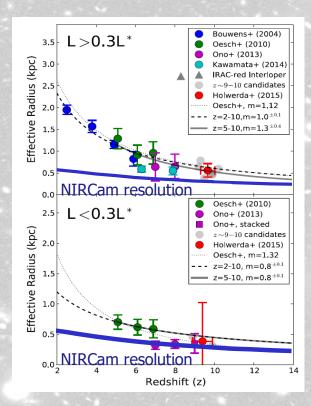






JWST + NIRCam have enough resolution to study the structure of distant galaxies. The plots at right show the two-pixel resolution at 2 microns. NIRSpec MSA slit at 0.2"x0.4" is well-matched to galaxy sizes.

#### **Angular Resolution**



Holwerda et al. 2015 ApJ, 808,6

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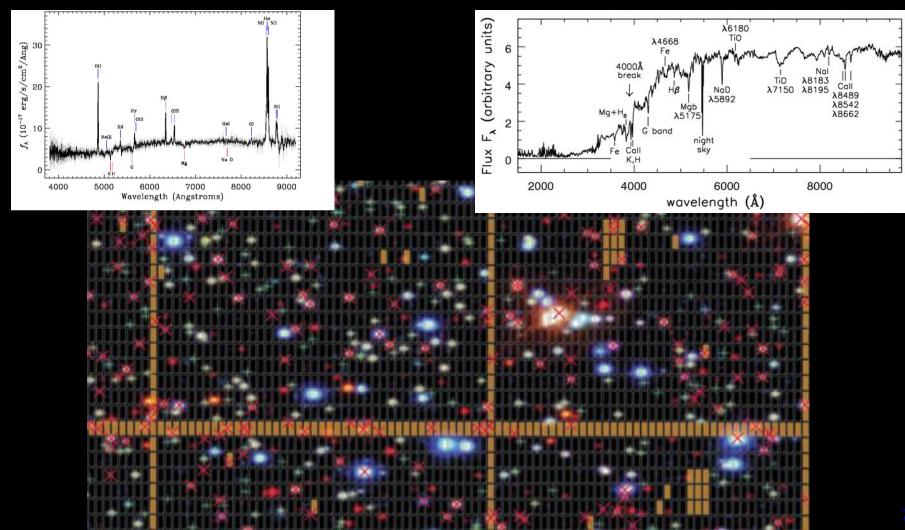


STScI



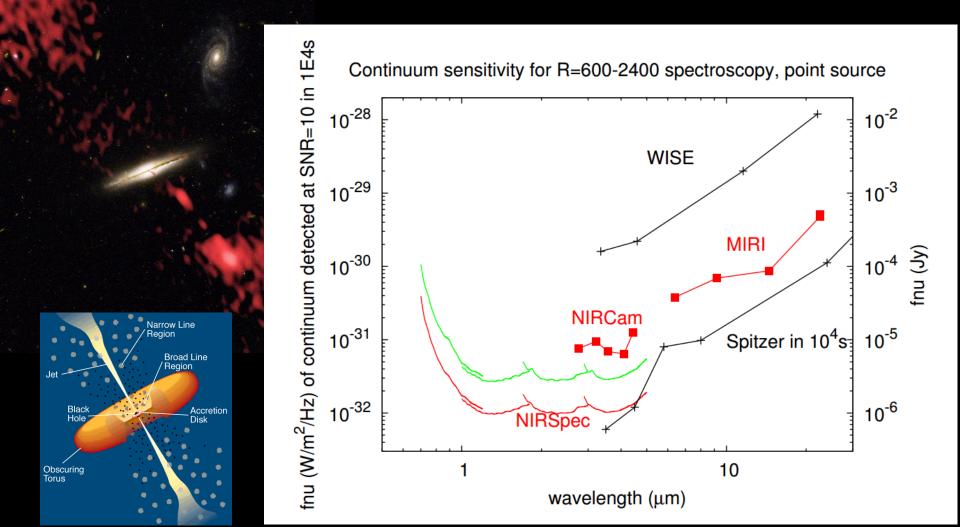
### Model-Dependent Rule of Thumb: MOS

- JWST's multi-object spectrograph will have a huge impact on galaxy evolution science
  - Full rest-frame optical spectrum from z~1 to z~6.
  - Up to ~100 sources at a time (or more).



