ALMA Observing Tool [OT]:

How to turn your great idea into an ALMA proposal

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Atacama Large Millimeter/submillimeter Array
Karl G. Jansky Very Large Array
Very Long Baseline Array

NRAO

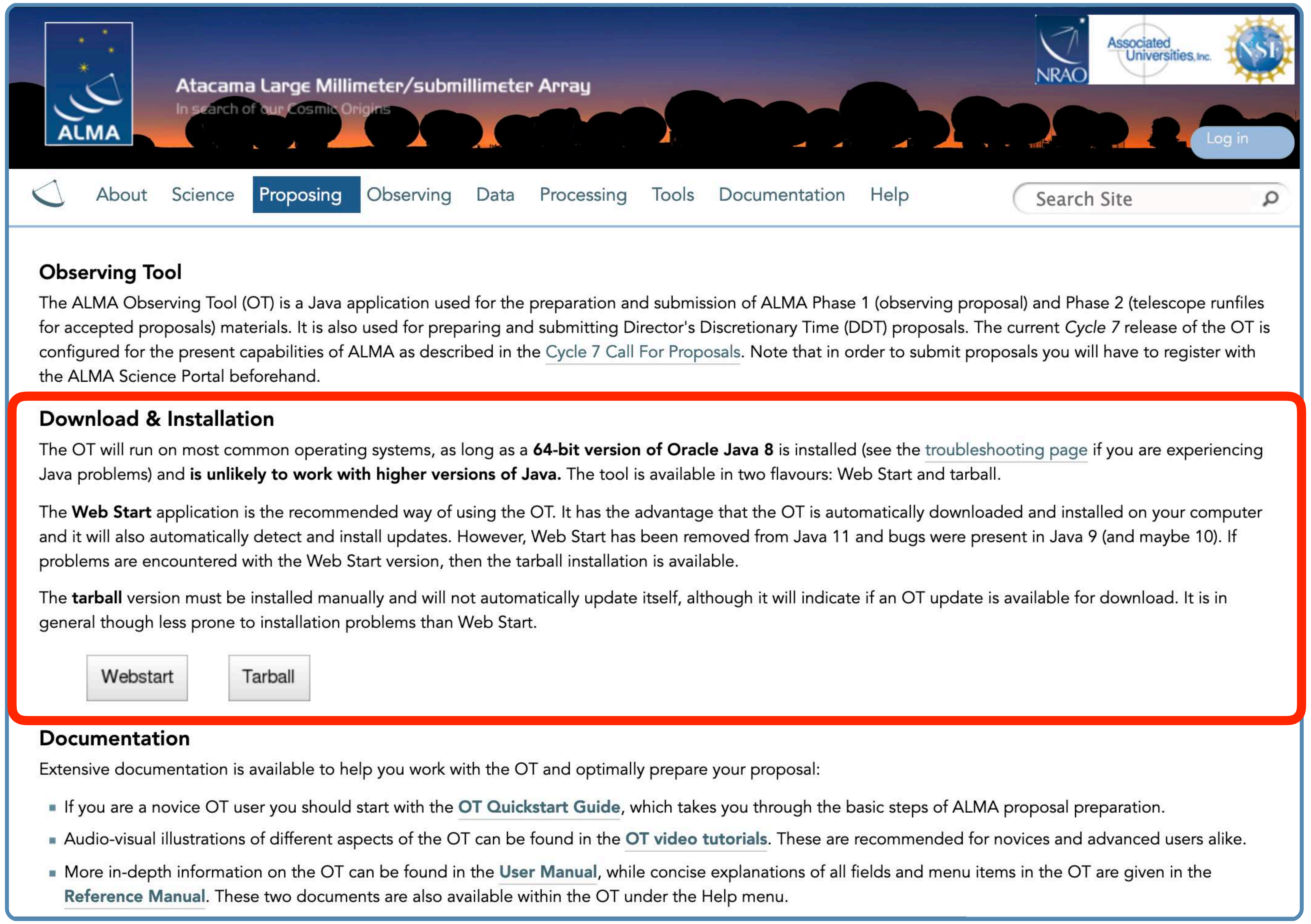
NSF

Associated Universities, Inc.

Thank you to Arielle Moullet & Harvey Liszt & Ian Czekala

Downloading the ALMA OT

Use the Web Start version [will update automatically]



Atacama Large Millimeter/submillimeter Array

In search of our Cosmic Origins

ALMA

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Observing Tool

The ALMA Observing Tool (OT) is a Java application used for the preparation and submission of ALMA Phase 1 (observing proposal) and Phase 2 (telescope runfiles for accepted proposals) materials. It is also used for preparing and submitting Director's Discretionary Time (DDT) proposals. The current *Cycle 7* release of the OT is configured for the present capabilities of ALMA as described in the Cycle 7 Call For Proposals. Note that in order to submit proposals you will have to register with the ALMA Science Portal beforehand.

Download & Installation

The OT will run on most common operating systems, as long as a **64-bit version of Oracle Java 8** is installed (see the troubleshooting page if you are experiencing Java problems) and **is unlikely to work with higher versions of Java.** The tool is available in two flavours: Web Start and tarball.

The **Web Start** application is the recommended way of using the OT. It has the advantage that the OT is automatically downloaded and installed on your computer and it will also automatically detect and install updates. However, Web Start has been removed from Java 11 and bugs were present in Java 9 (and maybe 10). If problems are encountered with the Web Start version, then the tarball installation is available.

The **tarball** version must be installed manually and will not automatically update itself, although it will indicate if an OT update is available for download. It is in general though less prone to installation problems than Web Start.

Webstart Tarball

Documentation

Extensive documentation is available to help you work with the OT and optimally prepare your proposal:

- If you are a novice OT user you should start with the **OT Quickstart Guide**, which takes you through the basic steps of ALMA proposal preparation.
- Audio-visual illustrations of different aspects of the OT can be found in the **OT video tutorials**. These are recommended for novices and advanced users alike.
- More in-depth information on the OT can be found in the **User Manual**, while concise explanations of all fields and menu items in the OT are given in the **Reference Manual**. These two documents are also available within the OT under the Help menu.

[https://almascience.nrao.edu/proposing/observing-tool]

Information You'll Need to Get Started

Source(s): Coordinates, RVs, PMs (for nearby sources), ephemerides (for Solar System objects)
[your responsibility to make sure these are correct]

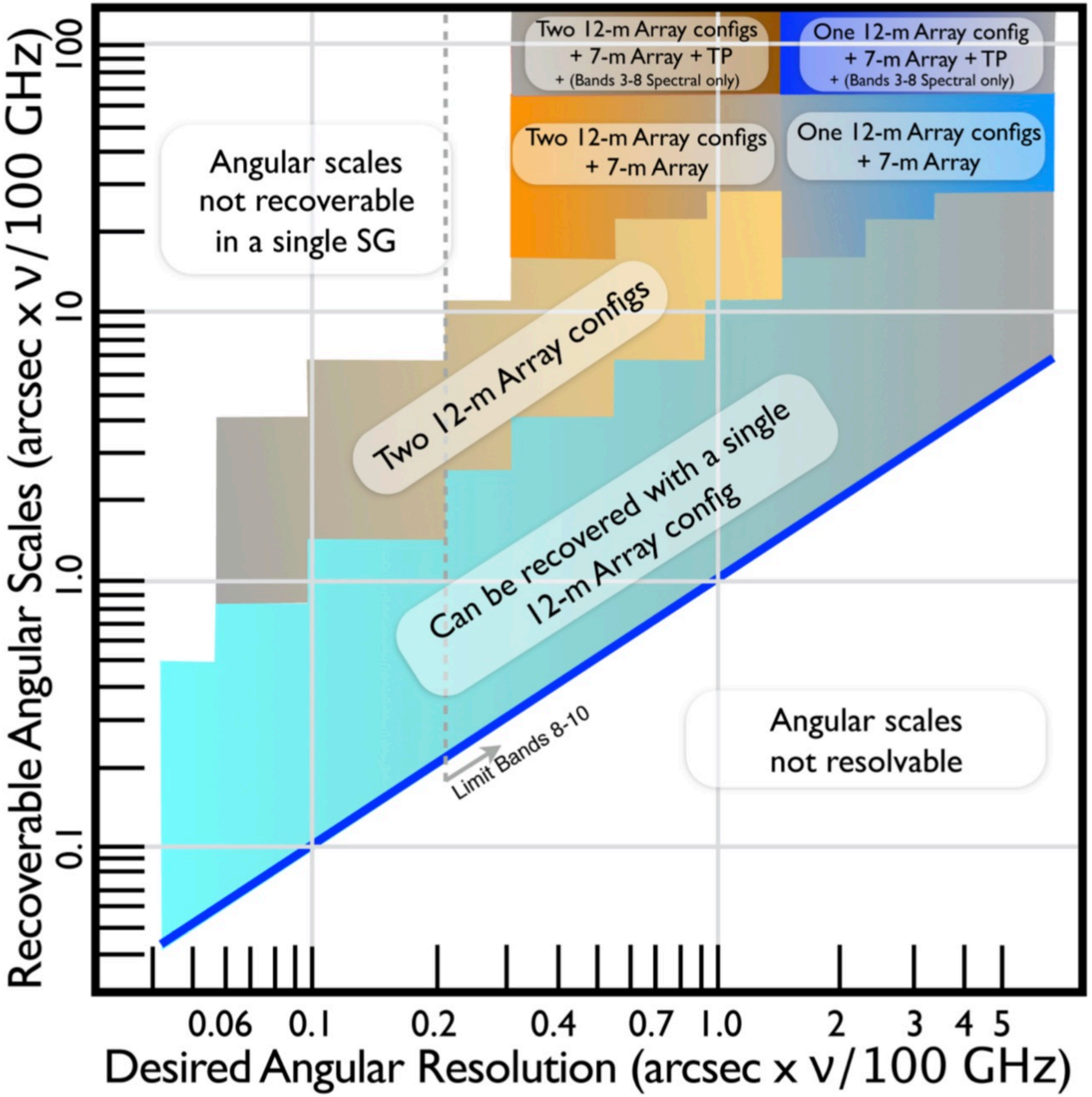
Frequency/spectral: frequency, bandwidth, spectral resolution needed to achieve science
[you must set up the correlator; templates available but spectral setups can get complicated for many lines]

Resolution/scales: angular resolution (largest baselines), largest angular scale (shortest baselines)
[OT decides required baselines automatically; can require multiple array configurations to recover all scales]

Mapping area: if desired FOV larger than primary beam, will need mosaic
[sensitivity of primary beam decreases w/distance from field center; mosaic if source > 1/3 primary beam]

