

ETC – Deep Field Example

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NIRSpec Configurations

To measure the continuum: 100k s for a SNR~10

- PRISM/CLEAR → see differences with point and extended source

To measure the lines: 30k s for a SNR~10

* Anchoring calculation with emission line

- G140M/F100LP → 1909 Å [C III] at z=6 is 1.34 μm
- G235M/F170LP → 3727 Å [O II] at z=6 is 2.61 μm
- G395M/F290LP → H-alpha at z=6 is 4.59 μm
- G395H/F290LP → H-alpha at z=6 is 4.59 μm

PRISM: 100k s for SNR \sim 10

Configuration parameters for point source

- Continuum tab in Scenes and Sources:
 - BCD UGCA 219
 - z=6
 - Default parameters for extinction
- Renorm tab:
 - Normalize to bandpass
 - 26 vegamag
 - HST WFC3 F160W
- Shape tab: keep point source
- Offset tab: keep default parameters
- ID tab: name of source
- Backgrounds tab: keep medium
- Instrument tab:
 - PRISM/CLEAR
 - 3 shutters
 - MSA on Quad 3 center
- Detector setup tab:
 - Subarray = Full Frame
 - Readout pattern = NRS
 - Groups = 44
 - Integrations = 2
 - Exposures = 27
- Strategy tab:
 - Centered on source
 - Wavelength of interest = 1.5

PRISM: 100k s for SNR~10

Point Source

Calculations Scenes and Sources Upload Spectra Caveats and Limitations

Select a Scene

ID	Name	Sources	# Calcs
1	BCD - point source 1	1	1
2	C III] at z=6	2	1
3	[O II] 3727 @ z=6	3	1
4	H-alpha @ z=6	4	1
5	BCD - extended	5	1

New Add Source Remove Source

Select a Source

ID	Plot Name	Scenes	# Calcs
1	<input checked="" type="checkbox"/> BCD - point sou 1	1	1
2	<input type="checkbox"/> C III] at z=6	2	1
3	<input type="checkbox"/> [O II] 3727 @ z= 3	1	1
4	<input type="checkbox"/> H-alpha @ z=6	4	1
5	<input type="checkbox"/> BCD - extender 5	1	1

