JWST Master Class Workshop

NIRSpec Slit and MOS mode: an introduction

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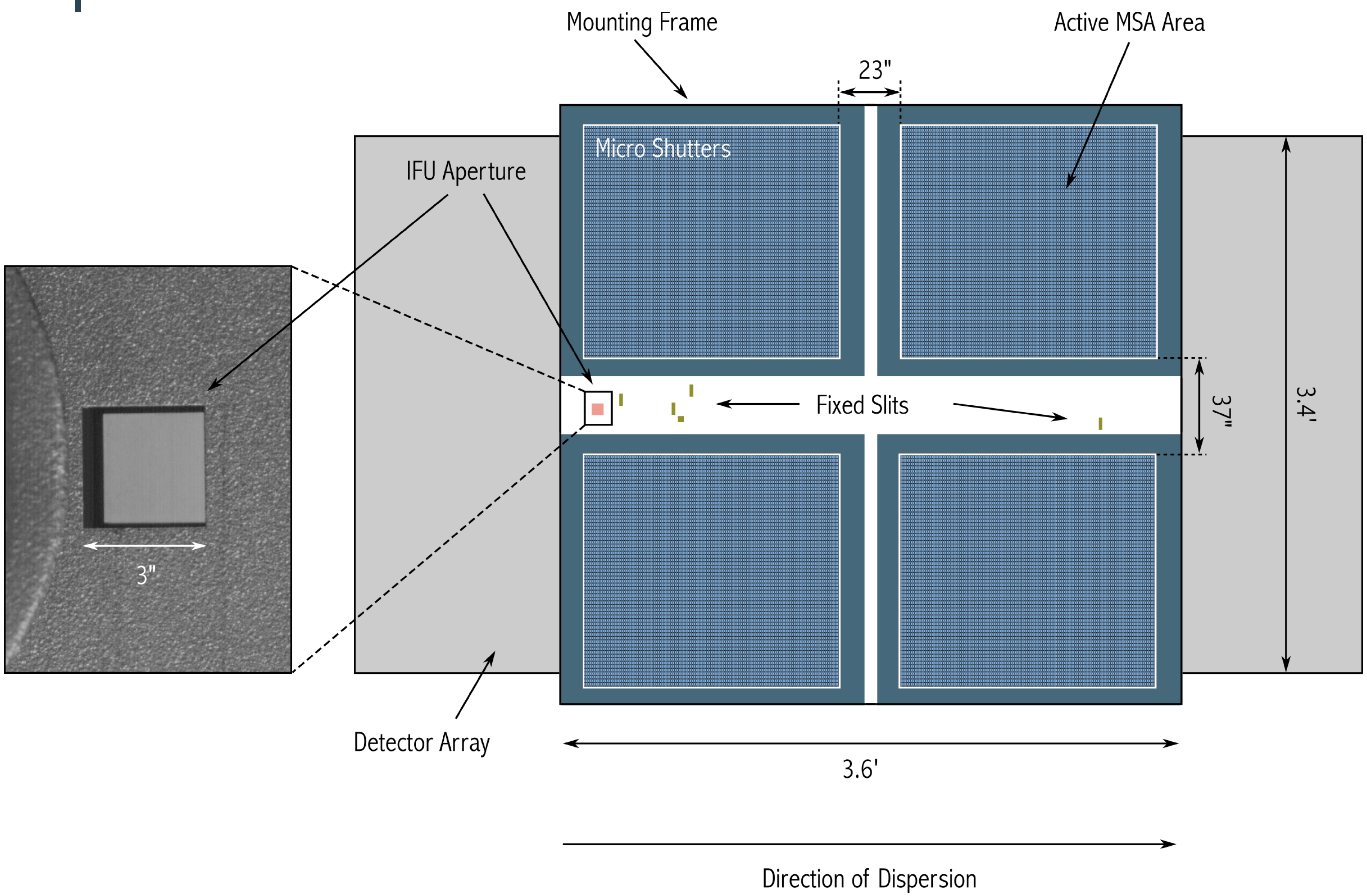
Fixed Slits