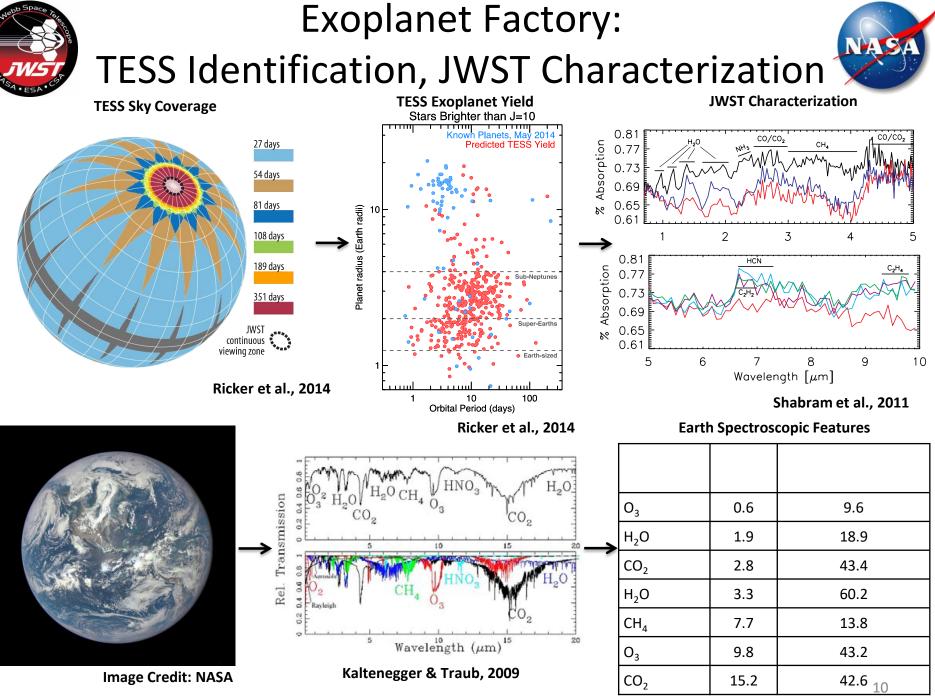
#### Model-Dependent Rule of Thumb: MIR spectroscopy

- JWST can easily get an R~3000 IFU spect of any WISE source
- JWST can get a spectrum of almost any Spitzer detection





