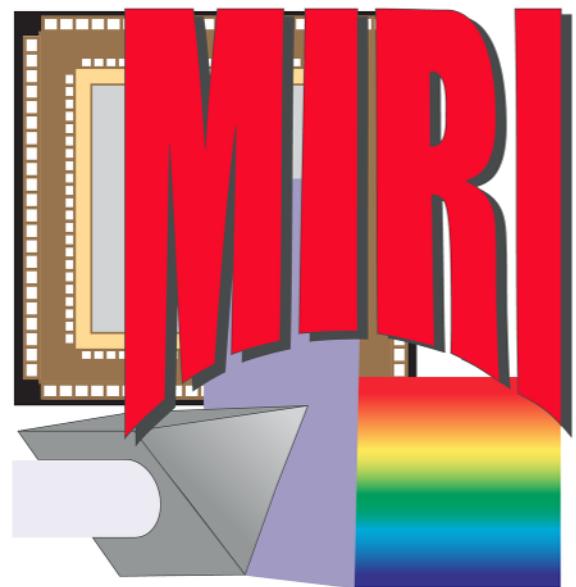


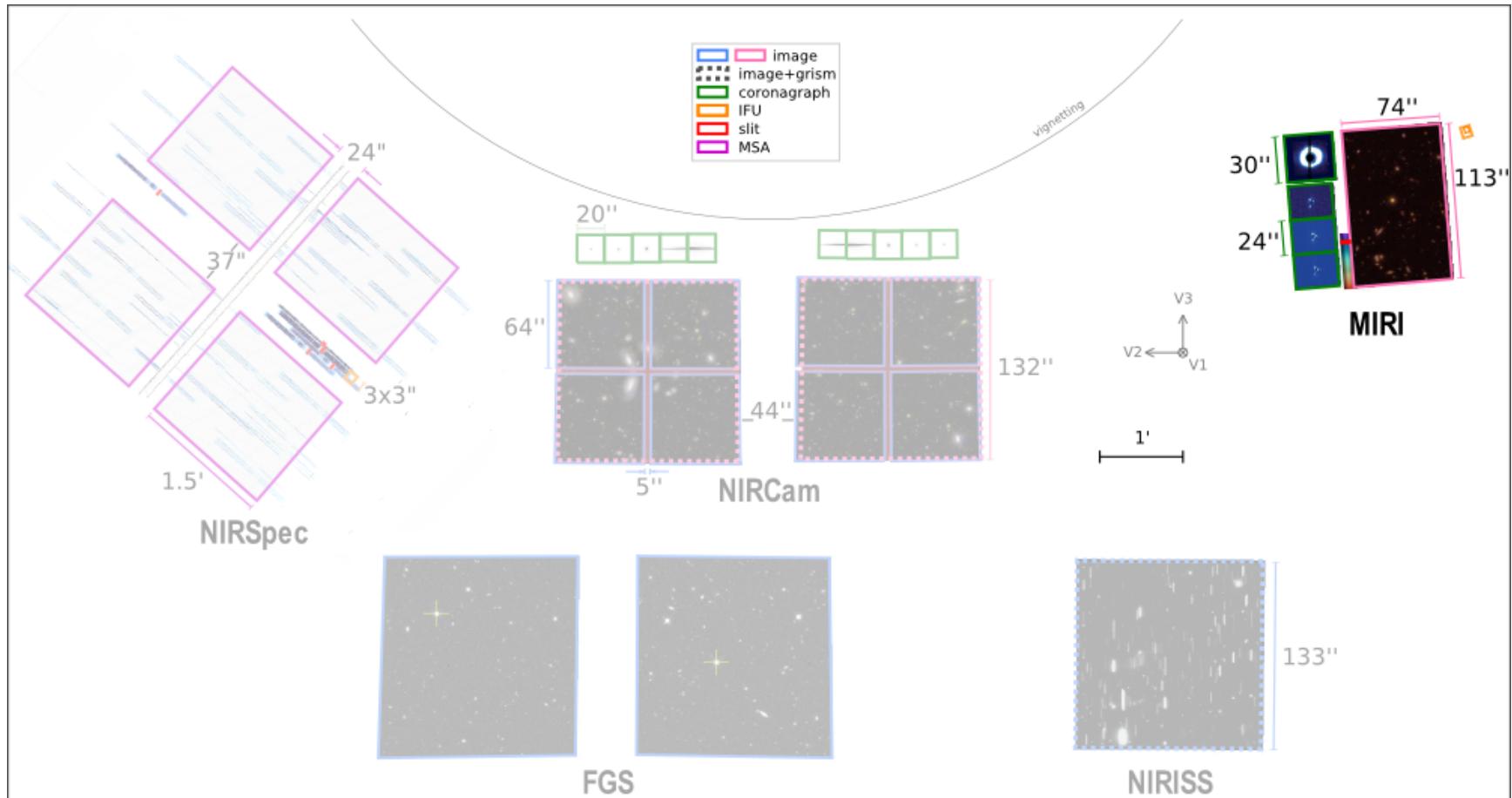
Spectroscopy from the James Webb Space Telescope

**By a whole lot of
people at STScl,
including G. C. Sloan**

**Primary source:
<http://jwst-docs.stsci.edu>**



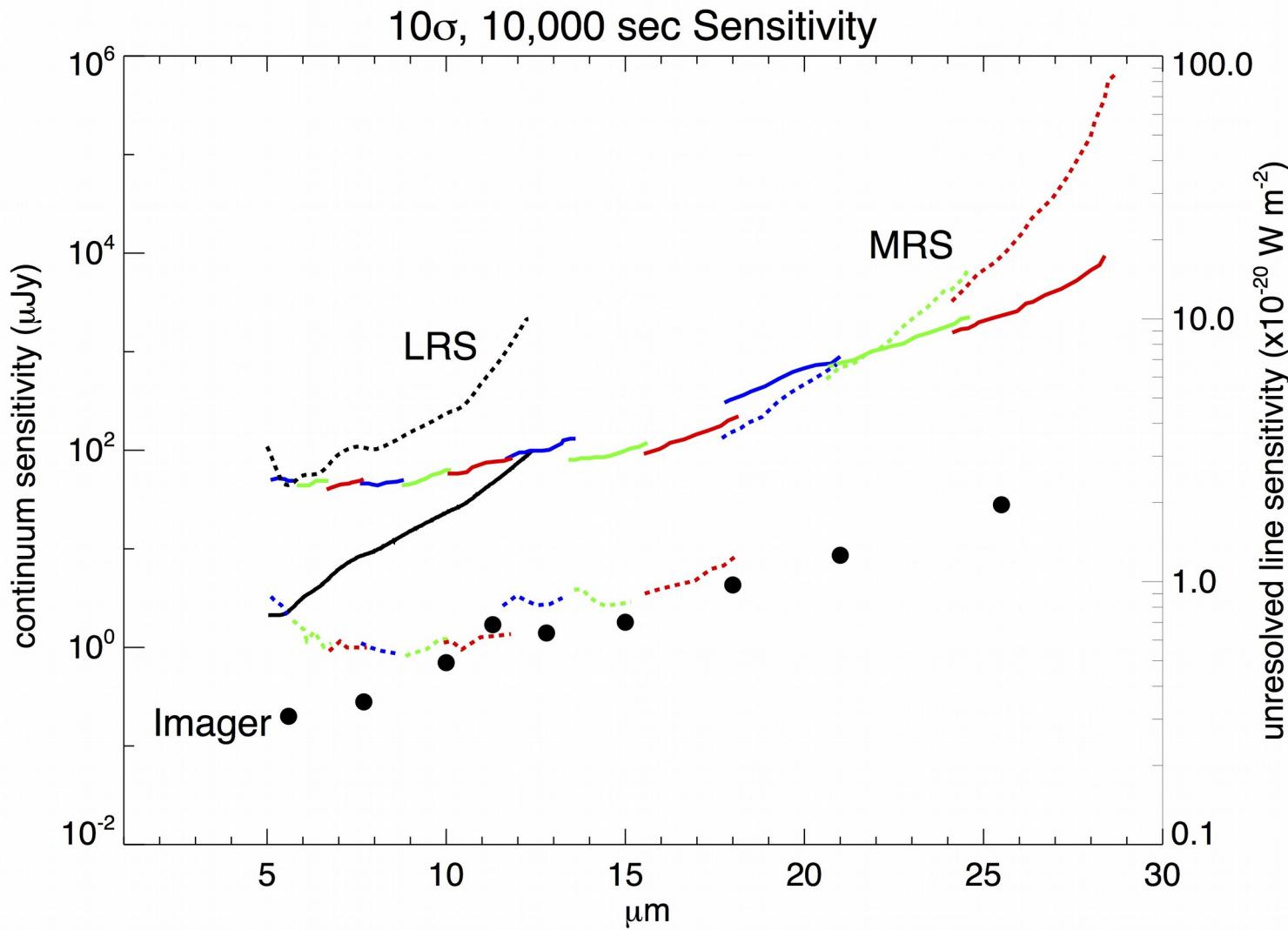
JWST Focal Plane



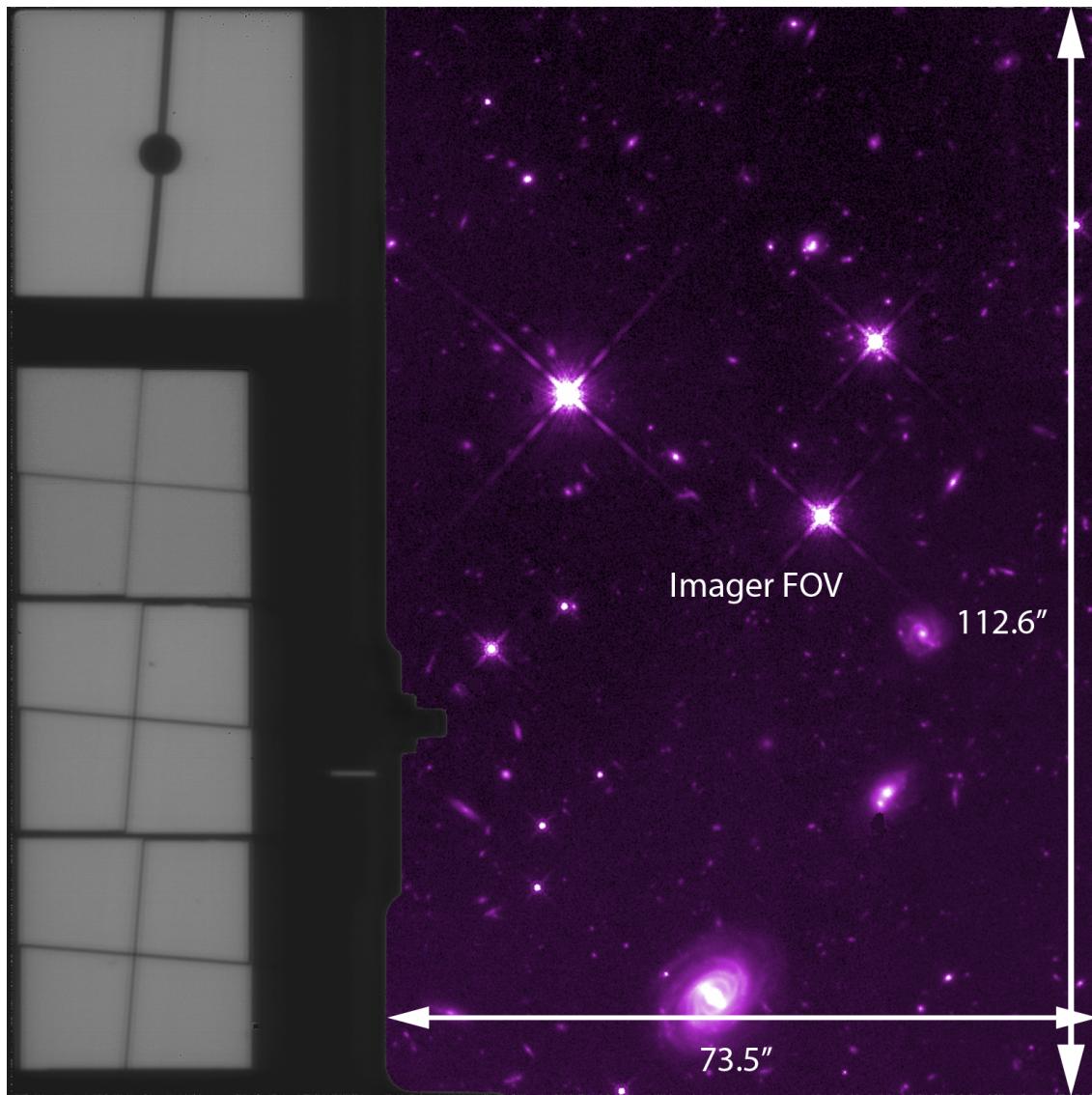
Spectroscopic modes

NIRISS	WFSS	0.8 – 2.25	~150	In 4 segments
	SOSS	0.6 – 2.8	~700	
NIRSPEC	MOS (MSA)	0.6 – 5.3	~100	
		0.6 – 5.3	~1000, ~2700	In 4 segments
	Fixed-slit	As MOS	As MOS	
	IFU	As MOS	As MOS	3" x 3"
NIRCAM	WFSS	2.4 – 5.0	~1200-1500	In 2 segments
	Imager	0.6 – 5.0	~4-5	8 wide-band filters
MIRI	LRS	5 – ~12	~40-160	
	MRS	4.9 – 28.5	~1600-3500	3" x 4" – 7" x 8" 4 x 3 segments
	Imager	5 – 28.5	~4-5	9 wide-band filters

