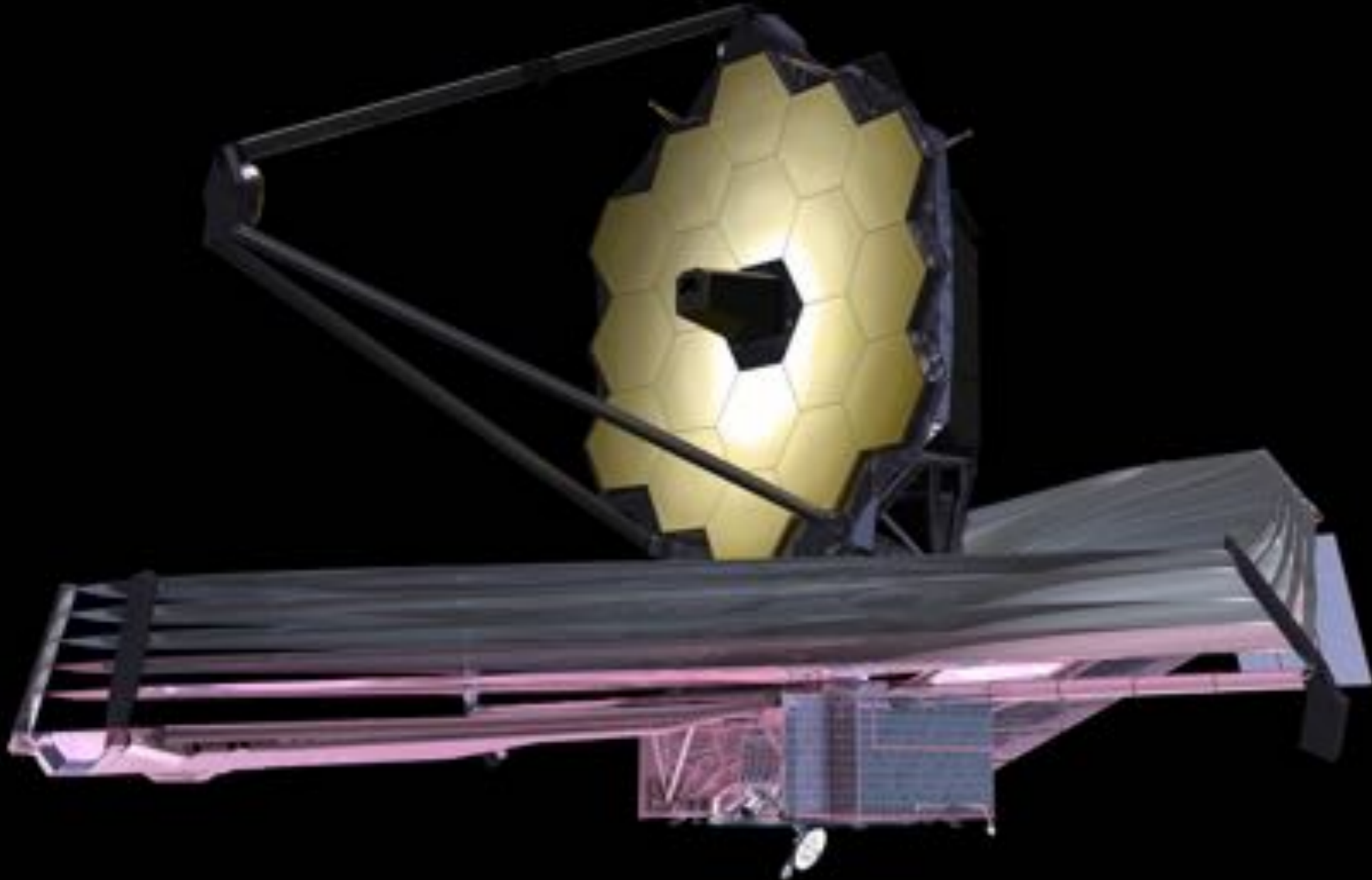


JAMES WEBB SPACE TELESCOPE



**PLANNED LAUNCH:
30 MARCH 2021**

Proposal Planning for the James Webb Space Telescope

An artist's conception of the James Webb Space Telescope (JWST) in space. The telescope is shown from a perspective that highlights its large, yellow, multi-layered sunshield, which is partially deployed. The main telescope structure is long and thin, with a complex arrangement of mirrors and instruments. The background is a dark, star-filled space.

Dana Anderson & Christian Eistrup

ASTR 8500

February 11, 2020

Artist conception from NASA



The Hubble Space Telescope successor

Introduction to JDox

<https://jwst-docs.stsci.edu>



James Webb Space Telescope User Documentation

Home Quick Links Search

Proposing Opportunities

- JWST Opportunities and Policies
- › Cycle 1 Call for Proposals
- Early Release Science Call for Proposals
- › Guaranteed Time Observations Call for Proposals
- › Science Policies

