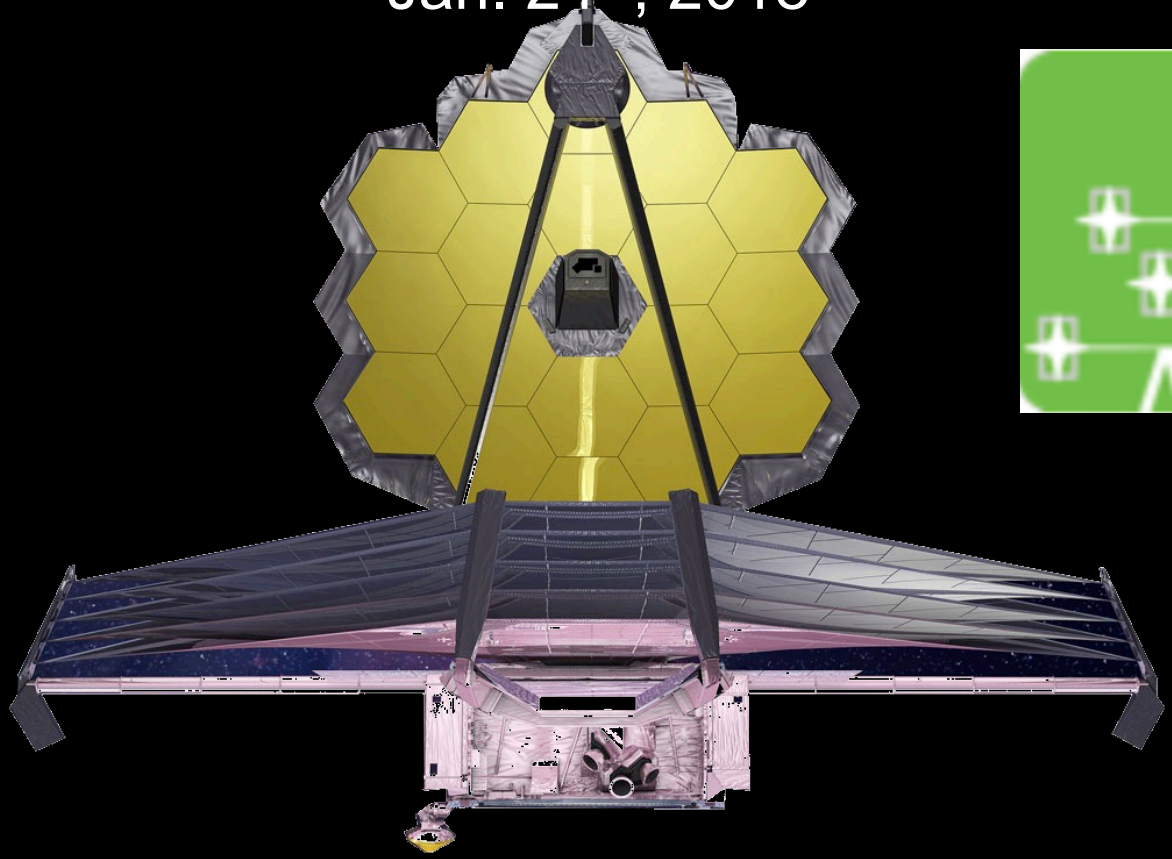
Multi-Object Spectroscopy with JWST

CSA webinar #6

Jan. 24th, 2018



MOS

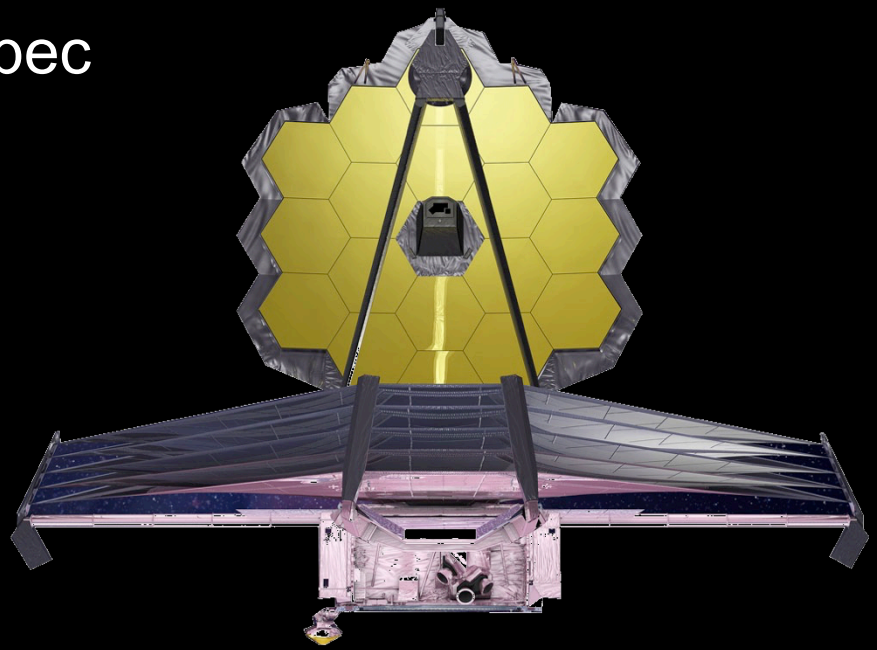
Université de Montréal

NASA esa CSA ASC James Webb Space Telescope JWST NASA • ESA • CSA iREx CRAQ Comprendre l'Univers OBSERVATOIRE DU MONT-MÉGANTIC

