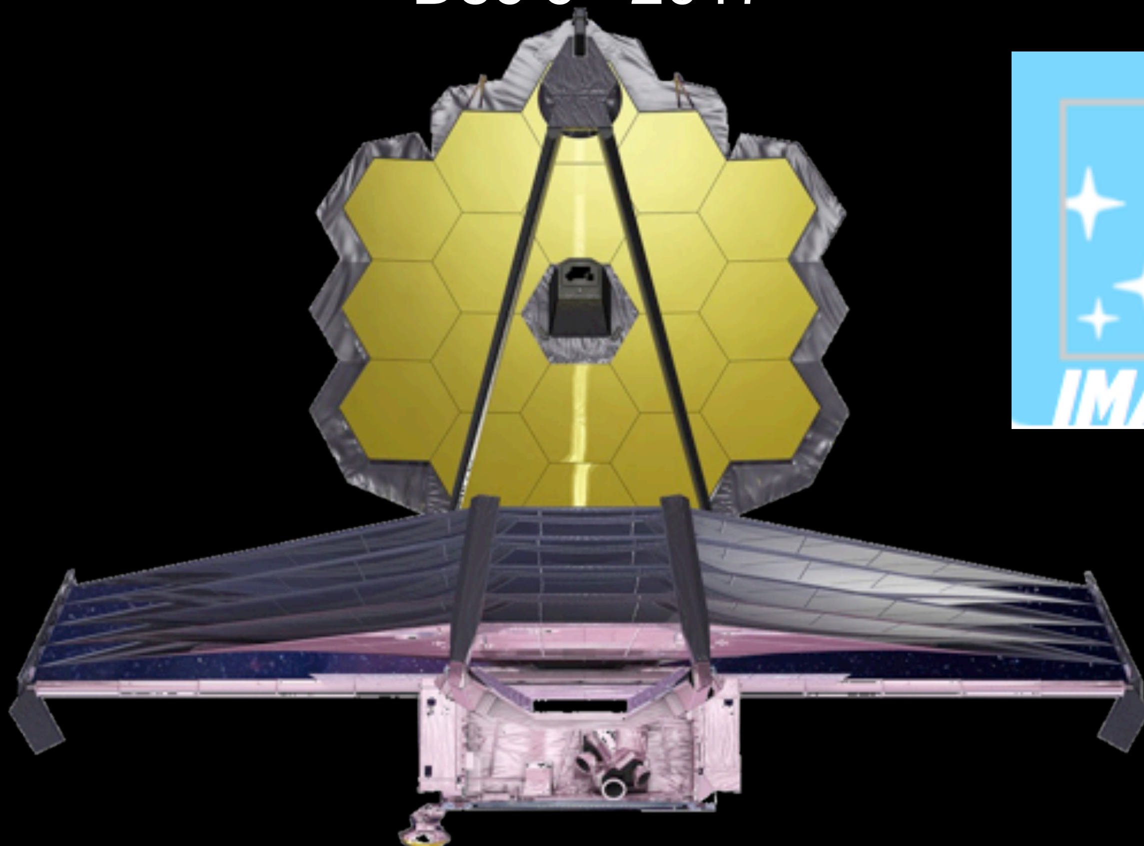
Imaging with JWST

CSA webinar #3

Dec 6th 2017



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OBSERVATOIRE DU MONT-MÉGANTIC

STScI Invites Scientists To Submit Proposals for JWST Cycle 1

News Feature • November 30, 2017

We are pleased to announce that the JWST Cycle 1 call for proposals for general observer (GO) time has been released, with up to 6,000 hours available in this cycle. Observing programs will be offered in multiple categories, determined by program size and other criteria.

Program Category	Size	Estimated Allocation*
Small programs	≤ 25 hours	3,500 hours
Medium programs	>25 and ≤ 75 hours	1,500 hours
Large programs	>75 hours	1,000 hours

* Subject to TAC adjustment.

In addition, the Cycle 1 call supports Calibration Proposals, Long-Term Proposals, Treasury Proposals, and Survey Proposals. We also invite proposals for Theory Programs, Data Science Software development, and Archival Programs to support analysis of calibration and the Director's Discretionary Early Release Science (DD-ERS) data.

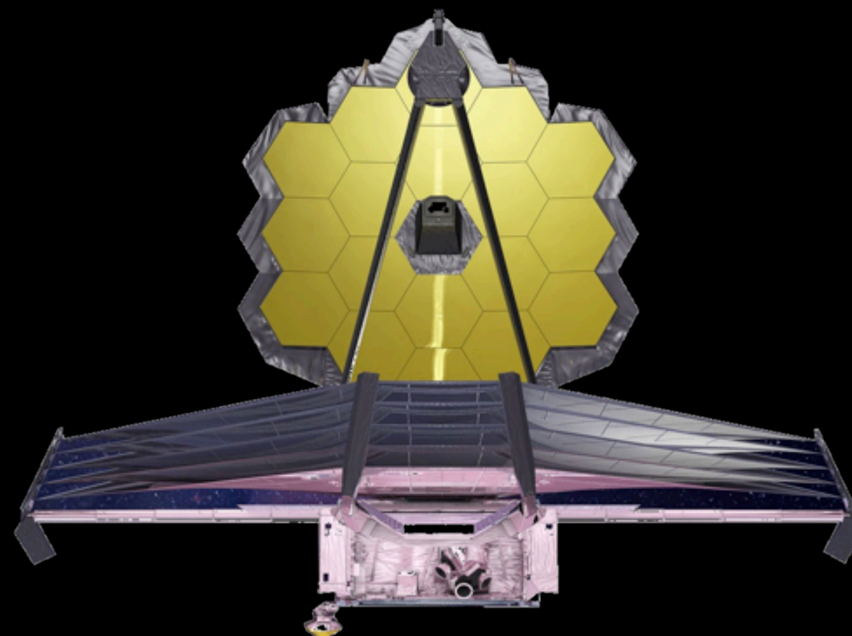
Proposals are due by 8 p.m. Eastern Time on April 6, 2018. The Cycle 1 Time Allocation Committee will meet in late June 2018, with selections announced in July 2018.

For more details, please consult the full call for proposals. Questions may be submitted to the JWST Help Desk.

