

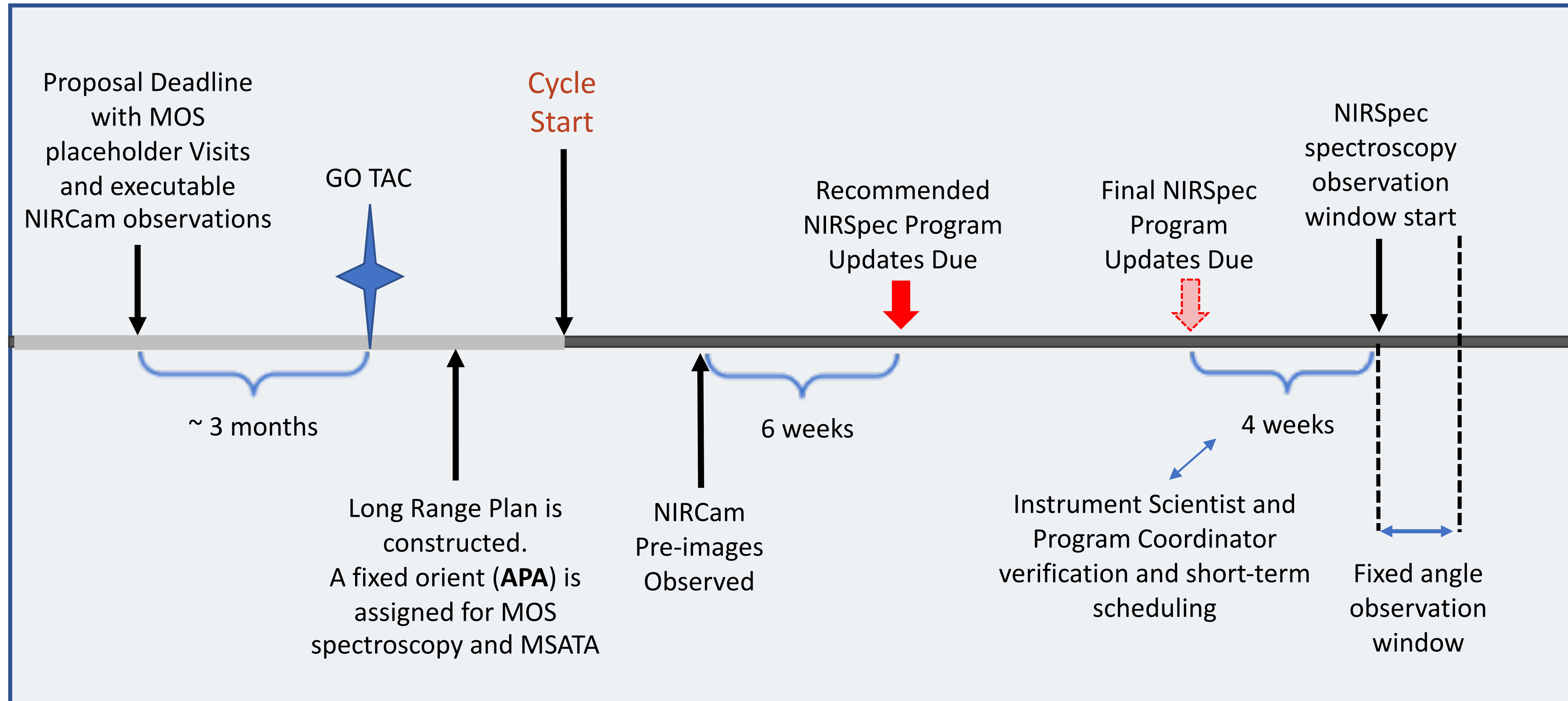
JWST Master Class Workshop

Available proposal tools: MPT

Elena Puga for the ESA JWST Science Operations Team

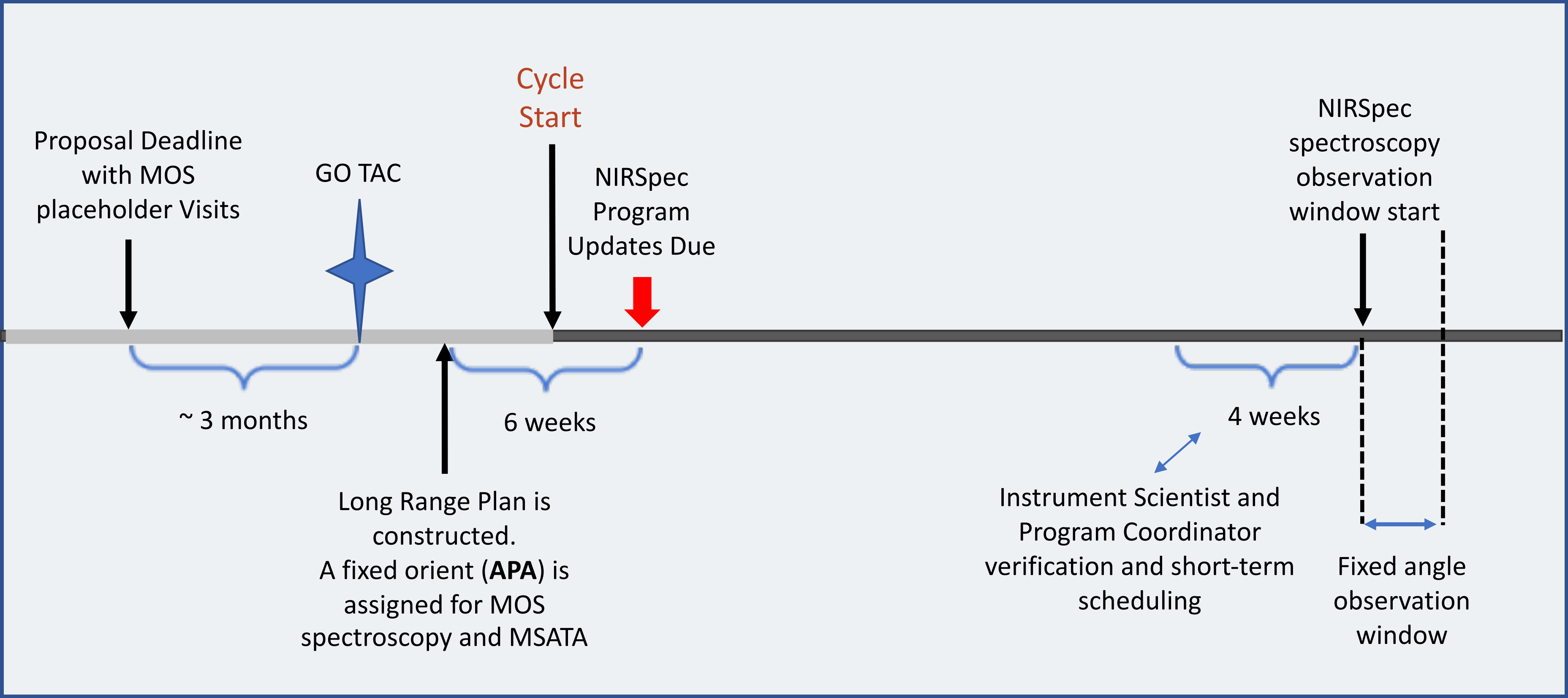


MOS proposal timeline: with pre-imaging



Proposal Submission: Users must request the time needed (including overheads) to observe an expected number of targets to desired exposure depths. Use the MPT with simulated or existing catalogs to explore the effects of planning choices (dithers, slit length, etc.) on the number of observable targets, and the number of MSA configurations needed to obtain all dithered exposures..

MOS proposal timeline: without pre-imaging



When the Position Angle is assigned (APA). Use MPT to generate the MSA configurations for the actual observations and finalize MPT. Finalized plan will be due 6 weeks after APA is assigned.



MSA Planning Tool (MPT)