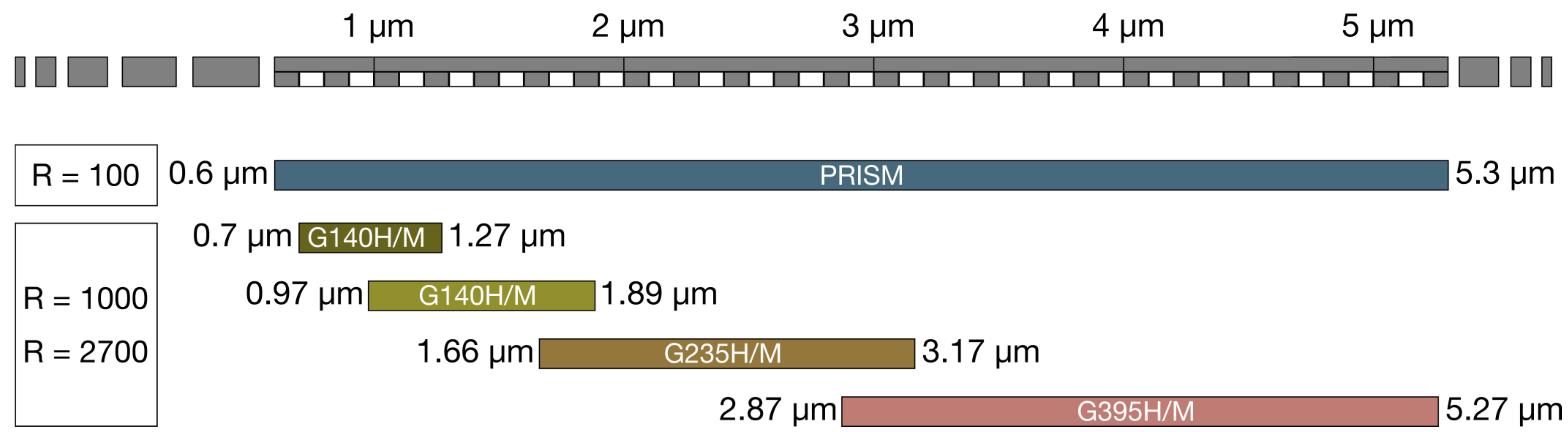
NIRSpec: Hardware



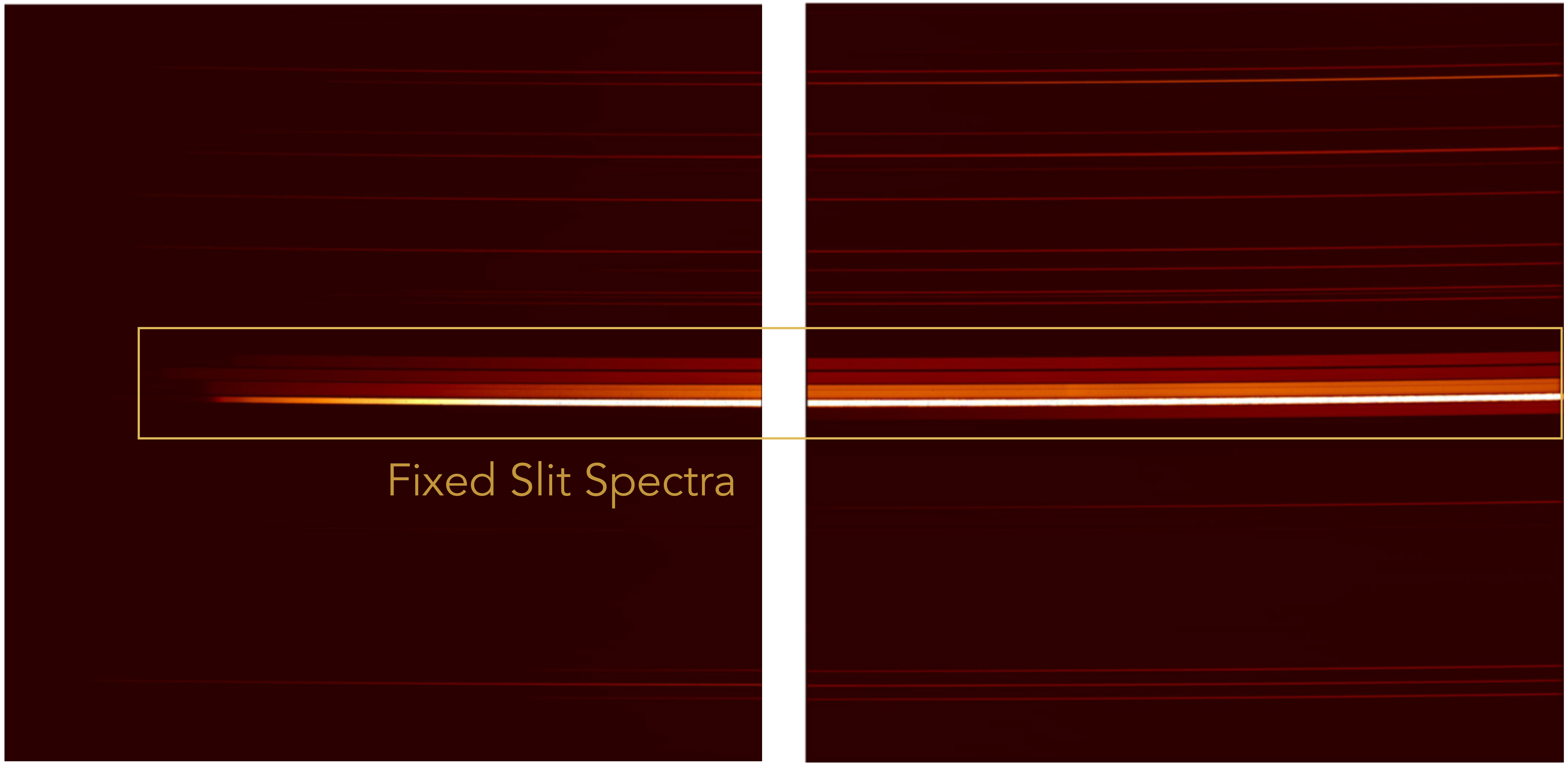
NIRSpec FS Basics and Design

FIXED SLIT SPECTROSCOPY	Single (compact) object (high contrast)	0.2″ x 3.2″ slits (3) 0.4″ x 3.65″ slit 1.6″ x 1.6″ aperture
BRIGHT OBJECT TIME SERIES	e.g. Transit/eclipse spectroscopy	1.6″ x 1.6″ aperture

Six gratings and one prism available as dispersers (full wavelength range)