New Delete

Source Editor

ID Continuum Renorm Lines Shape Offset

Normalize Source Flux Density
Renormalization applied after redshift

Normalize at wavelength

0.0001 mJy

lambda 2 μm

Normalize in bandpass

26 vegamag at

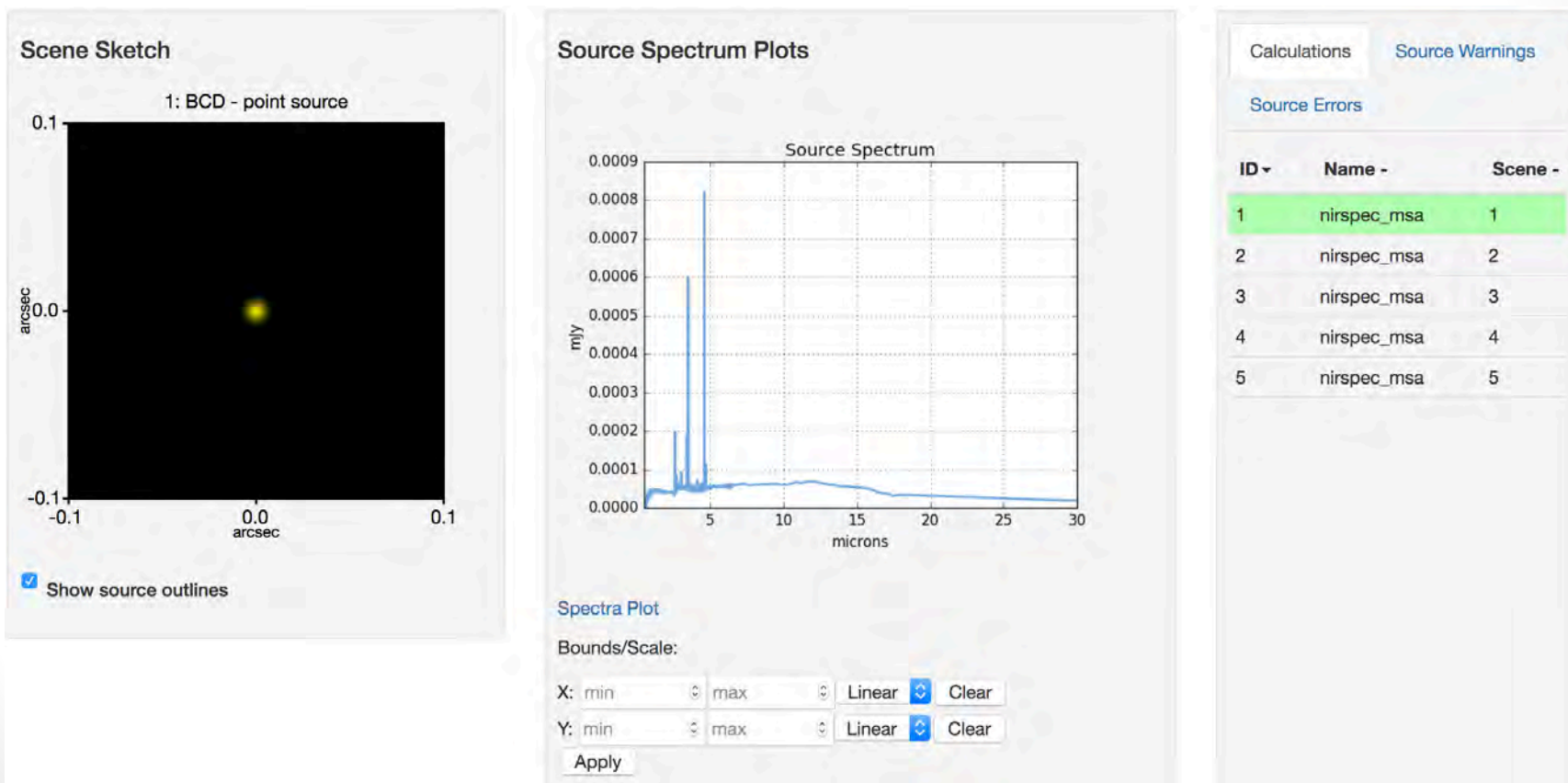
JWST MIRI/IMAGING F560W

HST WFC3/IR F160W

Source selected: 1 Reset Save

PRISM: 100k s for SNR~10

Point Source Scenes and Sources tab – lower half of screen



PRISM: 100k s for SNR~10

Point Source Extraction Strategy

Calculations | Scenes and Sources | Upload Spectra | Caveats and Limitations

MIRI | NIRCcam | NIRISS | NIRSpec

ID	Plot	Mode	Scene	(s)	SNR	
6		nirspec msa	6	29569.04	10.46	
5		nirspec msa	5	102621.9	11.80	
4		nirspec msa	4	29569.04	11.16	
3		nirspec msa	3	29569.04	10.66	
2		nirspec msa	2	29569.04	15.70	
1		nirspec msa	1	102621.9	10.26	

Scene ★ | Backgrounds | Instrument Setup | Detector Setup | Strategy

MSA Full Shutter Extraction

Centered on source

Angular units: arcsec

1: BCD - point source

X, Y: 0,0 arcsec

Perform Background Subtraction Using

background region

noiseless sky background

Source offset from shutter center

X: 0 arcsec (0.00 fractional shutters)

Y: 0 arcsec (0.00 fractional shutters)

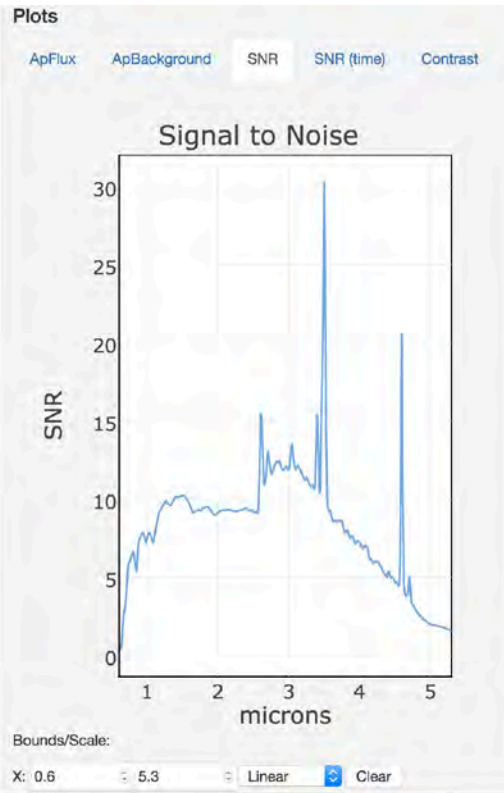
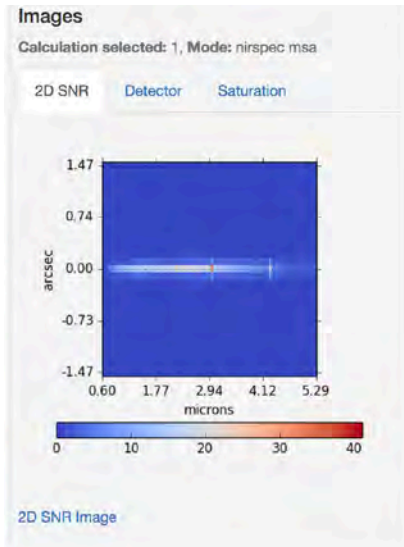
Wavelength of Interest: 1.5 microns (0.6 - 5.3)

