



STScI | SPACE TELESCOPE
SCIENCE INSTITUTE

EXPANDING THE FRONTIERS OF SPACE ASTRONOMY

Planning MOS Observations

JWST Master Class November 18-22, 2019

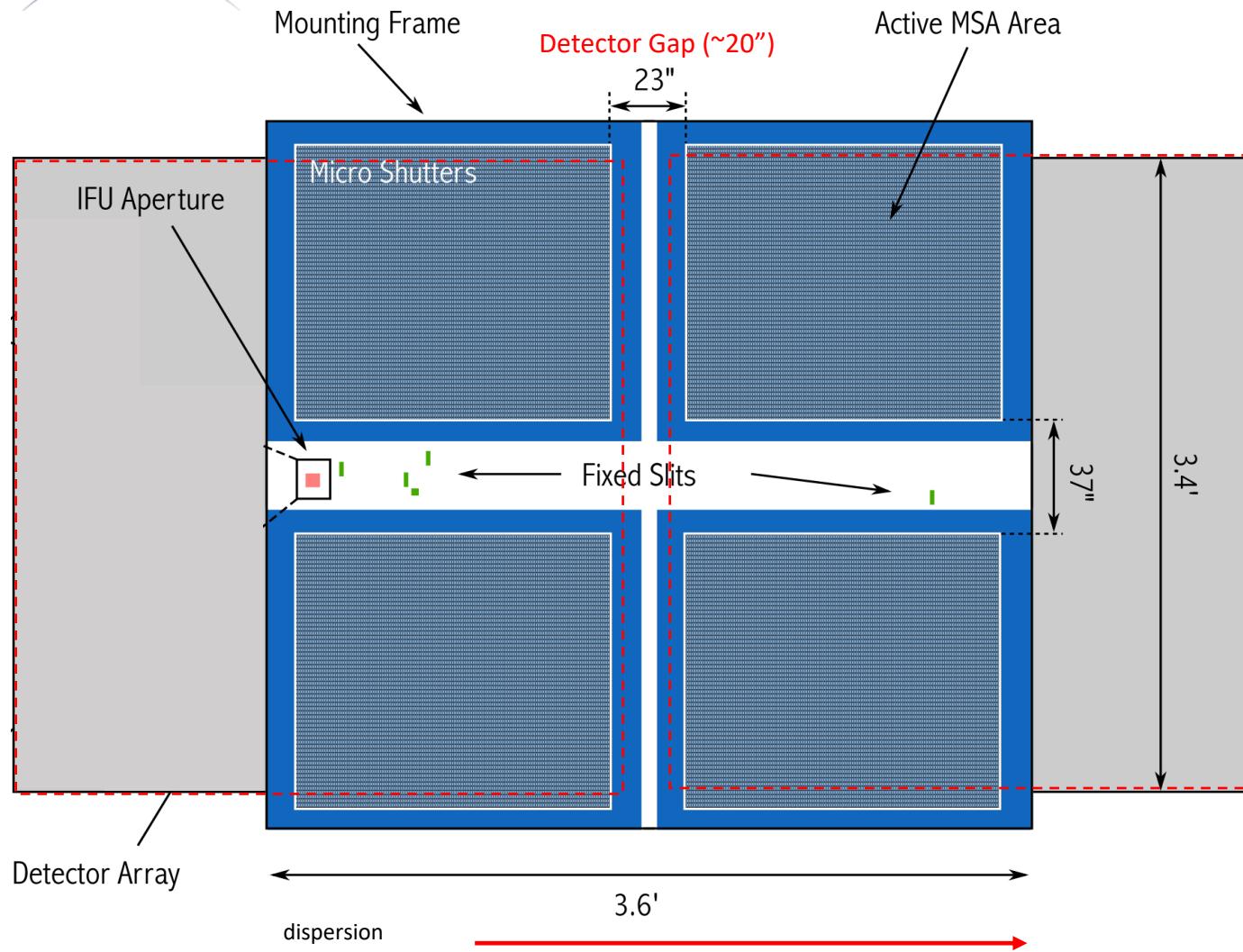
Diane Karakla, NIRSpec Instrument Team

The NIRSpec Micro-shutter Assembly





NIRSpec MSA for multi-object spectroscopy (MOS)



- The Micro-Shutter Assembly (**MSA**) is a 4 quadrant array of tiny configurable shutters. The entire array has nearly 250,000 shutters.
 - Each shutter is just 200 x 450 mas
- The MSA Field of View is $\sim 3.6' \times 3.4'$
- NIRSpec has 2 detectors. There is gap between them ($\sim 20''$).
- Spectra are dispersed from left to right, and in many cases, will fall across the gap.



The MOS Observing Process



Multi-step process

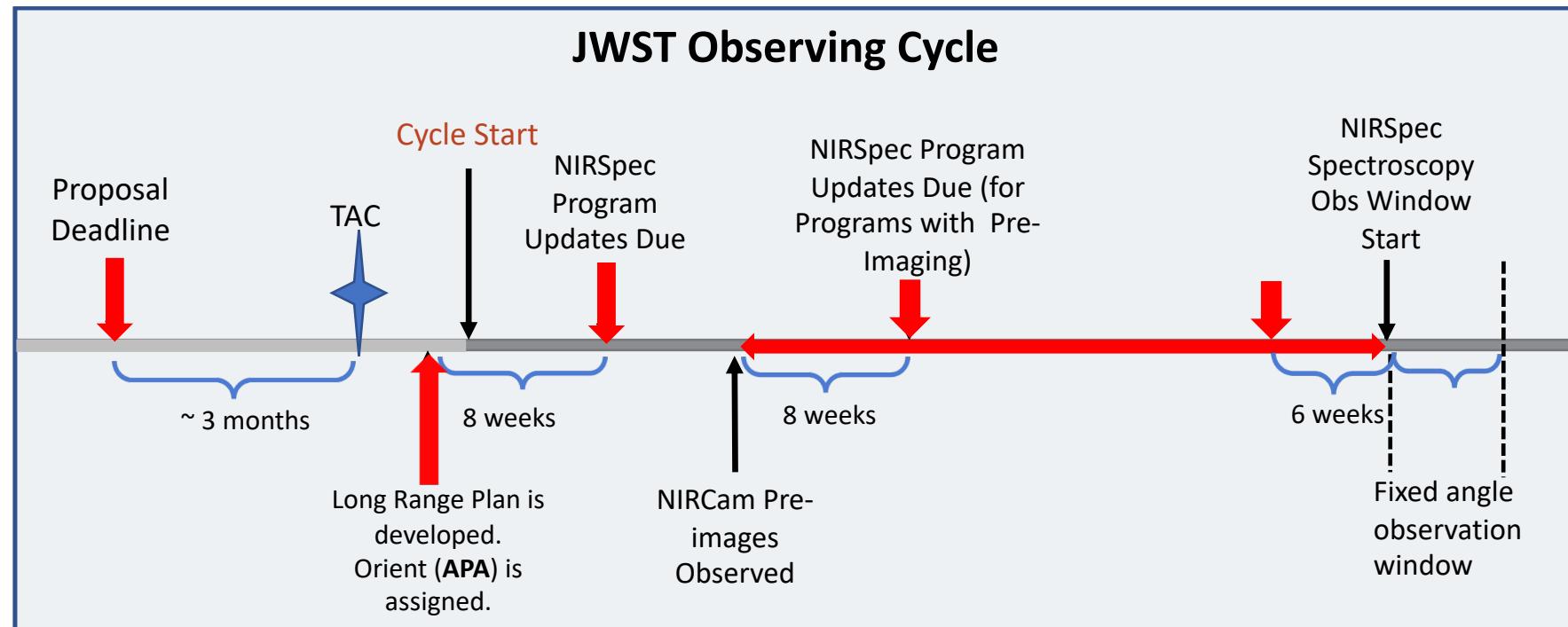
To accurately align science sources within the small MSA shutters, NIRSpec MOS mode observations must be **planned and executed at a fixed instrument Aperture Position Angle (APA), assigned by STScI**. Hence, a multi-step planning process.

For the **Proposal deadline**, use **MPT** to create placeholder visits to accurately estimate the overheads.

After the TAC, an **APA will be assigned** by STScI.

Flight ready programs are due **8 weeks after the APA is assigned** (no NIRCam pre-imaging)

Or, **8 weeks after the NIRCam pre-imaging** is observed.