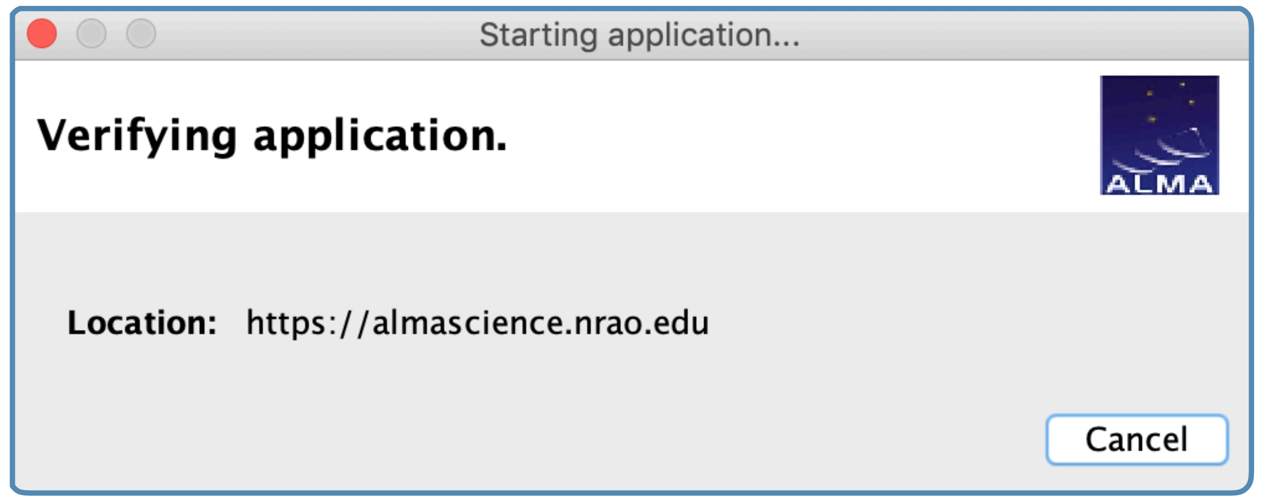
Sensitivity: required sensitivity (per synthesized beam!) to detect source
[beware: source that appears bright in large beam may be faint in smaller beam if source size unknown]

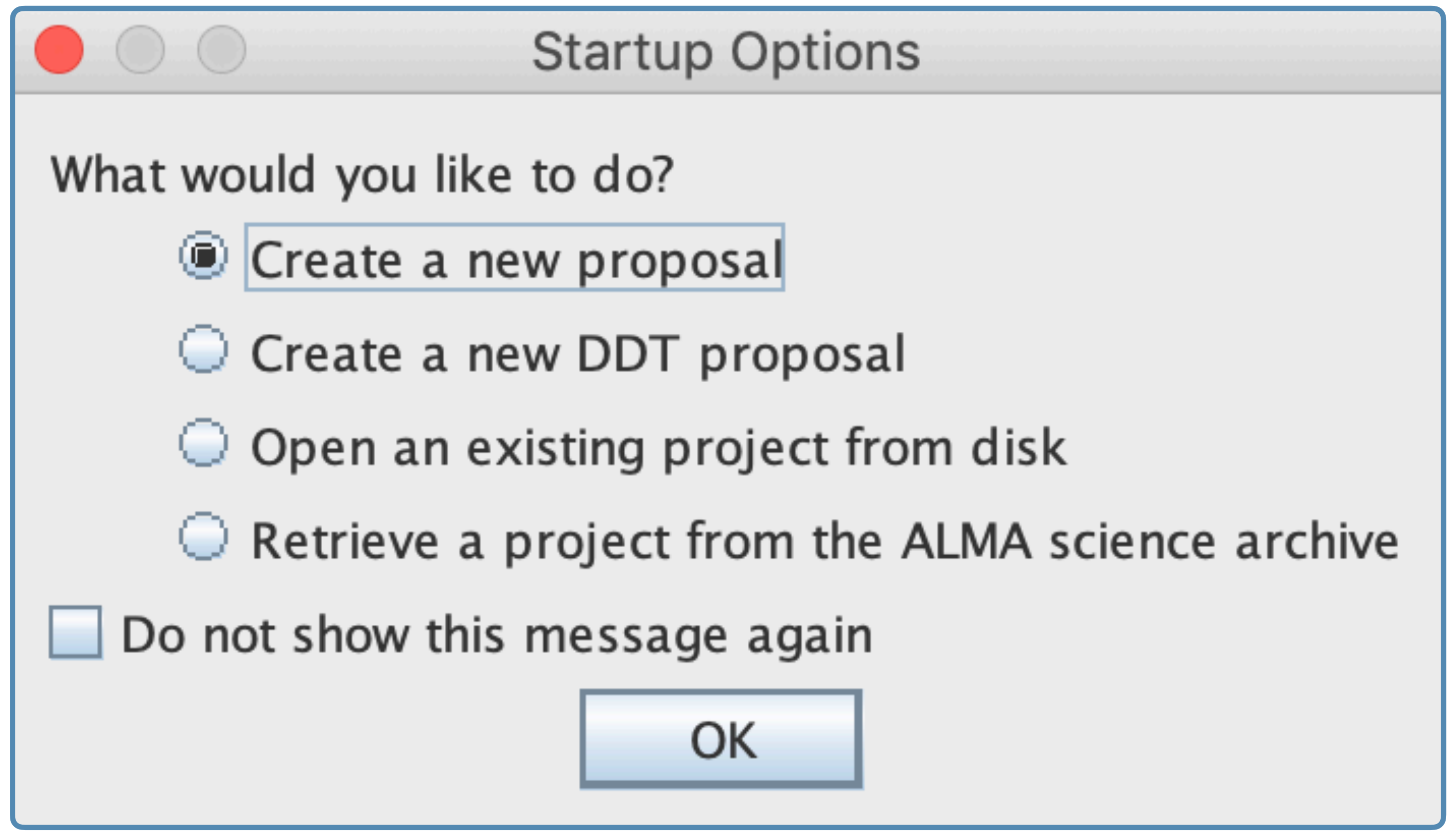
Dynamic Range: ratio of brightest to faintest emission (achievable rms suffers when > 50–100)
[becomes a problem with nearby bright sources when target is faint; use ALMA simulator + self-calibration]



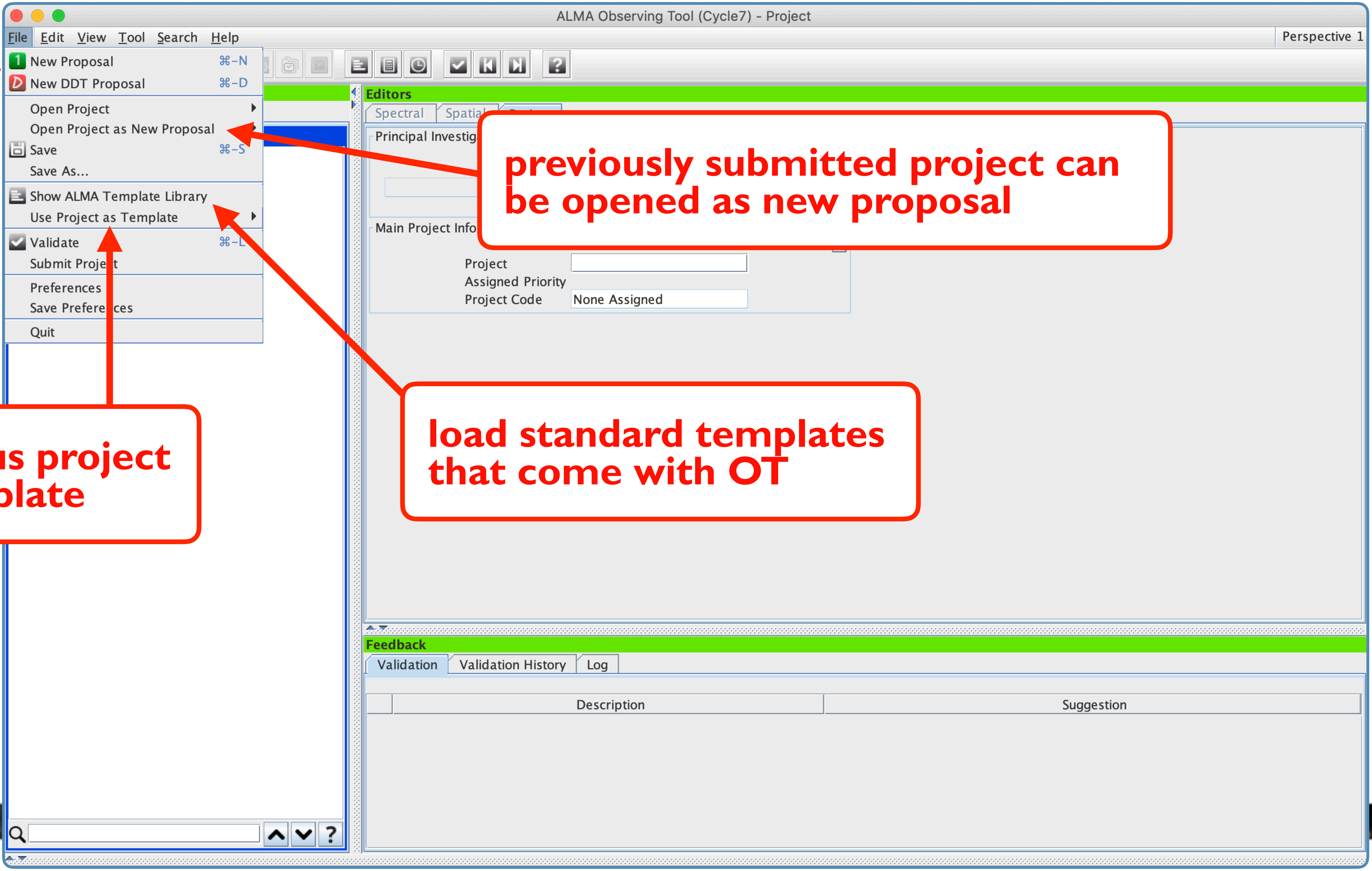
Two 12-m Array configs
+ 7-m Array + TP
+ (Bands 3-8 Spectral only)
One 12-m Array config
+ 7-m Array + TP
+ (Bands 3-8 Spectral only)
Two 12-m Array configs
+ 7-m Array
One 12-m Array configs
+ 7-m Array
Angular scales
not recoverable
in a single SG
Two 12-m Array configs
Can be recovered with a single
12-m Array config
Limit Bands 8-10
Angular scales
not resolvable
Recoverable Angular Scales (arcsec x ν / 100 GHz)
100
10
1.0
0.1
0.06
0.1
0.2
0.4
0.7
1.0
2
3
4
5
Desired Angular Resolution (arcsec x ν / 100 GHz)