Calculation selected: 1, Mode: nirspec msa

Reset Calculate

PRISM: 100k s for SNR~10

Point Source



Reports

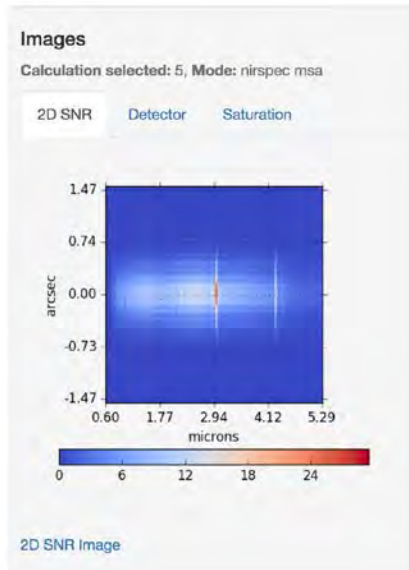
Calculation selected: 1, Mode: nirspec msa

Report Warnings Errors

Downloads

Instrument	clear/prism
Filter/Dispenser:	
Extraction Aperture Position (arcsec):	[0.00, 0.00]
Wavelength of Interest used to Calculate Scalar Values (microns):	1.50
Size of Extraction Aperture (arcsec):	N/A
Total Time Required for Observation (seconds):	102621.95
Total Exposure Time (seconds):	102621.95
Extracted Flux (e-/sec):	0.08
Variance in Extracted Flux (e-/sec):	0.01
Extracted Signal-to-Noise ratio:	10.26
Input Background Surface Brightness (MJy/sr):	0.37
Total Background Flux in Extraction Aperture (e-/sec):	1.91

Extended Source



PRISM: 100k s for SNR \sim 10

Configuration parameters for **extended source**

- The extraction strategy for an extended source is different
 - Choose Aperture Spectral Extraction (the shutter bars are not taken into account and the 3 shutters are treated as a single continuous area)
- Notice the change in SNR with all exact same parameters as for point source
- In order to get a SNR \sim 10 we need to renormalize
- Play around with the MSA Location in the Instrument Setup tab under Calculations to see the gap
 - If you choose for instance Quadrant 1 upper left the physical gap between detectors will show in the 2D SNR image and the S/N plot.

PRISM: 100k s for SNR~10

The extraction strategy is different for a point source (MSA Full Shutter Extraction) than for an extended source (Aperture Spectral Extraction). See JDoX for more information on this.

Extended source

The screenshot displays the PRISM JDoX interface. On the left, a table lists calculations with columns for ID, Plot, Mode, Scene, (s), and SNR. Row 5 is highlighted in yellow, indicating the selected calculation. On the right, the 'Strategy' configuration panel is shown, with 'Aperture Spectral Extraction' selected. The panel includes settings for aperture location, radius, background subtraction, and sky annulus.

ID	Plot	Mode	Scene	(s)	SNR	
6		nirspec msa	6	29569.04	10.46	
5		nirspec msa	5	102621.9	11.80	
4		nirspec msa	4	29569.04	11.16	
3		nirspec msa	3	29569.04	10.66	
2		nirspec msa	2	29569.04	15.70	
1		nirspec msa	1	102621.9	10.26	

Configuration Panel (Strategy):

- Scene: 5
- Aperture location: 5: BCD - extended
- Aperture radius: 0.4 arcsec
- Perform Background Subtraction Using: background region
- Sky annulus: Inner radius 0.8 arcsec, Outer radius 1.5 arcsec
- Angular units: arcsec

Calculation selected: 5, Mode: nirspec msa

PRISM: 100k s for SNR~10

To get a $S/N \sim 10$ we need to either change the number of groups, integrations, and exposures OR, since we want to keep the exposure time at $\sim 100k$ s, we can modify the renormalization.

