An Introduction to the Cycle 6 ALMA Observing Tool

How to turn that great idea into an ALMA proposal...

Patrick Sheehan

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Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Very Long Baseline Array

Downloading the ALMA OT

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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 4* release of the OT is configured for the present capabilities of ALMA as described in the Cycle 4 Call For Proposals. Note that in order to submit proposals you will have to register with the ALMA Science Portal beforehand.

Note that preparation of Cycle 3 Phase 1 and DDT proposals needs to be done using the Cycle 3 version of the Observing Tool. This version of the OT can be found in the DDT page, or the Phase 2 menu.

Download & Installation

The OT will run on most common operating systems, as long as you have **Java 8** installed (see the troubleshooting page if you are experiencing Java problems). The ALMA OT 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. There are some issues with Web Start, particularly that it does not work with the Open JDK versions of Java such as the "Iced Tea" flavour common on many modern Linux installations. The Sun/Oracle variant of Java should therefore be installed instead. If this is not possible, then the tarball installation of the OT is available.

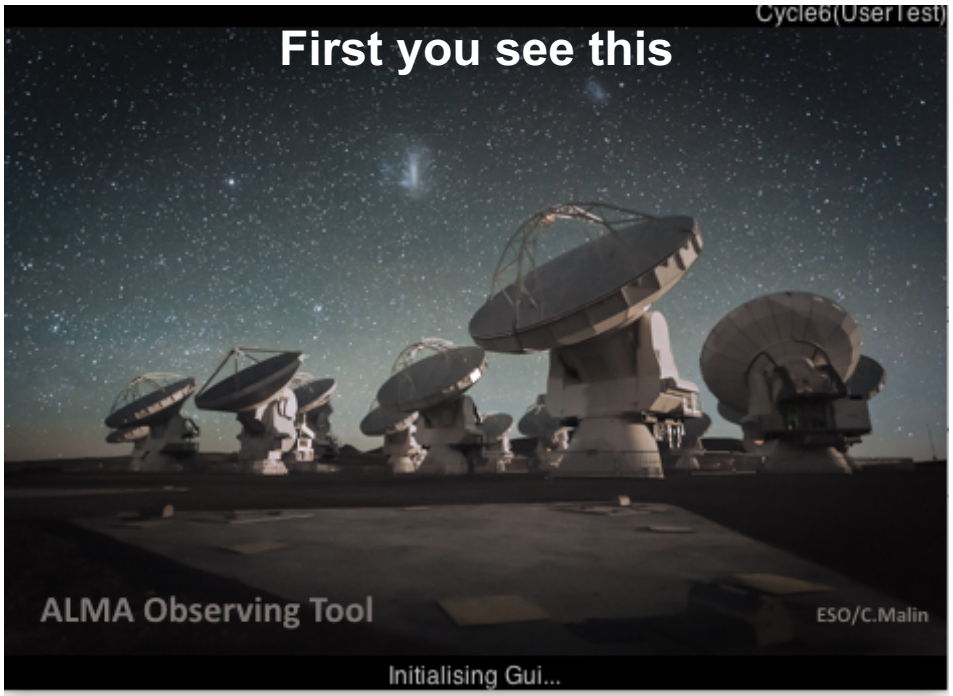
The **tarball** version must be installed manually and will [illegible]s. For Linux users, we also provide a download complete with a recommended version of the Java [illegible]rball install with your default Java.

Webstart | Tarball

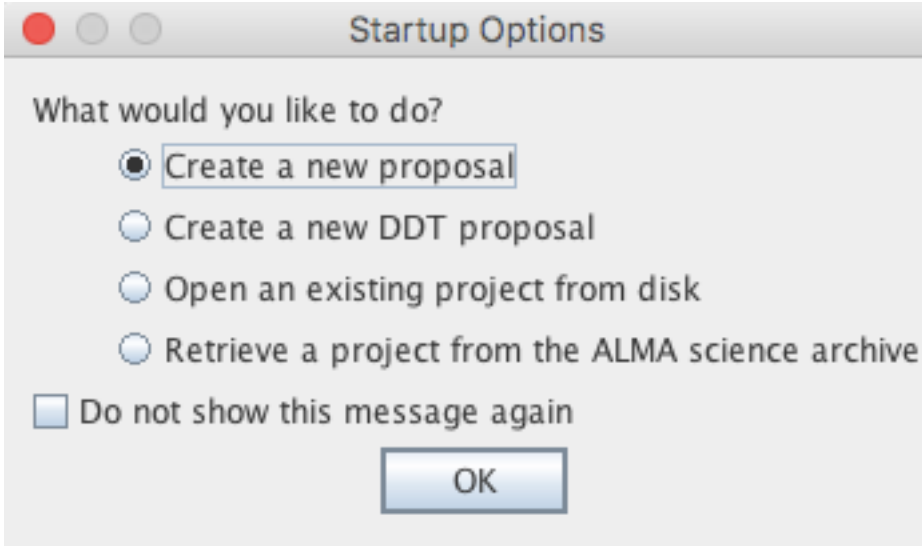
Using webstart is easier and has the advantage that it checks for and will download a newer version at startup