Proposal Preparation

Home

JWST User Documentation Home

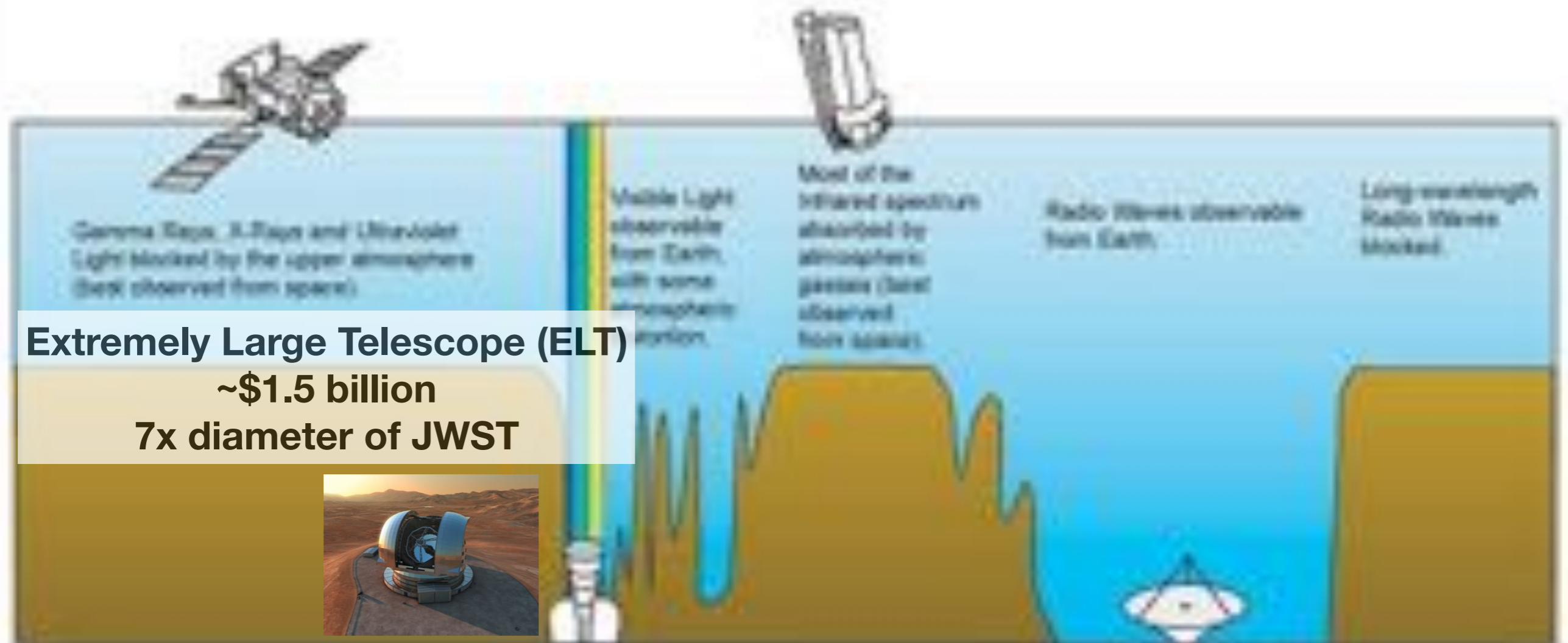
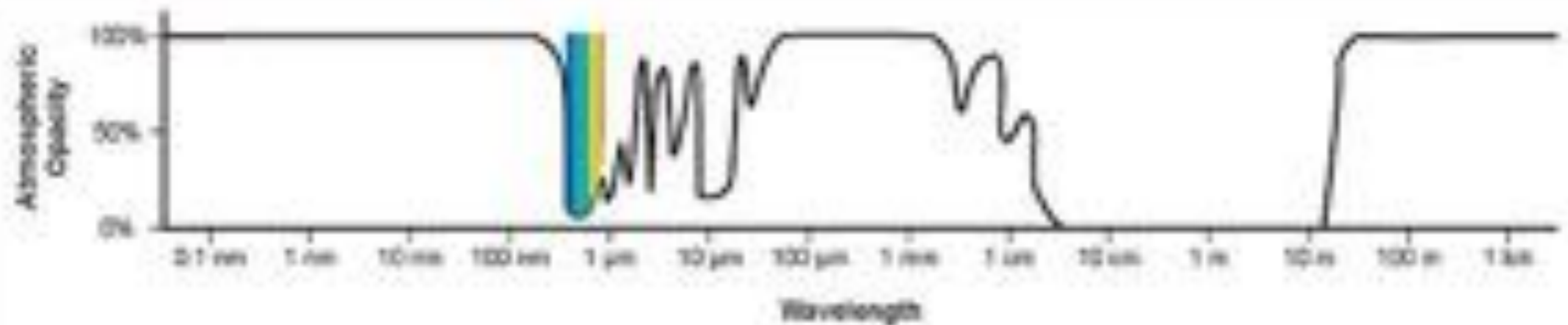


Release Information:

Release Date	January 23, 2020
Cycle	1
APT Version	2020.1.1
ETC Version	1.5.1 (after Jan. 27, 2020)

About JDox

Space vs. Ground Telescopes



Extremely Large Telescope (ELT)
~\$1.5 billion
7x diameter of JWST

History of Space Missions

.....
Cold War

1837

Discussions of
Moon-based
observatory

1965-1968

Soviet Proton
program

1968-1972

NASA sent the Orbiting
Astronomical Observatory
(OAO) satellites

1946

Lyman Spitzer
proposed sending a
large telescope to
space

1970s-1980s

Post-Apollo era, more effort was
focused on space observatories
and by more nations

.....
Lyman Spitzer lobbied US Congress

History of Space Missions

1983 IRAS



2009

Herschel

WISE

Planck

Kepler

2013 Gaia

2015 LISA Pathfinder

2018 TESS

1990-2003

“NASA’s Great Observatories”

CGRO



Chandra



Hubble



Spitzer



Upcoming: JWST

>15,000
publications
from Hubble

Gamma

X-ray

Ultra-
violet
(UV)

Infrared
(IR)