Starting up the OT





Setting up a New Project



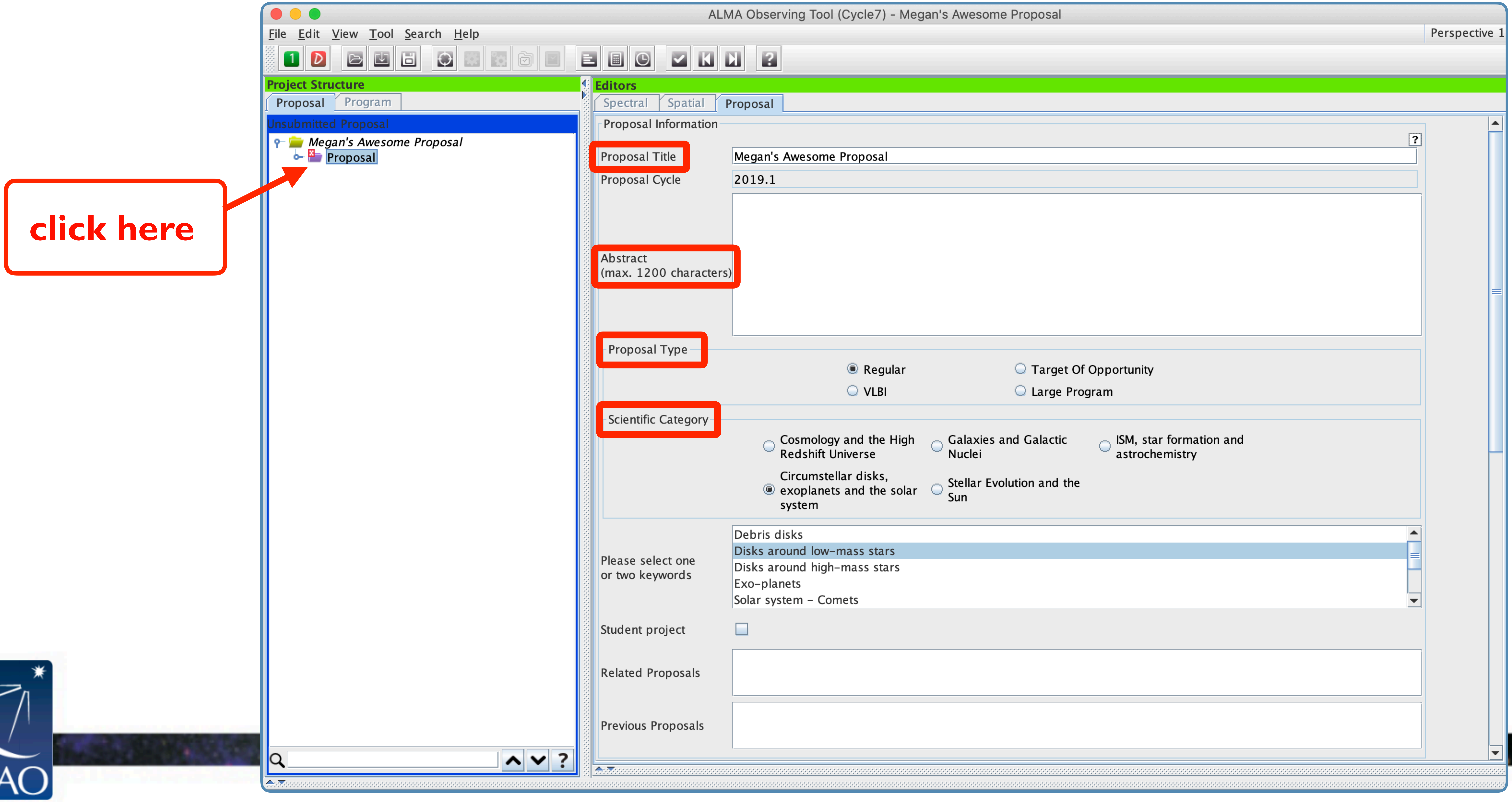
Start fresh with empty proposal

previously submitted project can be opened as new proposal

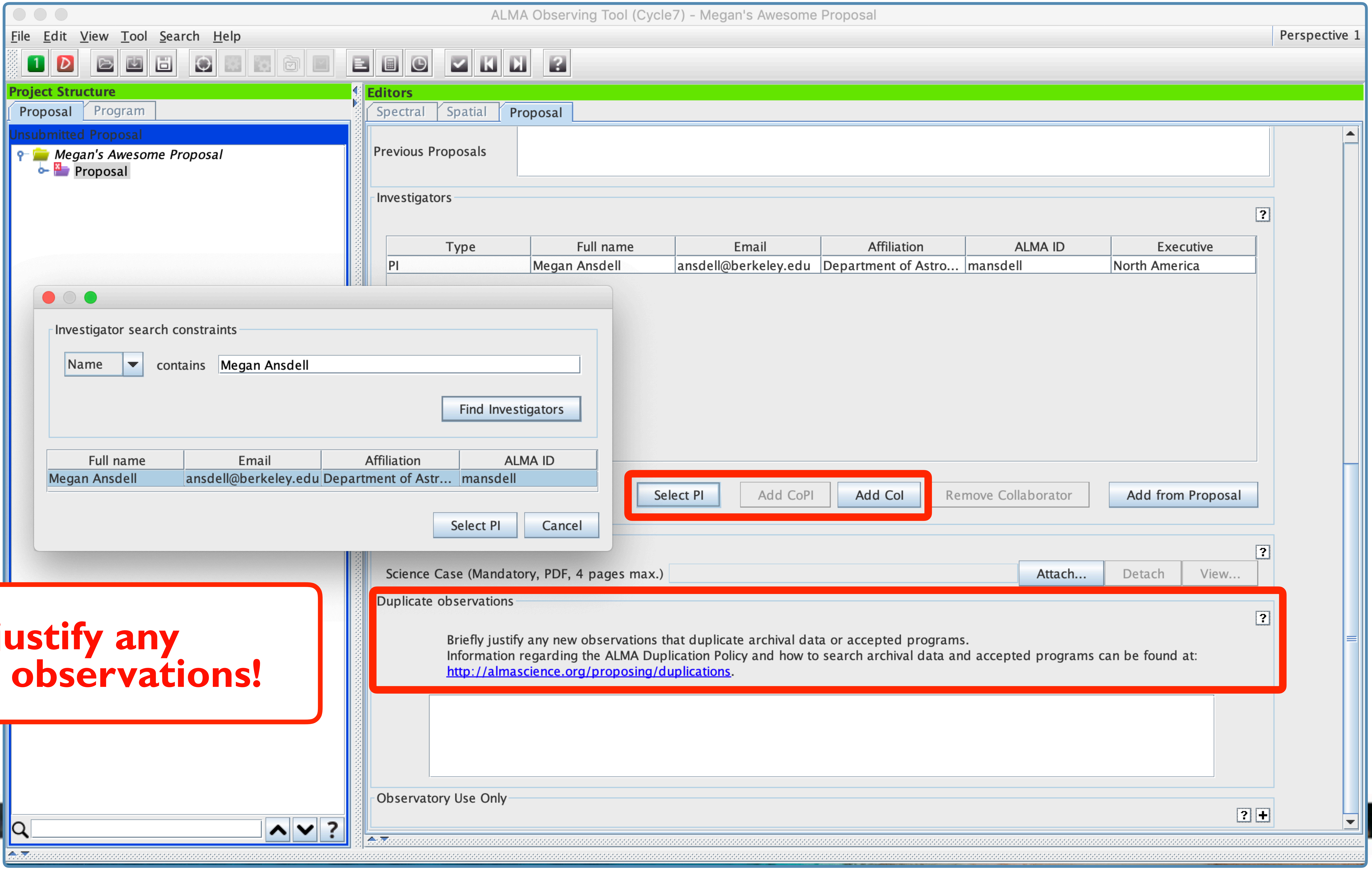
load previous project as new template

load standard templates that come with OT

Setting up a New Project



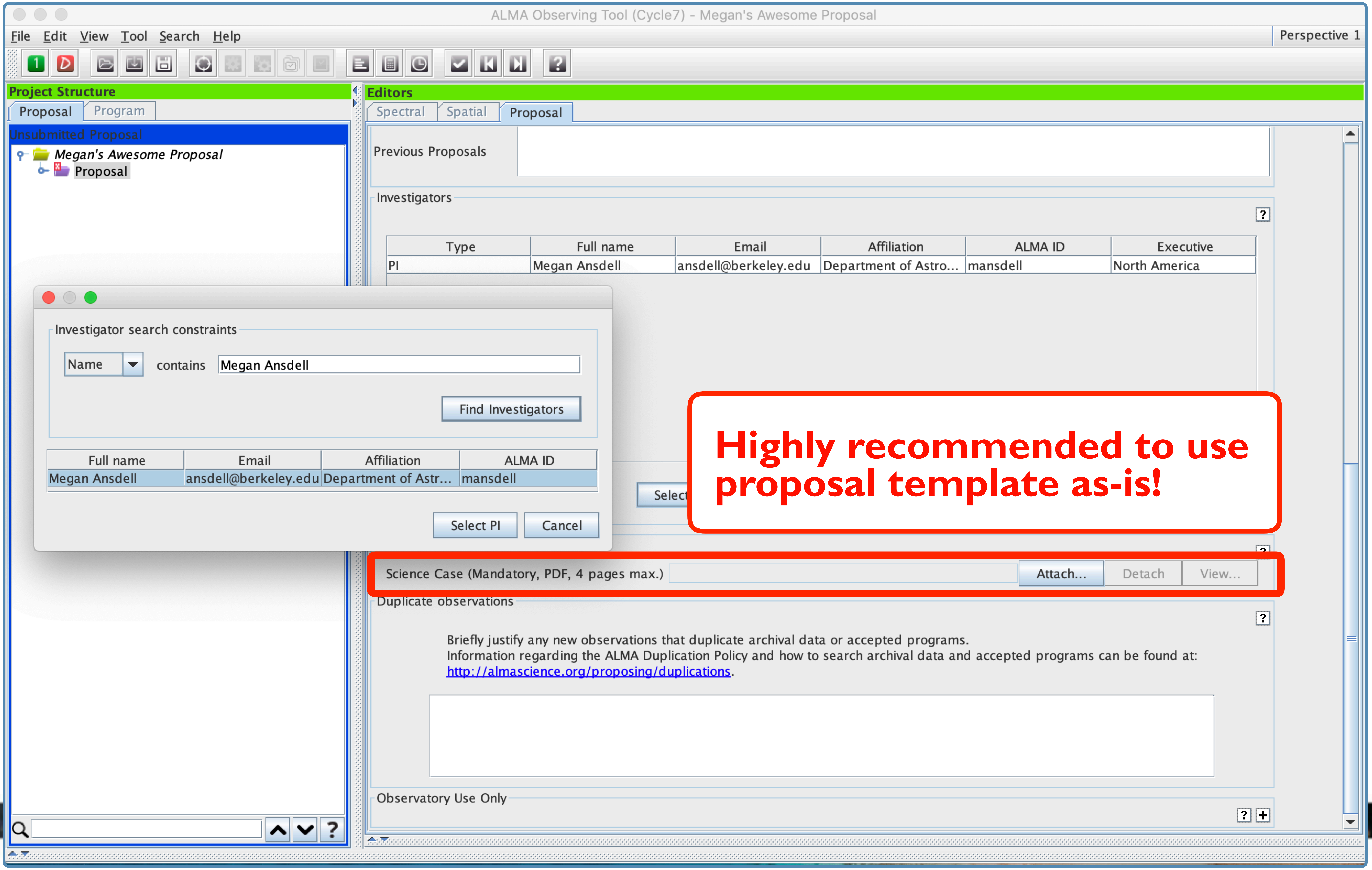
Setting up a New Project



Scroll down to select PI / CoIs from registered ALMA users

Need to justify any duplicate observations!