A guide to JWST MOS terminology

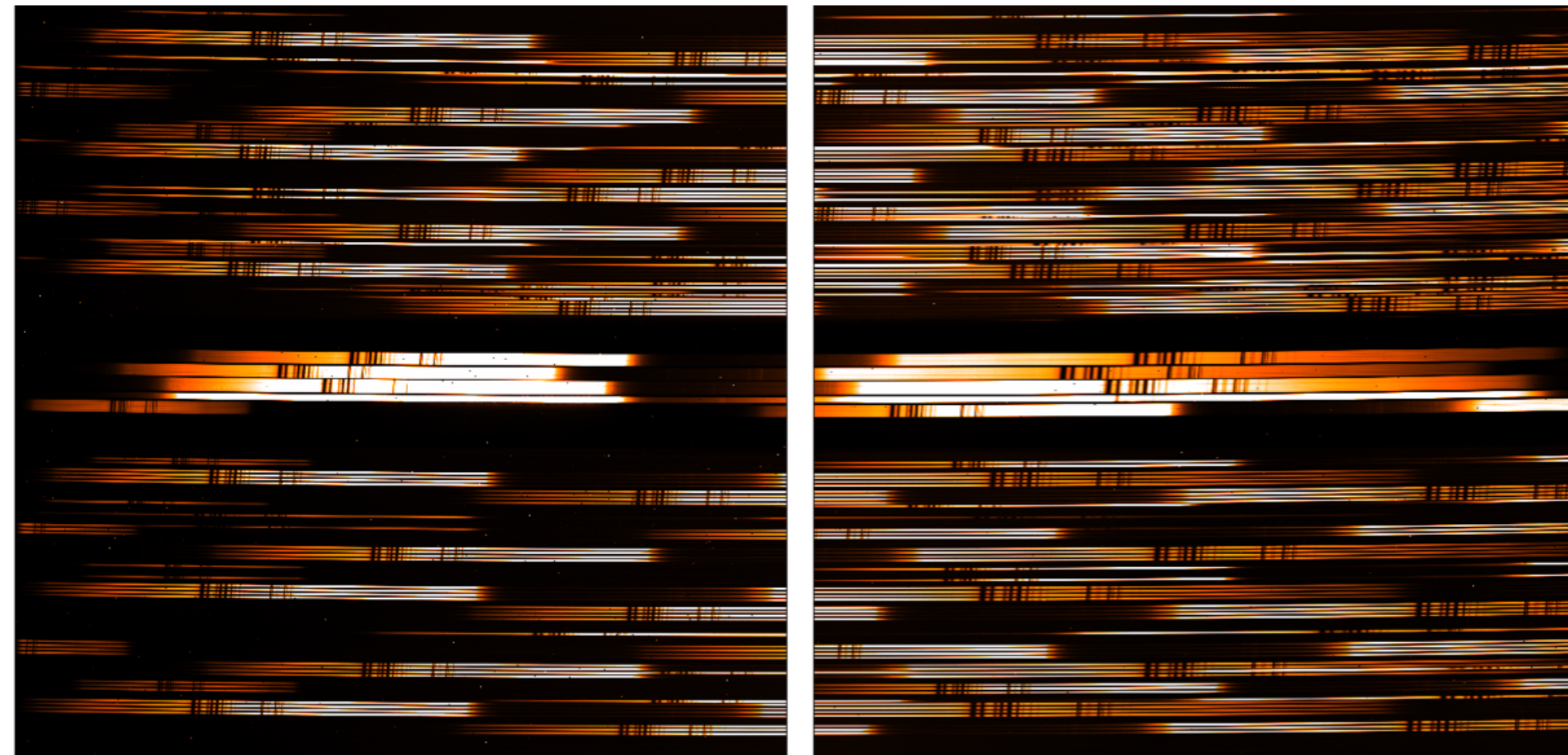


- **MOS** - Multi-Object Spectroscopy
 - ▶ the NIRSpec mode for obtaining spectra of 10-100s of specific targets simultaneously
- **MSA** - Micro-Shutter Assembly
 - ▶ the array of very small shutters (0.2x0.46 arcsec) within NIRSpec that allows specific targets to be selected and contaminants to be blocked
- **MPT** - MSA Planning Tool
 - ▶ the tool within APT for planning and optimising the MOS observations with the NIRSpec MSA

Why use MPT?



- NIRSpec MOS can obtain spectra for 10s-100s of objects simultaneously
- Targets are selected by opening a few of a grid of 250,000 micro-shutters
- MPT optimises this "MOS mask" given your target catalogue



Example (flat-field test exposure)
of 100 tightly-packed spectra
(G395H grating)

- ▶ strategies are covered in the MOS hands-on session

MSA Planning Tool (MPT) in APT



A screenshot of the Astronomer's Proposal Tools (APT) web interface. The browser title bar reads "Astronomer's Proposal Tools Version 27.3 mpt-demo (Thu Jul 25 2019) JWST PRD: PRDOPSSOC-L-023". The main navigation bar contains icons for various tools: Form Editor, Spreadsheet Editor, MSA Planning Tool (highlighted with a yellow hexagon), Orbit Planner, Visit Planner, Timeline, View in Aladin, BOT, Target Confirmation, PDF Preview, Submission, Errors and Warnings, and a loading spinner. Below the navigation bar, there are links for "New Document", "What's New", "Roadmap", and "Feedback". The main content area displays the title "Astronomer's Proposal Tools" in large blue font, followed by the version and date information. Below this, there is a list of bullet points detailing copyright and dependencies.

Astronomer's Proposal Tools
Version 27.3 mpt-demo (Thu Jul 25 2019) JWST PRD: PRDOPSSOC-L-023

- Copyright 2002 – 2007 United States Government as represented by the Administrator of the National Aeronautics and Space Administration. All Rights Reserved.
- This software has made use of the Aladin Sky Atlas (<http://aladin.u-strasbg.fr/>) developed at the *Centre de Données astronomiques de Strasbourg* (CDS – <http://cdsweb.u-strasbg.fr/>)
- This software has made use of the SIMBAD database, operated at CDS, Strasbourg, France.
- This software has made use of the NASA/IPAC Extragalactic Database (NED) which is operated by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.
- This software uses portions of the JSky library which is maintained by the European Southern Observatory.

What is needed to run MPT?

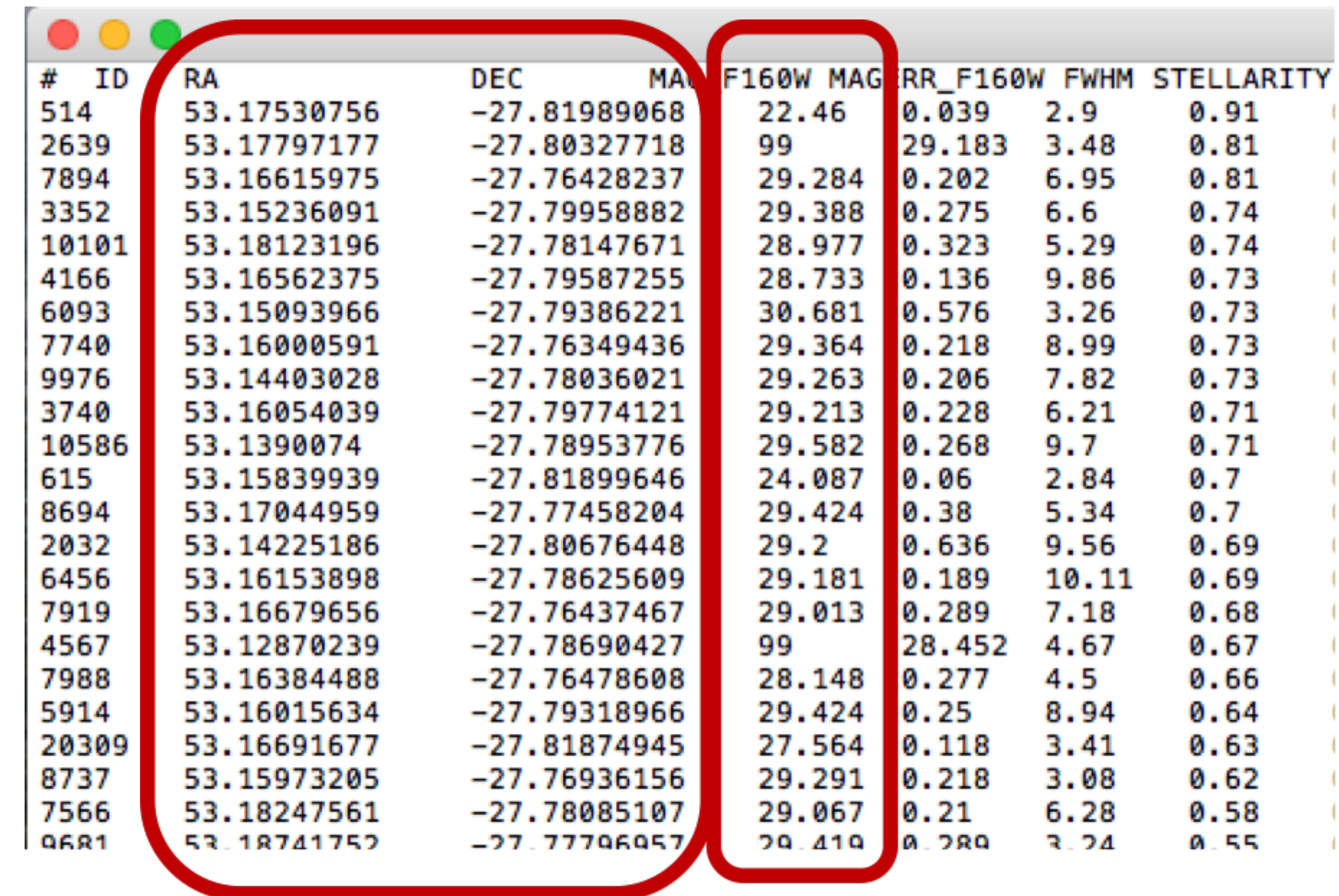


- An internet connection
 - ▶ access to the most up-to-date MSA shutter operability
 - ▶ checking for guide stars during planning
- A complete and accurate astrometric catalogue
 - ▶ accurate source positions (<15mas relative accuracy)... may require NIRCam pre-imaging
- MPT produces **plans** with:
 - ▶ 1 or more **pointings**
 - ▶ **MSA configurations**
 - ▶ target sets
- One or multiple **plans** can be selected for a given **observation**

The catalogue



- First step to create a MOS observation... upload **complete and accurate** catalogue of sources to the MPT
- Catalogue should include all known sources in the field, to properly identify contaminants
- Upload source catalogue as an ASCII file
- It **must** contains J2000 **RA** and **Dec** expressed in degrees or hexadecimal
- It **cannot** have duplicate **IDs** or NULL entries
- *Optional*: Fluxes or magnitudes for the sources helps
 - ▶ Magnitudes are needed to properly define reference stars
- *Optional*: Target priorities are recommended
- The file can have a header, marked by "**#**"
- Remember: the relative astrometric accuracy of the catalogue must be between 5 and 50 mas



#	ID	RA	DEC	MAG	F160W MAG	RR_F160W	FWHM	STELLARITY
514		53.17530756	-27.81989068		22.46	0.039	2.9	0.91
2639		53.17797177	-27.80327718		99	29.183	3.48	0.81
7894		53.16615975	-27.76428237		29.284	0.202	6.95	0.81
3352		53.15236091	-27.79958882		29.388	0.275	6.6	0.74
10101		53.18123196	-27.78147671		28.977	0.323	5.29	0.74
4166		53.16562375	-27.79587255		28.733	0.136	9.86	0.73
6093		53.15093966	-27.79386221		30.681	0.576	3.26	0.73
7740		53.16000591	-27.76349436		29.364	0.218	8.99	0.73
9976		53.14403028	-27.78036021		29.263	0.206	7.82	0.73
3740		53.16054039	-27.79774121		29.213	0.228	6.21	0.71
10586		53.1390074	-27.78953776		29.582	0.268	9.7	0.71
615		53.15839939	-27.81899646		24.087	0.06	2.84	0.7
8694		53.17044959	-27.77458204		29.424	0.38	5.34	0.7
2032		53.14225186	-27.80676448		29.2	0.636	9.56	0.69
6456		53.16153898	-27.78625609		29.181	0.189	10.11	0.69
7919		53.16679656	-27.76437467		29.013	0.289	7.18	0.68
4567		53.12870239	-27.78690427		99	28.452	4.67	0.67
7988		53.16384488	-27.76478608		28.148	0.277	4.5	0.66
5914		53.16015634	-27.79318966		29.424	0.25	8.94	0.64
20309		53.16691677	-27.81874945		27.564	0.118	3.41	0.63
8737		53.15973205	-27.76936156		29.291	0.218	3.08	0.62
7566		53.18247561	-27.78085107		29.067	0.21	6.28	0.58
9681		53.18741752	-27.77706057		29.410	0.280	3.24	0.55