The Eagle Nebula as seen in the infrared



Adapted from Kaltenegger & Traub, 2009

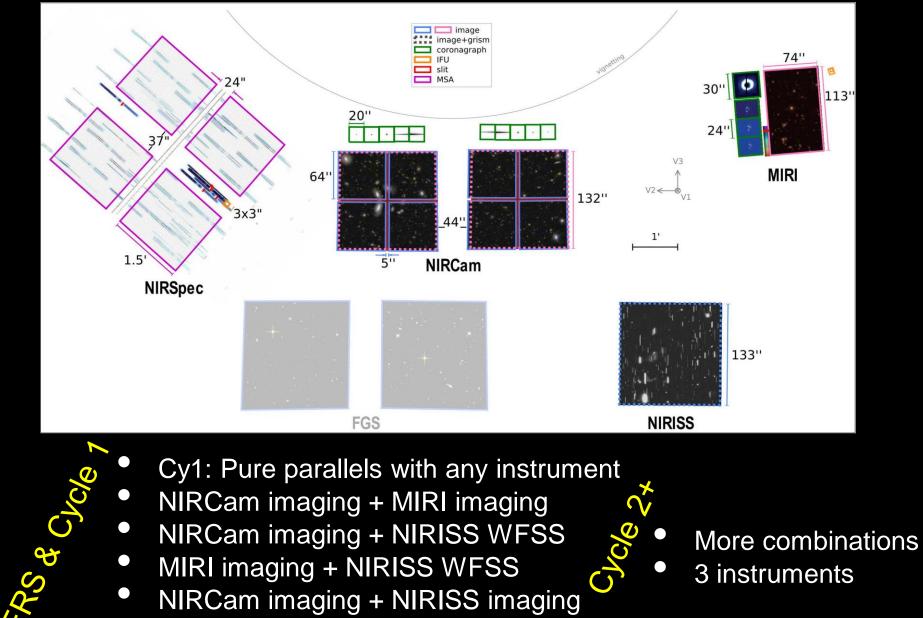
### **FGS/NIRISS**

NIRSpec

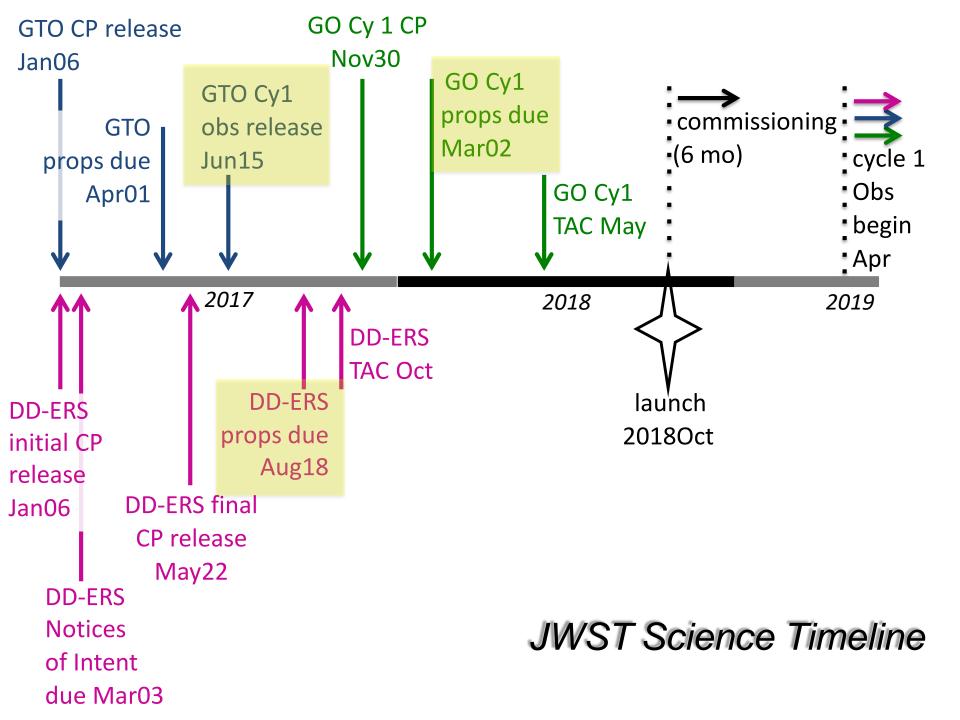
### MIRI

# NIRCam

# Parallels



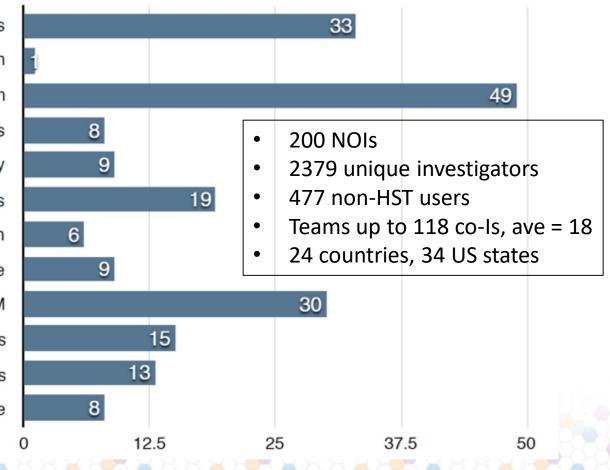
NIRSpec MOS + NIRCam imaging



# DD ERS NOI Topics



JWST DD-ERS Science Categories (Notices of Intent)