Outline

Recap of JWST MOS with NIRSpec

Demo with a science case



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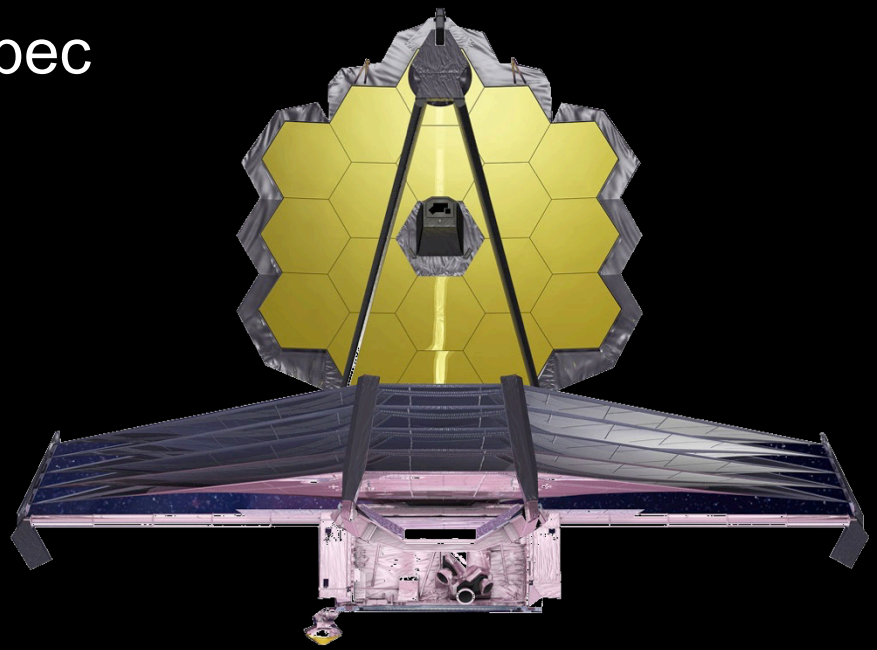
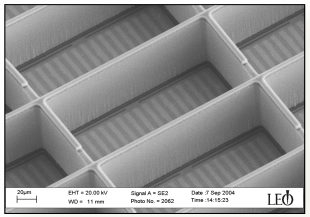
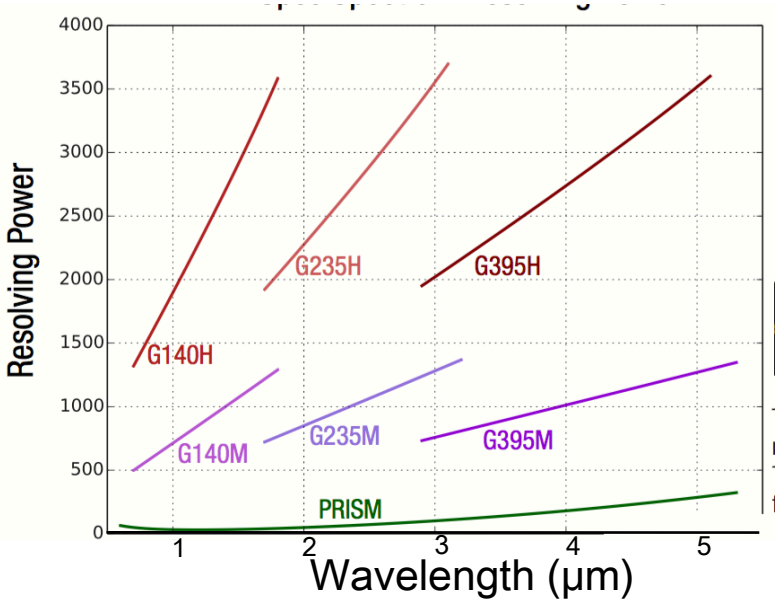