Load the catalogue as an MSA Source Catalogue Target



From the
Form Editor

The screenshot shows the Astronomer's Proposal Tools (APT) interface. The title bar reads "Astronomer's Proposal Tools Version 27.3 mpt-demo (Thu Jul 25 2019) JWST PRD: PRDOPSSOC-L-023 - JWST Draft Proposal (Unsaved)". The top toolbar includes icons for Form Editor, Spreadsheet Editor, MSA Planning Tool, Orbit Planner, Visit Planner, Timeline, View in Aladin, BOT, Target Confirmation, PDF Preview, Submission, Run All Tools, and Stop. Below the toolbar, there are buttons for "New JWST Proposal" and "New". The left sidebar shows a tree view with "JWST Draft Proposal (Unsaved)" expanded, containing sub-items: Proposal Information, Proposal Description, Team Expertise, Unnamed PI, Unnamed Col, Targets (highlighted in blue), Observations, and Observation Links. The main window displays "Targets of JWST Draft Proposal (Unsaved)" with a "Targets" section. This section contains several buttons: "Fixed Target Resolver" (Resolve a target name or position), "New Fixed Target" (Create a new Fixed Target), "New Target Group" (Create a new Target Group), "New Solar System Target" (Create a new Solar System Target), "New Generic Target" (Create a new Generic Target), "Import MSA Source Catalog..." (Import a source catalog to use in MSA Planning), and "Import Targets..." (Import Fixed Targets from whitespace, CSV, TSV, or VOTable). The "Import MSA Source Catalog..." button is highlighted with a red rectangular border. At the bottom of the main window, there are buttons for "Edit Unnamed Col", "New", and "Edit Observations". A status bar at the bottom right indicates "9 errors & warnings (Click for Details)".

Catalogue importer



- **Column for Flux** can be used for filtering sources when creating candidate sets
- **Weight** can be used to prioritise targets

Source Importer: file:/Users/sabbi/Desktop/Prove%20MPT/Rafel_2015_HUDF_small_ALLref.txt

Catalog Name is a required field.

File Format: Whitespace Separated

File to Import: /Users/sabbi/Desktop/Prove%20MPT/Rafel_2015_HUDF_small_ALLref.txt

Here is some of the content of the selected file:

ID	RA	DEC	MAG_F160W	MAGERR_F160W	FWHM	STELLARITY	ELLIPTICITY	THETA	Z_BPZ	ZMIN_BPZ	ZMAX_BPZ	ODDS_BPZ	CHISQ2_BPZ	STAR	WEIGHT	NRS_F110W	NRS_F140X	NRS_CLEAR	REFERENCE
514	53.17530756	-27.81989068	22.46	0.039	2.9	0.91	0.103	47.1	5.581	5.3	5.85	0.996	6.324	1	300	22.741	-99	22.46	TRUE
2639	53.17797177	-27.80327718	99	29.183	3.48	0.81	0.022	82.7	5.66	0.78	6.07	0.794	0.953	0	300	29.631	-99	99	TRUE
7894	53.16615975	-27.76428237	29.284	0.202	6.95	0.81	0.203	-50.6	6.45	5.75	6.98	0.887	1.047	0	300	29.126	28.984	29.284	TRUE

Columns selected below will be used as flux parameters of the sources for contamination calculations. All other columns can be used for filtering only.

Column for Flux: None Selected

Column for Flux Uncertainty: None Selected

Flux Units:

Cancel Import

MSA Source Catalogue Target



MSA Catalog is now in the **Targets Folder**

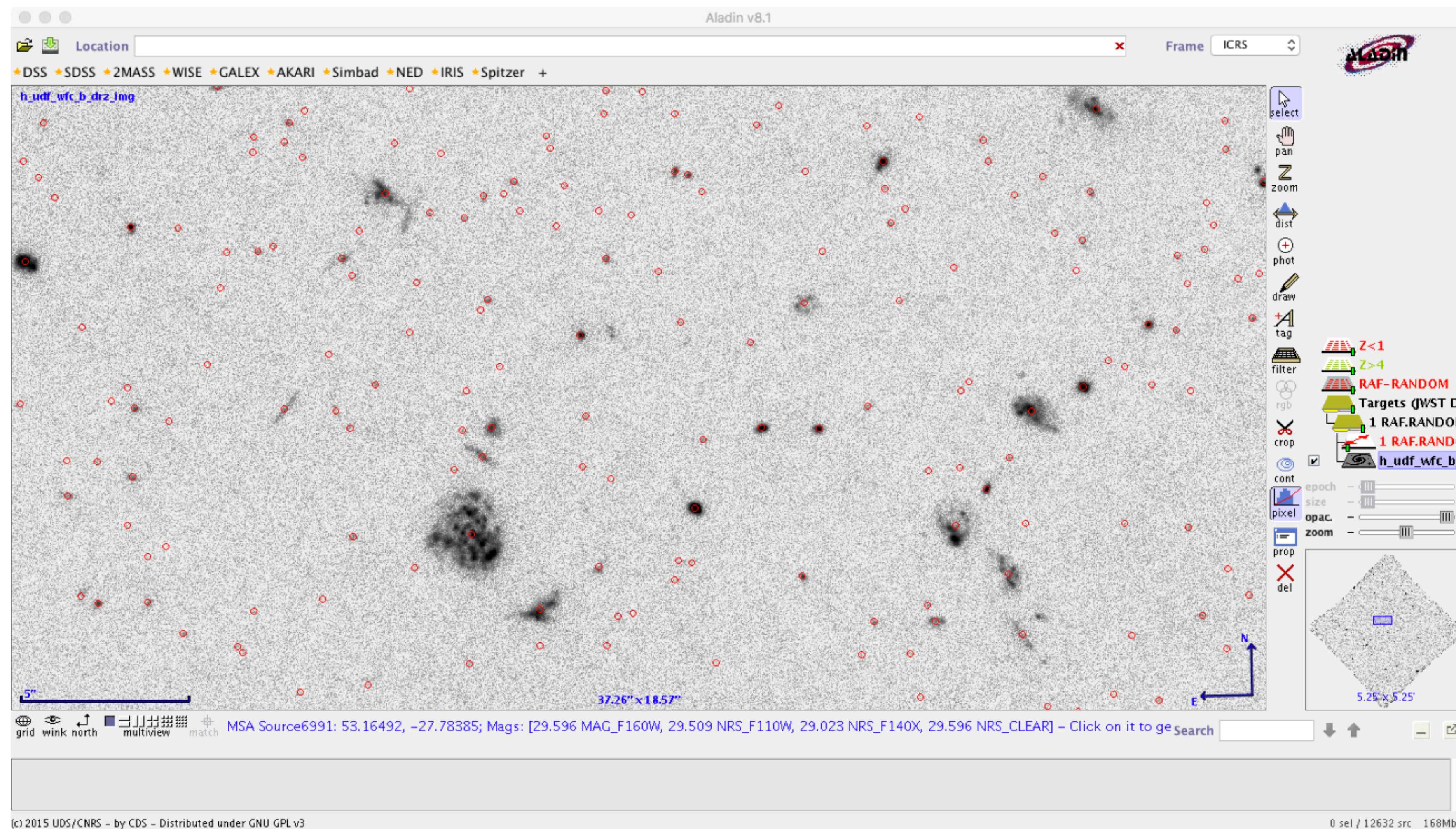
Can create multiple **candidate sets** from a single catalogue

Visualisation of the catalogue via **Aladin**

The screenshot shows the 'Astronomer's Proposal Tools Version 2020.1' interface. The main window is titled '1 RAFEL-2015 of JWST Draft Proposal (RA FEL-2015.aptx)'. The left sidebar shows a tree view with 'Targets' > 'MSA Catalogs' > '1 RAFEL-2015' selected. The main panel has input fields for 'Number' (1), 'Name in the Proposal' (RA FEL-2015), and 'Name for the Archive' (RA FEL-2015). Below these are tabs for 'Candidate Sets' and 'Comments'. A table of source data is displayed, with columns for ID, RA, DEC, Size, Redshift, Reference, Stellarity, and various magnitude filters. A 'Send to Aladin' button is visible at the bottom left of the table area.

ID	RA	DEC	Size	Redshift	Reference	Stellarity	MAG_F160W	NRS_F110W	NRS_F140X	NRS_CLEAR	W
23796	03 32 39.0842	-27 46 1.79	0	1.415	Yes	0.92	20.122	20.674	20.366	20.122	
54454	03 32 35.5075	-27 46 26.13	0	1.268	Yes	0.03	20.384	20.845	20.474	20.384	
22410	03 32 39.8827	-27 47 15.06	0	1.107	Yes	0.03	20.711	21.199	20.786	20.711	
24439	03 32 37.1930	-27 46 8.08	0	1.101	Yes	0.03	19.494	20.254	19.672	19.494	
23546	03 32 38.4836	-27 47 2.42	0	0.919	Yes	0.03	20.088	20.785	20.261	20.088	
21268	03 32 42.4216	-27 47 58.80	0	0.779	Yes	0.94	17.811	18.026	-99	17.811	
22990	03 32 38.7749	-27 47 32.14	0	0.767	Yes	0.03	20.286	20.695	20.415	20.286	
21840	03 32 37.3079	-27 47 29.36	0	0.708	Yes	0.03	18.793	19.473	18.966	18.793	
22951	03 32 40.6729	-27 47 30.99	0	0.692	Yes	0.03	20.163	20.839	20.34	20.163	
24350	03 32 38.4386	-27 46 31.90	0	0.69	Yes	0.03	20.68	21.324	20.855	20.68	
24353	03 32 38.5957	-27 46 31.36	0	0.663	Yes	0.03	20.768	21.177	20.893	20.768	
21298	03 32 39.2188	-27 47 58.36	0	0.662	Yes	0.03	19.618	20.265	19.785	19.618	
21281	03 32 35.7539	-27 47 58.82	0	0.66	Yes	0.03	19.35	19.991	19.507	19.35	
23847	03 32 38.7915	-27 46 48.90	0	0.657	Yes	0.03	20.287	20.927	20.451	20.287	
22428	03 32 41.4054	-27 47 17.17	0	0.612	Yes	0.03	19.596	20.241	19.767	19.596	
24587	03 32 40.7814	-27 46 15.69	0	0.571	Yes	0.03	19.482	19.901	19.615	19.482	
24348	03 32 38.9675	-27 46 30.23	0	0.447	Yes	0.03	20.152	20.541	20.258	20.152	
24685	03 32 41.7599	-27 46 19.40	0	0.383	Yes	0.04	20.047	20.635	20.189	20.047	
21671	03 32 38.0057	-27 47 41.71	0	0.253	Yes	1	18.276	18.562	18.369	18.276	