Extended source

The screenshot shows the PRISM web interface with the following components:

- Navigation tabs:** Calculations, Scenes and Sources, Upload Spectra, Caveats and Limitations.
- Instrument selection:** MIRI, NIRCam, NIRISS, NIRSpec.
- Source Table:**

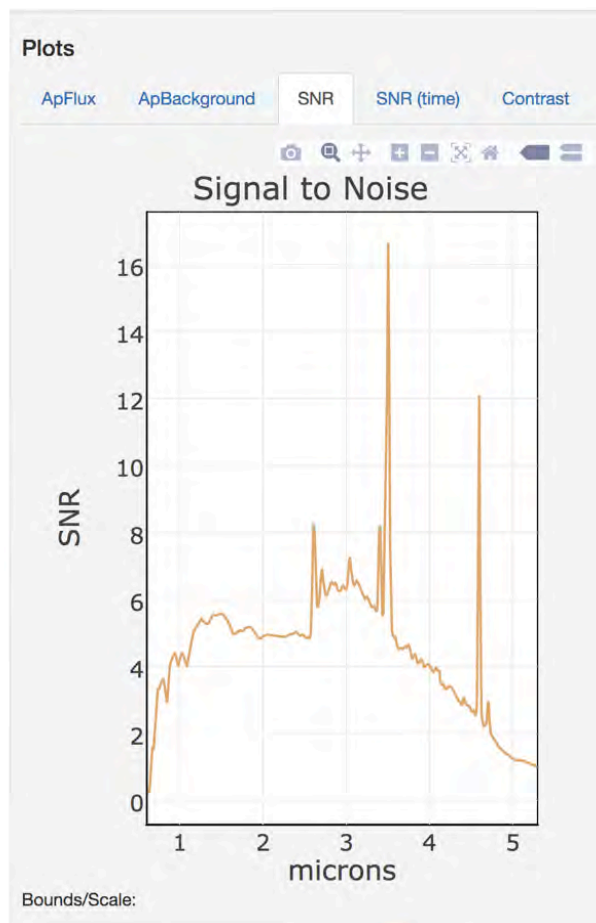
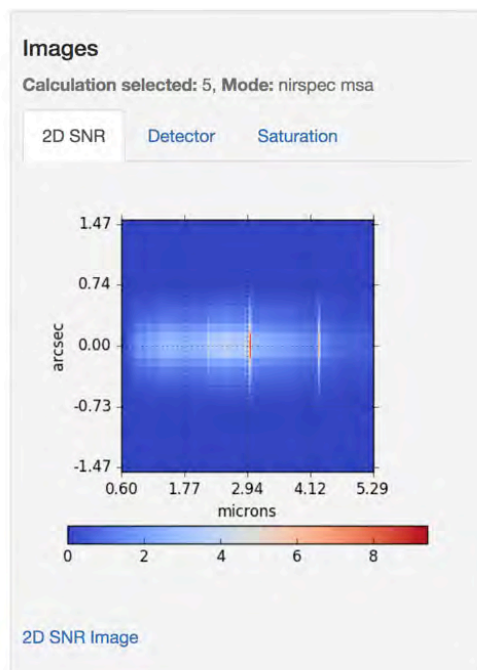
ID	Plot	Mode	Scene	(s)	SNR	
6	<input type="checkbox"/>	nirspec msa	6	29569.04	10.46	✓
5	<input checked="" type="checkbox"/>	nirspec msa	5	102621.9	11.80	✓
4	<input type="checkbox"/>	nirspec msa	4	29569.04	11.16	✓
3	<input type="checkbox"/>	nirspec msa	3	29569.04	10.66	✓
2	<input type="checkbox"/>	nirspec msa	2	29569.04	15.70	✓
1	<input type="checkbox"/>	nirspec msa	1	102621.9	10.26	✓

- Calculation Settings:** Scene: 5: BCD - extended; Continuum, Renorm, Lines, Shape; Offset.
- Sources in that Scene:** 5: BCD - extended.
- Normalize Source Flux Density:** Renormalization applied after redshift; Normalize at wavelength; 0.001 mJy; lambda 4.59 μm ; Normalize in bandpass; 24 vegamag at; JWST MIRI/IMAGING F560W.
- Buttons:** Reset, Calculate.
- Status:** Calculation selected: 5, Mode: nirspec msa.