Outline

Recap of JWST imaging modes

Demo with a science case



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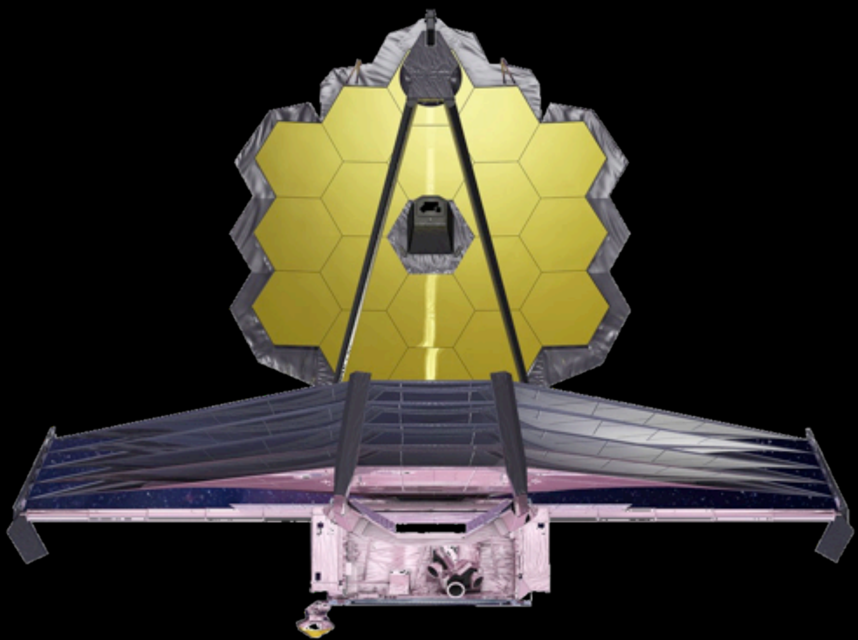
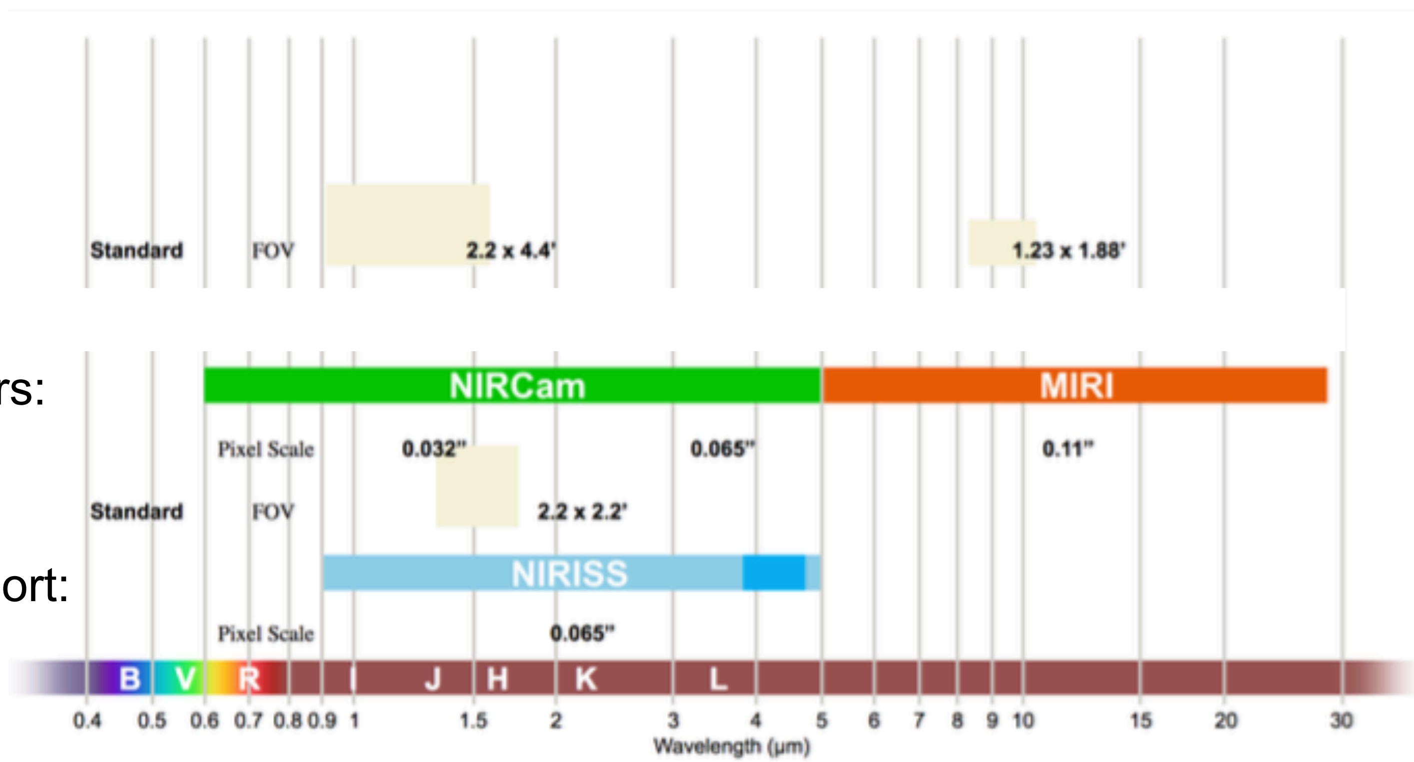


Wavelength coverage from 0.6 to 29.8 μm

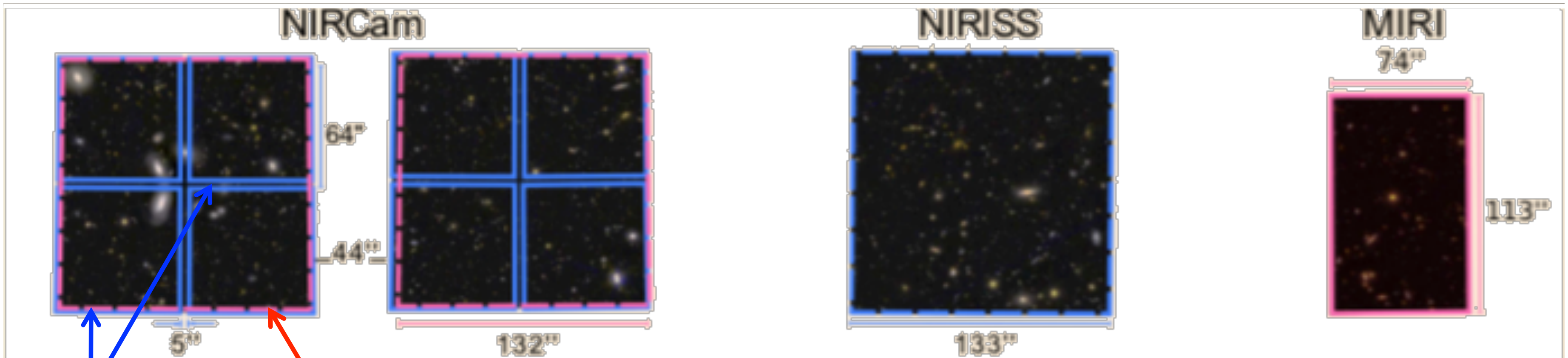
Prime imagers:

Parallel/support:



©G. Kriss

Field of view of imaging instruments



Short wavelength
detectors
32 mas/px

Long wavelength
Detector
65 mas/px

65 mas/px
(parallel only)

110 mas/px

Fully redundant modules (A&B)
2x 2.2'x2.2'

©G. Kriss

Dithering for spatial coverage, cosmetics, background, and pixel sampling

NIRCAM:

- primary dithers:

➡ fill in module (FULL) and detector (INTRAMODULE/INSTRASCA) gaps

- secondary dithers:

➡ improved data processing

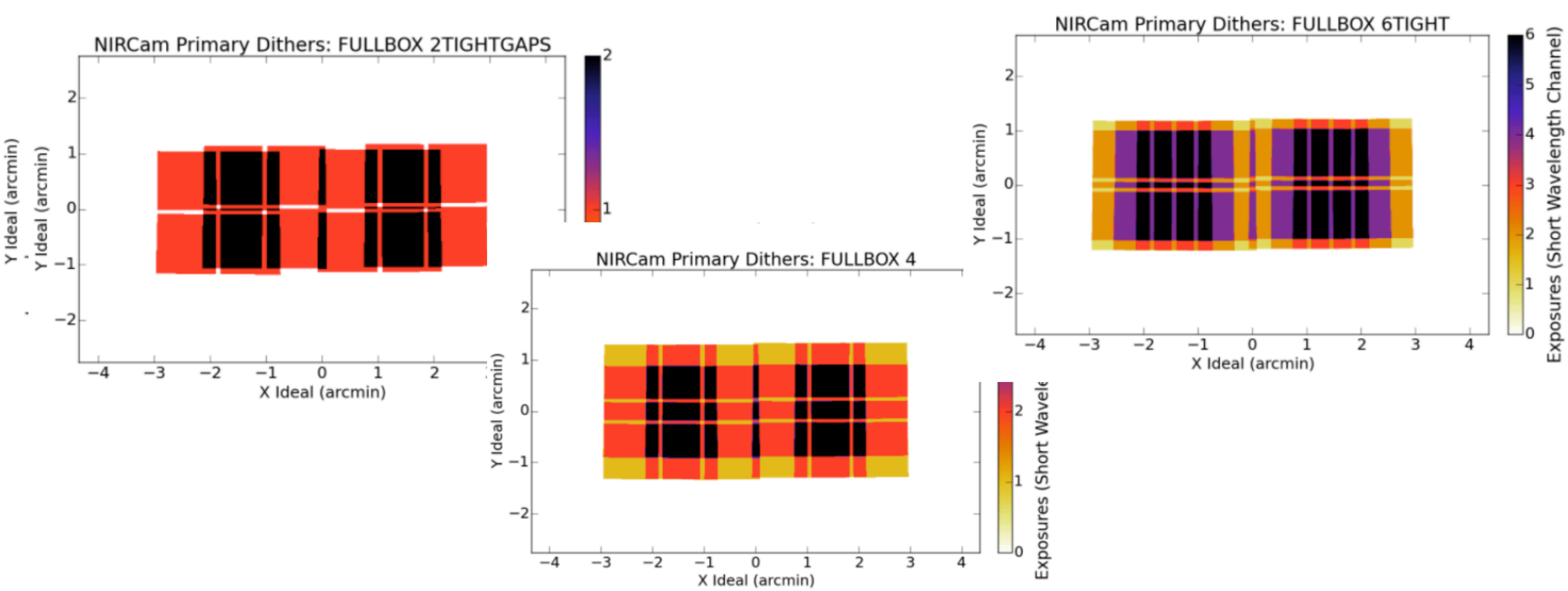
MIRI:

- Reuleaux triangles
- 2 and 4 point patterns
- cycling pattern

➡ for different strategies and source morphology

NIRCAM primary dithering patterns

(FULL)/FULLBOX: 3-45 points. Cover large fields (10’x10’) with both modules without gaps, designed to use with mosaics. FULLBOX more efficient (time, sampling) than FULL for >4pts.



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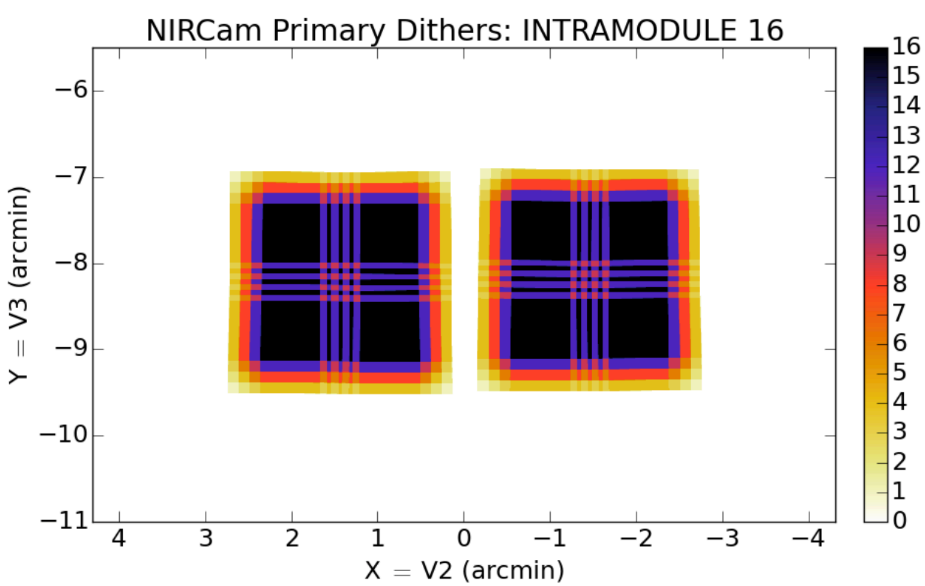
NIRCAM primary dithering patterns

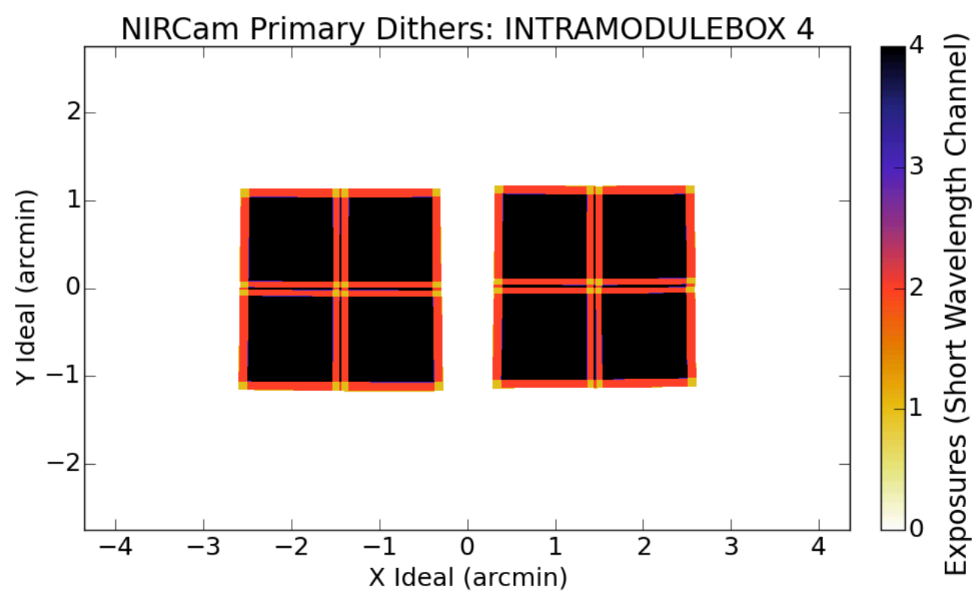
(INTRAMODULE)/INTRAMODULEX/INTRAMODULEBOX:

2-16 points. Fill in 5'' gaps on the SW detectors for objects smaller than 2'.