Catalogue sources displayed in Aladin



The MSA Planning Tool



MSA Planning Tool in the APT toolbar

The **Planner** tab is where you design MOS plans

- Select candidate lists from your MSA Catalog
- **Aperture PA** (position angle) is either a placeholder, or assigned to you by STScI (after acceptance)
- **Slitlet** configuration and **Centering Constraint** should be chosen

Astronomer's Proposal Tools Version 2020.1 mpt-demo (Thu Oct 24 2019) - JWST Draft Proposal (Unsaved)

Form Editor Spreadsheet Editor **MSA Planning Tool** Slitlet Planner Visit Planner Timeline View in Aladin BOT Target Confirmation Submission Errors and Warnings Run All Tools Stop

New JWST Proposal MSA Source Catalog

JWST Draft Proposal (Unsaved)

Proposal Information

Targets

MSA Catalogs

1 RAFELSKI-2015-RAND

Observations

Observation Links

Planner

Candidate Lists

Primary Candidate List None Selected

Filler Candidate List

RAFELSKI-2015-RANDOM (9969 sources)

Z>3 (3056 sources)

Z>5 (344 sources)

Plan Angle

Planned

Aperture PA Degrees

Slit Setup

Slitlet 3 Shutter Slitlet

Entire Open Shutter Area Source Centering Constraint

Pointing Setup

Nod in slitlet 3 exposures per configuration.

Dither Type None

Exposure Setup

Grating/Filter

G140H/F070LP

G140H/F100LP

G140M/F070LP

G140M/F100LP

G235H/F170LP

G235M/F170LP

G395H/F290LP

22 errors & warnings (Click for Details)

The MSA Planning Tool



The Planner is where you decide how to **dither**

- **Nodding** moves the sources within the slitlet – no shutter reconfiguration
- **Fixed Dither** moves the sources by a finite number of shutters specified by the user along the dispersion and/or the cross-dispersion direction.

Grating/Filter combination(s) must be selected to prevent spectral overlap in the chosen configurations

Examine and visualise a plan



The **Plans** tab is where you examine and visualise MOS plans

- MSA shutter view
- Collapsed shutter view
- Send to Aladin (on-sky visualisation)

Plan Selection

#	Plan	# Configs	# Exposures	Primary Sources	# Secondary Sources	Export
1	G140M-step10-cat	1	3	63	0	Export
2	G140M-step10-z5-fillers	1	3	35	27	Export
3	PRISM-step10-z5-fillers	1	3	56	55	Export

Select multiple plans to review them in combination.

Buttons: Create Observation, Update Observation, Import Plan(s), Describe Plan(s), Delete Plan(s)

Pointings

#	Plan number	Name	RA	Dec	RA (HMS)	Dec (DMS)	APA	Grating...	Target set size	Total weight	Show	Send to Aladin	Export
1	3	c1e1n1	53.1696588	-27.7888441	03 32 40.71...	-27 47 19.8...	134.996614...	PRISM/...	123	14187	Show	Send	Export
2	3	c1e1n2	53.1695414	-27.7887403	03 32 40.68...	-27 47 19.4...	134.996668...	PRISM/...	117	14106	Show	Send	Export
3	3	c1e1n3	53.1697762	-27.7889480	03 32 40.74...	-27 47 20.2...	134.996559...	PRISM/...	119	14148	Show	Send	Export

Targets

Target Set Operation: Targets in at least one selected exposure

Primary targets

56 targets are shown.

Send to Aladin

Targets:

Id	Weight	Exposures	c1e1n1	c1e1n2	c1e1n3
8030	300	3	x	x	x
4449	30	3	x	x	x
9768	300	3	x	x	x
9098	300	3	x	x	x
9104	300	3	x	x	x
8950	300	3	x	x	x
10492	30	3	x	x	x
7878	300	3	x	x	x
8346	30	3	x	x	x
2784	300	3	x	x	x
6542	300	3	x	x	x
1416	300	3	x	x	x

RAFEL_2015_HUDF_SMALL_ALLREF_RANDOM (9969 sources)

22 errors & warnings (Click for Details)

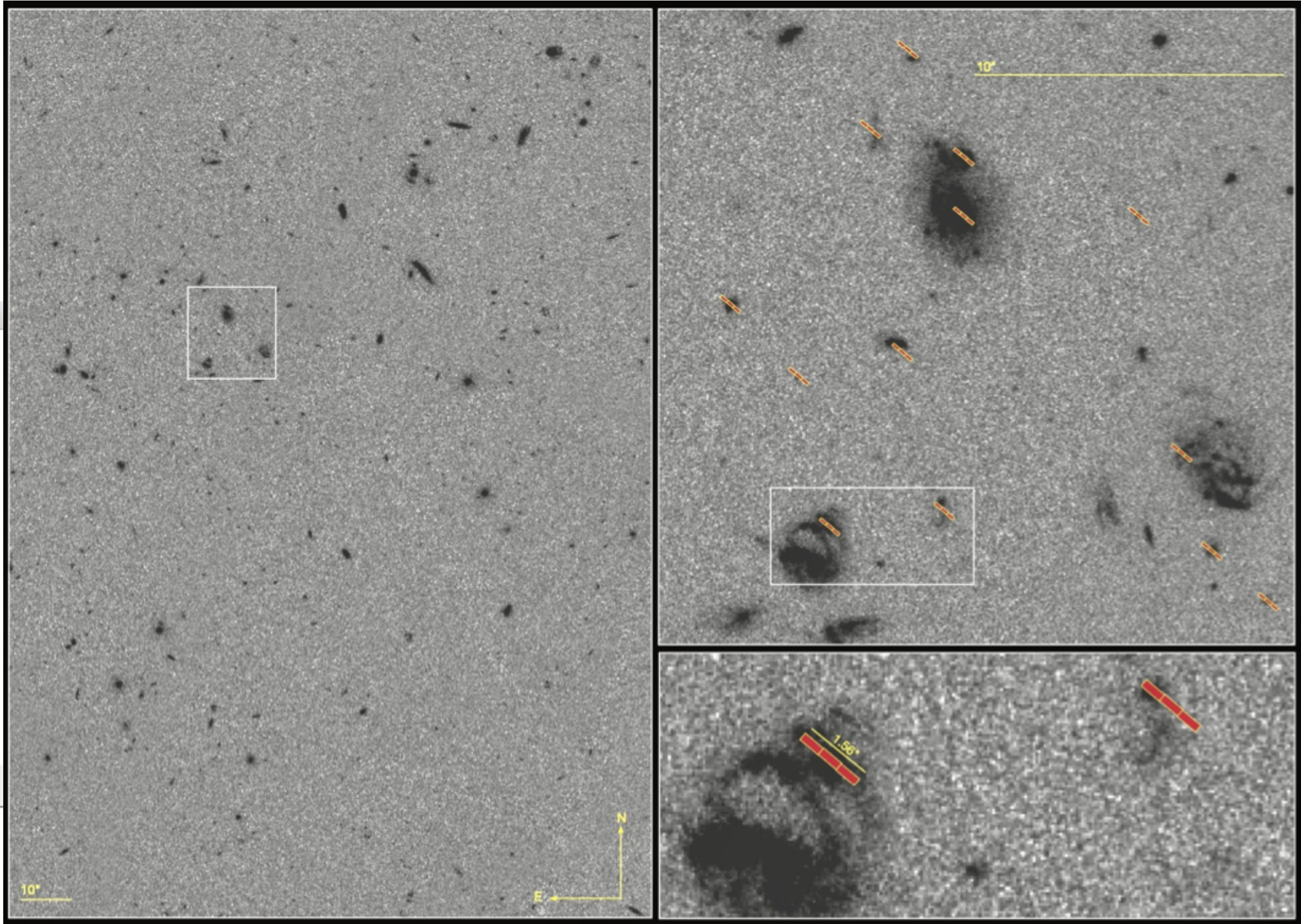
Examine and visualise a plan



Shutters projected onto the sky in Aladin

Targets on the MSA

A screenshot of the Aladin software interface. The window title is "Another Plan c1e1" and the status is "Ready". On the left, there are two icons: "Shutters" (a grid of green dots) and "Collapsed Shutters" (a grid of black dots). The main area shows four panels of shutter projections, each with green dots and red crosses. Below the panels are two buttons: "Save as svg" and "Export to CSV". At the bottom, there's a text box containing "PIPPO (9969 sources)" and a button labeled "Add shutters plane to Aladin".



Create an observation



From the **Plans** tab

- Highlight a plan or plans
- Select the pointings
- **Create Observation**

Plan Selection

#	Plan	# Configs	# Exposures	Primary Sources	# Secondary Sources	Export
1	G140M-step10-cat	1	3	63	0	Export
2	G140M-step10-z5-fillers	1	3	35	27	Export
3	PRISM-step10-z5-fillers	1	3	56	55	Export

Select multiple plans to view them in combination.