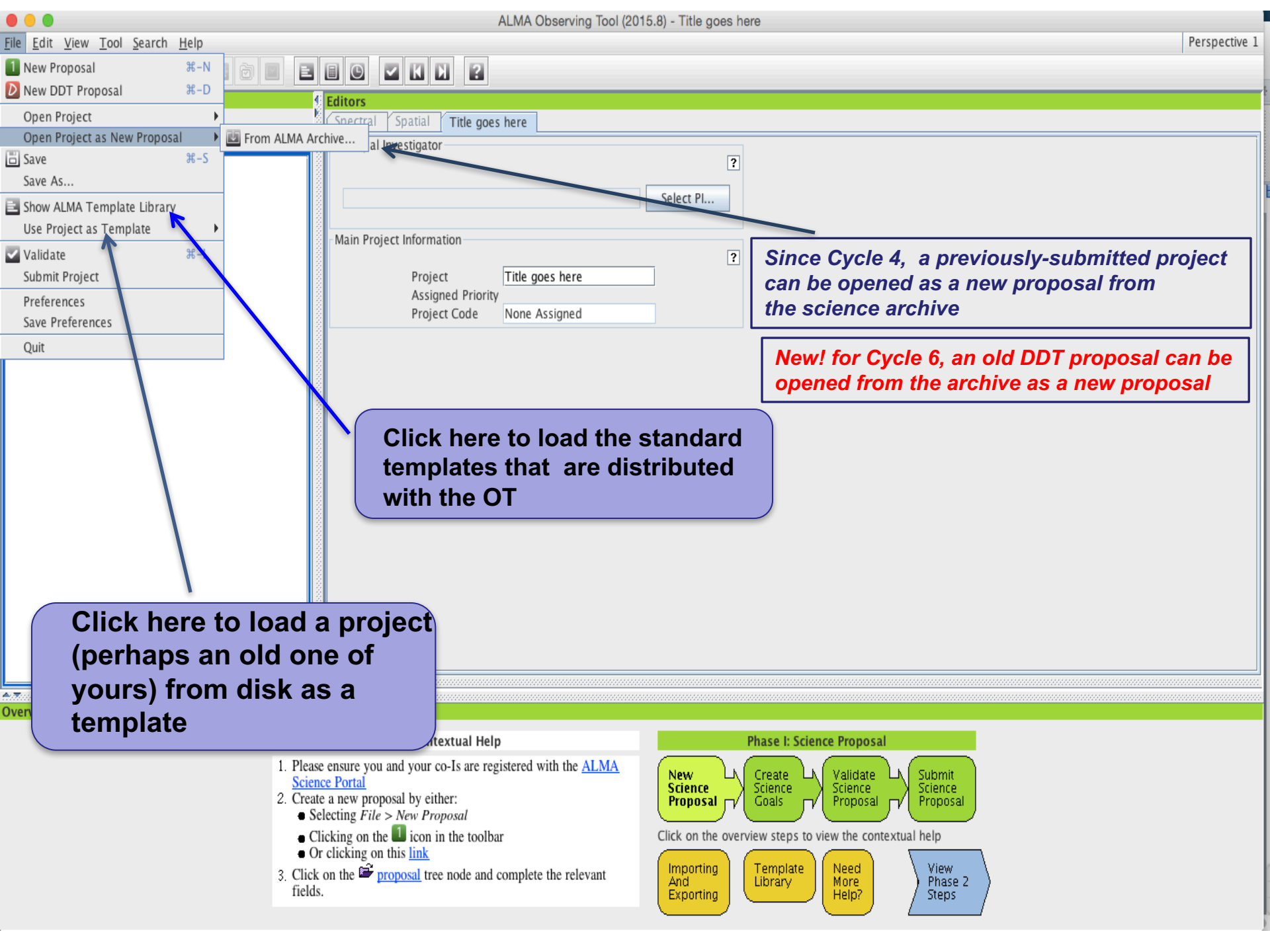
NRAO

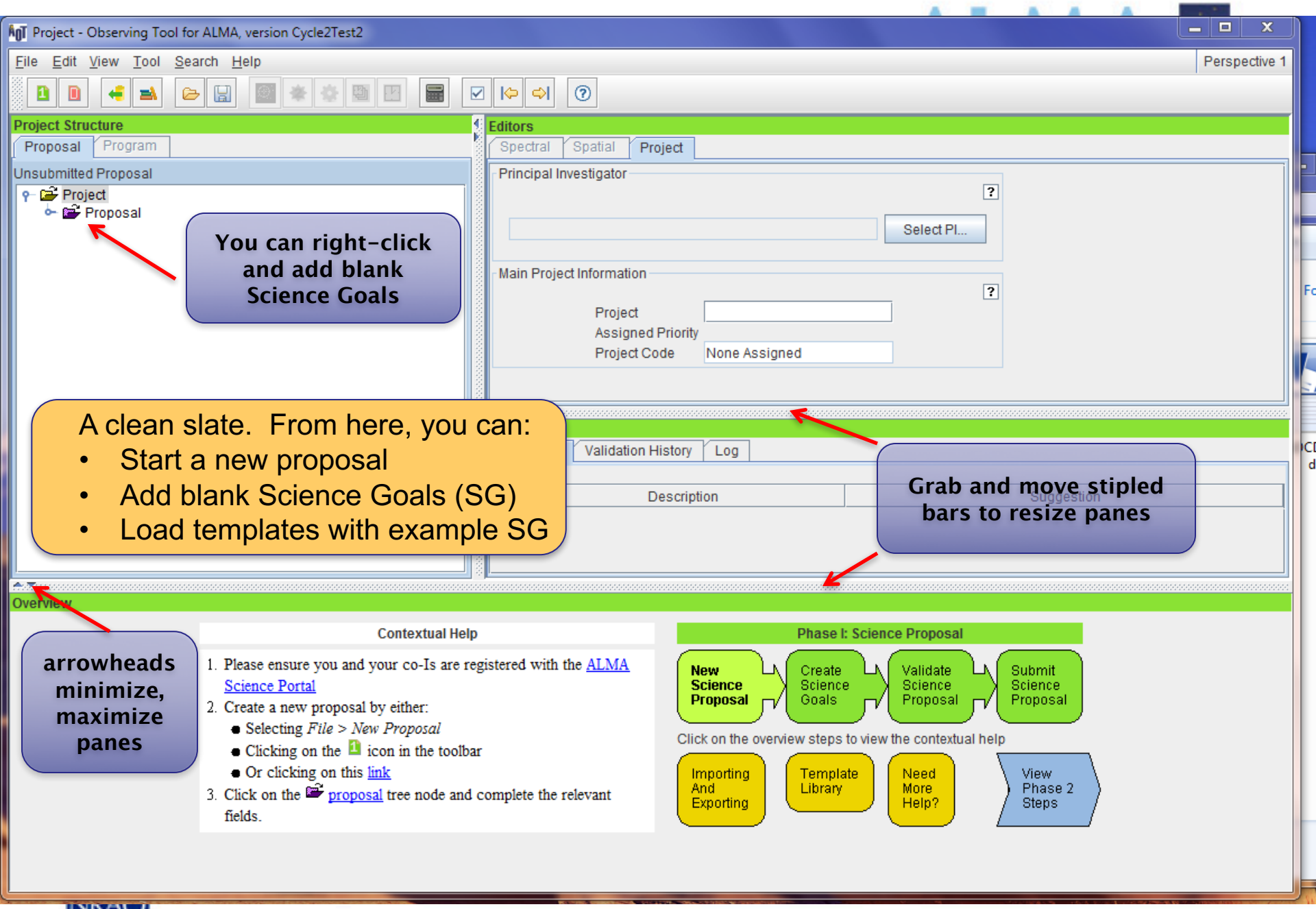
When the ALMA OT starts

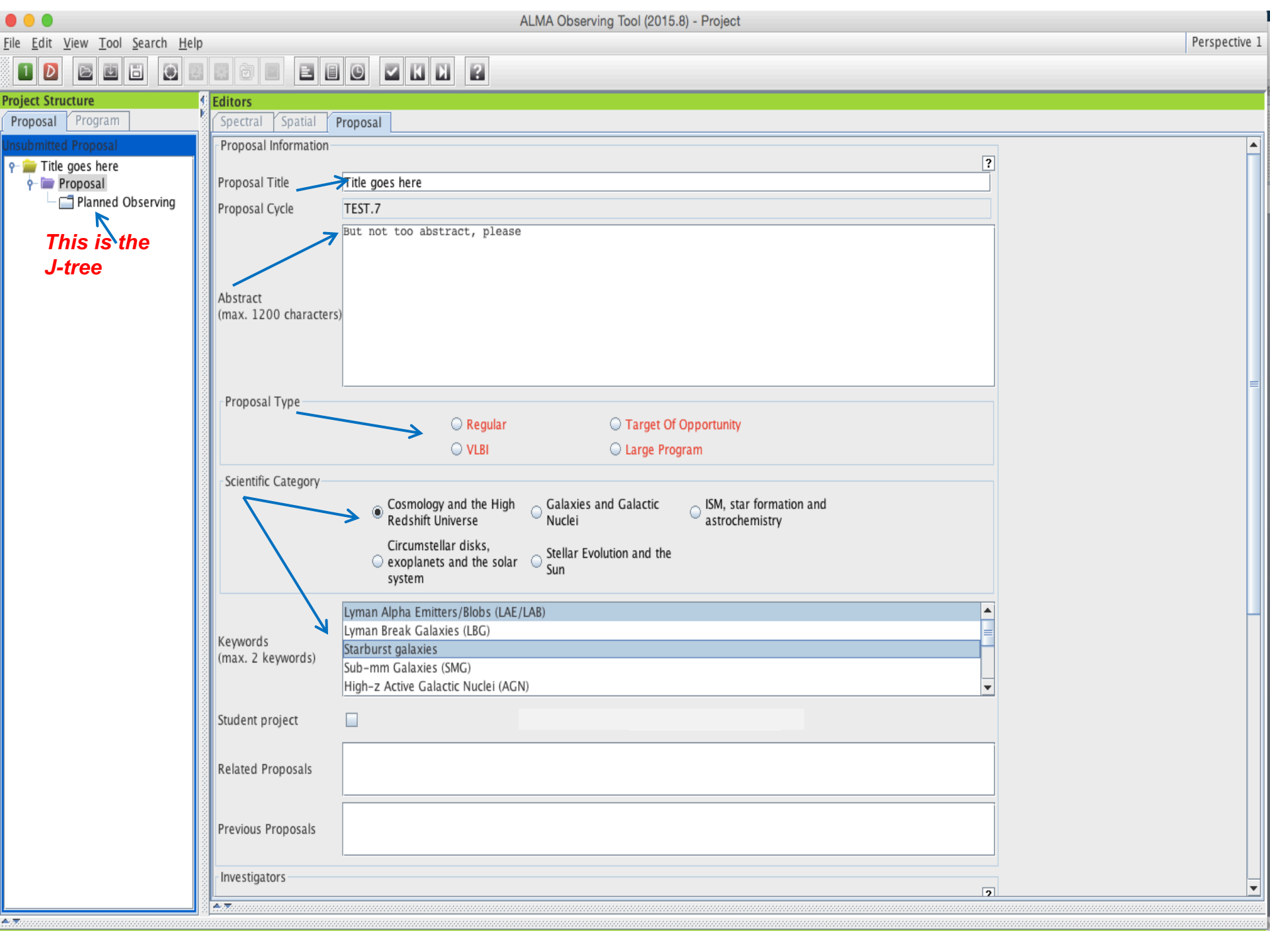


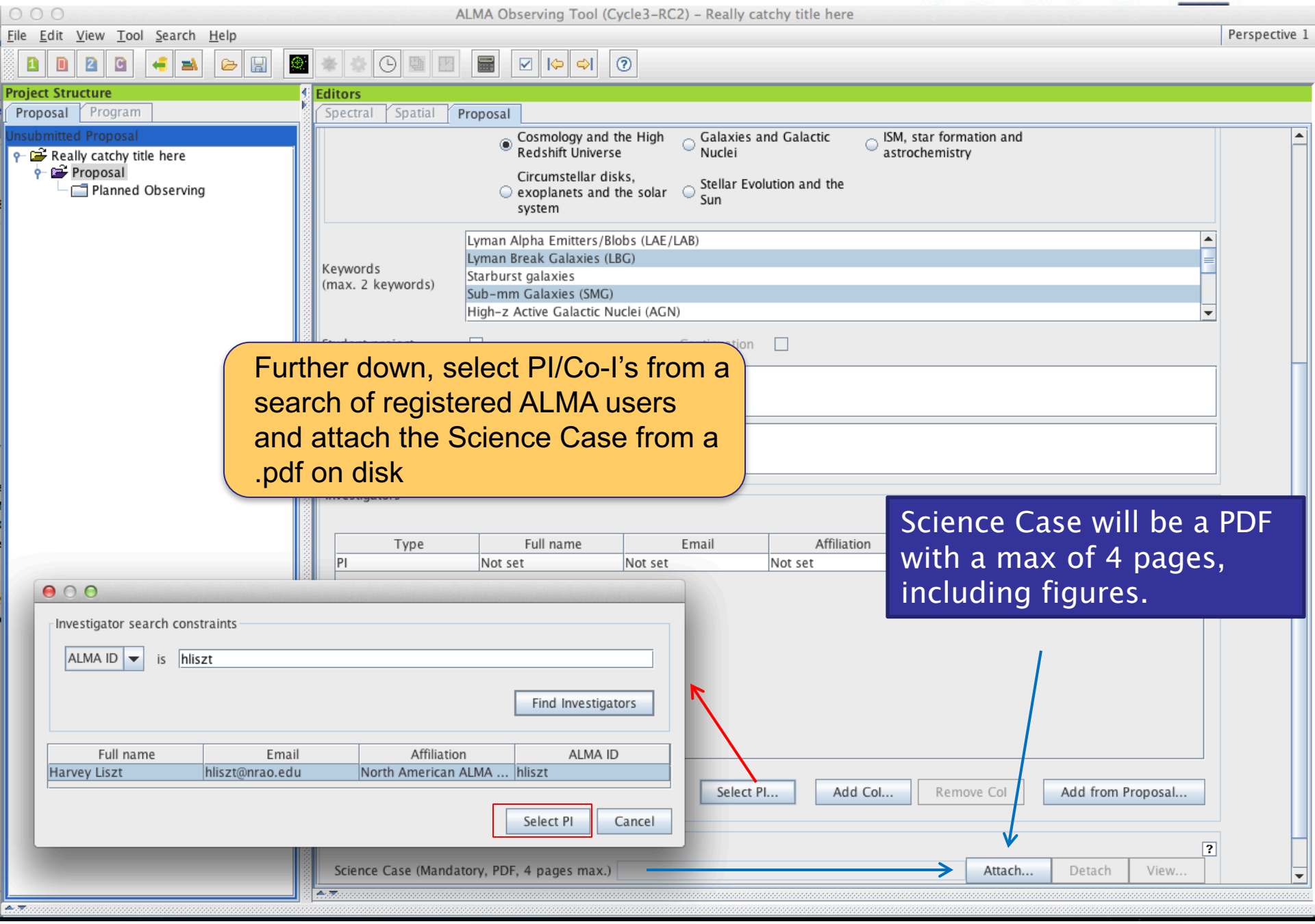
Then you see this




ALMA Observing Tool (2015.8) - Title goes here
File Edit View Tool Search Help
Perspective 1
New Proposal ⌘-N
New DDT Proposal ⌘-D
Open Project
Open Project as New Proposal
From ALMA Archive...
Save ⌘-S
Save As...
Show ALMA Template Library
Use Project as Template
Validate
Submit Project
Preferences
Save Preferences
Quit
Editors
Spectral
Spatial
Title goes here
Select PI...
Main Project Information
Project
Title goes here
Assigned Priority
Project Code
None Assigned
Since Cycle 4, a previously-submitted project can be opened as a new proposal from the science archive
New! for Cycle 6, an old DDT proposal can be opened from the archive as a new proposal
Click here to load the standard templates that are distributed with the OT
Click here to load a project (perhaps an old one of yours) from disk as a template
Contextual Help
1. Please ensure you and your co-Is are registered with the ALMA Science Portal
2. Create a new proposal by either:
Selecting File > New Proposal
Clicking on the icon in the toolbar
Or clicking on this link
3. Click on the proposal tree node and complete the relevant fields.
Phase I: Science Proposal
New Science Proposal
Create Science Goals
Validate Science Proposal
Submit Science Proposal
Click on the overview steps to view the contextual help
Importing And Exporting
Template Library
Need More Help?
View Phase 2 Steps