MIRI sensitivities



MIRI imaging field



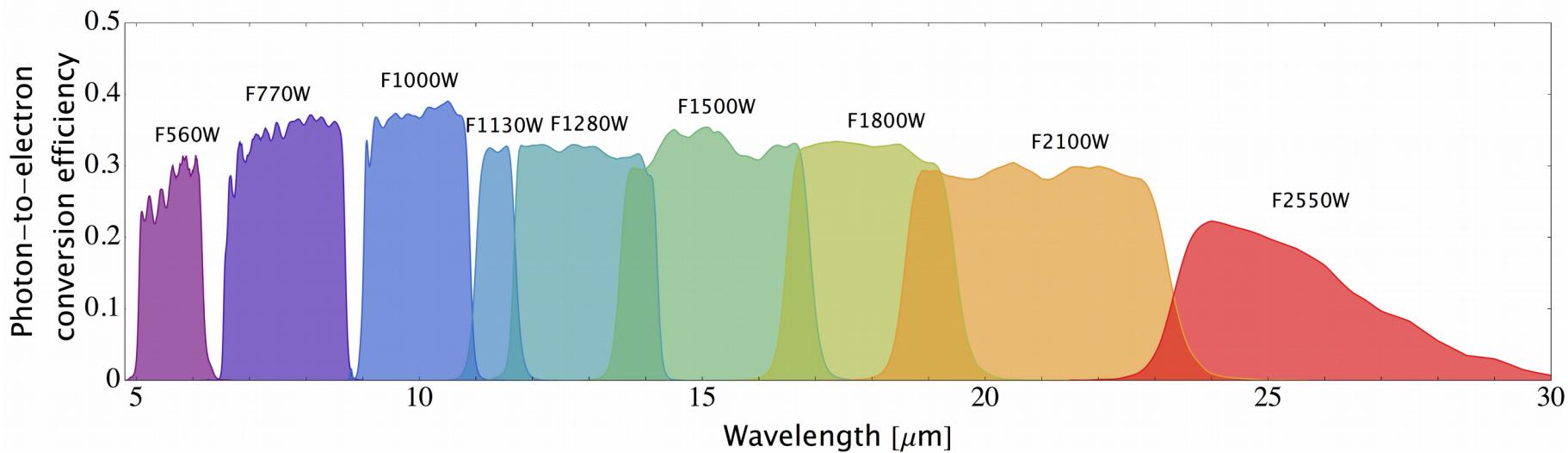
Pixels: 0.11''
Field-of-view:
73.5'' x 112.6''

VLRS (or SED mode)

Very Low Resolution Spectrometer

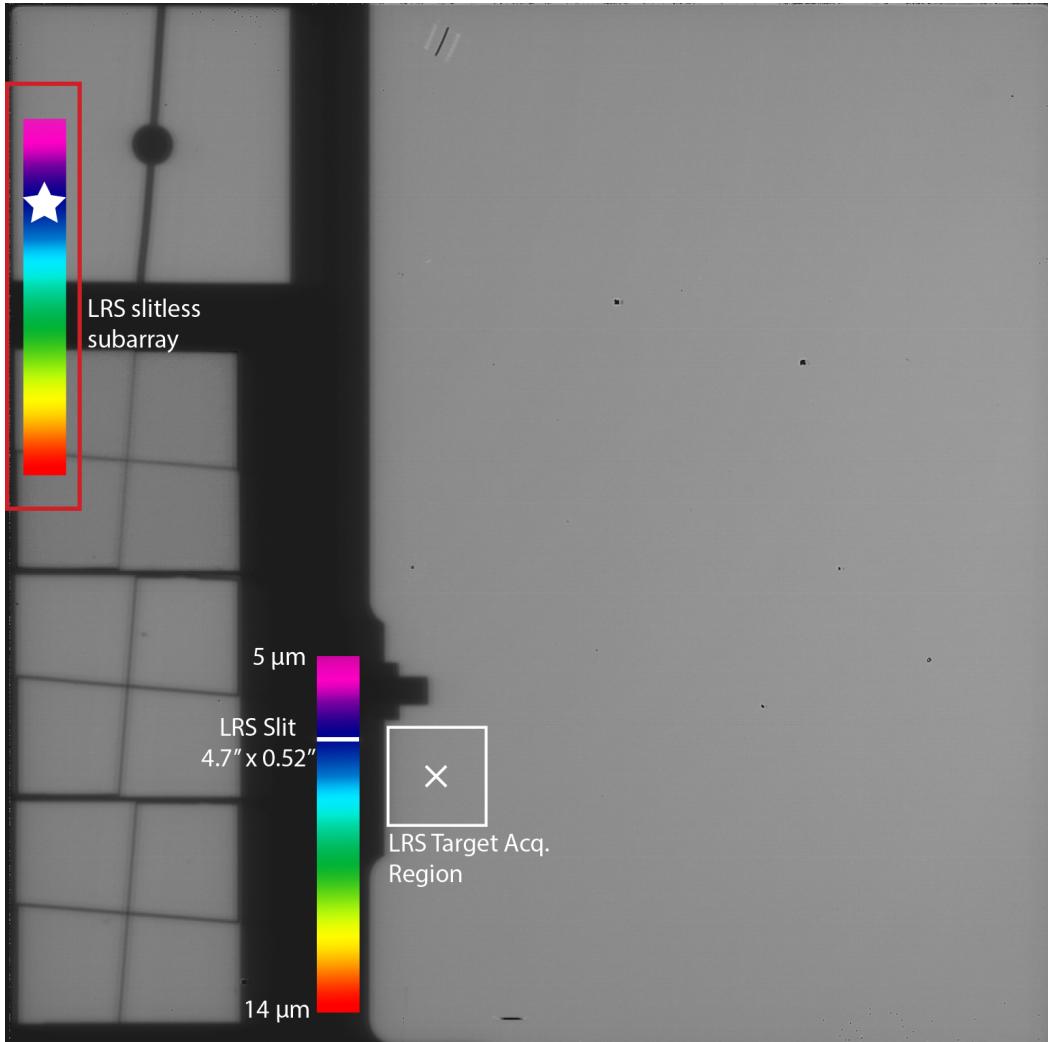
$R \sim 4-5$

Closest MIRI gets to wide-field slitless



Limits	7.7 μm	12.8 μm	21 μm
10σ in 10,000 sec (μJy)	0.3	1.0	3.3
Saturation (mJy)	7.4	9	66

Low-Resolution Spectrometer

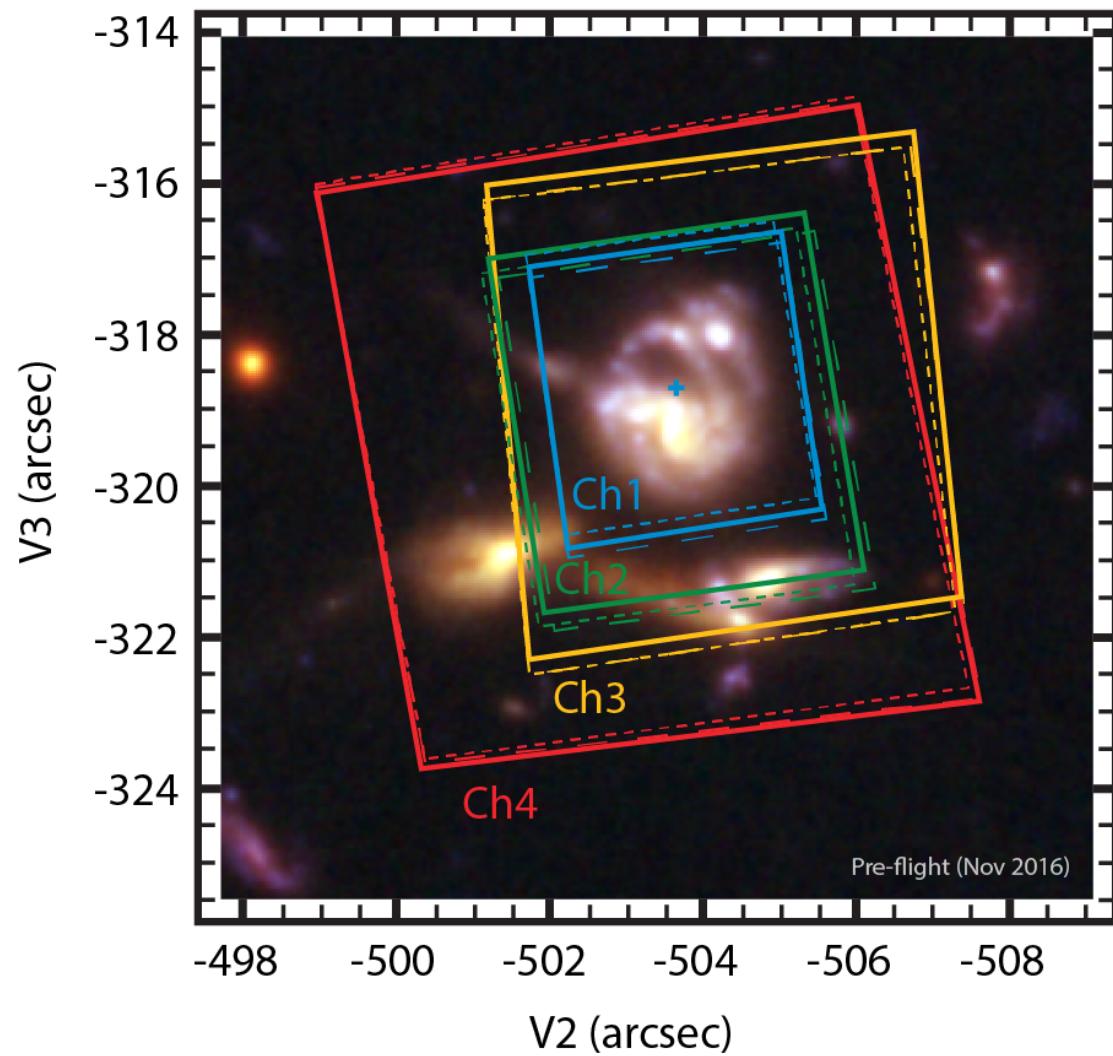


Slit: 0.52" x 4.7"

Limits (at ~10 μm)
10 σ in 10,000 sec: 8 μJy
Saturation: 70 mJy

Slitless mode – much higher saturation limit

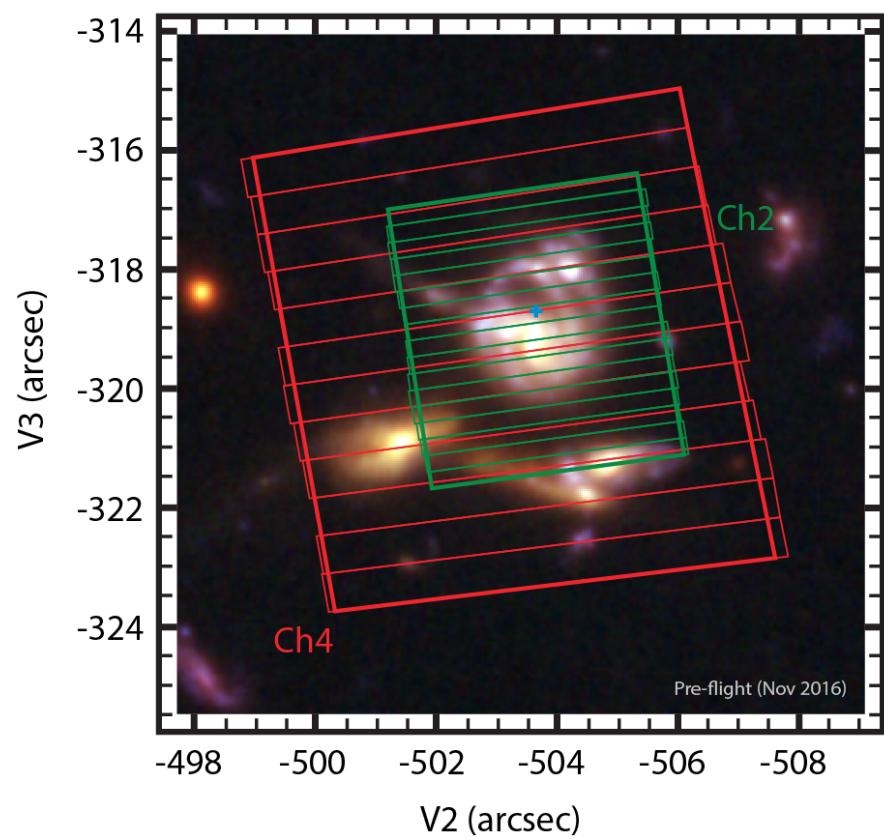
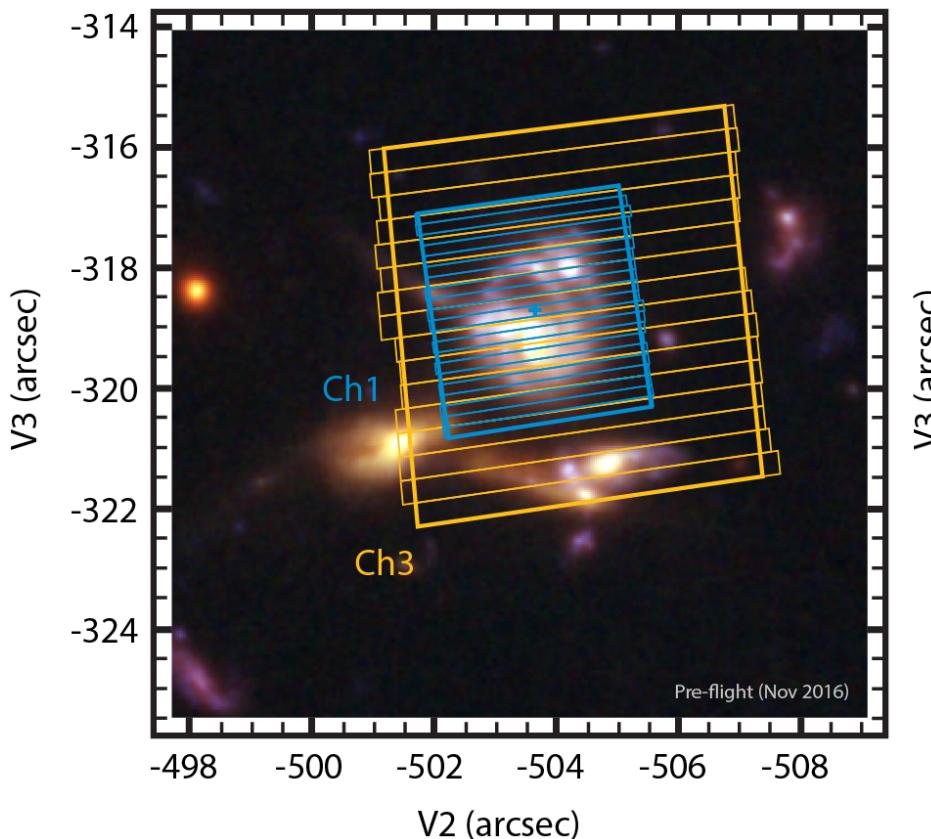
Medium-Resolution Spectrometer