Uploading Your Science Case



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Uploading Your Science Case

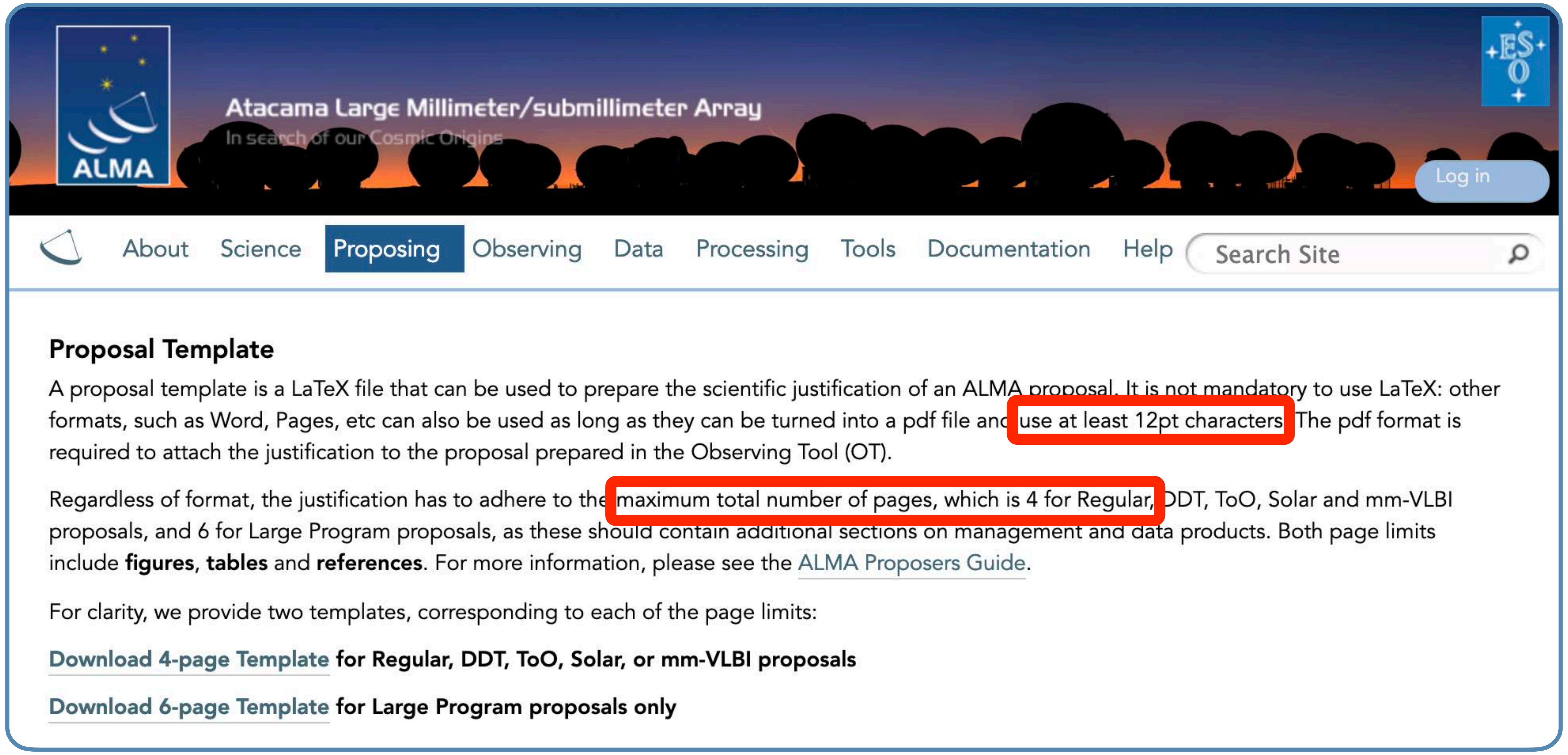
You **MUST** include:

- *Astronomical importance*
- *Estimate of intensity of targets*
- *Justification of requested SNR*
- *Size of target sample*

You may include:

- *Figures & tables*
- *References (must be self-contained)*
- *Simulations (see afternoon tutorial)*

Using proposal template (as-is!) is strongly encouraged



Proposal Template

A proposal template is a LaTeX file that can be used to prepare the scientific justification of an ALMA proposal. It is not mandatory to use LaTeX: other formats, such as Word, Pages, etc can also be used as long as they can be turned into a pdf file and use at least 12pt characters. The pdf format is required to attach the justification to the proposal prepared in the Observing Tool (OT).

Regardless of format, the justification has to adhere to the maximum total number of pages, which is 4 for Regular, DDT, ToO, Solar and mm-VLBI proposals, and 6 for Large Program proposals, as these should contain additional sections on management and data products. Both page limits include **figures**, **tables** and **references**. For more information, please see the ALMA Proposers Guide.

For clarity, we provide two templates, corresponding to each of the page limits:

Download 4-page Template **for Regular, DDT, ToO, Solar, or mm-VLBI proposals**

Download 6-page Template **for Large Program proposals only**

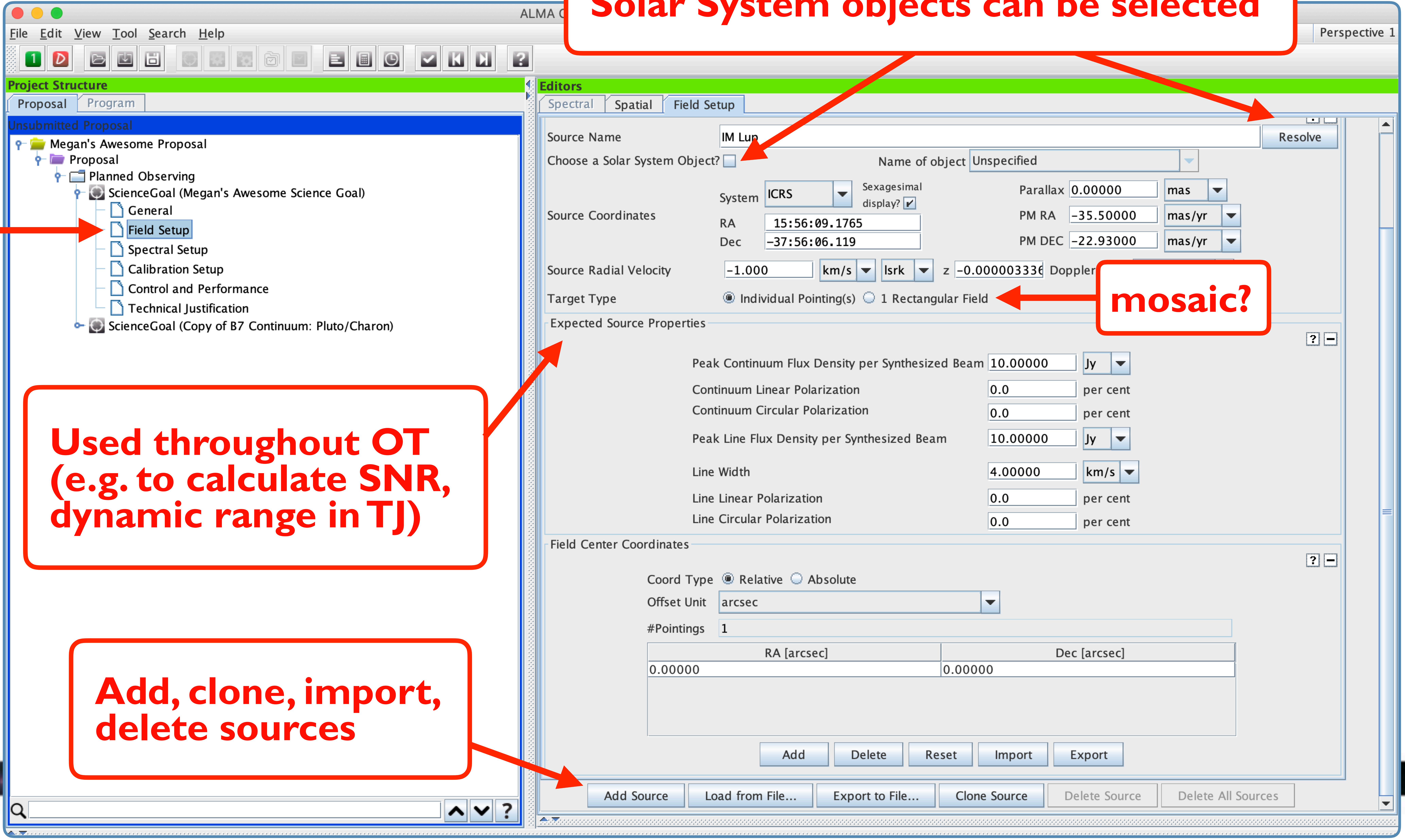
[https://almascience.eso.org/documents-and-tools/proposing/proposal-template]

Setting up a Science Goal

Inputting Your Targets

General target info can be resolved; Solar System objects can be selected

click to add/ edit targets



mosaic?

Used throughout OT (e.g. to calculate SNR, dynamic range in TJ)

Add, clone, import, delete sources

Correlator / Spectral Window Setup

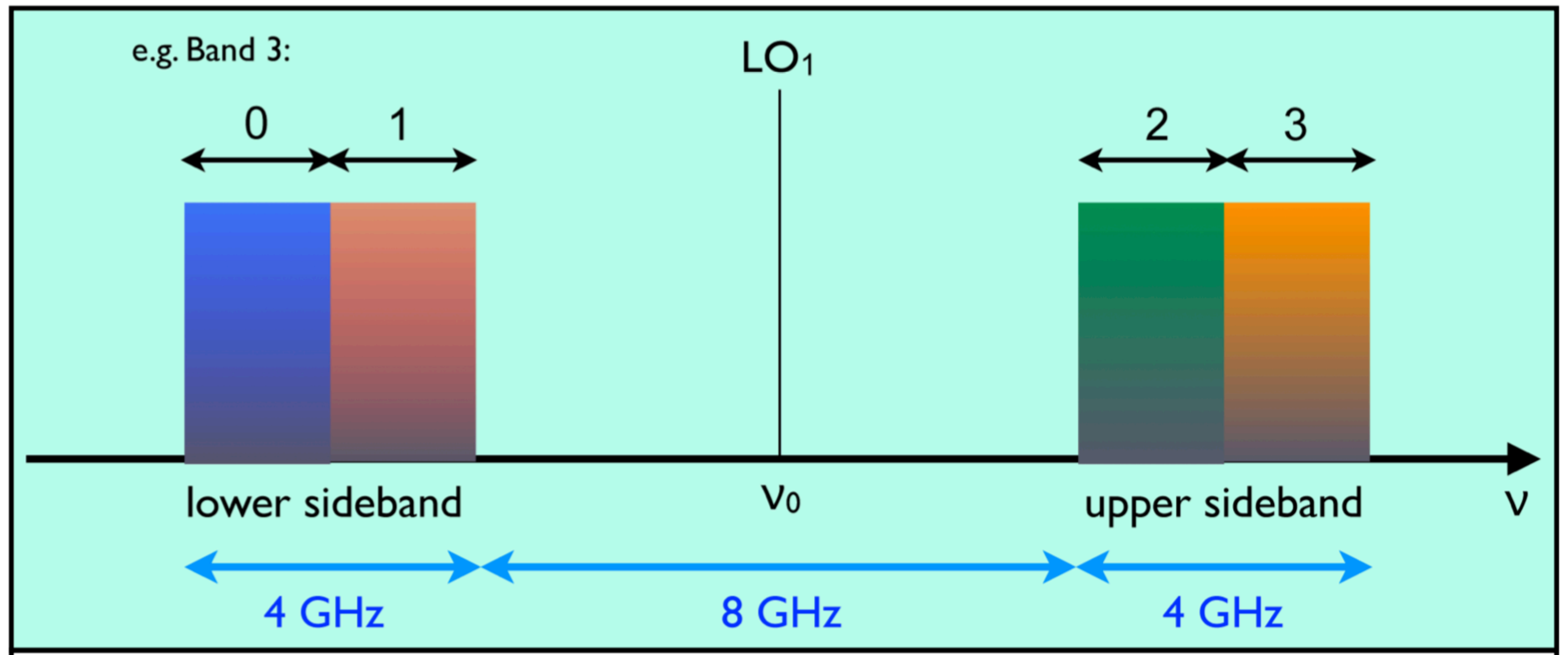


Figure 31: *A graphical view of basebands and sidebands. Basebands may be tuned to overlap if the user wishes, or may be located so as to maximize the total bandwidth (as shown). Each baseband may be further subdivided into as many as 8 spectral windows. Up to four spectral windows per baseband will be available during Cycle 7.*