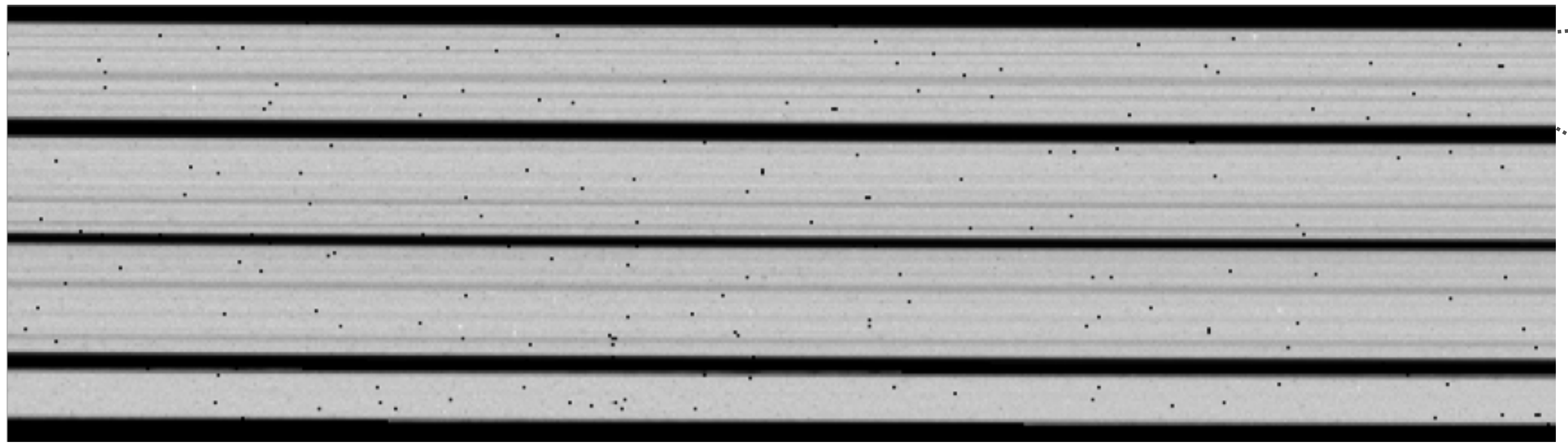


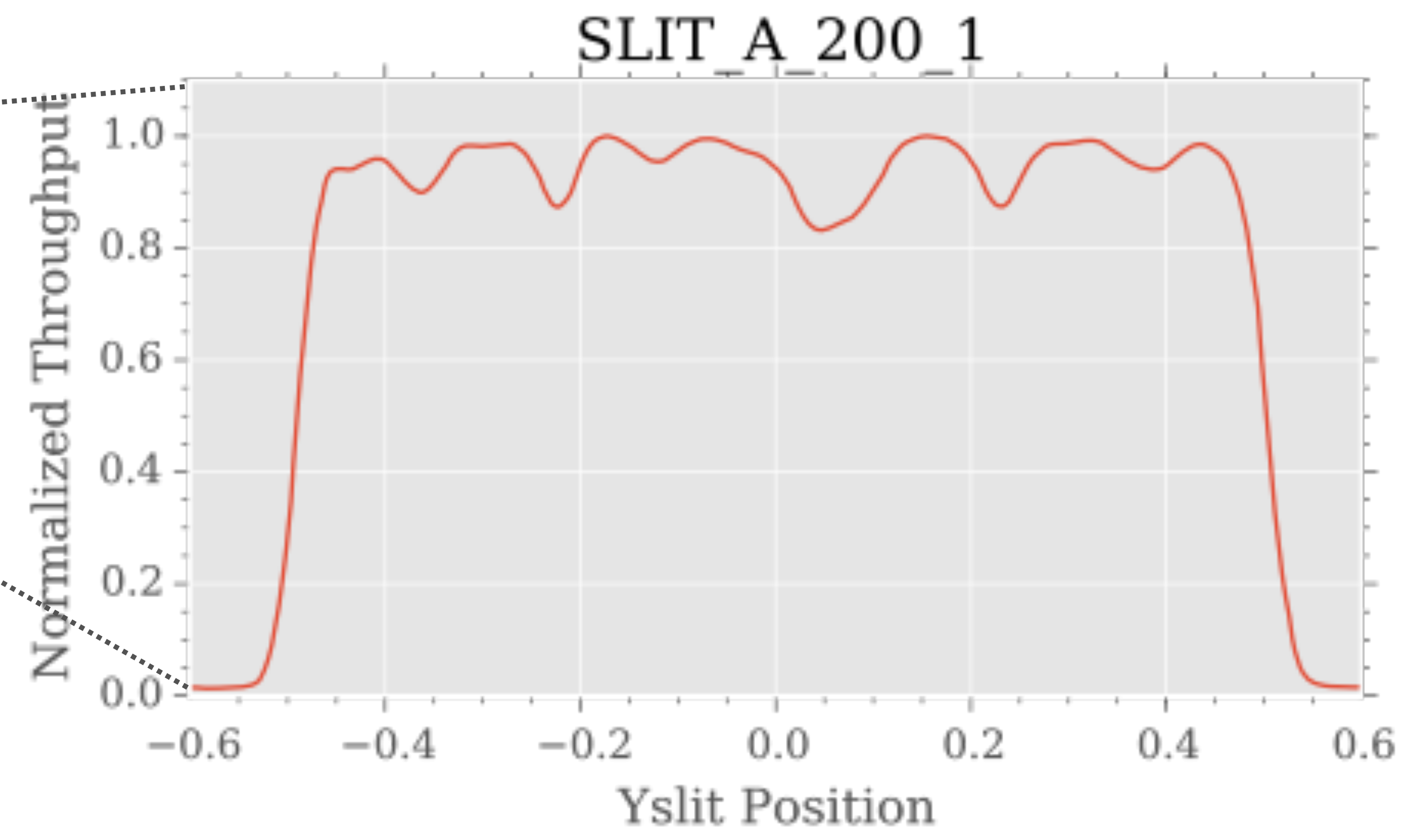
NIRSpec FS Basics and Design



NIRSpec FS "stripy-ness"

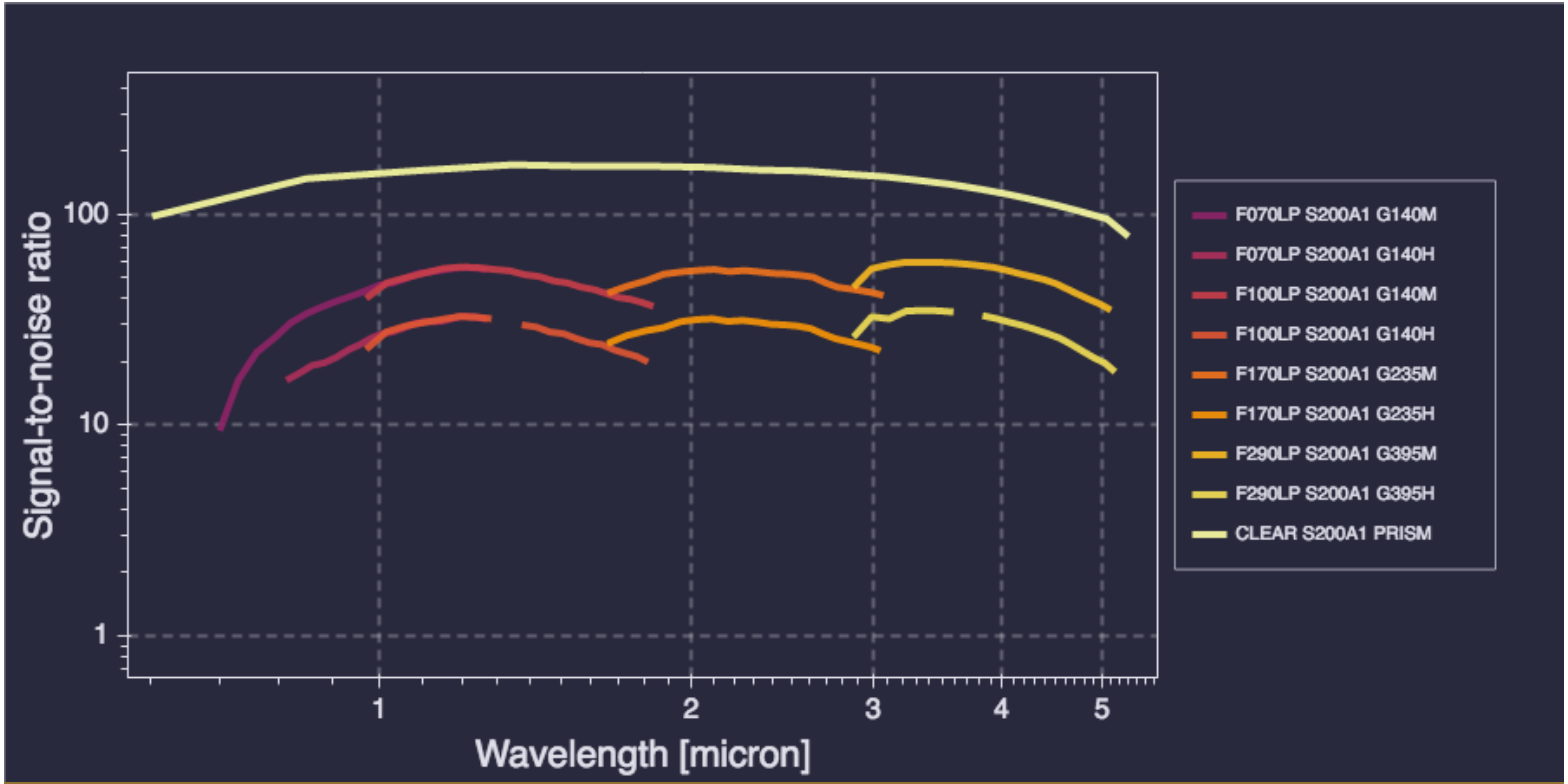
- The S200 and S400A1 slits have width variations of up to 20% (P-V)
- Expected to mostly flat field out
- Nodding positions are defined to avoid the narrower slit regions (valleys) where possible
- Slit losses (for point sources) will be calibrated at the defined nod/ dither positions