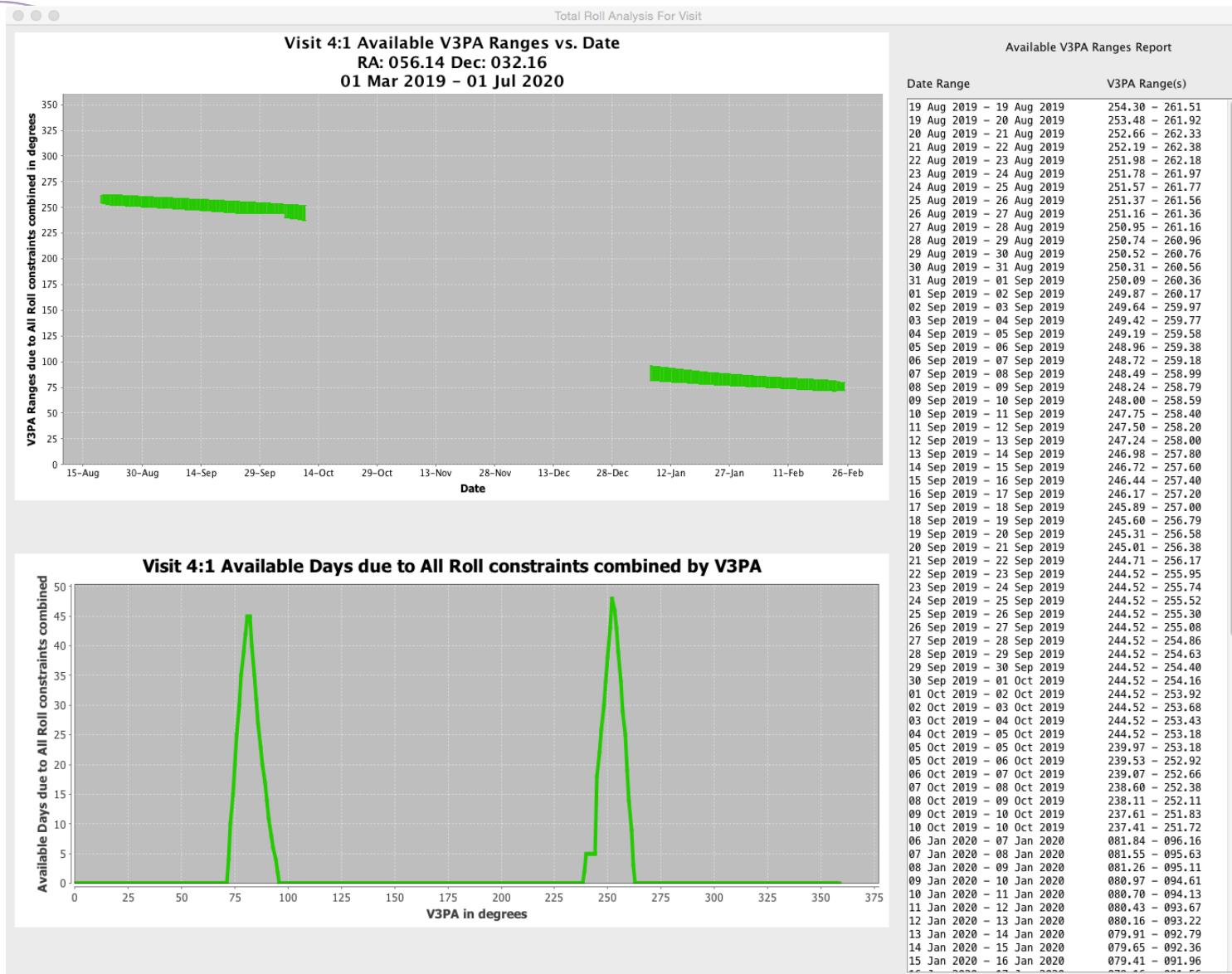


For best success, users should place their NIRCam pre-imaging and NIRSpec observations **in different visibility windows** to have time to reduce and analyze the NIRCam astrometry.

When that's not possible, program updates will be due **a min of 6 weeks in advance of the NIRSpec observing window**.



Target visibility



For most targets, there will be two visibility windows, separated by about 180 degrees

Can assess the target visibility using the TTVT or in APT using the Visit Planner



Positional Accuracies, Target Acq, and Pre-imaging



Pointing accuracies

Most MOS science will require the pointing accuracy delivered by MSATA (using reference stars). The delivered TA pointing accuracy depends on the input **Catalog relative astrometric accuracy**.

TA Type	Catalog Relative Accuracy	Delivered Pointing Accuracy	Science Goal
Optimal (MSATA)	5 - 15 mas (HST: ~ 10 mas is possible. NIRCam: 5 mas is the goal)	20 - 25 mas (20 mas = 1/10 th shutter)	Best possible photometric accuracy
Relaxed (MSATA)	< 40 mas	< 50 mas	Extended sources, or reduced flux accuracy w/ MSA
VERIFY_ONLY	No ref stars required	~ 100 mas (TBD)	Special cases – extended source

If accurate astrometry is required for the science, and if **HST imaging** does not exist – request **NIRCam pre-imaging**. Pre-imaging needs to be **fully executable** at Proposal submission.



Target acquisition considerations

- **Moving targets must use Wide Aperture TA.** WATA does not require pre-imaging or reference stars, only a good ephemeris.
- **For their Program Update submissions – observers will use MPT to select reference stars at the assigned APA** that will not be behind MSA bars or in failed shutters. This vetting is done at the Visit level, at the first pointing in the Visit.
- **MSATA for Cycle 1 requires 5-8 reference stars.**
 - MPT will impose a limit of 8 maximum.
 - Programs using MSATA will be charged a **fixed overhead** equivalent to an average charge for 8 reference stars.
- **8 reference stars have been determined to be optimal.**
 - This means that **more than 8 suitable candidates** should be defined in the Catalog.
 - There are tradeoffs between increased accuracy and overheads.
 - The number will be adjusted if needed.



Pre-imaging with NIRCam

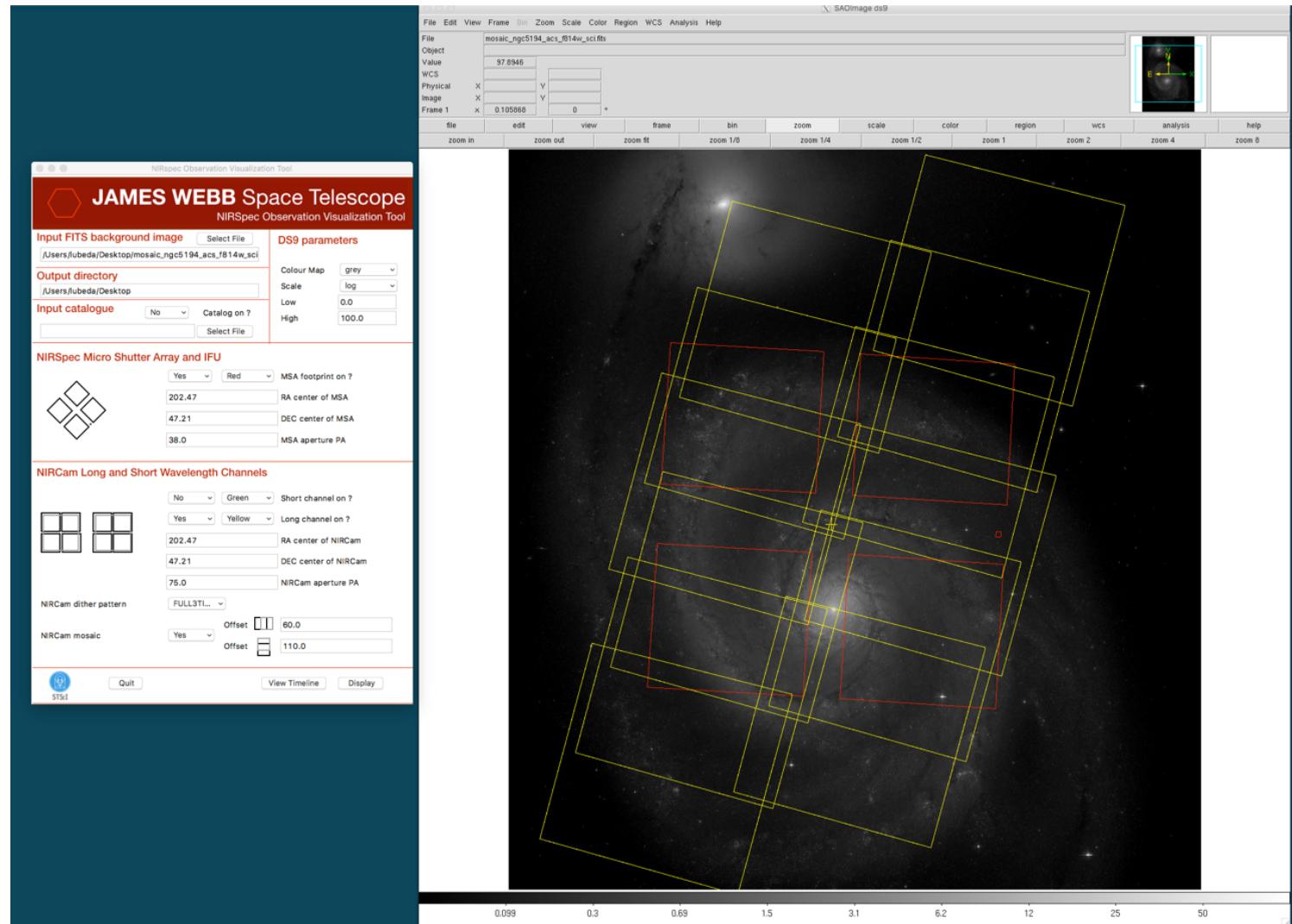
Is imaging available that is :

- Deep enough and wide enough to identify sources and reference stars.
 - The brightest reference stars must be no brighter than 18-19th mag.
- accurate enough to plan MOS obs?

If not → request **NIRCam pre-imaging** in your Proposal:

- Area should be large enough to **allow for any APA** for the NIRSpec obs:
 - Ideally 5 x 5 arcmin:
 - typically a 2x1 mosaic + dithers to cover the gaps.
- **NIRCam observations must be fully executable at proposal submission.**

NIRSpec Observation Visualization Tool, NOVT (L. Ubeda)





The MSA Planning Tool in APT



The MPT Cast

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Andrew Myers

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Christine Ritchie

Sasha Shyrokov

David Soderblom

Andrew Spina

Jeff Valenti

Emily Wislowski



MSA Planning Tool (MPT) in APT



- NIRSpec MOS observing mode is able to obtain spectra of **tens to hundreds objects** within the 3.6' x 3.4' FoV at the same time.
- The **MPT** was designed to align science sources with the very small MSA shutters (0.2" x 0.46")

A screenshot of the Astronomer's Proposal Tools (APT) software interface. The title bar reads "Astronomer's Proposal Tools Version 27.3 mpt-demo (Thu Jul 25 2019) JWST PRD: PRDOPSSOC-L-023". The menu bar includes "Form Editor", "Spreadsheet Editor", "MSA Planning Tool" (which is highlighted with a blue box), "Orbit Planner", "Visit Planner", "Timeline", "View in Aladin", "BOT", "Target Confirmation", "PDF Preview", "Submission", "Errors and Warnings", "What's New", "Roadmap", and "Feedback". The main window displays the title "Astronomer's Proposal Tools" and subtitle "Version 27.3 mpt-demo (Thu Jul 25 2019) JWST PRD: PRDOPSSOC-L-023". Below the title is a list of credits:

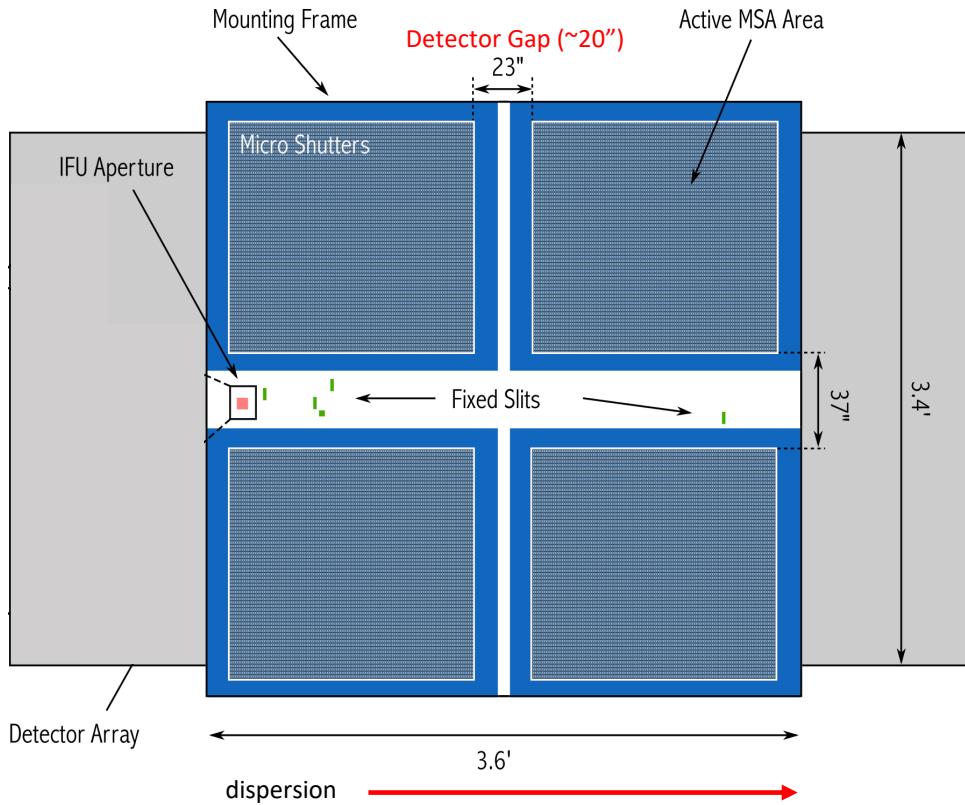
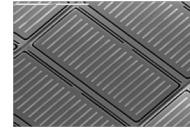
- Copyright 2002 – 2007 United States Government as represented by the Administrator of the National Aeronautics and Space Administration. All Rights Reserved.
- This software has made use of the Aladin Sky Atlas (<http://aladin.u-strasbg.fr/>) developed at the Centre de Données astronomiques de Strasbourg (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.

The bottom right corner of the interface shows a green checkmark and the text "No errors & warnings (Click for Details)".



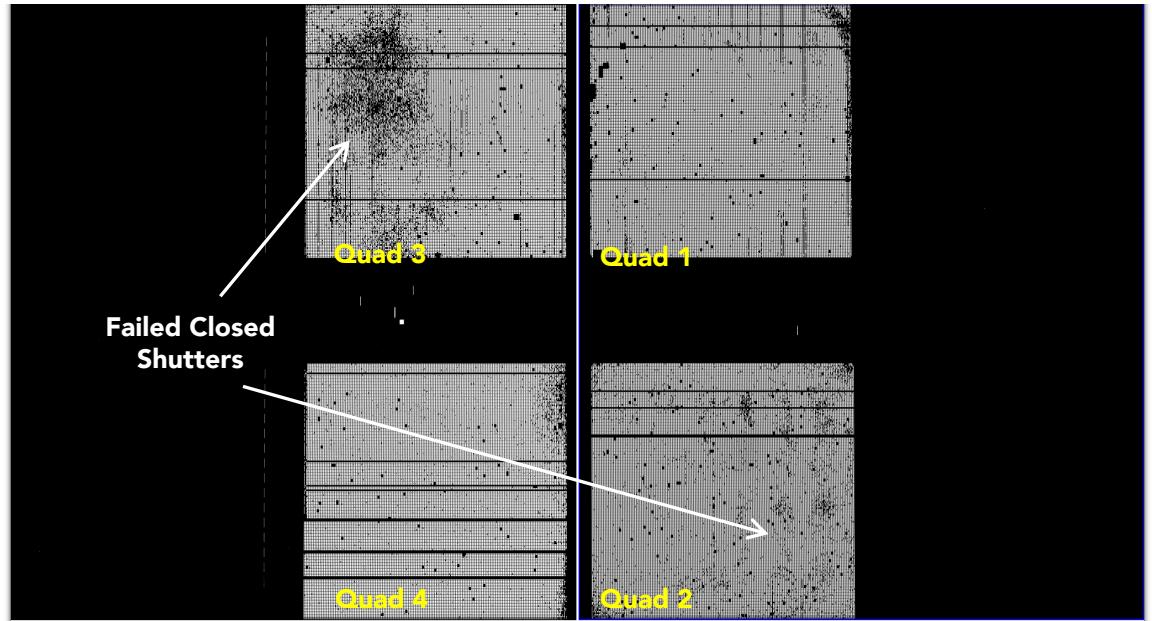
Why use MPT?

- The MSA is a **fixed grid** (with bars that vignette light from sources behind them)
- There is a **gap** between the 2 detectors → missing wavelengths.



- The MSA has **Failed shutters, shorted rows/columns**. Shutter status evolves! MPT plans using the most up-to-date operability.
- Source positions in MSA require knowledge of **optical distortions and velocity aberrations** at a planned Aperture Position Angle.

Shutter Operability





What's needed to run the MSA Planning Tool?

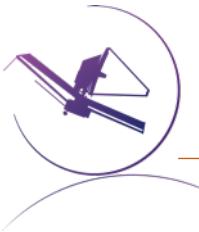
- An internet connection:
 - to access the most up-to-date **MSA shutter operability**
 - To check for **guide stars** during planning
- A complete astrometric Catalog
 - With accurate source positions (< 15 mas relative accuracy for optimal TA) – may require NIRCam pre-imaging.
 - “Complete” to indicate when planned sources are impacted by nearby sources.

MPT produces: “Plans” with Pointings, MSA configurations, Target Sets

One or multiple plans can be selected and made into an **Observation**

The background of the slide features a deep space scene with numerous small, glowing stars of varying colors. On the left side, there is a prominent, dark blue and purple nebula with intricate, wispy structures and several bright, star-like points of light embedded within it.

The Source Catalog



Source Catalog requirements

The first step - create a complete **catalog of sources**. The catalog should include **all known sources in the field**.

- The source catalog is an **ASCII file**
- It must contain J2000 **RA and Dec** expressed in degrees or hexadecimal units.
- It **cannot** have **duplicate IDs nor NULL entries**.
- A header is optional. The header is marked with "#".

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	

Because of the small size of the shutters (just 200 mas in width) the relative positional accuracy of the planning catalog must be **between 5 and 40 mas**.



Source Catalog at program update

- For (later) program update submission

MPT needs magnitudes in TA filters to properly define the reference stars.

- There will be a tool for creating this data by converting HST magnitudes. (The tool will be made available in time for updates.)

ID	RA	DEC	Size	Redshift	Reference	Stellarity	MAG_F160W	NRS_F110W	NRS_F140X	NRS_CLEAR	V
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	
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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	
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22951	03 32 40.6729	-27 47 30.99	0	0.692	Yes	0.03	20.163	20.839	20.34	20.163	
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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	
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21671	03 32 38.0057	-27 47 41.71	0	0.253	Yes	1	18.276	18.562	18.369	18.276	

Candidate Sets Comments

Astrometric Accuracy (mas) 10.0

Reference Position RA: 03 32 38.9682 Dec: -27 47 26.86

Pre-Image Availability Not required

Edit MSA Catalogs New Edit Observations

✗ 12 errors & warnings (Click for Details)



The MPT Planner
Making a plan for an observation



The MPT Planner

In the **MSA Planning Tool** -

Select the **Planner** tab.

The Planner is where you design plans for your MOS observation.

- Choose the **Primary Candidates** (and Filler Candidates)
- Choose an **APA** (place holder or assigned from STScI)
- Choose the **slitlet configuration**
- Choose the **source centering constraints**

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

New JWST Proposal | Import MSA Source Catalog...

JWST Draft Proposal (RAFEL-2015.a)
JWST Draft Proposal (Unsaved)
Proposal Information
Targets
MSA Catalogs
Observations
Observation Links

Planner Plans

Candidate Lists
Primary Candidate List: RAFELSKI-2015-RANDOM (9969 sources)
Filler Candidate List: 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

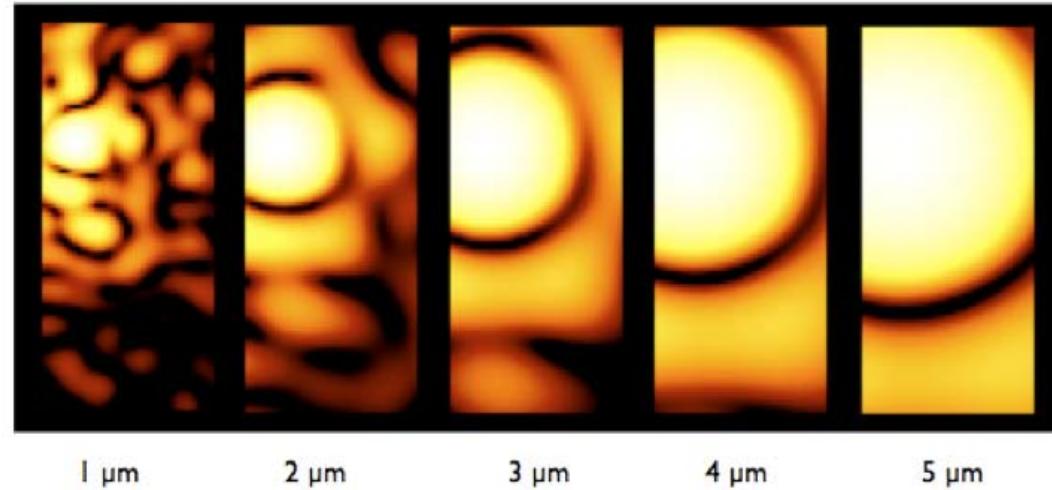
Pointing Setup
Nod in slitlet []
3 exposures per configuration.
Dither Type: None

Exposure Setup
Grating/Filter: G140H/F070LP, G140H/F100LP, G140M/F070LP, G140M/F100LP, G235H/F170LP, G235M/F170LP, G395H/F290LP

22 errors & warnings



Source centering and slit losses



Slit throughput or slit loss is a function of wavelength and the relative placement of the science source in the MSA shutter



Source centering constraint

A **tighter constraint on the source shutter** yields more accurate photometry and higher flux, but may reduce the number of observable targets. Important for point sources.

