



STScI | SPACE TELESCOPE
SCIENCE INSTITUTE

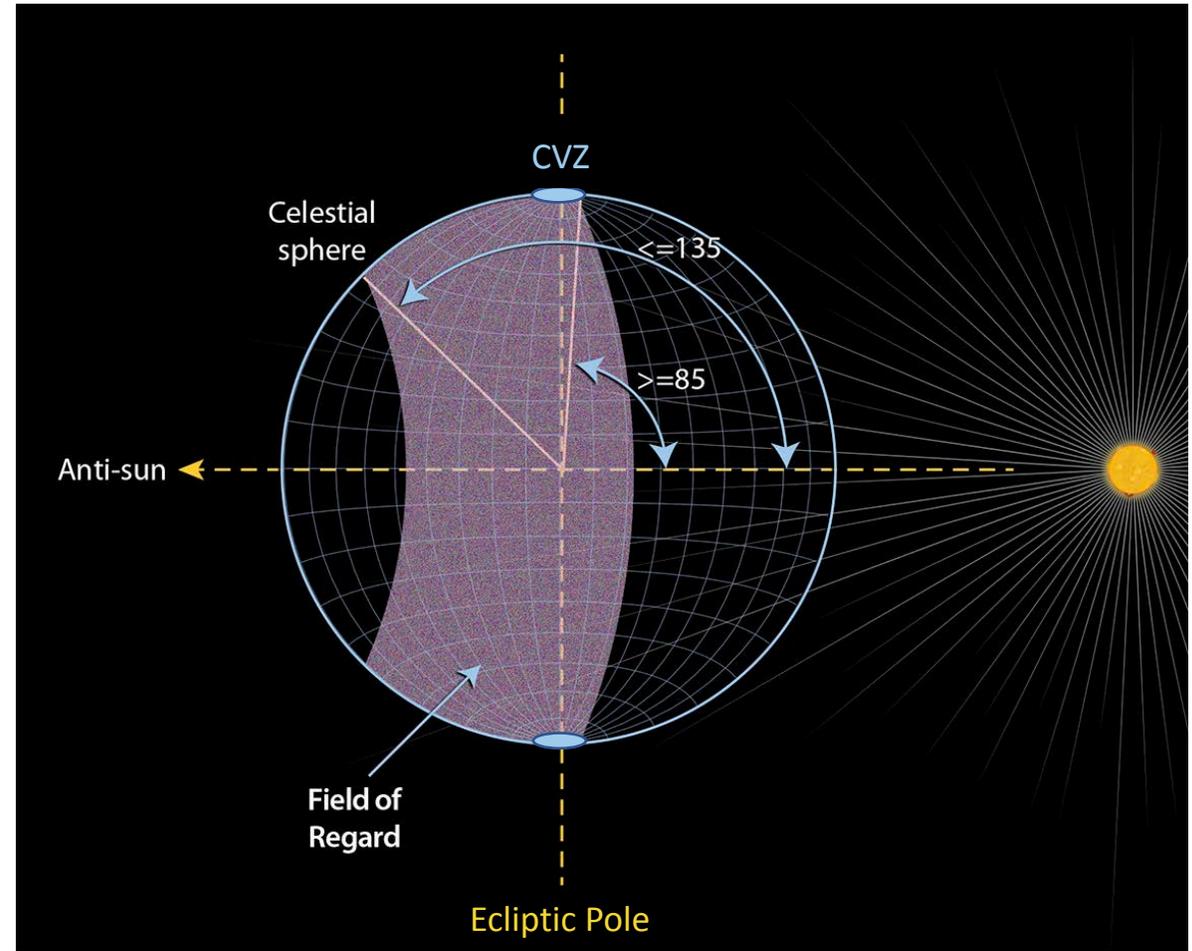
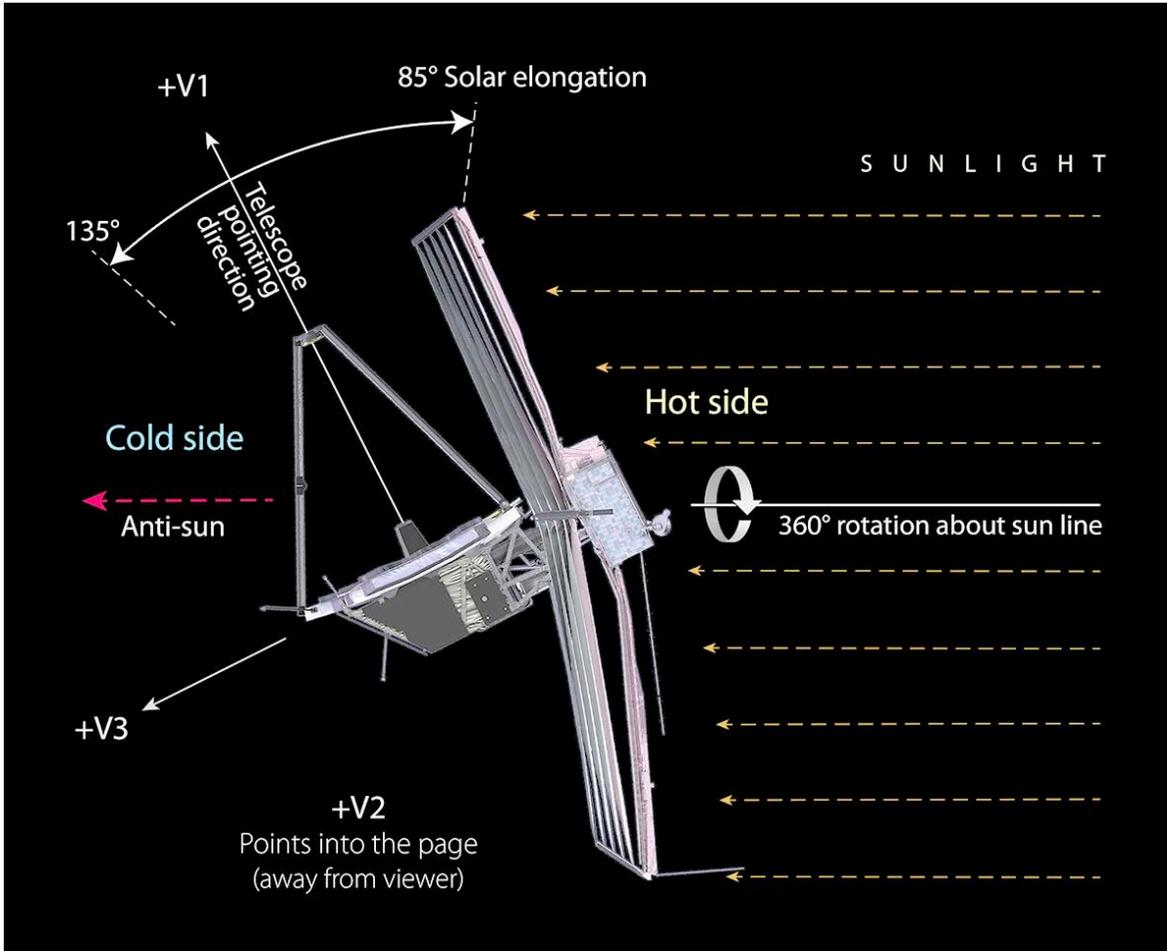
EXPANDING THE FRONTIERS OF SPACE
ASTRONOMY