INTRAMODULEX more efficient for >4pts

INTRAMODULEBOX for 4 pts is more compact and homogeneous





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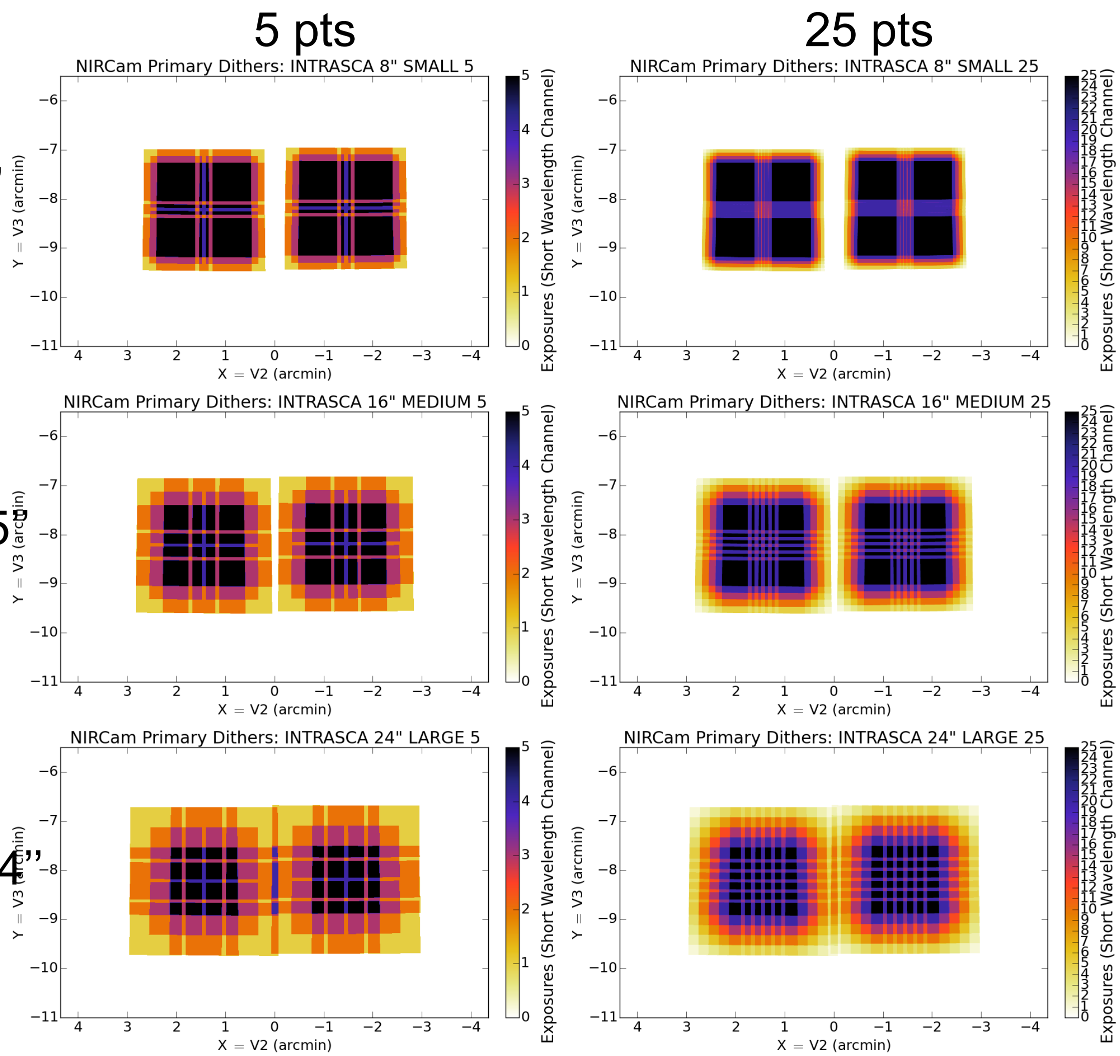
NIRCAM primary dithering patterns

INTRASCA:
2-25 points,
three sizes,
mitigate flat field variation
for small targets
(<64’’)

½ pattern:8’’

½ pattern:15’’

½ pattern: 24’’



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NIRCAM secondary dithering patterns

Important for pixel sampling below 2 µm in the SW channel and 4 µm in the LW channel.

1-64 points.
<9 fit within 13x13 pixels.

>9 for flat field mitigation and bad pixel rejection

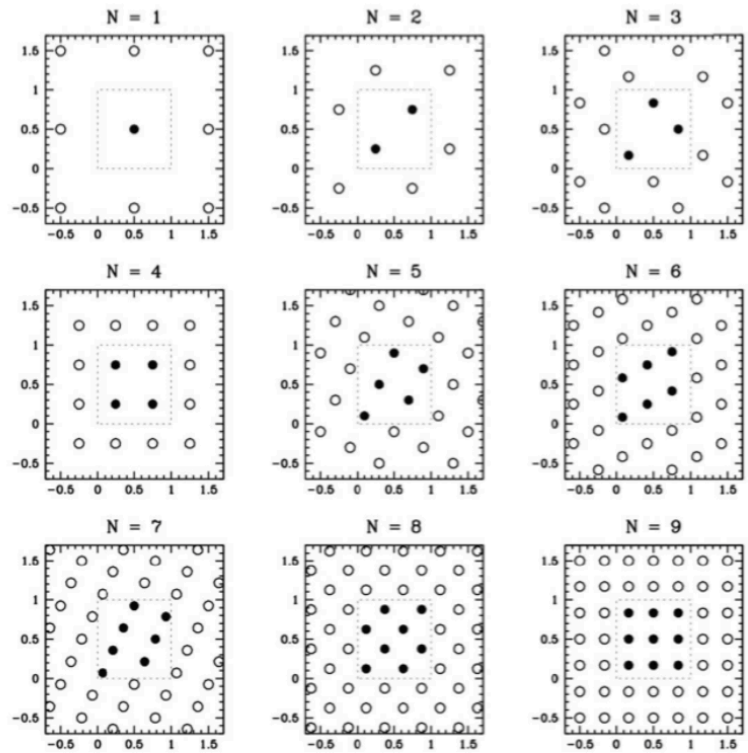

Figure 5: The pixel-phase coverage for the secondary dither patterns with N_S from 1 to 9. The dotted line shows the outline of a pixel and the filled circles are the pixels from the N_S dithers that would fall within the bounds of that pixel. The open circles show where relative to this pixel the neighboring pixels would sample.