Create Observation Update Observation Import Plan(s) Describe Plan(s) Delete Plan(s)

Pointings

#	Plan number	Name	Dec	RA (HMS)	Dec (DMS)	APA	Grating...	Target set size	Total weight	Show	Send to Aladin	Export Config	
1	3	c1e1n1	53.1696588	-27.7888441	03 32 40.71...	-27 47 19.8...	134.996614...	PRISM/...	123	14187	Show	Send	Export
2	3	c1e1n2	53.1695414	-27.7887403	03 32 40.68...	-27 47 19.4...	134.996668...	PRISM/...	117	14106	Show	Send	Export
3	3	c1e1n3	53.1697762	-27.7889480	03 32 40.74...	-27 47 20.2...	134.996559...	PRISM/...	119	14148	Show	Send	Export

Targets

Target Set Operation: Targets in at least one selected exposure Primary targets

56 targets are shown. Send to Aladin

Targets:

Id	Weight	Exposures	c1e1n1	c1e1n2	c1e1n3
8030	300	3	x	x	x
4449	30	3	x	x	x
9768	300	3	x	x	x
9098	300	3	x	x	x
9104	300	3	x	x	x
8950	300	3	x	x	x
10492	30	3	x	x	x
7878	300	3	x	x	x
8346	30	3	x	x	x
2784	300	3	x	x	x
6542	300	3	x	x	x
1416	300	3	x	x	x

Proposing for MOS



- New version of the MPT available for the Cycle 1 call
- Remember: need a catalogue with accurate relative astrometry
 - ▶ $<15\text{mas}$ relative accuracy
- MOS will have a multi-step planning process
 - ▶ Final plans not possible until the program is accepted and scheduled (giving the actual Aperture PA)
 - ▶ A particular APA can be requested in a proposal, but must be strongly justified
- Instrument overheads are not negligible - use APT/MPT for the estimate

Additional helpful hints



- **Dither!!!** ...to improve background subtraction, wavelength coverage, etc
- Order your input catalogue by weight... during optimisation, MPT adds sources in the catalogue order
- Use a **Filler Set** to maximise efficiency/multiplexing
- Include **Primary** candidates in the **Filler** list to obtain additional observations of important sources
- Weight only matters for **Primary** sources (not for **Fillers**)
- If observability window is large, test optimisation for several APAs... if multiplexing differs significantly, consider including an **Orient Special Requirement**, with a minimum range of 30 deg
- If using a high-res grating (GxxxH), attempt to place most sources on the leftmost quadrants (MPT orientation) to avoid detector cutoffs
- Use Aladin to show the position of NIRCcam parallels during NIRSspec exposures
- Input catalogue should be as complete as possible to check for contaminants in commanded open (or known **Failed Open**) shutters
- The MSA Configuration Editor can be used to amend MPT-optimised configurations. It can be found at the **observation level** in APT



Exposure Time Calculator (ETC)

Where is ETC?



jwst.etc.stsci.edu

Welcome to the JWST Exposure Time Calculator

Quick Start

Create User

Login

Work Anonymously

News

Welcome to version 1.5 of the JWST ETC!

This release features new instrument modes, accuracy improvements, usability enhancements, and more: see the [Release Notes](#) for details, and be sure to review the [Known Issues](#) for this release.

When you log in to the 1.5 ETC, your old workbooks will be marked "Out of Date":

- When you load them, they will open in Read-Only mode: this ensures that your previous results are not overwritten and remain available to you for reference.
- If you copy an out of date workbook, and load the copy, all its calculations will be automatically updated for you with the current version of the software.
- For more information, see [ETC Releases and Out-of-Date Workbooks](#).

- - ▶ Pontoppidan et al., Proc. SPIE. 9910, Observatory Operations: Strategies, Processes, and Systems VI, 991016. July 15, 2016 (<https://arxiv.org/abs/1707.02202>)

The “Pandeia” project



3D ETC engine
Python library

**Reference
database**

Throughputs, detector
noise, PSFs, ...

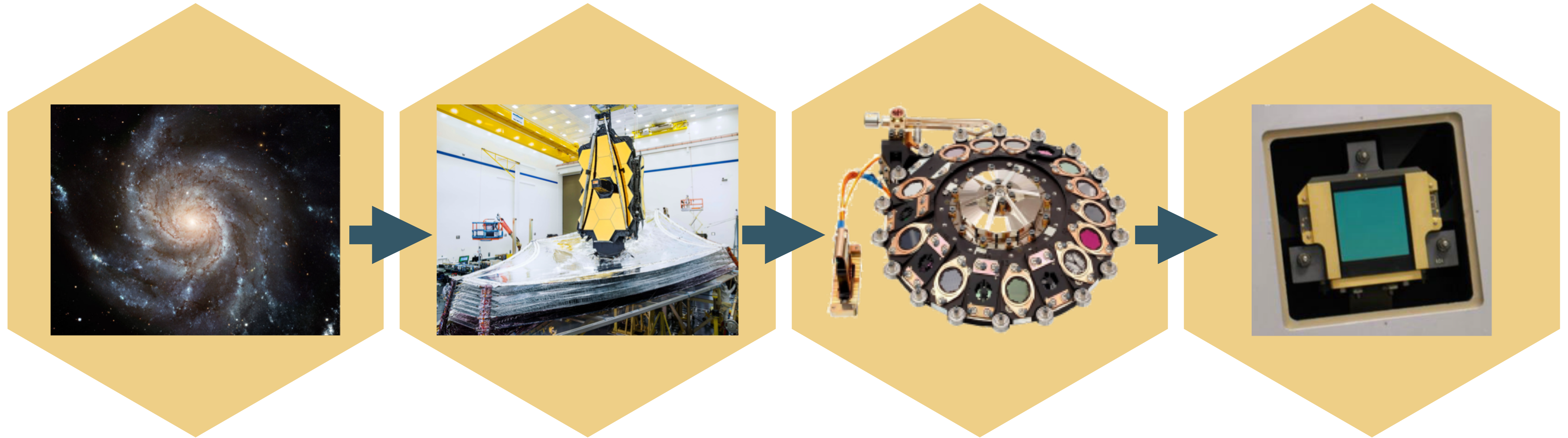
Web application
(jwst.etc.stsci.edu)

User interface,
collaborative function

**JWST
background
model**

Integrated into web
application or as a
standalone tool

The engine algorithm



Space

Telescope

Instrument

Detector

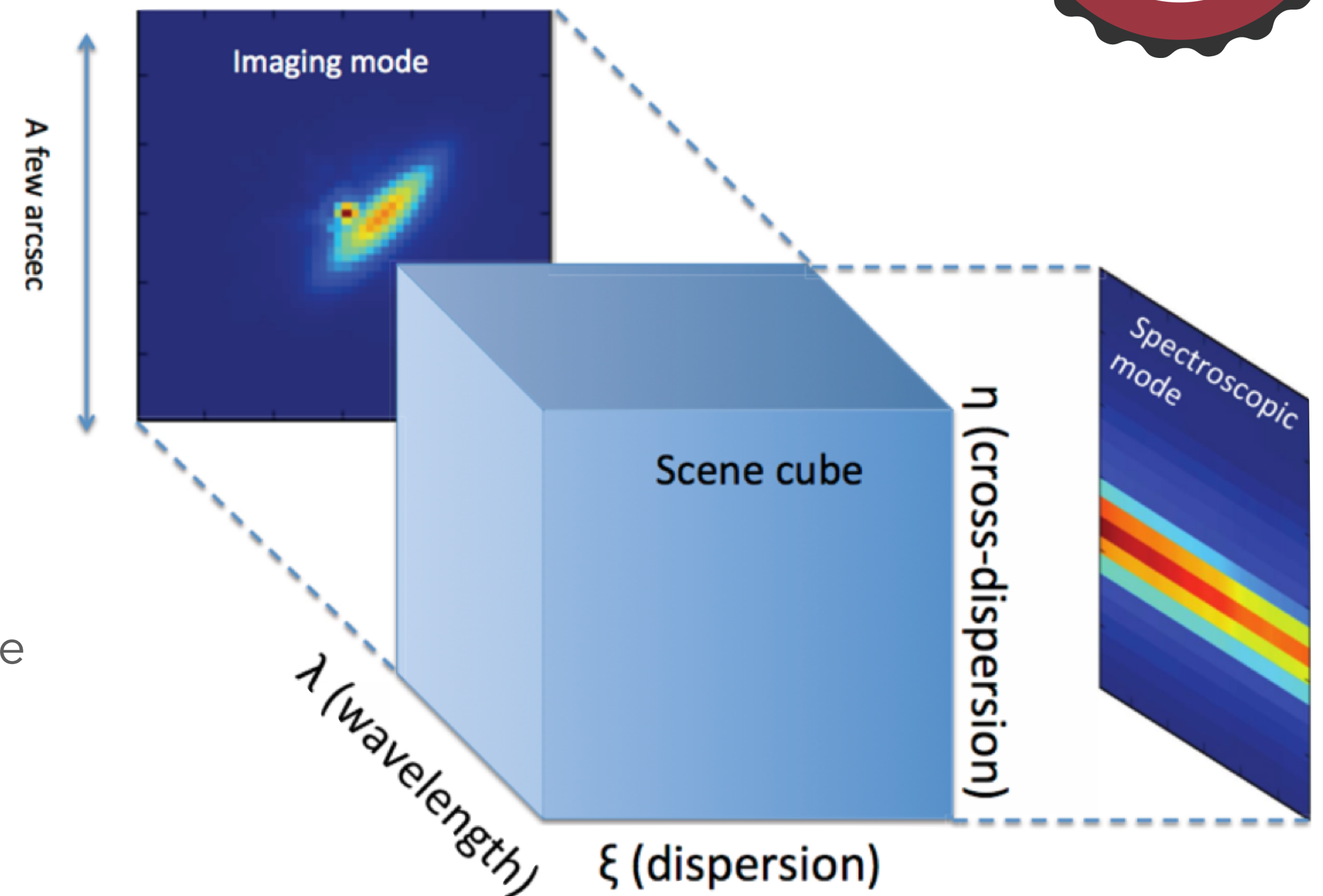
JWST ETC concept



- **Modern design**

- ▶ Signal (source + background) modelled in 3D
 - conserves flux
 - resolve lines
 - oversample JWST resolution
- ▶ Pixel based:
 - Models the detector (e.g. correlated noise)
 - Final S/N calculation includes data analysis and post-processing steps ("strategy")
 - Allows the modelling of complex scenes (e.g. estimate contamination from bright sources)