Field-of-view:
Ch 1 – 3.3" x 3.7"
Ch 2 – 4.2" x 4.8"
Ch 3 – 5.6" x 6.2"
Ch 4 – 7.2" x 7.9"

Pixels: 0.20-0.27"
PSF: 0.22" at 6.25 μm

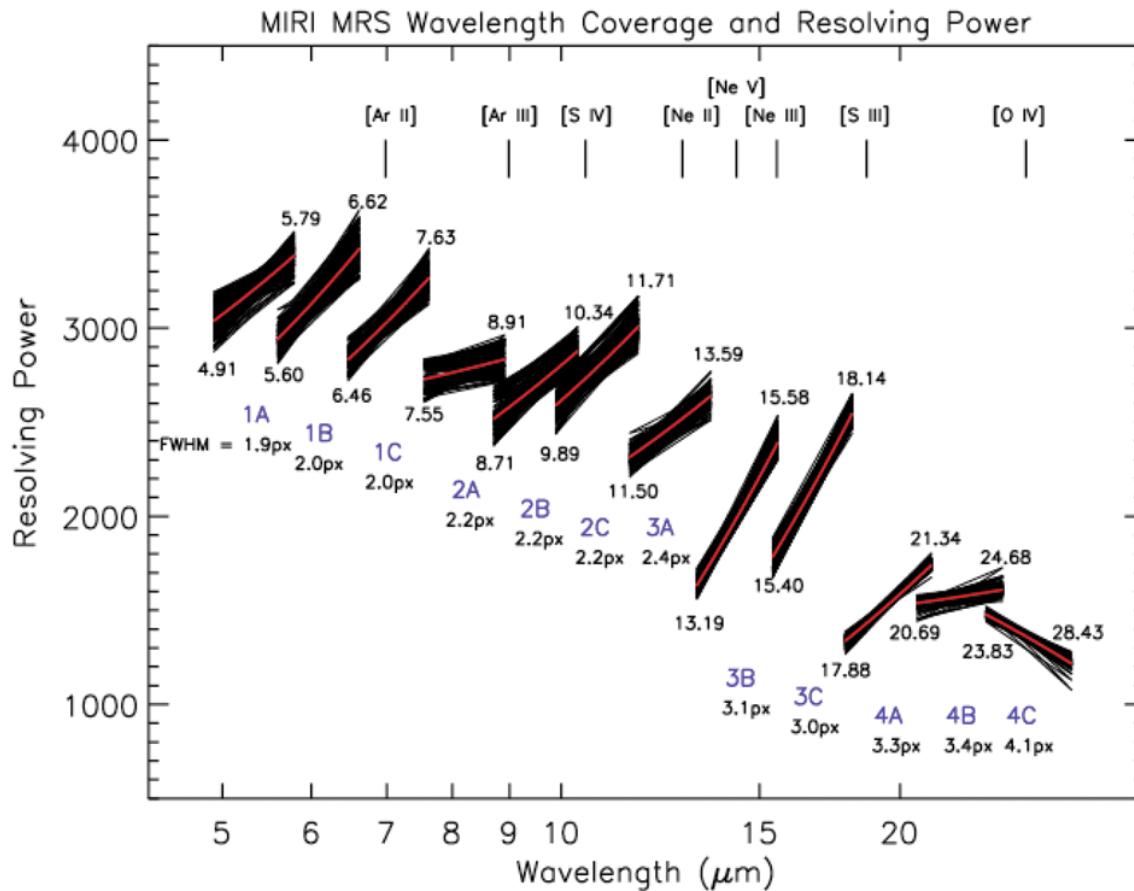
What the MRS fields really look like



All four channels observed simultaneously

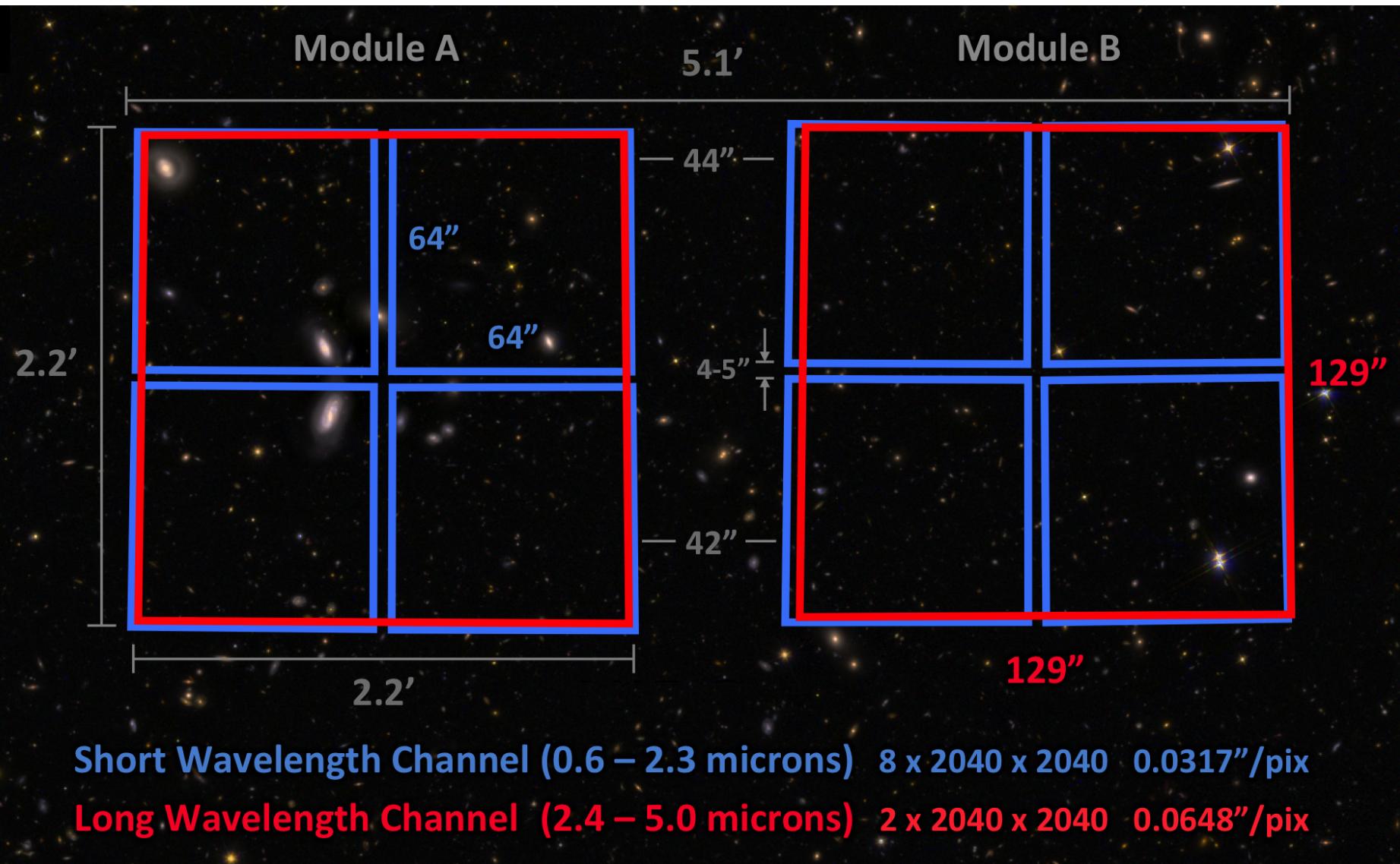
Each channel requires 3 segments

MRS specifications

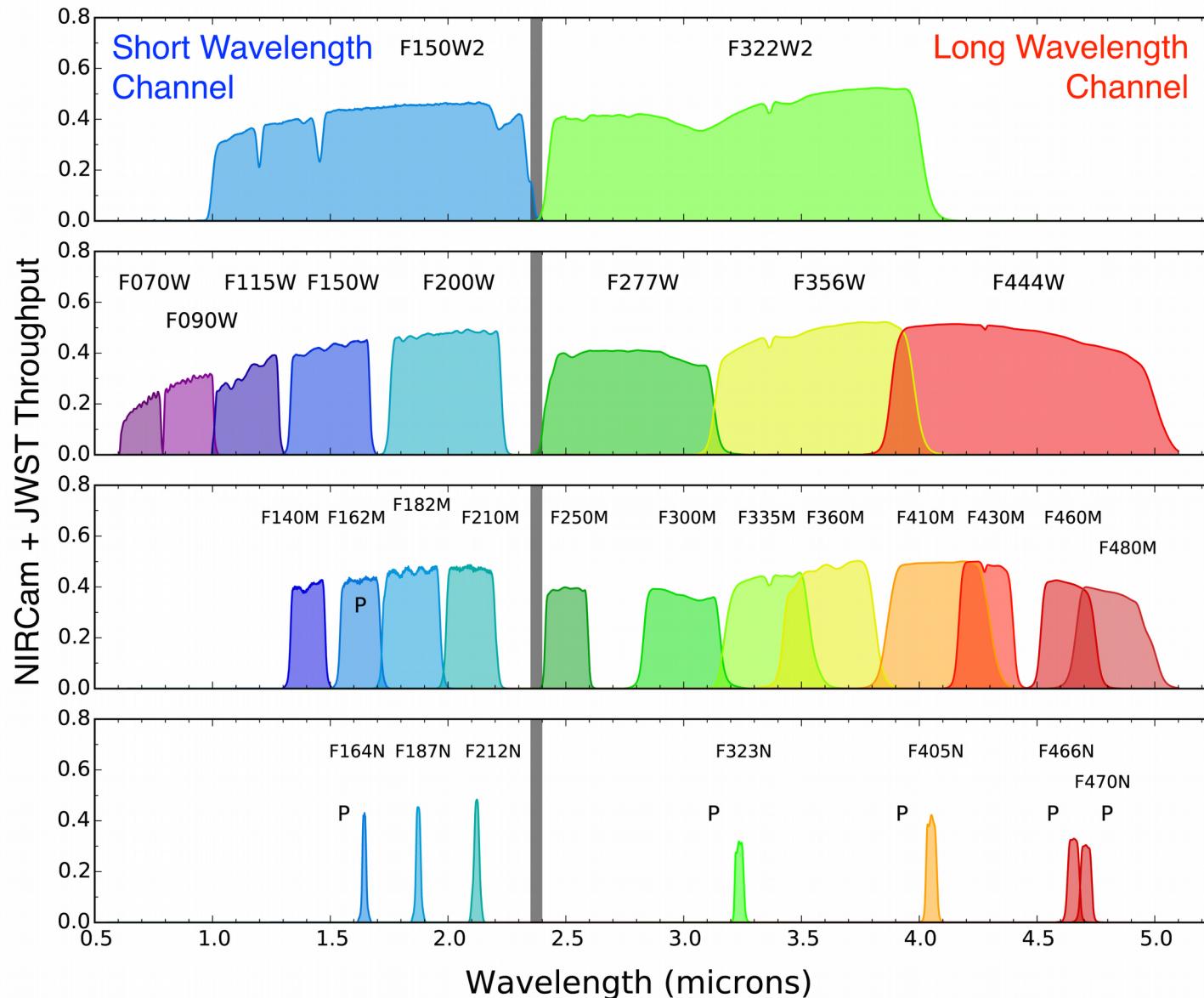


Limits (Channels 1-3): 10σ in 10,000 sec: 60-100 μJy
Saturation: $\sim 4.5 \text{ Jy}$