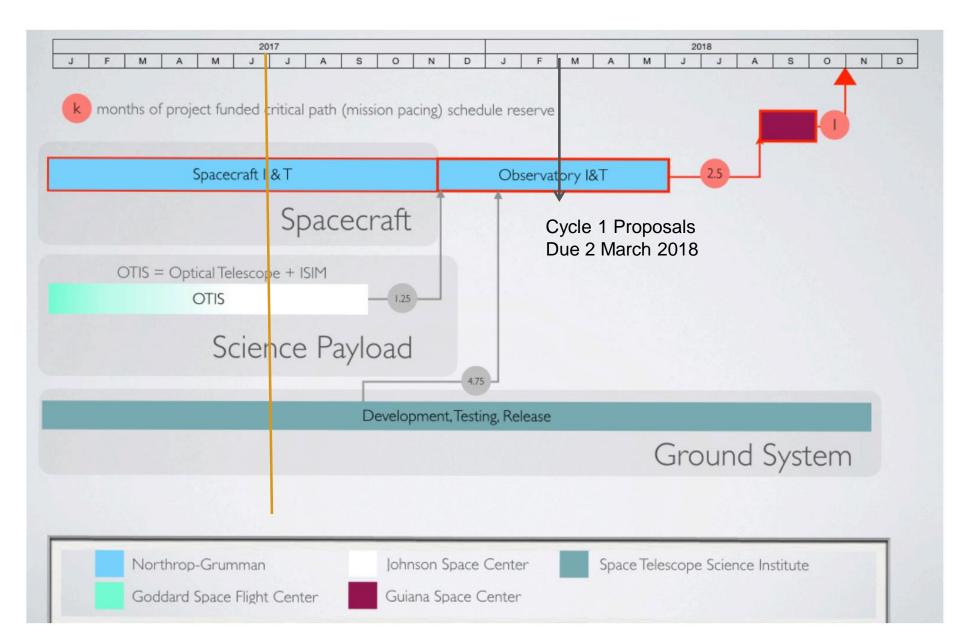
AGN/QSO/Black holes Calibration Galaxy Assembly and Evolution Galaxy Clusters High Redshift Universe and Cosmology Planet formation: Exoplanets and Disks Solar System Star Clusters and Galactic Structure Star Formation and the ISM Stars Stellar Populations Supernovae

STScI

## GTO reserved observation list released 15 June

- <u>https://jwst-docs.stsci.edu/display/JSP/JWST</u>
  <u>+GTO+Observation+Specifications</u>
- Duplication policy:
  - Purpose is to not take the same data twice
  - Reserved observations, not science or targets
    - Same RA & dec and same instrument mode
    - Within a factor of x4 in exposure time
  - MSA: duplications are determined slit-by-slit. OK to propose same field center.
  - Scientifically justified duplications are OK