PRISM: 100k s for SNR~10

Calculations tab - lower half of screen

Extended source



Reports

Calculation selected: 5, Mode: nirspec msa

Report Warnings Errors

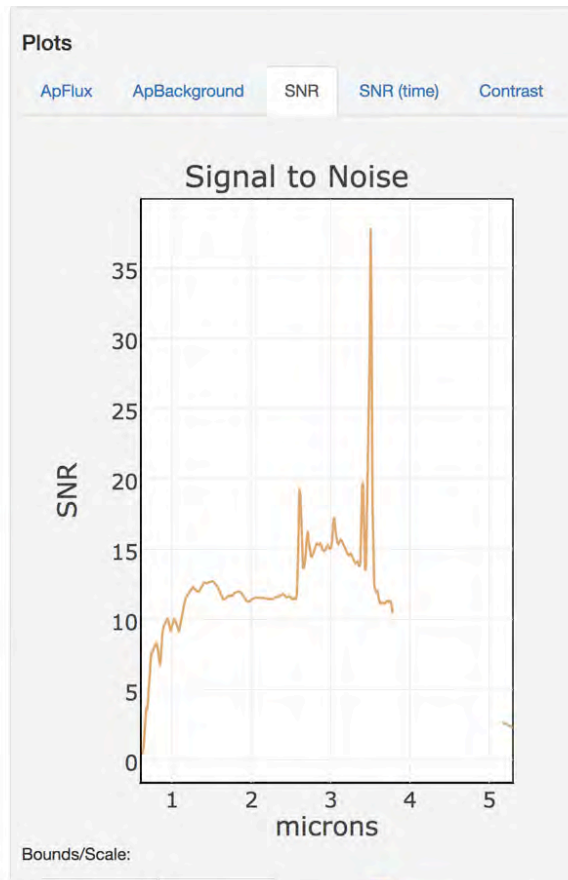
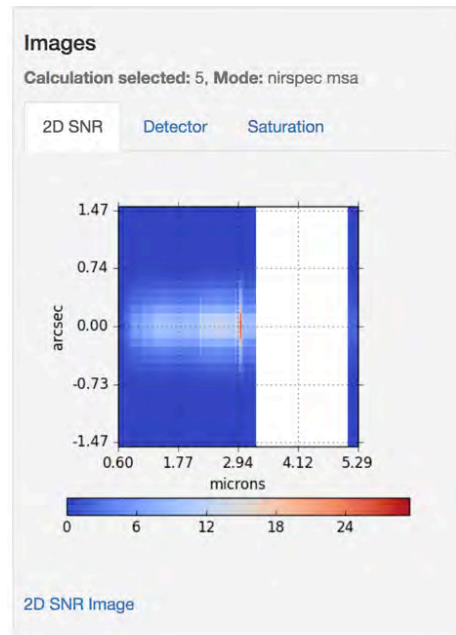
Downloads

Instrument	clear/prism
Filter/Disperser:	
Extraction Aperture Position (arcsec):	[0.00, 0.00]
Wavelength of Interest used to Calculate Scalar Values (microns):	4.59
Size of Extraction Aperture (arcsec):	0.4
Total Time Required for Observation (seconds):	102621.95
Total Exposure Time (seconds):	102621.95
Extracted Flux (e-/sec):	0.04
Variance in Extracted Flux (e-/sec):	3.3e-3
Extracted Signal-to-Noise ratio:	11.80
Input Background Surface Brightness (MJy/sr):	0.43
Total Background Flux in Extraction Aperture	4.6e-4

PRISM: 100k s for SNR~10

Gap shows when moving the MSA location option

Extended source



Reports

Calculation selected: 5, Mode: nirspec msa

Report Warnings Errors

Downloads

Instrument	clear/prism
Filter/Disperser:	
Extraction Aperture	[0.00, 0.00]
Position (arcsec):	
Wavelength of Interest used to Calculate Scalar Values (microns):	1.50
Size of Extraction Aperture (arcsec):	N/A
Total Time Required for Observation (seconds):	102621.95
Total Exposure Time (seconds):	102621.95
Extracted Flux (e-/sec):	0.10
Variance in Extracted Flux (e-/sec):	0.01
Extracted Signal-to-Noise ratio:	12.72
Input Background Surface Brightness (MJy/sr):	0.37
Total Background Flux in Extraction Aperture	1.94

G140M/F100LP: 30k s SNR~10

Configuration parameters: Anchor to 1909 C III]

- Continuum tab in Scenes and Sources:
 - No Continuum
- ID tab: name of line @ z=6
- Renorm tab:
 - Do not renormalize
- Lines tab:
 - Name = C III] @ z=6
 - Line center = 1.34 μm
 - Line width = 40 km/s
 - Line strength = $2.1\text{e-}18$ erg/cm²/s
- Shape tab: keep point source
- Offset tab: keep default parameters
- Instrument tab:
 - G140M/F100LP
 - 3 shutters
 - MSA on Quad 3 center
- Detector setup tab:
 - Subarray = Full Frame
 - Readout pattern = NRS
 - Groups = 38
 - Integrations = 2
 - Exposures = 9
- Strategy tab:
 - Centered on source
 - Wavelength of interest = 1.34

G140M/F100LP: 30k s SNR~10

Anchoring calculation to 1909 Å C III] at z=6

Calculations Scenes and Sources Upload Spectra Caveats and Limitations

MIRI NIRCam NIRISS NIRSpec

ID	Plot	Mode	Scene	(s)	SNR	
5	<input type="checkbox"/>	nirspec msa	5	102621.9	12.72	✓
4	<input type="checkbox"/>	nirspec msa	4	29569.04	11.16	✓
3	<input type="checkbox"/>	nirspec msa	3	29569.04	10.66	✓
2	<input checked="" type="checkbox"/>	nirspec msa	2	29569.04	15.75	✓
1	<input type="checkbox"/>	nirspec msa	1	102621.9	10.26	✓
-	-	-	-	-	-	-