NIRSpec FS: Sensitivity

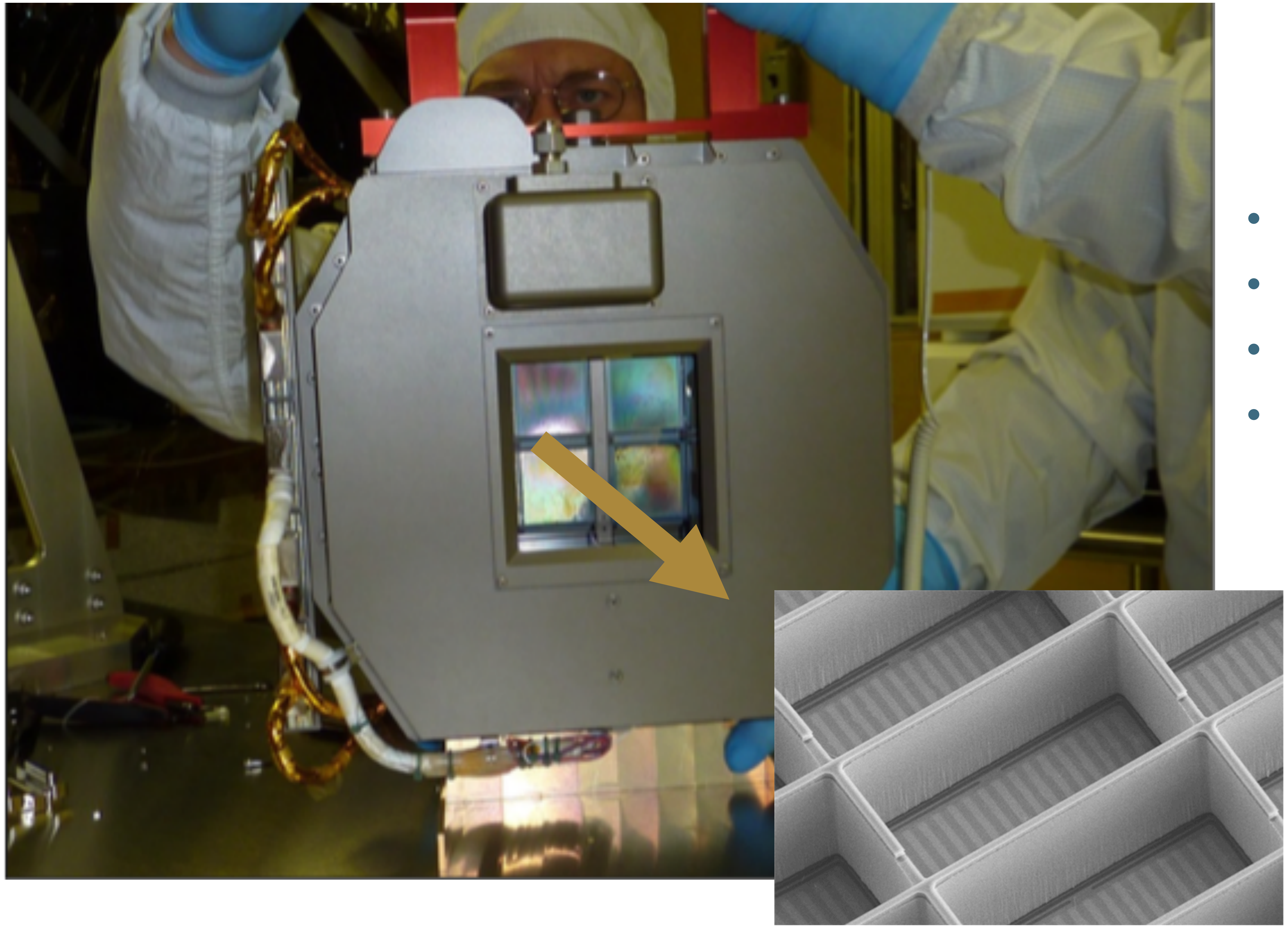
PS, 18 ABmag, 300s



DISCLAIMER: Data taken from https://jist.stsci.edu/jist, will likely change with new ETC release

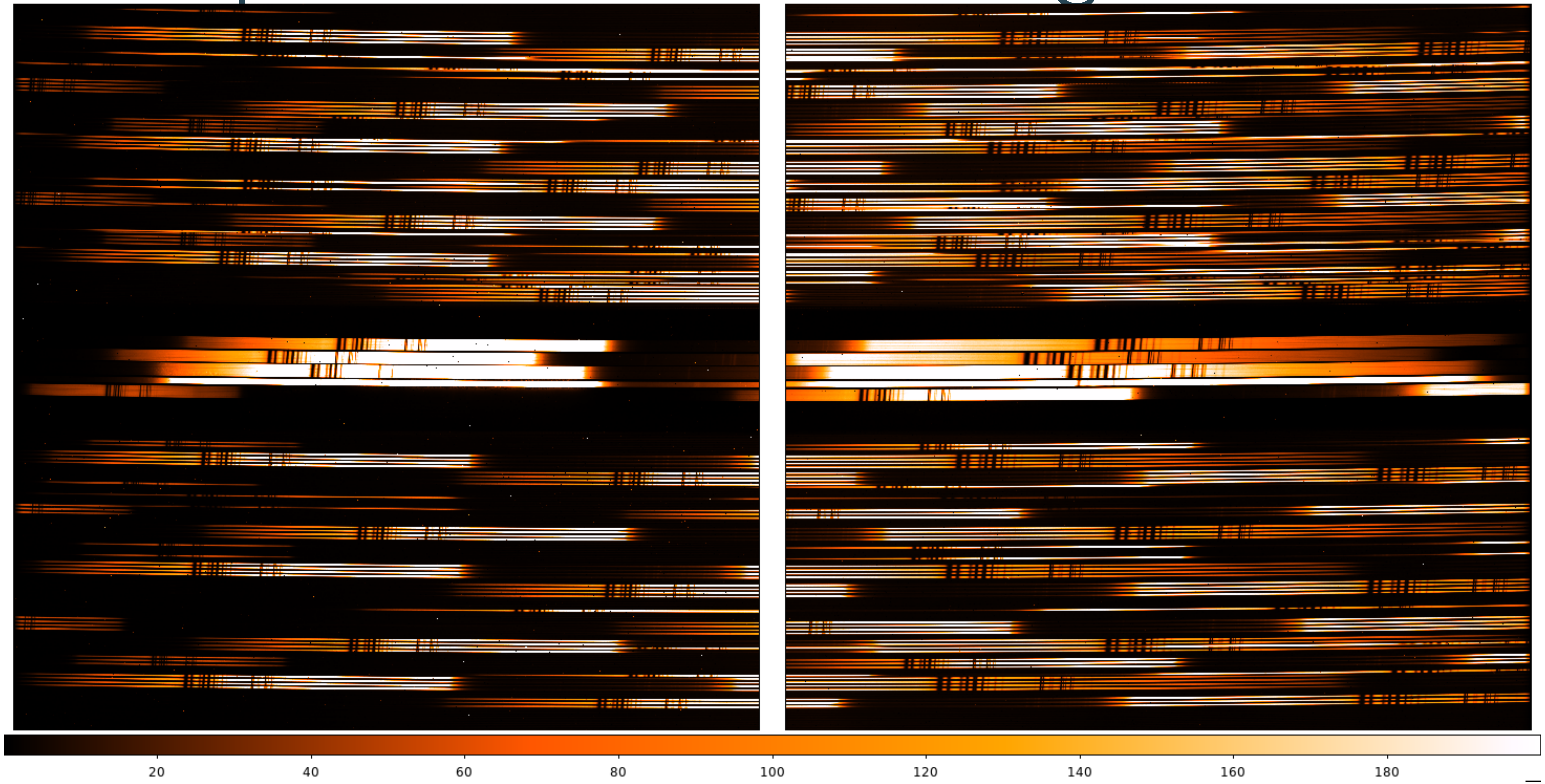
NIRSpec MOS

The Micro Shutter Assembly (MSA)