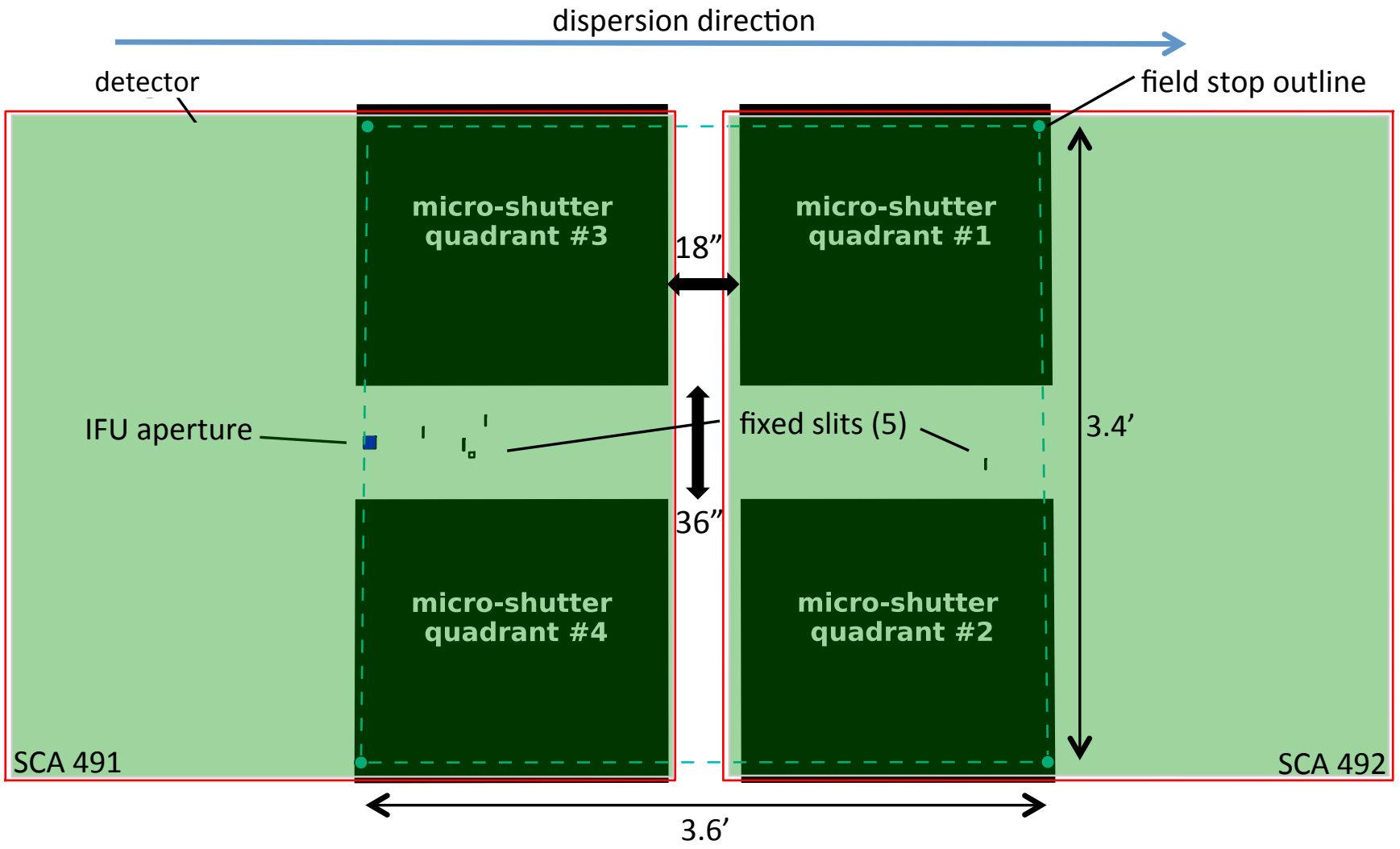
MSA characteristics

250 000 micro shutters on a fixed grid
Micro-shutter FoV: 0.2’’x 0.46’’
FoV: 3.6’x3.4’
λ: 0.6-5.3 μm
Resolution: ~ 100/1000/2700
Very accurate astrometry recommended (5mas)





NIRSpec Focal plane



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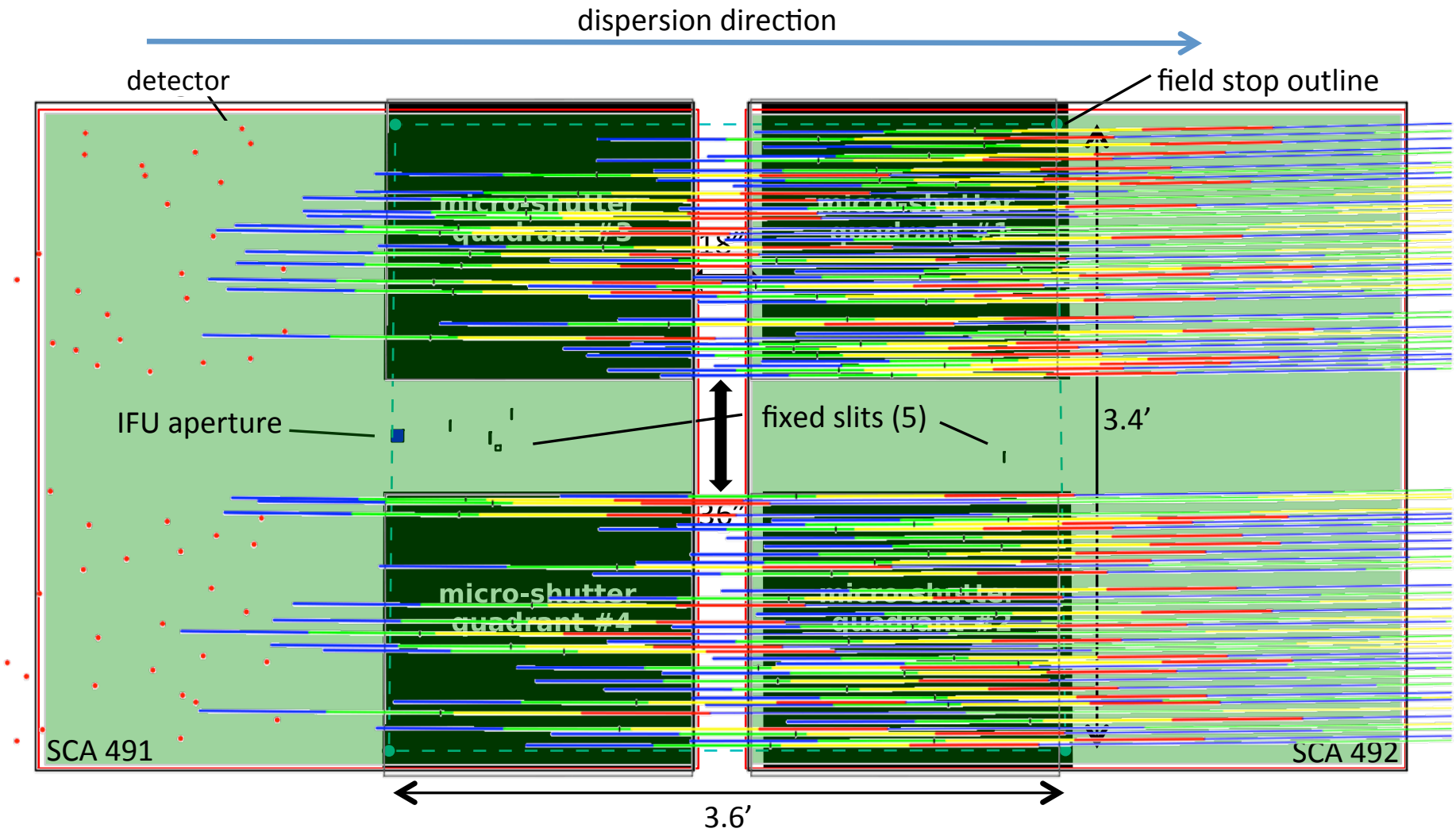