Scene ★ Backgrounds Instrument Setup Detector Setup Strategy

Select Scene for Calculation
2: C III] at z=6

Sources in that Scene
2: C III] at z=6

Line name
C III] @ z=6

Line center Line width Line strength
1.34 μm 30 km/s 2.1e-18 erg/cm²/s

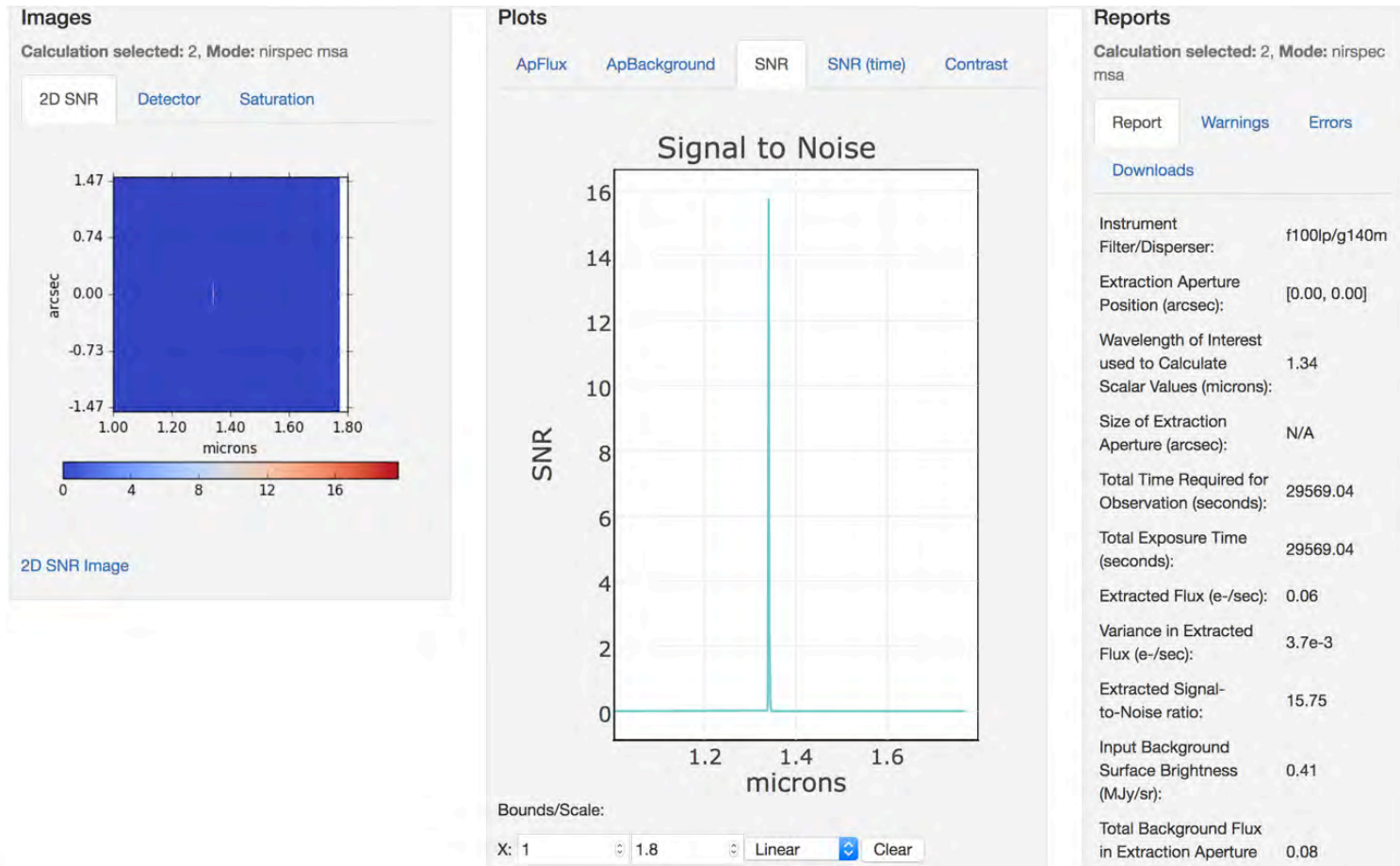
Name	Center	Width	Strength
C III] @ z=6	1.34	30	2.1e-18

Calculation selected: 2, Mode: nirspec msa

Reset Calculate

G140M/F100LP: 30k s SNR~10

Anchoring calculation to 1909 Å C III] at z=6



G235M/F170LP: 30k s SNR~10

Configuration parameters: Anchor to 3727 [O II]