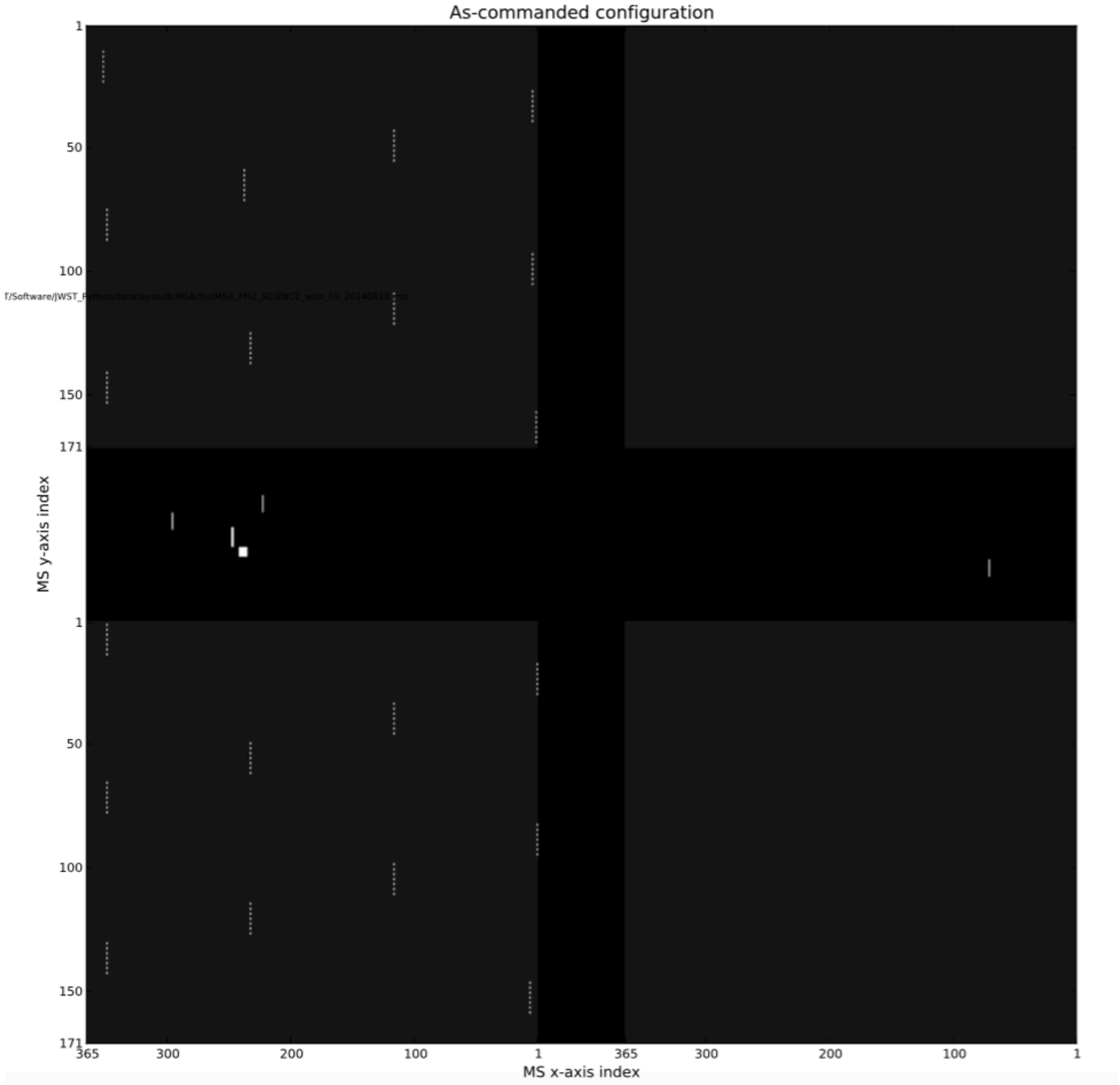
- 4 arrays of 365x171 micro-shutters
- 250,000 individually addressable shutters
- 3.6′x3.4′ field-of-view ~ 9 arcmin^2
- Each shutter 0.20" ×0.46"
  (width in the dispersion direction
  × height)

Example MOS data - Testing



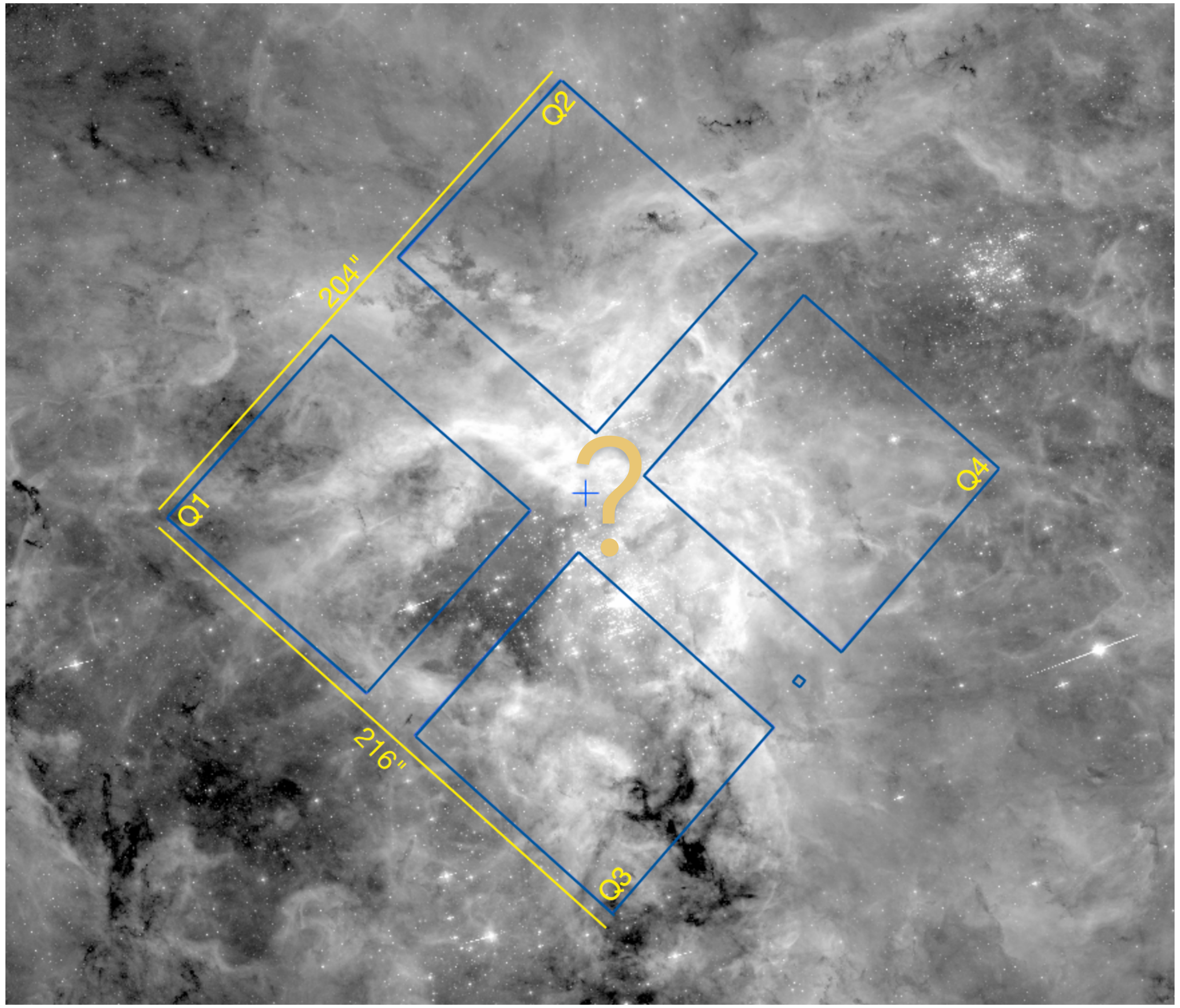
Flatfield illumination: 100 spectra (G395H) tightly packed together