Radio

Originated 1996:
Next Generation Space Telescope
(NGST)
2002-: JWST

Collaboration among NASA,
European Space Agency and
Canadian Space Agency



Administrator: 1961-1968

Space Race

Named after NASA's
2nd Administrator

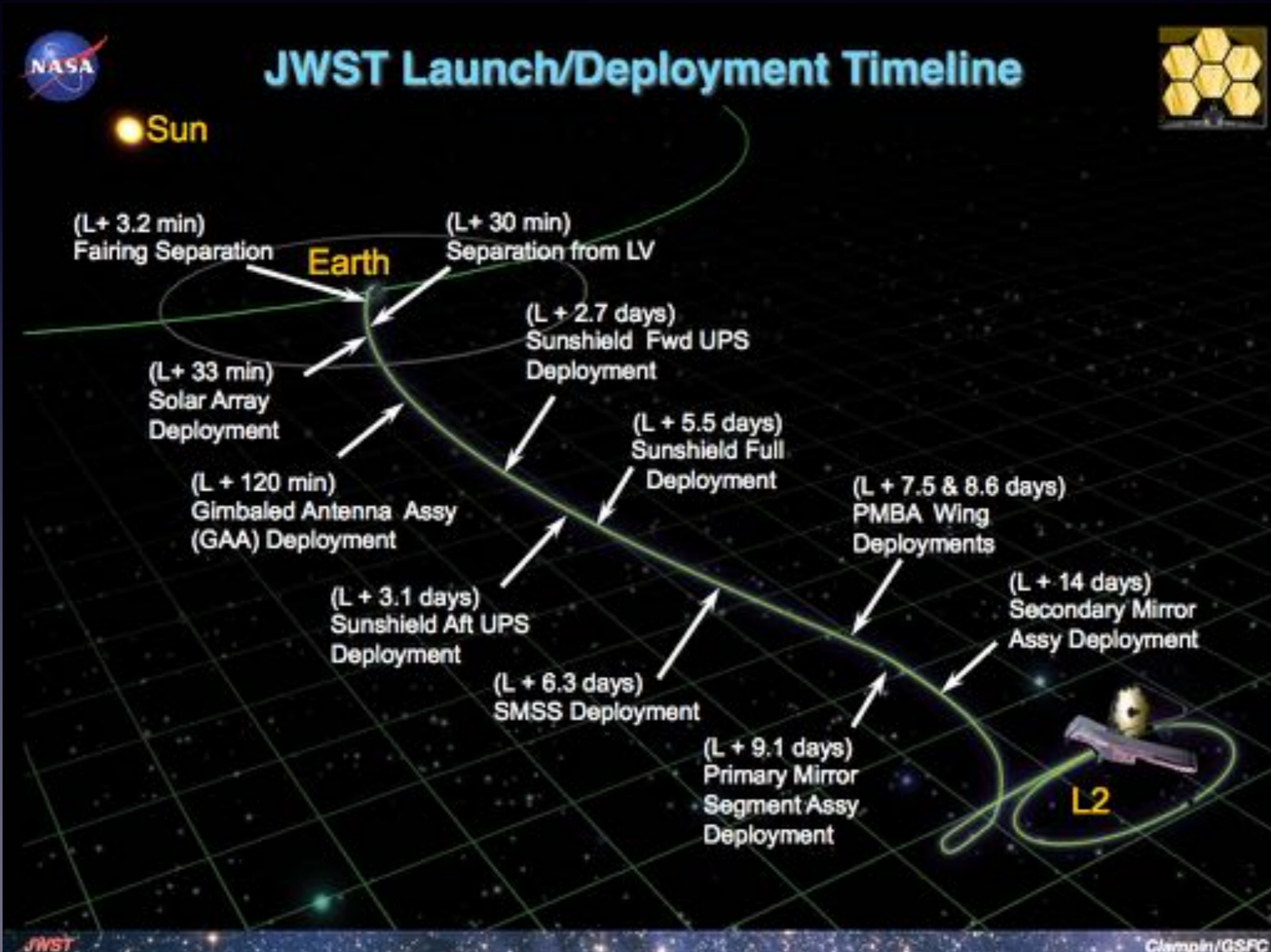
Designing and building it

Year	Planned launch	Budget Plan (Billion USD)
1997	2007 ^[75]	0.5 ^[75]
1998	2007 ^[80]	1 ^[50]
1999	2007 to 2008 ^[81]	1 ^[50]
2000	2009 ^[38]	1.8 ^[50]
2002	2010 ^[82]	2.5 ^[50]
2003	2011 ^[83]	2.5 ^[50]
2005	2013	3 ^[84]
2006	2014	4.5 ^[85]
2008, Preliminary Design Review		
2008	2014	5.1 ^[86]
2010, Critical Design Review		
2010	2015 to 2016	6.5 ^[citation needed]
2011	2018	8.7 ^[87]
2013	2018	8.8 ^[88]
2017	2019 ^[89]	8.8
2018	2020 ^[90]	≥8.8
2018	2021 ^[91]	9.66

10 years out

Now: 1 year out

Getting out there

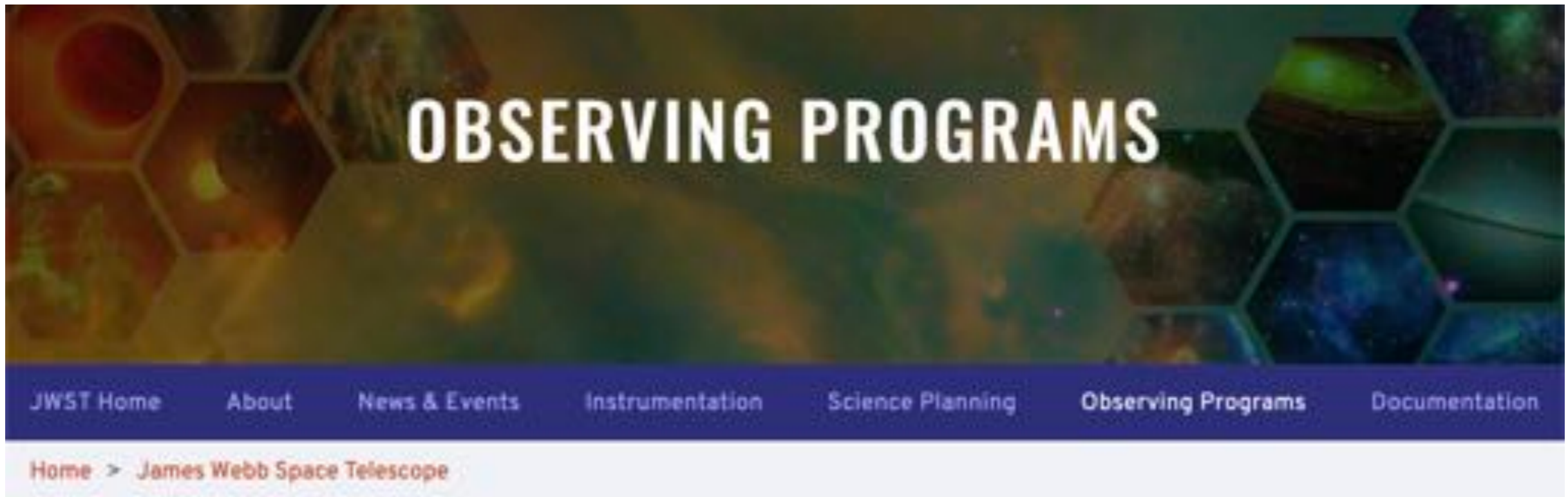


Science goals

- The primary aim is to examine the first light in the Universe - those objects which formed shortly after the Big Bang.
- Further aims include: looking at how galaxies form and evolve, studying the birth of stars and planets, looking at our own Solar System, and studying the properties of exoplanets.

Activity: Select an Observing Program

<http://www.stsci.edu/jwst/observing-programs>



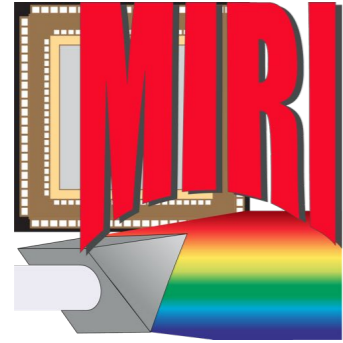
Science Observations with JWST

Learn more about the approved JWST observing programs:

- [Program Information lookup tool](#)
- [Approved ERS programs](#)
- [Approved GTO programs](#)