JWST Observing Modes

Massimo Robberto
JWST/NIRCam Team Lead

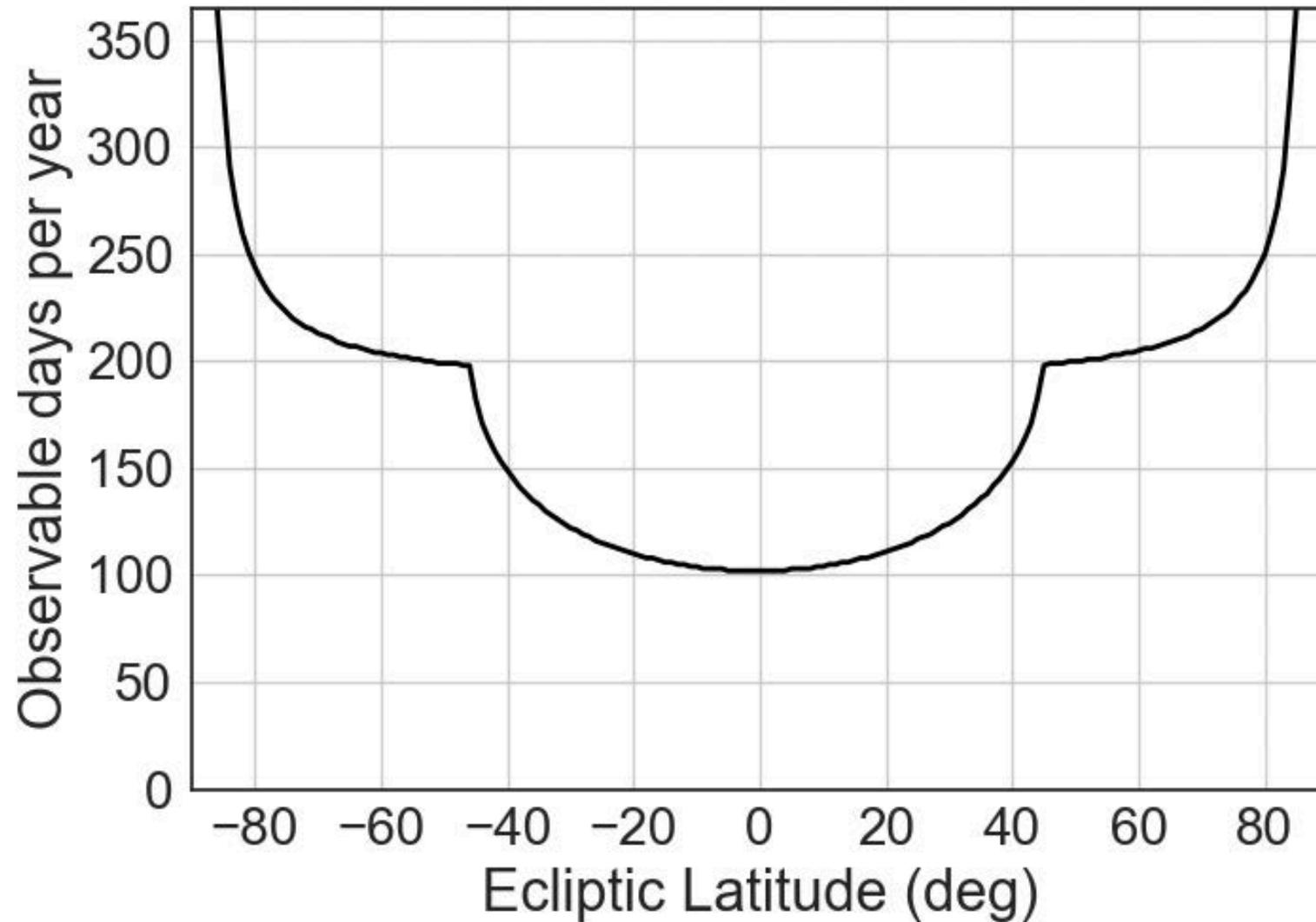


Instantaneous field of regard | Continuous viewing zone





Days per year a target is in the field of regard

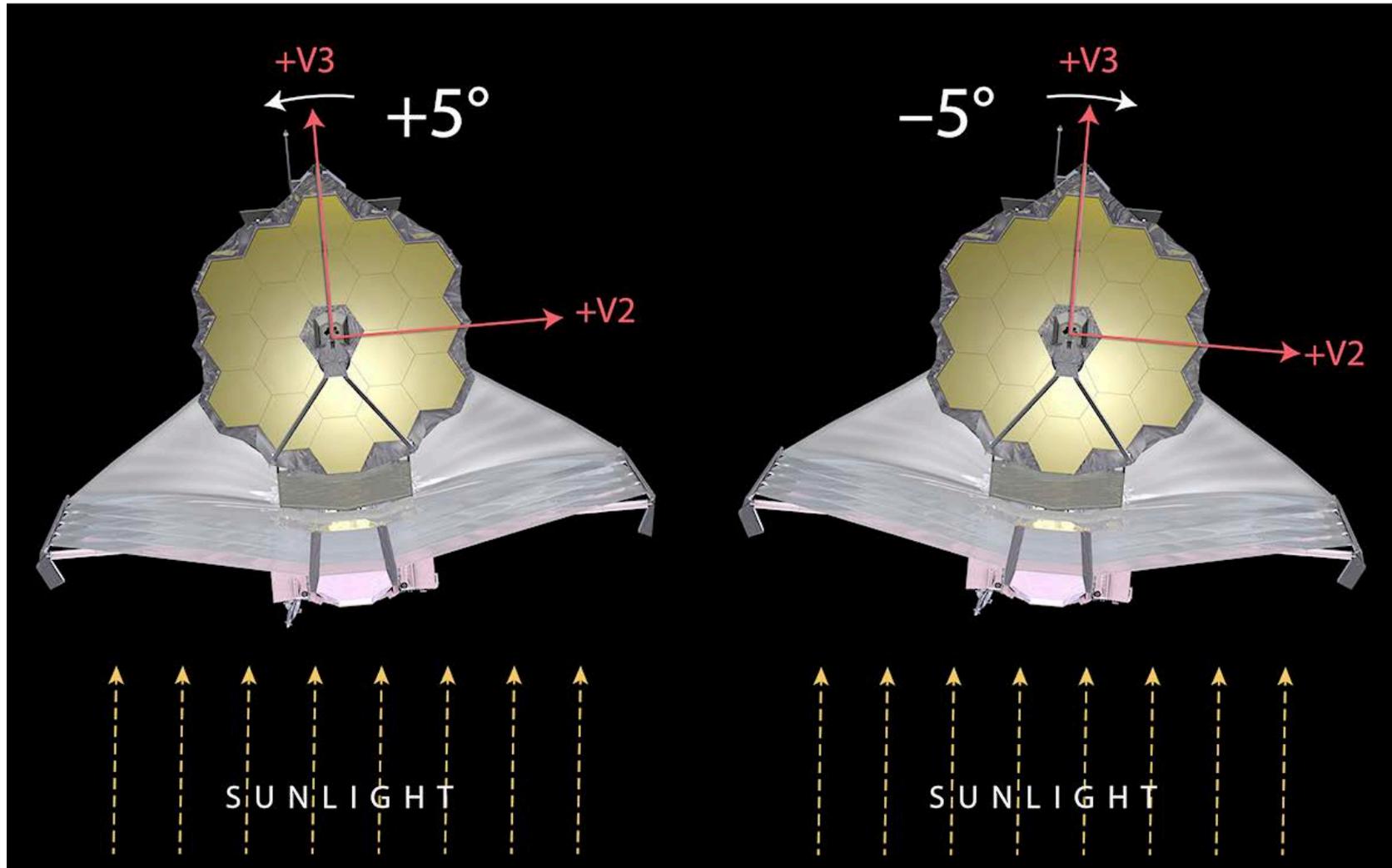


One long window per year

Two shorter windows

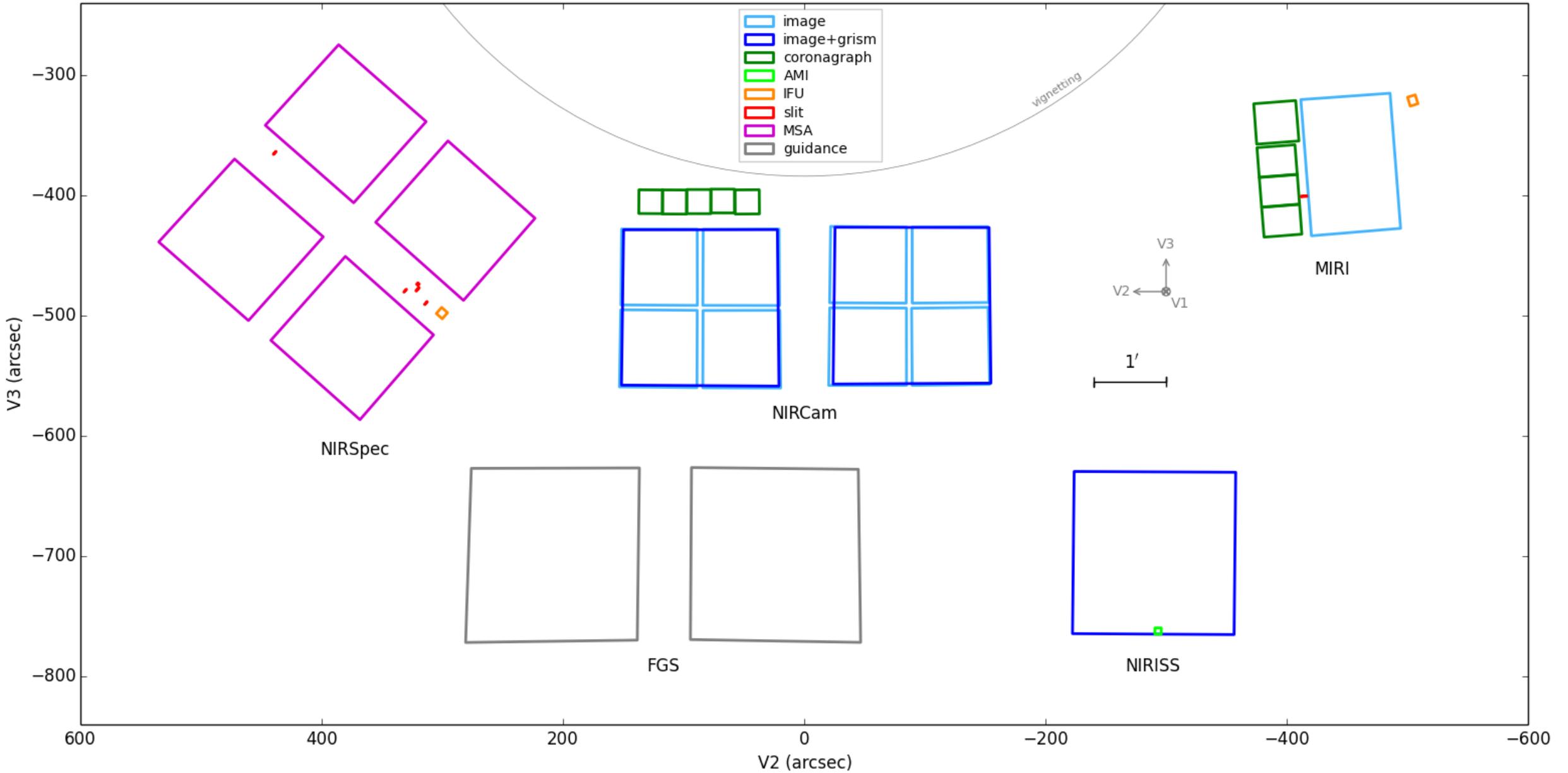


Narrow roll limits

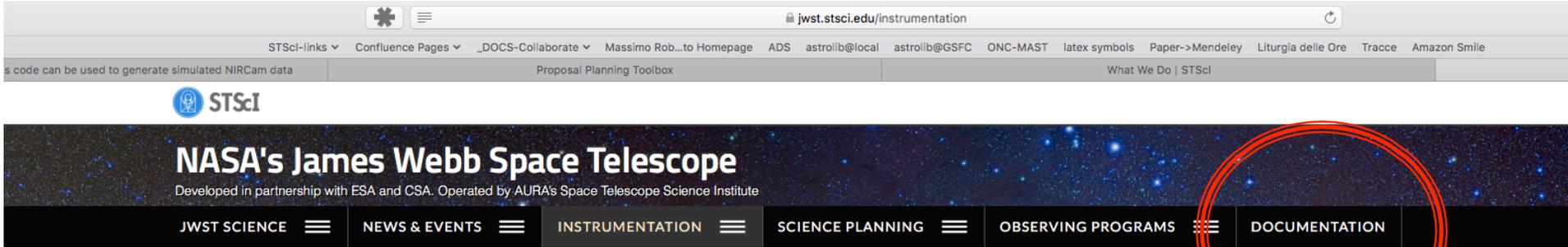




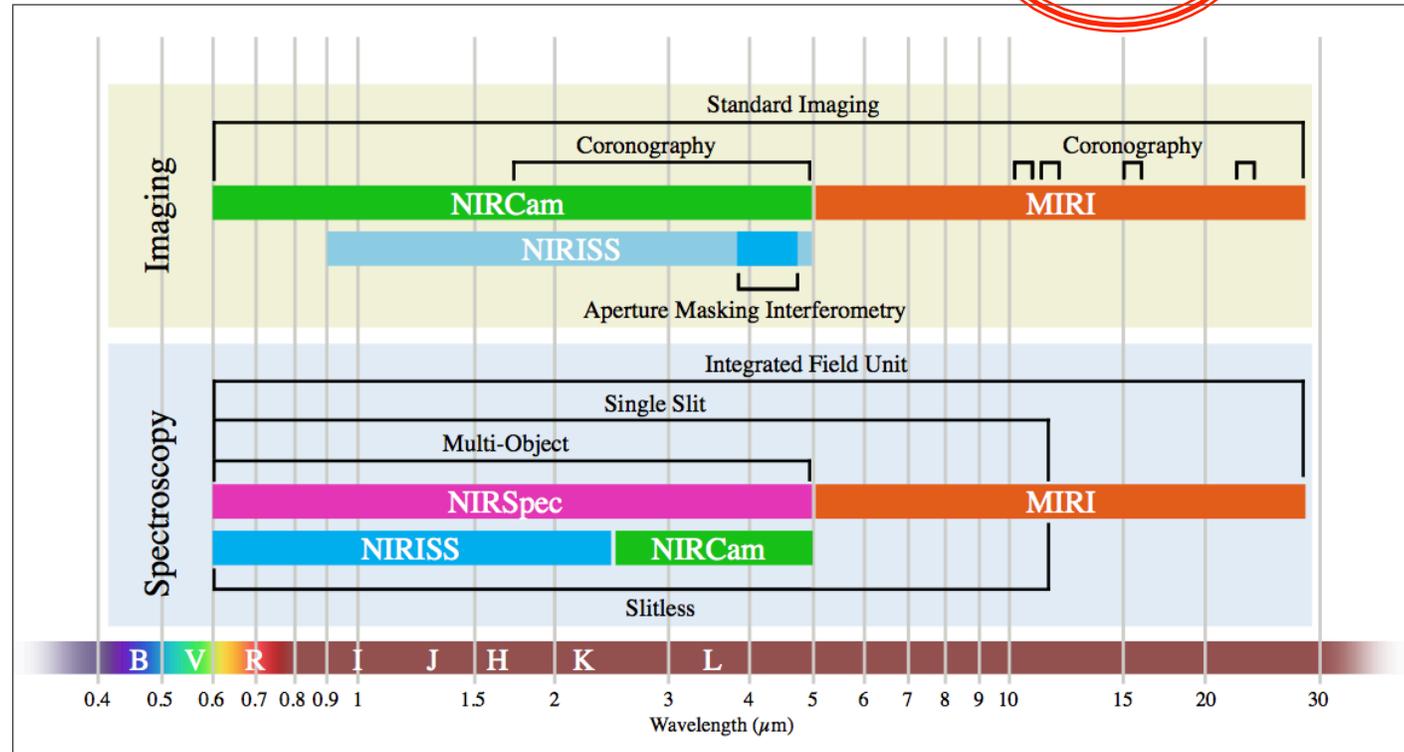
JWST Field of View



Main Source of Documentation



Instrumentation



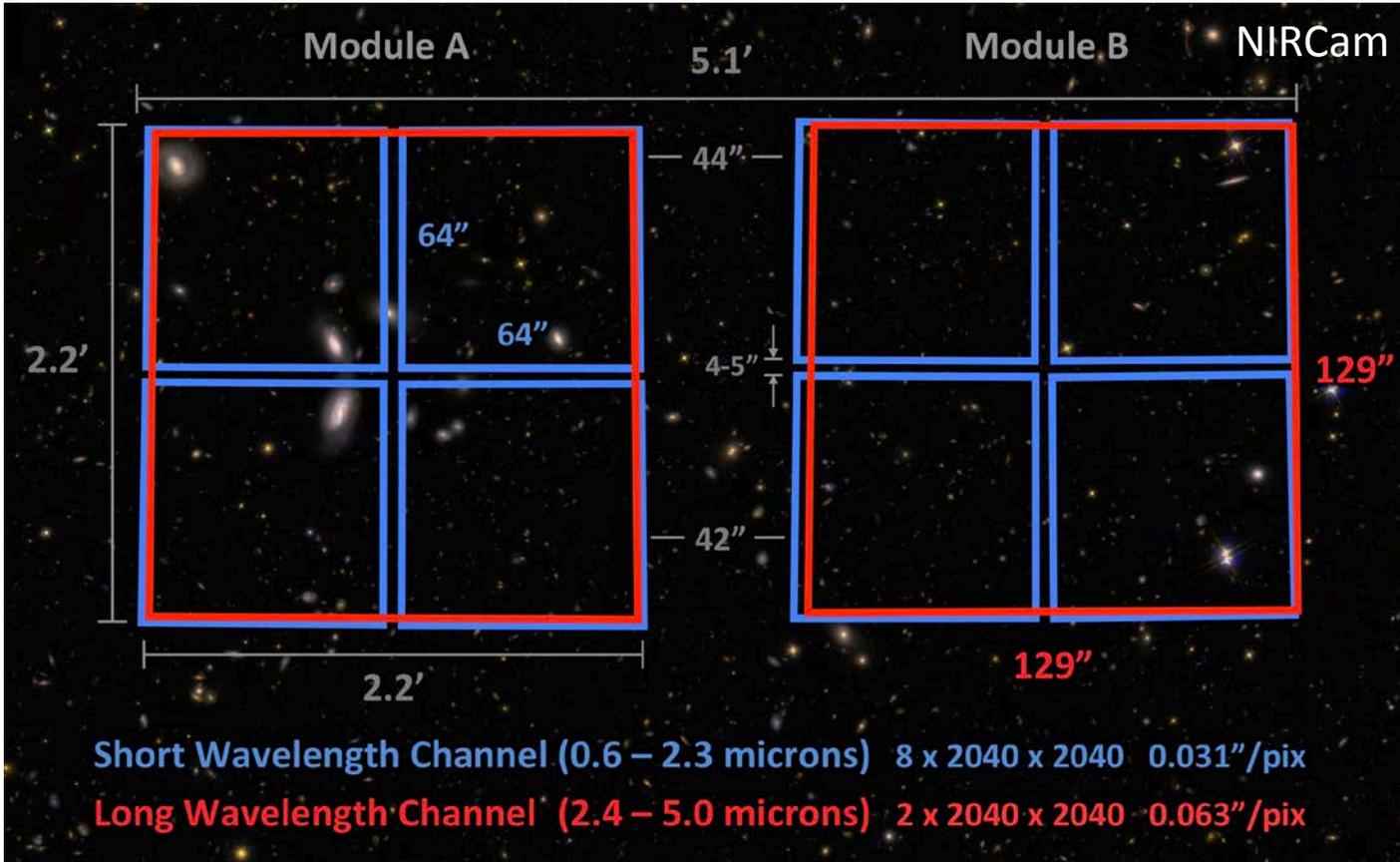


Observing modes

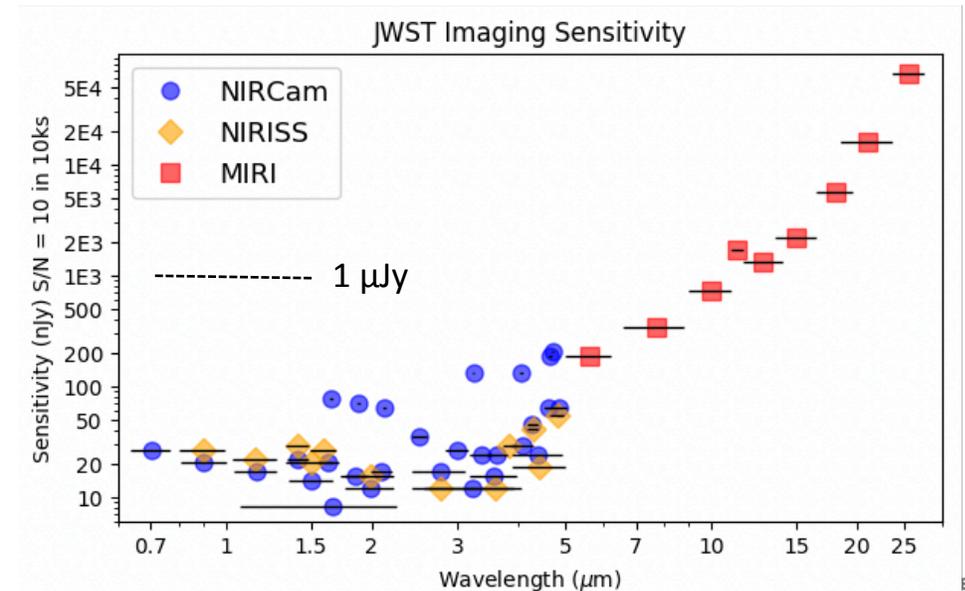