MSA configuration - Testing



Regular pattern of open micro-shutters used with flat-field illumination: Easy ☺

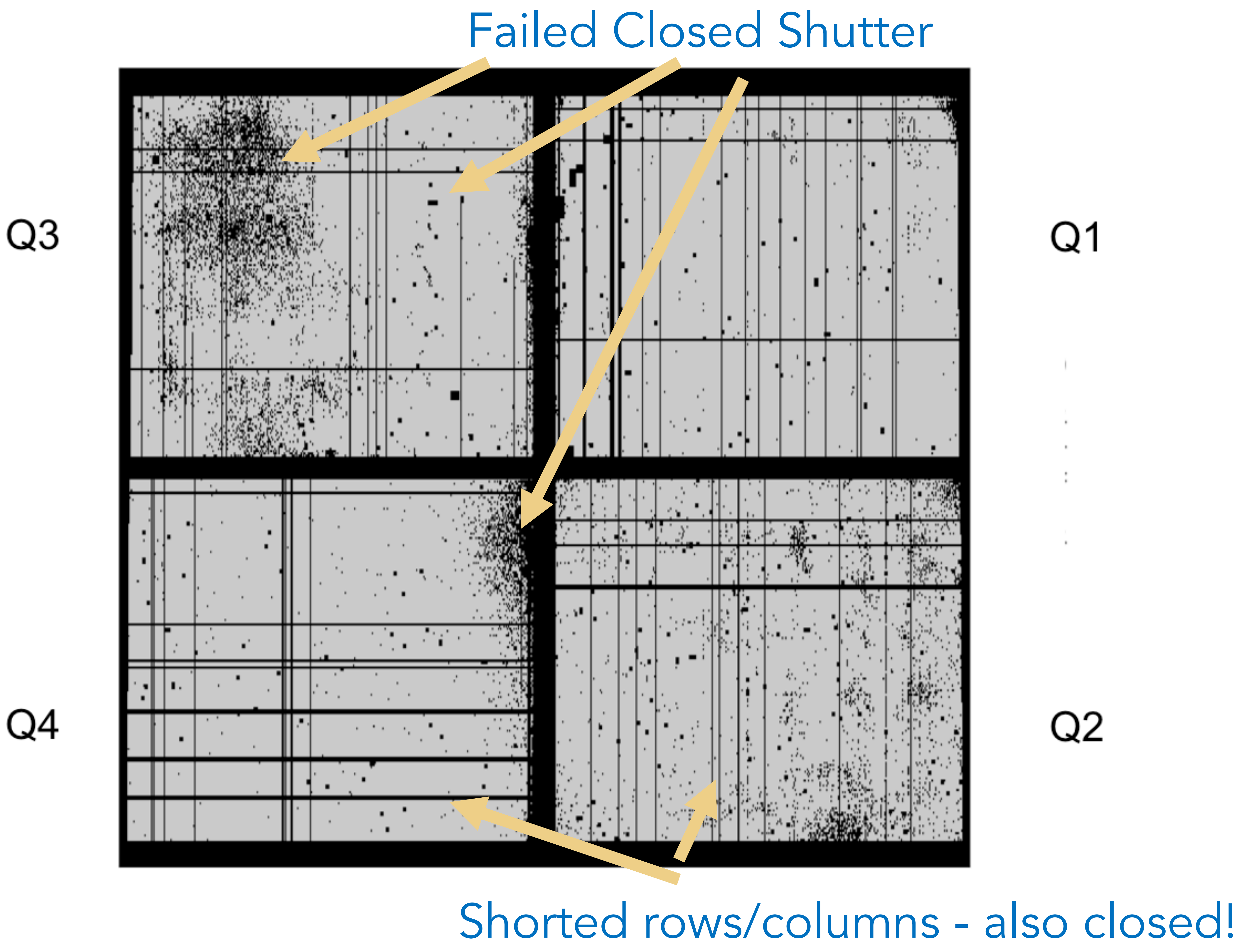
What about the planning of a real observation?



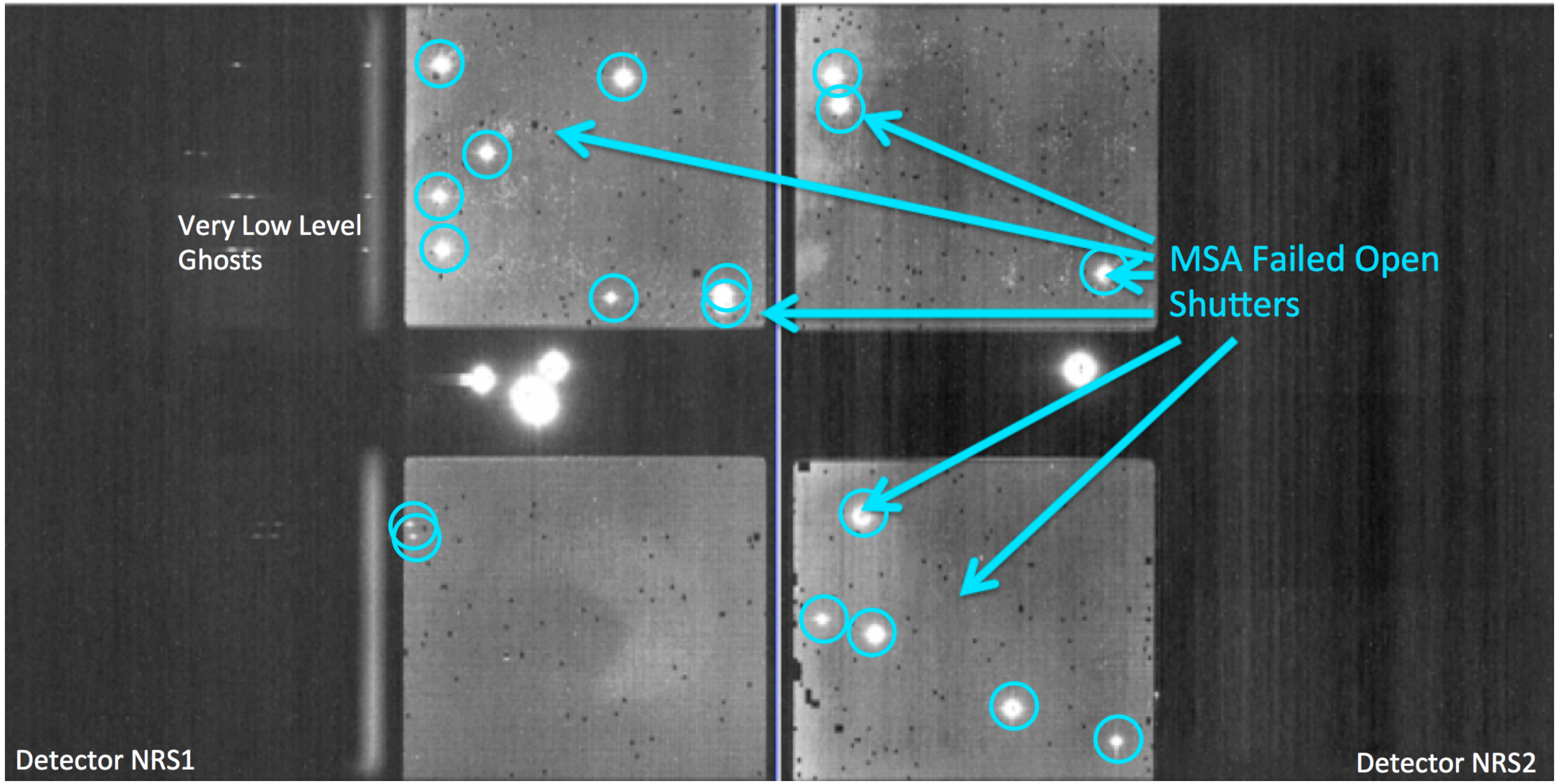
What are the considerations of such a plan?

What does the observer need to know?