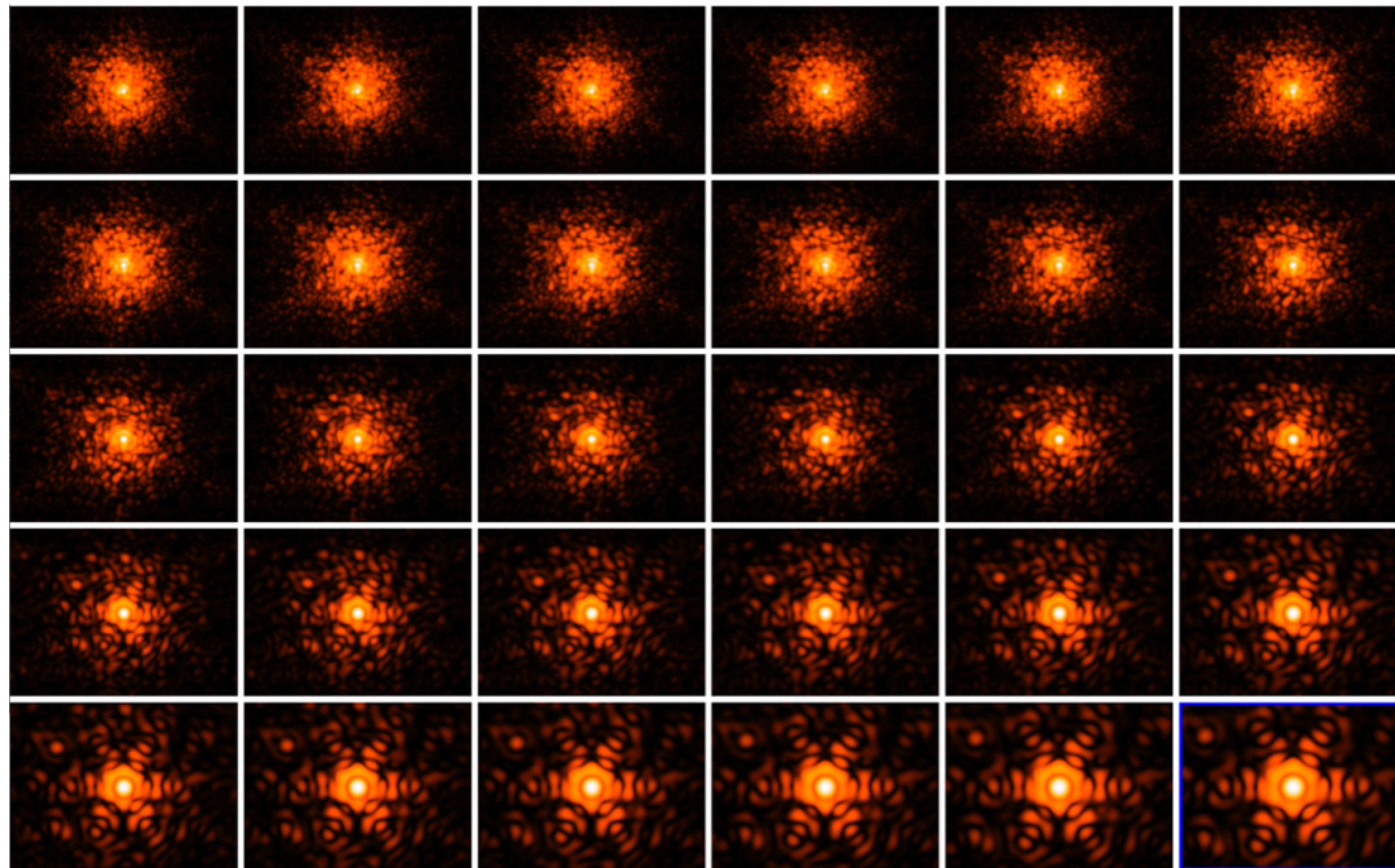
- **Supports all JWST modes**



PSF library



- Uses WebbPSF to calculate PSF including realistic wavefront errors
- Almost 5000 individual monochromatic PSFs
- Subsampled by integer factor of pixel size

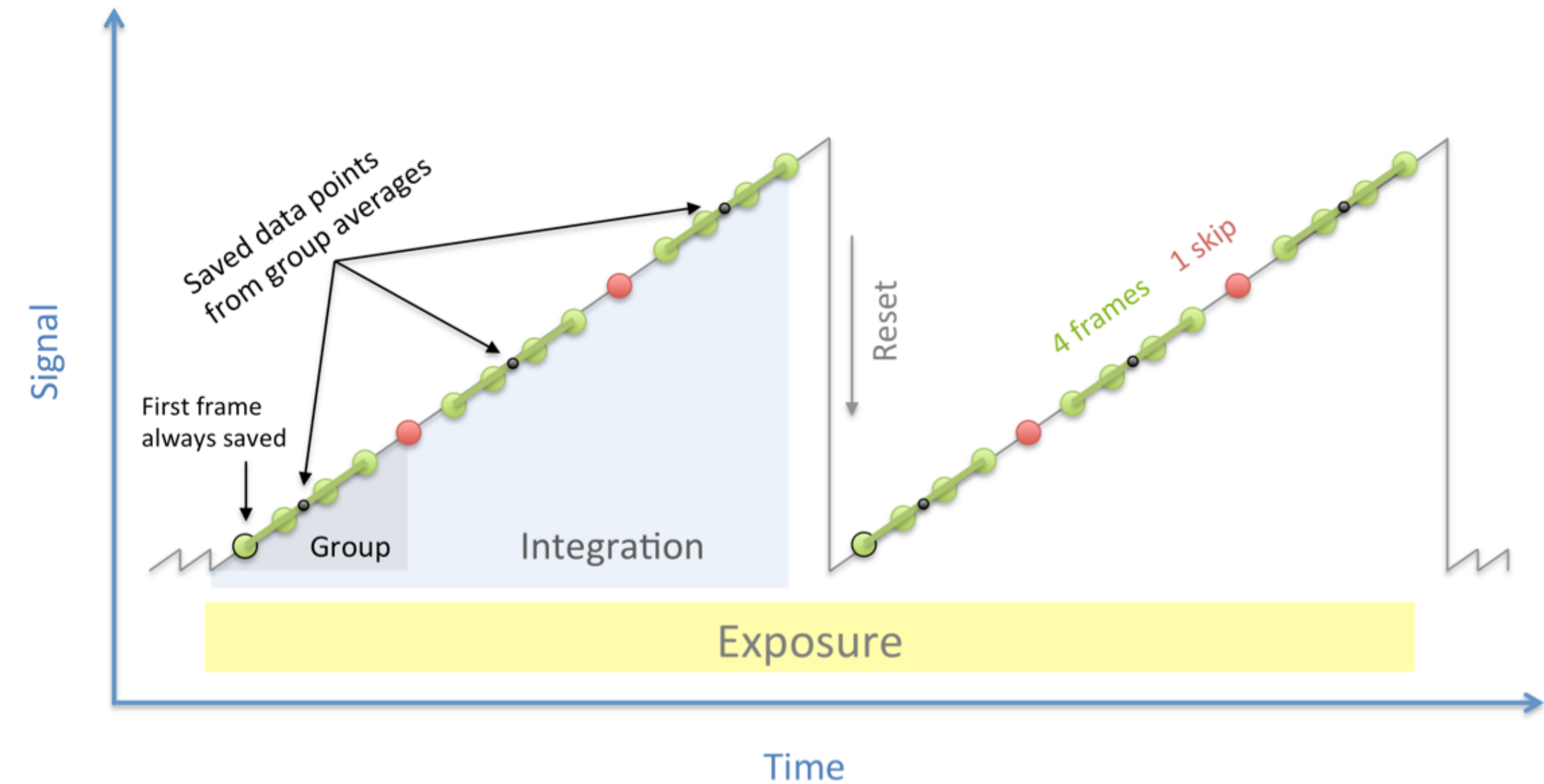


NIRCam SW PSFs
(0.6-5.2 micron)

Readout terminology



- **subarray:** the window on the detector being read out
- **frame:** one complete read of the detector or subarray
- **group:** a set of consecutive frames averaged onboard (some frames may be skipped)
- **integration:** one non-destructive ramp
- **exposure:** a set of consecutive integrations at the same pointing
- **dither:** an exposure at a new pointing