*Each antenna's **receiver** outputs 4x2GHz **basebands** in each polarization, which are fed into the **correlators** that combine the signals from individual antennas*

Table 2: *Spectral Capabilities per baseband for observations in dual polarization*

Mode	Polar-ization*	Band width (MHz)	Nchan	Chan. Spacing (MHz)	Spectral Resolution† 300 GHz (km/s)
FDM	*Dual*	*1875*	*3840*	*0.488*	*0.98*
FDM	*Dual*	*938*	*3840*	*0.244*	*0.49*
FDM	*Dual*	*469*	*3840*	*0.122*	*0.24*
FDM	*Dual*	*234*	*3840*	*0.061*	*0.12*
FDM	*Dual*	*117*	*3840*	*0.0305*	*0.061*
FDM	*Dual*	*58.6*	*3840*	*0.0153*	*0.031*
TDM	*Dual*	*2000‡*	*128*	*15.625*	*31.2*

*The correlators sample each baseband according to a **correlator mode** that determines the total **bandwidth**, number of channels, and **spectral resolution***

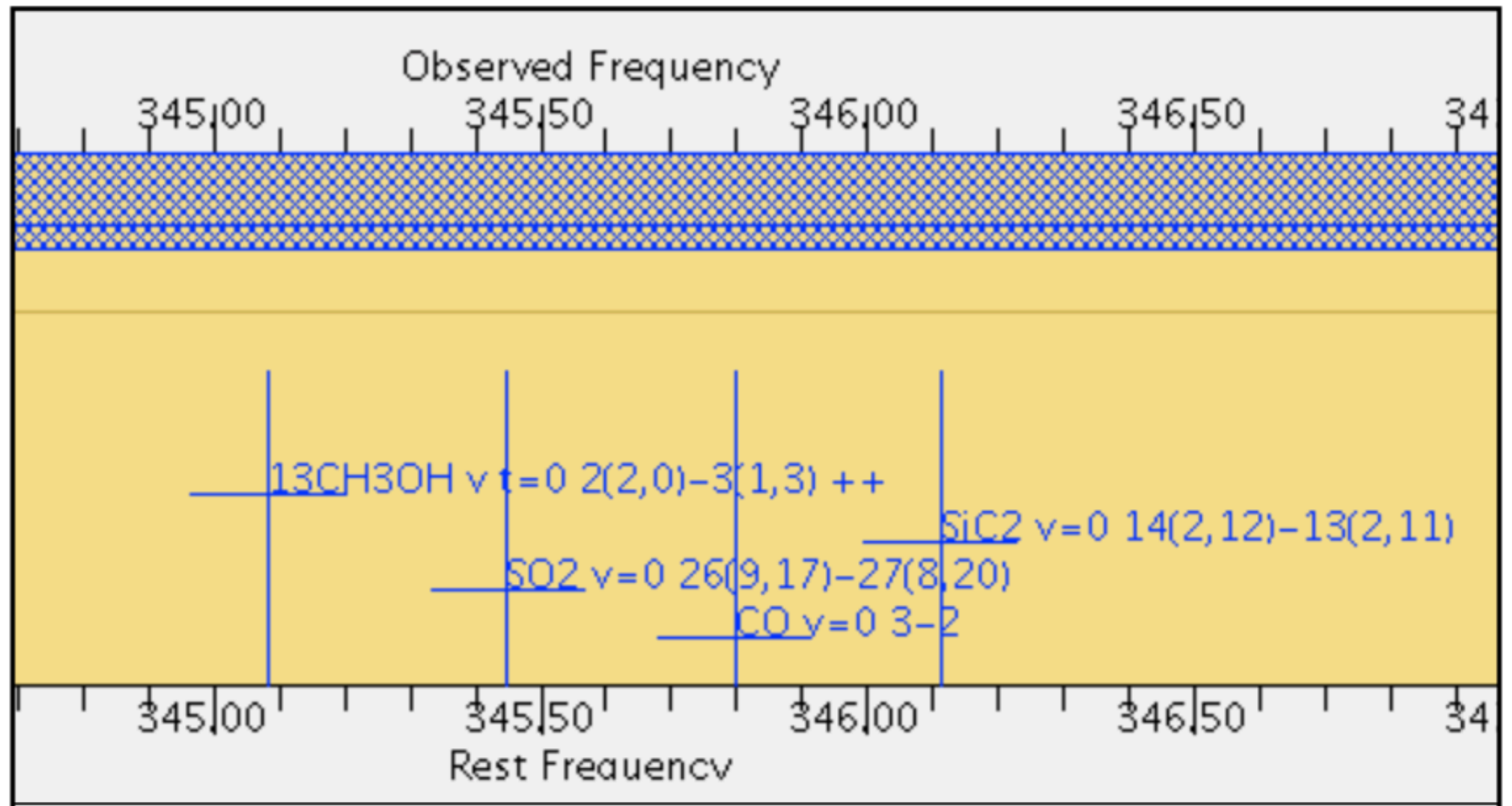


Figure 36: *Four spectral windows were set up to observe these four lines simultaneously in one baseband using the OT. The windows are each 234 MHz wide (with 0.43 km/s channels), and are centered at 345.80, 345.45, 346.11 and 345.09 GHz. The spectral windows must fit within the 2 GHz wide baseband.*

*Basebands can be divided into up to 8 **spectral windows**; useful for observing multiple spectral lines*

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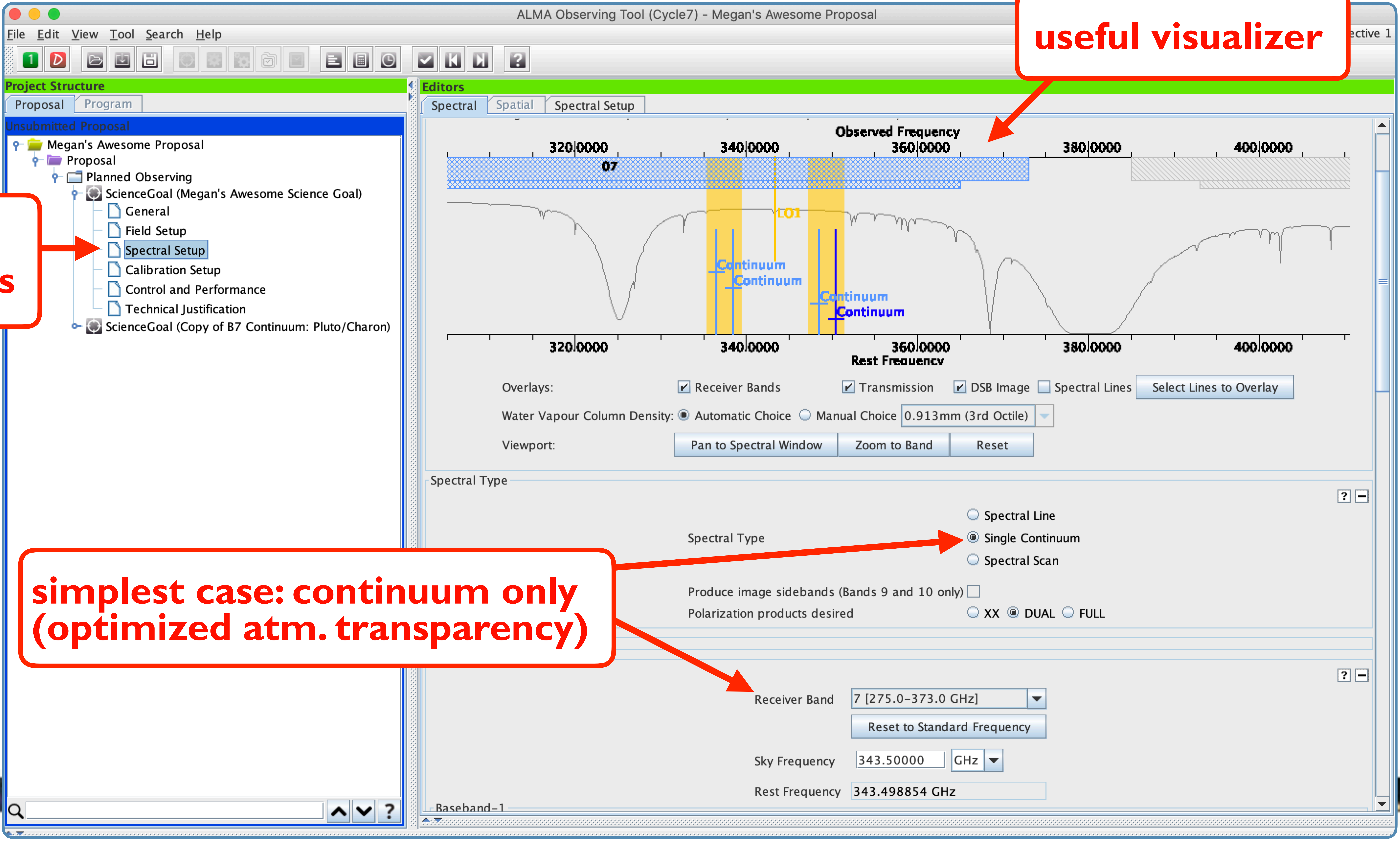
Correlator / Spectral Window Setup