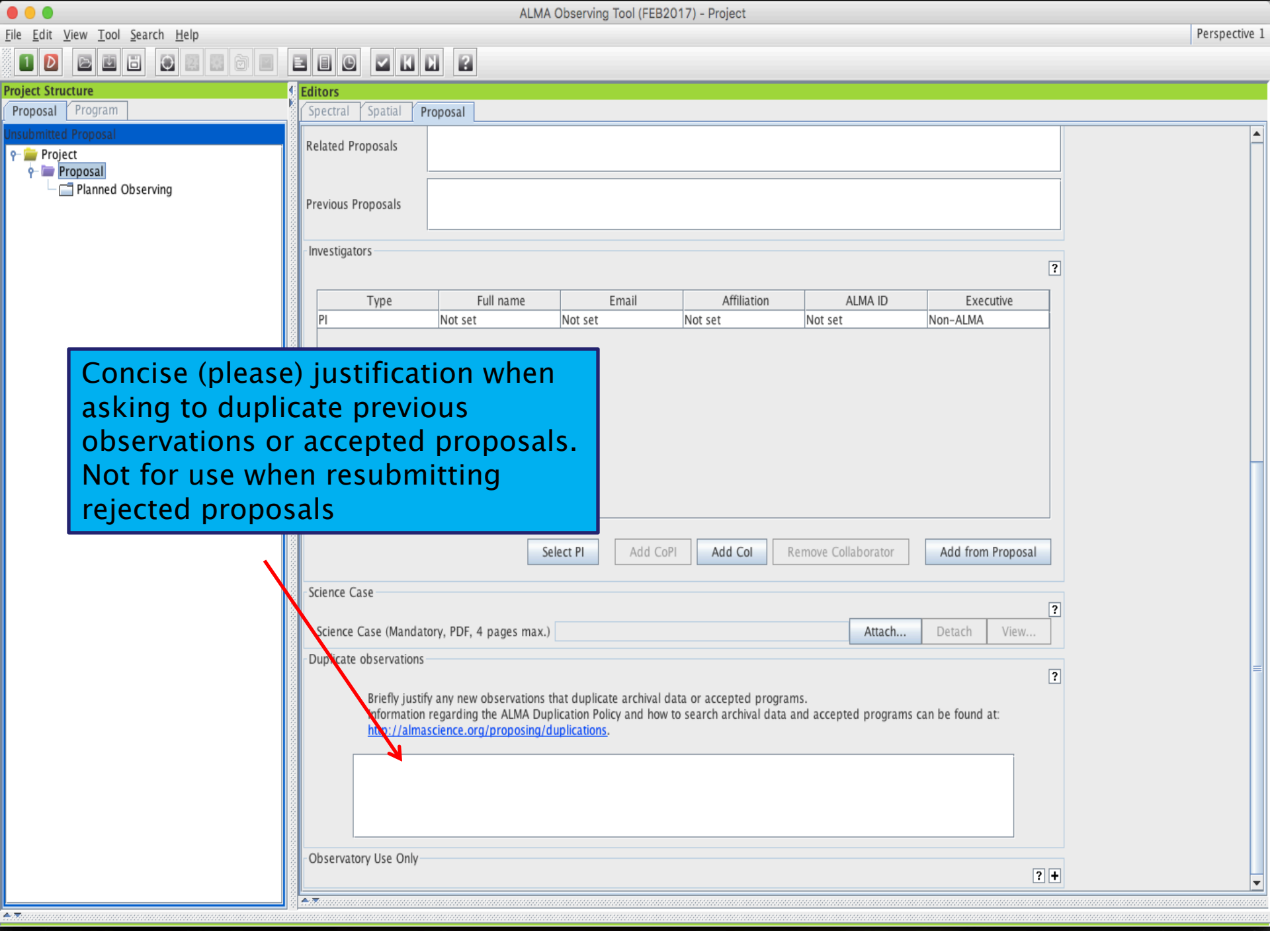

Project - Observing Tool for ALMA, version Cycle2Test2
File Edit View Tool Search Help
Perspective 1
Project Structure
Proposal Program
Unsubmitted Proposal
Project
Proposal
You can right-click and add blank Science Goals
Editors
Spectral Spatial Project
Principal Investigator
Select PI...
Main Project Information
Project
Assigned Priority
Project Code
None Assigned
A clean slate. From here, you can:
• Start a new proposal
• Add blank Science Goals (SG)
• Load templates with example SG
Validation History Log
Description
Grab and move stipled bars to resize panes
Overview
arrowheads minimize, maximize panes
Contextual Help
1. Please ensure you and your co-Is are registered with the ALMA Science Portal
2. Create a new proposal by either:
Selecting File > New Proposal
Clicking on the icon in the toolbar
Or clicking on this link
3. Click on the proposal tree node and complete the relevant fields.
Phase I: Science Proposal
New Science Proposal
Create Science Goals
Validate Science Proposal
Submit Science Proposal
Click on the overview steps to view the contextual help
Importing And Exporting
Template Library
Need More Help?
View Phase 2 Steps

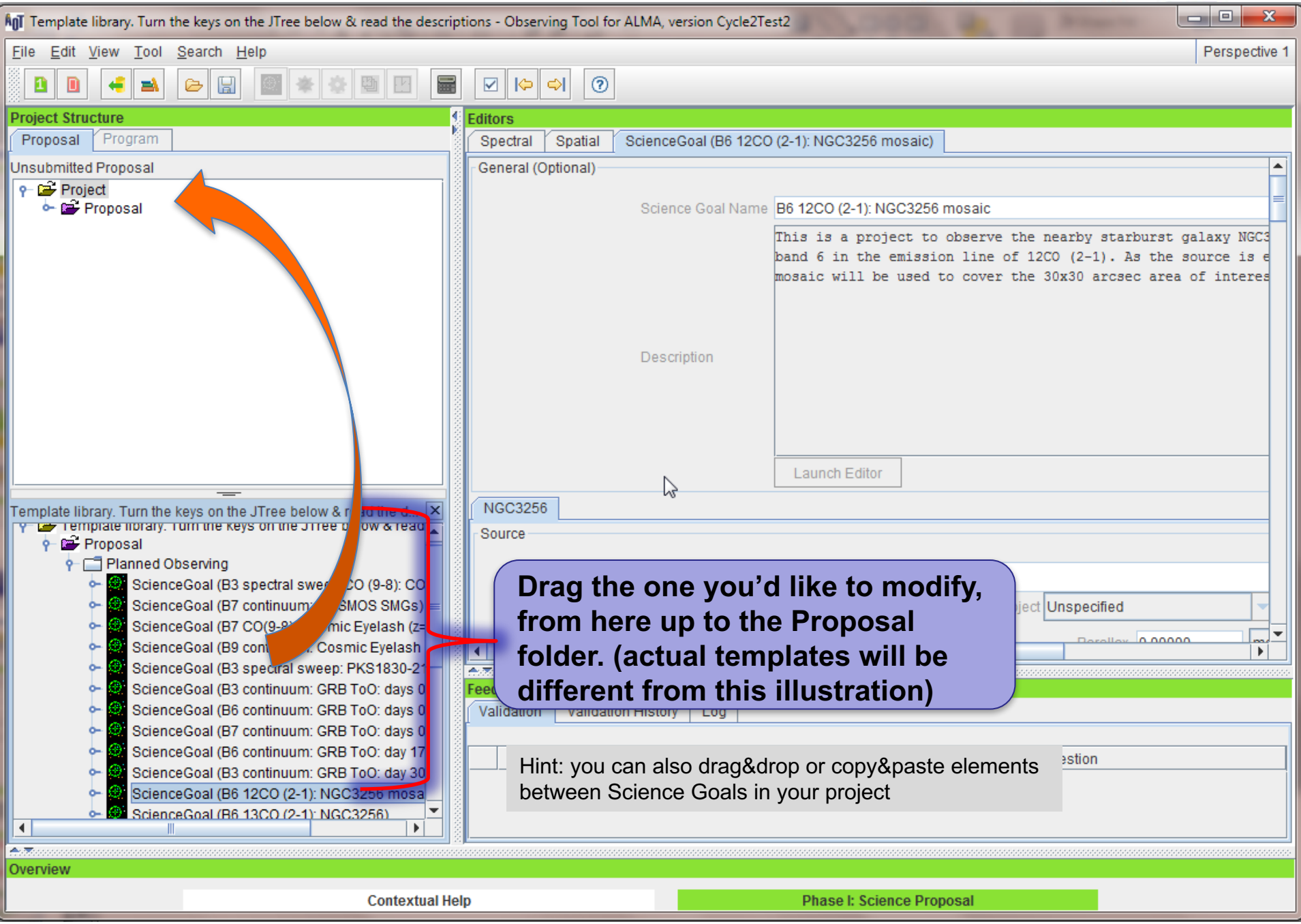

ALMA Observing Tool (2015.8) - Project
File Edit View Tool Search Help
Perspective 1
Project Structure
Proposal Program
Unsubmitted Proposal
Title goes here
Proposal
Planned Observing
This is the J-tree
Editors
Spectral Spatial Proposal
Proposal Information
Proposal Title
Title goes here
Proposal Cycle
TEST.7
Abstract (max. 1200 characters)
But not too abstract, please
Proposal Type
Regular
Target Of Opportunity
VLBI
Large Program
Scientific Category
Cosmology and the High Redshift Universe
Galaxies and Galactic Nuclei
ISM, star formation and astrochemistry
Circumstellar disks, exoplanets and the solar system
Stellar Evolution and the Sun
Keywords (max. 2 keywords)
Lyman Alpha Emitters/Blobs (LAE/LAB)
Lyman Break Galaxies (LBG)
Starburst galaxies
Sub-mm Galaxies (SMG)
High-z Active Galactic Nuclei (AGN)
Student project
Related Proposals
Previous Proposals
Investigators