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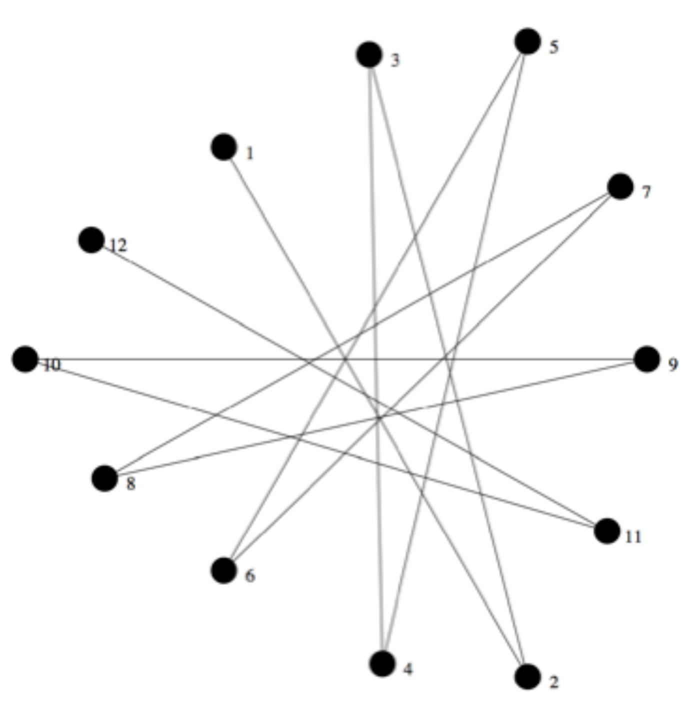
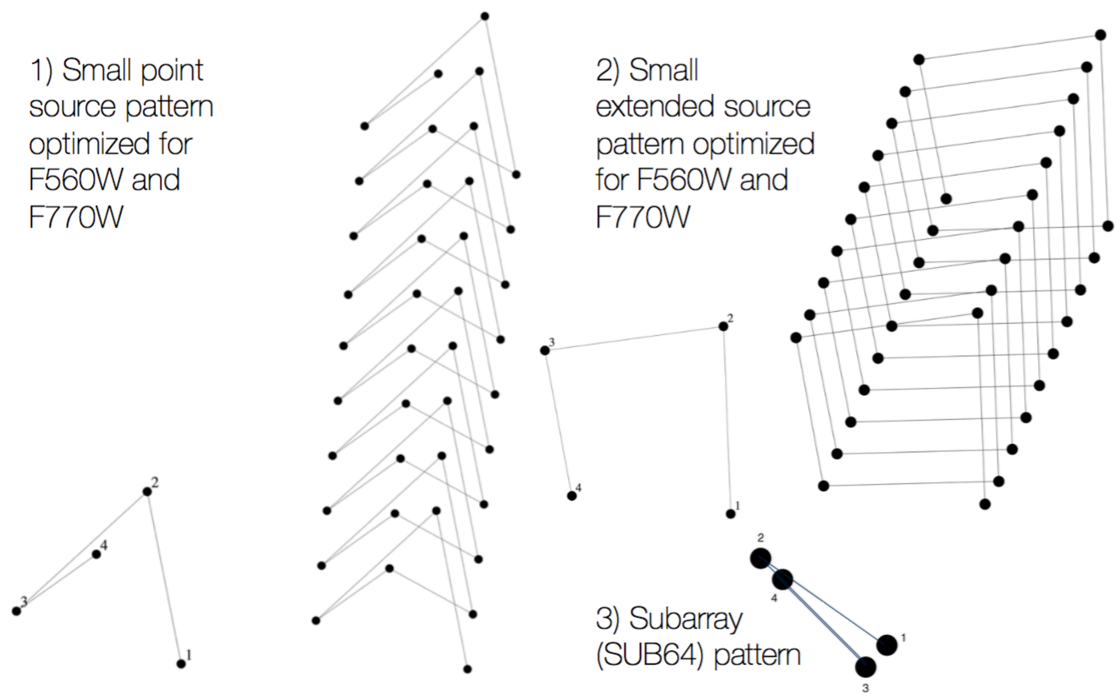
MIRI dithering patterns

Reuleaux: 13 points in 3 sizes for barely resolved targets.



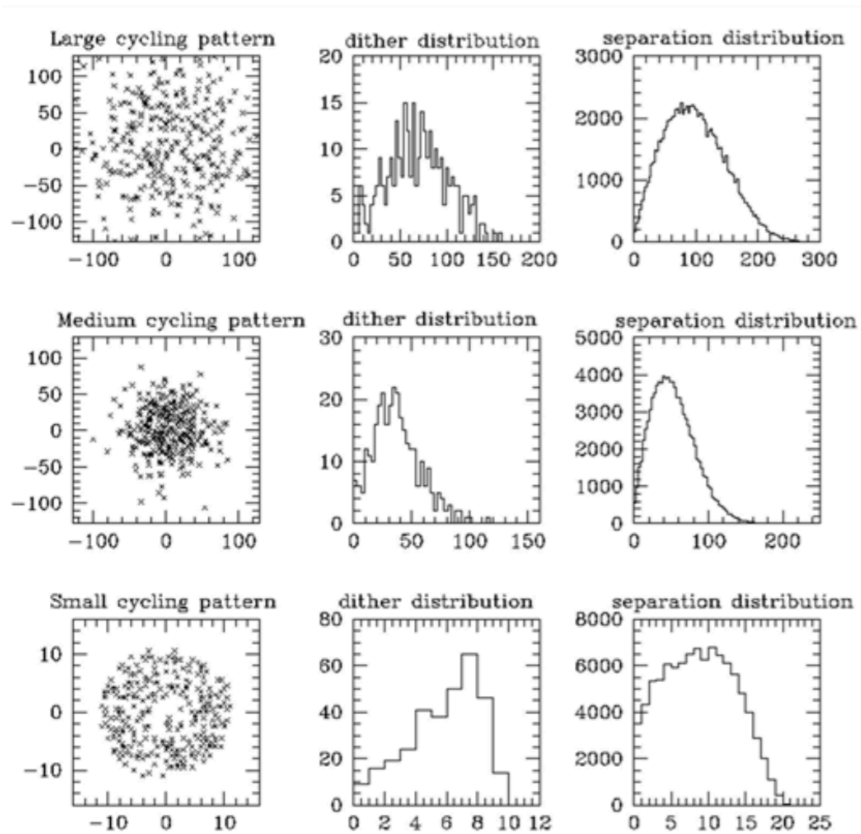
MIRI dithering patterns

4-points: 5 patterns for point or extended sources.



MIRI dithering patterns

Cycling: flexible within three sizes and 311 points.



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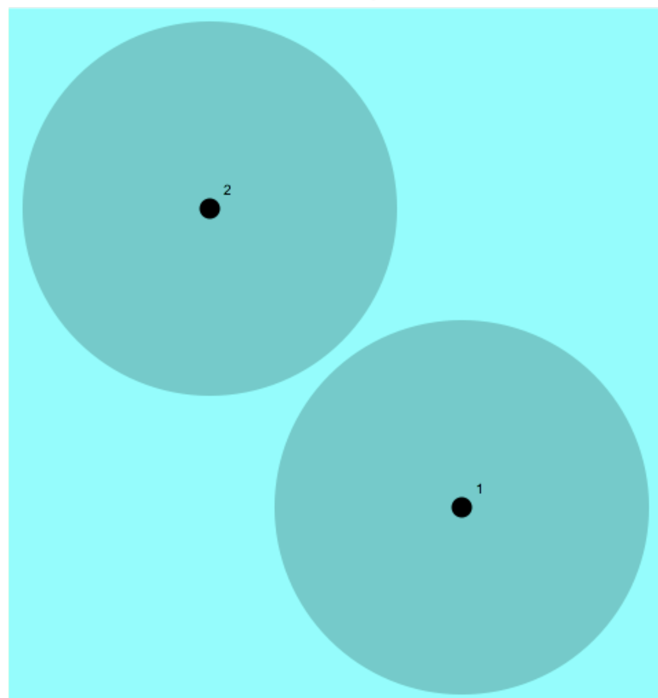
MIRI dithering patterns