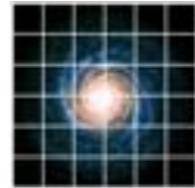


JWST Instruments & Observing Modes



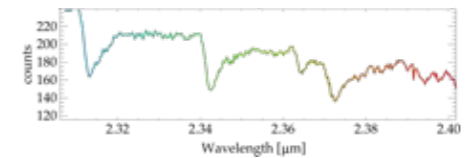
NIRISS

- Imaging



- Time Series Imaging
- Coronagraphy
- Aperture Masking Interferometry

- Spectroscopy

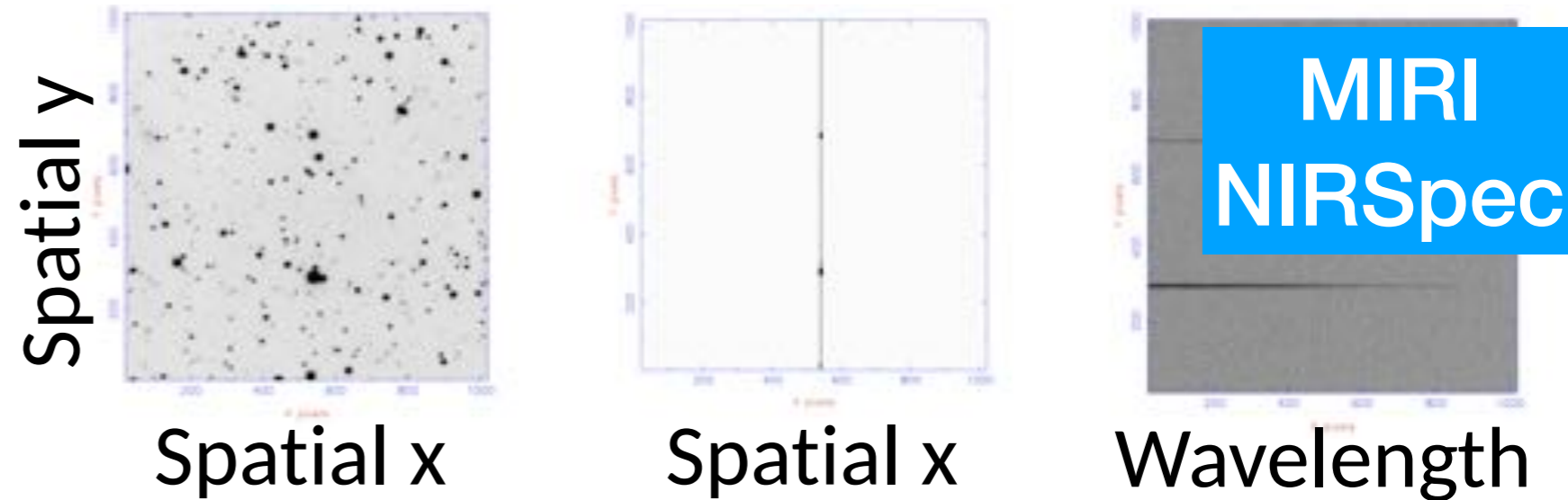
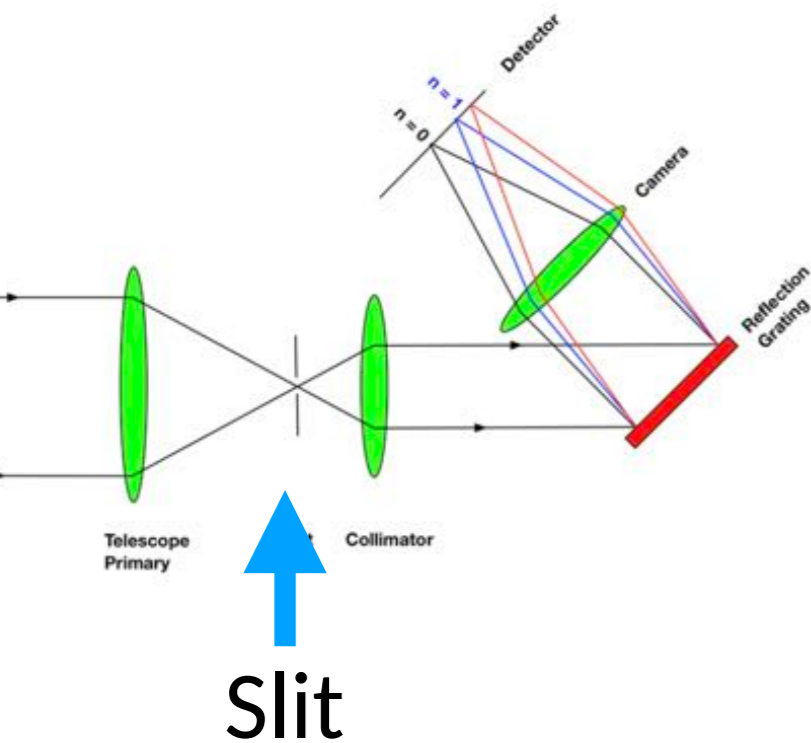


- Integral Field Spectroscopy
- Multi-Object Spectroscopy
- Single-Object & Time-Series Spectroscopy
- Wide-Field Slitless Spectroscopy

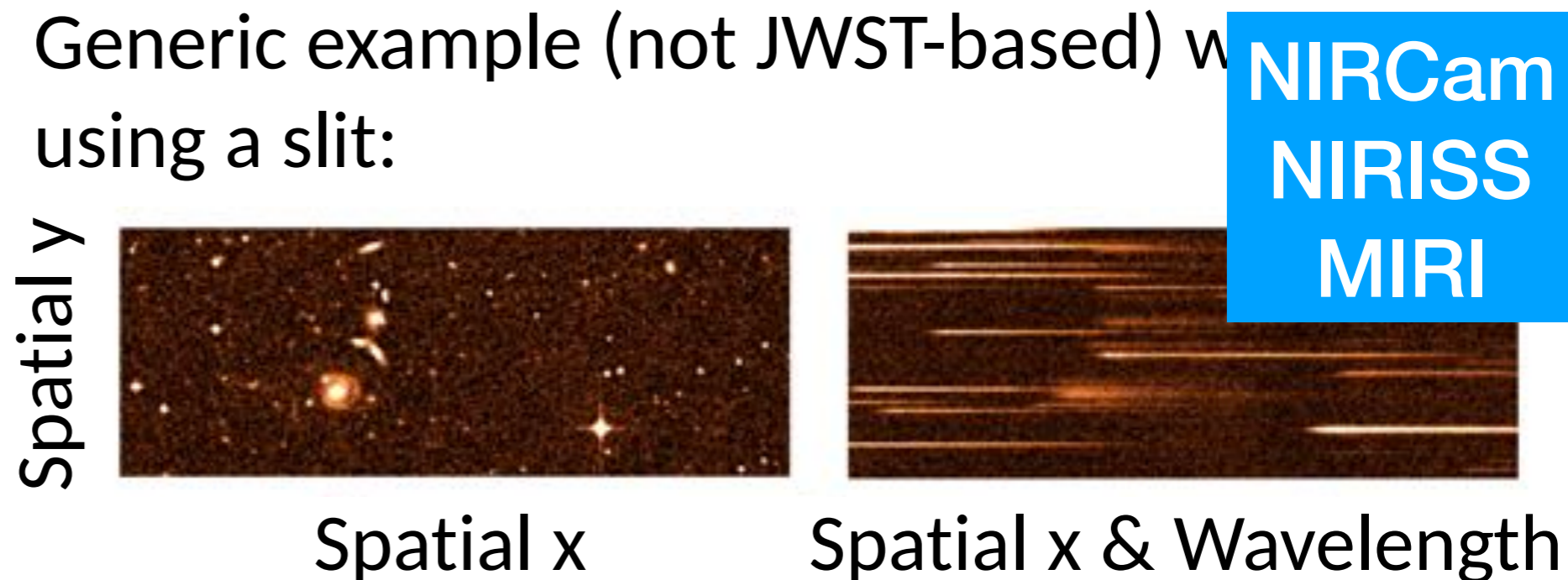
Single-Slit & Slitless Spectroscopy

Generic example (not JWST-based) using a slit:

Generic
(not JWST-based)
spectrograph:



Generic example (not JWST-based) w
using a slit:



Integral Field Spectroscopy

MIRI
NIRSpec

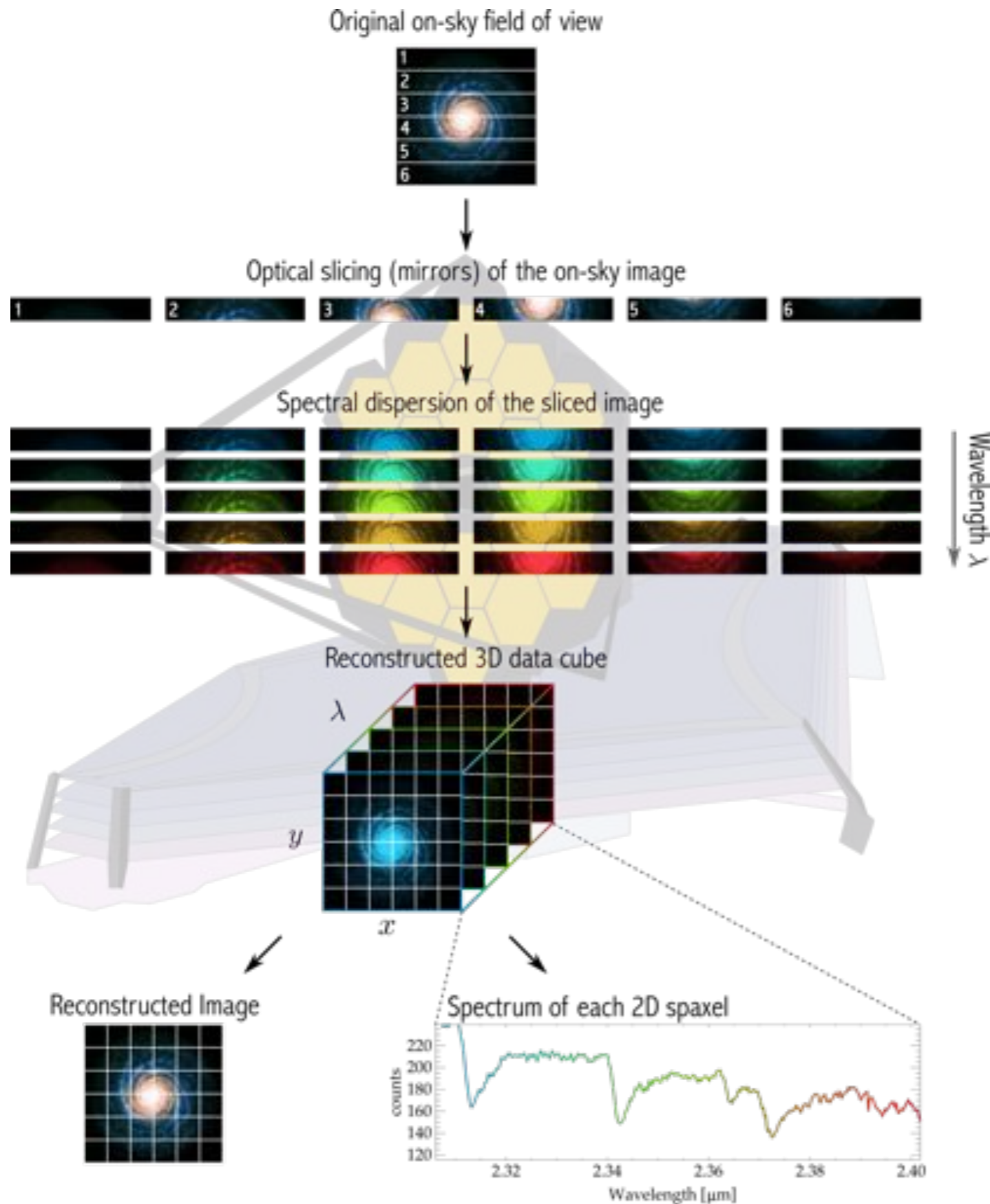
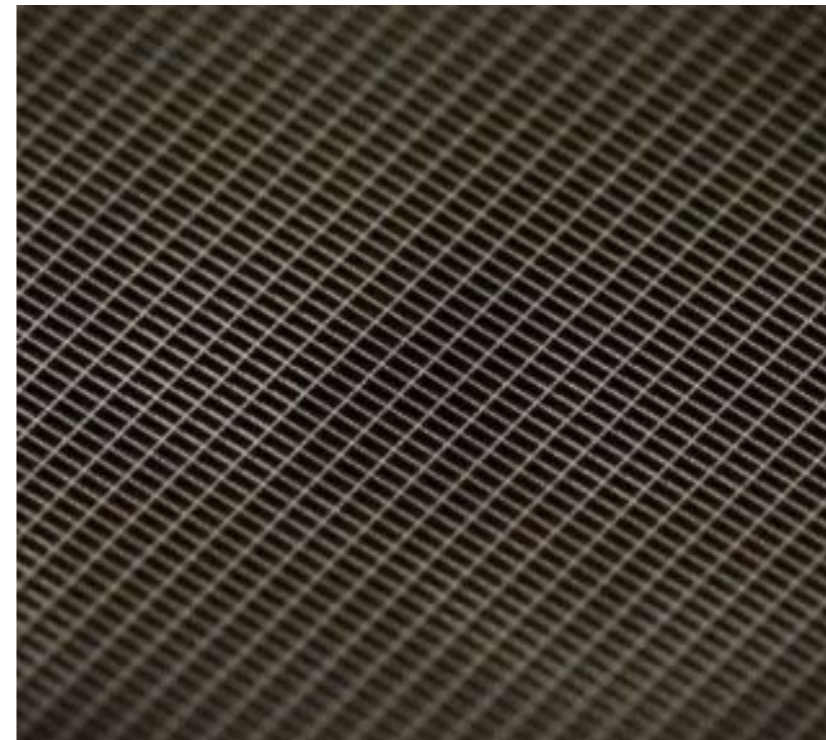
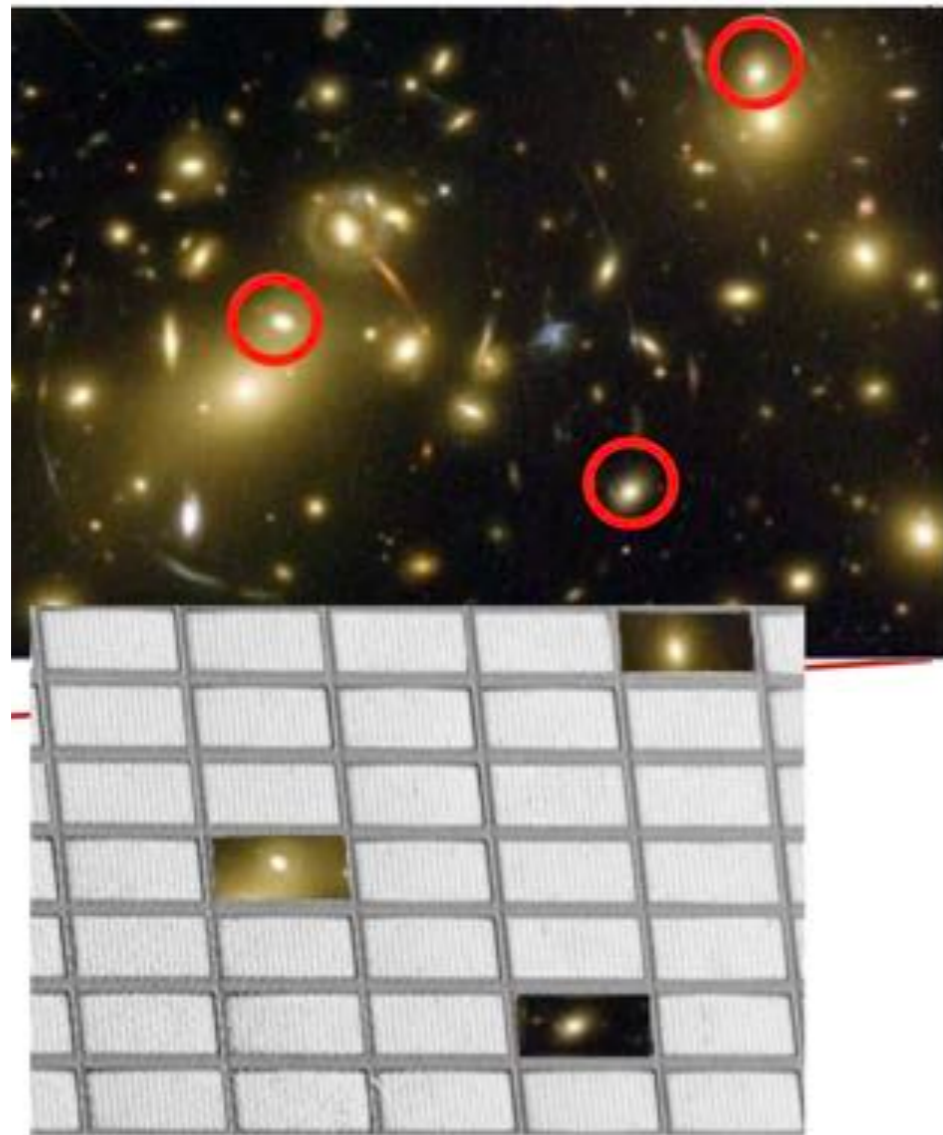