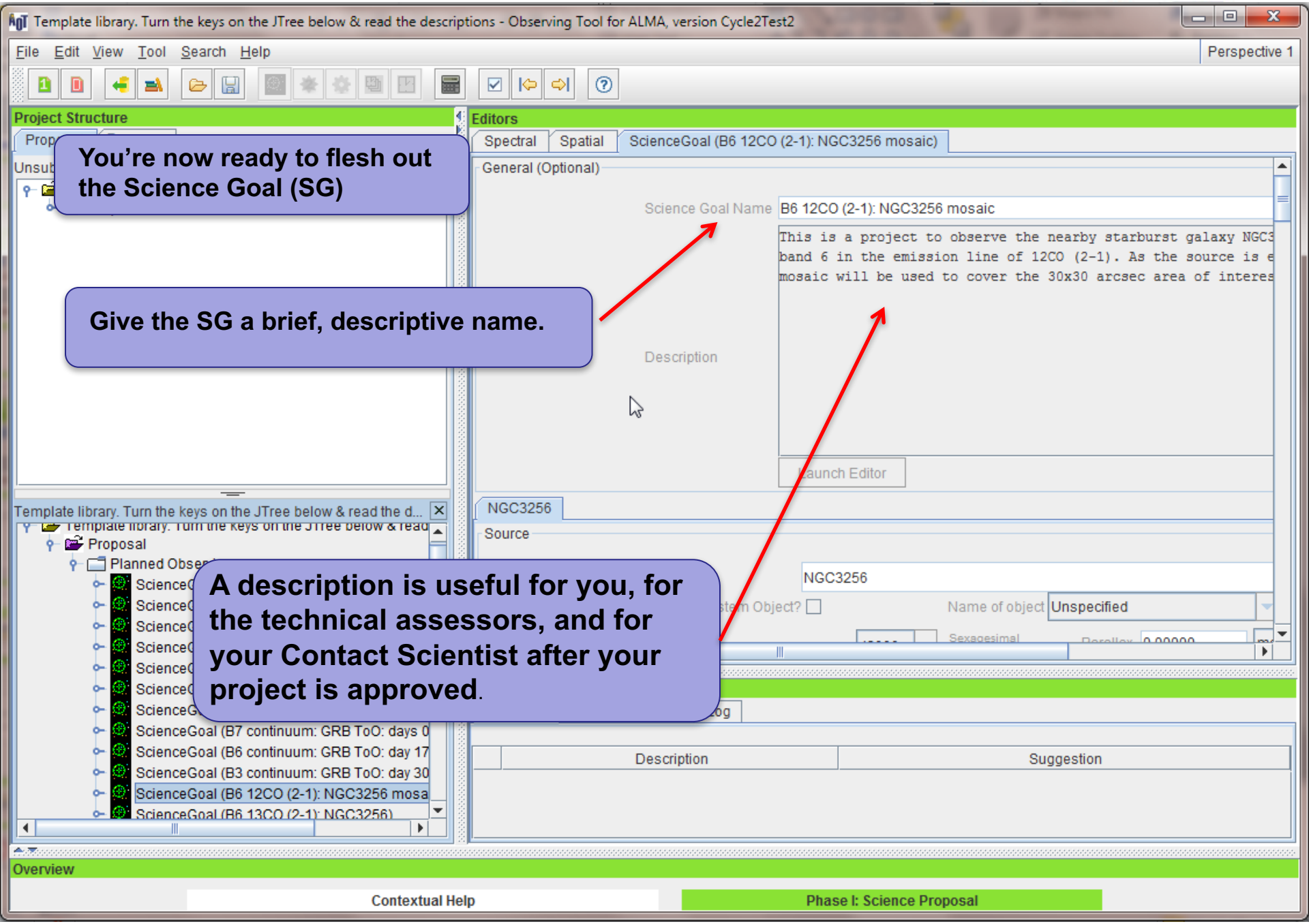


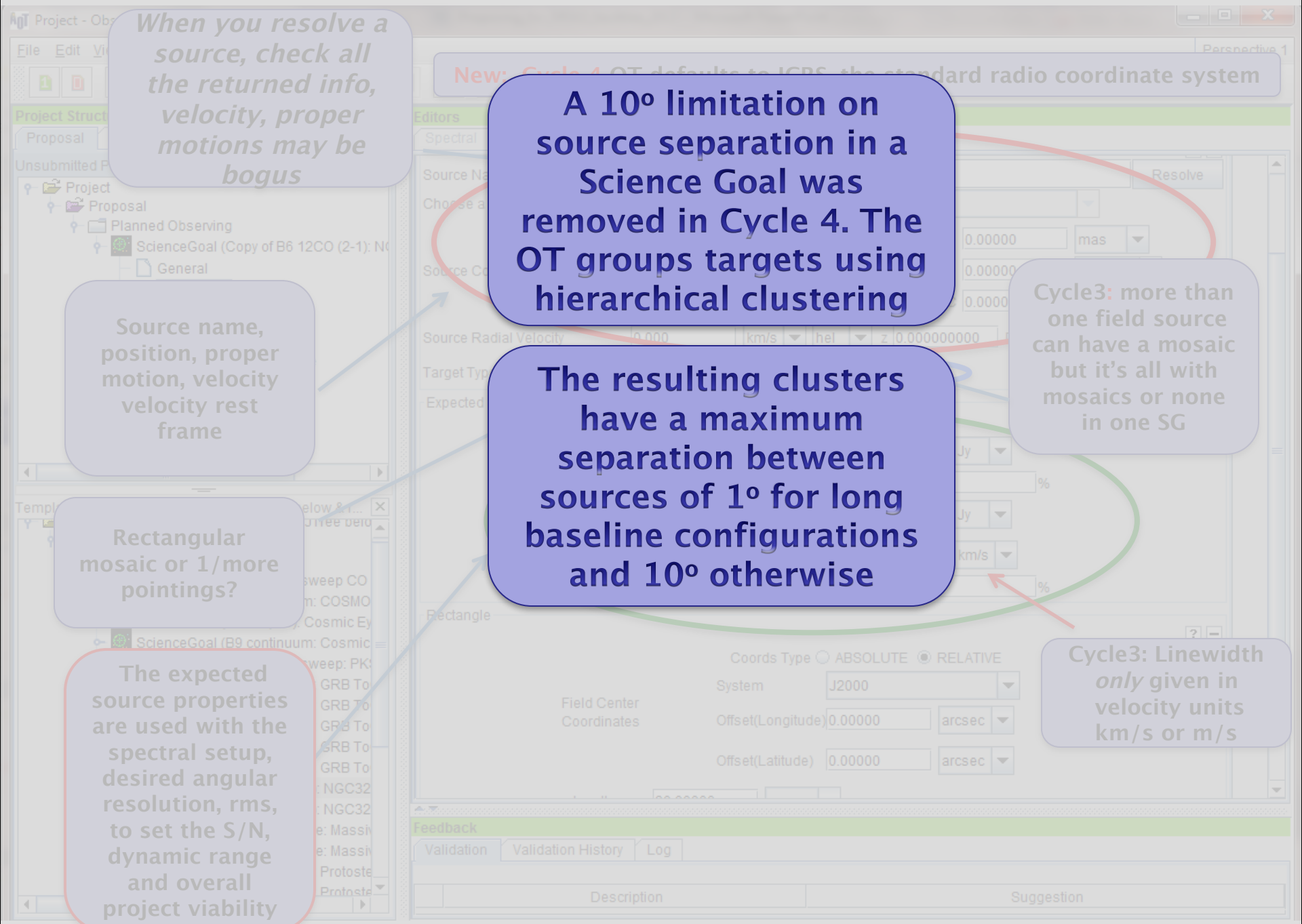
Further down, select PI/Co-I's from a search of registered ALMA users and attach the Science Case from a .pdf on disk

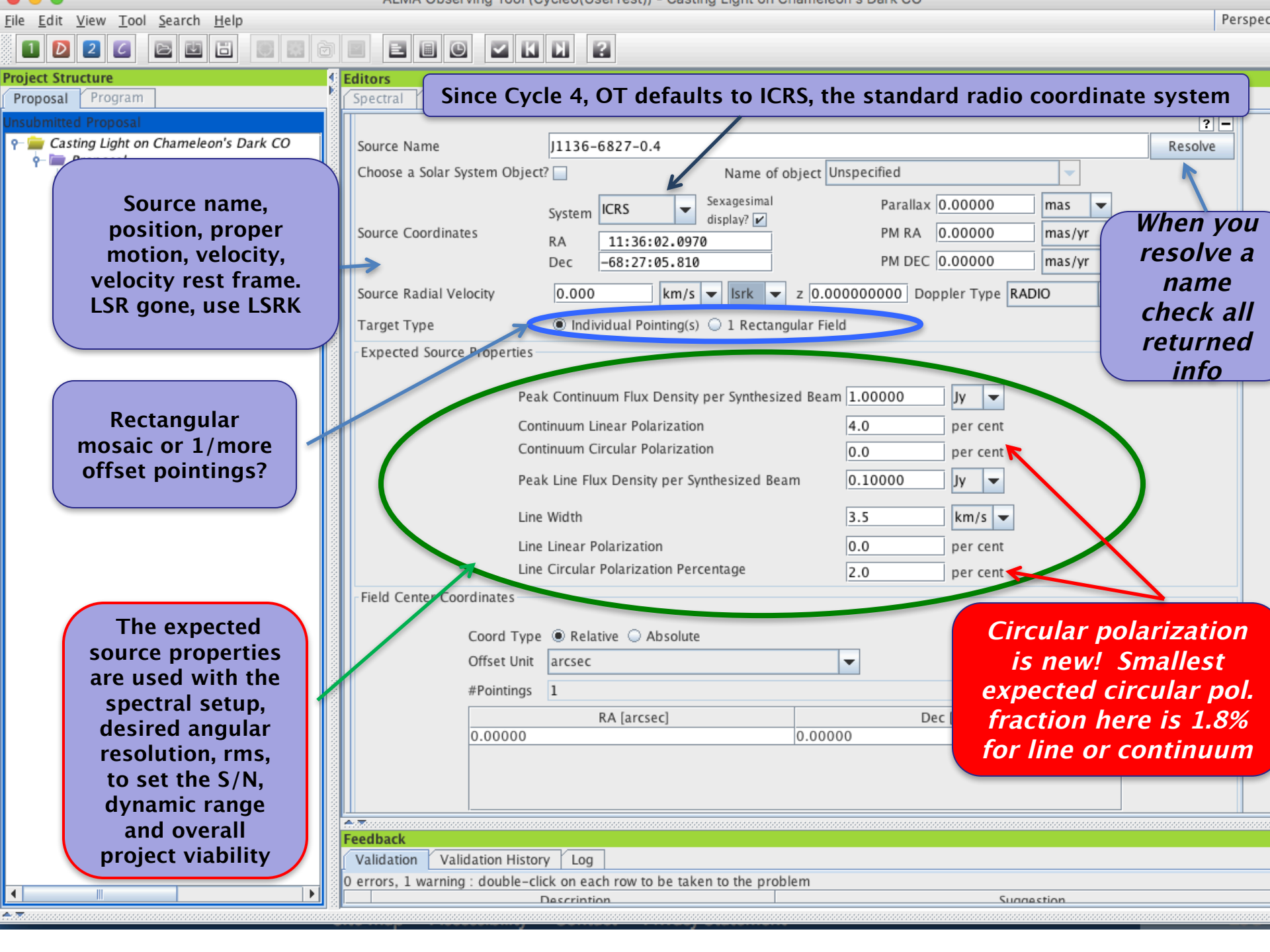
Science Case will be a PDF with a max of 4 pages, including figures.


ALMA Observing Tool (FEB2017) - Project
File Edit View Tool Search Help
Perspective 1
Project Structure
Proposal Program
Unsubmitted Proposal
Project
Proposal
Planned Observing
Editors
Spectral Spatial Proposal
Related Proposals
Previous Proposals
Investigators
Type Full name Email Affiliation ALMA ID Executive
PI Not set Not set Not set Not set Non-ALMA
Select PI
Add CoPI
Add CoI
Remove Collaborator
Add from Proposal
Science Case
Science Case (Mandatory, PDF, 4 pages max.)
Attach...
Detach
View...
Duplicate observations
Briefly justify any new observations that duplicate archival data or accepted programs.
Information regarding the ALMA Duplication Policy and how to search archival data and accepted programs can be found at:
http://almascience.org/proposing/duplications.
Observatory Use Only
Concise (please) justification when asking to duplicate previous observations or accepted proposals. Not for use when resubmitting rejected proposals


Template library. Turn the keys on the JTree below & read the descriptions - Observing Tool for ALMA, version Cycle2Test2
File Edit View Tool Search Help
Perspective 1
Project Structure
Proposal Program
Unsubmitted Proposal
Project
Proposal
Editors
Spectral Spatial ScienceGoal (B6 12CO (2-1): NGC3256 mosaic)
General (Optional)
Science Goal Name
B6 12CO (2-1): NGC3256 mosaic
This is a project to observe the nearby starburst galaxy NGC3
band 6 in the emission line of 12CO (2-1). As the source is e
mosaic will be used to cover the 30x30 arcsec area of interes
Description
Launch Editor
Template library. Turn the keys on the JTree below & read the d
Proposal
Planned Observing
ScienceGoal (B3 spectral swee CO (9-8): CO
ScienceGoal (B7 continuum SMOS SMGs)
ScienceGoal (B7 CO(9-8 mic Eyelash (z=
ScienceGoal (B9 cont Cosmic Eyelash
ScienceGoal (B3 spectral sweep: PKS1830-2
ScienceGoal (B3 continuum: GRB ToO: days 0
ScienceGoal (B6 continuum: GRB ToO: days 0
ScienceGoal (B7 continuum: GRB ToO: days 0
ScienceGoal (B6 continuum: GRB ToO: day 17
ScienceGoal (B3 continuum: GRB ToO: day 30
ScienceGoal (B6 12CO (2-1): NGC3256 mosa
ScienceGoal (B6 13CO (2-1): NGC3256)
NGC3256
Source
Unspecified
Drag the one you'd like to modify, from here up to the Proposal folder. (actual templates will be different from this illustration)
Validation Validation History Log
Hint: you can also drag&drop or copy&paste elements between Science Goals in your project
Overview
Contextual Help
Phase I: Science Proposal