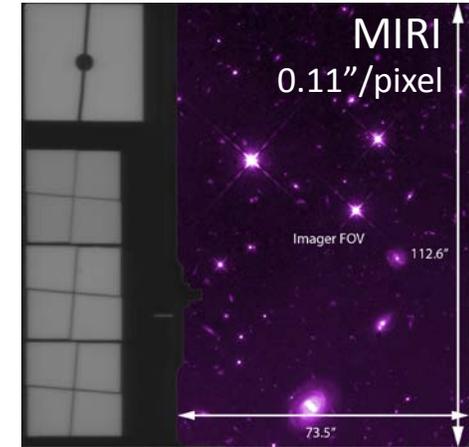
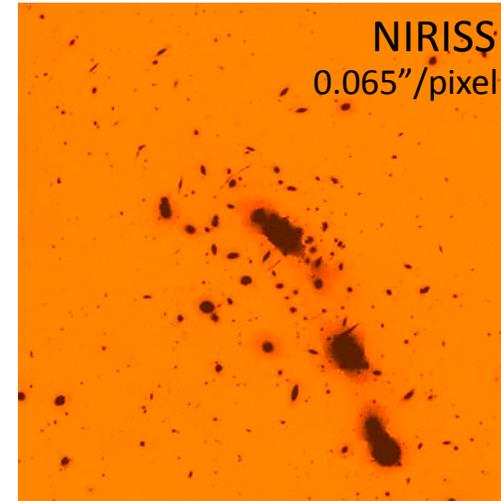
- Imaging
- Defocused photometry
- Coronagraphy
- Aperture masking interferometry
- Single-object slit spectroscopy
- Multi-object slit spectroscopy
- Single-object slitless spectroscopy
- Wide-field slitless spectroscopy
- Integral field unit spectroscopy
- Coordinated Parallel
- Pure Parallels
- Moving Targets
- Time Series
- Targets of Opportunity



Imaging fields of view | Imaging sensitivity

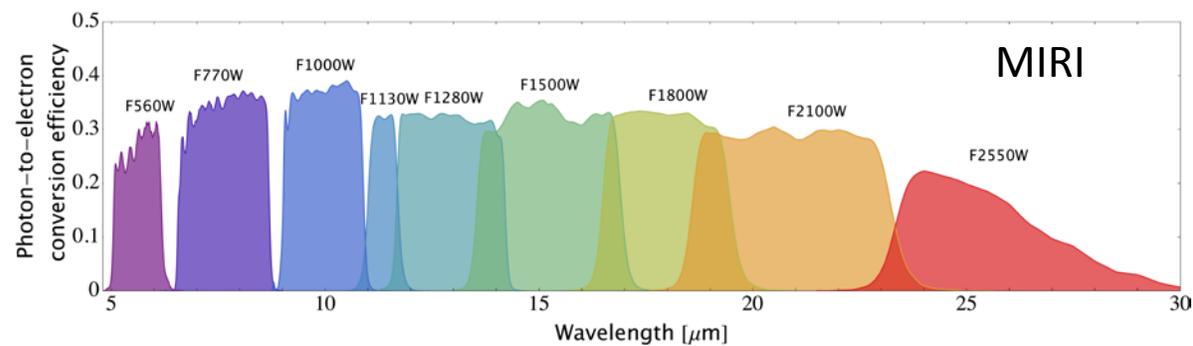
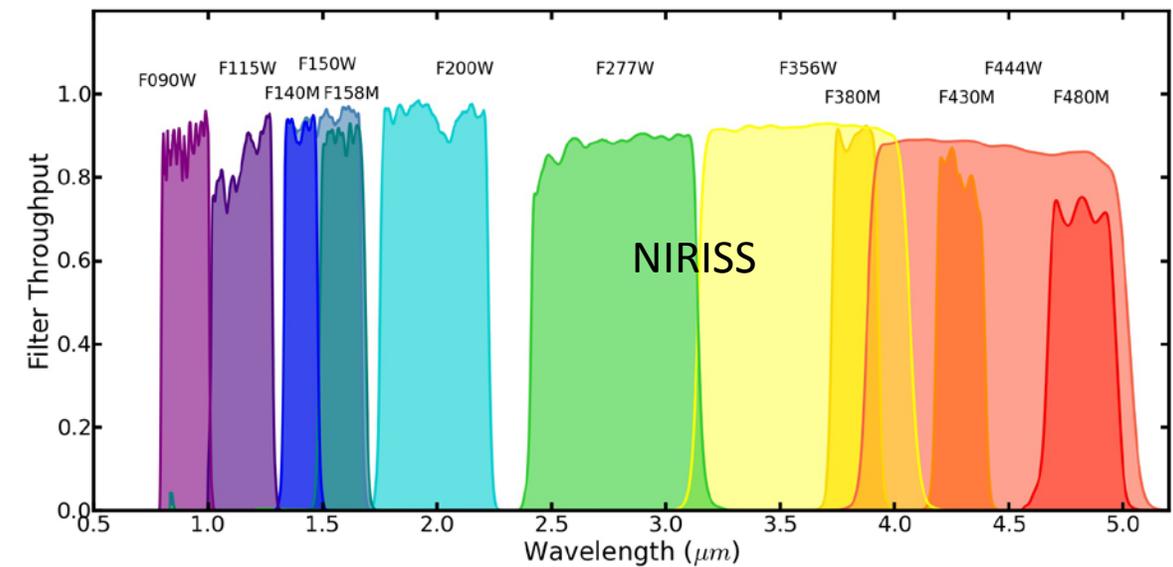
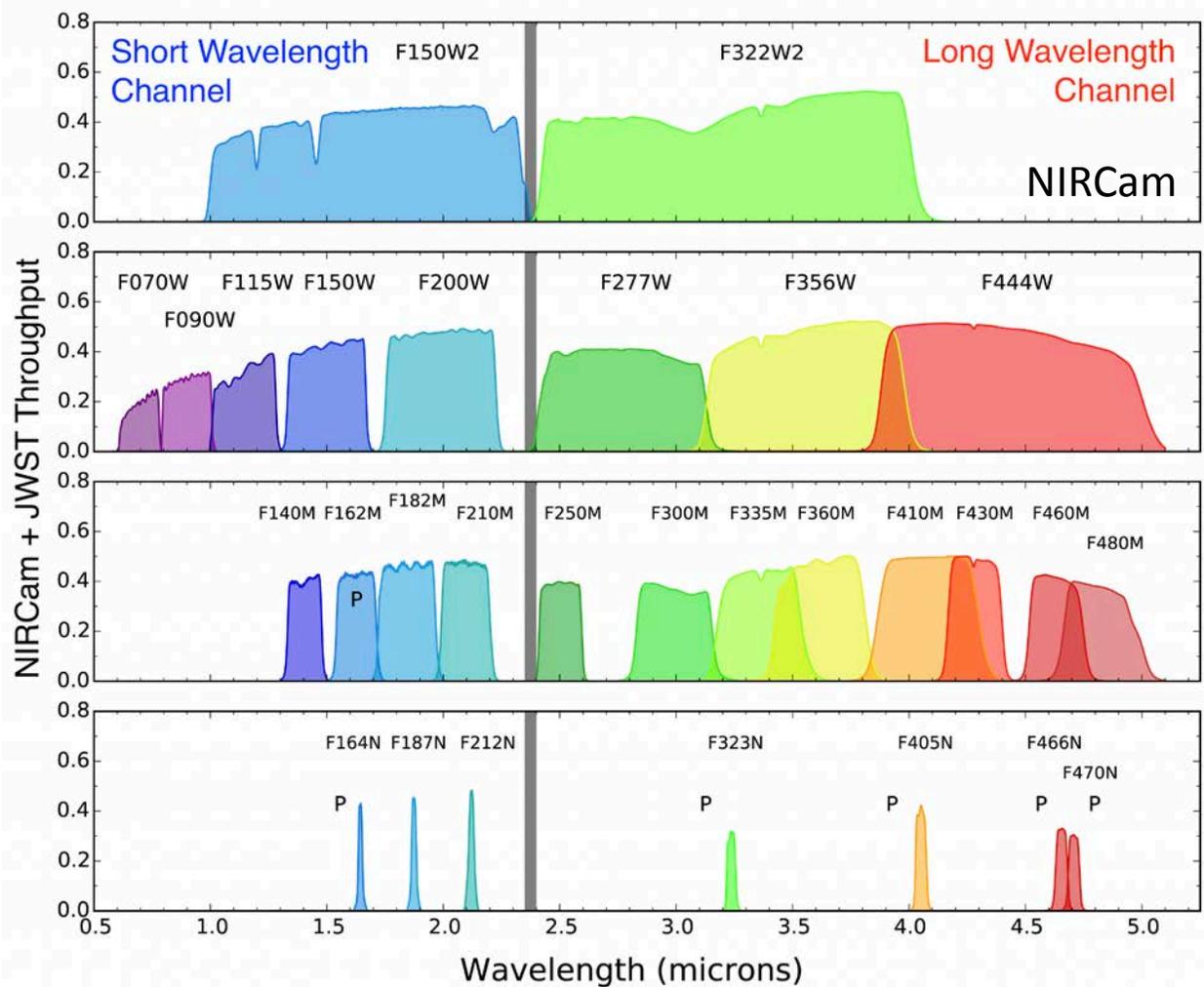