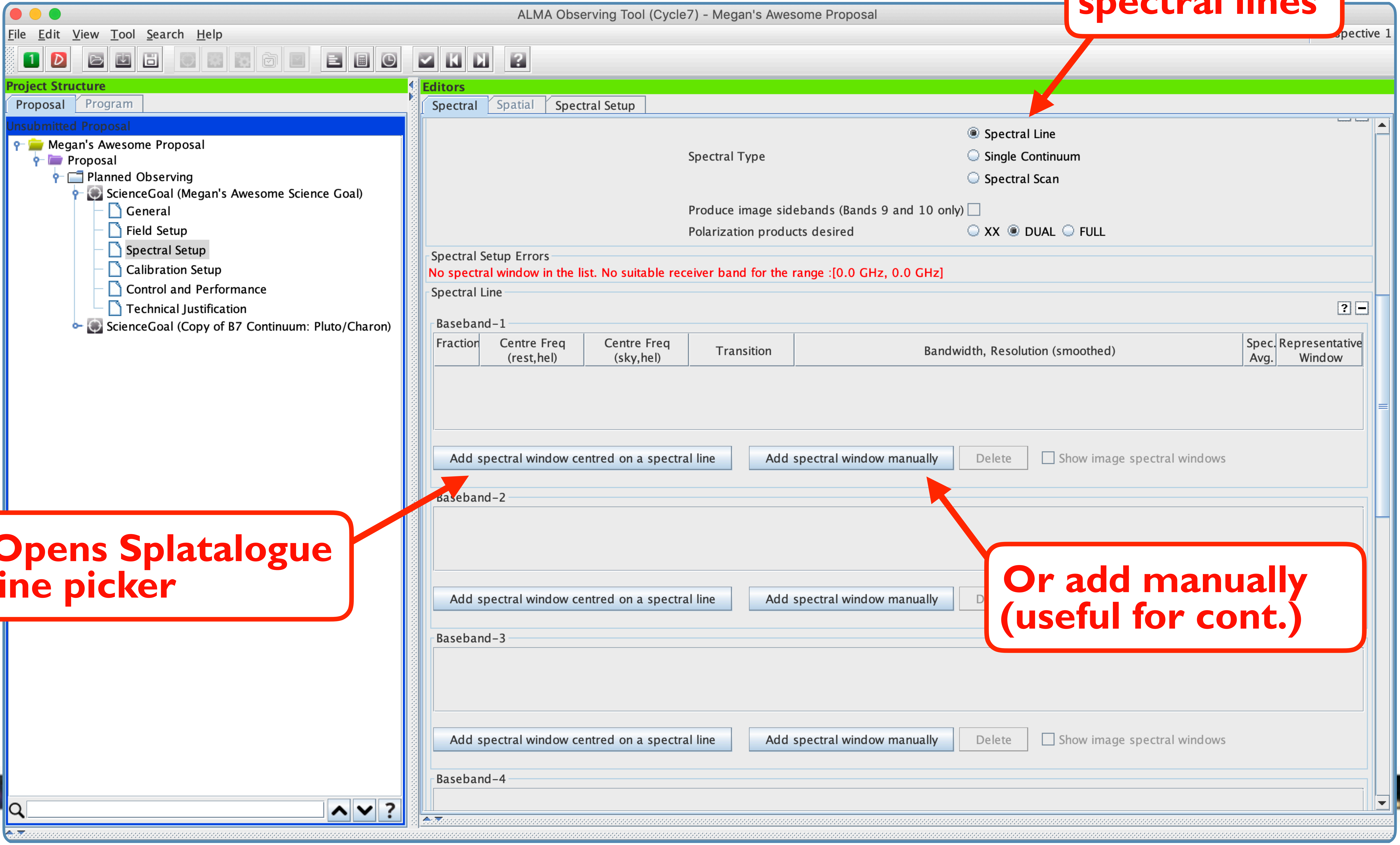


useful visualizer

click to setup spectral windows

simplest case: continuum only (optimized atm. transparency)

Correlator / Spectral Window Setup

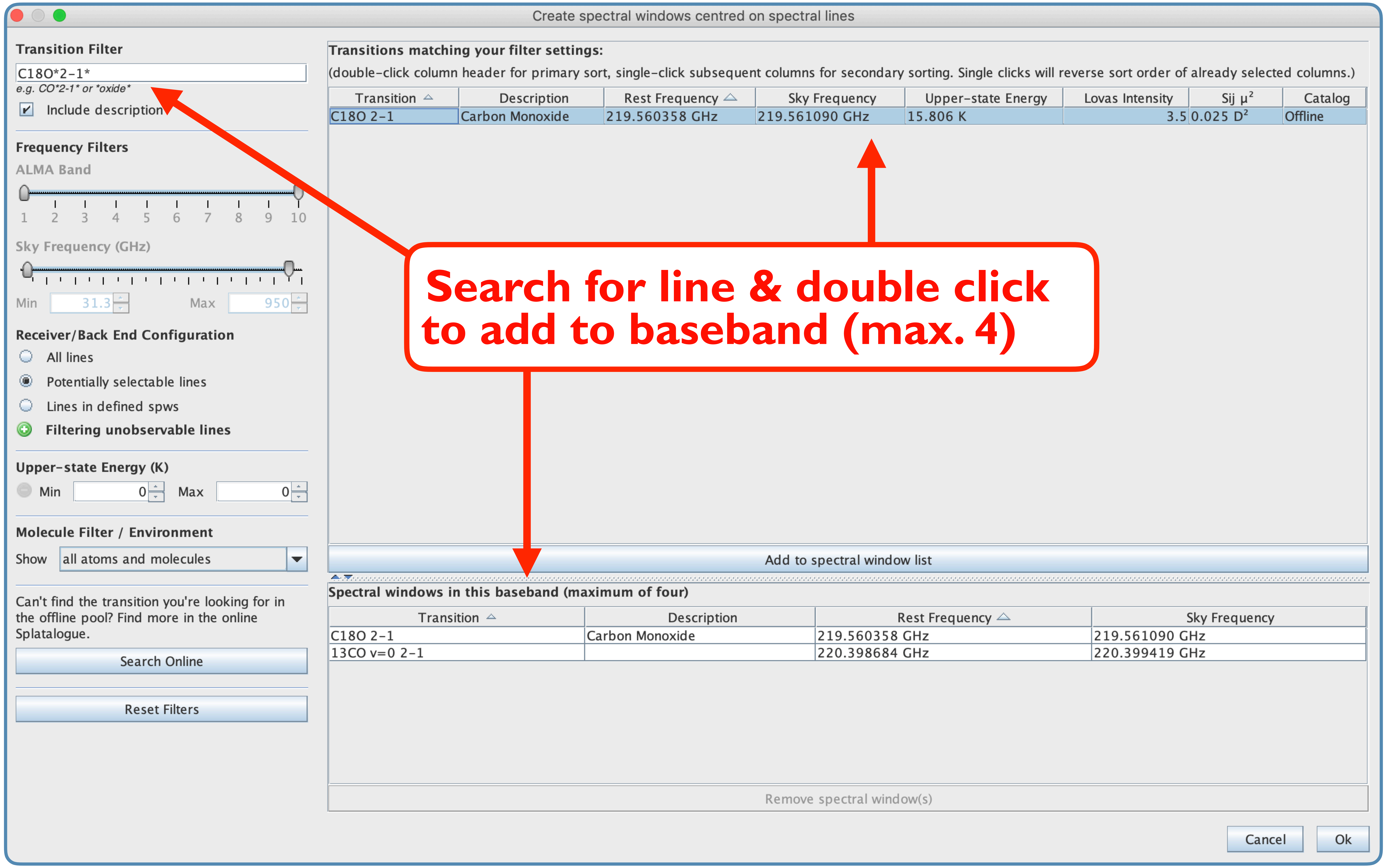


Click to add spectral lines

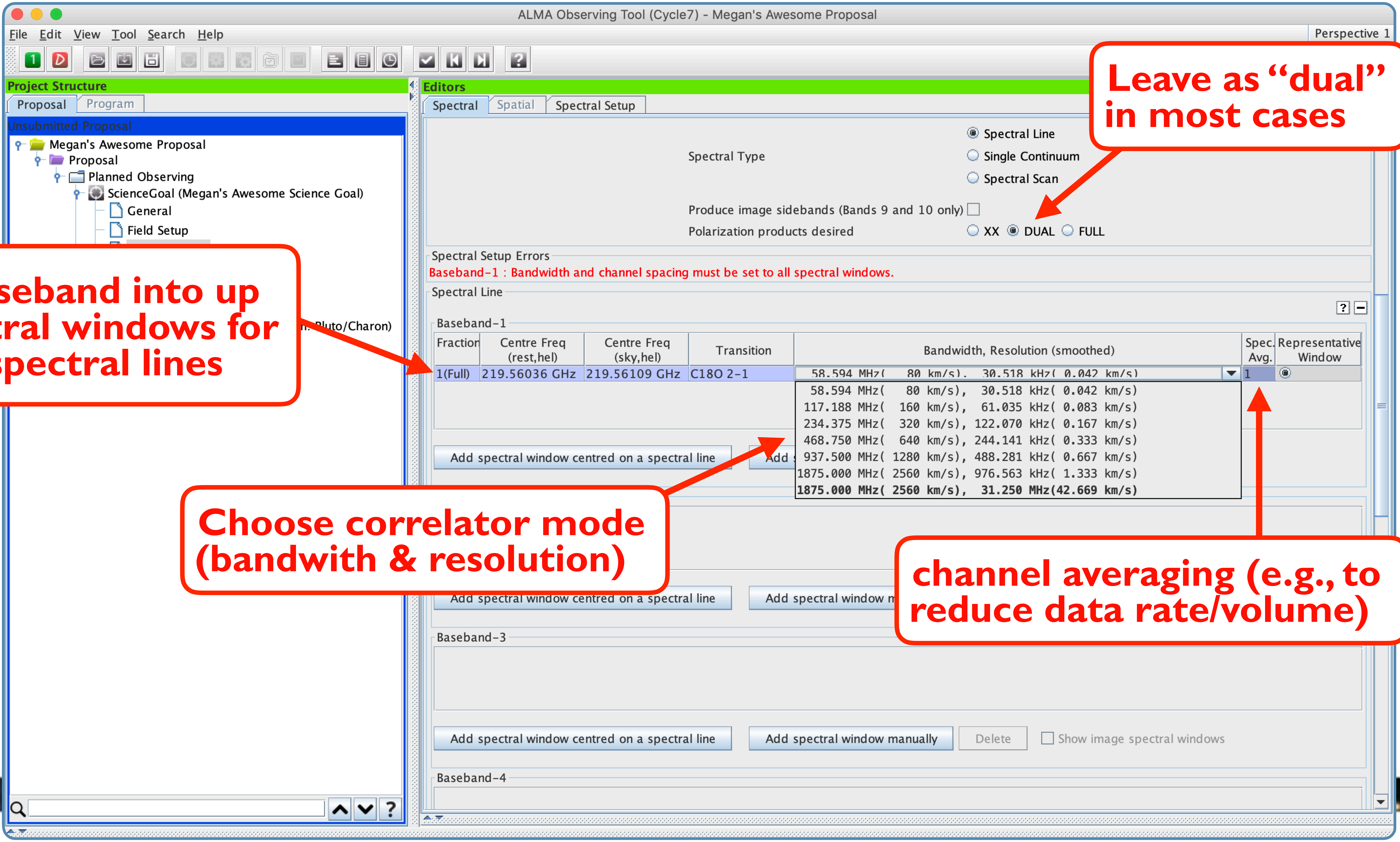
Opens Splatalogue line picker

Or add manually (useful for cont.)