Template library. Turn the keys on the JTree below & read the descriptions - Observing Tool for ALMA, version Cycle2Test2
File Edit View Tool Search Help
Perspective 1
Project Structure
Editors
Spectral
Spatial
ScienceGoal (B6 12CO (2-1): NGC3256 mosaic)
You're now ready to flesh out the Science Goal (SG)
General (Optional)
Science Goal Name
B6 12CO (2-1): NGC3256 mosaic
This is a project to observe the nearby starburst galaxy NGC3
band 6 in the emission line of 12CO (2-1). As the source is e
mosaic will be used to cover the 30x30 arcsec area of interes
Description
Give the SG a brief, descriptive name.
Launch Editor
NGC3256
Source
NGC3256
Name of object
Unspecified
Proposal
ScienceGoal (B7 continuum: GRB ToO: days 0
ScienceGoal (B6 continuum: GRB ToO: day 17
ScienceGoal (B3 continuum: GRB ToO: day 30
ScienceGoal (B6 12CO (2-1): NGC3256 mosa
A description is useful for you, for the technical assessors, and for your Contact Scientist after your project is approved.
Description
Suggestion
Overview
Contextual Help
Phase I: Science Proposal


When you resolve a source, check all the returned info, velocity, proper motions may be bogus
New: Cycle 4 OT defaults to ICRS, the standard radio coordinate system
A 10º limitation on source separation in a Science Goal was removed in Cycle 4. The OT groups targets using hierarchical clustering
Source name, position, proper motion, velocity velocity rest frame
Cycle3: more than one field source can have a mosaic but it's all with mosaics or none in one SG
The resulting clusters have a maximum separation between sources of 1º for long baseline configurations and 10º otherwise
Rectangular mosaic or 1/more pointings?
Cycle3: Linewidth *only* given in velocity units km/s or m/s
The expected source properties are used with the spectral setup, desired angular resolution, rms, to set the S/N, dynamic range and overall project viability


File Edit View Tool Search Help
Project Structure
Proposal Program
Unsubmitted Proposal
Casting Light on Chameleon's Dark CO
Editors
Spectral
Since Cycle 4, OT defaults to ICRS, the standard radio coordinate system
Source Name
J1136-6827-0.4
Resolve
Choose a Solar System Object?
Name of object
Unspecified
System
ICRS
Sexagesimal display?
Source Coordinates
RA
11:36:02.0970
Dec
-68:27:05.810
Parallax
0.00000
mas
PM RA
0.00000
mas/yr
PM DEC
0.00000
mas/yr
Source Radial Velocity
0.000
km/s
lsrk
z
0.000000000
Doppler Type
RADIO
Target Type
Individual Pointing(s)
1 Rectangular Field
Expected Source Properties
Peak Continuum Flux Density per Synthesized Beam
1.00000
Jy
Continuum Linear Polarization
4.0
per cent
Continuum Circular Polarization
0.0
per cent
Peak Line Flux Density per Synthesized Beam
0.10000
Jy
Line Width
3.5
km/s
Line Linear Polarization
0.0
per cent
Line Circular Polarization Percentage
2.0
per cent
Field Center Coordinates
Coord Type
Relative
Absolute
Offset Unit
arcsec
#Pointings
1
RA [arcsec]
Dec
0.00000
0.00000
Feedback
Validation
Validation History
Log
0 errors, 1 warning : double-click on each row to be taken to the problem
Description
Suggestion
When you resolve a name check all returned info
Source name, position, proper motion, velocity, velocity rest frame. LSR gone, use LSRK
Rectangular mosaic or 1/more offset pointings?
The expected source properties are used with the spectral setup, desired angular resolution, rms, to set the S/N, dynamic range and overall project viability
Circular polarization is new! Smallest expected circular pol. fraction here is 1.8% for line or continuum

When you toggle the coordinate system between ICRS and Galactic the OT will convert between them

When using the spatial visualizer, the OT will find the correct image for a position specified in galactic coordinates, but images returned by the standard image query servers are always in ICRS

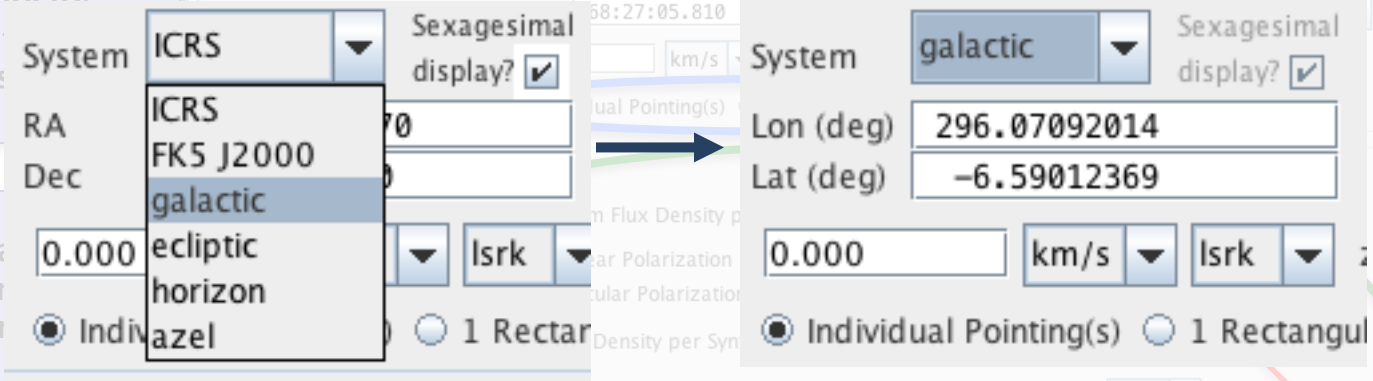
Source name, position, proper motion, velocity velocity res LSR gone, us

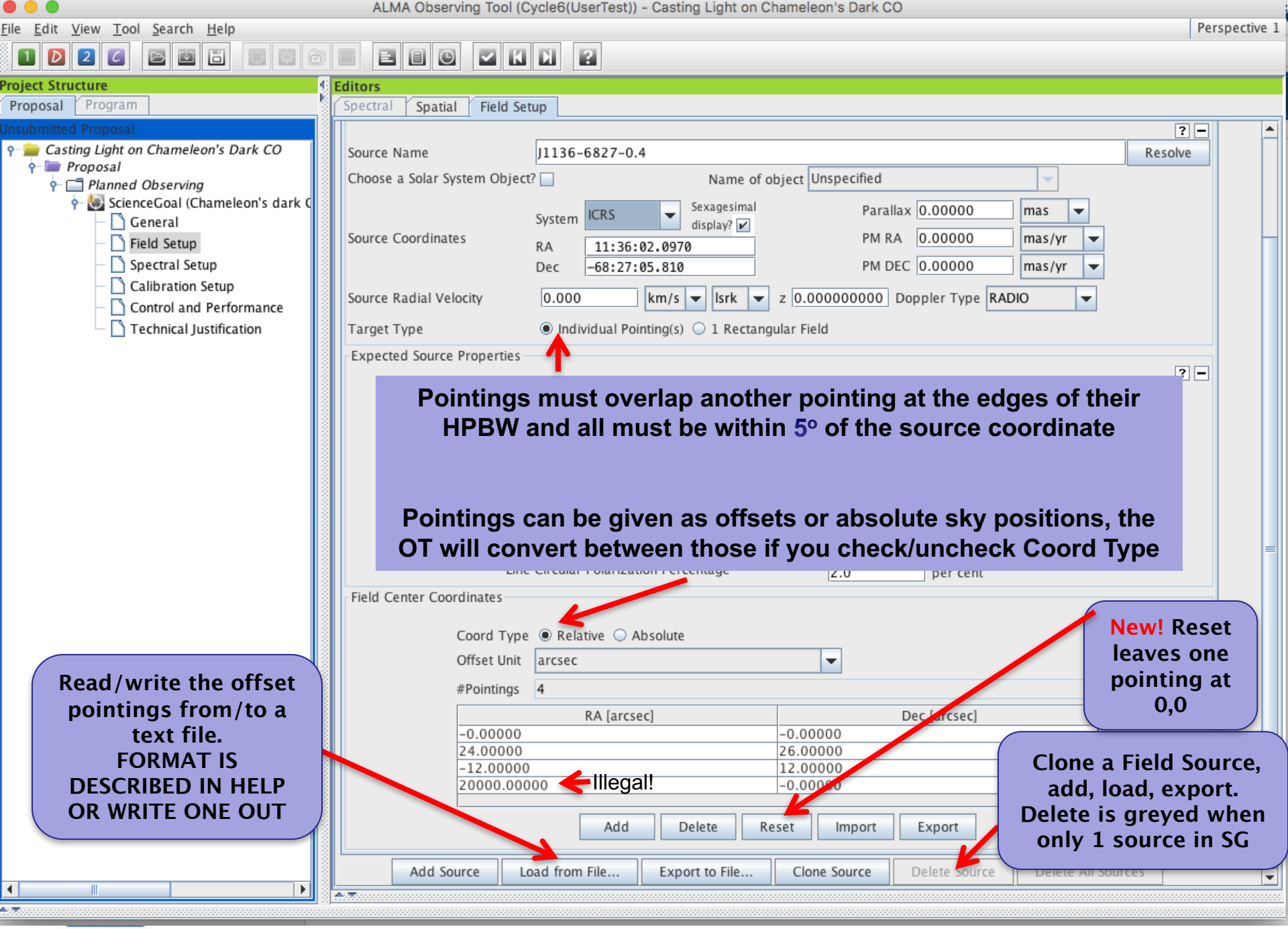
Rectangula mosaic or 1/r offset pointi

The expected source properties are used with the spectral setup, desired angular resolution, rms, to set the S/N, dynamic range and overall project viability