Figure from STScI JDOx

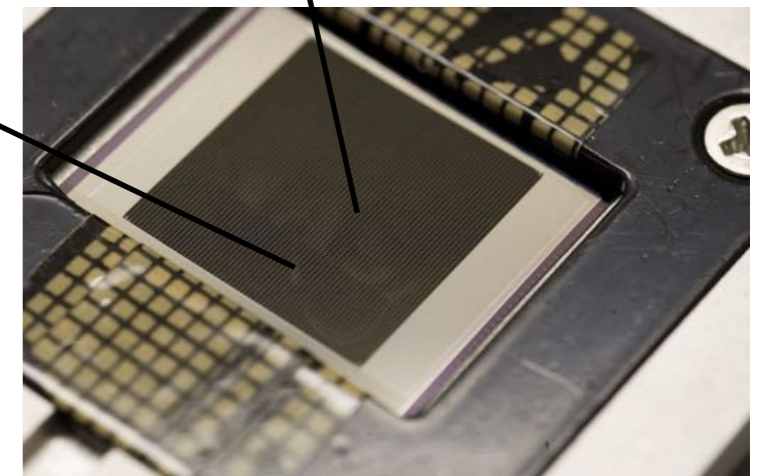
Multi-Object Spectroscopy

Micro-Shutter Assembly (MSA)



NIRSpec

Each shutter is 80 x 180 microns in size



Time Series Observations

- When the duration of an astronomical event is setting the conditions for observations
- NIRCcam, NIRSpec, NIRISS and MIRI all have this mode
- NIRCcam/NIRSpec/NIRISS: $0.6-5\mu\text{m}$
- MIRI: $4.8-28.5\mu\text{m}$
- Different spectral resolving powers
- Different signal/noise achieved for same observing time

NIRISS Single Object Slitless Spectroscopy

The image is a screenshot of a web browser displaying the James Webb Space Telescope User Documentation website. The browser's address bar shows the URL: jwst-docs.stsci.edu/near-infrared-imager-and-slitless-spectrograph/niriss-example-science-programs/niriss-soss-time-series-observations-of-hat-p-1. The page title is "James Webb Space Telescope User Documentation".

The main content area features a breadcrumb trail: [Home](#) / [Near Infrared Imager and Slitless Spectrograph](#) / [NIRISS Example Science Programs](#) / [NIRISS SOSS Time-Series Observations of HAT-P-1](#). The page title is "NIRISS SOSS Time-Series Observations of HAT-P-1".

The introductory text states: "This goal of this example program is to observe the exoplanet transit of HAT-P-1b, and is based on the GTO program 'NIRISS Exploration of the Atmospheric diversity of Transiting exoplanets (NEAT)'. NEAT is designed to study exoplanet atmospheric composition, energy budget, and dynamics."

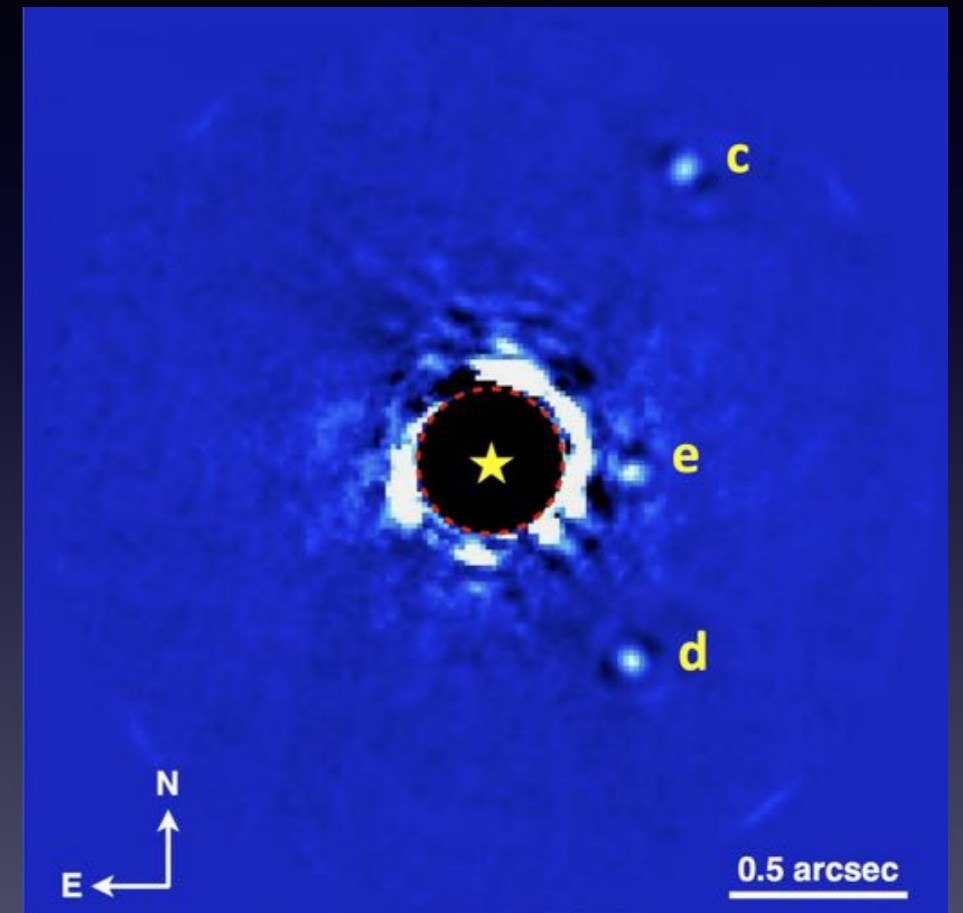
The page includes a section titled "Example Science Program #31" and a "On this page" section with the following list of items:

- [Steps for creating observations](#)
 - [Step 1 - Determine the required wavelength coverage: near-infrared or mid-infrared](#)
 - [Step 2 - Select an instrument observing mode](#)
 - [Step 3 - Determine the readout pattern and subarray configuration](#)
 - [Step 4 - Calculate required exposure configuration using the JWST Exposure Time Calculator \(ETC\)](#)
 - [Step 5 - Use PandExo for more detailed modeling of spectroscopic exoplanet transits](#)
 - [Step 6 - Determine whether target acquisition is required and use the ETC to determine the appropriate strategy](#)
 - [Step 7 - Complete the Astronomer's Proposal Tool \(APT\) template](#)
- [References](#)

The left sidebar contains navigation links under "Proposing Opportunities" and "Proposal Preparation".