2 arcmin

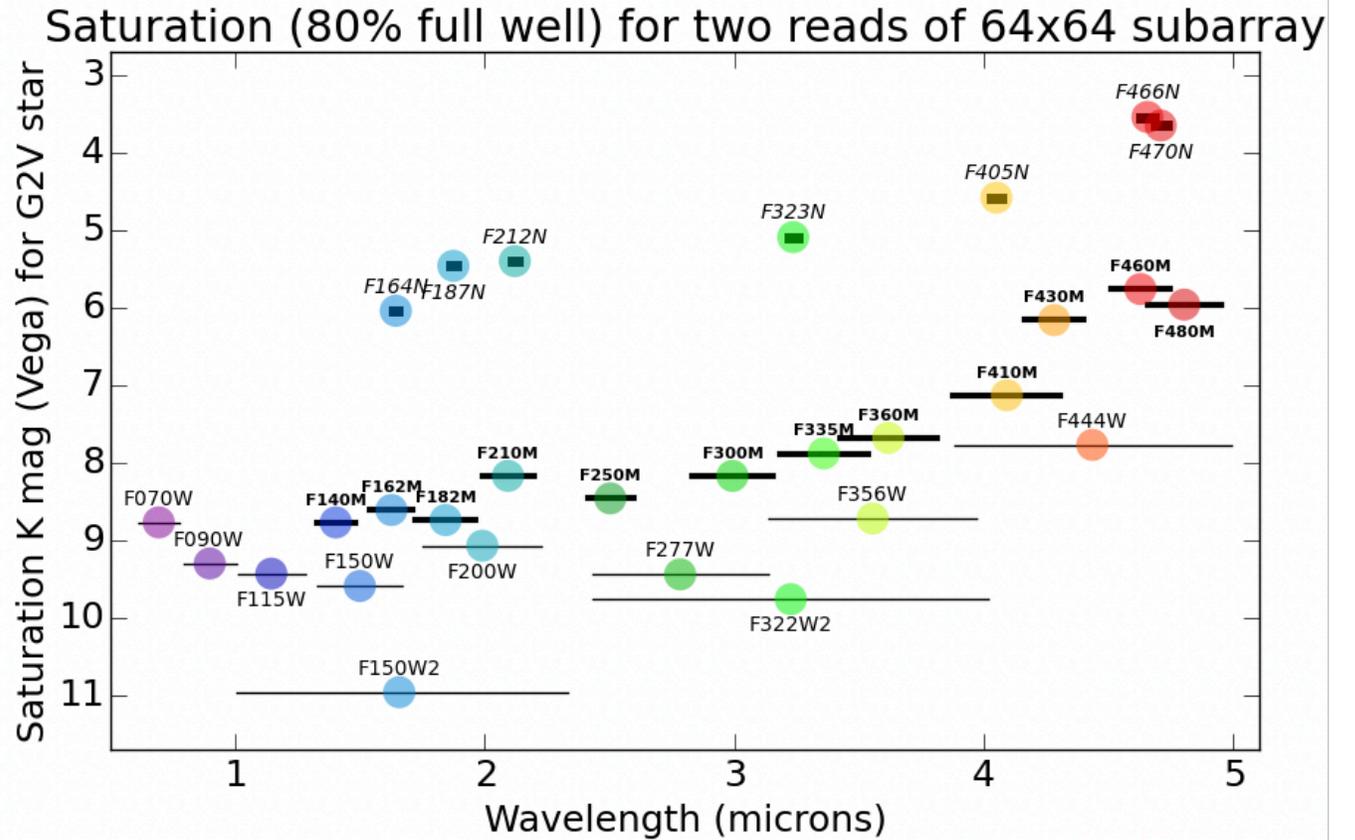
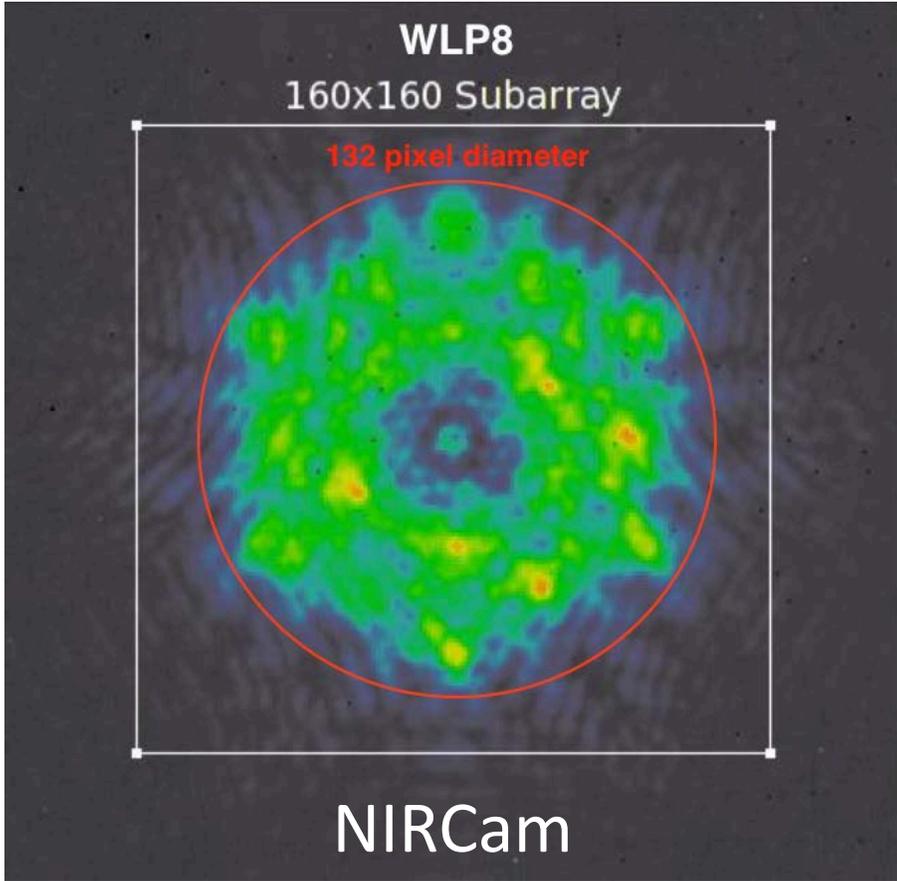




Imaging filters



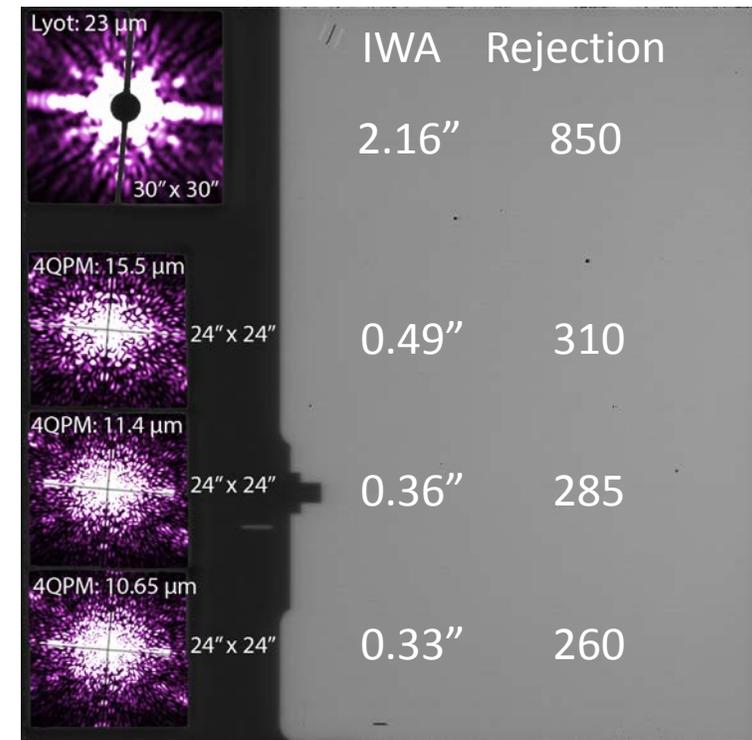
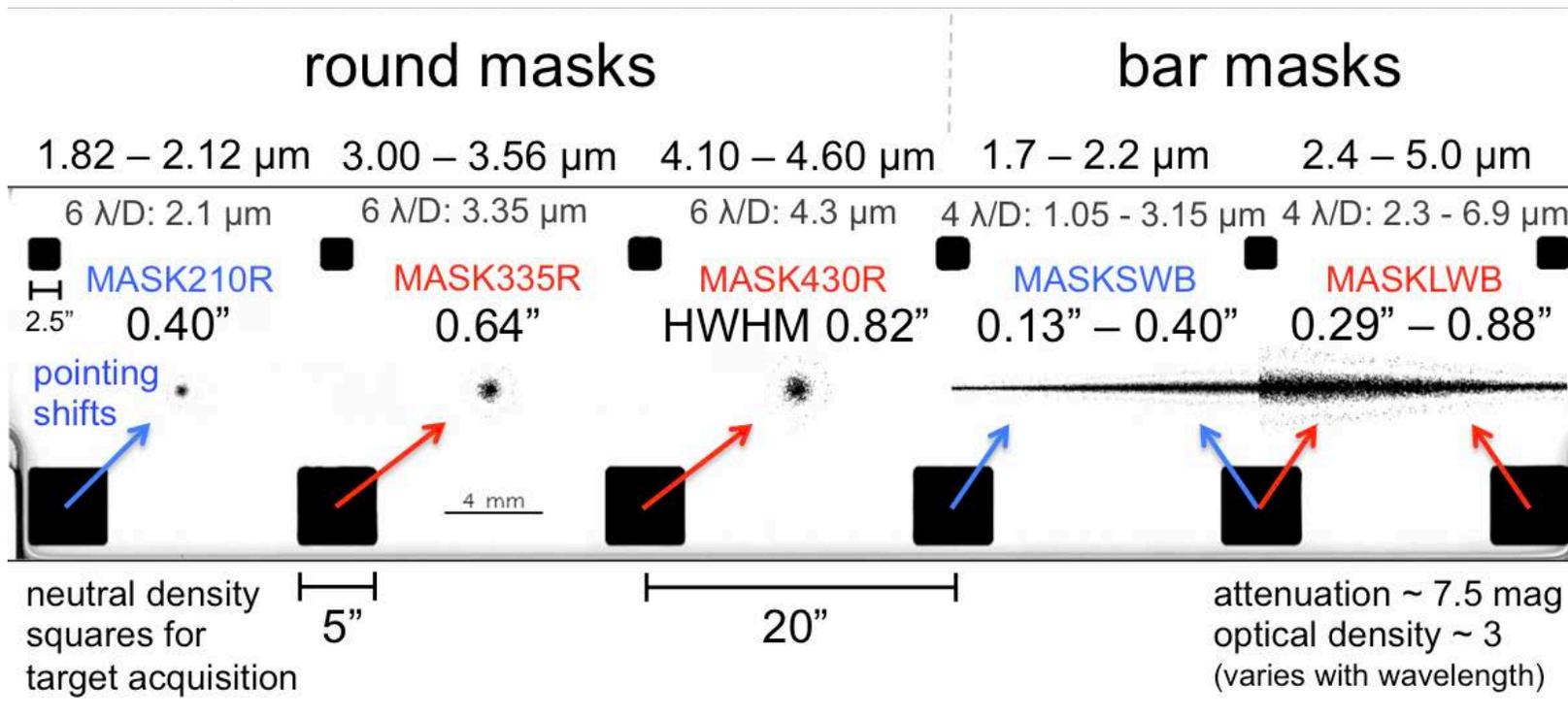
Defocused photometry | Weak lens | Saturation limits



= Time series observation (e.g., monitoring a transiting exoplanet)

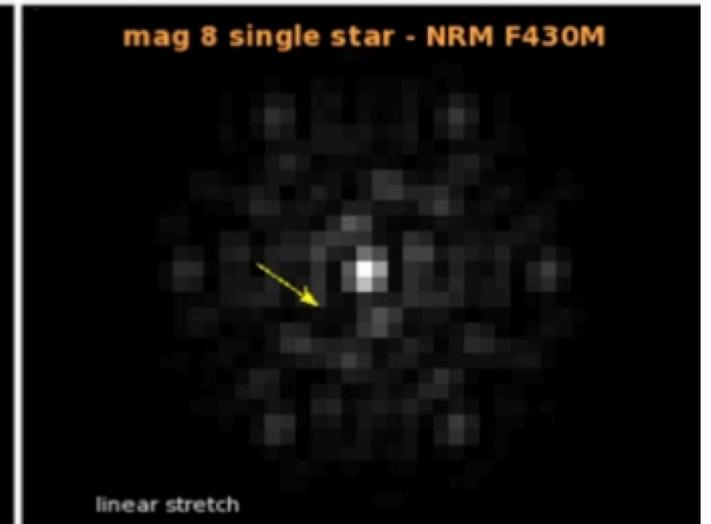
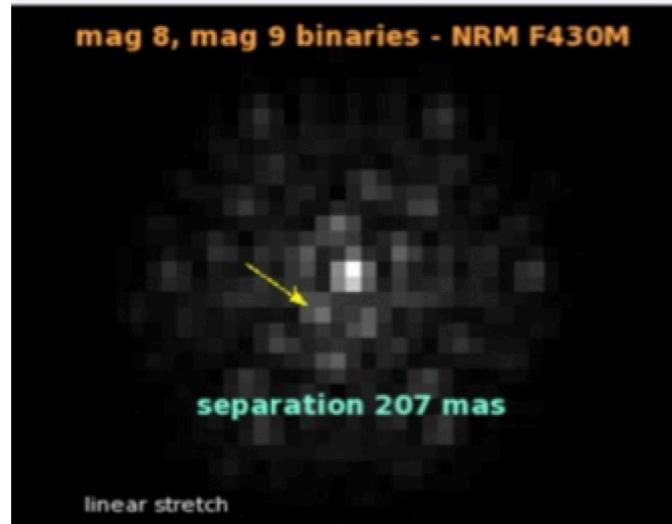
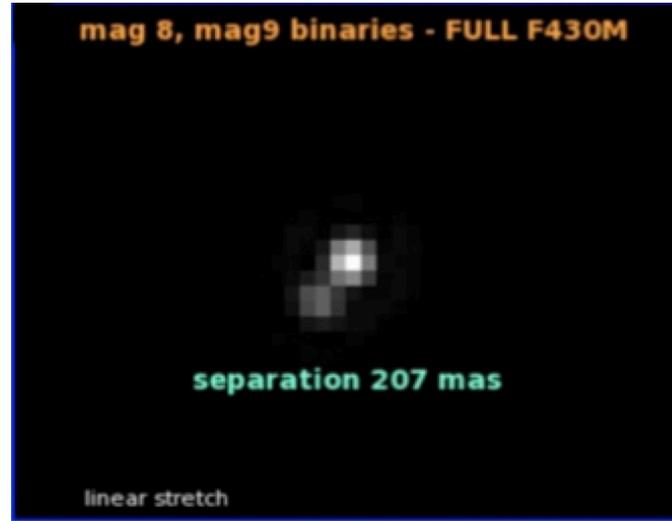
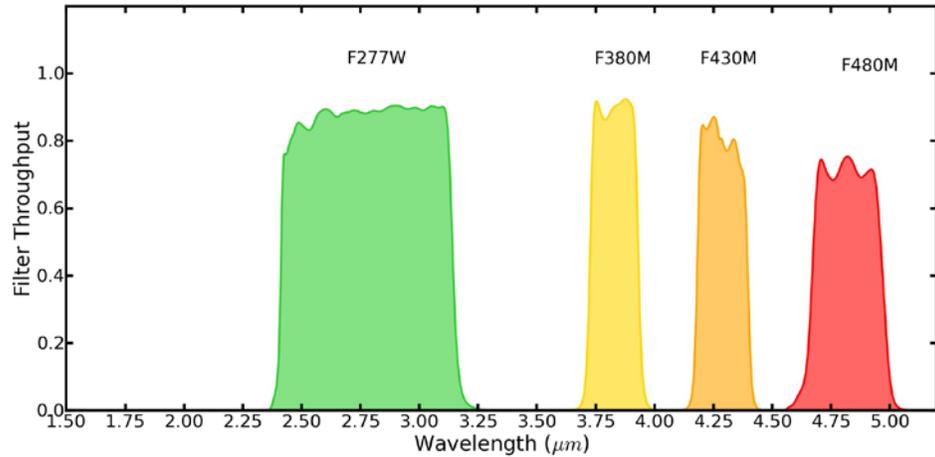