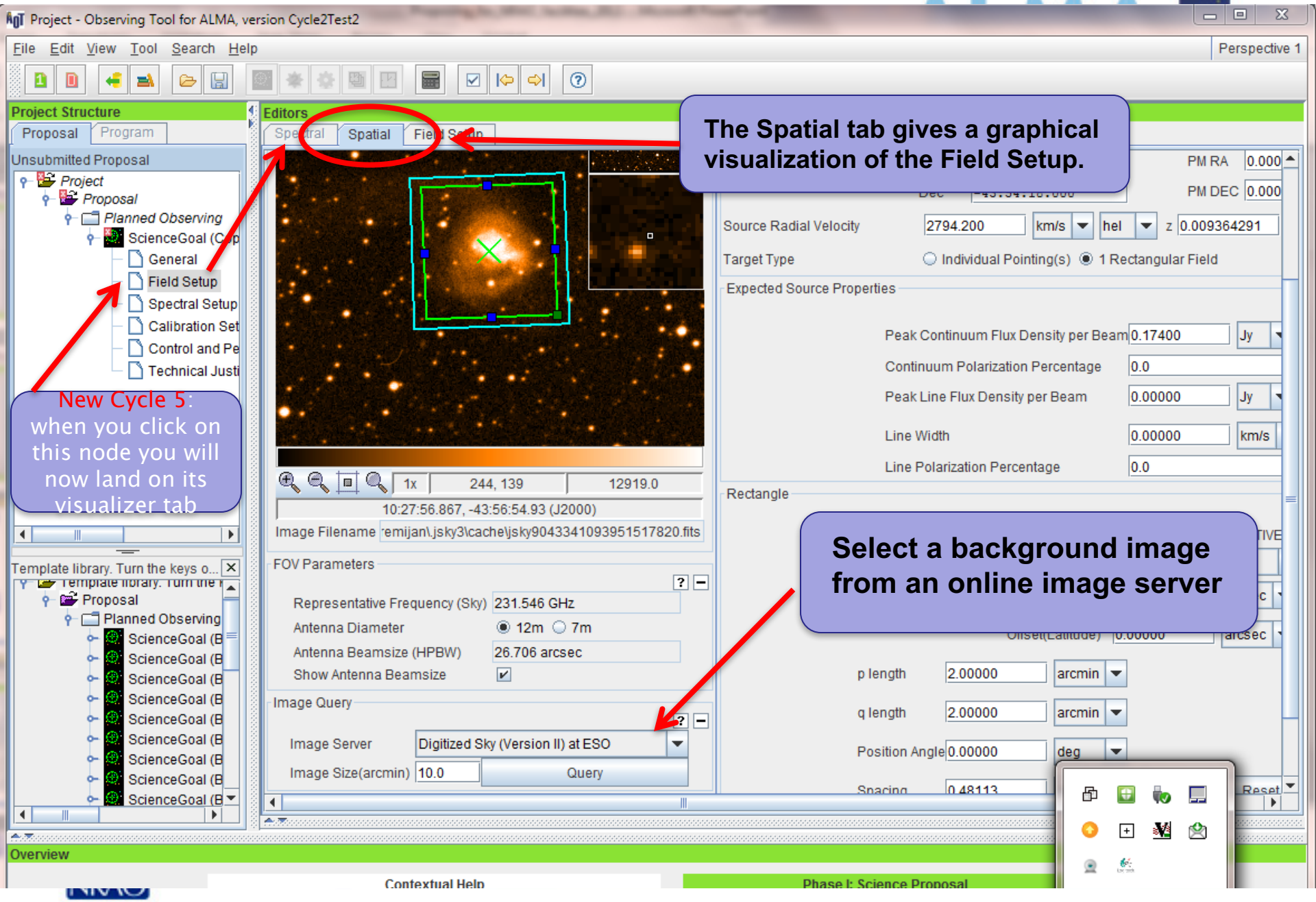
When yo source r all the info: proper may b

Circular polarization is r Smallest detect circular pol fraction is 1.8% line or continu

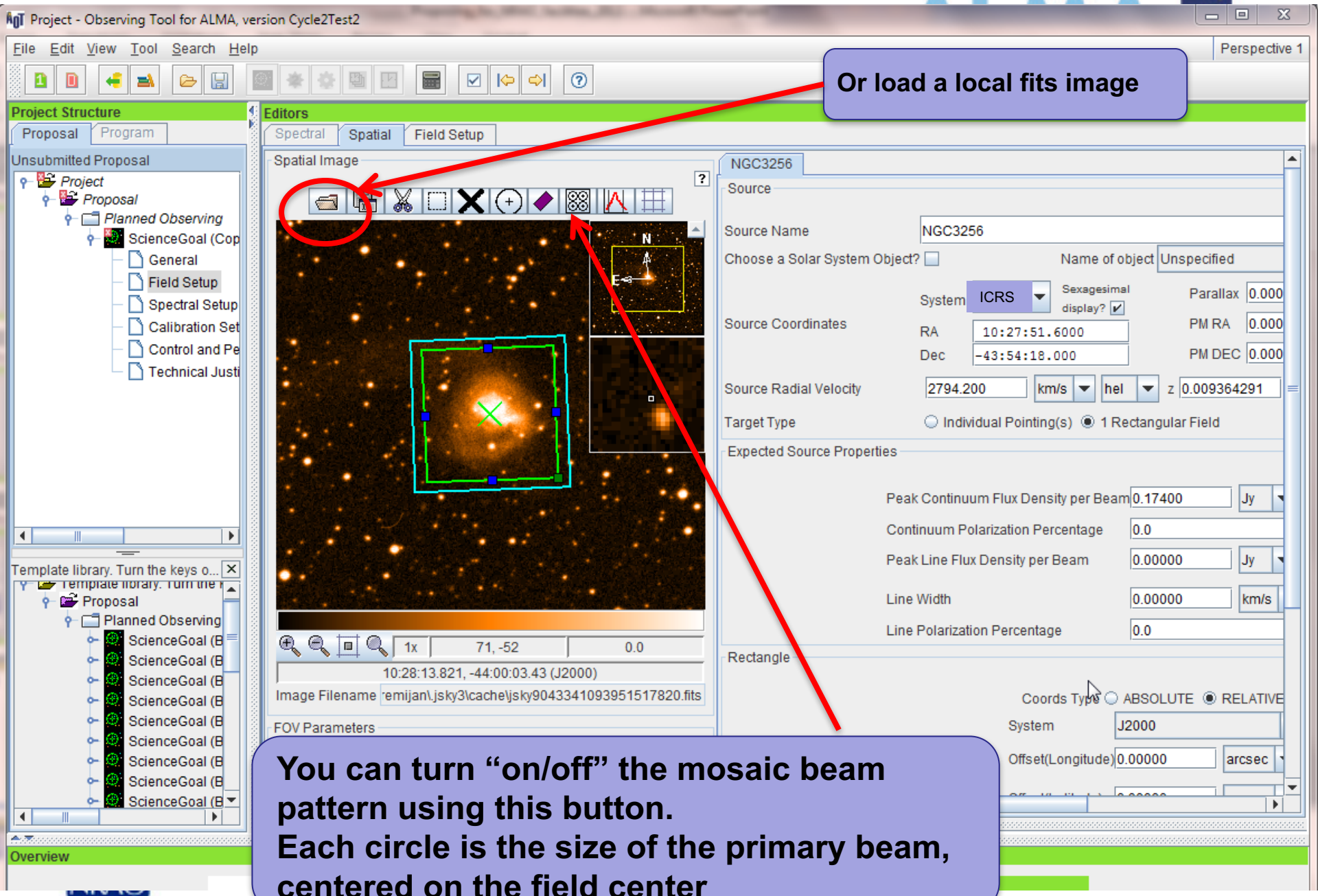



ALMA Observing Tool (Cycle6(UserTest)) - Casting Light on Chameleon's Dark CO
File Edit View Tool Search Help
Perspective 1
Project Structure
Proposal Program
Unsubmitted Proposal
Casting Light on Chameleon's Dark CO
Proposal
Planned Observing
ScienceGoal (Chameleon's dark C
General
Field Setup
Spectral Setup
Calibration Setup
Control and Performance
Technical Justification
Editors
Spectral Spatial Field Setup
Source Name
J1136-6827-0.4
Resolve
Choose a Solar System Object?
Name of object
Unspecified
Source Coordinates
System
ICRS
Sexagesimal display?
RA
11:36:02.0970
Dec
-68:27:05.810
Parallax
0.00000
mas
PM RA
0.00000
mas/yr
PM DEC
0.00000
mas/yr
Source Radial Velocity
0.000
km/s
lsrk
z
0.000000000
Doppler Type
RADIO
Target Type
Individual Pointing(s)
1 Rectangular Field
Expected Source Properties
Pointings must overlap another pointing at the edges of their HPBW and all must be within 5° of the source coordinate
Pointings can be given as offsets or absolute sky positions, the OT will convert between those if you check/uncheck Coord Type
Field Center Coordinates
Coord Type
Relative
Absolute
Offset Unit
arcsec
#Pointings
4
RA [arcsec]
Dec [arcsec]
-0.00000
-0.00000
24.00000
26.00000
-12.00000
12.00000
20000.00000
Illegal!
Add
Delete
Reset
Import
Export
Add Source
Load from File...
Export to File...
Clone Source
Delete Source
Read/write the offset pointings from/to a text file. FORMAT IS DESCRIBED IN HELP OR WRITE ONE OUT
New! Reset leaves one pointing at 0,0
Clone a Field Source, add, load, export. Delete is greyed when only 1 source in SG