NIRCam fields

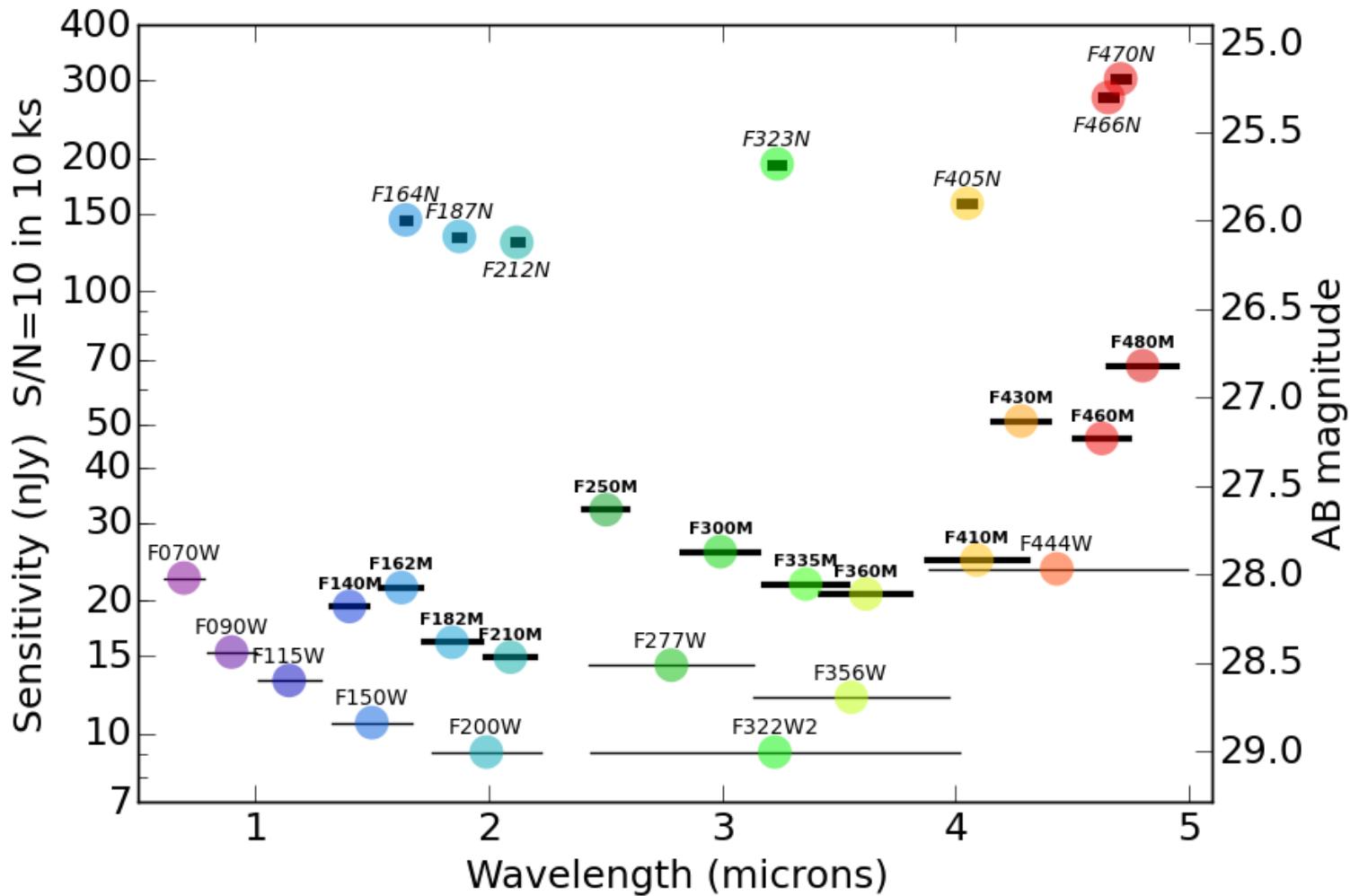


NIRCam filters

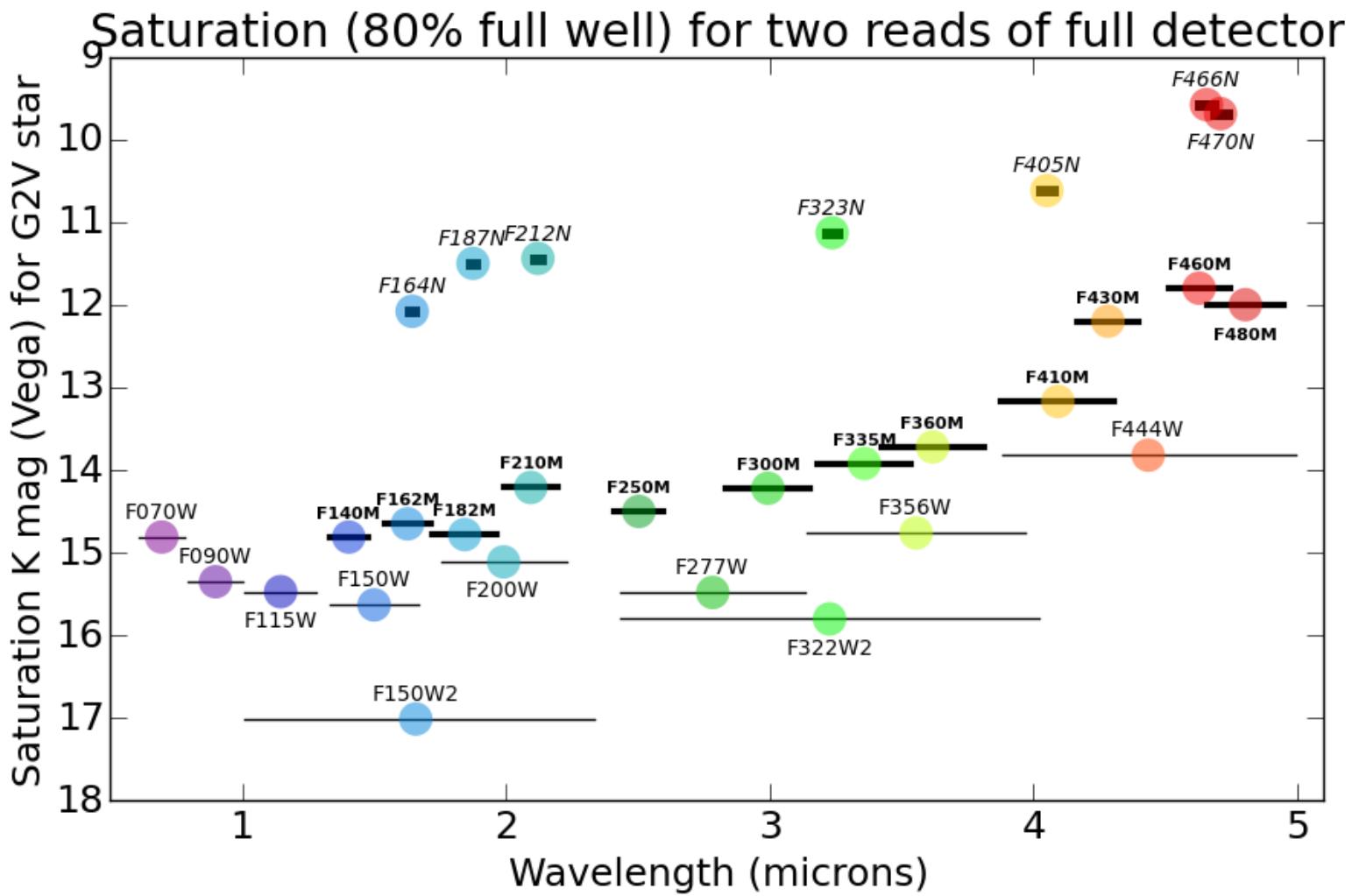


VLRS
or SED!