Coronagraphy | Inner working angle





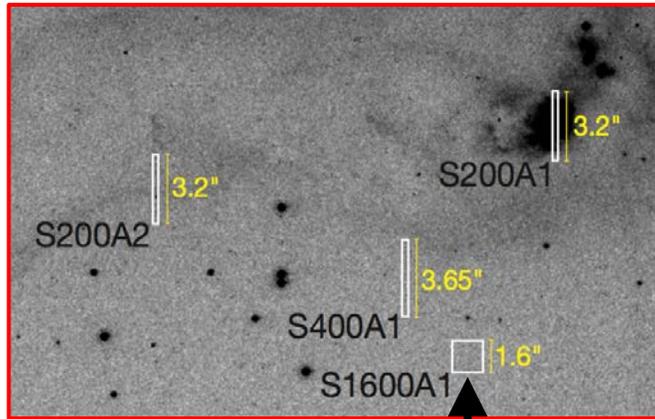
Aperture masking interferometry | Separations down to 0.07''



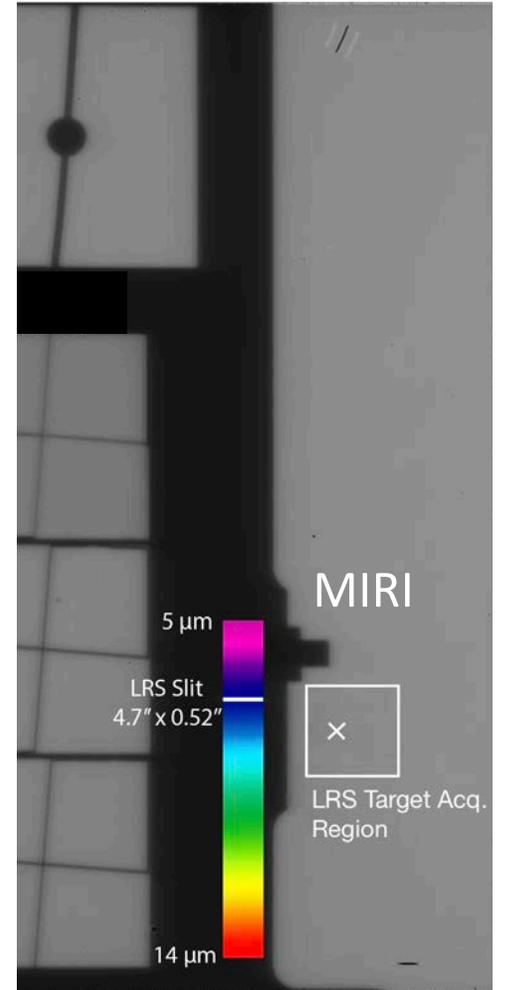
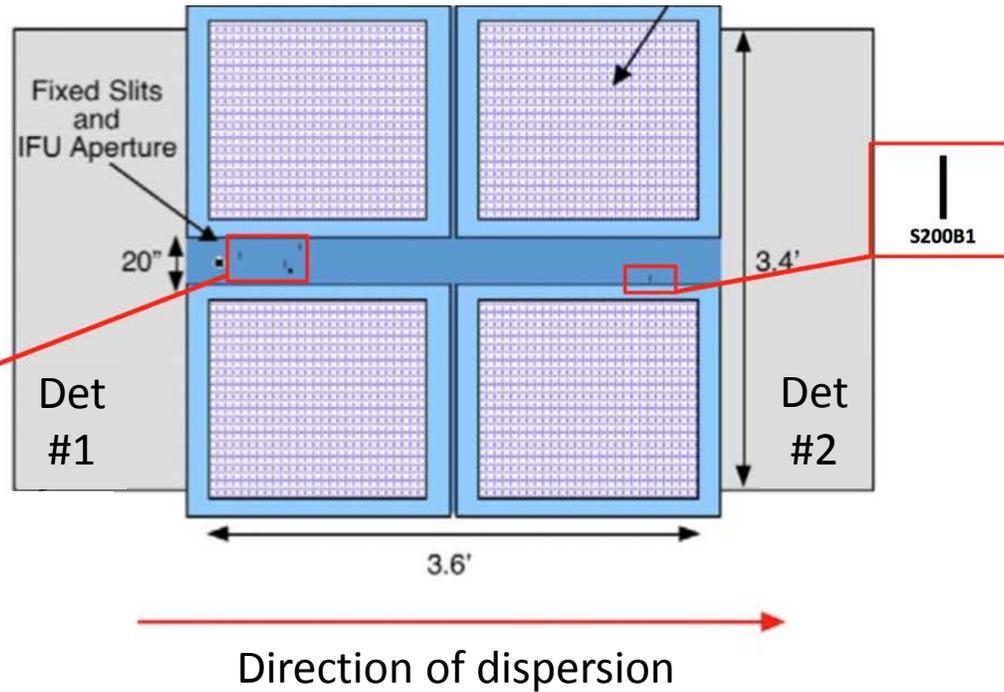


Single-object slit spectroscopy | Apertures

NIRSpec fixed slits

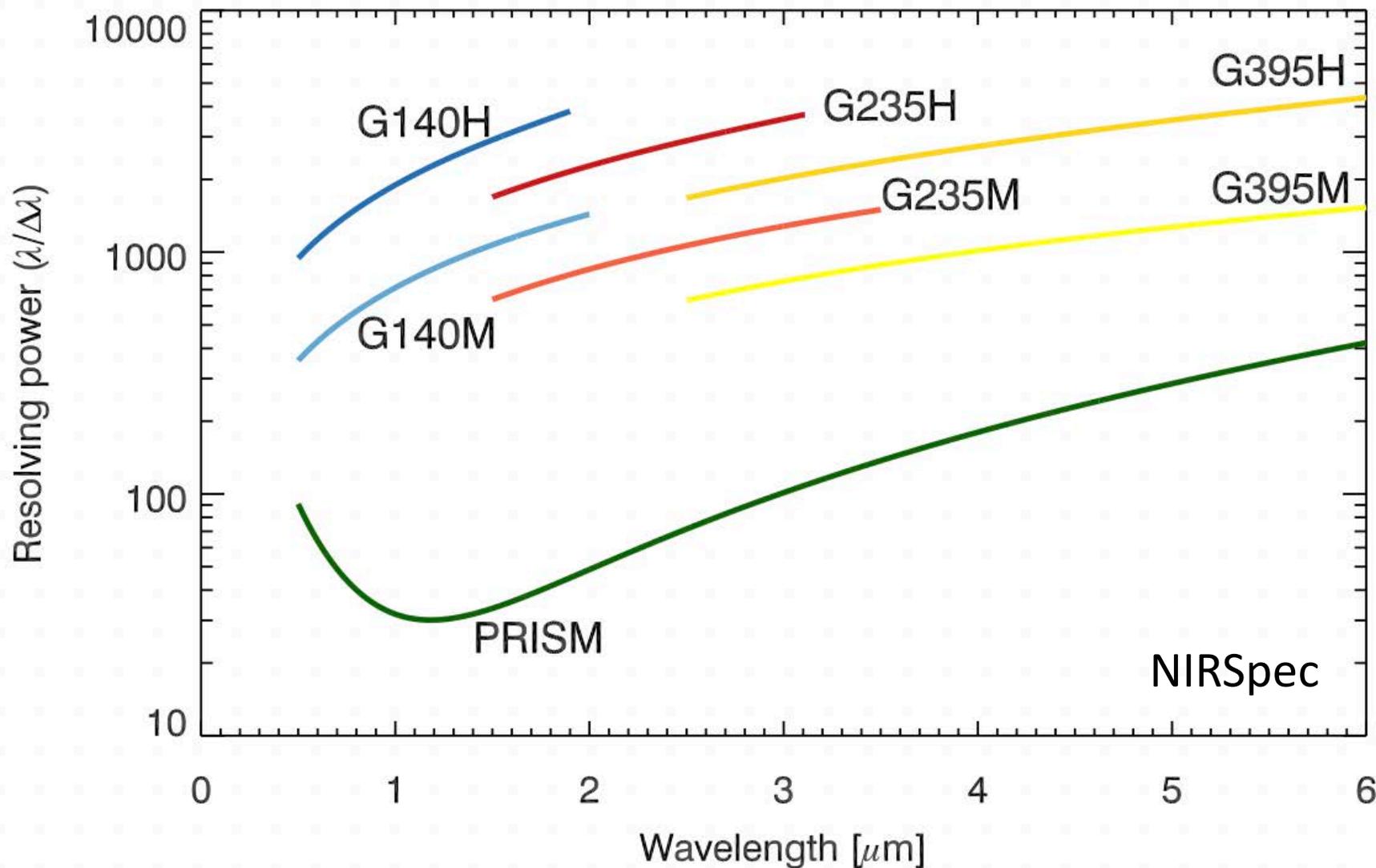


Target acquisition
in wide aperture
(WATA)