Crafting mosaics



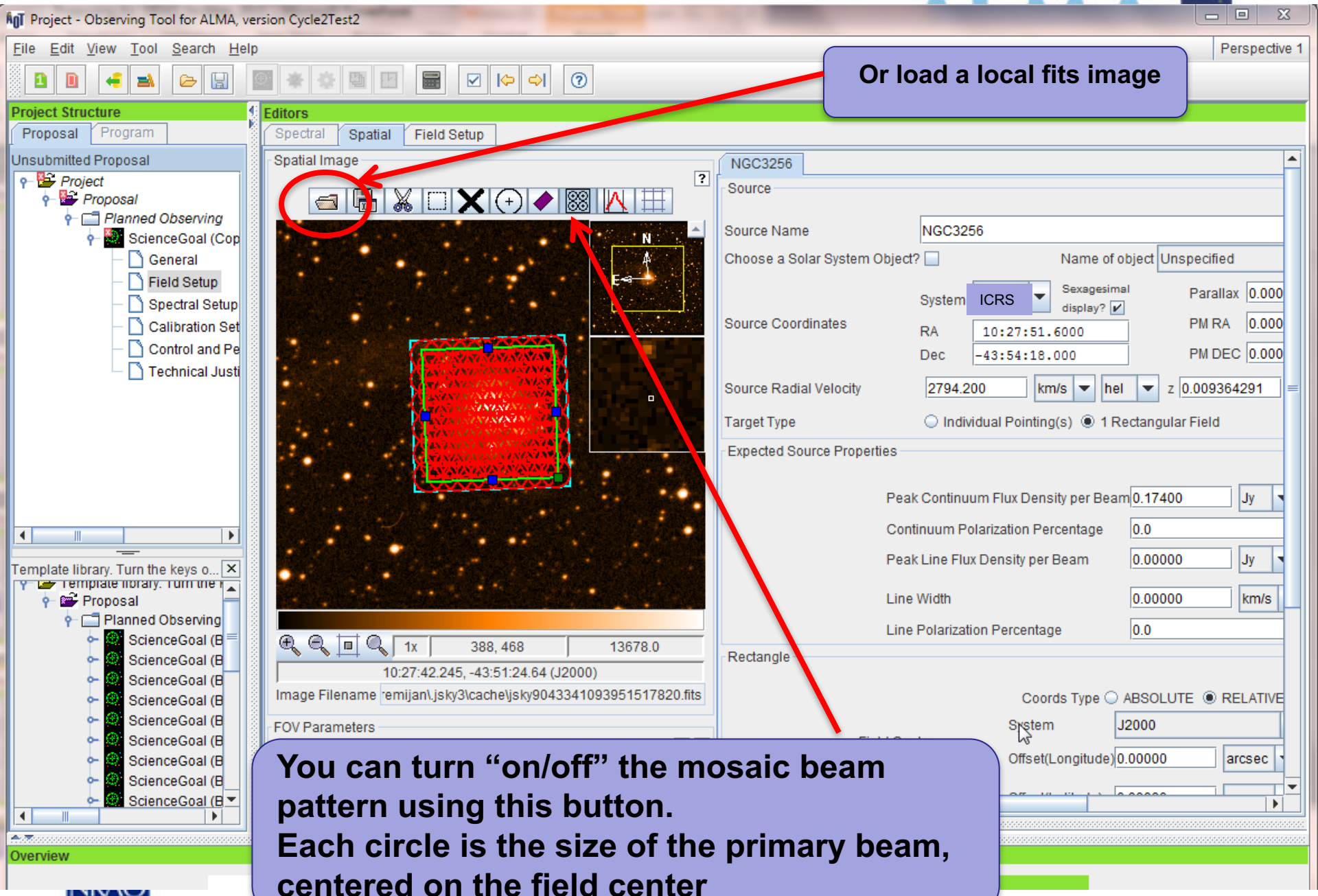
Crafting mosaics



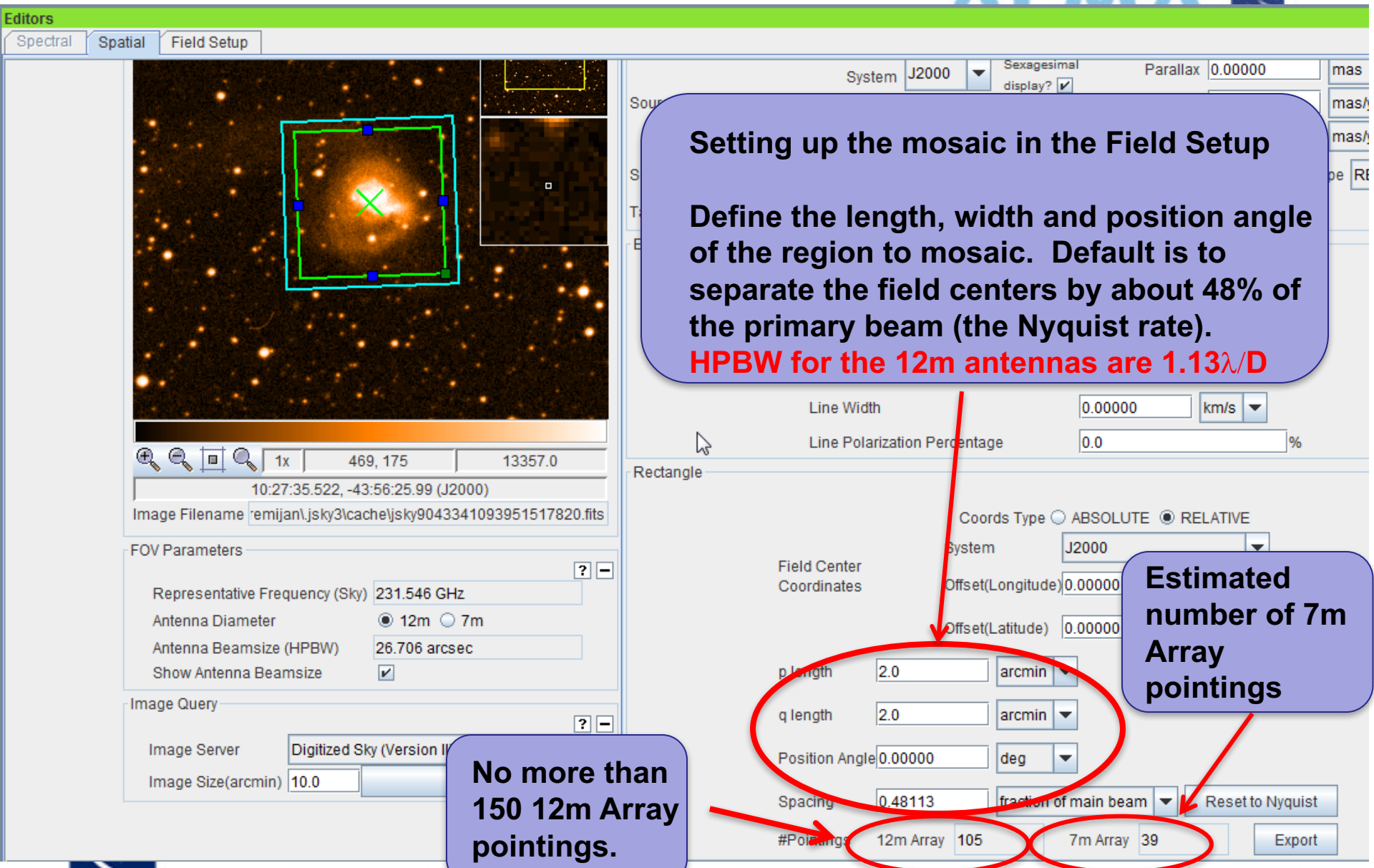
Or load a local fits image

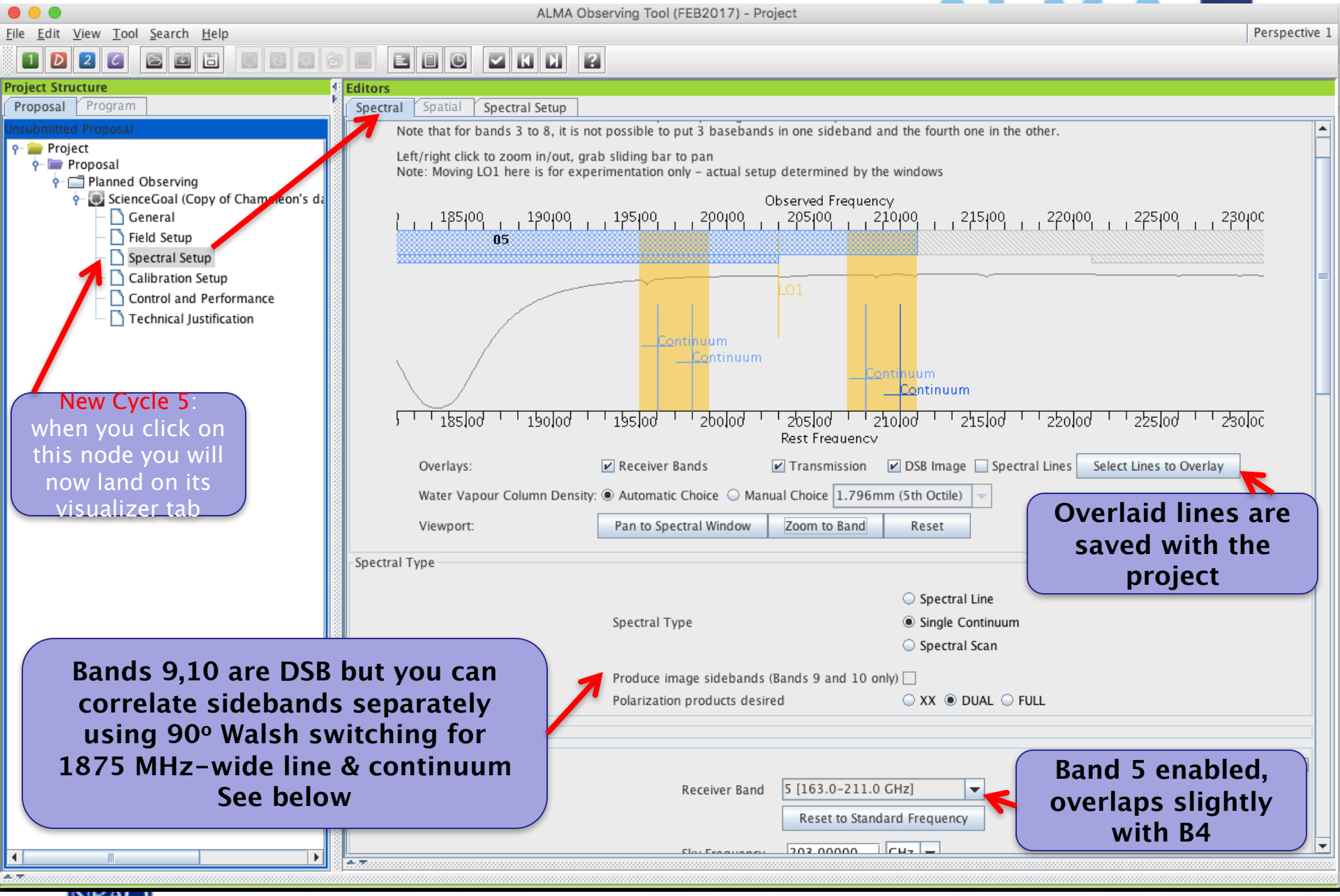
You can turn “on/off” the mosaic beam pattern using this button.
Each circle is the size of the primary beam, centered on the field center