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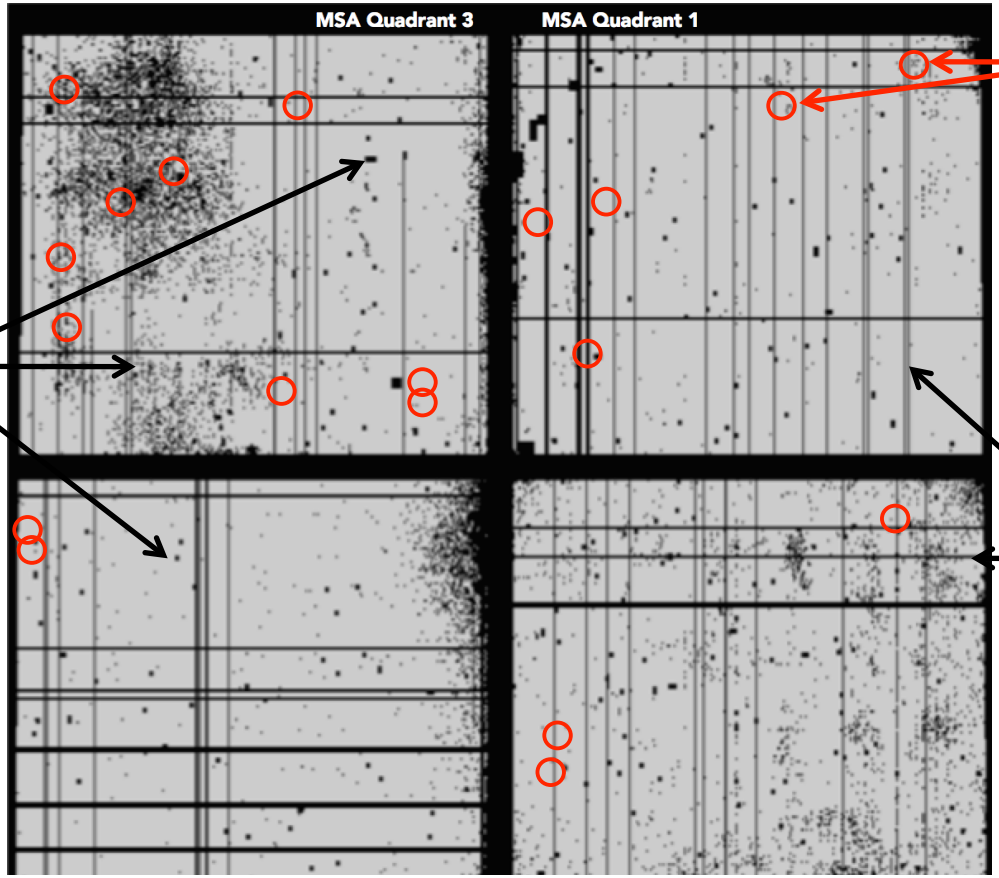
MSA operability map