The MSA is not an 'ideal' grid - I

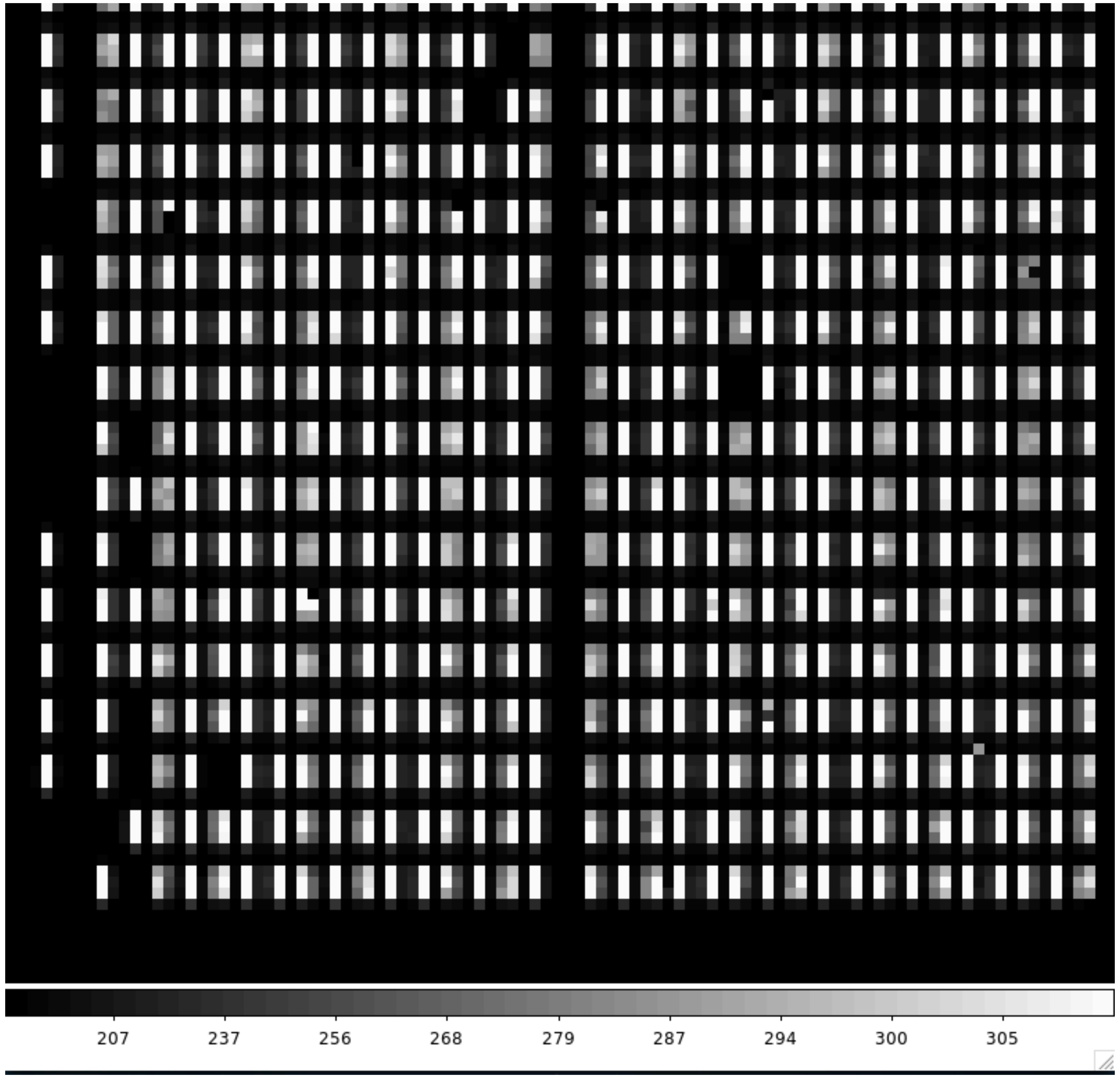


The MSA is not an 'ideal' grid - II



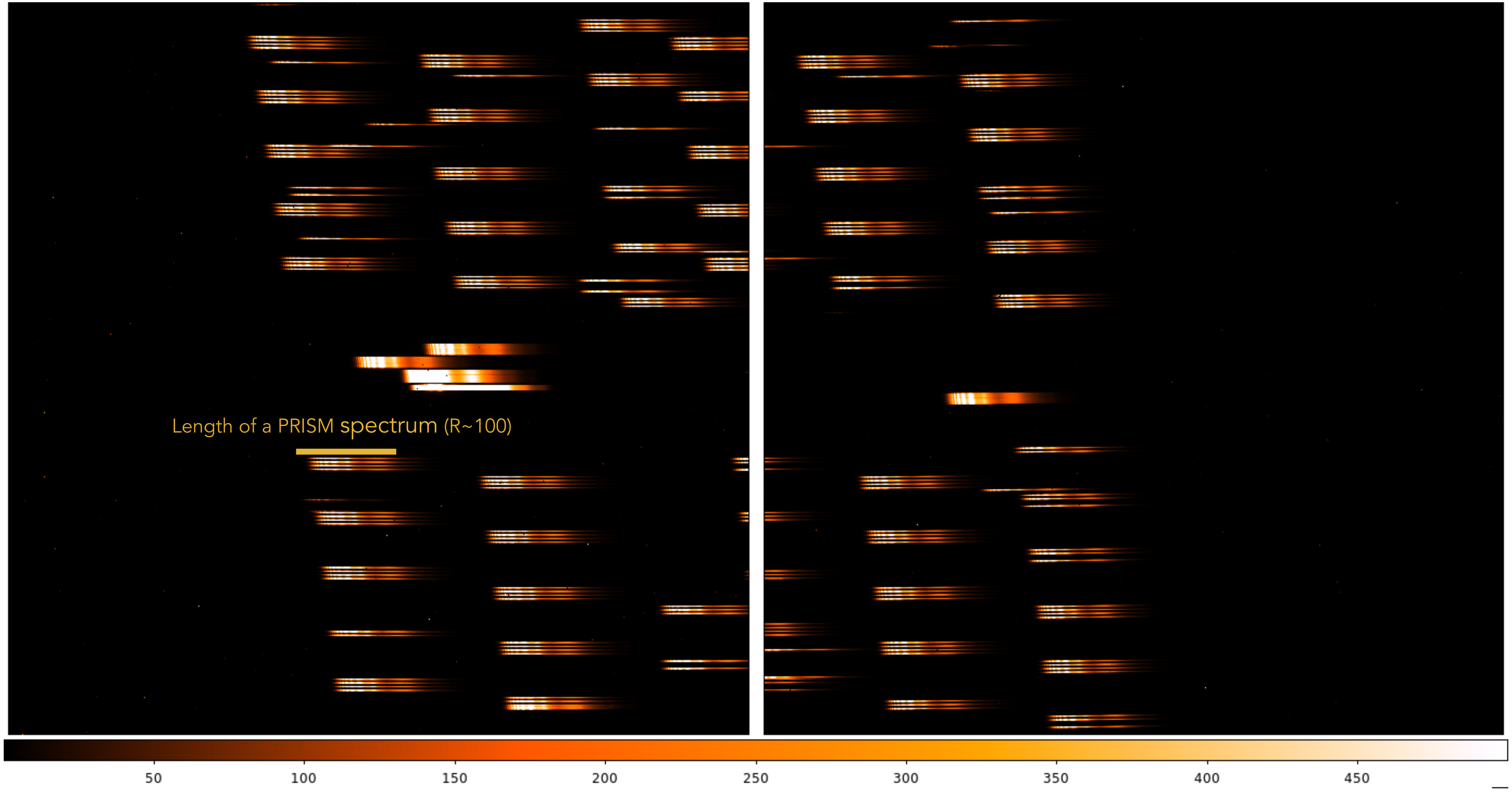
- Dispersed light falling on a failed-open shutter can contaminate spectrum of target
- Closed shutter are nor perfectly opaque
- The status of failed open/failed closed shutters can evolve