2-points: 1 option for background subtraction

2−Point
on SUB64 @ 21 μm



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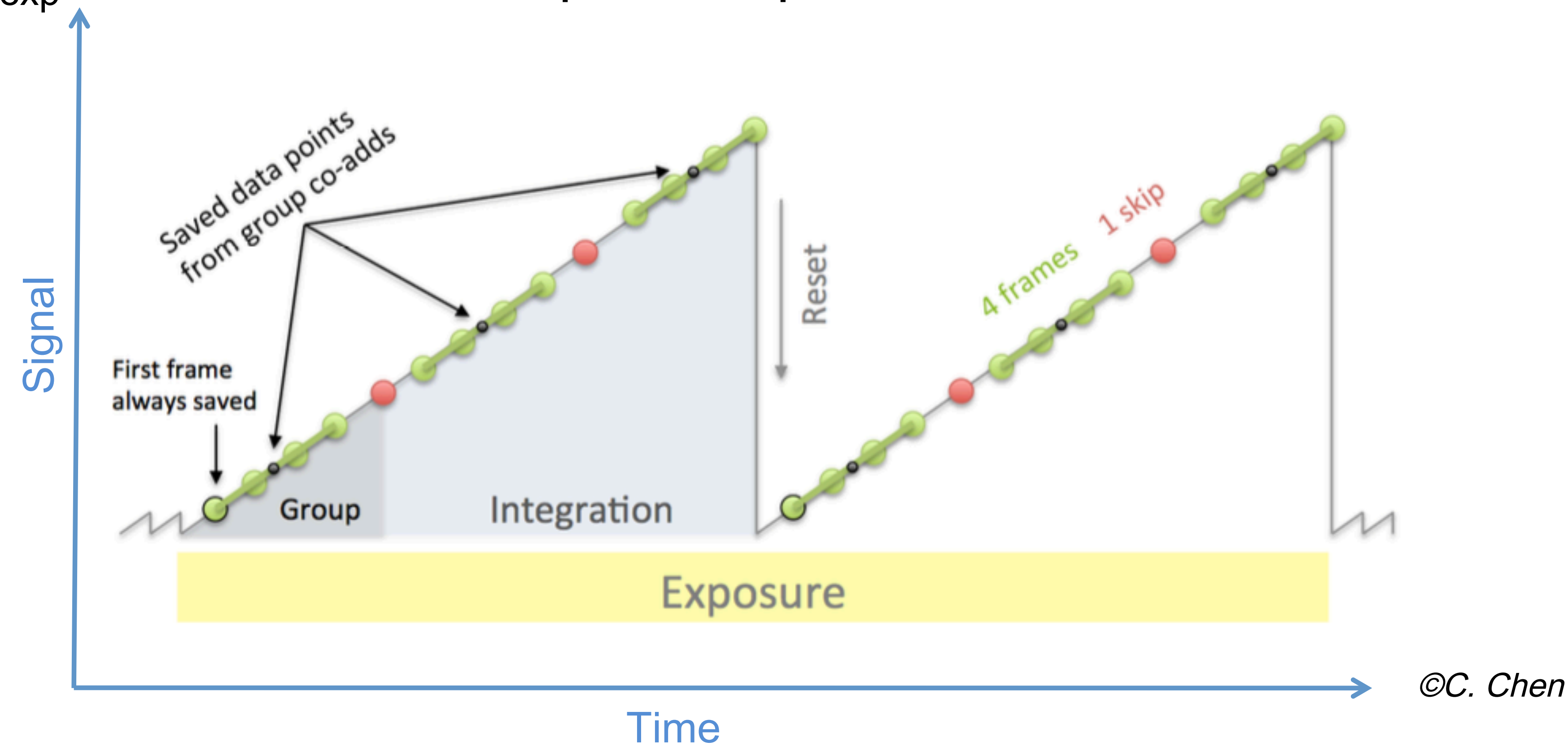
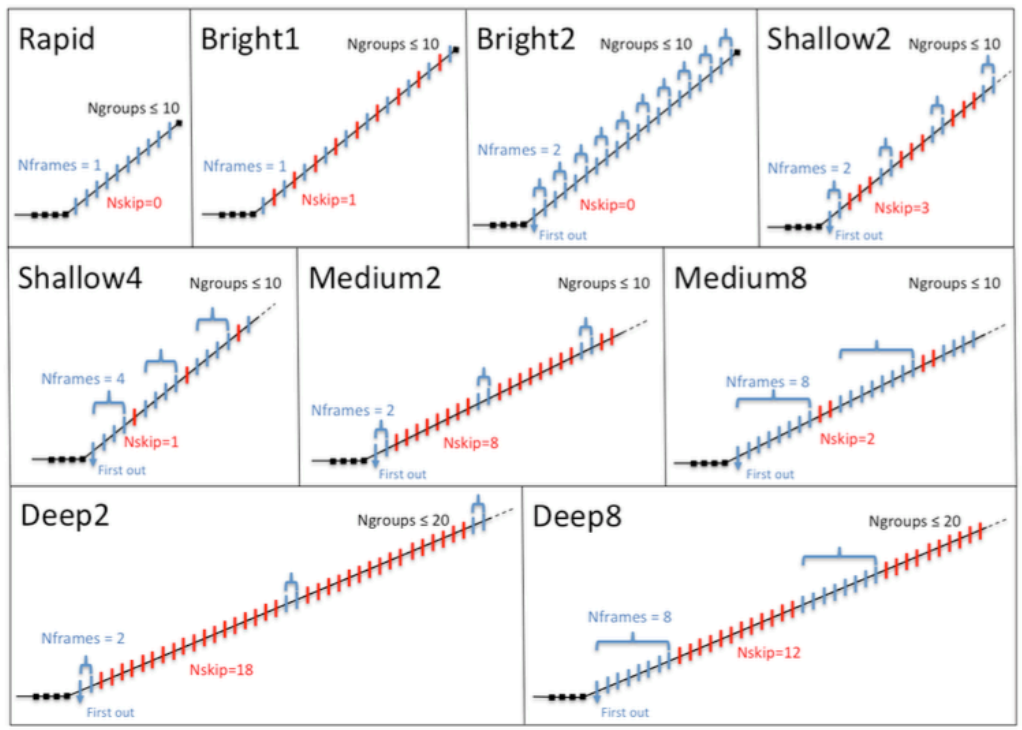
Review your IR vocabulary

N_f is the number of frames averaged in a group
N_g is the number of groups in an integration (ramp)
N_{int} is the number of integrations (ramps)
N_{exp} is the number of exposures per visit