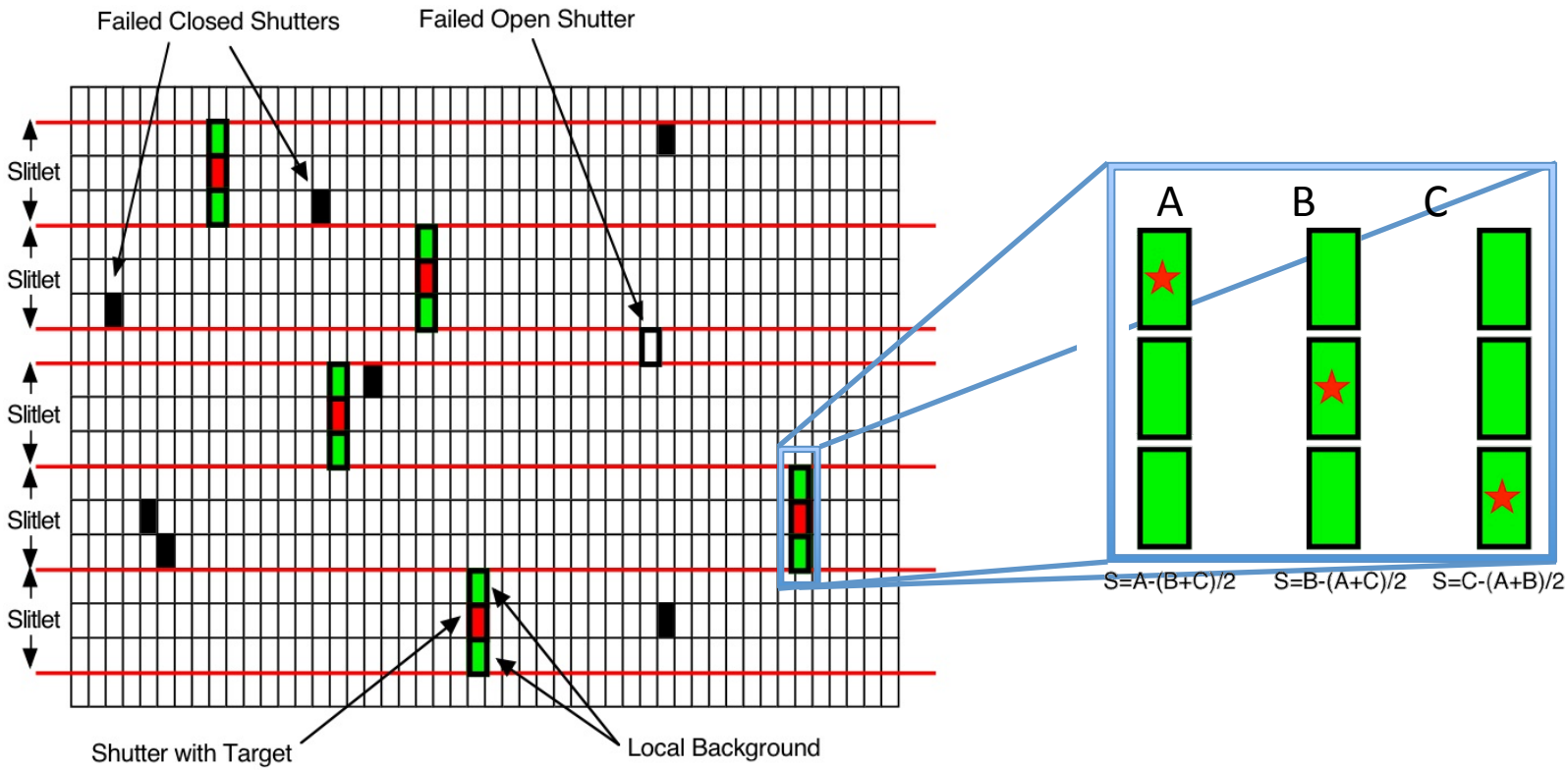


Failed open shutters

Failed closed shutters (12%)

Field stops (electrical shorts)

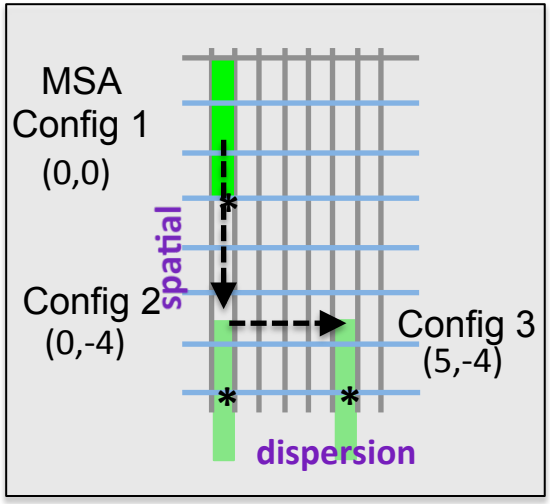
Default observing strategy: slitlet nods



Dithering for improved sampling, cosmetics, background, and flux accuracy

Nodding (0,2,3,5 points)
- default in mini-slits to subtract brackground
- can be combined with dithering