# **Simplified Schedule**

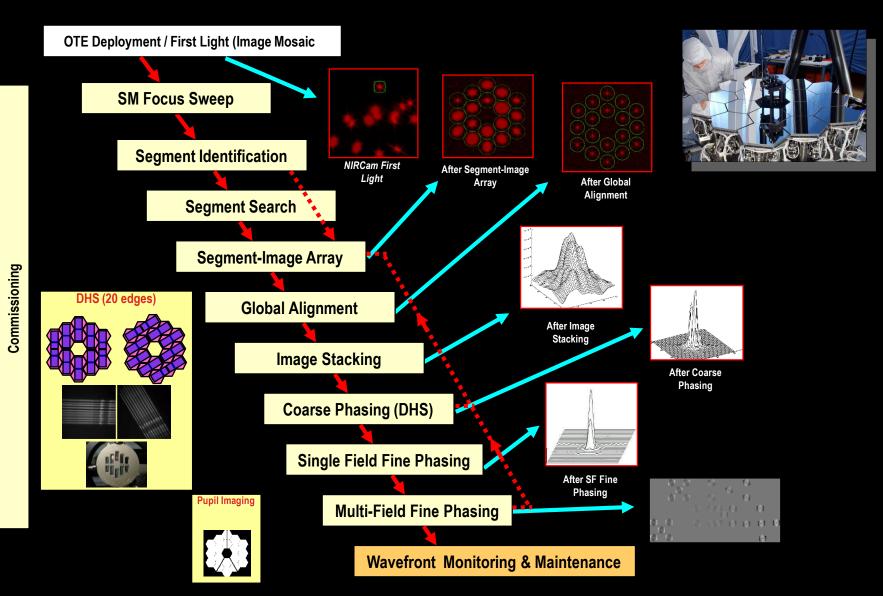


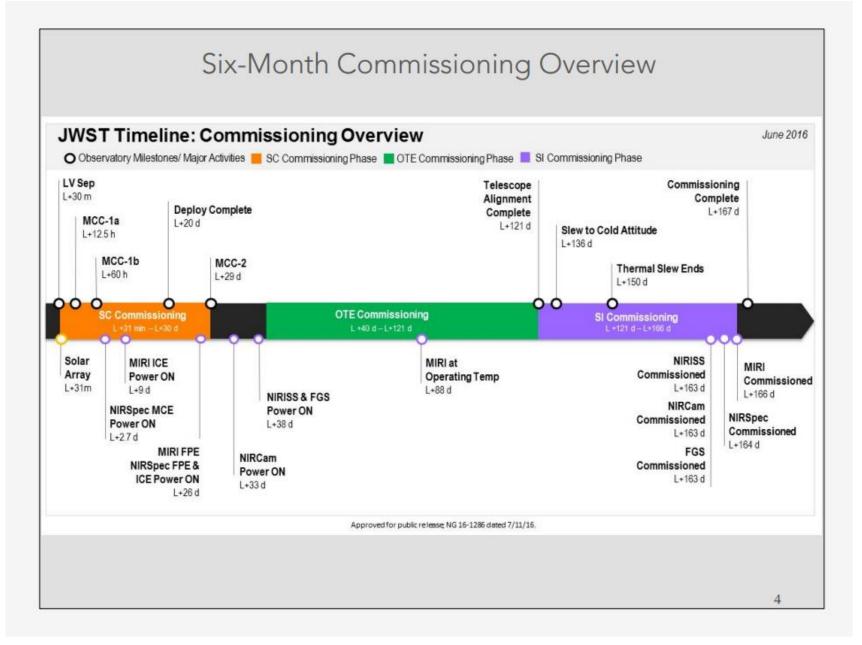




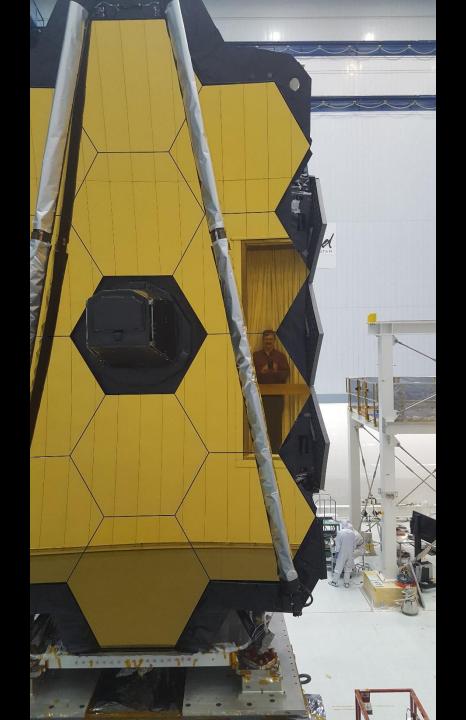
# Wavefront Sensing and Control







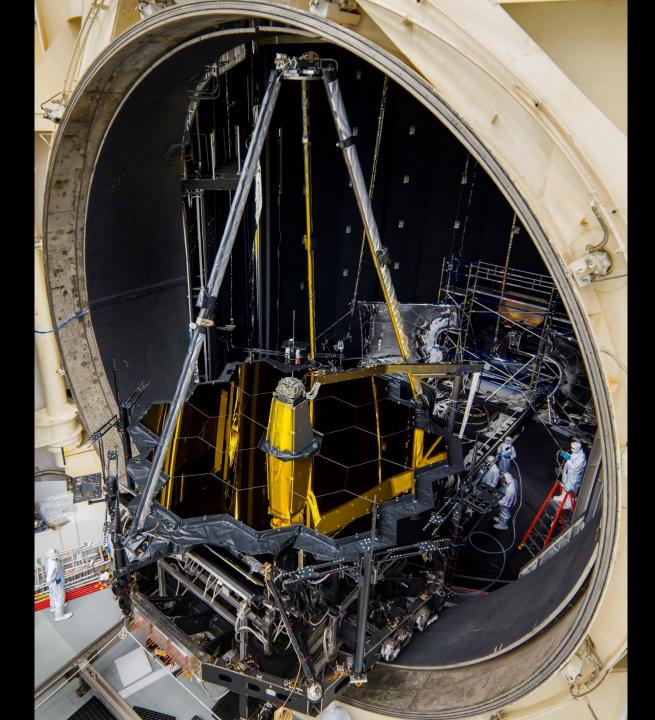


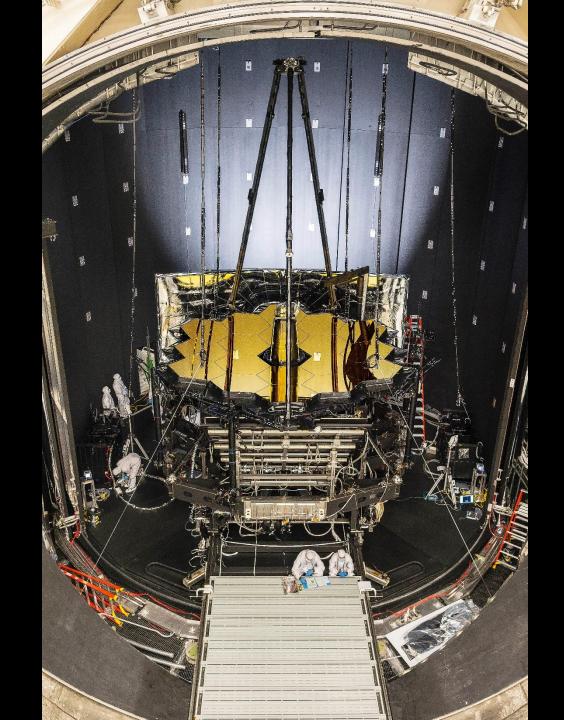














# **Spacecraft and Sunshield**



# Want to Learn More about JWST?

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#### SPACE SCIENCE REVIEWS

#### THE JAMES WERB SPACE TELESCOPE

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Gardner et al. 2006, Space Science Reviews, 123/4, 485 http://jwst.nasa.gov/scientists.html



#### 2011 Baltimore



**JWST** Conferences On-line

2015
Noordwij

White Papers: JWST in Decadal Survey Solar System Objects Dark Energy **Transiting Planets** Coronagraphy **Planetary Systems Stellar Pops** Star Formation Galaxy Assembly First Light Astrobiology **Scientific Capabilities Observation Planning** 

Science White Papers http://www.stsci.edu/ jwst/science/whitepapers/

#### Annual Sessions at AAS and SPIE meetings

# JWST Workshops and Conferences

- Enabling Transiting Exoplanet Observations with JWST
  - July 10 12, 2017 Baltimore, MD
- Spectral Diagnostics to Explore the Cosmic Dawn with JWST
  - July 31 August 2, 2017 Baltimore STScI
- JWST ESAC Workshop Mastering the Science Instruments and the Observing Modes of JWST: Get Set
  - October 4 6, 2017 Madrid, Spain ESAC
- Planning Solar System Observations with JWST STScI venue
  - November 13 15, 2017 Baltimore STScl
- JWST Proposal and Planning Workshop
  - December 11 15, 2017 Pasadena, CA
- Planning Solar System Observations with JWST ESTEC venue
  - December 13 15, 2017 Noordwijk, Netherlands ESTEC
- American Astronomical Society 231st Meeting
  - January 7 11, 2018 National Harbor, MD

https://jwst.stsci.edu/science-planning/workshops-and-lectures/jwst-workshops

Most workshops will allow electronic participation.