- Continuum tab in Scenes and Sources:
 - No Continuum
- ID tab: name of line @ z=6
- Renorm tab:
 - Do not renormalize
- Lines tab:
 - Name = [O II] @ z=6
 - Line center = 2.61 μm
 - Line width = 40 km/s
 - Line strength = $7\text{e-}19$ erg/cm²/s
- Shape tab: keep point source
- Offset tab: keep default parameters
- Backgrounds tab: keep medium
- Instrument tab:
 - G235M/F170LP
 - 3 shutters
 - MSA on Quad 3 center
- Detector setup tab:
 - Subarray = Full Frame
 - Readout pattern = NRS
 - Groups = 38
 - Integrations = 2
 - Exposures = 9
- Strategy tab:
 - Centered on source
 - Wavelength of interest = 2.61

G395M/F290LP: 30k s SNR~10

Configuration parameters: Anchor to H-alpha

- Continuum tab in Scenes and Sources:
 - No Continuum
- ID tab: name of line @ z=6
- Renorm tab:
 - Do not renormalize
- Lines tab:
 - Name = H-alpha @ z=6
 - Line center = 4.59 μm
 - Line width = 40 km/s
 - Line strength = $5.15\text{e-}19$ erg/cm²/s
- Shape tab: keep point source
- Offset tab: keep default parameters
- Instrument tab:
 - G395M/F290LP
 - 3 shutters
 - MSA on Quad 3 center
- Detector setup tab:
 - Subarray = Full Frame
 - Readout pattern = NRS
 - Groups = 38
 - Integrations = 2
 - Exposures = 9
- Strategy tab:
 - Centered on source
 - Wavelength of interest = 4.59

G395H/F290LP: 30k s SNR~10

Configuration parameters: Anchor to H-alpha

- Continuum tab in Scenes and Sources:
 - AGN NGC 4138
- ID tab: name of line @ z=6
- Renorm tab:
 - Norm at 0.02 mJy for $\lambda=4.59 \mu\text{m}$
- Lines tab:
 - Name = H-alpha @ z=6
 - Line center = $4.59 \mu\text{m}$
 - Line width = 2000 km/s
 - Line strength = $5.15\text{e-}19 \text{ erg/cm}^2/\text{s}$
- Shape tab: choose extended source with a 2D Gaussian
- Offset tab: keep default parameters
- Backgrounds tab: keep medium
- G395H/F290LP
- 3 shutters
- MSA on Quad 4 lower right
- Detector setup tab:
 - Subarray = Full Frame
 - Readout pattern = NRS
 - Groups = 38
 - Integrations = 2
 - Exposures = 9
- Strategy tab:
 - Choose Aperture Spectral Extraction:
 - Aperture radius=0.4
 - Background region with inner radius = 0.8 and outer radius = 1.5
 - Centered on source
 - Wavelength of interest = 4.59

G395H/F290LP: 30k s SNR~10

Extended AGN extraction strategy

Calculations | Scenes and Sources | Upload Spectra | Caveats and Limitations

MIRI | NIRCam | NIRISS | NIRSpec

ID	Plot	Mode	Scene	(s)	SNR	
6	<input checked="" type="checkbox"/>	nirspec msa	6	29569.04	10.46	✓
5	<input type="checkbox"/>	nirspec msa	5	102621.9	11.80	✓
4	<input type="checkbox"/>	nirspec msa	4	29569.04	11.16	✓
3	<input type="checkbox"/>	nirspec msa	3	29569.04	10.66	✓
2	<input type="checkbox"/>	nirspec msa	2	29569.04	15.70	✓
1	<input type="checkbox"/>	nirspec msa	1	102621.9	10.26	✓

Scene ★ | Backgrounds | Instrument Setup | Detector Setup | Strategy

Aperture Spectral Extraction

Aperture location

Centered on source

Aperture radius: 0.4 arcsec

6: AGN

X, Y: 0,0 arcsec (unused)

Specify offsets in scene

Y: 0 arcsec

Wavelength of Interest: 4.59 microns

Perform

background region

Background Subtraction Using

noiseless sky background

Sky annulus

Inner radius: 0.8 arcsec

Outer radius: 1.5 arcsec

Angular units: arcsec

Calculation selected: 6, Mode: nirspec msa

Reset Calculate

G395H/F290LP: 30k s SNR~10

Extended AGN renormalization

Calculations Scenes and Sources Upload Spectra Caveats and Limitations

MIRI NIRCam NIRISS NIRSpec

ID	Plot	Mode	Scene	(s)	SNR	⚠
6	<input checked="" type="checkbox"/>	nirspec msa	6	29569.04	10.46	✓
5	<input type="checkbox"/>	nirspec msa	5	102621.9	11.80	✓
4	<input type="checkbox"/>	nirspec msa	4	29569.04	11.16	✓
3	<input type="checkbox"/>	nirspec msa	3	29569.04	10.66	✓
2	<input type="checkbox"/>	nirspec msa	2	29569.04	15.70	✓
1	<input type="checkbox"/>	nirspec msa	1	102621.9	10.26	✓
-	-	---	-	---	---	-