Source Centering Constraint	Figure†	Minimum Relative Flux Transmission at 2.95 $\mu\text{m}^{\dagger\dagger}$	Margin (milli-arcsec)
<i>Unconstrained</i> (sources can be behind the MSA bars)		12%	0
<i>Entire Open Shutter Area</i> (default)		30%	38
<i>Midpoint</i>		62%	59
<i>Constrained</i>		75%	72
<i>Tightly Constrained</i>		85%	91

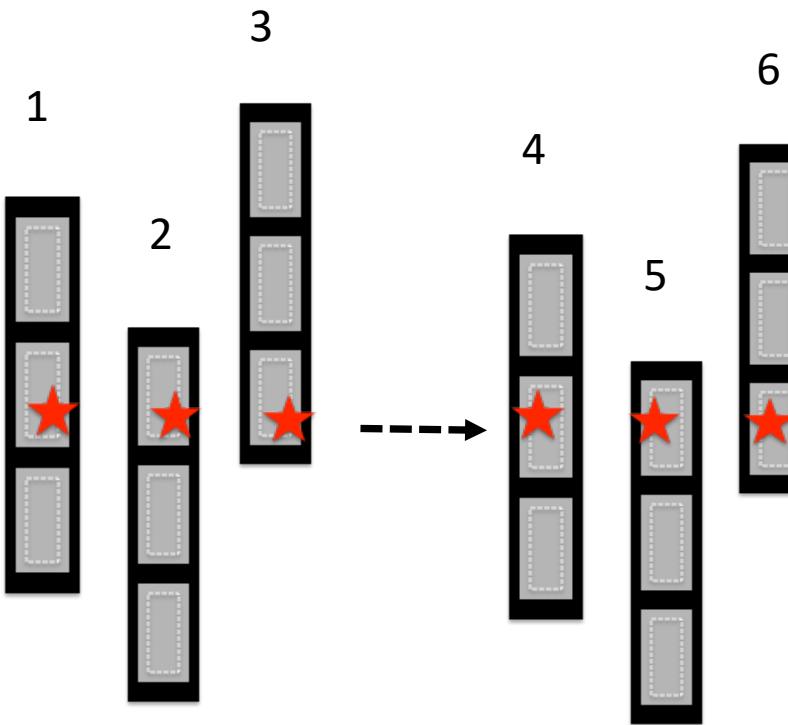


The benefits of dithering

In addition to improving the sampling of the PSF and correcting for hot/bad pixels, dithering helps with:

- Improve background subtraction (**Nodding**)
- Recover important wavelengths that could fall in the detector gap (**Fixed dither**)
- Mitigate the effects of **light leakage** through the MSA
- Observe additional sources behind bars or mounting plate.

Nod in 3-shutter slitlet:
3 exposures



Fixed dithers:
MSA is reconfigured at the new dither point.

MPT takes dithers into account and will attempt to observe as many sources as possible through a set of dithers.



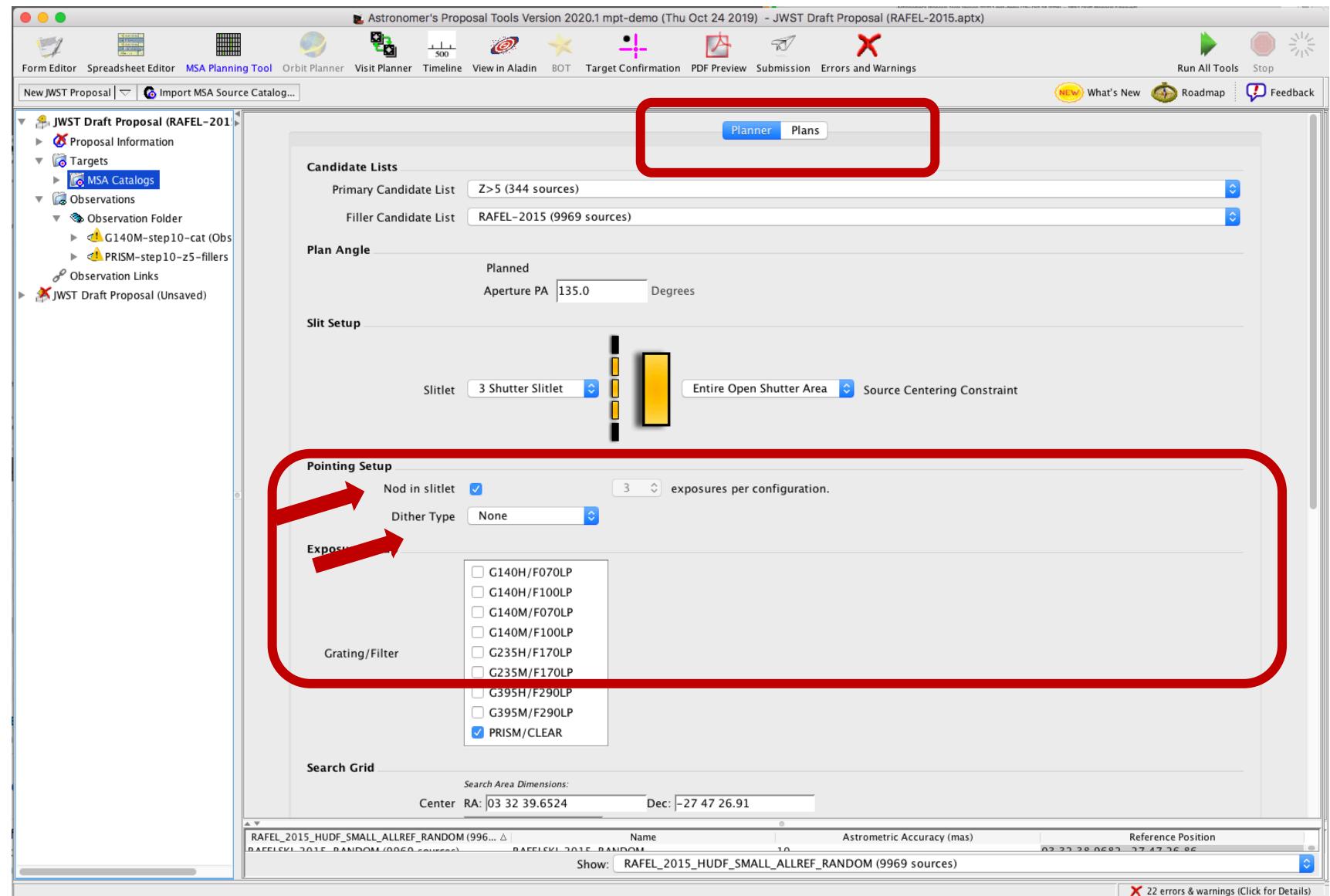
Specifying dithers and nods in the MPT Planner

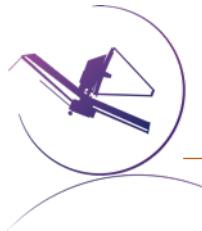
The Planner is where you decide how to dither:

Nodding moves the sources within the slitlet – no MSA 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.

Nodding and dithering can be used together or independently.





A few more options, and then create a Plan in MPT

Grating and Filter combination must be selected in the Planner (each has different masking to prevent spectral overlaps).

Can select “Use Weights” and “Enable Monte Carlo” to test randomly shuffled ordering of sources.



The screenshot shows the Astronomer's Proposal Tools Version 2020.1 mpt-demo (Thu Oct 24 2019) - JWST Draft Proposal (RAFEL-2015.aptx) window. The left sidebar shows the project structure: JWST Draft Proposal (RAFEL-2015), Proposal Information, Targets, MSA Catalogs (selected), Observations, Observation Folder (G140M-step10-cat (Obs), PRISM-step10-z5-filters), Observation Links, and JWST Draft Proposal (Unsaved). The main area is the Planner tab, which includes sections for Candidate Lists (Primary Candidate List: Z>5 (344 sources), Filler Candidate List: RAFEL-2015 (9969 sources)), Plan Angle (Planned Aperture PA: 135.0 Degrees), Slit Setup (Slit: 3 Shutter Slit, Entire Open Shutter Area, Source Centering Constraint), Pointing Setup (Nod in slitlet checked, 3 exposures per configuration, Dither Type: None), and Exposure Setup. The 'Grating/Filter' dropdown menu is highlighted with a red box, showing options like G140H/F070LP, G140H/F100LP, G140M/F070LP, G140M/F100LP, C235H/F170LP, C235M/F170LP, G395H/F290LP, G395M/F290LP, and PRISM/CLEAR, with PRISM/CLEAR checked. Below the dropdown is a 'Search Grid' section. The bottom status bar shows 'RAFEL_2015_HUDF_SMALL_ALLREF_RANDOM (996...)' and 'RAFELSKL_2015_RANDOM (9969 sources)', 'Name', 'Astrometric Accuracy (mas)', 'Reference Position', and 'Show: RAFEL_2015_HUDF_SMALL_ALLREF_RANDOM (9969 sources)'. A note at the bottom right says '22 errors & warnings (Click for Details)'.