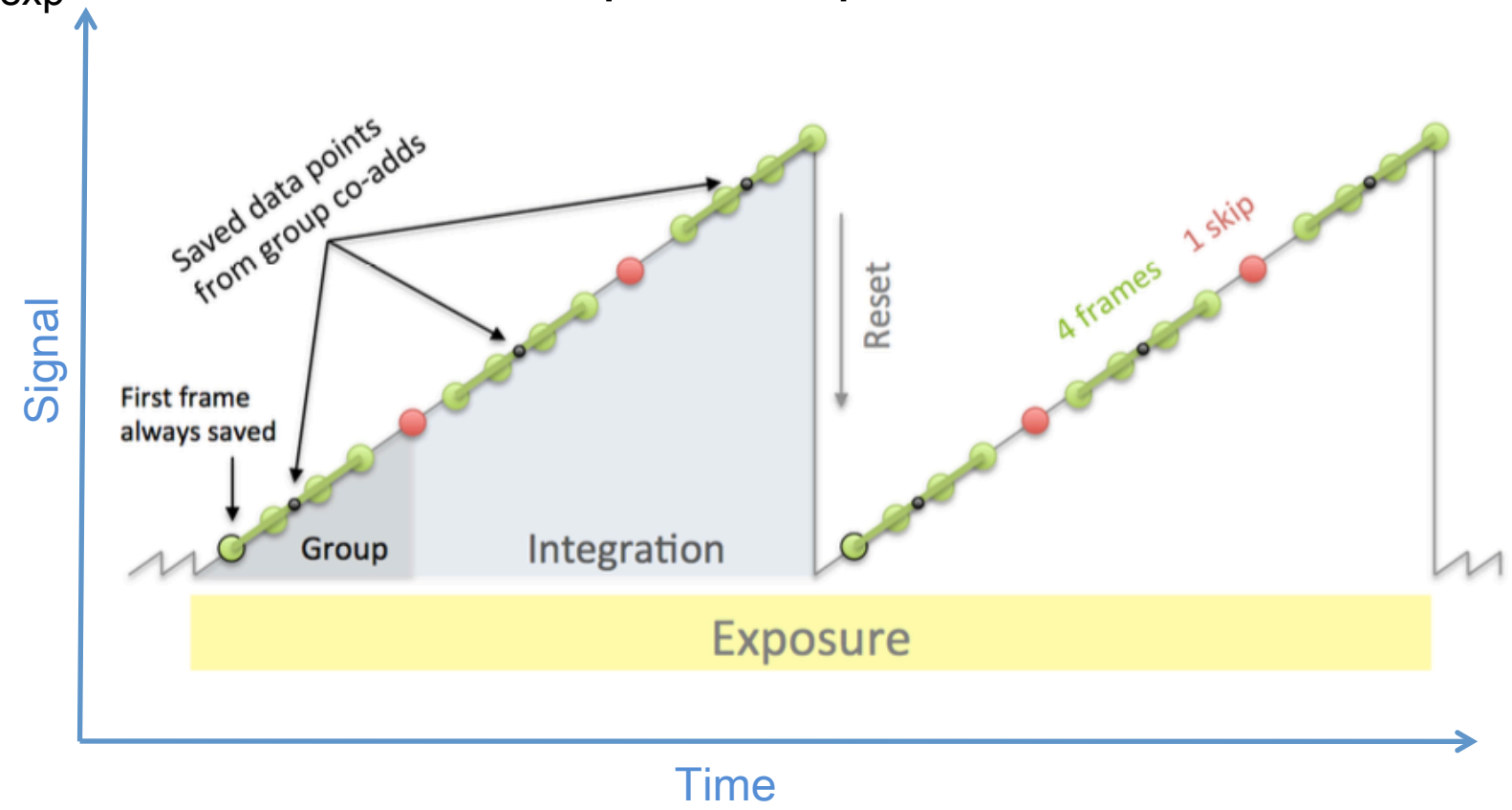
Fixed dithering patterns (recommended)
- translate the source to other slitlets
- all sources are observed at each point



Flexible dithering patterns
- user-specified spatial and dispersion offset
- some sources can be observed once
- handle relative distortion (usefull for large dithers)

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



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NIRSpec MOS readout patterns

NRSRAPID:

N_f=1, t_f=10.7s

NRS:

N_f=4, t_f=42.8s

Both with IRS^2:

improved sensitivity (longer t_f and higher data volume)

Target acquisition (MSTA) is needed

TA type	Estimated Delivered TA accuracy	Catalog relative astrometric accuracy	Science Goal
Optimal 5-20 ref. stars	<20 mas (0.1 shutter width)	~ 5 mas	Best possible photometric accuracy
Relaxed 5-20 ref. stars	<~ 50 mas	< 40 mas	Extended sources, or reduced flux accuracy w/ MSA
Verify Only – no TA, just GS acq	~100 mas **TBD**	NO reference stars required.	Limited MSA science