#### Latest News jwst.nasa.gov **Project Milestones** updated monthly Bookmarks • 🎪 Access Launchpad, same as NAMS (+31) 🛣 jpgardne 🕌 Save 🥝 Generate 🏠 Hong EXPLOYE WEBB SPACE TELESCOPE NASA **Social Media** Recent Ac What's Next? NEV Recent Accomplishments + www.stsci.edu/jwst ABOUT THE WEBE SCIENCE INSTRUMENTS Updated June 9, 2017 FEATURES Search IMAGES & VIDEOS SPACE TELESC OPE SCIENCE INSTITUTE **View Status:** MEET THE TEAM FOR SCIENTISTS News and Future Missions and About Data Research Events The following tables contain Home Archives Education Initiatives Support FOR JUCATOR project accomplishments. The date co OR PRESS indicate the following: James Webb Space Telescope GREEN JWST SOCIAL MEDIA BLACK **IWST Software** then Dies RSS will be updated approximately every month JWST Overview WebbPSE: The program Webb SF models Point Spread Functions for the James Webb Space Telescope, using predicted Advisory Committee The image to the right points out various majo wavefronts based on the optical quirements and error budgets for the telescope and instruments. WebbPSF can produce hardware components of the observatory referred to in Science monochromatic and broadband F is for all instruments in direct imaging and coronagraphic modes; spectroscopic modes are not the tables to orient the reader (click '+' to expand) vet supported Zoom in to see the JWST's subsystems **Optical Telescope** You can also explore the spacecraft in more detail with (image credit: STSci) or launch the JWST 3d Element the JWST Interactive 3d Model (requires Flash plugin). Model for more detail. Astronomer's Proposal Tool: APT the operational tool for writing HST proposals and it is being modified to also write JWST Instruments proposals. You can download the current operational version of APT here and look at the current draft version for JWST by Instagrat clicking on File>New>New JWST Propo I. Note that at this point the observation templates generally reflect what has been developed for the on board scripts and necessarily all planned functionality. Software Tools JWST Prototype ETC: This JWST prototy Exposure Time Calculator (ETC) is a web-based application that assists users in exploring JWST's science capabilities. The calculates Signal-To-Noise Ratio (SNR) for a given exposure time and for JWST's Glossary science instruments Meetinas

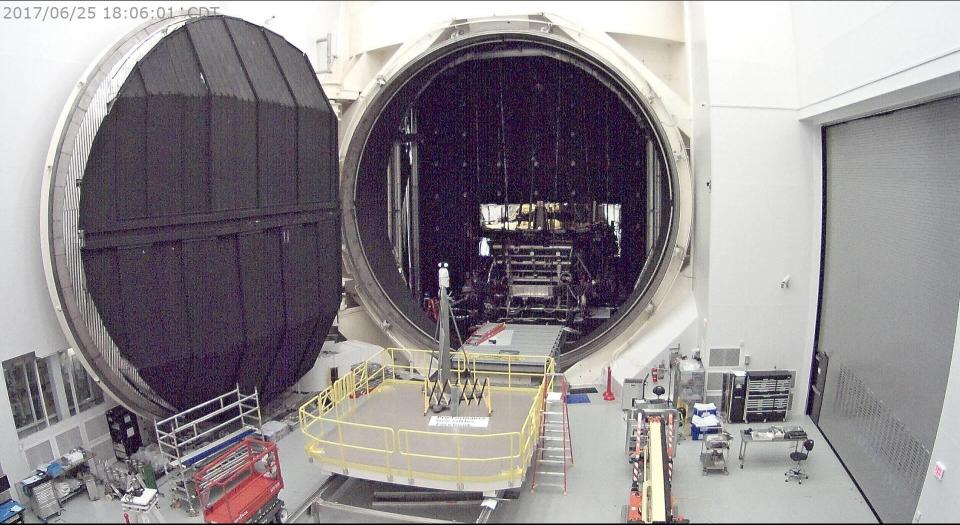
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#### **Astronomy Software Tools** ETC, PSF, APT

Intranet

#### Webbcam

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Live update every 60 seconds http://jwst.nasa.gov/webcam.html.

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