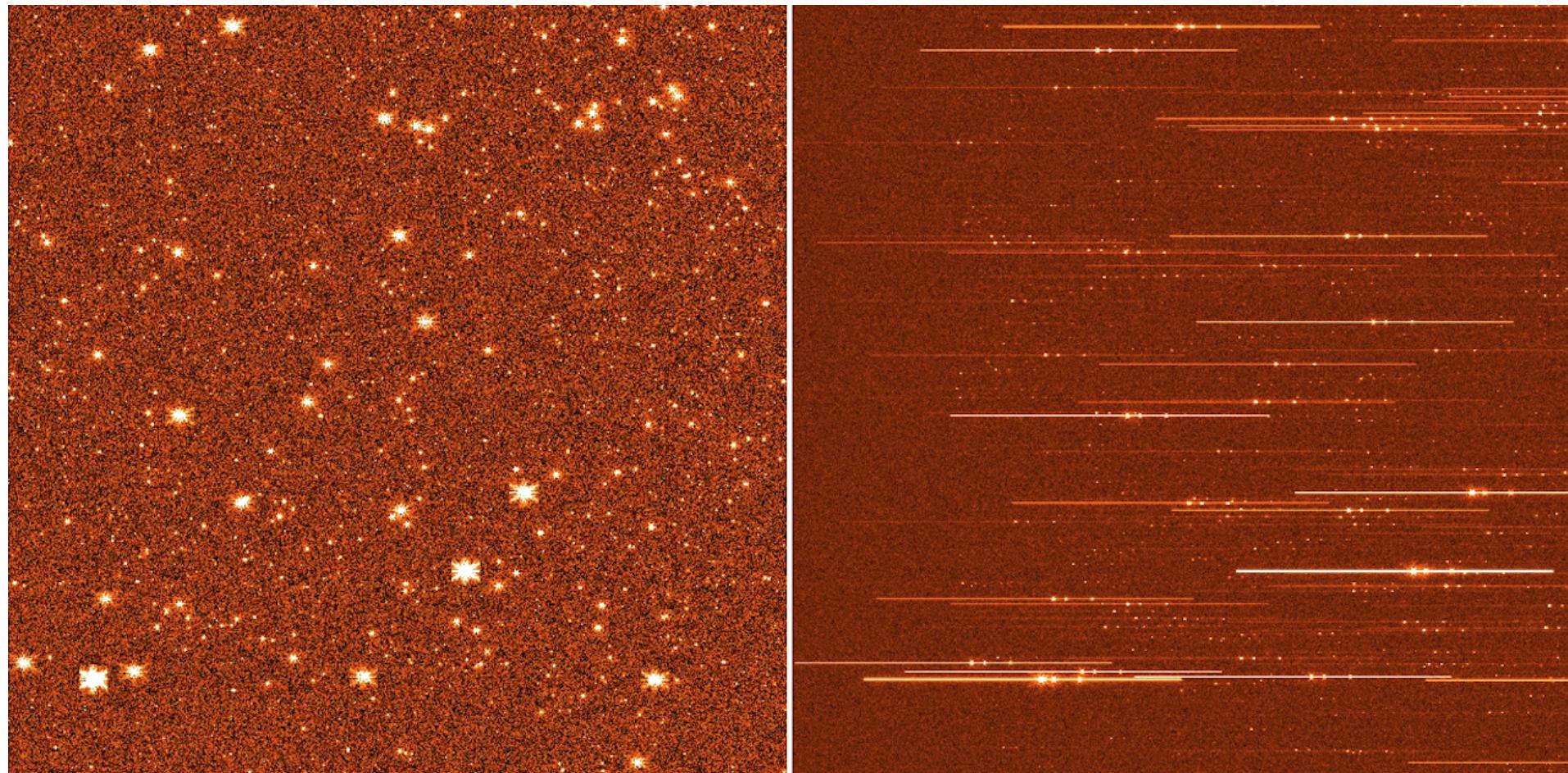
NIRCam sensitivities



NIRCam saturation

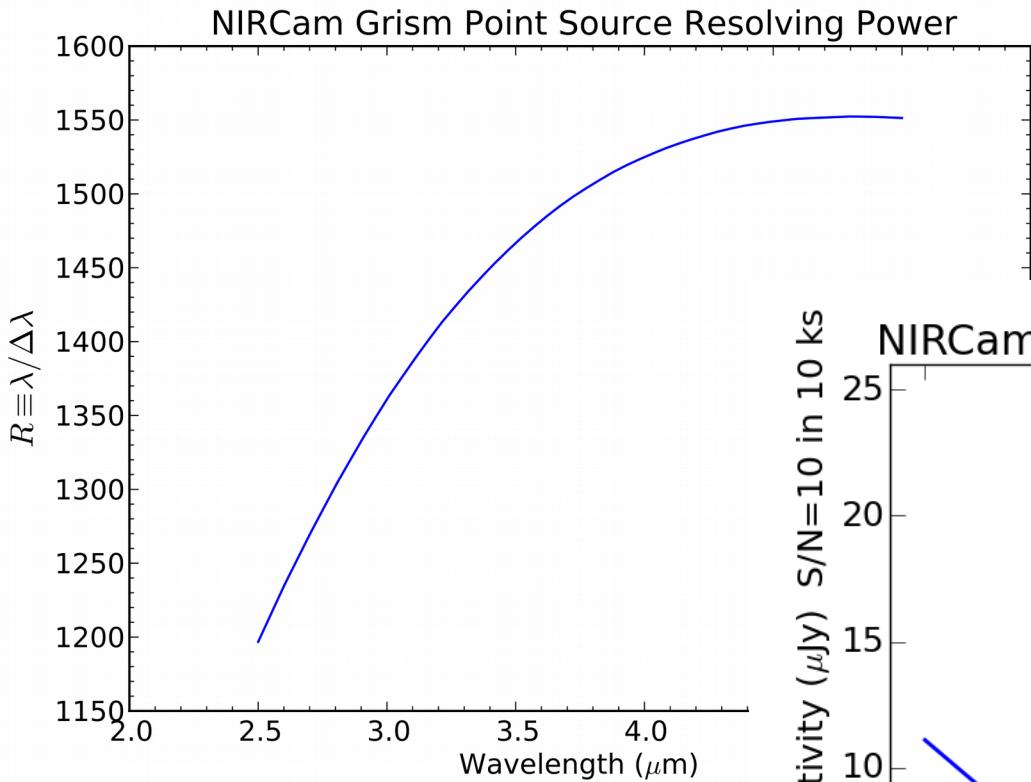


NIRCam grism example

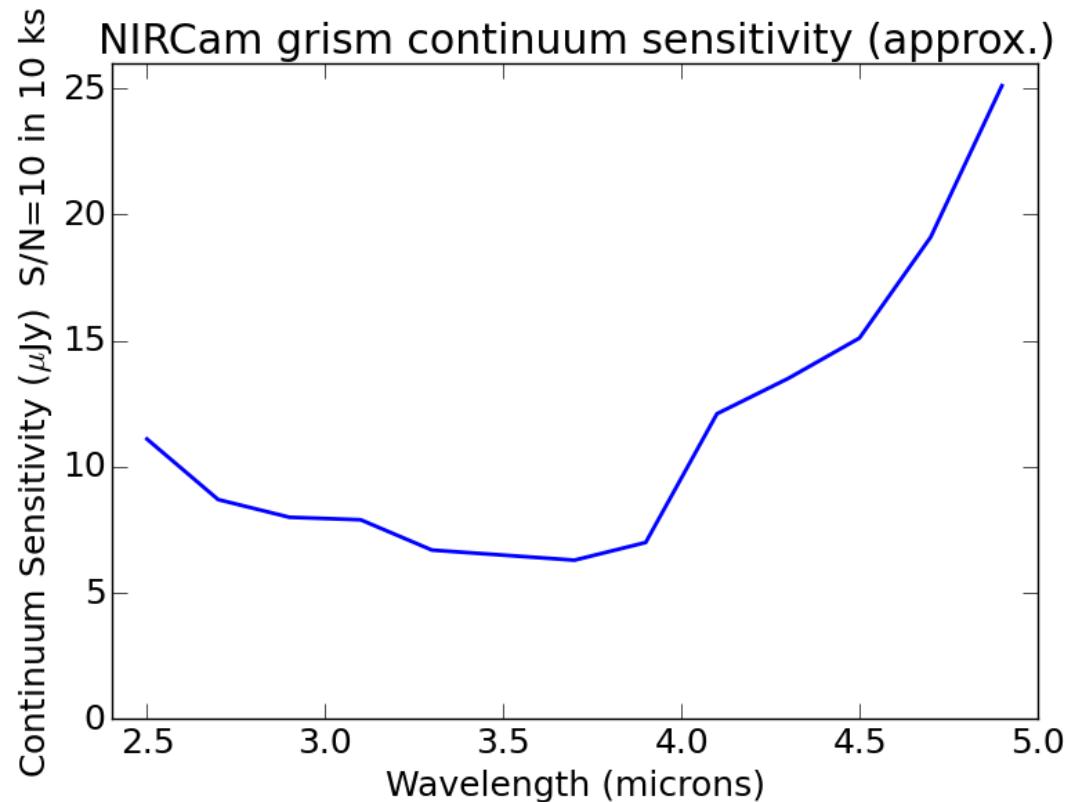


Each integration includes direct image and orthogonal spectra

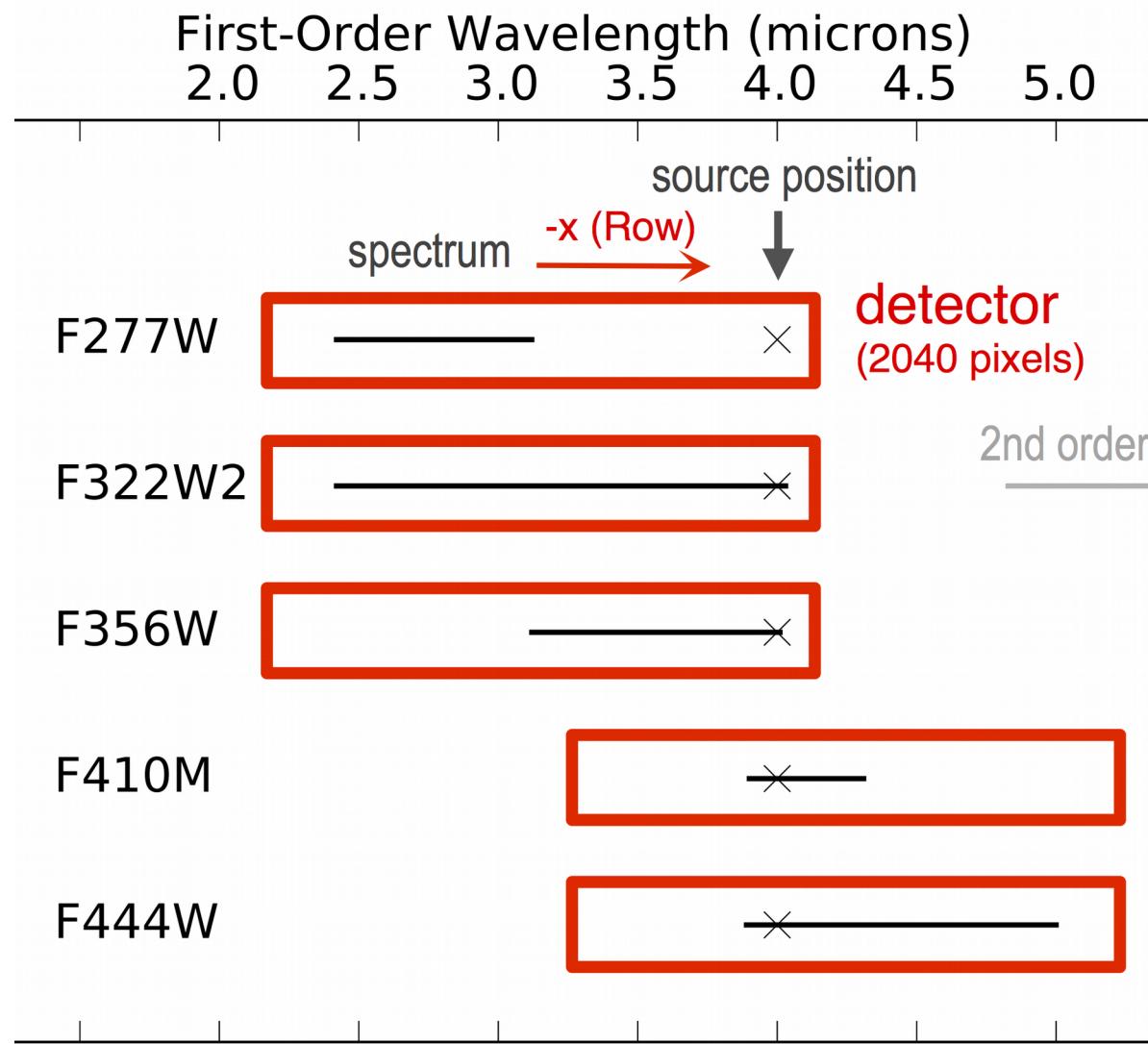
NIRCam grism properties



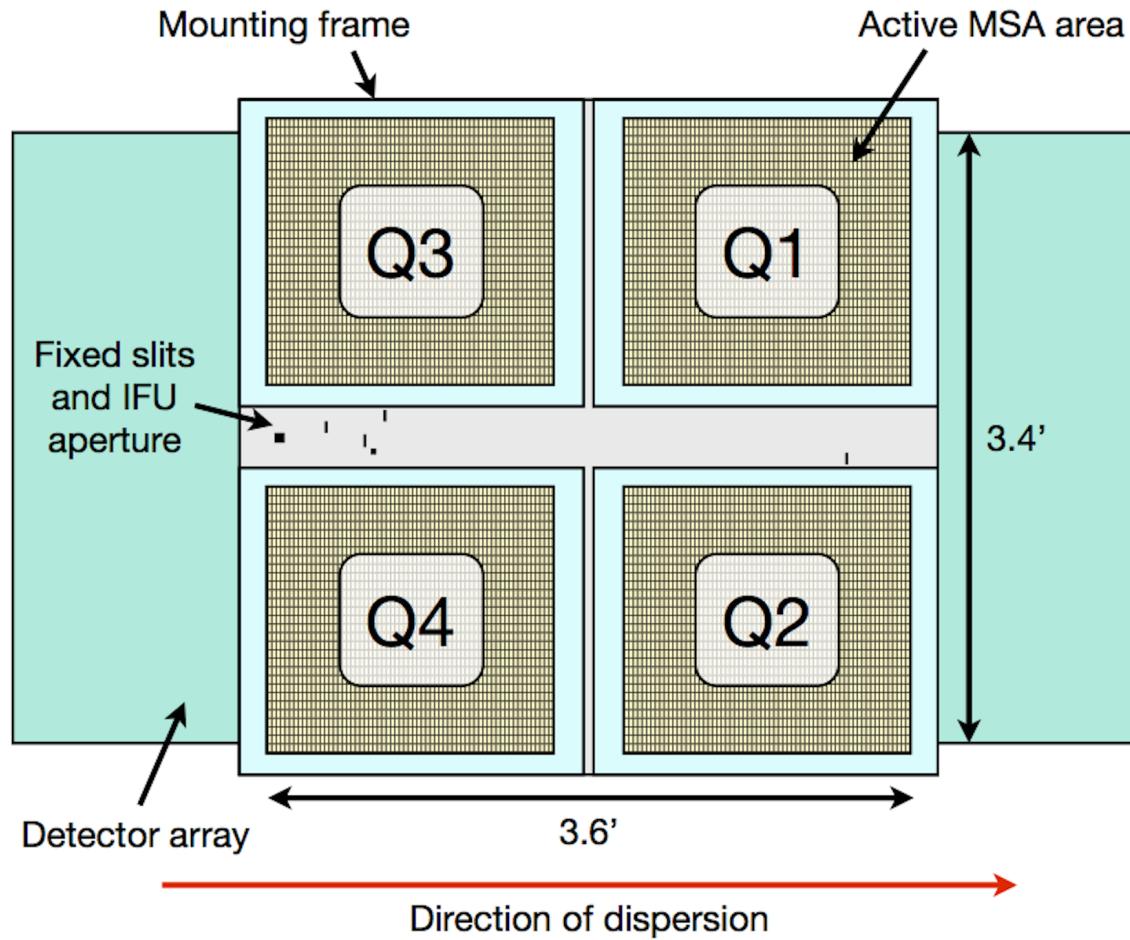
Saturation: K~4
(subarray mode)