Single-object slit spectroscopy | Spectral resolution



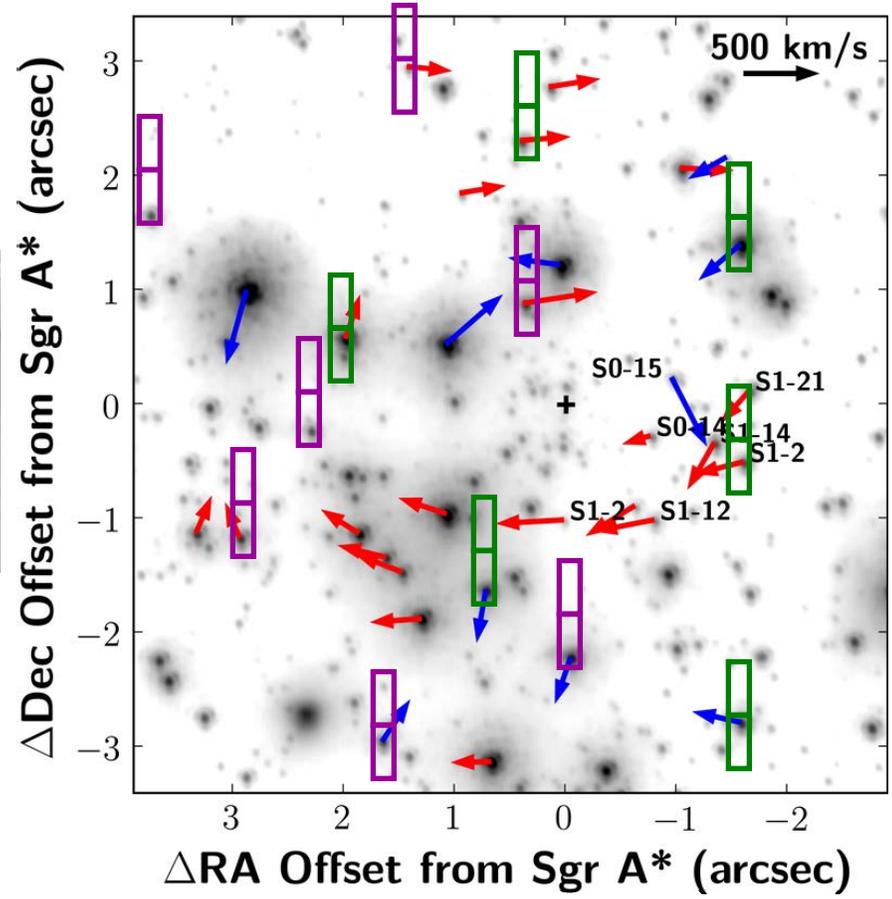
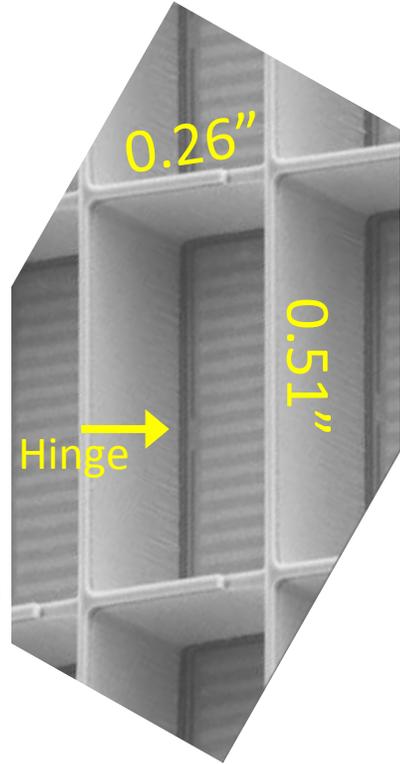
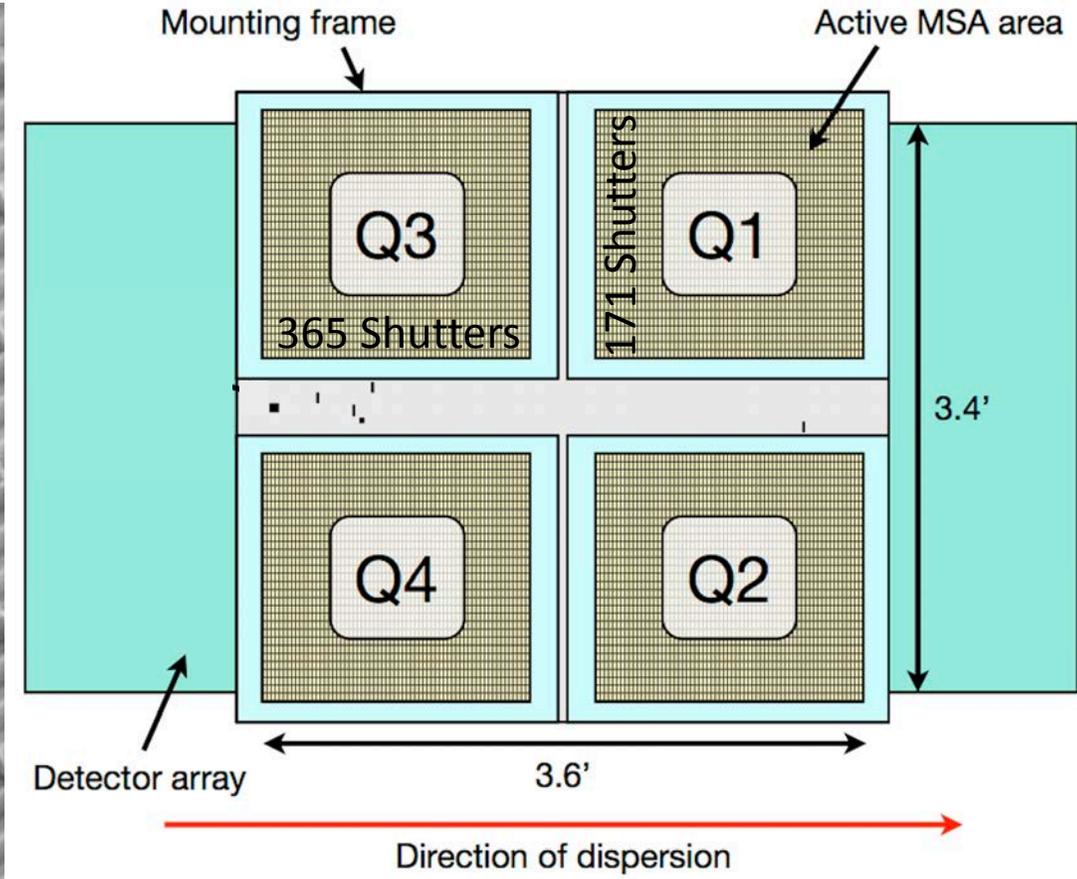
MIRI

Low
Resolution
Spectroscopy

$R = 40 @ 5 \mu\text{m}$

$R = 80 @ 10 \mu\text{m}$

Multi-object slit spectroscopy | Quadrants | Shutters | Slitlets

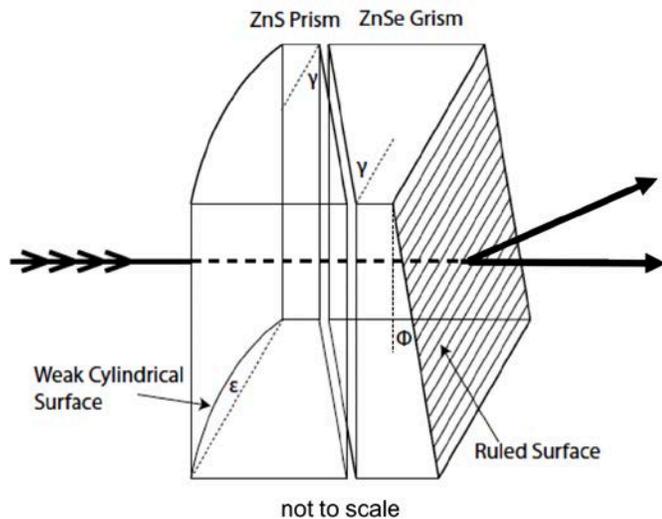
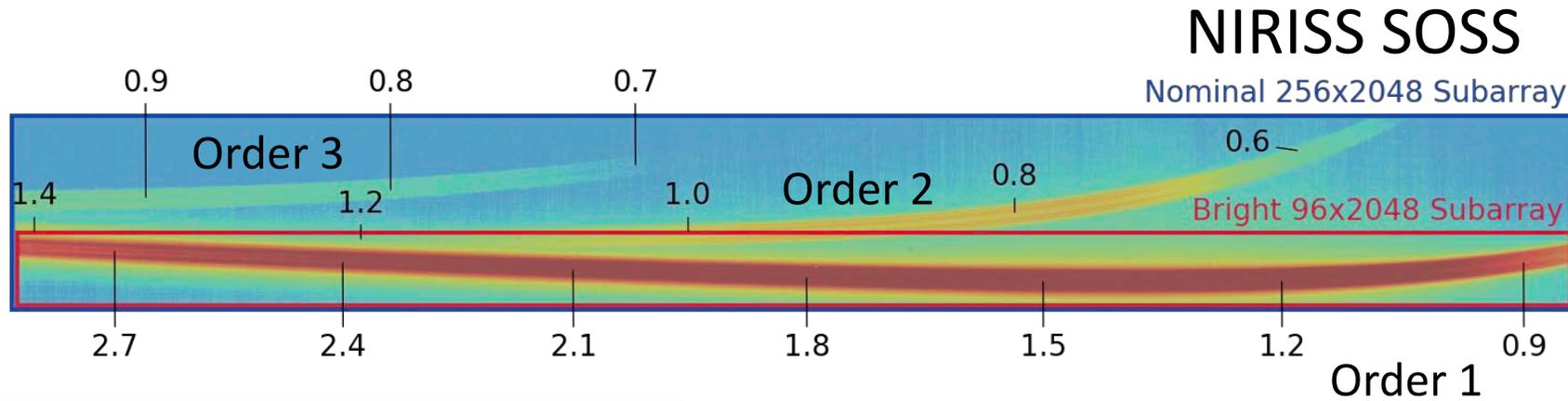


Same dispersers as NIRSpc fixed slit spectroscopy

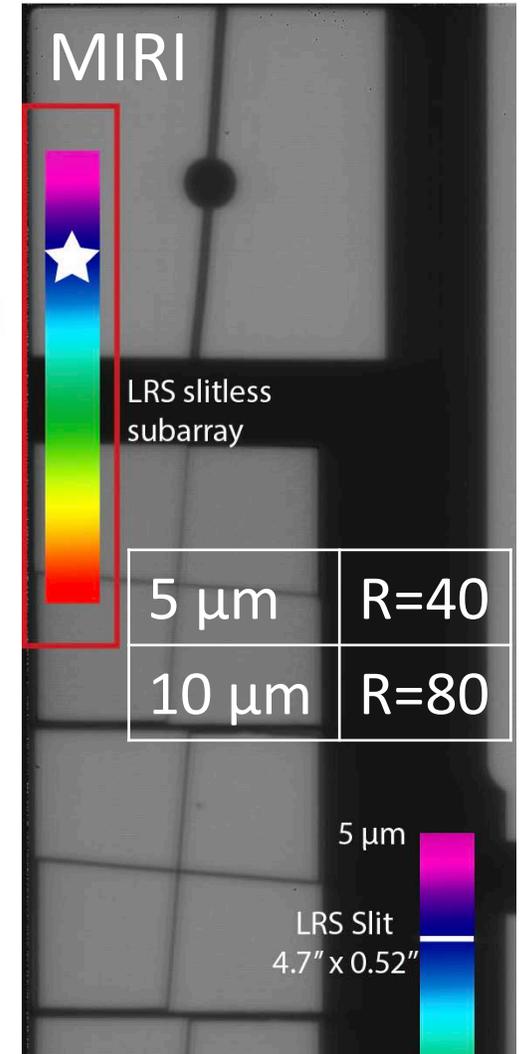
Microshutter array (MSA)