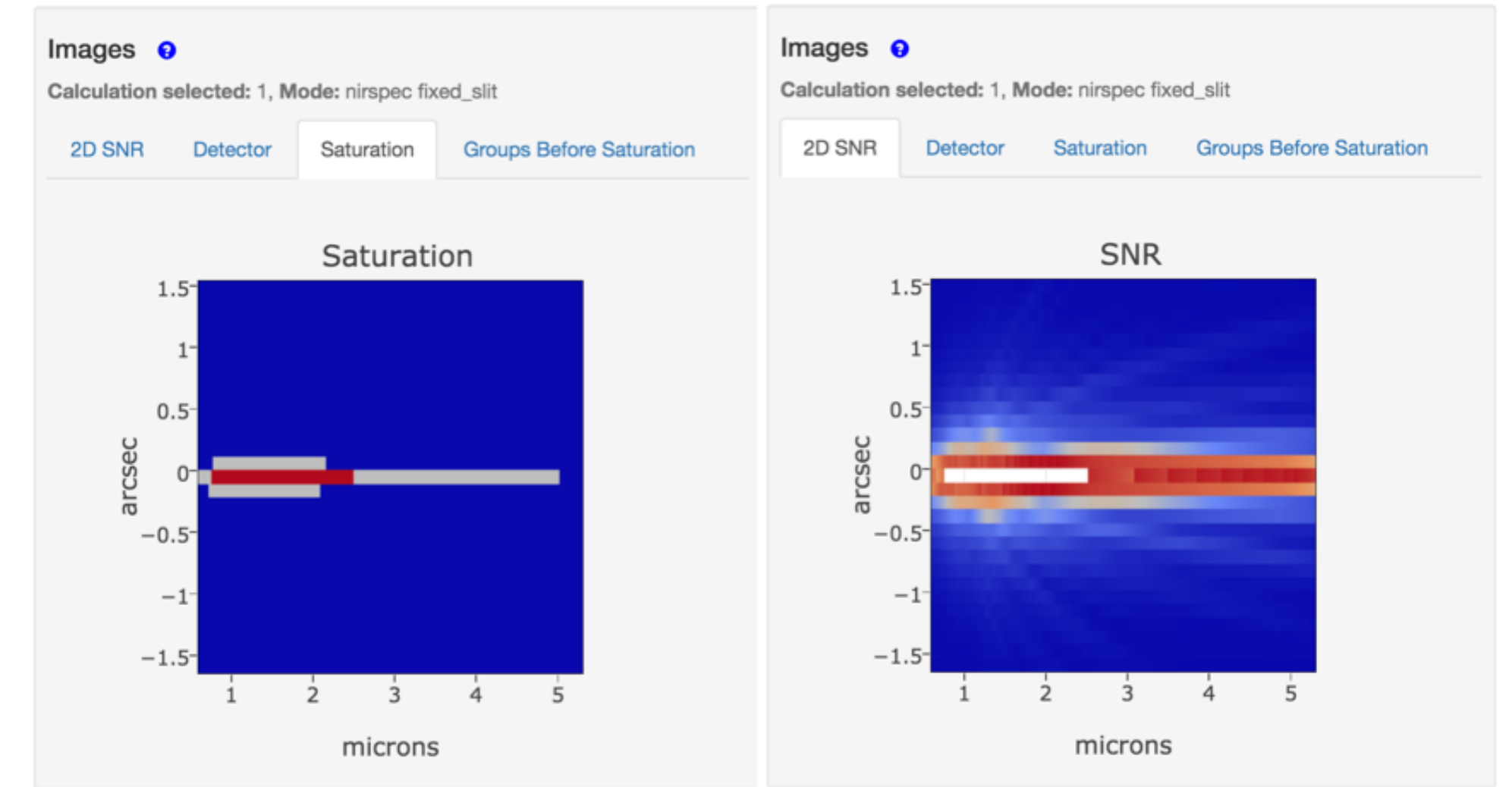
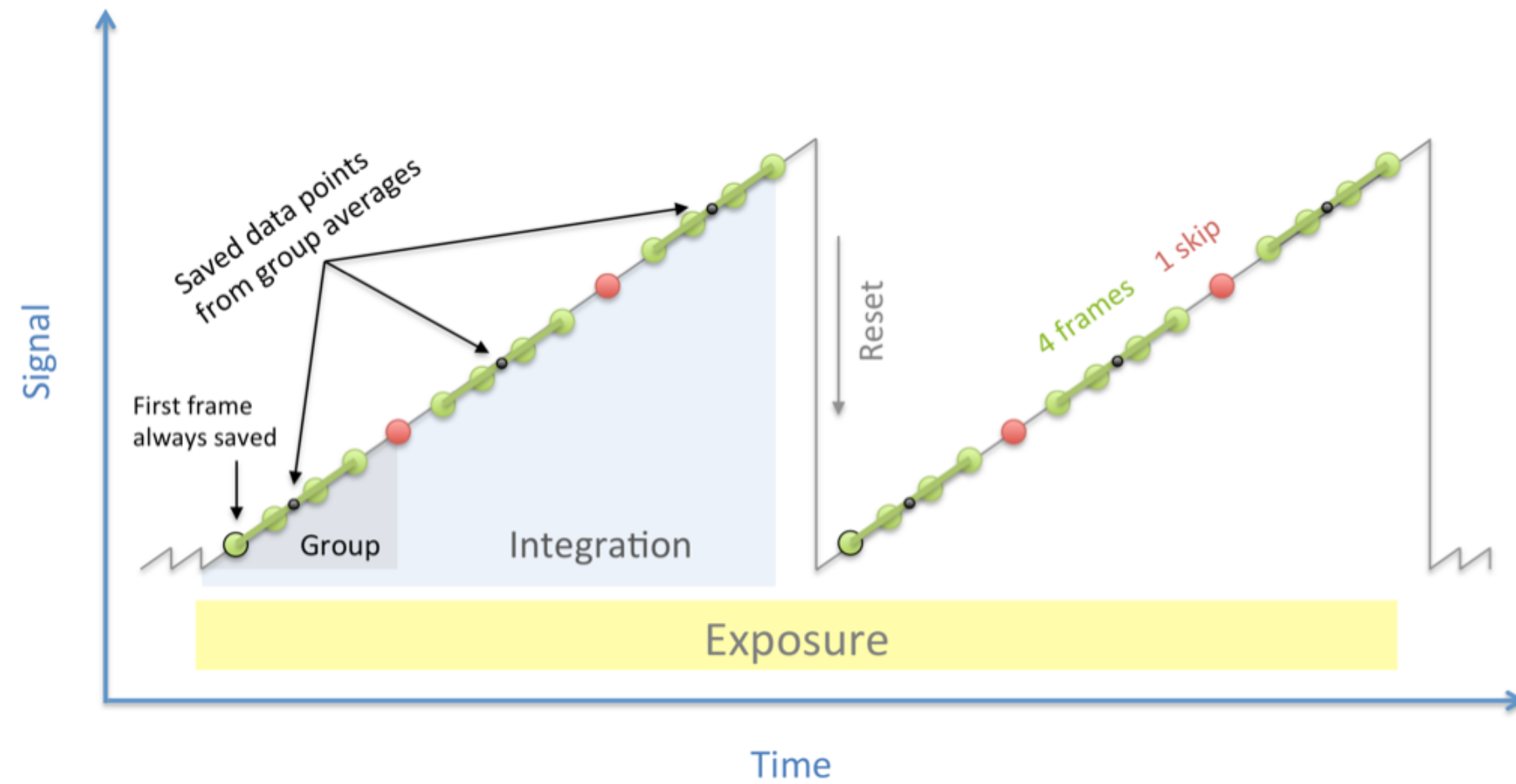
Time terminology



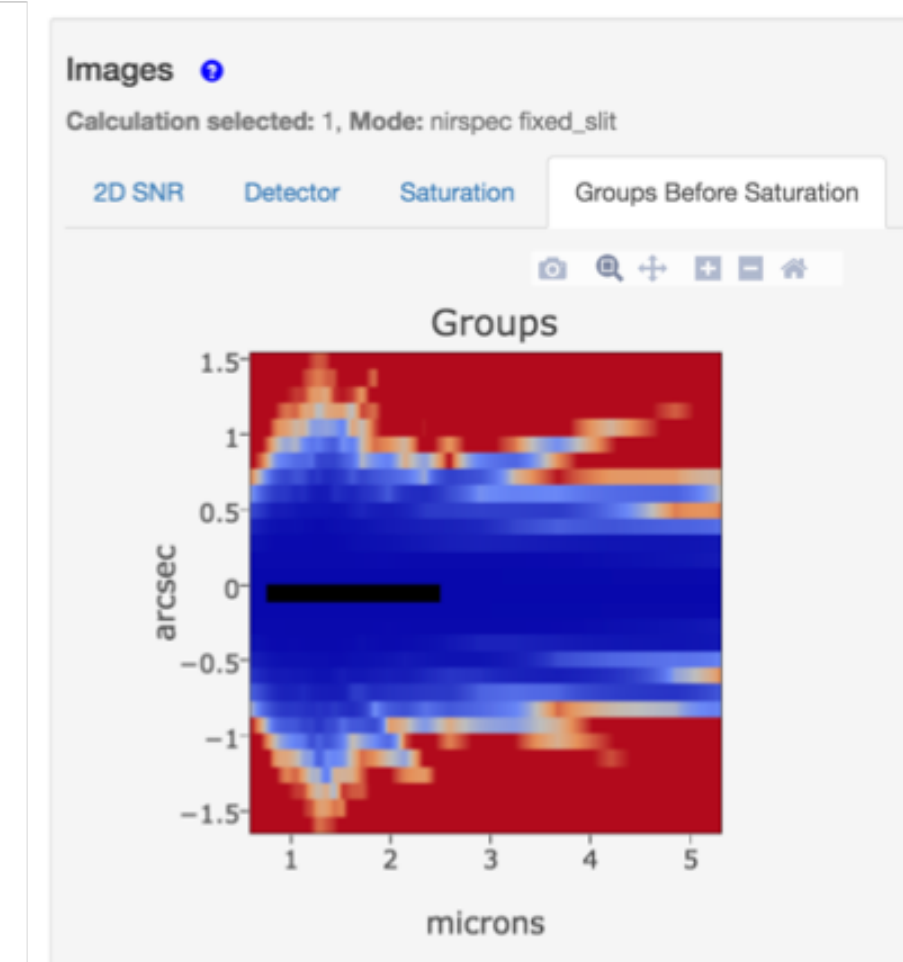
- **exposure time:** Time the detector is operating during a single exposure
 - ▶ includes resets
 - ▶ excludes initial synchronisation time
 - ▶ includes all integrations, but no repetitions per pointing, per tile, or per observation
- **measurement time:** For any individual pixel, the interval between first and last measurements during a single integration, multiplied by the number of integrations per exposure
 - ▶ used to determine count rate
- **saturation time:** For any individual pixel, the interval from reset to the final read of an integration, multiplied by the number of integrations per exposure
 - ▶ depends on exposure parameters, not target brightness or instrument throughput
- **exposure duty cycle:** measurement time divided by exposure time



How is saturation treated in ETC?



- Two types of saturation
 - ▶ **Partial saturation:** the integration saturates before it completes, but more than the minimum number of groups are unsaturated - DATA RECOVERED
 - ▶ **Full saturation:** the integration saturates before the minimum number of groups achieved - NO DATUM (for that pixel)
 - ▶ Usually, the minimum $n_{\text{groups}} = 2$



Tips for optimising detector set-up



- More frames per integration decreases read noise
- Longer groups decreases data volume
- Shorter groups decreases chance of cosmic ray hit per group
- More groups per integration make the cosmic ray correction better
- Longer integrations may make ramp fitting more certain
- More dithered exposures decreases flat-field errors and the impact of bad pixels

Note: in ETC, all exposures are assumed to be dithers, except for time-series observations

- Readout patterns that skip lots of frames have higher read noise, but slightly better duty cycle