$$F322W2 + F444W = 2.4\text{--}4.9 \mu\text{m}$$



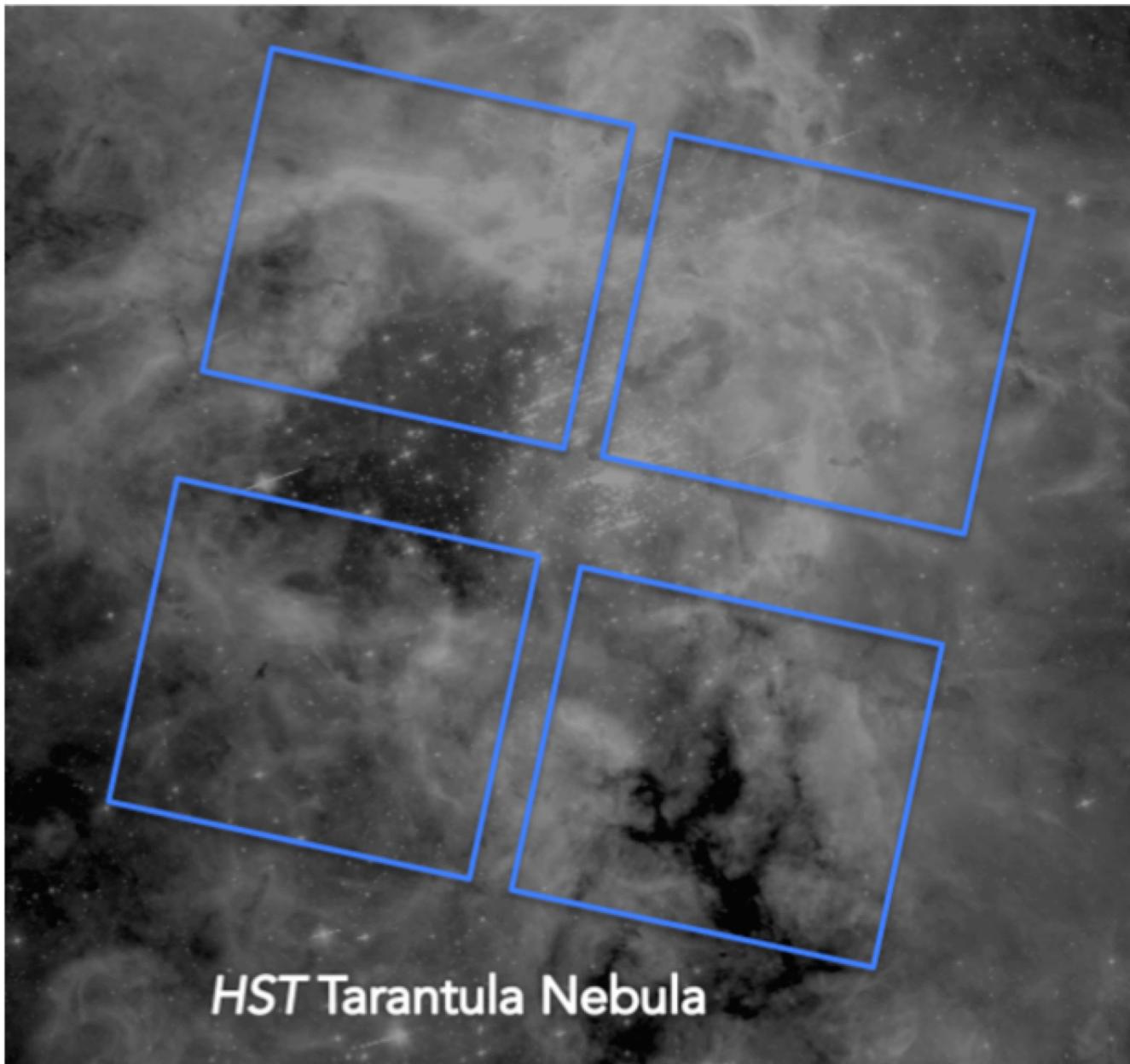
NIRSpec focal plane



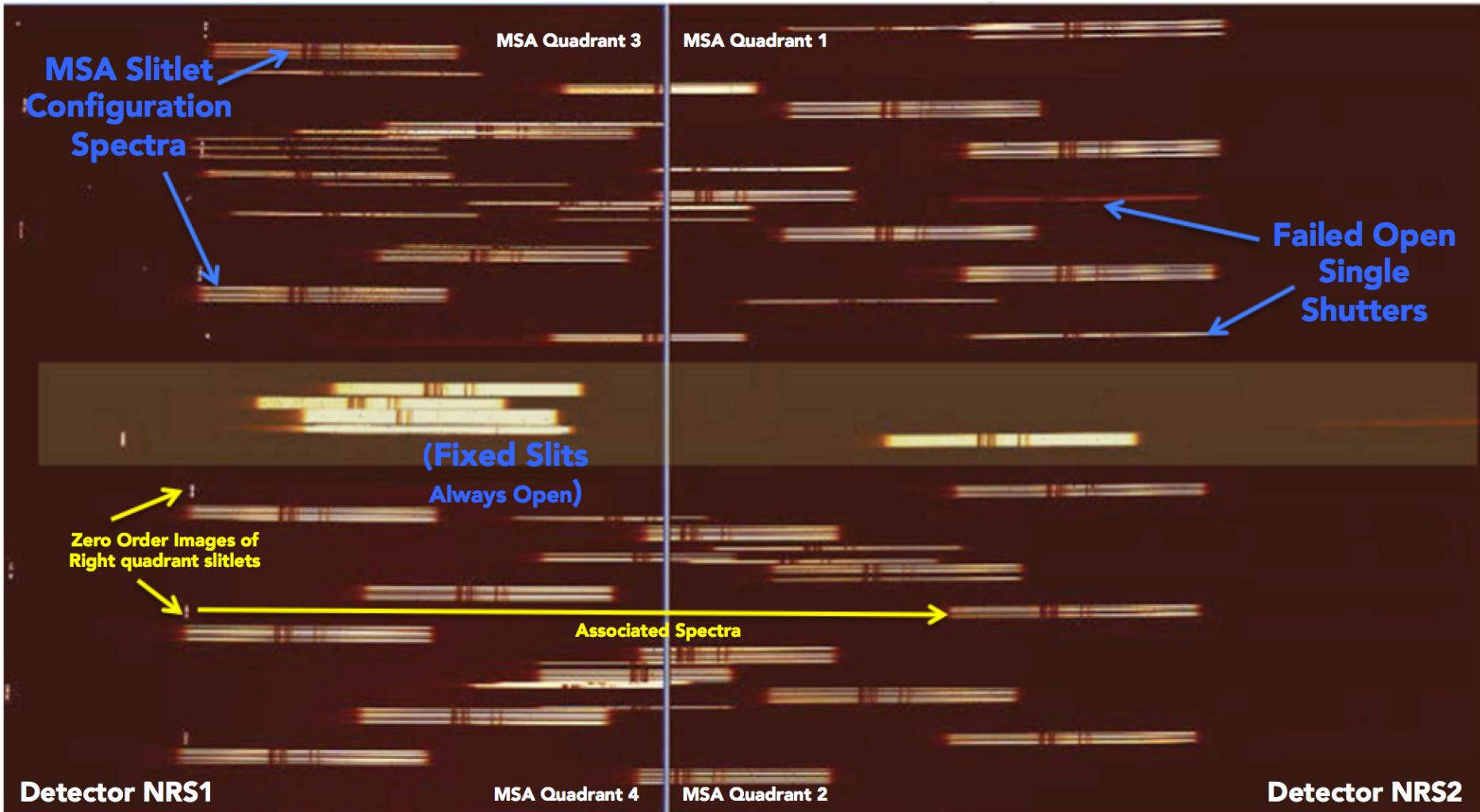
MSA = Multi-Shutter Array

MOS = Multi-Object Spectrometer

NIRSpec MSA Quadrant View



NIRSpec MSA image

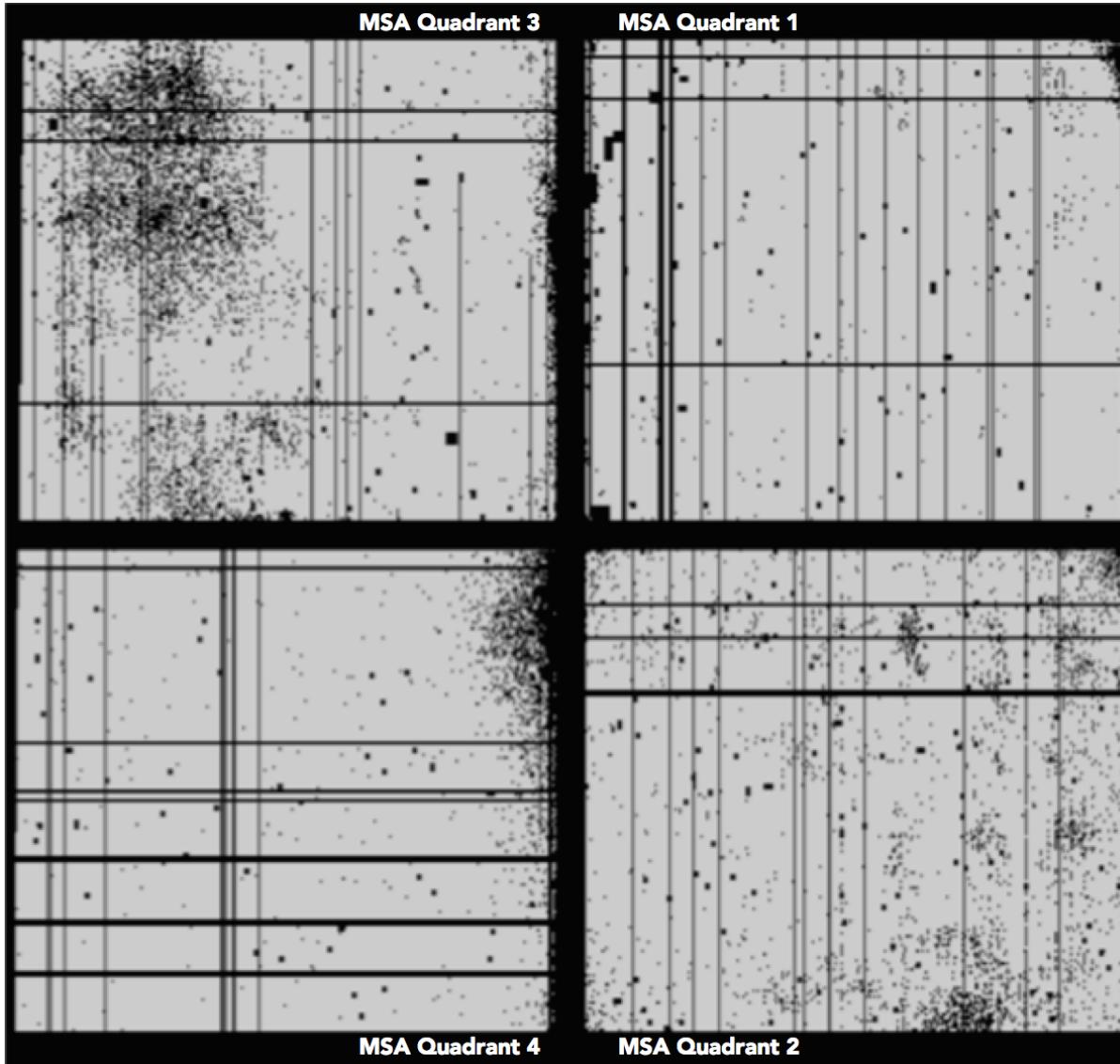


Grism and filter combinations

grism	filter	R	wavelength (μm)	gaps for IFU at $R \sim 2700$ (μm)
G140M / H	F070LP	~ 1000 / ~ 2700	0.70 – 1.27	none
G140M / H	F100LP		0.97 – 1.89	1.44 – 1.48
G235M / H	F170LP		1.66 – 3.17	2.42 – 2.48
G395M / H	F290LP		2.87 – 5.27	4.08 – 4.19
PRISM	CLEAR	~ 100	0.60 – 5.30	

For both MSA and IFU

MSA – failed shutter map



~250,000 shutters
~12% failed closed
~20 failed open

Each shutter
0.20" x 0.46"

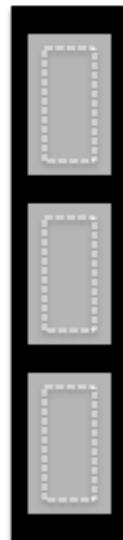
Need 5-10 mas
astrometry

NIRSpec – planning for MSA

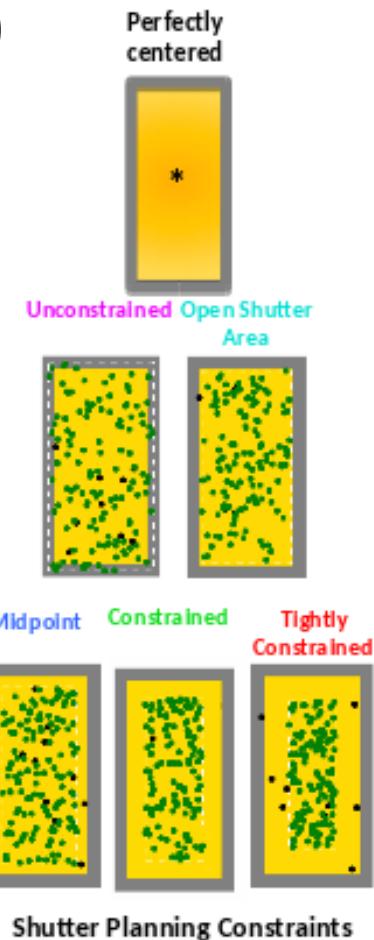
Many parameters,
including:

Slitlet shape

1, 2, 3, 5 shutters



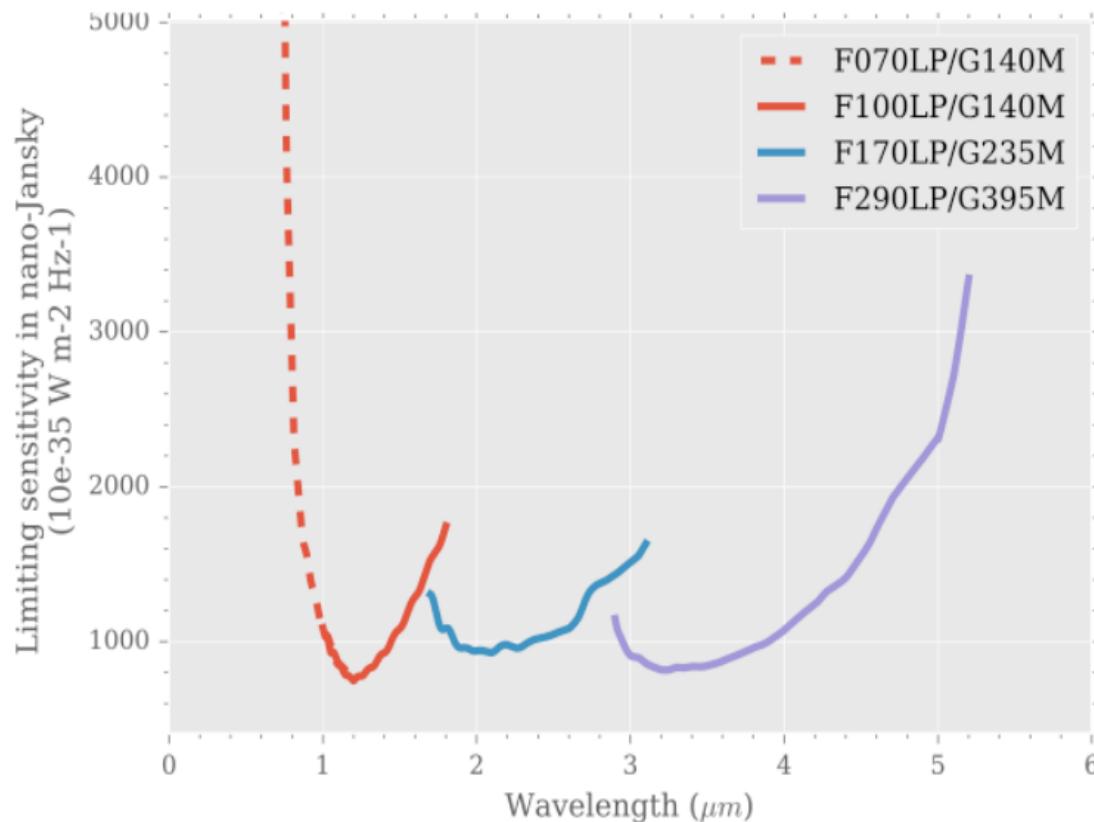
Shutter margin (5
choices)