Single-object slitless spectroscopy | Resolution

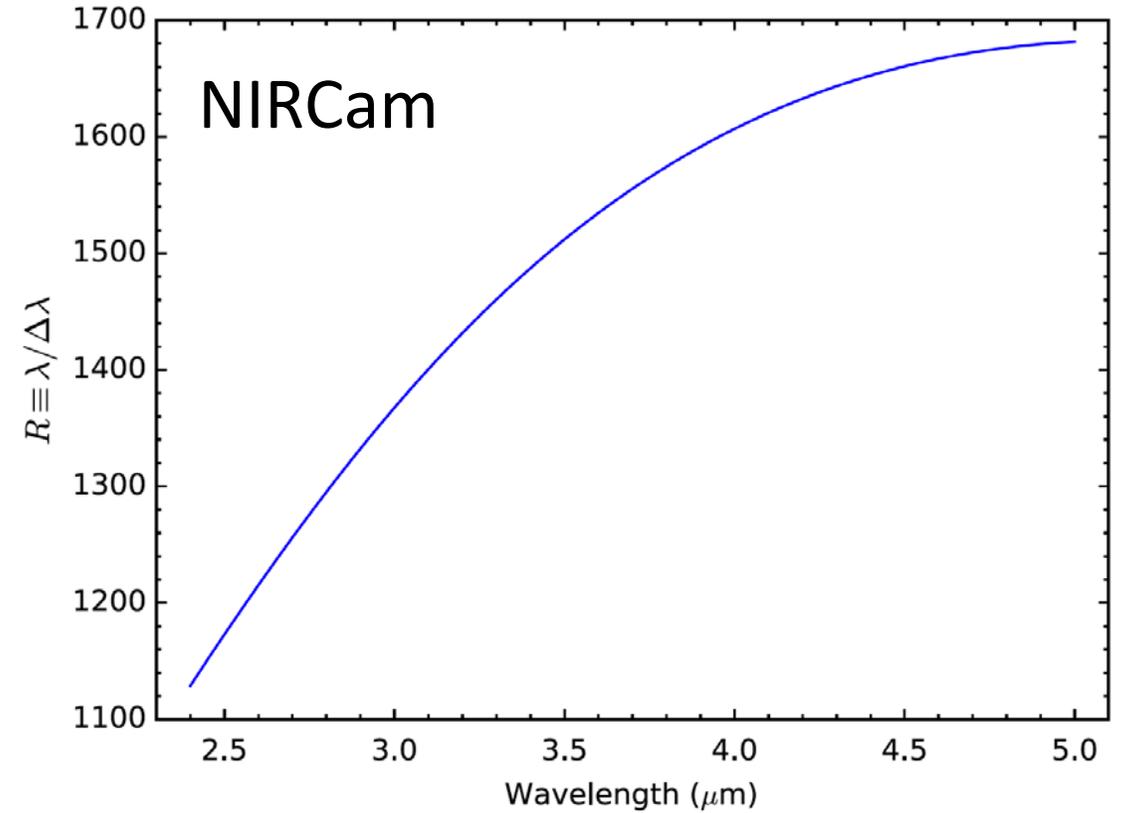


0.6 μm	R=400
1.4 μm	R=700
2.8 μm	R=1400



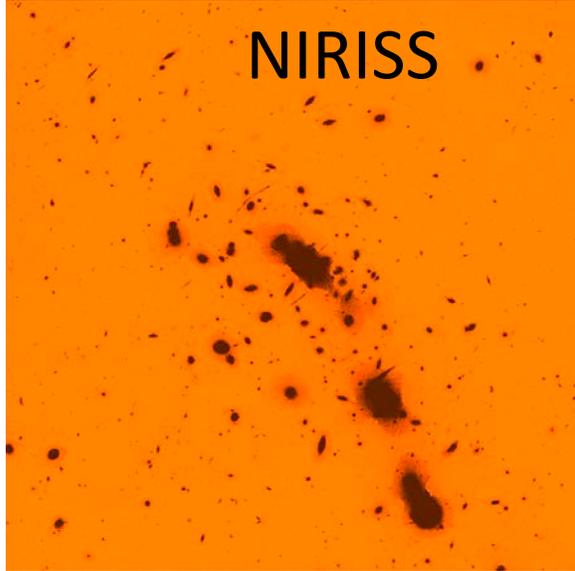


Single-object slitless spectroscopy | Resolution



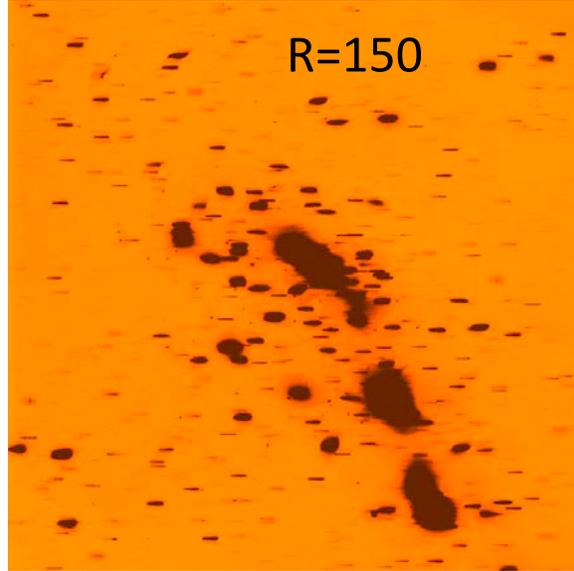


Wide field slitless spectroscopy | Direct image | Orthogonal dispersers



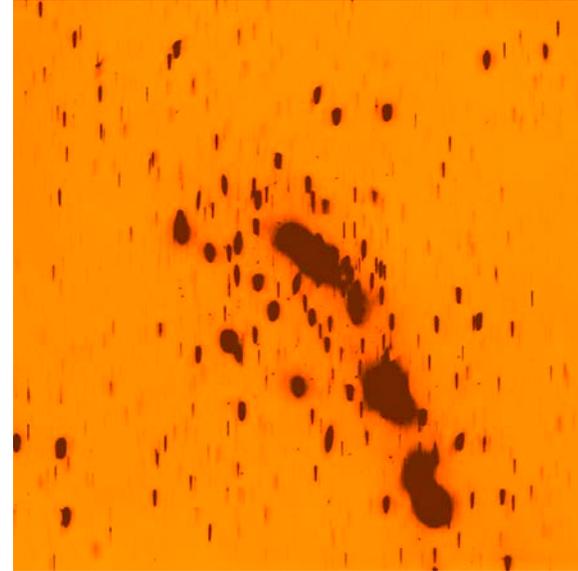
NIRISS

Direct image

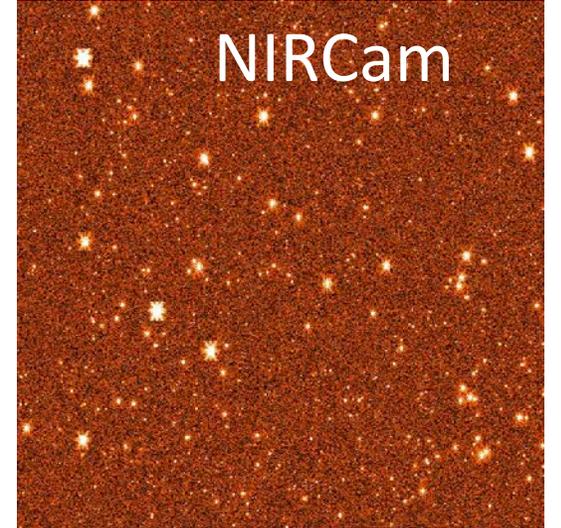


R=150

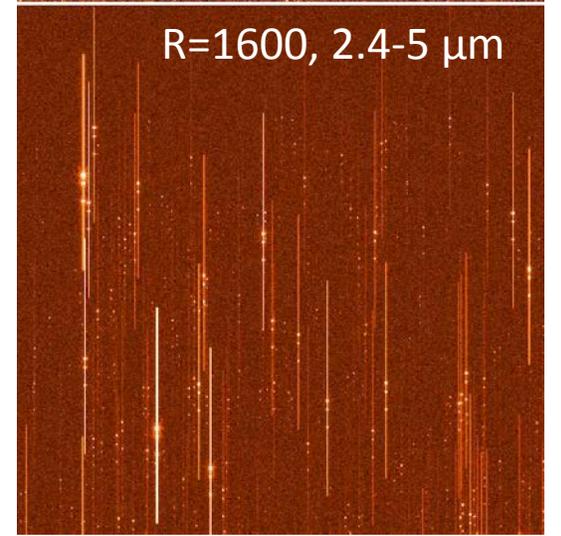
GR150C grism



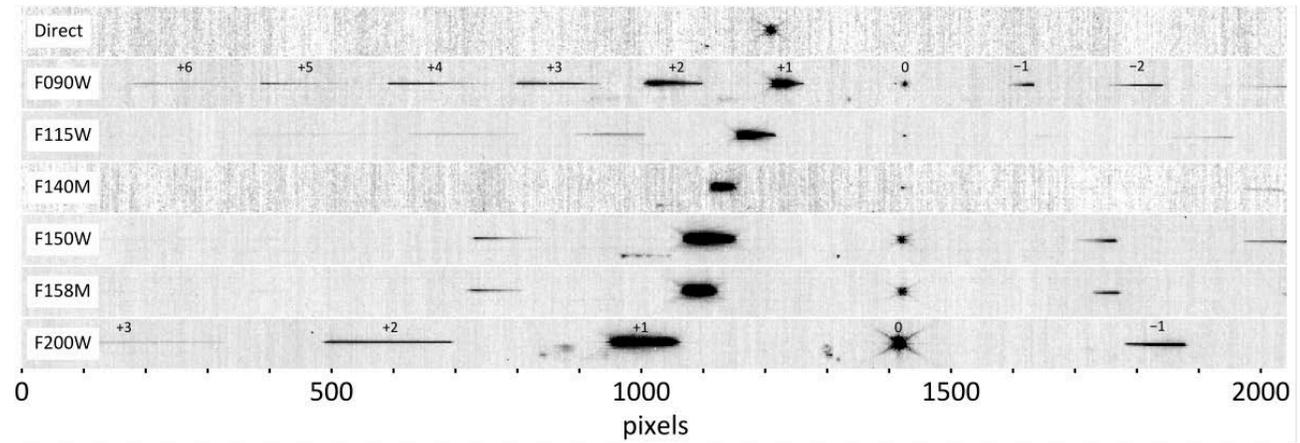
GR150R grism



NIRCam



R=1600, 2.4-5 μ m

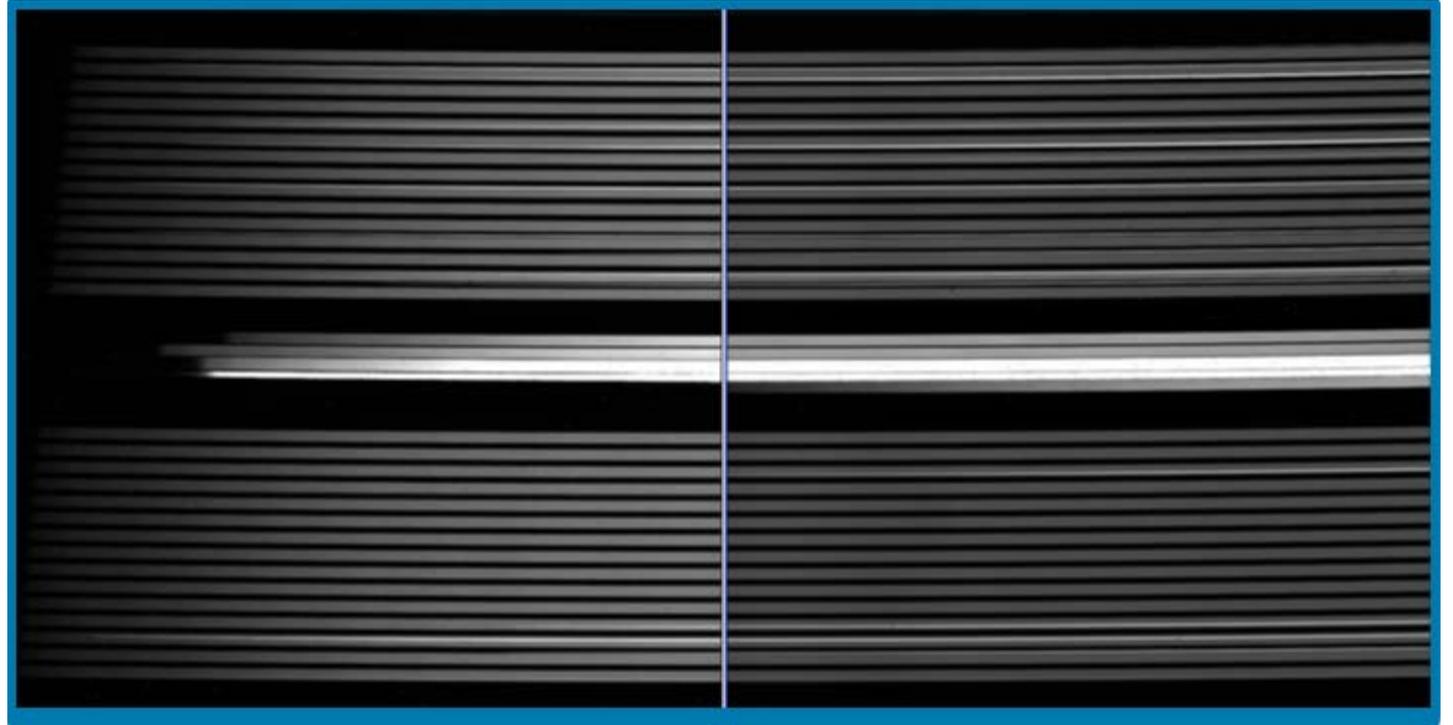
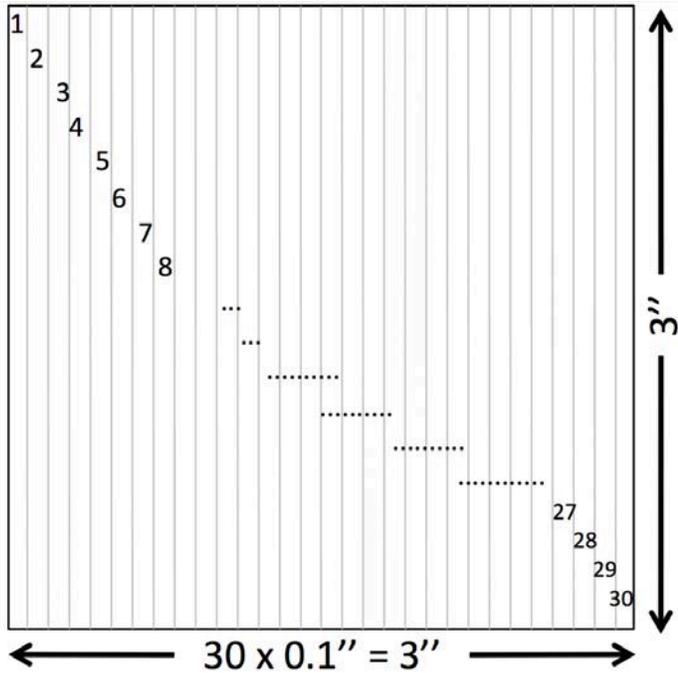


μ m	Ly- α redshift
0.79 – 1.00	5.50 – 7.23
1.01 – 1.28	7.31 – 9.53
1.33 – 1.48	9.94 – 11.17
1.33 – 1.67	9.94 – 12.74
1.48 – 1.68	11.17 – 13.82
1.75 – 2.22	13.40 – 17.26