MSA Operability: Failed shutters and shorts

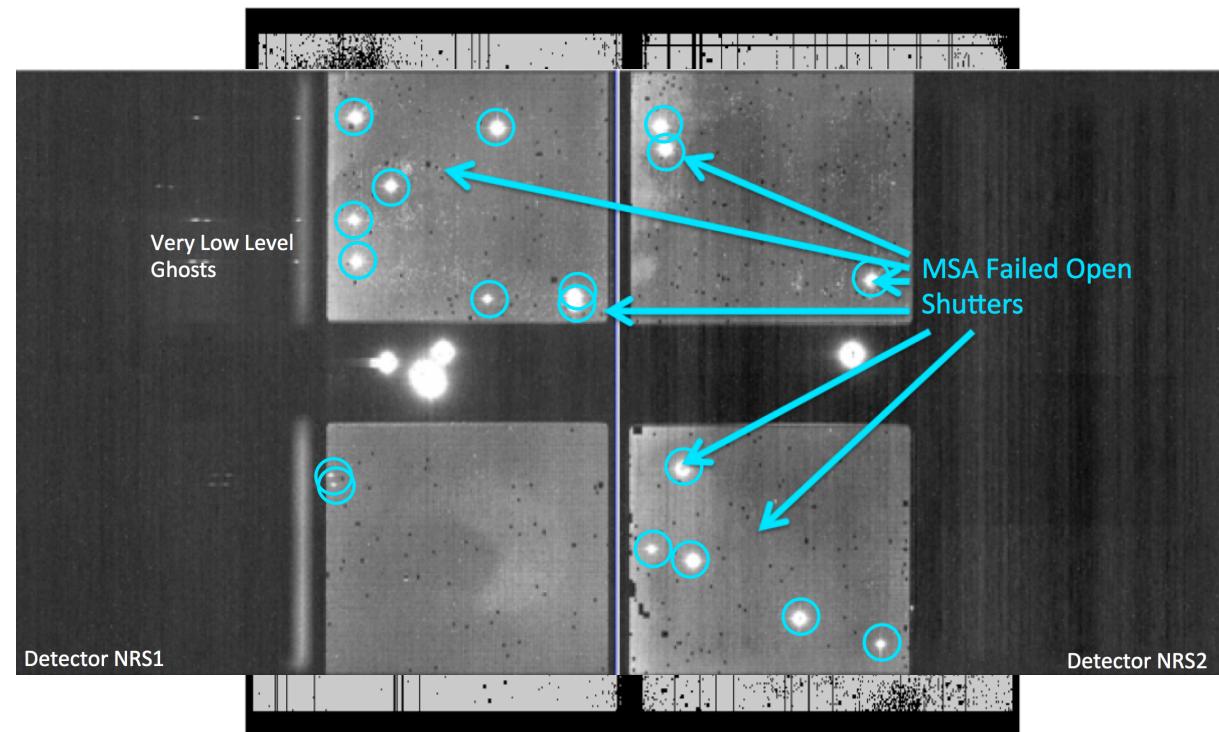
Some of the MSA shutters are not operable...

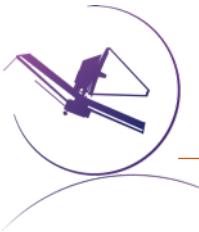
Failed Closed shutters affect sources that may happen to fall into them.

Shorts between columns and rows can occur, but are expected to be fairly stable.

Failed Open shutters have the most severe impact on the observations, and can prohibit observing sources over a sizeable area. Unintended spoilers can contaminate spectra of planned sources.

At each test pointing, MPT plans around failed shutters and shorts and searches for an optimal MSA configuration. The latest operability information is used.

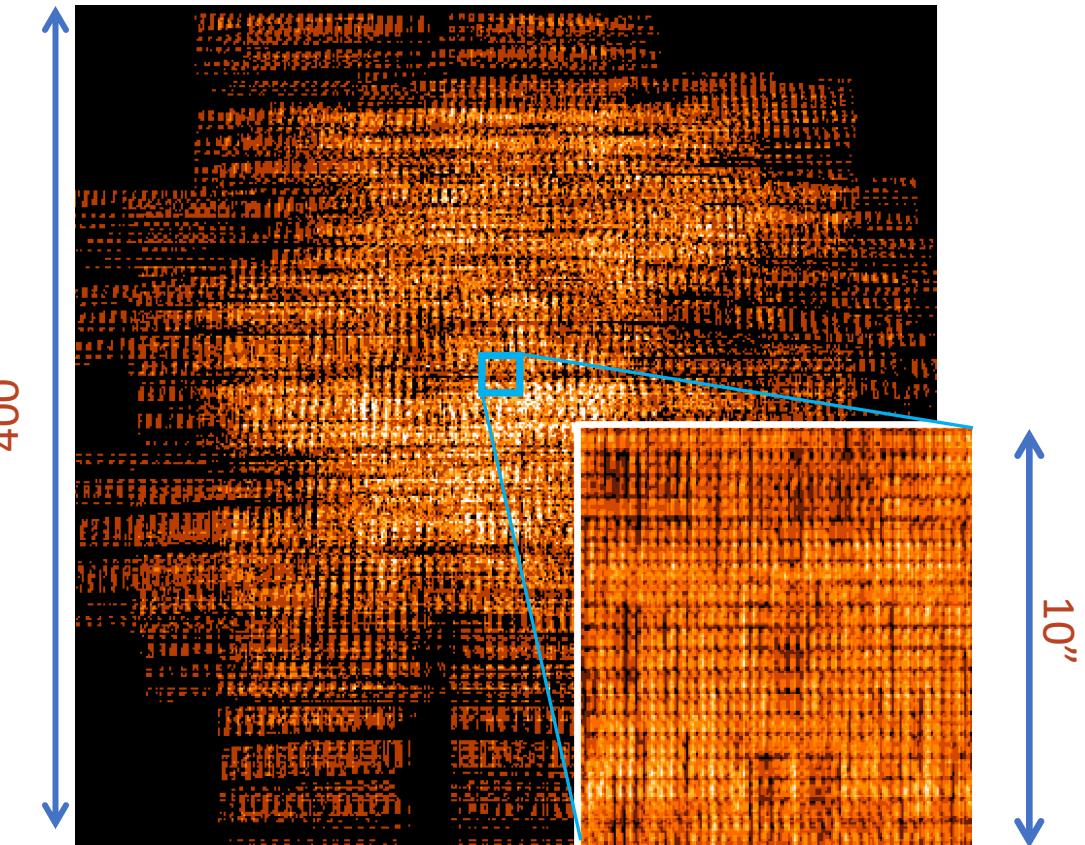




How MPT works

- The Catalog sources are mapped to the MSA plane.
- MPT creates a grid of test pointings over the area of the Primary candidate list using the **user-specified search grid parameters**.
- At each test pointing, MPT checks each source in the **Primary list** (in the order given) to find those that are in operable shutters and within constraints set in the Planner, and that present no conflict to other selected sources. These checks are done at all of the points in the **user-specified dither** pattern before accepting a source.
- At each test pointing, the **weights of all observable primary sources in an MSA configuration are summed**. These steps are repeated at each test pointing. The result is a **Heatmap**.

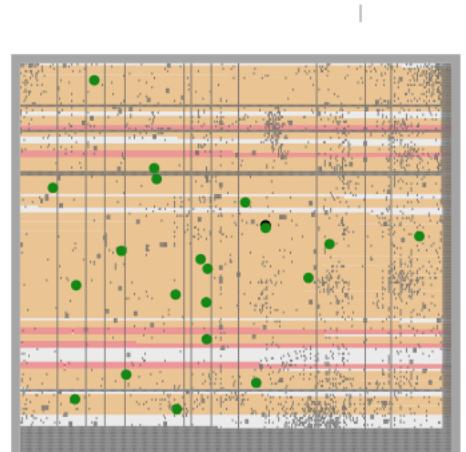
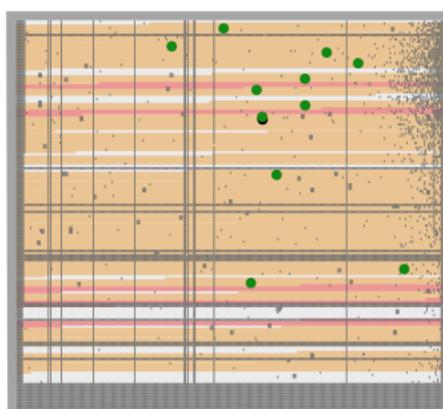
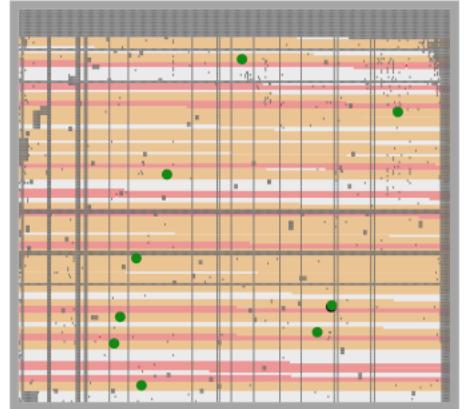
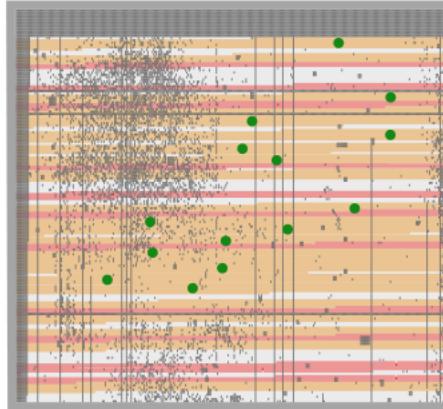
Heatmap:
Every point is the sum of source weights





How MPT works

- The “best” pointing is selected. (Or, a **set of pointings**, if dithers were specified.) These are solely based on the Primary candidates.
- The MSA configs for the selected pointings are built, and Filler sources are added.
- A **Plan** is created in MPT.
 - Plans have **Pointings**, a **set of sources** that will be **observed**, and associated **MSA configurations**.
- One or more Plans are selected by the user and made into an **Observation**.





The MPT Plans

Evaluating and selecting plans for an observation



Examine and visualize Plan results

Examine plan results in the
Plans pane of MPT

- MSA shutter view
- Collapsed shutter view

Screenshot of the Astronomer's Proposal Tools (MPT) version 2020.1 interface showing the "JWST Draft Proposal (RAFEL-2015.aptx)" window.

The top menu bar includes: Form Editor, Spreadsheet Editor, MSA Planning Tool (highlighted in blue), Orbit Planner, Visit Planner, Timeline, View in Aladin, BOT, Target Confirmation, PDF Preview, Submission, Errors and Warnings, Run All Tools, Stop, What's New, Roadmap, and Feedback.

The left sidebar shows the proposal structure:

- JWST Draft Proposal (RAFEL-2015)
 - Proposal Information
 - Targets
 - MSA Catalogs
 - Observations
 - Observation Folder
 - G140M-step10-cat (Obs)
 - PRISM-step10-z5-filters
 - Observation Links
 - JWST Draft Proposal (Unsaved)

The main area has tabs: Planner (highlighted with a red box) and Plans.