NIRCAM Readout patterns

Choice depends on source flux and requested integration time

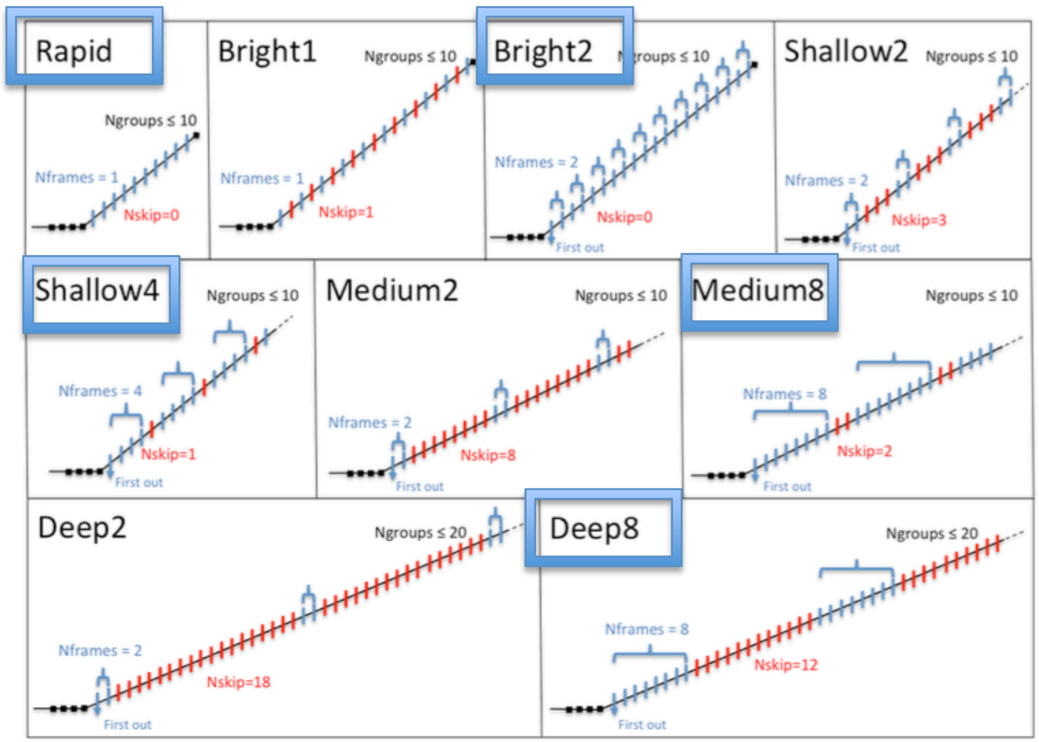


See Jdox: NIRCAM imaging sensitivity
See Robberto 2010 JWST-STScI-2128
"NIRCam Point Source SNR vs. Filter, Source Brightness and Readout Combinations"

NIRCAM Readout patterns

Choice depends on source flux and requested integration time

Choose highest N_{frames} for required integration length



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NIRCAM Readout patterns

Choice depends on source flux and requested integration time

Table 6 Optimal readout pattern vs. photon flux. Red cell indicate saturation.

IT	0.000625e/s	0.00625e/s	0.0625e/s	0.625e/s	6.25e/s	62.5e/s
21.2	RAPID-2					
31.8	RAPID-3					
42.4	RAPID-4					
53	BRIGHT1-3	RAPID-5				
63.6	RAPID-6					
74.2	BRIGHT1-4	RAPID-7				
84.8	BRIGH2-3	RAPID-8				
95.4	BRIGHT1-5	RAPID-9				
106	RAPID-10					
116.6	BRIGHT1-6	BRIGH2-4				
127.2	MEDIUM2-2	SHALLOW2-3				
137.8	BRIGHT1-7					
148.4	BRIGH2-5		SHALLOW4-3			
159			BRIGHT1-8		BRIGHT1-8	
180.2	SHALLOW2-4		BRIGH2-6			

See Jdox: NIRCAM imaging sensitivity
See Robberto 2010 JWST-STScI-2128
“NIRCam Point Source SNR vs. Filter, Source Brightness and Readout Combinations”

MIRI& NIRISS Readout patterns

MIRI:

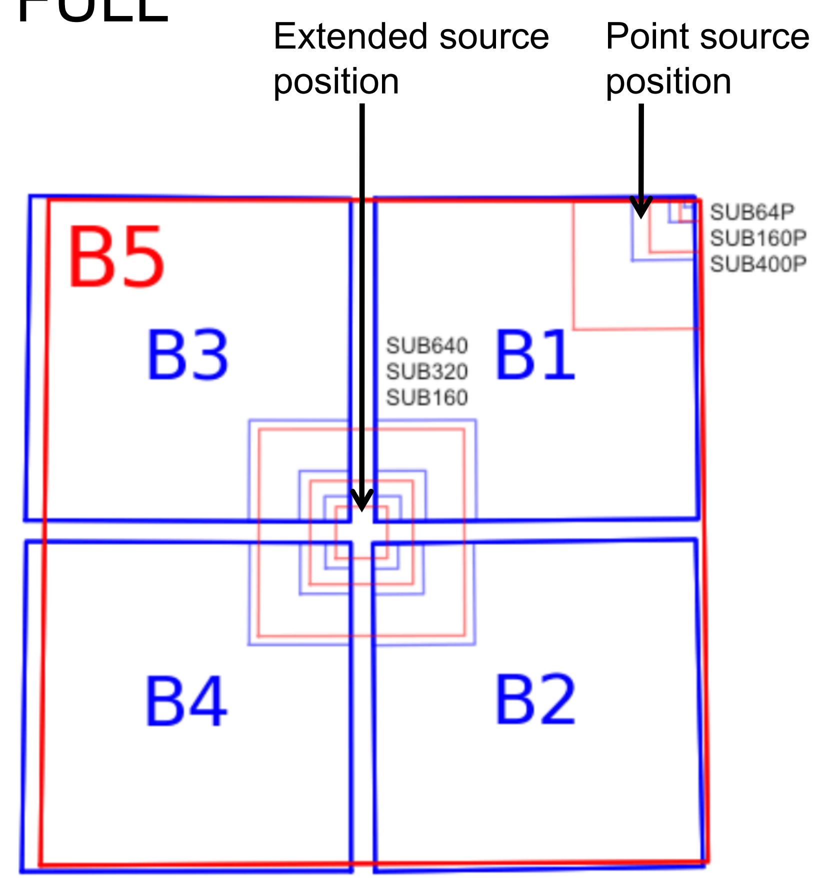
- FAST (default in subarray): N_f=1, N_s=0, t_f=2.775s

NIRISS:

- NISRAPID: N_f=1, N_s=0
- NIS (faint source): N_f=4, N_s=0

Subarrays for small or bright targets (bkgd)

NIRCAM: point (SCA3) & extended (all SCA) sources
- SUB64, 160, 320, 400, 640,& FULL



MIRI:
- SUB64, 128, 256, BRIGHTSKY,& FULL

NIRISS:
- SUB64, 128, 256,& FULL

JWST higher-level observations

Coordinated Parallels (for Cycle 1)

- NIRCam Imaging + MIRI Imaging
- NIRCam Imaging + NIRISS Imaging (NIRCam is prime)
- NIRSpec MOS + NIRCam Imaging (NIRSpec is prime)
- NIRISS WFSS + NIRCam Imaging
- NIRISS WFSS + MIRI Imaging

Dithering vs Mosaicking

- mosaic patterns for areas >FoV
- dithering with large patterns and steps
can incur significant overheads
- see visit splitting distance (30 to 80 arcsec) in APT/JDOX

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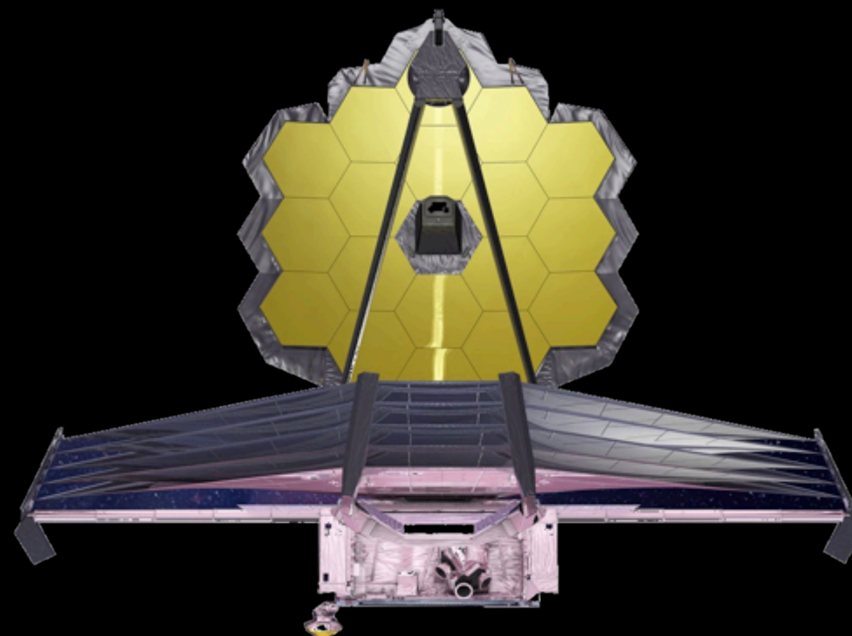


JWST Cycle 1 proposals are due by Apr 6, 2018, in a single phase.