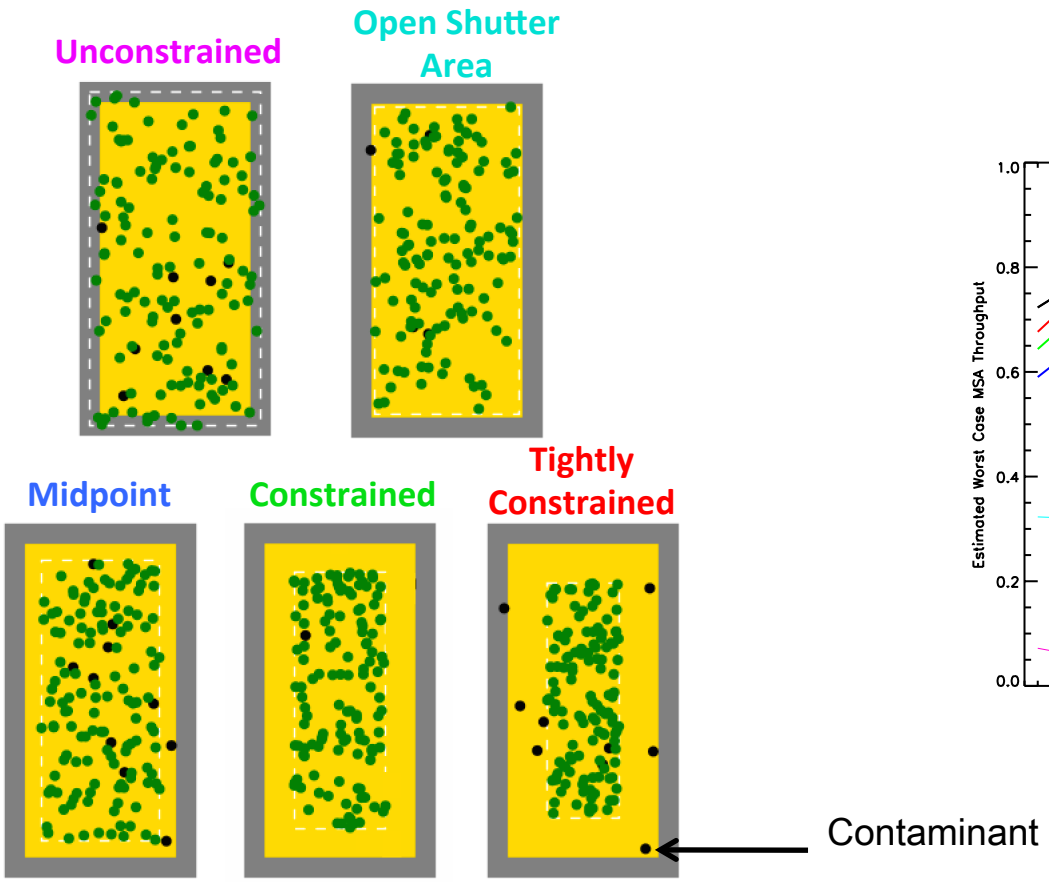
NIRSpec MSA observing planning

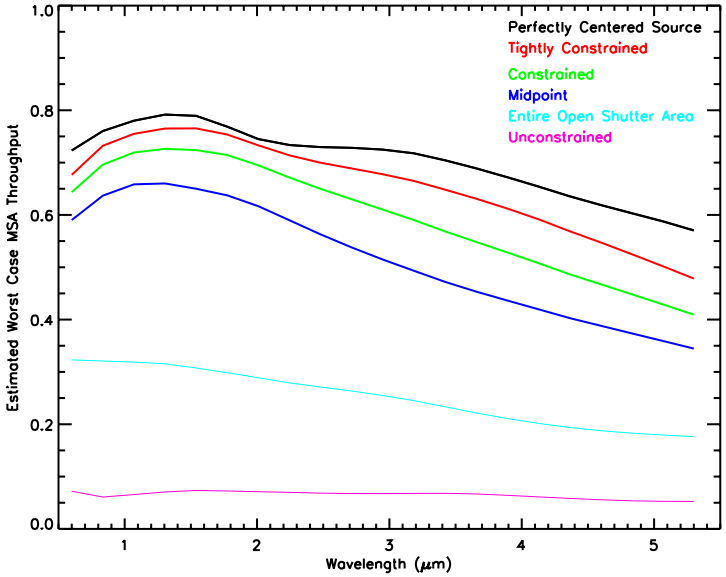
1. HST/NIRCAM pre imaging for high-accuracy input catalog
2. Input catalog:
   - Design primary and filler
   - Weigthing by importance
3. Choose slitlet pattern
4. Choose dispers
5. Choose a pointing constraint => affect # observed sources
6. Choose a dithering pattern
7. Use the MSA Planning Tool (MPT) on the APT

   $\Rightarrow$ Orient, poiting, and placement optimization calculation to observe the maximum number of sources