Plan Selection table:

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

Pointings table:

#	Plan number	Name	RA	Dec	RA (HMS)	Dec (DMS)	APA	Grating...	Target set size	Total weight	Show	Send to	Export Config
1	3	cleln1	53.1696588	-27.7888441	03 32 40.71...	-27 47 19.8...	134.996614...	PRISM/...	123	14187	Show	Send	Export
2	3	cleln2	53.1695414	-27.7887403	03 32 40.68...	-27 47 19.4...	134.996668...	PRISM/...	117	14106	Show	Send	Export
3	3	cleln3	53.1697762	-27.7889480	03 32 40.74...	-27 47 20.2...	134.996559...	PRISM/...	119	14148	Show	Send	Export

Targets section:

Target Set Operation: Targets in at least one selected exposure

Primary targets: 56 targets are shown.

Targets table:

ID	Weight	Exposures	cleln1	cleln2	cleln3
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 v	v	v	

Bottom status bar: RAFEL_2015_HUDF_SMALL_ALLREF_RANDOM (996...), Name: RAFEL_2015_HUDF_SMALL_ALLREF_RANDOM (9969 sources), Astrometric Accuracy (mas): 10, Reference Position: 02 33 28.0603 17 47 36.06, Show: RAFEL_2015_HUDF_SMALL_ALLREF_RANDOM (9969 sources), and 22 errors & warnings (Click for Details).



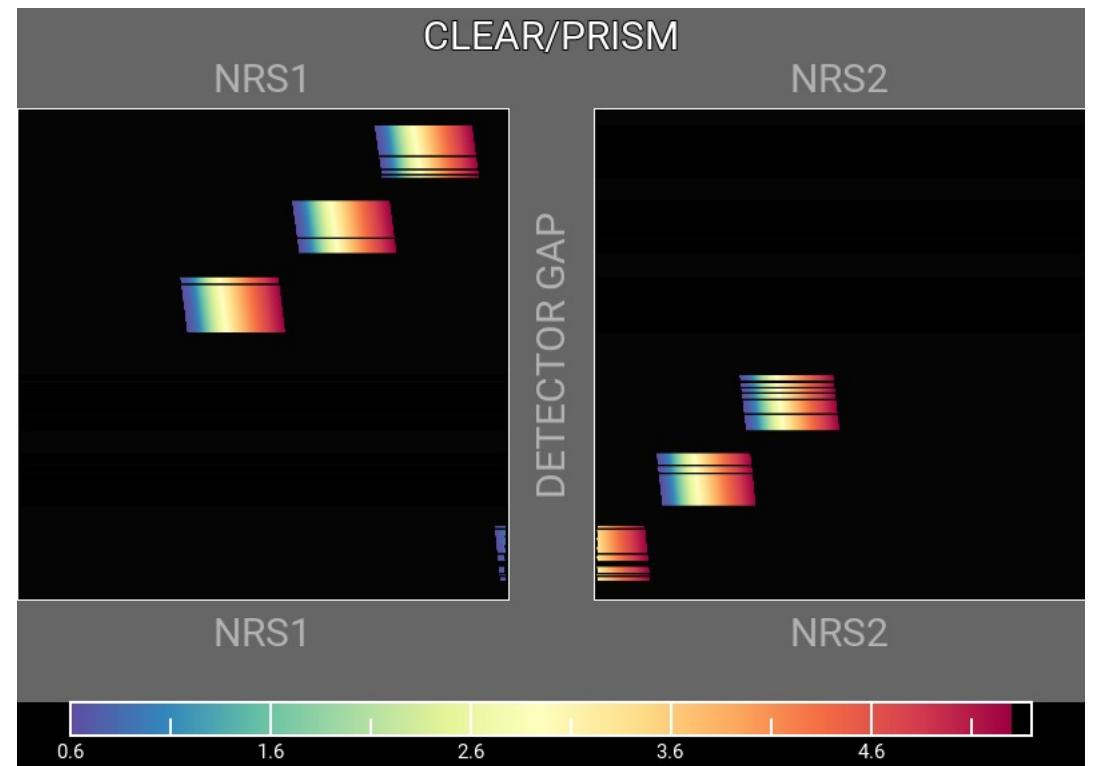
MSA Spectral Visualization Tool

MSAVis is a standalone tool that can be downloaded from GitHub.

It takes the export file “MSA Target Info” output from MPT and projects the spectra of the observed targets on the 2 NIRSpec detectors for both visual inspection and a report indicating wavelength cutoffs.

Instructions to download, install and run MSAVis can be found in the **NIRSpec JDoc**:

<https://jwst-docs.stsci.edu/near-infrared-spectrograph/>

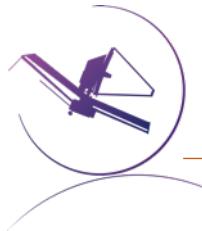


G. Kanarek



Take Away

- New version of MPT will be available for the Cycle 1 call for proposal – easier to use, more intuitive and discoverable, lighter.
- Need high precision **relative** astrometry – 5-15 mas for point sources – up to 40 mas for extended objects.
- MOS is one of the very few observing modes of JWST that will follow a **multi-step planning process**.
- MOS **requires an aperture position angle** – it is **assigned by STScI** (although it may be requested at the time of call for proposals, but have to be strongly justified).
- NIRSpec **overheads** for MSA are considerable – USE MPT to have a good estimate.
- You can use **MSAVis** to verify that wavelengths are properly sampled.
- You can use **Nirspec Obs Visualization Tool (NOVT)** to visualize NIRCam pre-imaging relative to MSA observations.
- **Dither! Dither!! Dither!!!** It improves background subtraction, wavelength coverage, etc.



Helpful Hints

- Order the input Catalog by target weights prior to ingest into MPT. When building an MSA configuration, MPT tries adding sources in the order they appear in the Catalog.
- Include Primary candidates in the Filler list if you want to obtain observe more of them.
- Only the weights of the Primaries matter (not the Fillers), so to help ensure observations of certain sources, include them in the Primary candidate list, with appropriate weighting.
- Add Fillers to maximize efficiency/multiplexing.
- If feasibility windows are large, test several APAs to see if it makes a statistical difference. If so, set conservative limits on requested exposure time. Add an Orient SR only if needed, with a min range of 20 - 30 deg.
- If using the high-res gratings (G140H, G235H, G395H), try to get your sources onto the leftmost quadrants to avoid red-end detector cutoffs.
- Use Aladin FoV to show the position of NIRCam parallels with respect to the NIRSpec MSA.
- Your catalog should be complete to be able to check for contaminants getting into failed open shutters, or into planned target shutters/slitlets.
- The MSA Config Editor can be used to make changes to your MSA configurations designed automatically with MPT. It's found at the observation level in APT.



END



Starting from scratch in APT

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

Form Editor Spreadsheet Editor MSA Planning Tool Orbit Planner Visit Planner Timeline View in Aladin BOT Target Confirmation PDF Preview Submission Errors and Warnings

New Document
New HST Proposal
New JWST Proposal

What's New Roadmap Feedback

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.
- This product includes code licensed from RSA Data Security.
- This product includes software developed by the Apache Software Foundation (<http://www.apache.org/>).

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Show:

No errors & warnings (Click for Details)

The screenshot shows the APT application window. At the top, there's a toolbar with various icons for different tools like Form Editor, Spreadsheet Editor, and Orbit Planner. Below the toolbar is a menu bar with the same tool names. A red arrow points to a dropdown menu titled 'New Document' which contains three items: 'New HST Proposal' and 'New JWST Proposal'. The main content area of the window displays the APT title 'Astronomer's Proposal Tools' and its version 'Version 27.3 mpt-demo (Thu Jul 25 2019) JWST PRD: PRDOPSSOC-L-023'. Below the title is a large block of text detailing the software's dependencies and legal notices, including mentions of the Aladin Sky Atlas, SIMBAD database, NASA/IPAC Extragalactic Database, and the Apache Software Foundation. At the bottom right of the main window, there's a status message 'No errors & warnings (Click for Details)' with a green checkmark icon. The overall interface has a clean, modern look with a light gray background and a grid pattern in the background of the main content area.



Load the Catalog as an MSA Catalog Target

Notice that we are in the Form Editor

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

Form Editor Spreadsheet Editor MSA Planning Tool Orbit Planner Visit Planner Timeline View in Aladin BOT Target Confirmation PDF Preview Submission Run All Tools Stop

New JWST Proposal ▾ New ▾ NEW What's New Roadmap Feedback

JWST Draft Proposal (Unsaved)
Proposal Information
Proposal Description
Team Expertise
Unnamed PI
Unnamed Col
Targets
Observations
Observation Links

Targets of JWST Draft Proposal (Unsaved)

Targets

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

Import Targets... Import Fixed Targets from whitespace, CSV, TSV, or VOTable

Edit Unnamed Col ↵ New ▾ Edit Observations

✖ 9 errors & warnings (Click for Details)