Coronagraphy/HCI

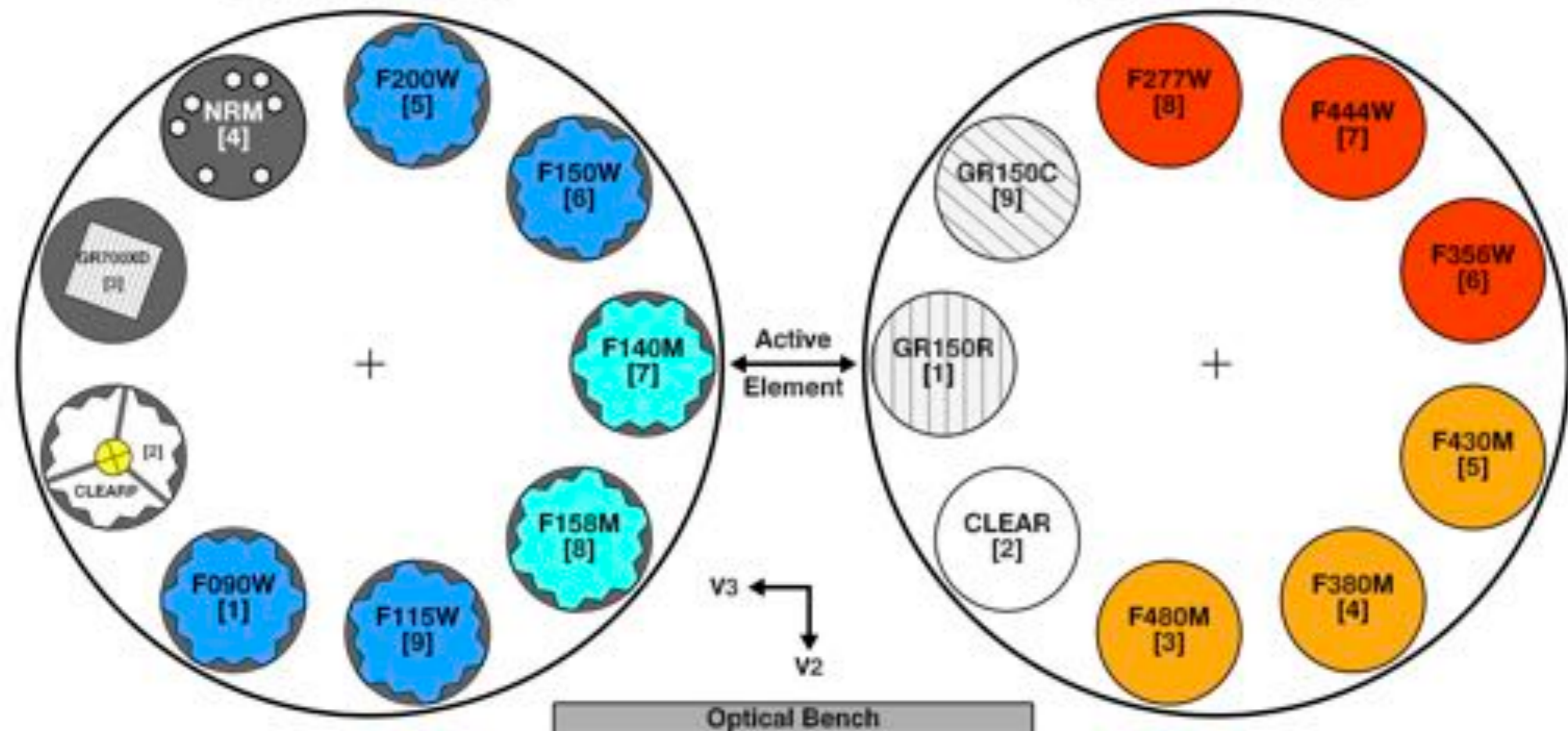
- “Masking out”/removing signal from star
- NIRCam:
Planet/star contrast 10^{-8} - 10^{-7}
- MIRI:
Planet/star contrast 10^{-6} - 10^{-5}