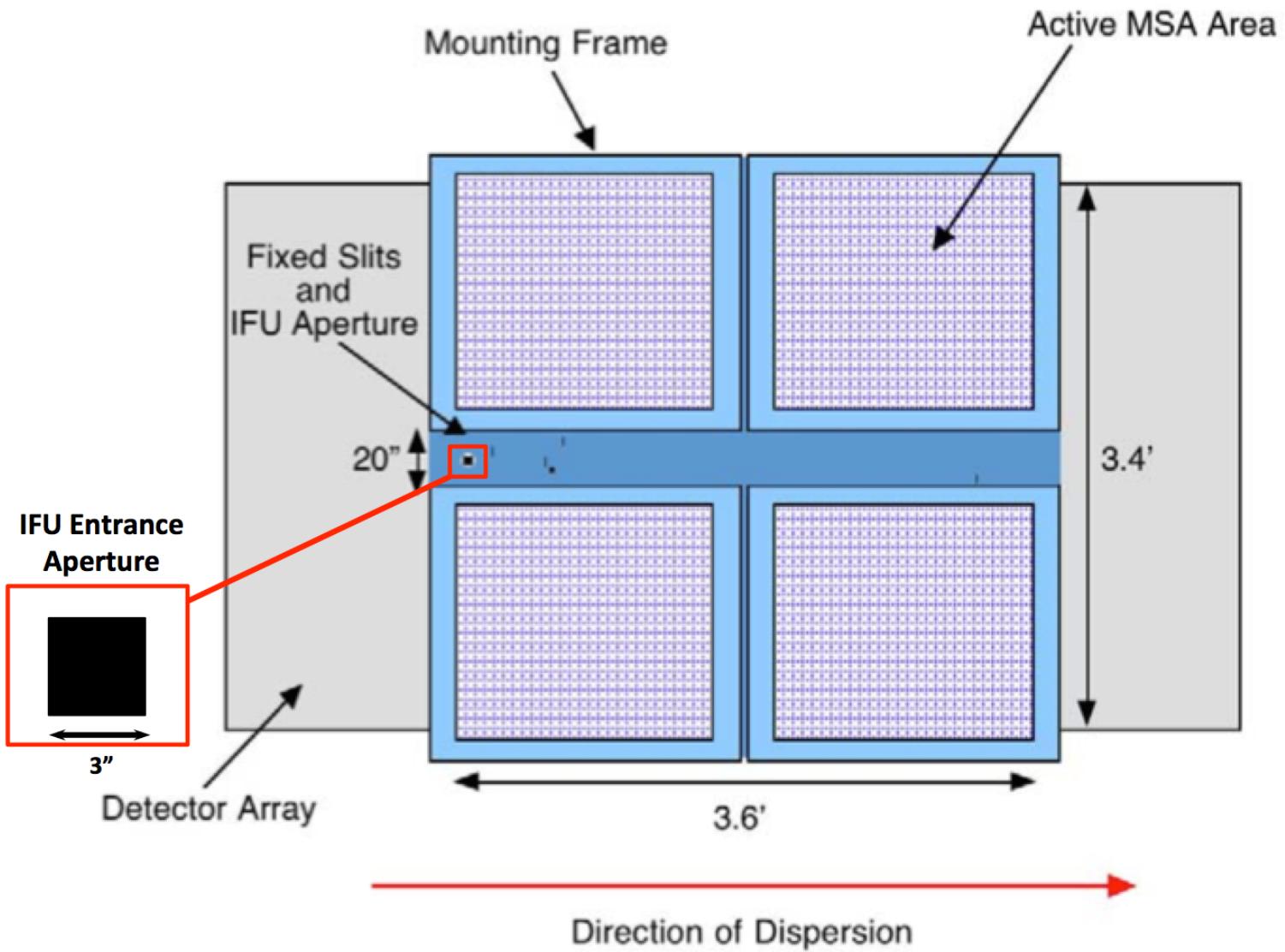
Courtesy Diane Karakla

NIRSpec sensitivity

R=1000

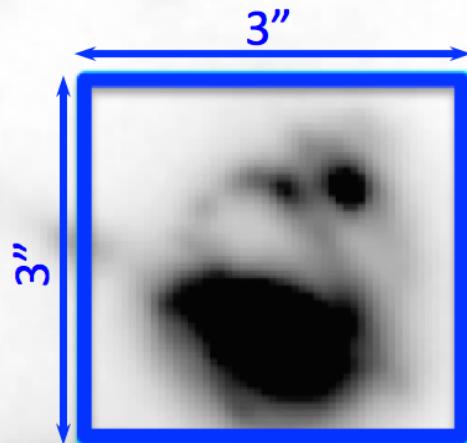


NIRSpec Integrated Field Unit

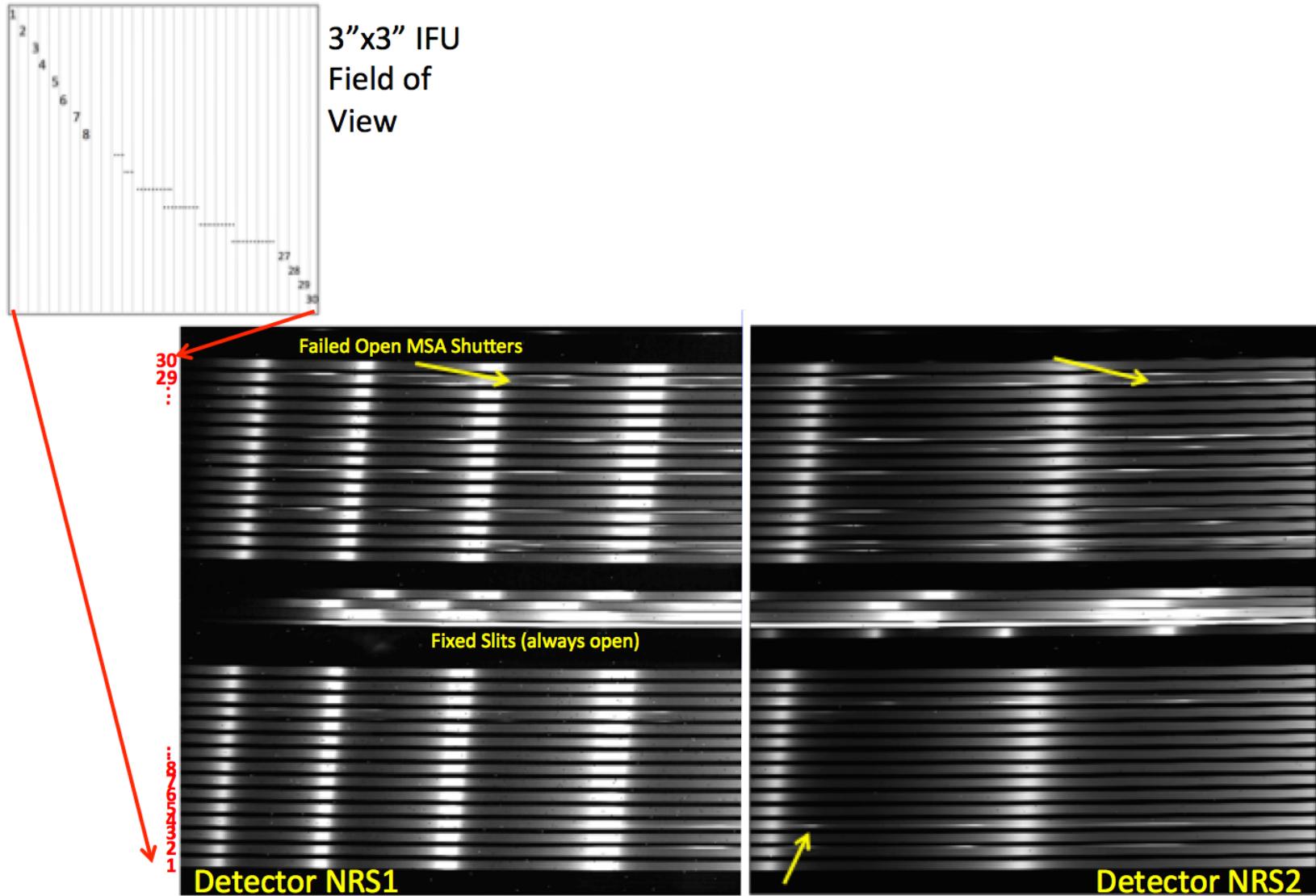


NIRSpec IFU and HUDF

JWST NIRSpec IFU Field

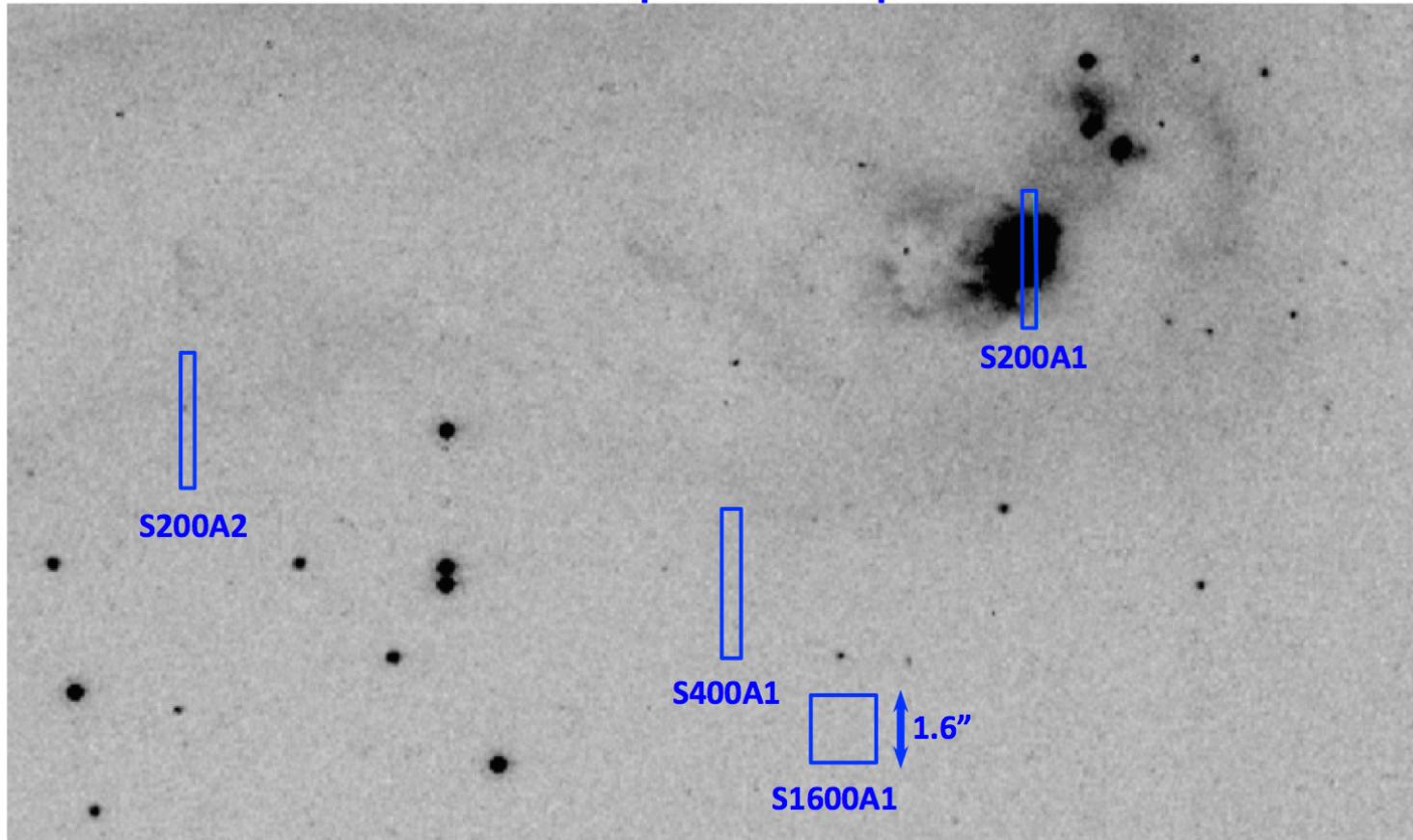


IFU – slicing and dicing



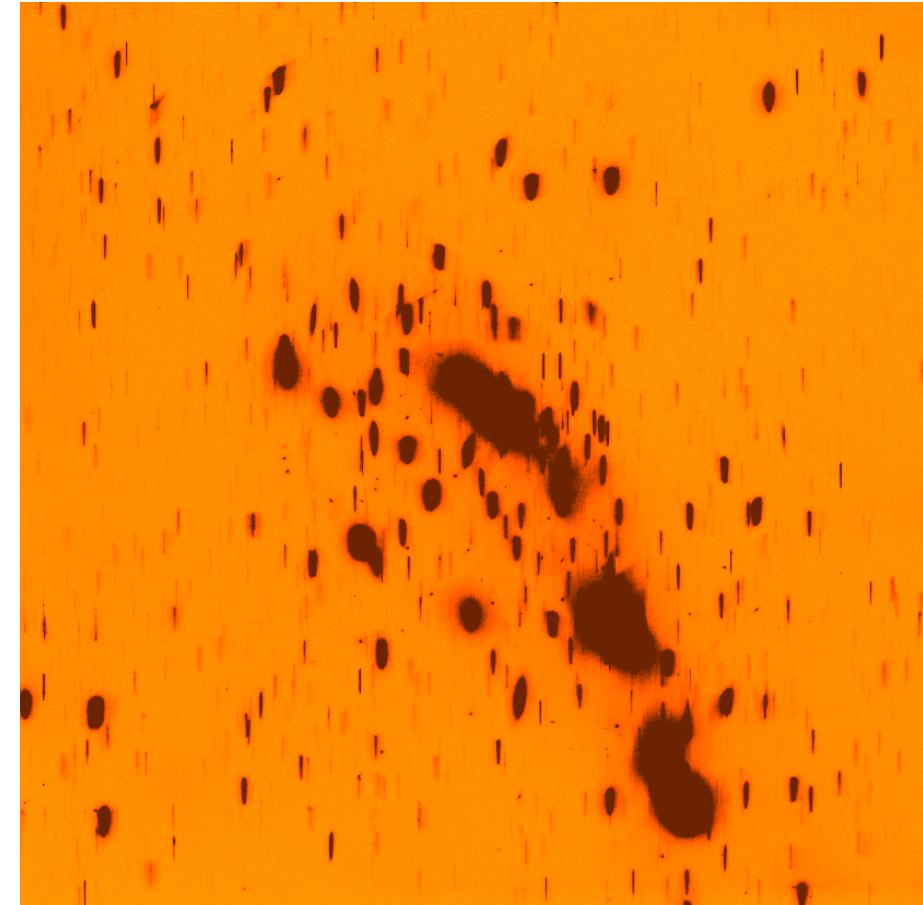
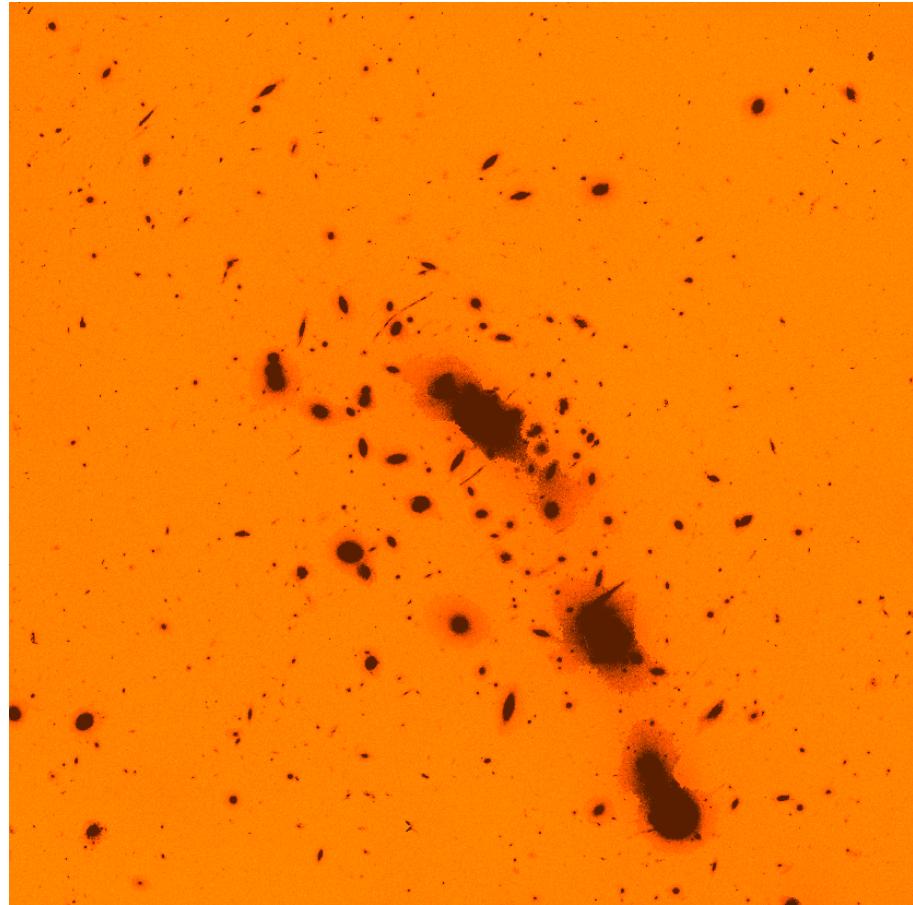
NIRSpec fixed slits