JWST ETC features

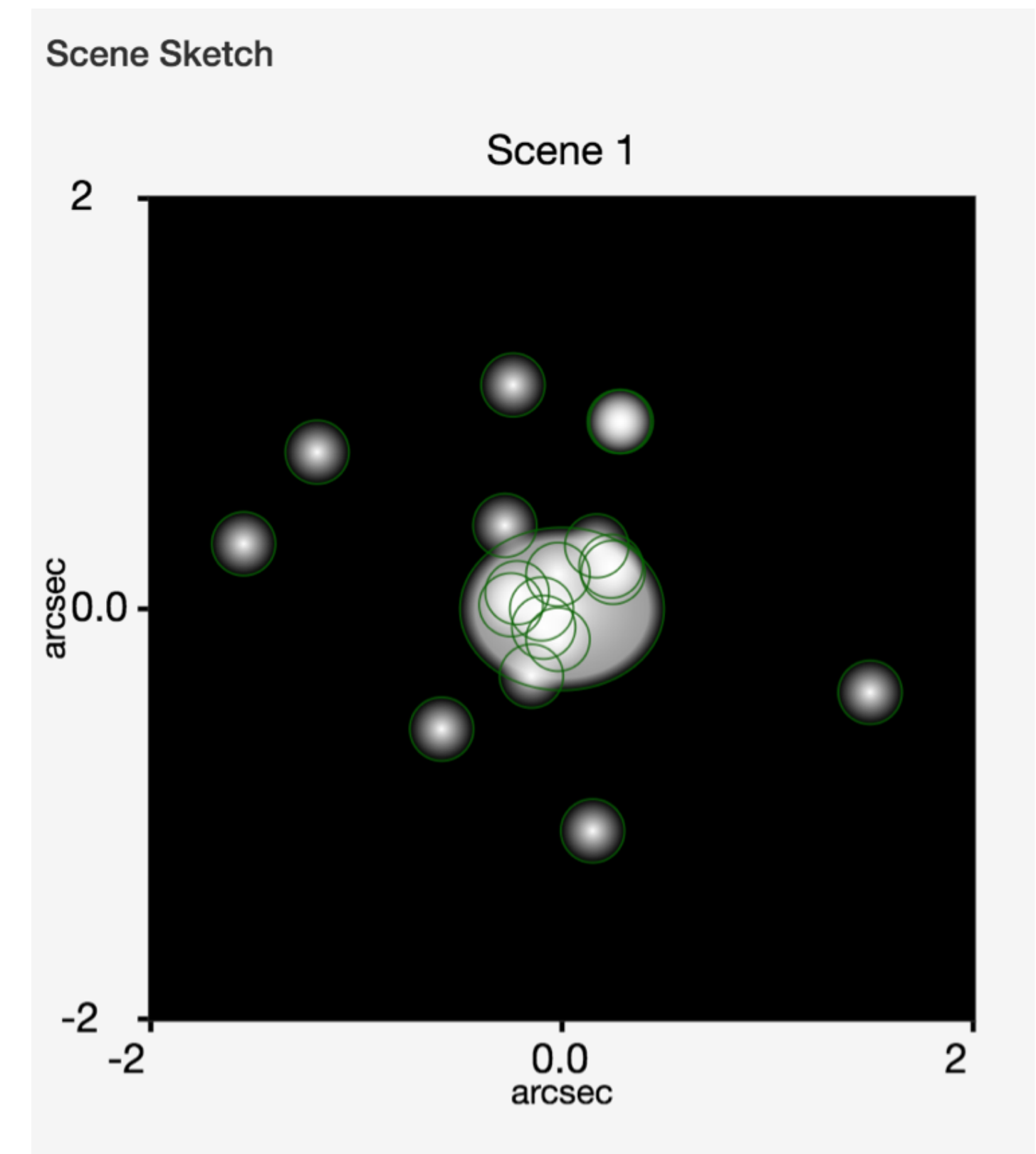


- **Workbooks**
 - ▶ Organise several ETC calculations into a workbook
 - ▶ A workbook can contain multiple sources, scenes and calculations
 - ▶ Workbooks remain in your MyST account, and are shareable
- **Reusability**
 - ▶ Calculations in a workbook start with reasonable defaults
 - ▶ Simply copy a calculation, modify the inputs as desired and recalculate
- **Batch expansion**
 - ▶ Efficiently run a batch of many calculations
 - ▶ Calculation is duplicated N times varying only the selected parameter
 - ▶ Expansion over e.g. Ngroups offers a way to show the behaviour of SNR as a function of "exposure" time
- **Auto-update**
 - ▶ Changes made to the input, flow through to associated forms and calculations

Scenes and sources



- **Scene:** small postage-stamp of the sky (a few arcsec on a side)
 - ▶ A scene can have no source (just background) or multiple sources
 - ▶ Scenes can be reused in multiple calculations
- **Source:** specify SED, normalisation, extinction, emission lines and shape
 - ▶ Each sources can be reused in multiple scenes
 - ▶ Location: x,y offset (with orientation) within the postage stamp scene
 - ▶ Shape: point source or extended (flat, Gaussian, Sersic, power law...)
 - ▶ Spectrum:
 - Continuum: flat, black body, power law, templates
 - Lines: centre, width, flux
 - Normalise to magnitude/flux in JWST or HST bandpass, or at a λ
 - Upload a spectrum (ASCII or FITS format)



Issues to think about when using ETC



- ETC is a highly versatile tool
- There are many parameters affecting ETC sensitivities and program preparation
 - ▶ Different read-out patterns change the read noise
 - ▶ Be aware of saturation
 - ▶ Which background subtraction scheme?
 - ▶ Is the background correct for your target?
 - ▶ What extraction aperture is optimal? (Point or extended source?)
 - ▶ Does your extraction aperture contain contaminating flux from other sources in the scene?

Remember: ETC approximates our current best knowledge and understanding of performance. There are remaining uncertainties associated with system throughputs, detector noise properties, etc., which will remain unknown until JWST is in flight.

BEWARE: The ETC is not intended to be a complete observation simulator

Useful links



- JWST ETC (v1.5)
 - ▶ <https://jwst.etc.stsci.edu/>
- Documentation:
 - ▶ ETC introduction
 - ▶ Links to all pages, video tutorials and more
 - ▶ <https://jwst-docs.stsci.edu/jwst-exposure-time-calculator-overview>
- ETC release notes, known issues and FAQ (@ JWST Help Desk)
 - ▶ [JWST Help Desk ETC FAQ](#)
 - ▶ [JWST Help Desk ETC known issues](#)
- JWST Community Lecture Webcasts
 - ▶ ["The JWST Exposure Time Calculator"](#) - Klaus Pontoppidan (Nov 2019)
 - ▶ ["JWST ETC Demo" \(interface demonstration\)](#) - Swara Ravindranath (Feb 2017)



JWST Interactive Sensitivity Tool (JIST)

JWST Interactive Sensitivity Tool (JIST)

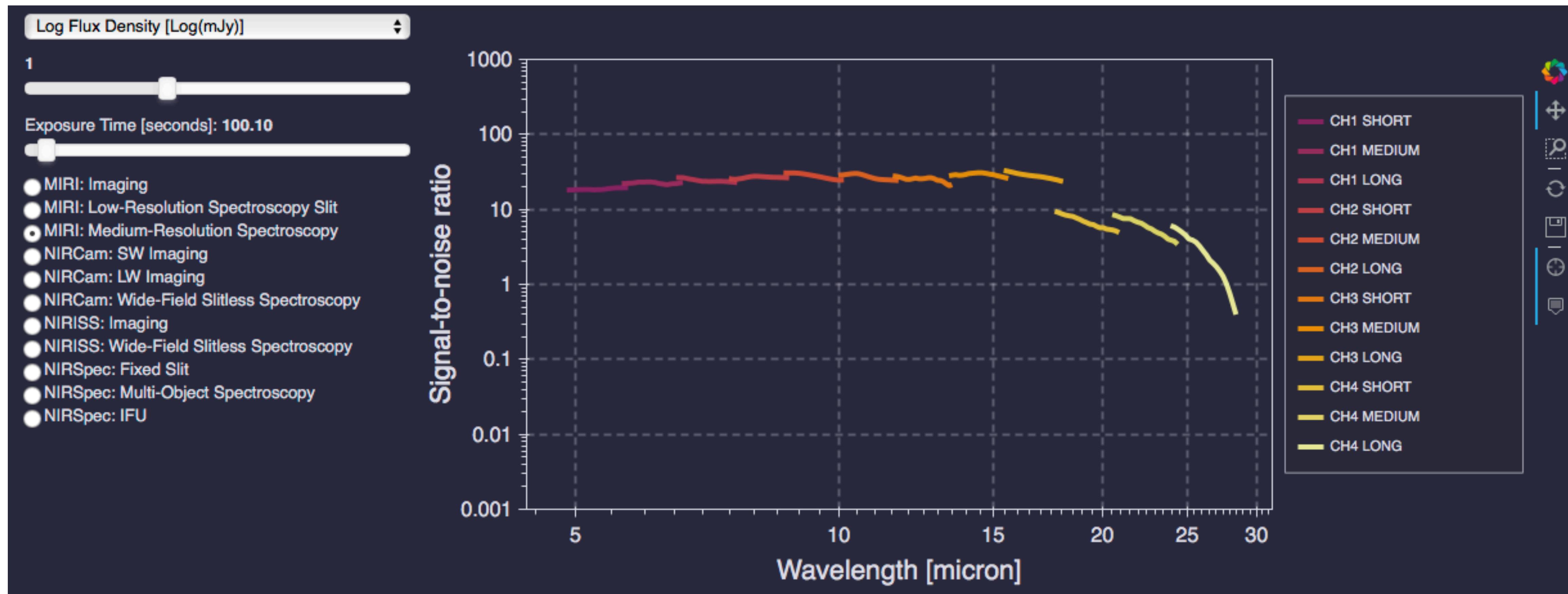


- Quick-look observation feasibility
- Runs directly in a browser window
 - ▶ Online tool: jist.stsci.edu
 - ▶ JDox: [JIST](#)
- For all basic observing modes, explore S/N values by adjusting source flux or telescope exposure parameters

JWST Interactive Sensitivity Tool (JIST)



- Example view of the interface



JWST Interactive Sensitivity Tool (JIST)



- Beware of the simplifying assumptions...
 - ▶ All calculations based on a point source:
 - Flat SED
 - Background spectrum set to 120% of minimum zodiacal background at a reference point (see usage notes for more detail)
 - ▶ Single integrations are considered. For multiple integrations (or dithers), SNR can be scaled by $\text{SQRT}(N_{\text{INTS}})$
 - ▶ Saturation simply handled by setting $\text{SNR}=0$ (JIST is not recommended for saturated data)
 - ▶ For WFSS modes, only R Grism values presented (C Grism assumed identical)



Accessing the tool - reminder

Accessing the tools



- ▶ Astronomer's Proposal Tool (APT)
→ apt.stsci.edu
- ▶ MSA Planning Tool (MPT)
→ apt.stsci.edu
- ▶ Exposure Time Calculator (ETC)
→ jwst.etc.stsci.edu
- ▶ JWST Interactive Sensitivity Tool (JIST)
→ jist.stsci.edu