Integral field unit spectroscopy | Aperture | MSA leak calibration

NIRSpec



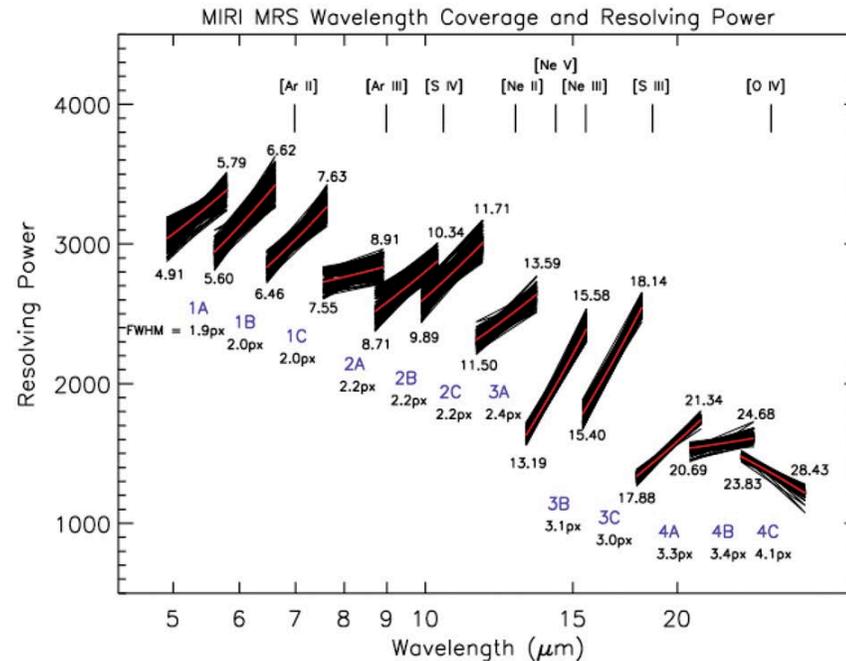
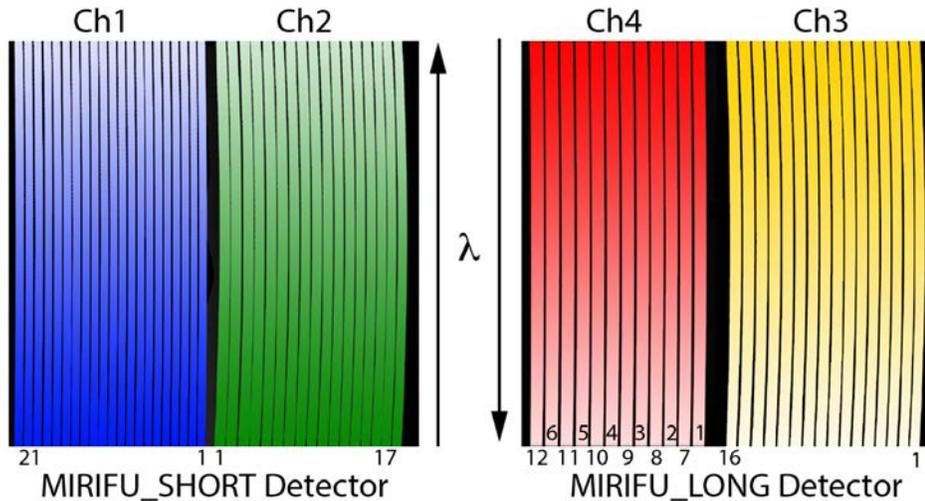
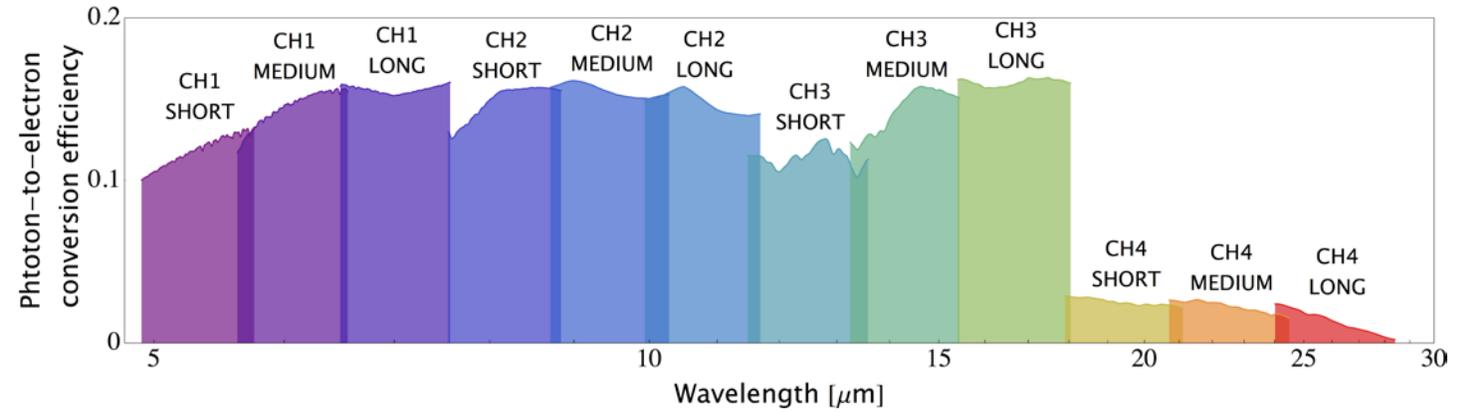
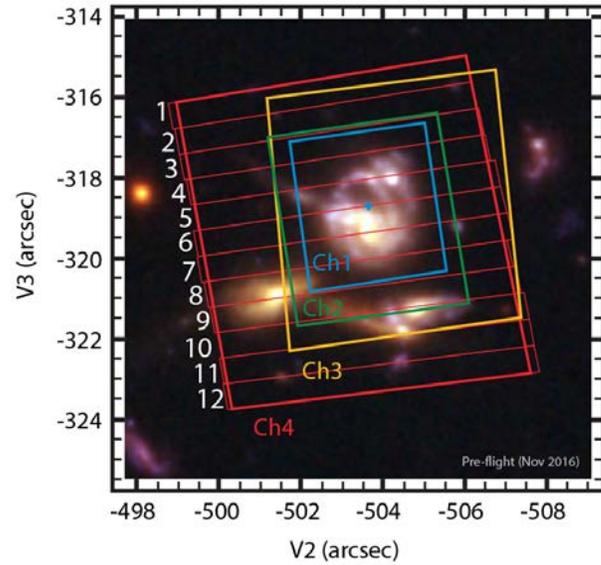
After Leak Subtraction

Same dispersers as NIRSpec MSA and fixed slit spectroscopy ($R=100, 1000, 2700$)



Integral field spectroscopy | Dichroics | Resolution | 3 settings

MIRI



3 Settings
Short
Medium
Long



Templates in APT

Instrument

✗ Template

✗ Target

- ✓ MIRI
- NIRCAM
- NIRSPEC
- NIRISS

Instrument

✗ Template

✗ Target

- ✓ None Selected
- MIRI Imaging
- MIRI Low Resolution Spectroscopy
- MIRI Medium Resolution Spectroscopy
- MIRI Coronagraphic Imaging

Site Splitting: 20.0 Arcsec

Instrument

✗ Template

✗ Target

- ✓ None Selected
- NIRSpec Fixed Slit Spectroscopy
- NIRSpec IFU Spectroscopy
- NIRSpec MultiObject Spectroscopy
- NIRSpec Bright Object Time Series

Site Splitting: 20.0 Arcsec

Instrument

✗ Template

✗ Target

- ✓ None Selected
- NIRCam Imaging
- NIRCam Coronagraphic Imaging
- NIRCam Time Series
- NIRCam Grism Time Series

Site Splitting: 20.0 Arcsec

Instrument

✗ Template

✗ Target

- ✓ None Selected
- NIRISS Imaging
- NIRISS Wide Field Slitless Spectroscopy
- NIRISS Single-Object Slitless Spectroscopy
- NIRISS Aperture Masking Interferometry

Site Splitting: 20.0 Arcsec



Coordinated parallels available in Cycle 1

Instrument: MIRI

Template: MIRI Imaging

Coordinated Parallel: None Selected
 MIRI-NIRCam Imaging
 MIRI Imaging-NIRISS WFSS

Target:

Splitting Distance: Num

Instrument: NIRCAM

Template: NIRCam Imaging

Coordinated Parallel: None Selected
 NIRCam-MIRI Imaging
 NIRCam-NIRISS Imaging
 NIRCam Imaging-NIRISS WFSS

Target:

Splitting Distance: Num

Instrument: NIRSPEC

Template: NIRSpec MultiObject Spectroscopy

Coordinated Parallel: None Selected
 NIRSpec MOS-NIRCam Imaging
 None Selected

Target:

Splitting Distance: Num

Instrument: NIRISS

Template: NIRISS Wide Field Slitless Spectroscopy

Coordinated Parallel: None Selected
 NIRISS WFSS-MIRI Imaging
 NIRISS WFSS-NIRCam Imaging

Target:

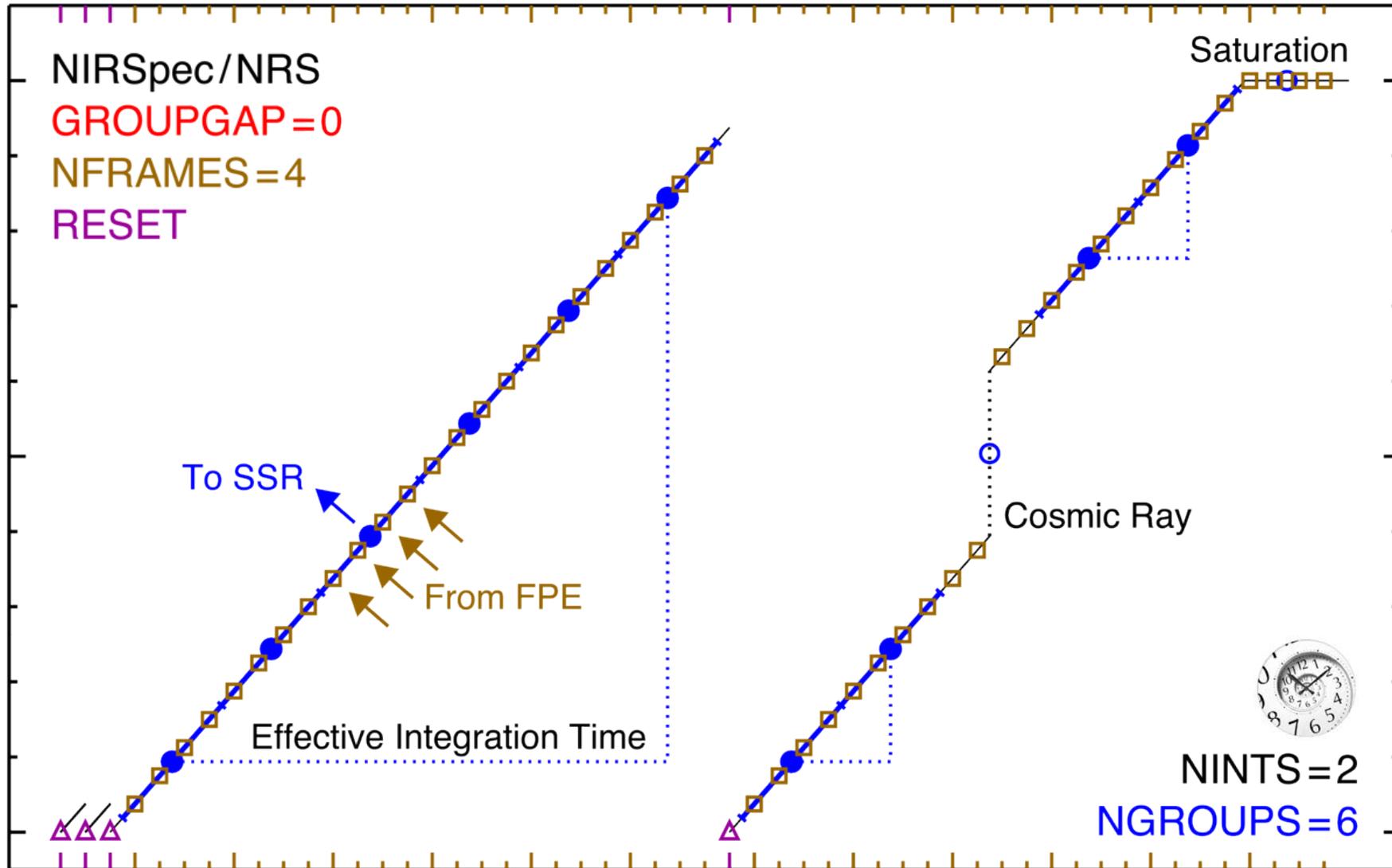
Splitting Distance: Num

Can also propose for pure parallels (attach exposures to other programs)

- Imaging with MIRI, NIRISS, or NIRCAM
- Wide field slitless spectroscopy with NIRISS or NIRCAM (**shared risk**)



Detector readout pattern | Frame | Group | Integration | Exposure



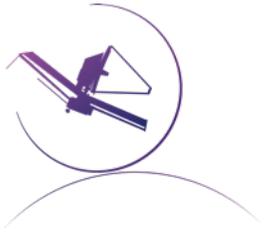


Observing modes

- Imaging
- Defocused photometry
- Coronagraphy
- Aperture masking interferometry
- Single-object slit spectroscopy
- Multi-object slit spectroscopy
- Single-object slitless spectroscopy
- Wide-field slitless spectroscopy
- Integral field unit spectroscopy

Other topics

- Field of regard
- Target visibility
- Roll limits
- Templates
- Parallels
- Exposure terminology



Backup slides



Template | Observation | Visit

- Template
 - Constrained observing strategy
 - Defines interface between subsystems
 - Reduces complexity, but still quite complicated
- Observation
 - Expresses a high-level observing task
 - An instance of a template
 - Can split into multiple visits
- Visit
 - Smallest scheduling unit
 - Begins with a guide star acquisition
 - Cumulative pointing offset less than 30-80 arcsec



Narrow roll limits