HR 8799 by GPI
Contrast: 10^{-5}

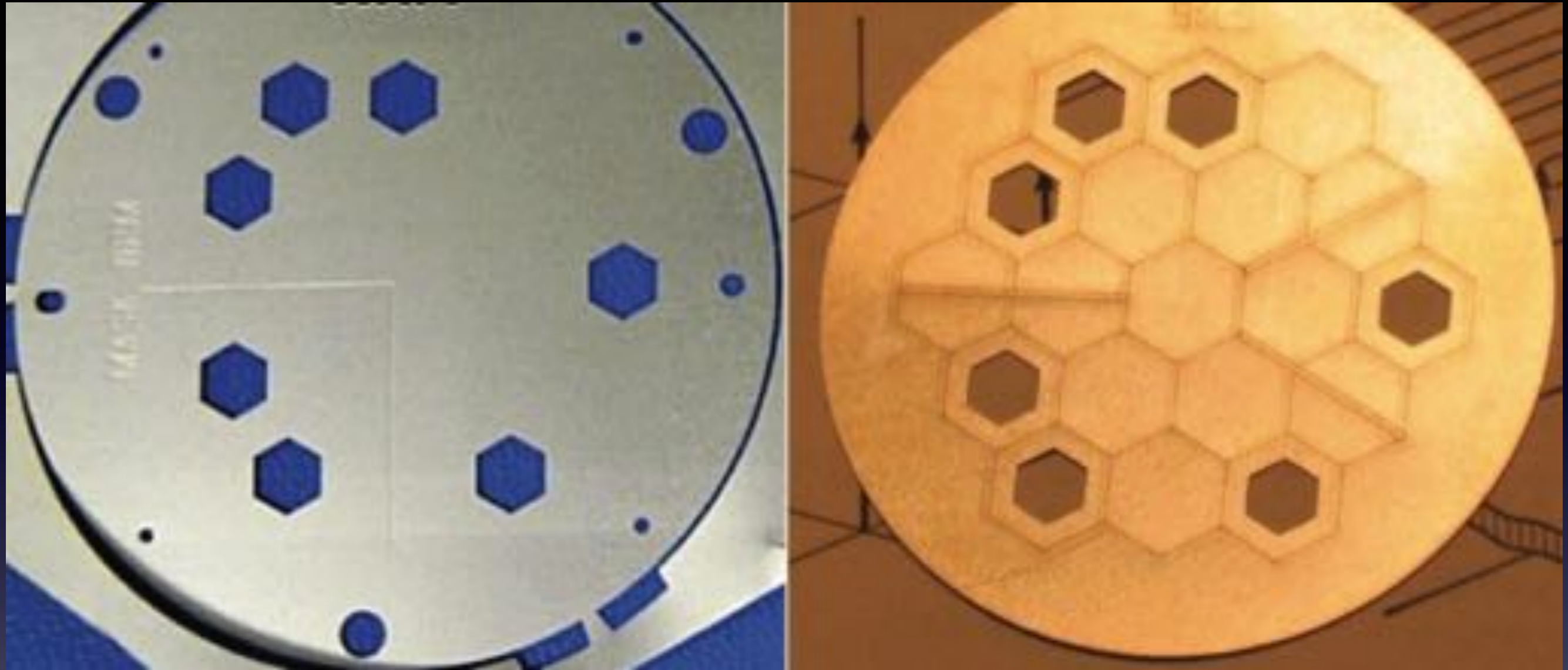
Pupil Wheel

Filter Wheel



Aperture-Masked Interferometry

NIRISS



Aperture-Masked Interferometry

- Transforms JWST into an interferometer like ALMA or VLA
- Light lost, but spatial resolution gained!
- From Rayleigh diffraction limit ($1.22 \times \text{wavelength/diameter}$)
- To Michelson diffraction limit ($\sim 0.5 \times \text{wavelength/diameter}$)

Activity: Exploring Observing Programs

<http://www.stsci.edu/jwst/observing-programs>

1. What are the main science questions that the observations will address?
2. What objects and/or phenomena are being targeted?
3. What instruments and observing modes are used?
4. Can you find a corresponding Example Science Program on JDOx that walks you through the process of setting up similar observations?

JWST General Observing Proposals

What is expected in a proposal?

- **Science case** – motivating questions to address, concrete science goals and observations to address them, why this observatory is necessary to address the questions
- **Observational settings** to achieve goals – sensitivity, spectral/spatial resolution, field of view, overall time of observations
- **Source selection** – select targets, source visibility, check for duplicates
- **Predict observations** – based on previous observations or theoretical models, estimate observing time needed

Brainstorming Proposal Ideas

- **Science case** – What scientific question would you like to answer? What observations could address this?
- **Observational settings** - Imaging? Spectroscopy? Time Series?
- **Source selection** – What types of sources would you need to observe?
- **Predict observations** – What information or models would you need to make predictions?

JWST Proposal Roadmap

Pick instrument(s) and observing mode(s)



Determine target visibility



Check for duplicates



Determine exposure settings using the Exposure Time Calculator (ETC)

Set up proposed observing program in the Astronomer's Proposal Tool (APT)



Prepare your proposal document



Scientific justification

Technical justification



Time Allocation Committee (TAC) meets



Accepted proposals:

Optimize settings with STScI

(US Investigators) Apply for funding in Oct. 2020

Get Involved with JWST

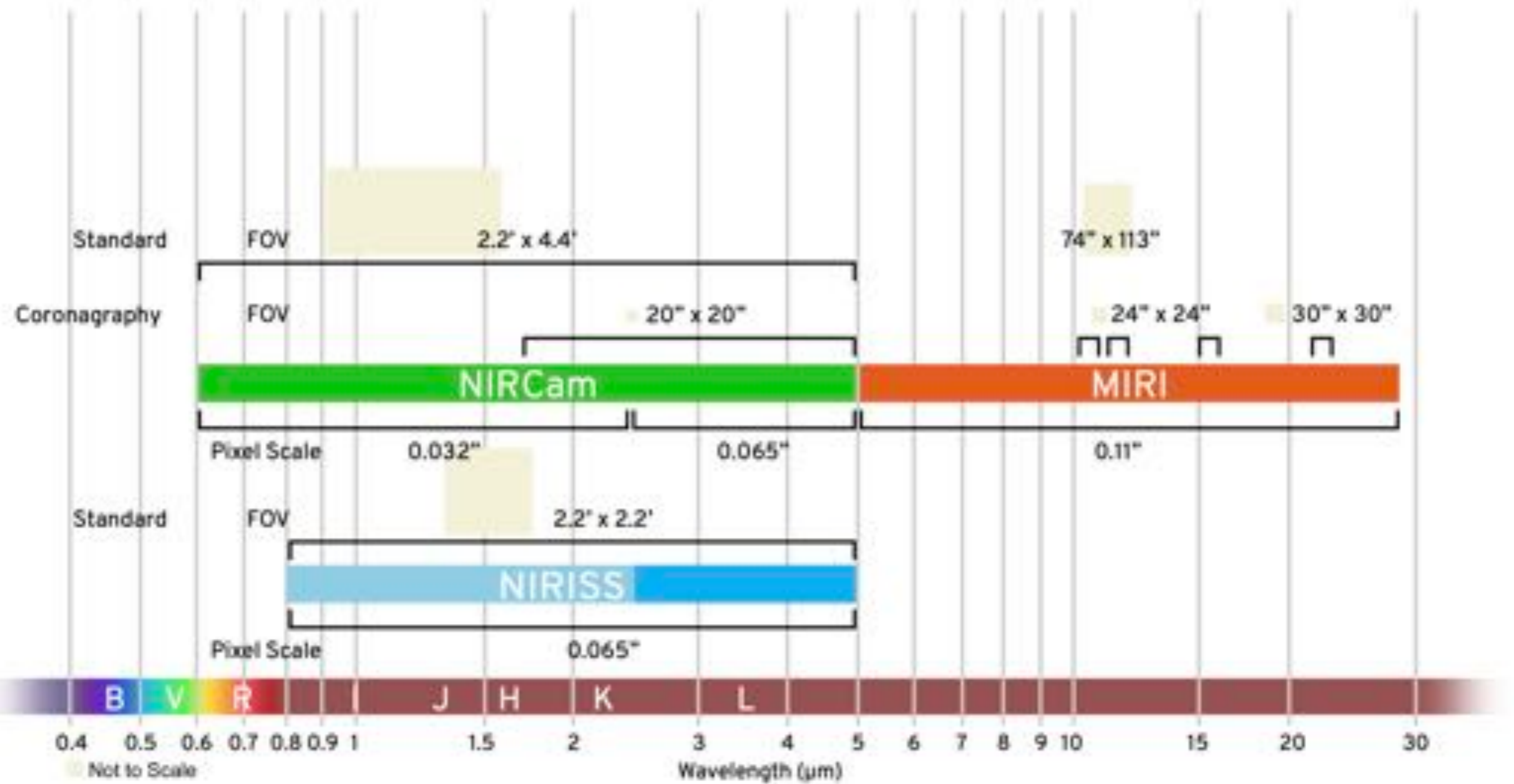
Resources:

- STScI Website & JDox

How to get involved:

- Talk to your advisors & mentors about opportunities to get involved with JWST
- NRAO/UVA Proposal Planning Workshop
 - Dates: Feb. 18 & 24 (Registration deadline tomorrow)
 - <http://people.virginia.edu/~da4vn/jwst.html>

Imaging Modes



Spectroscopy Modes