Splatalogue: spectral line picker



Correlator / Spectral Window Setup



Leave as “dual” in most cases

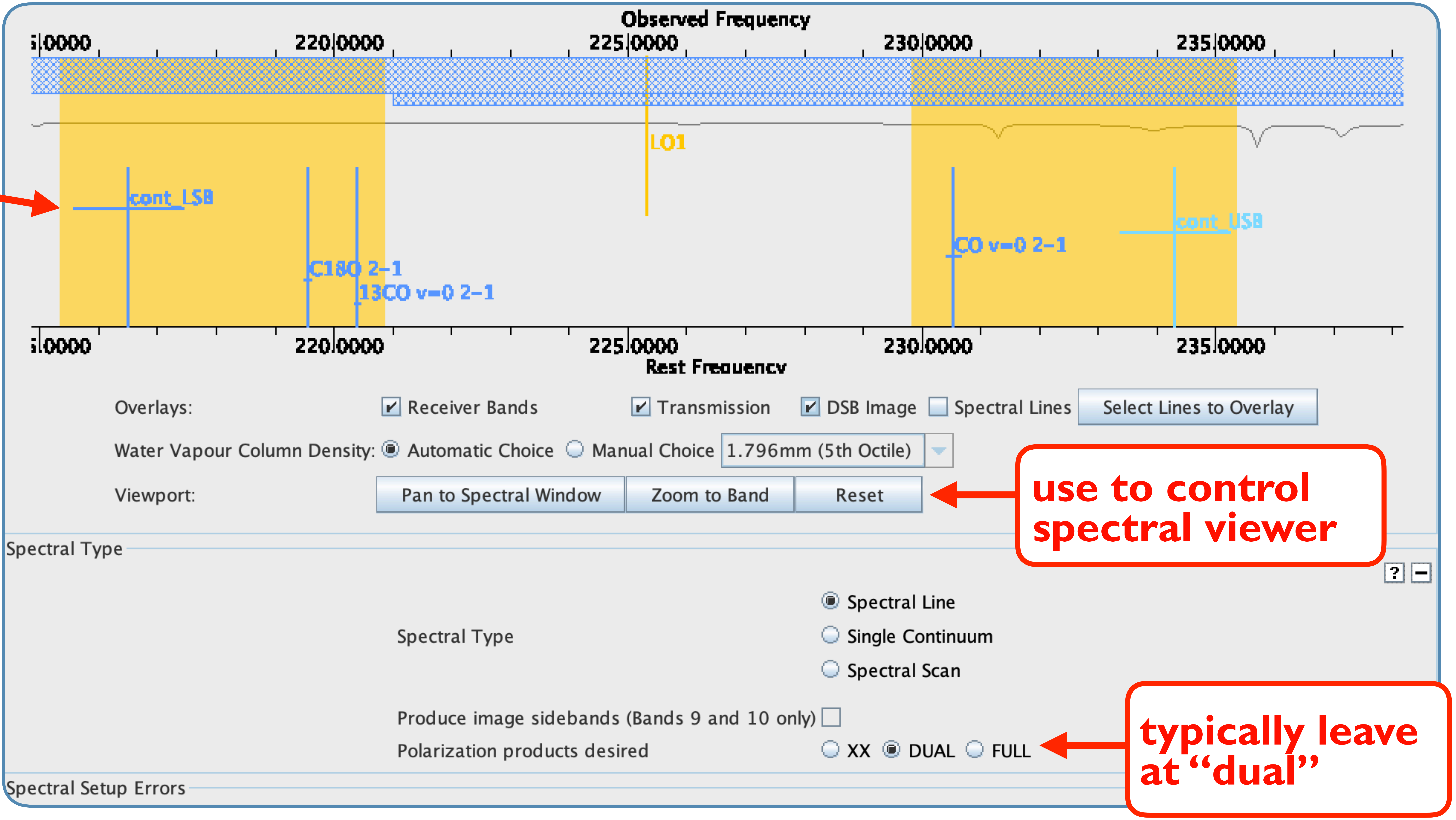
Divide baseband into up to 4 spectral windows for multiple spectral lines

Choose correlator mode (bandwith & resolution)

channel averaging (e.g., to reduce data rate/volume)

Correlator / Spectral Window Setup

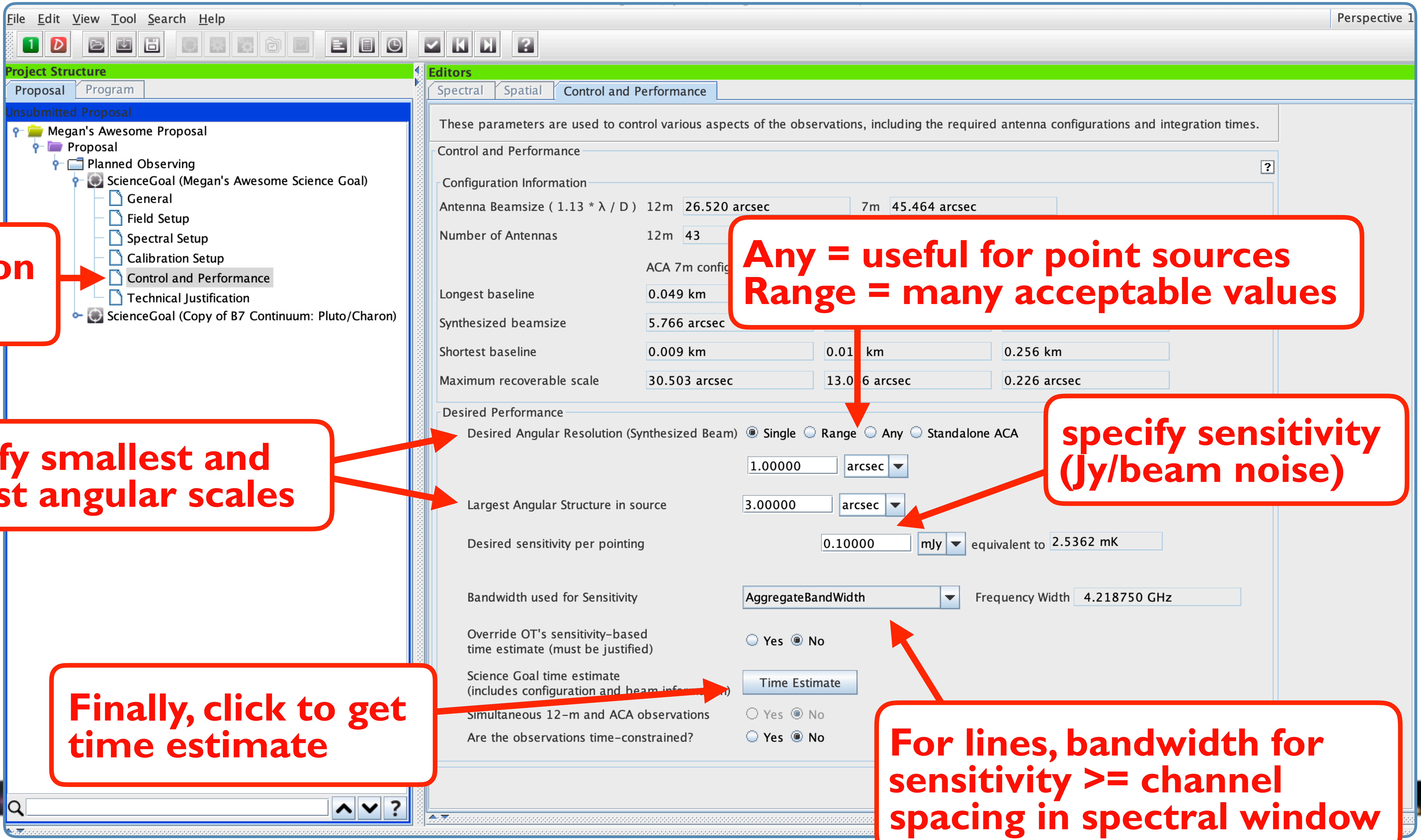
fill basebands with continuum for calibrations



use to control spectral viewer

typically leave at "dual"

Angular Resolution & Sensitivity



click for resolution & sensitivity

Any = useful for point sources
Range = many acceptable values

specify smallest and largest angular scales

specify sensitivity (Jy/beam noise)

Finally, click to get time estimate

For lines, bandwidth for sensitivity >= channel spacing in spectral window

https://science.nrao.edu/opportunities/courses/alma-instructional-videos/alma-single-dish

Observing Time Estimate

OT will group targets within 10 deg into single scheduling block

and decide needed or available configurations

Time Estimate

Note: The time in brackets is that required to reach the sensitivity. Operational requirements often mean that the actual observed time is longer, especially for mosaics. Please see the User Manual for more details.

Input Parameters

Requested sensitivity	0.1000 mJy
Bandwidth used for sensitivity	4.219 GHz
Representative frequency (sky, first source)	219.565 GHz
Estimated Total time for Science Goal	**1.14 h**

Cluster 1 | Cluster 2

Source Name	RA	Dec	Velocity
IM Lupi	15:56:09.1765	-37:56:06.119	-1.000 km/s
RU Lupi	15:56:42.3109	-37:49:15.473	-6.400 km/s

Possible Configuration Combinations

12-m (1)	12-m (2)	7-m	TP	Nominal Beam(")	Max expected axial ratio
C43-4	C43-1	No	No	0.403 x 0.448	1.5

Input Parameters

Precipitable water vapour (all sources)	1.796mm (5th Octile)

Time required for 12m (1) [C43-4]

Time on source per pointing (first source)	2.52 min [2.24 min]
Total number of pointings (all sources)	2
Number of tunings	1
Total time on source	5.04 min [4.47 min]
Total calibration time	13.17 min
Other overheads	1.92 min
Total time for 1 SB execution	20.12 min
Number of SB executions	1
Total time to complete SB	20.12 min

Calibration Breakdown per SB execution

2 x Pointing	4.00 min
1 x Amplitude/bandpass	5.00 min

Close

Time Estimate

Note: The time in brackets is that required to reach the sensitivity. Operational requirements often mean that the actual observed time is longer, especially for mosaics. Please see the User Manual for more details.

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Total time for 1 SB execution	20.12 min
Number of SB executions	1
Total time to complete SB	20.12 min

Calibration Breakdown per SB execution

2 x Pointing	4.00 min
1 x Amplitude/bandpass	5.00 min
2 x Phase	60.00 s
2 x Atmospheric	1.33 min
Calibration overheads	1.83 min

Additional Arrays

Time required for additional 12-m	14.10 min
Estimated total time for cluster 2	**34.22 min**

Close

Total SG time can change drastically with small amount of on-source time if new execution required!