Click

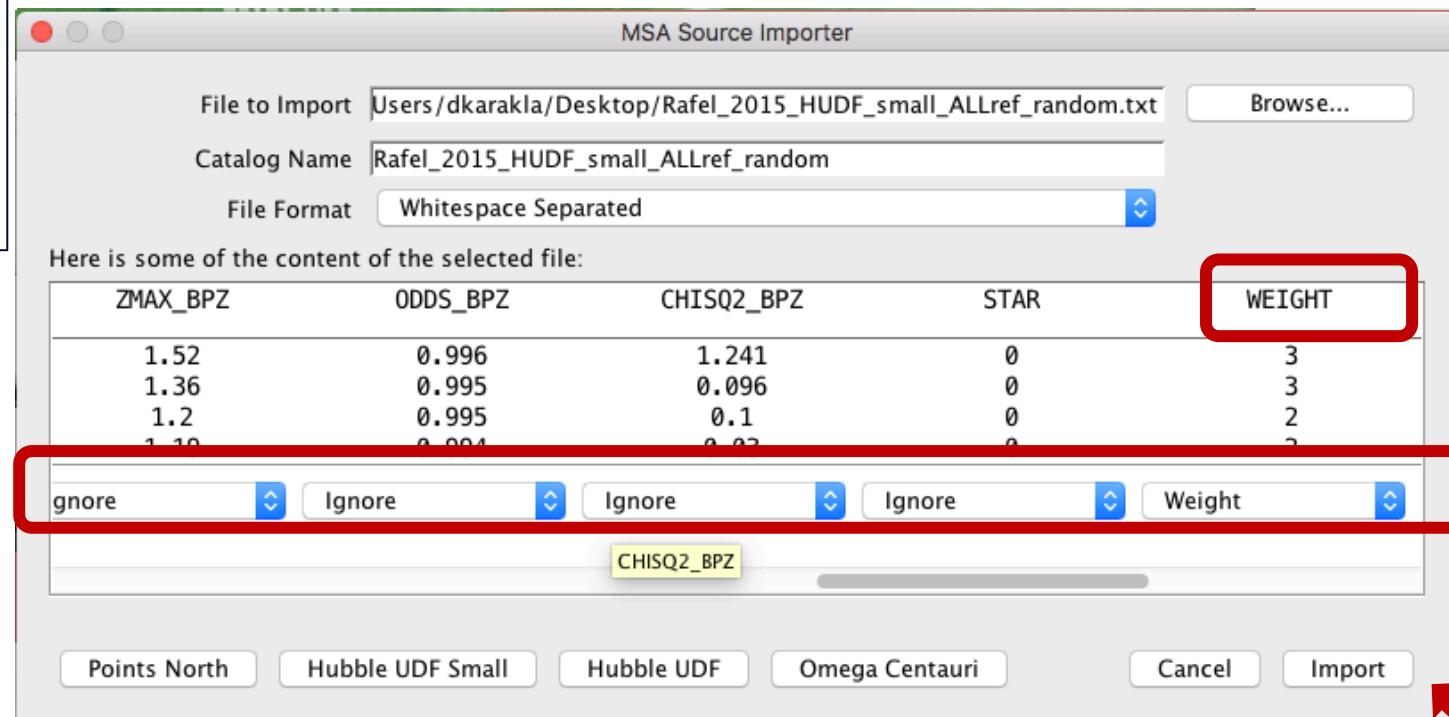


Load the Catalog as an MSA Catalog Target

- Browse and select the Catalog file.
- Choose a name and file format

MPT tries to identify the type of data in each column

A window will pop up...



Weights can be used to prioritize the targets. Higher weights are for more interesting targets.

Click



Catalog declarations and making candidate sets

MPT complains because:

- 1) The target is not used in the proposal (yet! – It's just a warning)
- 2) We must specify the astrometric accuracy
- 3) We must tell MPT if we need pre-imaging or not:
 - If NIRCam pre-imaging will be done in this program, it is linked here for archival purposes.

The screenshot shows the MPT interface with the following details:

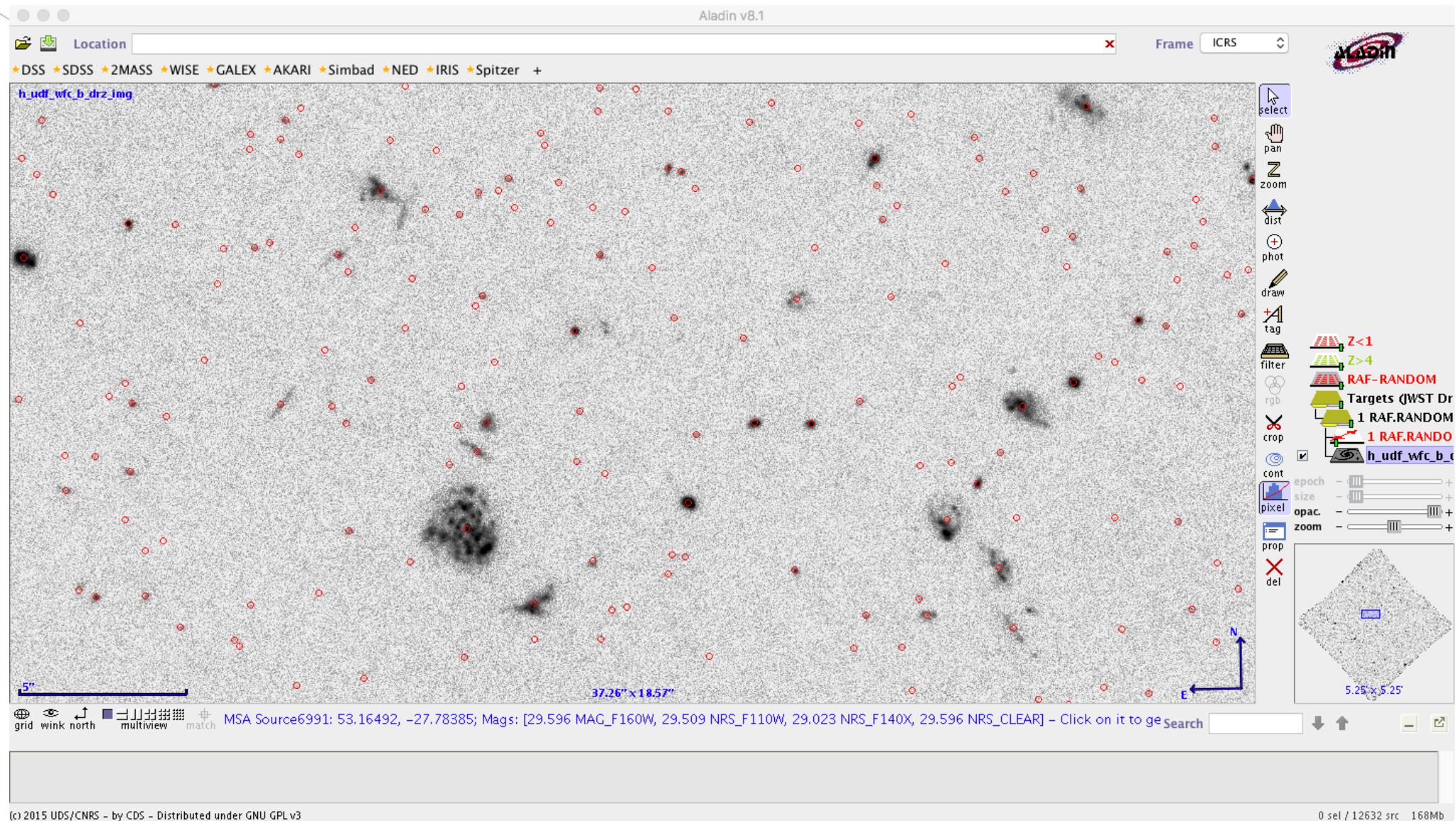
- Toolbar:** Includes Form Editor, Spreadsheet Editor, MSA Planning Tool, Orbit Planner, Visit Planner, Timeline, View in Aladin, BOT, Target Confirmation, PDF Preview, Submission, Errors and Warnings, Run All Tools, Stop, What's New, Roadmap, and Feedback.
- Left Sidebar:** Shows the project structure: New JWST Proposal, Import MSA Source Catalog..., JWST Draft Proposal (RAFEL-2015), JWST Draft Proposal (Unsaved), Proposal Information, Targets, MSA Catalogs (highlighted), Observations, and Observation Links.
- Main Window:** Displays the "1 RAFELSKI-2015-RANDOM of JWST Draft Proposal (Unsaved)" entry. The "Candidate Sets" tab is selected. The "Astrometric Accuracy (mas)" field contains "03 32 38.9682" and the "Reference Position" is RA: 03 32 38.9682 Dec: -27 47 26.86. The "Pre-Image Availability" dropdown is set to "Not required".
- Dialog Box:** A "Select" dialog is open, listing "RAFELSKI-2015-RANDOM (9969)" and providing options: "New Candidate Set...", "Delete", and "Send to Aladin". The "Send to Aladin" button is highlighted with a red box and arrow.
- Data Table:** A large table lists 21 catalog entries with columns: ID, RA, DEC, Size, Redshift, Reference, Stellarity, MAG_F160W, NRS_F110W, NRS_F140X, and NRSt. The first few rows include:

ID	RA	DEC	Size	Redshift	Reference	Stellarity	MAG_F160W	NRS_F110W	NRS_F140X	NRSt
23796	03 32 39.0842	-27 46 1.79	0	1.415	Yes	0.92	20.122	20.674	20.366	3
54454	03 32 35.5075	-27 46 26.13	0	1.268	Yes	0.03	20.384	20.845	20.474	3
22410	03 32 39.8827	-27 47 15.06	0	1.107	Yes	0.03	20.711	21.199	20.786	2
24439	03 32 37.1930	-27 46 8.08	0	1.101	Yes	0.03	19.494	20.254	19.672	2
23546	03 32 38.4836	-27 47 2.42	0	0.919	Yes	0.03	20.088	20.785	20.261	2
21268	03 32 42.4216	-27 47 58.80	0	0.779	Yes	0.94	17.811	18.026	-99	2
22990	03 32 38.7749	-27 47 32.14	0	0.767	Yes	0.03	20.286	20.695	20.415	2
21840	03 32 37.3079	-27 47 29.36	0	0.708	Yes	0.03	18.793	19.473	18.966	2
22951	03 32 40.6729	-27 47 30.99	0	0.692	Yes	0.03	20.163	20.839	20.34	1
24350	03 32 38.4386	-27 46 31.90	0	0.69	Yes	0.03	20.68	21.324	20.855	1
24353	03 32 38.5957	-27 46 31.36	0	0.663	Yes	0.03	20.768	21.177	20.893	1
21298	03 32 39.2188	-27 47 58.36	0	0.662	Yes	0.03	19.618	20.265	19.785	1
21281	03 32 35.7539	-27 47 58.82	0	0.66	Yes	0.03	19.35	19.991	19.507	1
23847	03 32 38.7915	-27 46 48.90	0	0.657	Yes	0.03	20.287	20.927	20.451	1
22428	03 32 41.4054	-27 47 17.17	0	0.612	Yes	0.03	19.596	20.241	19.767	1
24587	03 32 40.7814	-27 46 15.69	0	0.571	Yes	0.03	19.482	19.901	19.615	1
24348	03 32 38.9675	-27 46 30.23	0	0.447	Yes	0.03	20.152	20.541	20.258	1
24685	03 32 41.7599	-27 46 19.40	0	0.383	Yes	0.04	20.047	20.635	20.189	1
21671	03 32 38.0057	-27 47 41.71	0	0.253	Yes	1	18.276	18.562	18.369	1
- Status Bar:** Shows 23 errors & warnings (Click for Details).