Think of a science project ← You

Verify visibility and orient ← Target visibility tool

Calculate exposure time ← Exposure Time calculator

Plan visits ← Astronomer's proposal tool

Justify science ← You

Submit proposal ← You

Demo: NIRCAM+MIRI Imaging

Photometry of nearby galaxies: NIR-MidIR structure of Arp220

© ESAC Workshop (Brooks, Leurini, Boyer, Macarena, & Martin)

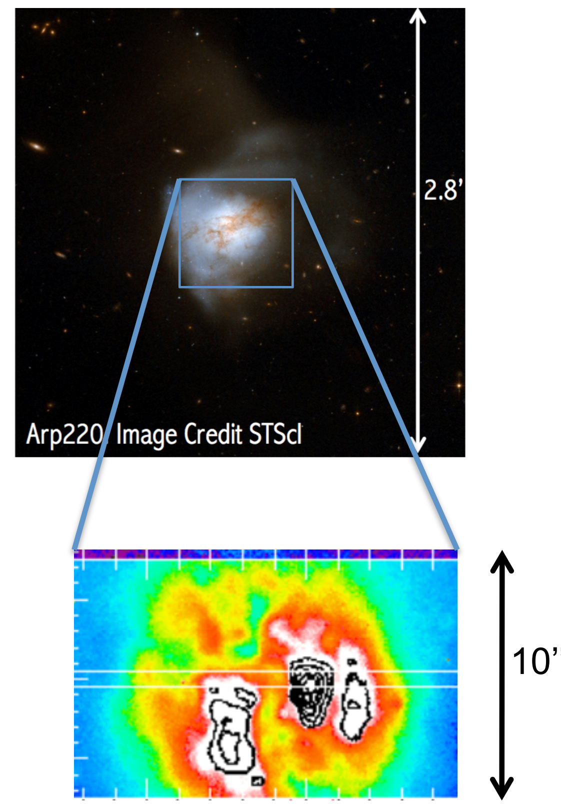
Goal: Multi-component model fitting via unresolved measurements of surface brightness fluctuations and radial stellar population gradiants in the core and disk.

Method: NIRCAM and MIRI photometry in a set of filters that probe the stellar population and the ISM at SNR of 100 in the core (at 5'').

NIRCAM filters: F090W, F115W (stars)
F335M, F444W (dust)

MIRI filters: F770W, F1130W, F1280W (dust)

Source: Extended (z=0.0018)



Ohyuama et al. (2001)

Other useful informations

All JWST data will be reduced by the STScI pipeline (python)
Additional sets of tools are available for analysis

http://ssb.stsci.edu/doc/jwst/jwst/introduction.html

Simulated datasets are available for training

http://archive.stsci.edu/jwst/simulations/index.html

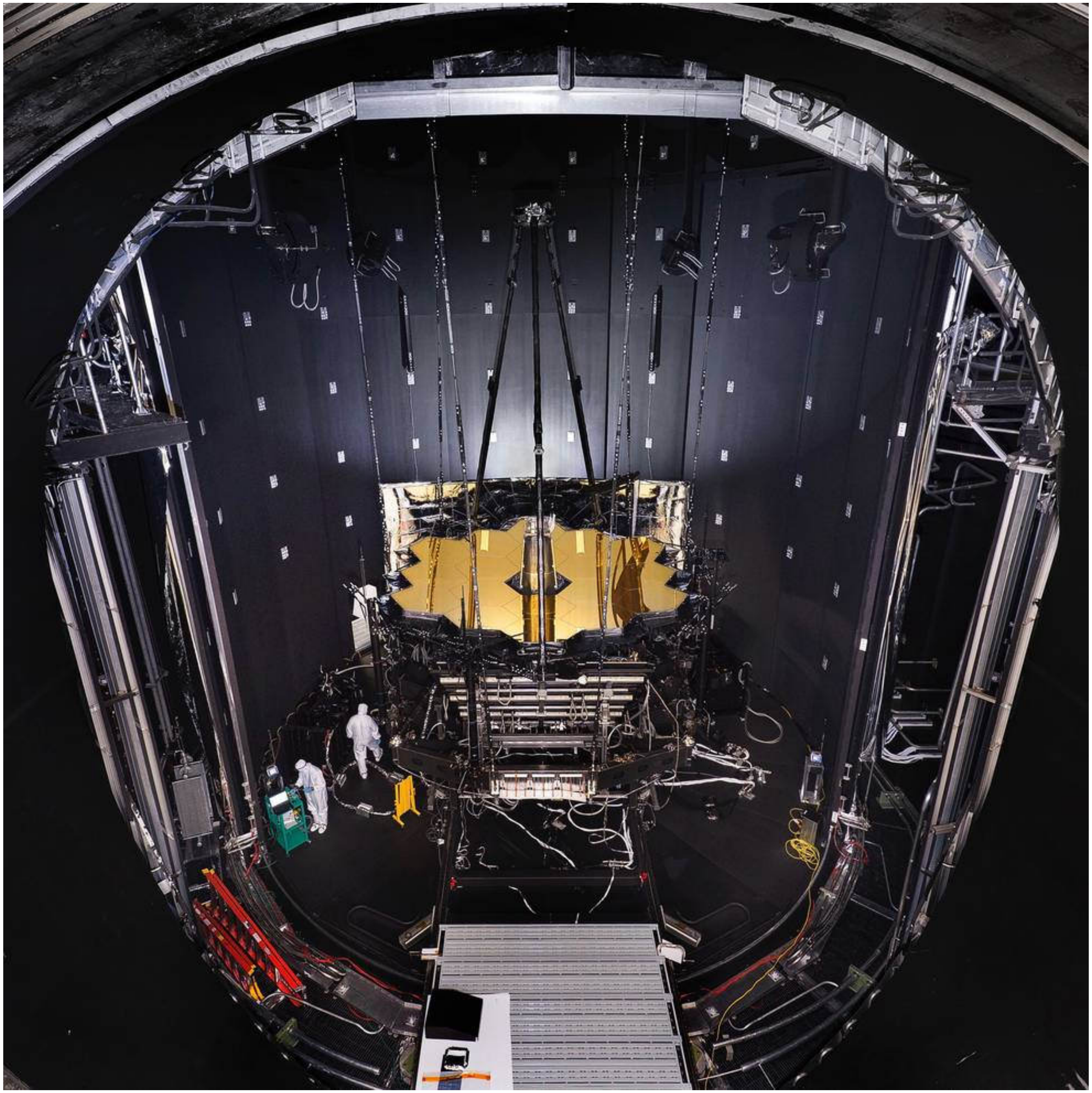
Everything you need to know
(observatory, planning, policies, data): JDox

jwst-docs.stsci.edu

Workshops:

Next:11-14 December 2017, Pasadena (Proposal)

Thank you



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