JWST NIRSpec FS Apertures



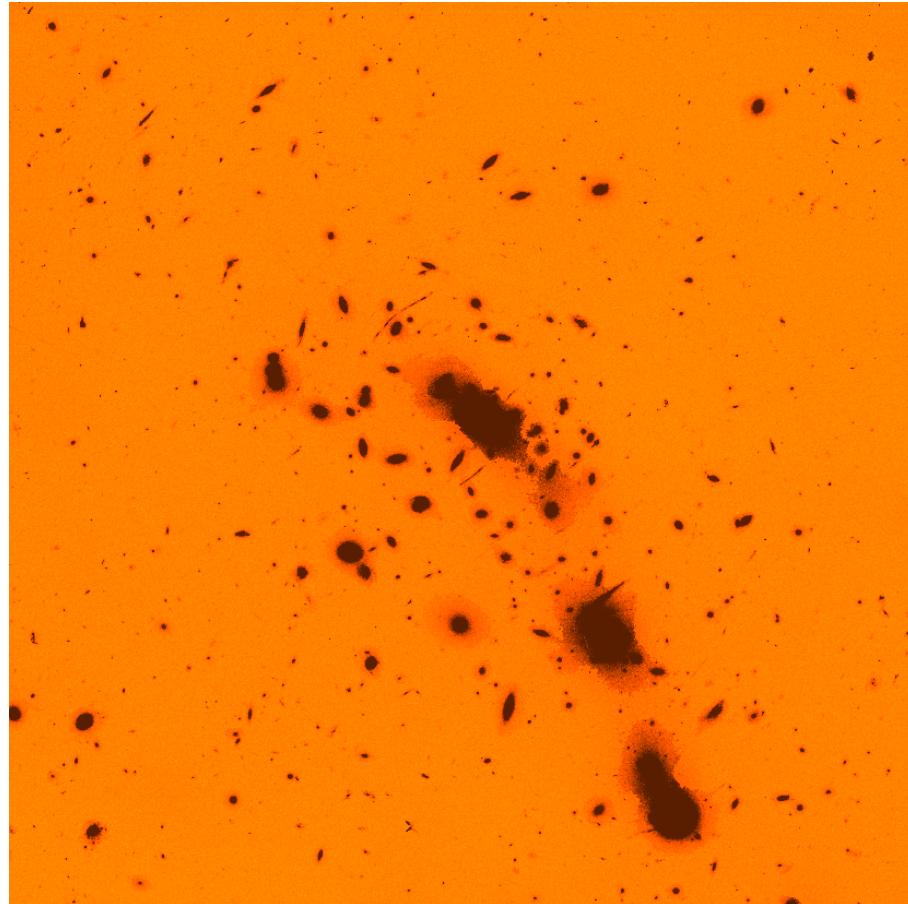
NIRISS

Wide-Field Slitless Spectrometer

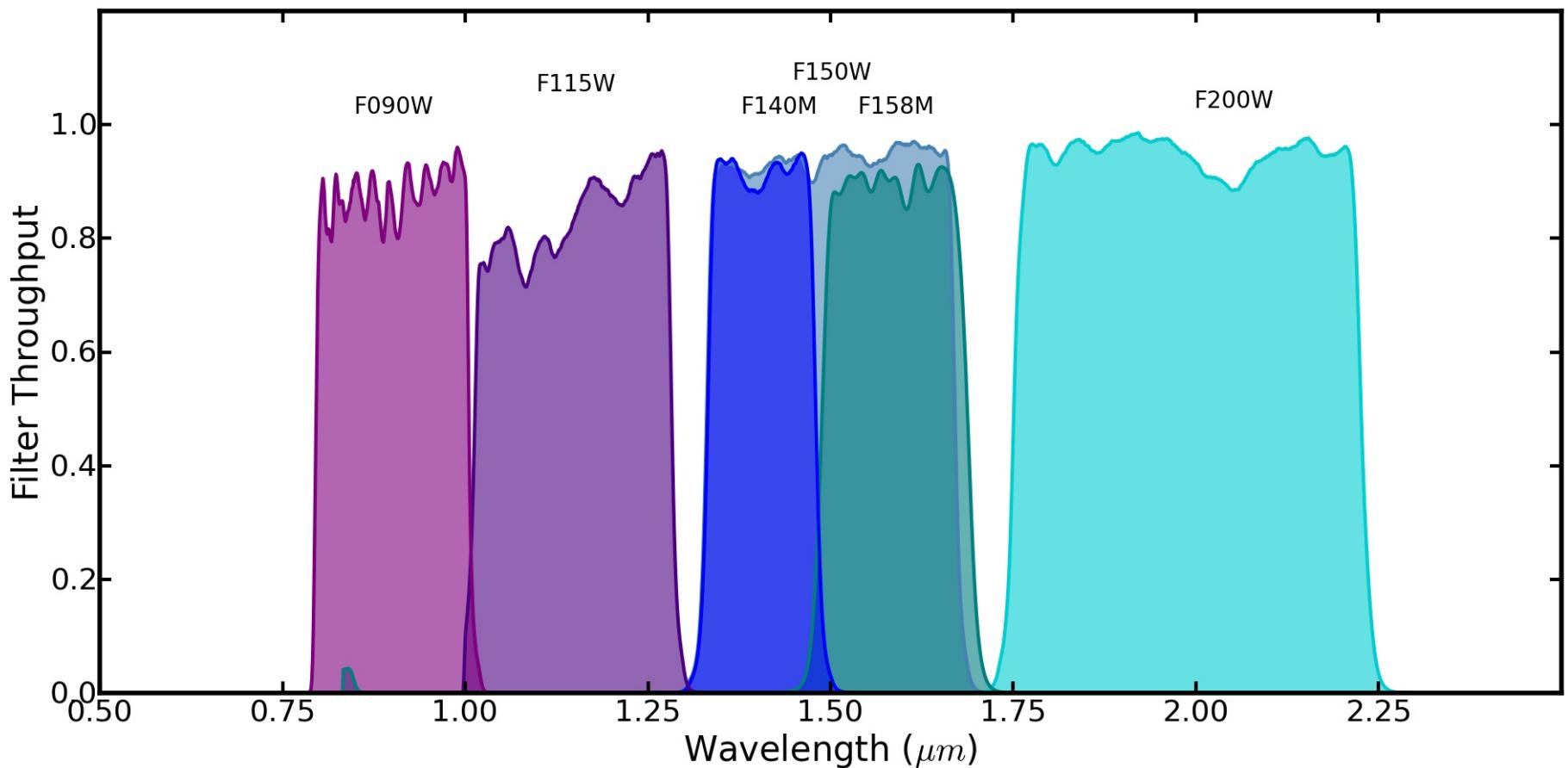


NIRISS

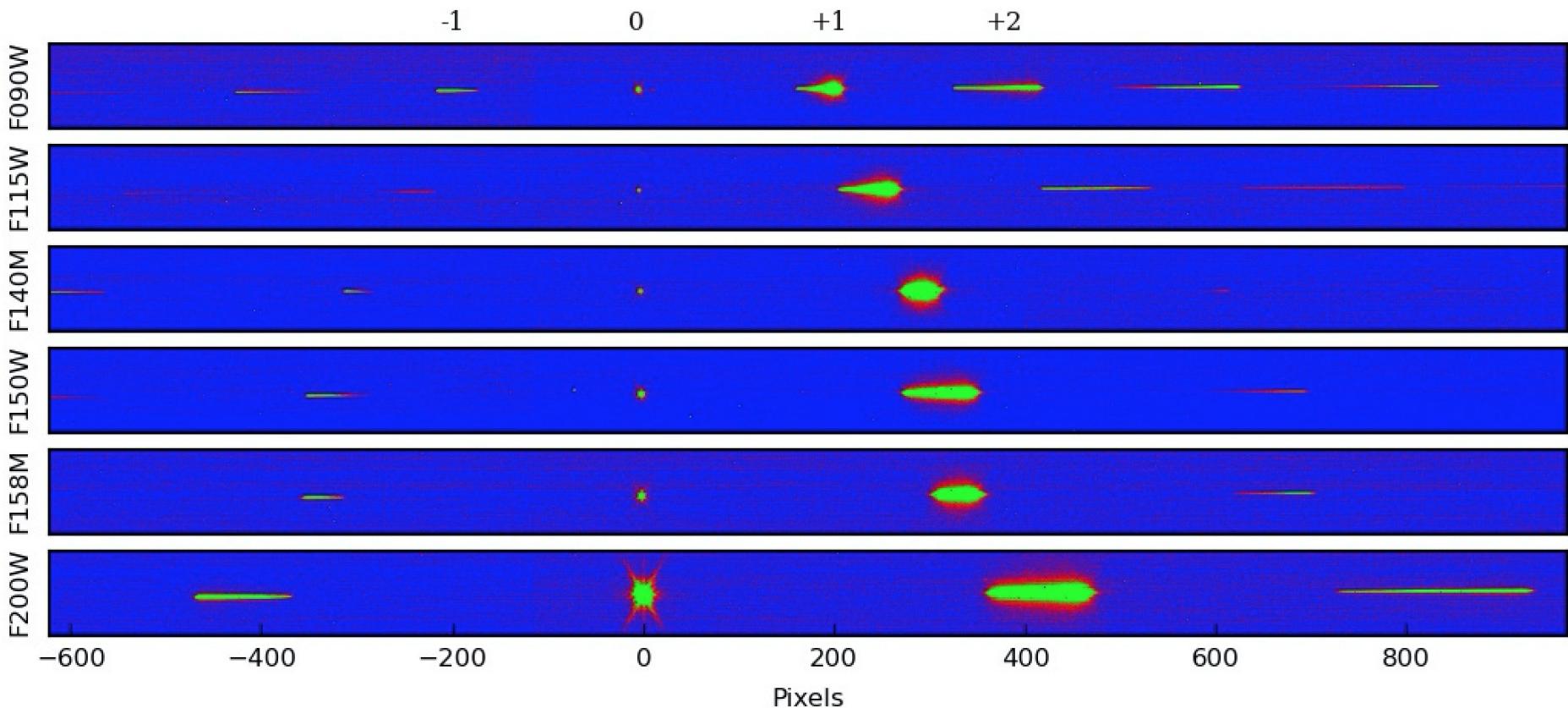
Wide-Field Slitless Spectrometer



NIRISS filters



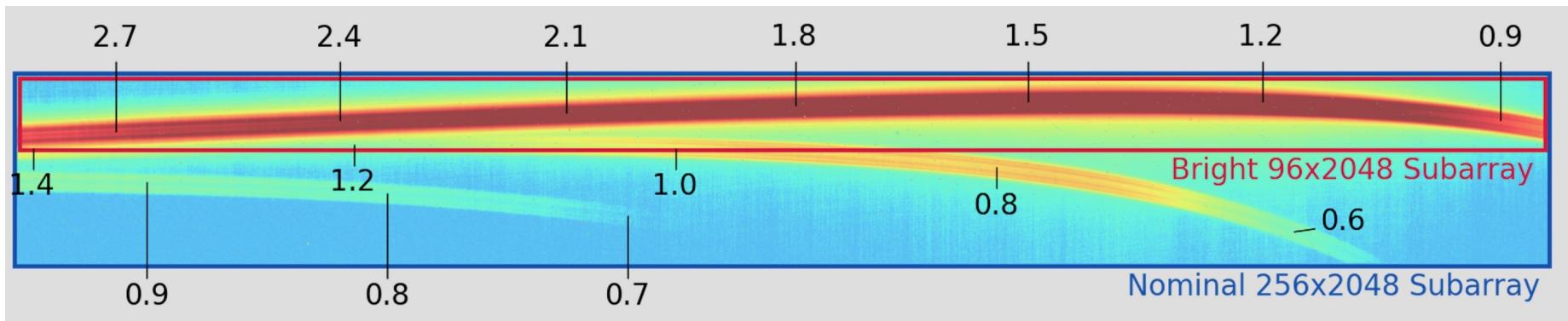
NIRISS – WFSS orders



Sensitivity: ~1.5 mag less than NIRSpec

NIRISS

Single-Object Slit Spectroscopy



Saturation limits:

SUBSTRIP256: $J \sim 8$ in 1st order, 6.8 in 2^d order

SUBSTRIP96: $J \sim 7$ in 1st order