Scene ★ Backgrounds Instrument Setup Detector Setup Strategy

Select Scene for Calculation
6: Broad emission line

Sources in that Scene
6: AGN

Normalize Source Flux Density
Renormalization applied after redshift

Normalize at wavelength
0.02 mJy
lambda 4.59 μm

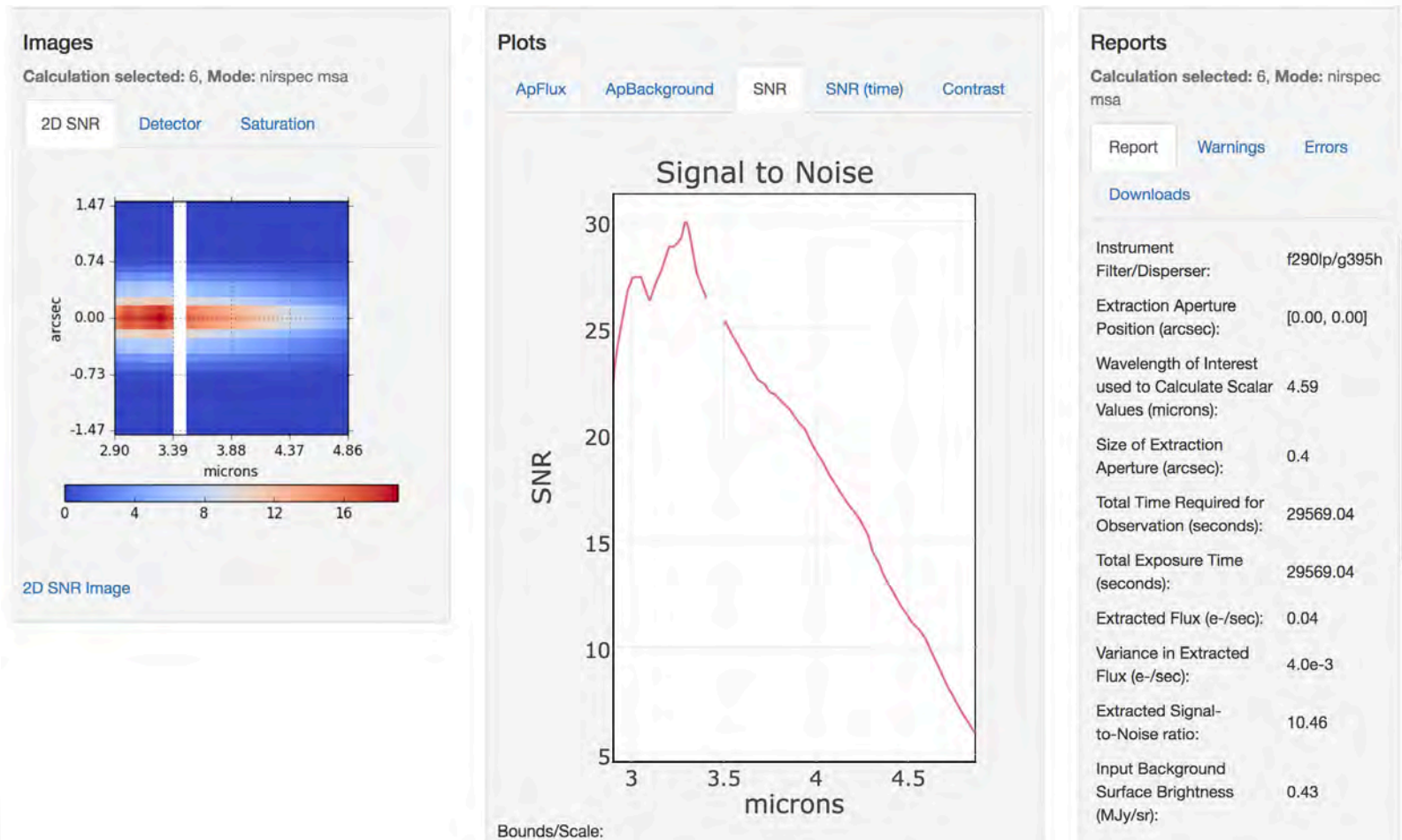
Normalize in bandpass
26 vegamag at

JWST MIRI/IMAGING F560W

Calculation selected: 6, Mode: nirspec msa

G395H/F290LP: 30k s SNR~10

Extended AGN SNR



Gracias = Thank you

Enjoy playing around with the JWST ETC!