The MSA is a fixed grid

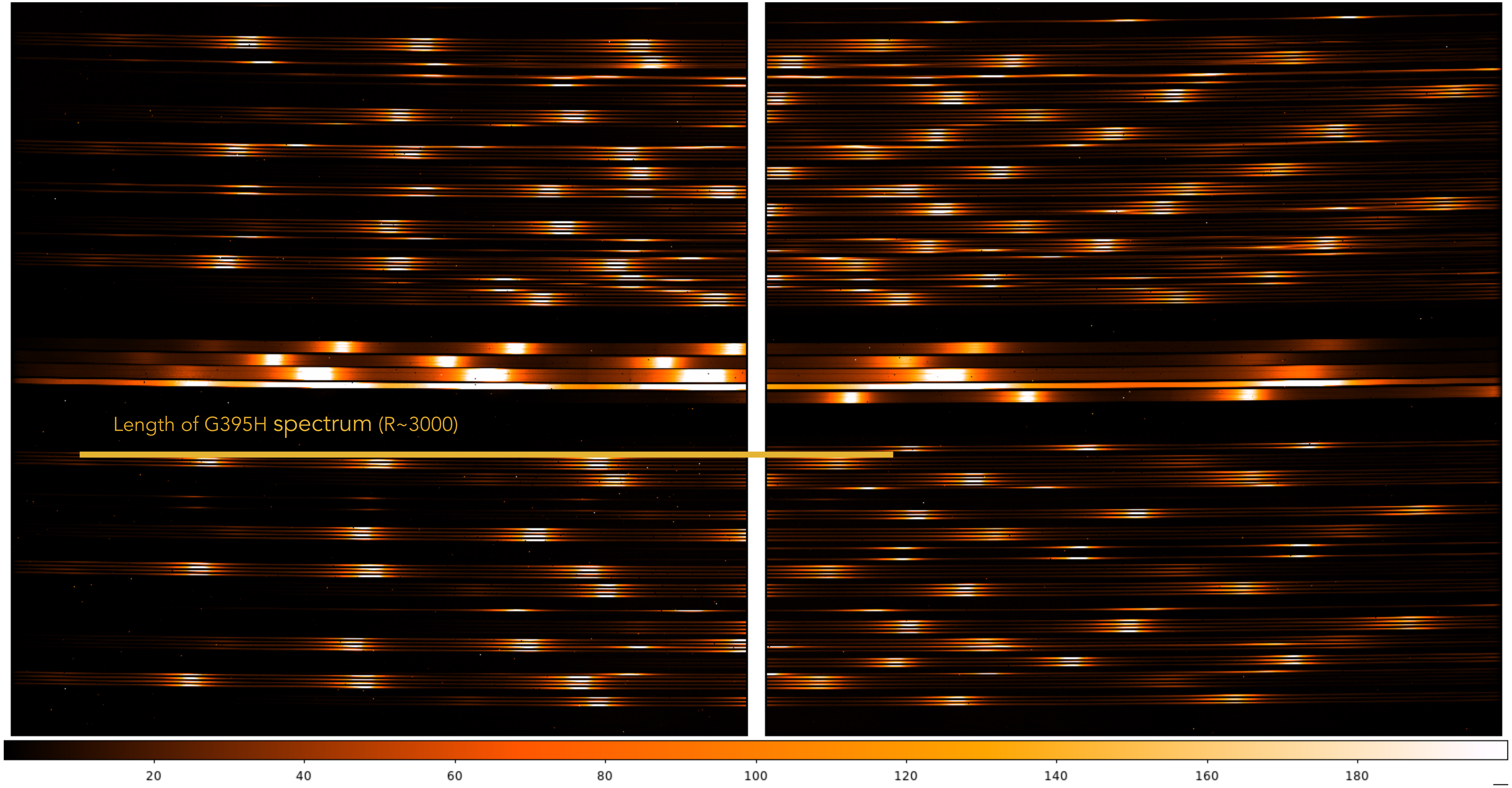


- Shutter bars vignette light from an extended sources
- Gap between the 2 detectors that leads to a gap in wavelength coverage
- In general sources will not be centered in the aperture
- Positioning sources in MSA require knowledge of optical distortions/ velocity aberrations

Spectra on the detector have different length: PRISM



Spectra on the detector have different length: G395H



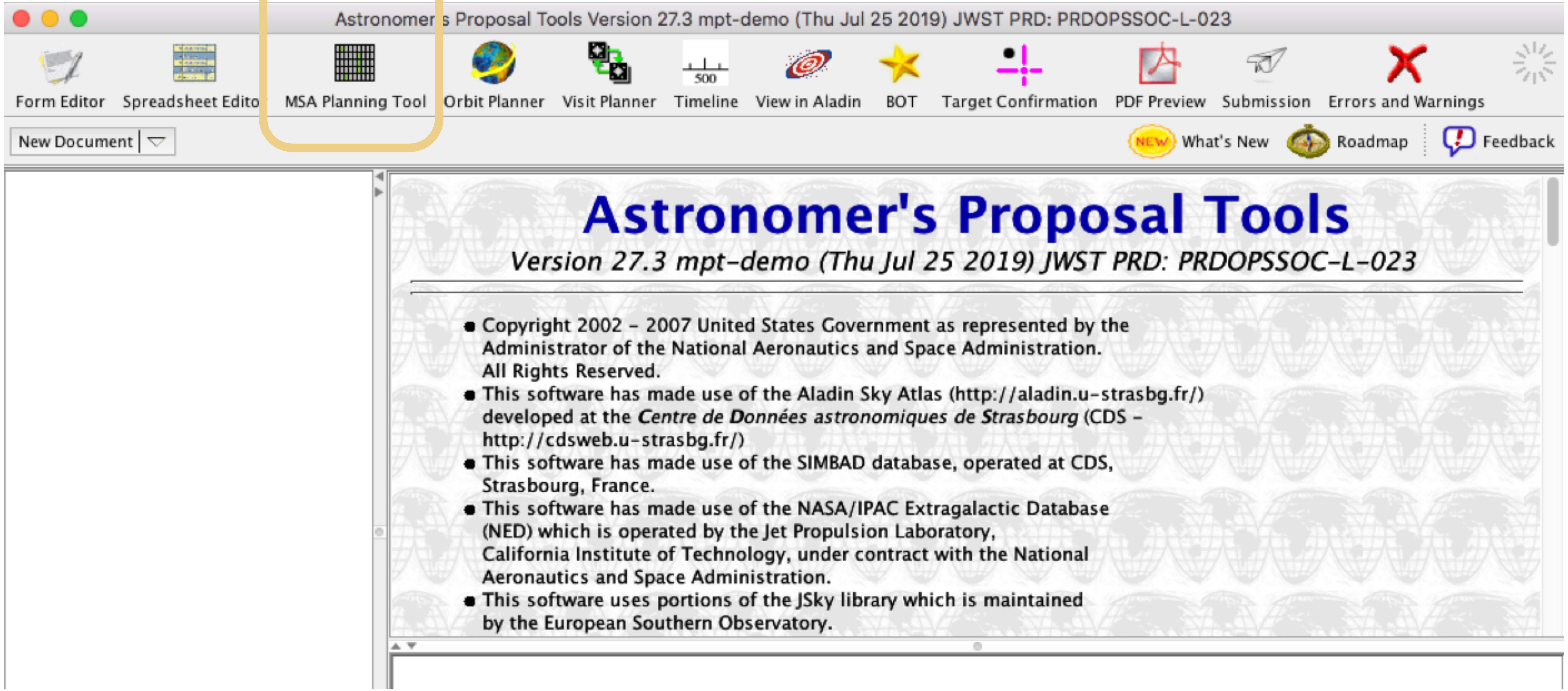
Multiplexing levels (optimal planning – real MSA)

PRISM: With catalog source densities greater than ~600 sources/arcmin^2
➔ typically ~180 to 200 sources can be observed simultaneously.

Gratings: With catalog source densities greater than ~200 sources/arcmin^2
➔ typically ~65 to 70 sources.

Which are the observational parameters that influence the multiplexing levels & drive the planning of a MOS observation?

The answer: MSA Planning Tool (MPT)



➔ See also presentation :
Available Proposal Tools