MPT margin affects # observed sources

5 shutter magins to limit slit loss at the cost of pointing restrictions





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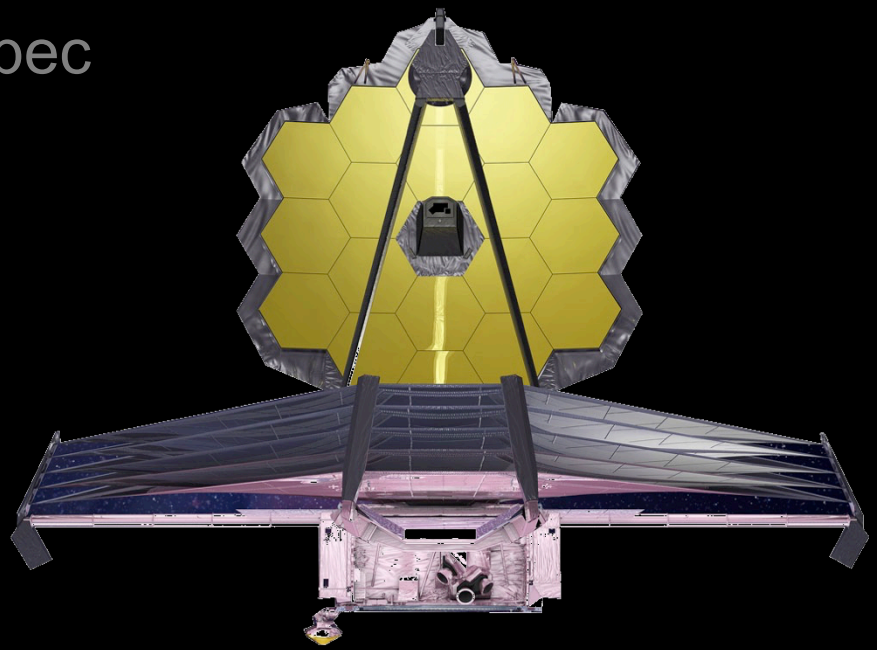
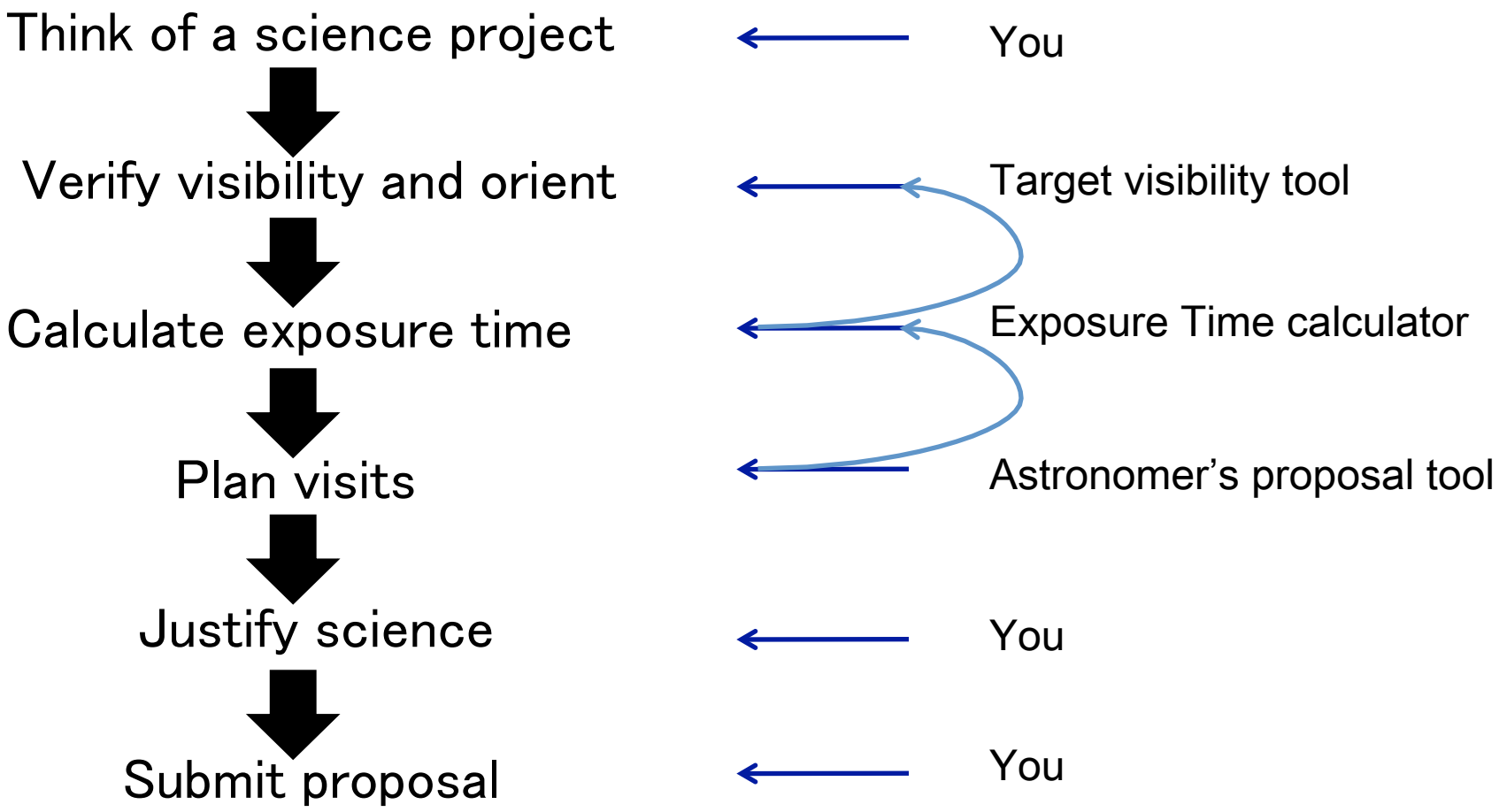


JWST Cycle 1 proposals are due by Apr 6, 2018, in a single phase.



Demo: NIRSpec MOS

MOS of distant galaxies

Goal: Study the evolution of galaxies from z>10 to z=2-6 to understand the early stage of galaxy formation, the role of galaxies in the reionization, measuring SMF and role of AGNs

Method: NIRCAM pre-imaging and NIRSpec MSA of the HUDF at low and medium resolution (F100LP, 170LP, 290LP). Nodding and dithering (3 slitlets). Aim for SNR of ~5-10 on a 26.5 Abmag z=6 blue-compact galaxy and an emission line galaxy

Source: Deep field

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

Thank you