OT will calculate required calibrations

and total observing time per cluster, broken down by arrays

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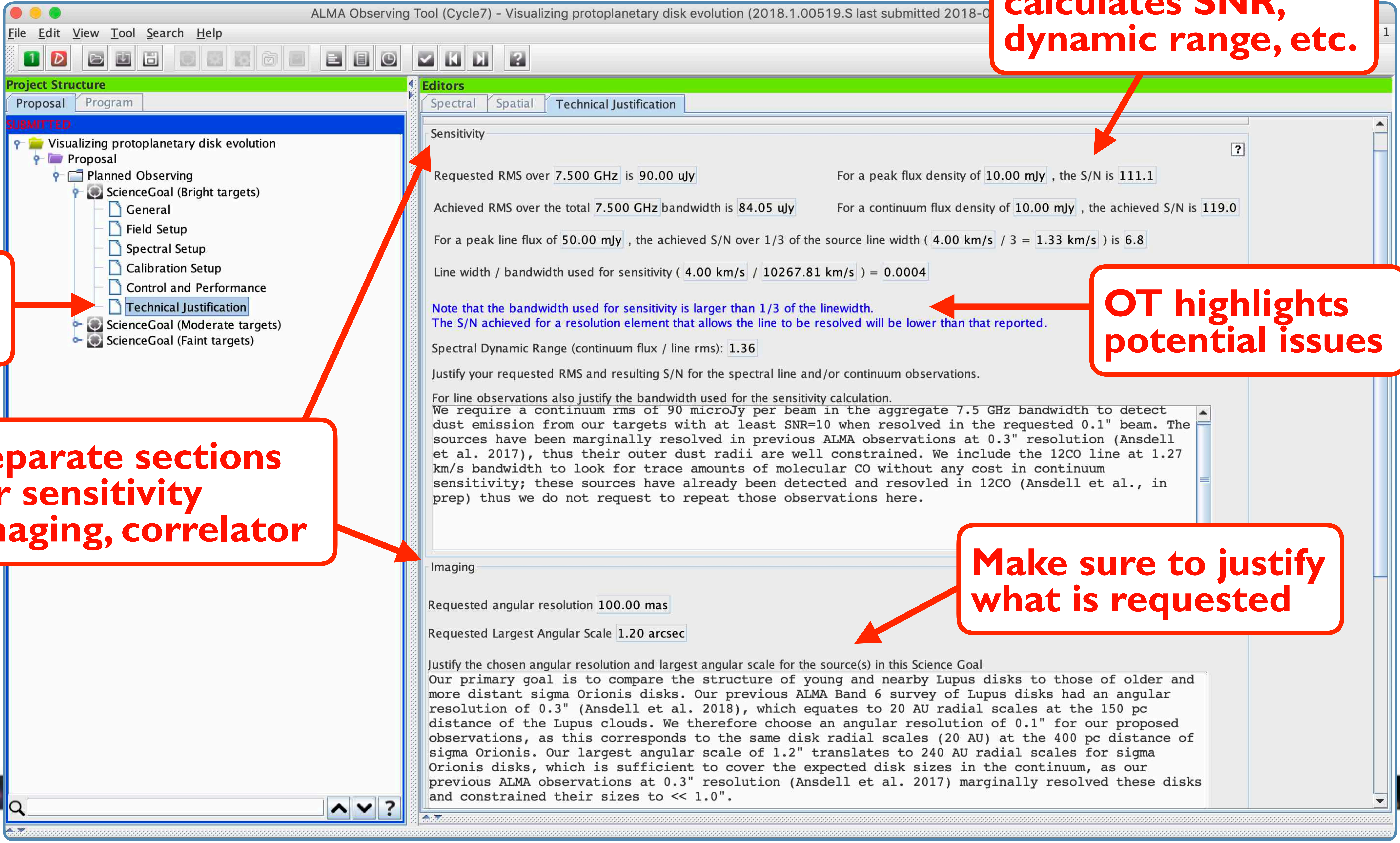
Technical Justification



OT automatically calculates SNR, dynamic range, etc.

click to add/edit tech. justification

OT highlights potential issues

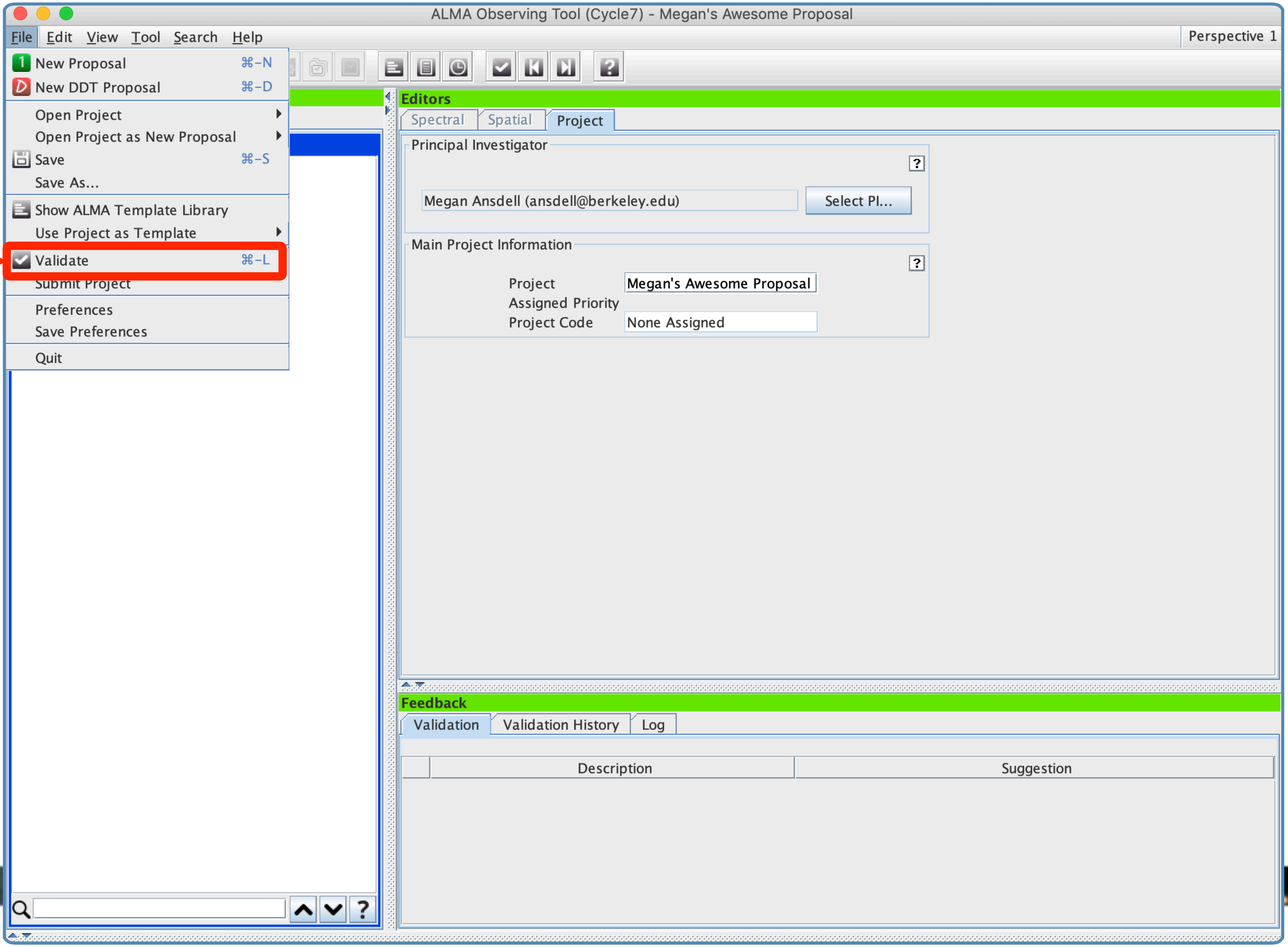
Separate sections for sensitivity imaging, correlator

Make sure to justify what is requested

Validating & Submitting Your Proposal

Projects must be validated before they are submitted

Validation can take a while for large/ complicated projects!



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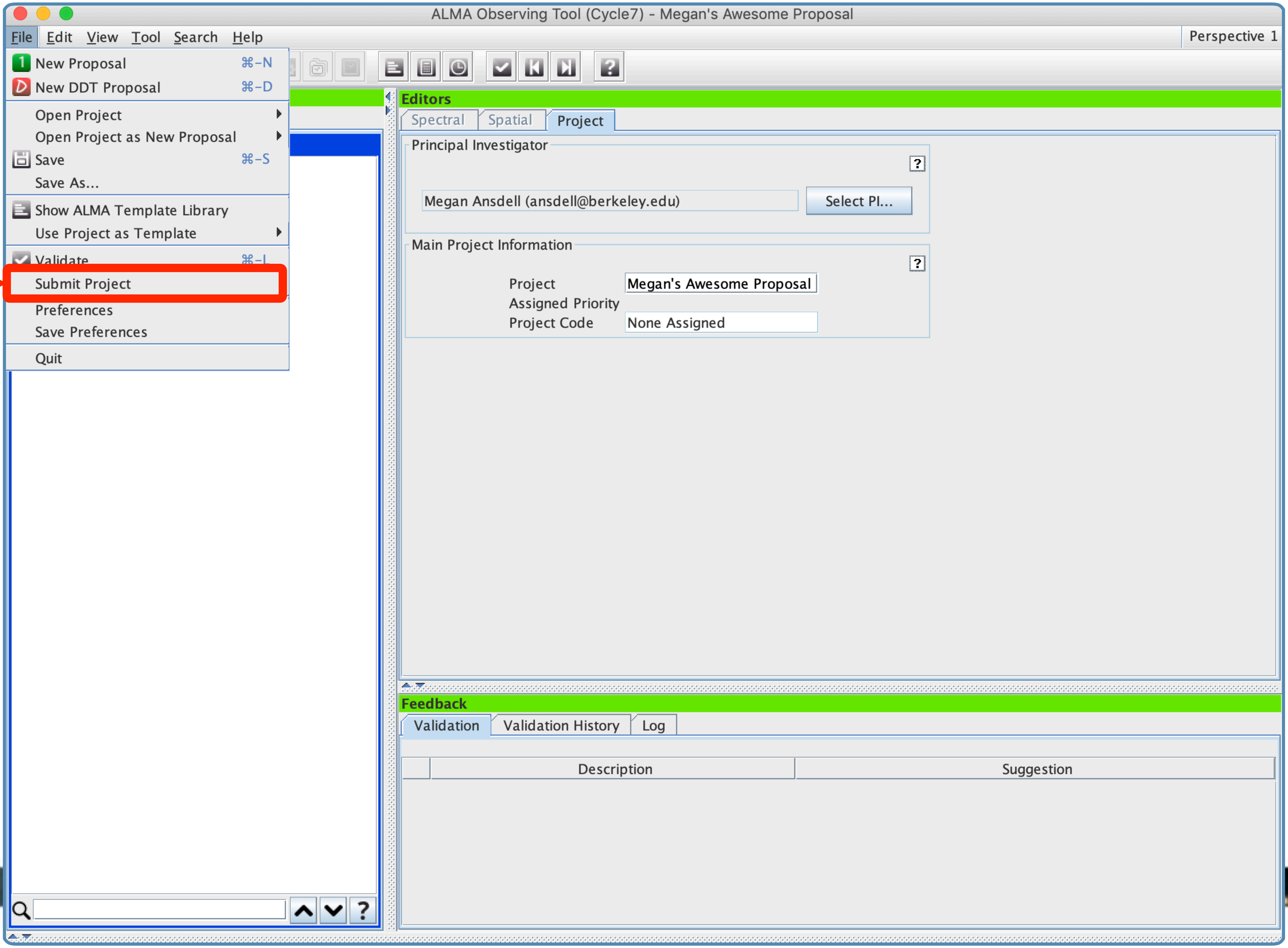
Validating & Submitting Your Proposal

Submit proposal early! Do not wait until last minute.

You can submit as often as needed [server gets busy near deadline]



OT Resources

ALMA Help Desk

Questions answered within 48 hours (faster on week of deadline)
[https://help.almascience.org/]

Documentation

OT User Manual, OT Reference Manual, OT trouble-shooting page
[https://almascience.nrao.edu/documents-and-tools]

Video Tutorials

Visual demonstrations of OT usage (produced in Cycle 6)
[https://almascience.eso.org/proposing/observing-tool/video-tutorials]

Simulation Tutorials

Check that your observations are feasible in chosen configuration
[https://casaguides.nrao.edu/index.php/ALMAguides]