Notice that we are in the Form Editor



Catalog sources can be displayed in Aladin





MSA Catalog Target

The MSA Catalog
Target is now in the
Targets Folder

Highlight/select the
Catalog to see its data

Astronomer's Proposal Tools Version 2020.1 mpt-demo (Thu Oct 24 2019) - JWST Draft Proposal (RAFEL-2015.aptx)

Form Editor Spreadsheet Editor MSA Planning Tool Orbit Planner Visit Planner Timeline View in Aladin BOT Target Confirmation PDF Preview Submission Errors and Warnings Run All Tools Stop What's New Roadmap Feedback

New Document Import MSA Source Catalog...

JWST Draft Proposal (RAFEL-2015)
Proposal Information
Targets
MSA Catalogs
1 RAFEL-2015
Observations
Observation Folder
G140M-step10-cat (Obs)
PRISM-step10-z5-filters
Observation Links

1 RAFEL-2015 of JWST Draft Proposal (RAFEL-2015.aptx)

Number 1
Name in the Proposal RAFEL-2015 (unique within proposal)
Name for the Archive RAFEL-2015 (standard resolvable name)

Candidate Sets Comments

Astrometric Accuracy (mas) 10.0
Reference Position RA: 03 32 38.9682 Dec: -27 47 26.86
Pre-Image Availability Not required

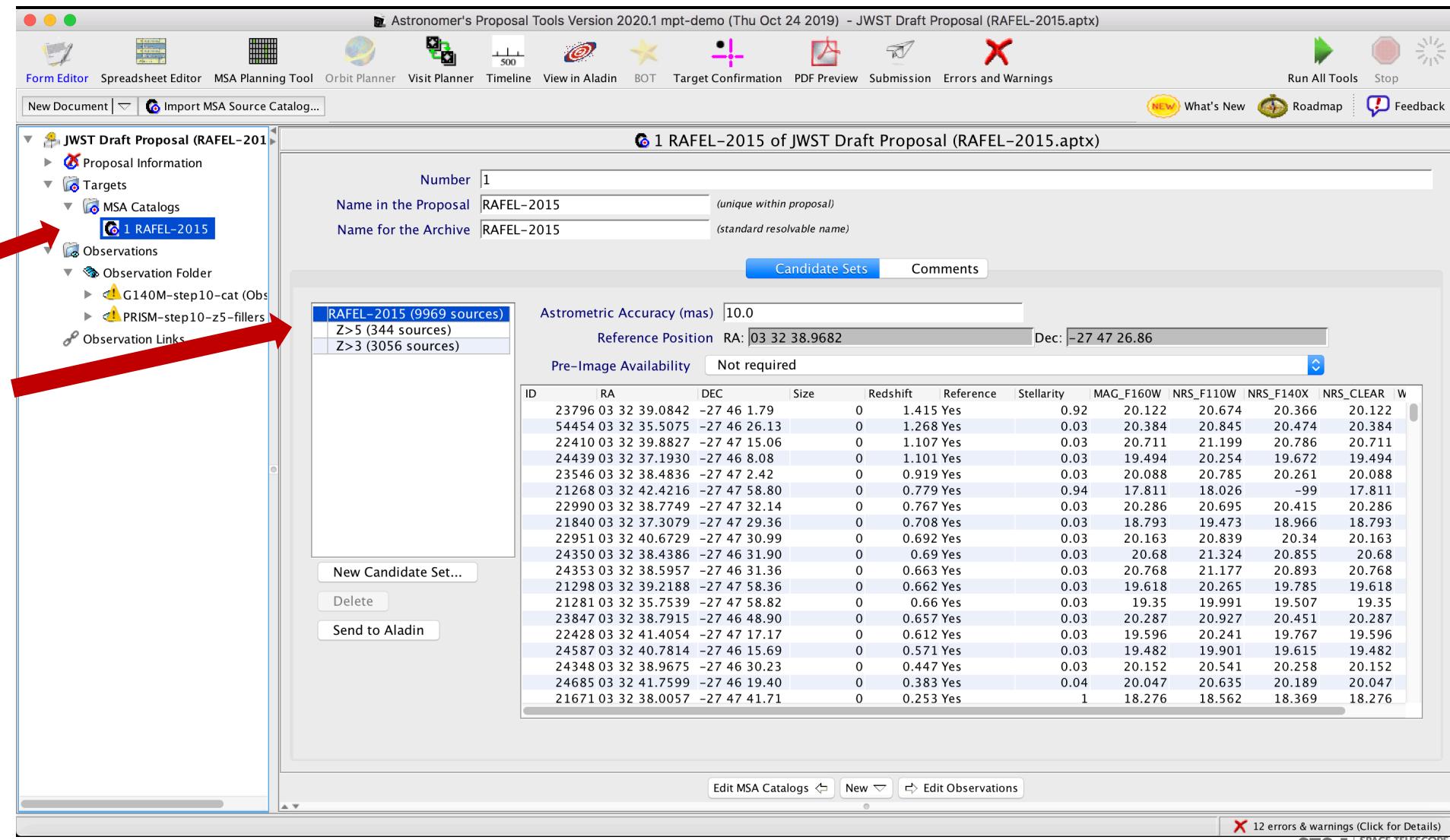
RAFEL-2015 (9969 sources)
Z>5 (344 sources)
Z>3 (3056 sources)

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	

Edit MSA Catalogs New Edit Observations

12 errors & warnings (Click for Details)

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The MPT Planner

In the **MSA Planning Tool** -

Select the **Planner** tab.

The Planner is where you design plans for your MOS observation.

- Choose the **Primary Candidates** (and Filler Candidates)
- Choose an **APA** (place holder or assigned from STScI)
- Choose the **slitlet configuration**
- Choose the **source centering constraints**

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

New JWST Proposal | Import MSA Source Catalog...

JWST Draft Proposal (RAFEL-2015.a)
JWST Draft Proposal (Unsaved)
Proposal Information
Targets
MSA Catalogs
Observations
Observation Links

Planner Plans

Candidate Lists
Primary Candidate List: RAFELSKI-2015-RANDOM (9969 sources)
Filler Candidate List: 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



Create an observation

Examine plan results in the
Plans pane of MPT

Highlight a Plan or Plans, and Exposures
Filter results

...and Create an Observation!



Screenshot of Astronomer's Proposal Tools Version 2020.1 (MPT) showing the 'JWST Draft Proposal (RAFEL-2015.aptx)' window.

The left sidebar shows the project structure:

- New JWST Proposal
- Import MSA Source Catalog...
- JWST Draft Proposal (RAFEL-2015)
 - Proposal Information
 - Targets
 - MSA Catalogs
 - Observations
 - Observation Folder
 - G140M-step10-cat (Obs)
 - PRISM-step10-z5-filters
 - JWST Draft Proposal (Unsaved)

Three red arrows point from the text instructions to the 'Plan Selection' table, the 'Pointings' table, and the 'Targets' section respectively.

Plan Selection

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

Pointings

#	Plan number	Name	RA	Dec	RA (HMS)	Dec (DMS)	APA	Grating...	Target set size	Total weight	Show	Send to Aladin	Export Config
1	2	cleln1	53.1696588	-27.7888441	03 32 40.71...	-27 47 19.8...	134.996614...	G140M...	69	9954	Show	Send	Export
2	2	cleln2	53.1695414	-27.7887403	03 32 40.68...	-27 47 19.4...	134.996668...	G140M...	66	9921	Show	Send	Export
3	2	cleln3	53.1697762	-27.7889480	03 32 40.74...	-27 47 20.2...	134.996559...	G140M...	66	9918	Show	Send	Export
4	3	cleln1	53.1696588	-27.7888441	03 32 40.71...	-27 47 19.8...	134.996614...	PRISM/...	123	14187	Show	Send	Export
5	3	cleln2	53.1695414	-27.7887403	03 32 40.68...	-27 47 19.4...	134.996668...	PRISM/...	117	14106	Show	Send	Export
6	3	cleln3	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

57 targets are shown.

Send to Aladin

Targets:

ID	Weight	Exposures	cleln1	cleln2	cleln3	cleln1	cleln2	cleln3
4449	30	6x	x	x	x	x	x	x
7988	300	6x	x	x	x	x	x	x
9708	300	3x	x	x	x	x	x	x
1912	300	6x	x	x	x	x	x	x
9768	300	6x	x	x	x	x	x	x
6093	300	6x	x	x	x	x	x	x
9104	300	6x	x	x	x	x	x	x
8950	300	6x	x	x	x	x	x	x
4056	300	6x	x	x	x	x	x	x
7878	300	6x	x	x	x	x	x	x
6542	300	6x	x	x	x	x	x	x
9298	300	6x	x	x	x	x	x	x
615	300	6x	x	x	x	x	x	x
1416	300	6x	x	x	x	x	x	x
1844	29	6x	x	x	x	x	x	x
635	300	6x	x	x	x	x	x	x
5944	300	6x	x	x	x	x	x	x
7180	29	6x	x	x	x	x	x	x
6420	300	6x	x	x	x	x	x	x
6428	30	6x	x	x	x	x	x	x

Coverage:

Number of Targets vs Number of Exposures

Number of Exposures	Number of Targets
1	0
2	0
3	22
4	0
5	0
6	35
7	0
8	0

Bottom Status Bar:

RAFEL_2015_HUDF_SMALL_ALLREF_RANDOM (9969 sources) Name Astrometric Accuracy (mas) Reference Position
RAFEL_2015_RANDOM (6069 sources) RAFEL_2015_RANDOM 1.0 02 22 28.0622 27 47 26.95
Show: RAFEL_2015_HUDF_SMALL_ALLREF_RANDOM (9969 sources)

22 errors & warnings (Click for Details)

The background of the image is a deep, dark space filled with numerous small, white stars of varying sizes. In the center, there is a prominent, large nebula. This nebula is composed of wispy, translucent clouds of gas and dust that are illuminated from within by young, hot stars. The colors within the nebula range from deep blues and purples to bright oranges and reds, with some greenish hues. The overall effect is one of vastness and the beauty of stellar formation.

EXPANDING THE FRONTIERS OF SPACE ASTRONOMY