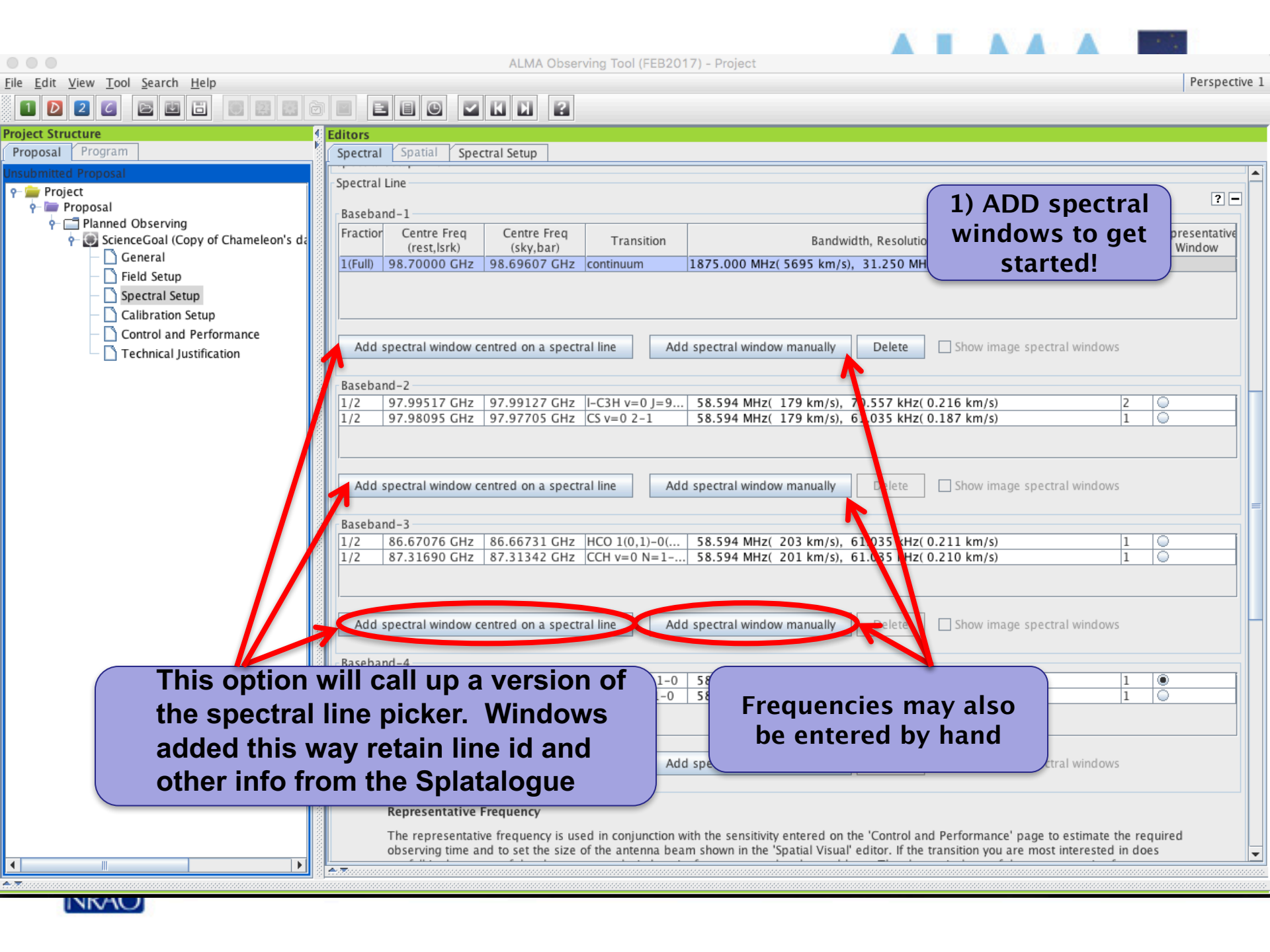
Crafting mosaics



Crafting mosaics




ALMA Observing Tool (FEB2017) - Project
File Edit View Tool Search Help
Perspective 1
Project Structure
Proposal Program
Unsubmitted Proposal
Project
Proposal
Planned Observing
ScienceGoal (Copy of Chameleon's da
General
Field Setup
Spectral Setup
Calibration Setup
Control and Performance
Technical Justification
Editors
Spectral Spatial Spectral Setup
Note that for bands 3 to 8, it is not possible to put 3 basebands in one sideband and the fourth one in the other.
Left/right click to zoom in/out, grab sliding bar to pan
Note: Moving LO1 here is for experimentation only – actual setup determined by the windows
Observed Frequency
185,00 190,00 195,00 200,00 205,00 210,00 215,00 220,00 225,00 230,00
05
LO1
Continuum
Continuum
Continuum
Continuum
185,00 190,00 195,00 200,00 205,00 210,00 215,00 220,00 225,00 230,00
Rest Frequency
Overlays: Receiver Bands Transmission DSB Image Spectral Lines Select Lines to Overlay
Water Vapour Column Density: Automatic Choice Manual Choice 1.796mm (5th Octile)
Viewport: Pan to Spectral Window Zoom to Band Reset
Spectral Type
Spectral Type
Spectral Line
Single Continuum
Spectral Scan
Produce image sidebands (Bands 9 and 10 only)
Polarization products desired XX DUAL FULL
Receiver Band 5 [163.0–211.0 GHz]
Reset to Standard Frequency
New Cycle 5: when you click on this node you will now land on its visualizer tab
Overlaid lines are saved with the project
Bands 9,10 are DSB but you can correlate sidebands separately using 90° Walsh switching for 1875 MHz-wide line & continuum See below
Band 5 enabled, overlaps slightly with B4


ALMA Observing Tool (FEB2017) - Project
File Edit View Tool Search Help
Perspective 1
Project Structure
Proposal Program
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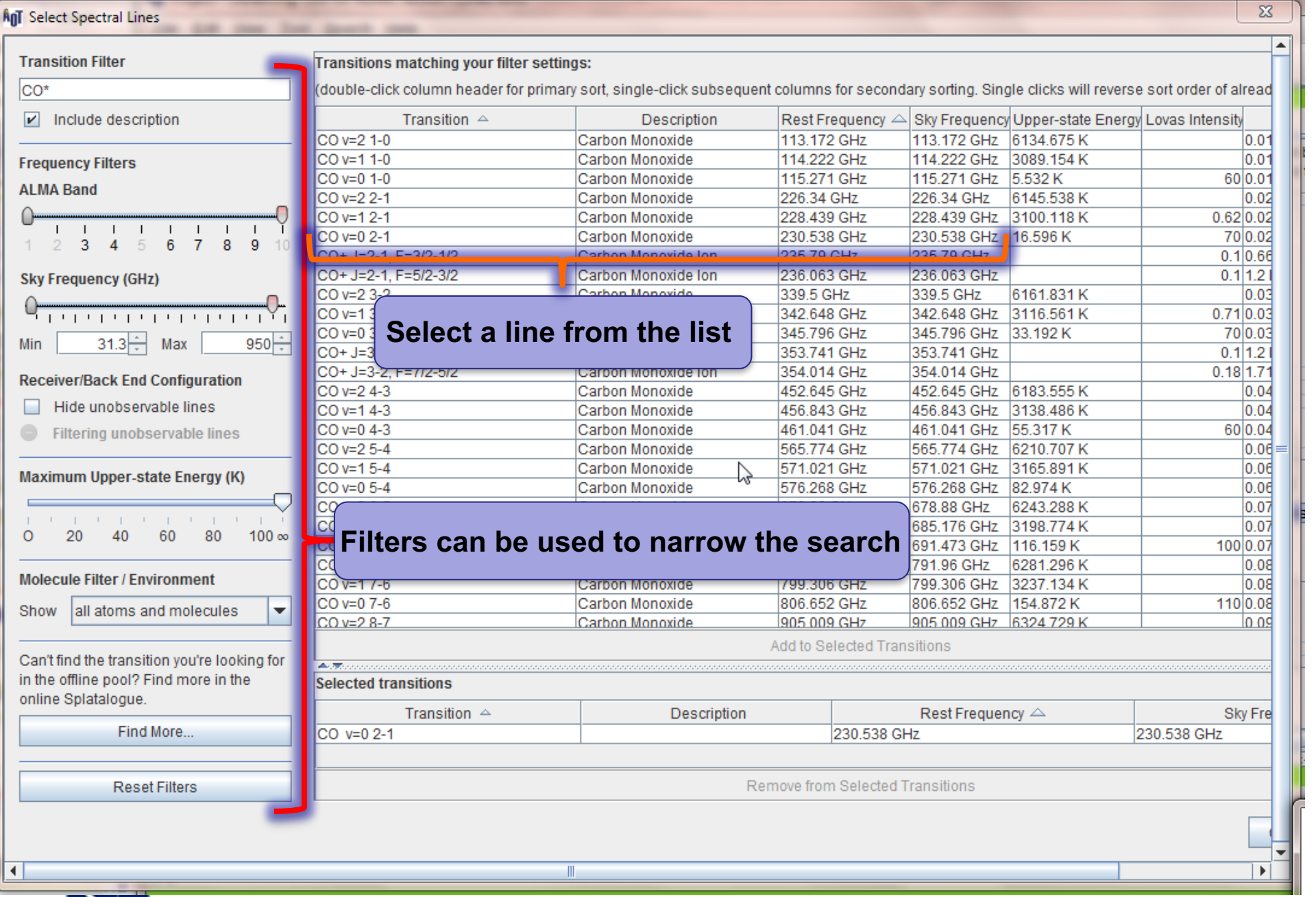
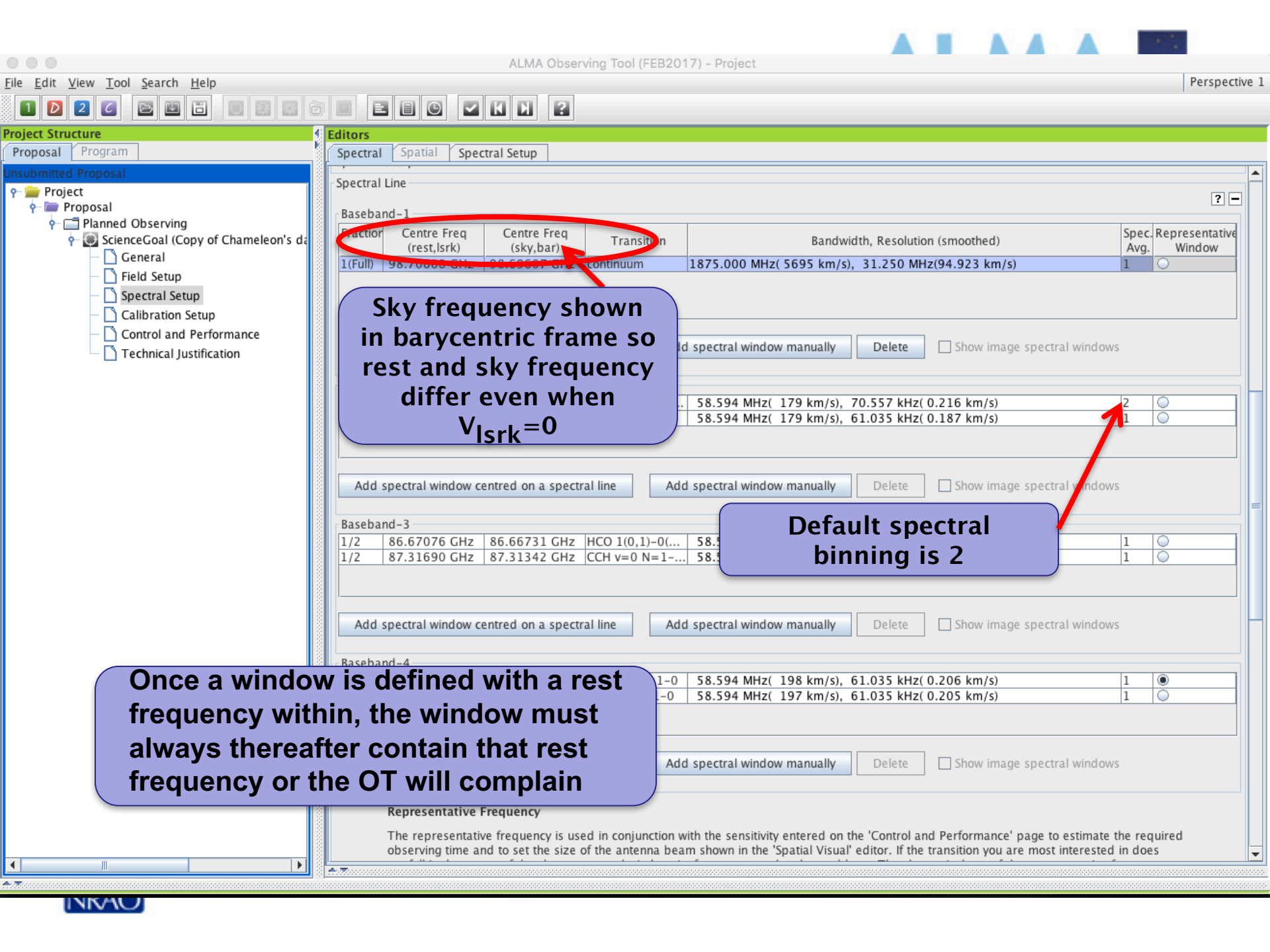
Proposal
Planned Observing
ScienceGoal (Copy of Chameleon's da
General
Field Setup
Spectral Setup
Calibration Setup
Control and Performance
Technical Justification
Editors
Spectral Spatial Spectral Setup
Spectral Line
Baseband-1
Fraction
Centre Freq (rest,lsrk)
Centre Freq (sky,bar)
Transition
Bandwidth, Resolutio
Representative Window
1(Full) 98.70000 GHz 98.69607 GHz continuum 1875.000 MHz(5695 km/s), 31.250 MH
Add spectral window centred on a spectral line
Add spectral window manually
Delete
Show image spectral windows
Baseband-2
1/2 97.99517 GHz 97.99127 GHz l-C3H v=0 J=9... 58.594 MHz(179 km/s), 70.557 kHz(0.216 km/s) 2
1/2 97.98095 GHz 97.97705 GHz CS v=0 2-1 58.594 MHz(179 km/s), 61.035 kHz(0.187 km/s) 1
Add spectral window centred on a spectral line
Add spectral window manually
Delete
Show image spectral windows
Baseband-3
1/2 86.67076 GHz 86.66731 GHz HCO 1(0,1)-0(... 58.594 MHz(203 km/s), 61.035 kHz(0.211 km/s) 1
1/2 87.31690 GHz 87.31342 GHz CCH v=0 N=1-... 58.594 MHz(201 km/s), 61.035 kHz(0.210 km/s) 1
Add spectral window centred on a spectral line
Add spectral window manually
Delete
Show image spectral windows
Baseband-4
Representative Frequency
The representative frequency is used in conjunction with the sensitivity entered on the 'Control and Performance' page to estimate the required observing time and to set the size of the antenna beam shown in the 'Spatial Visual' editor. If the transition you are most interested in does
1) ADD spectral windows to get started!
This option will call up a version of the spectral line picker. Windows added this way retain line id and other info from the Splatalogue
Frequencies may also be entered by hand

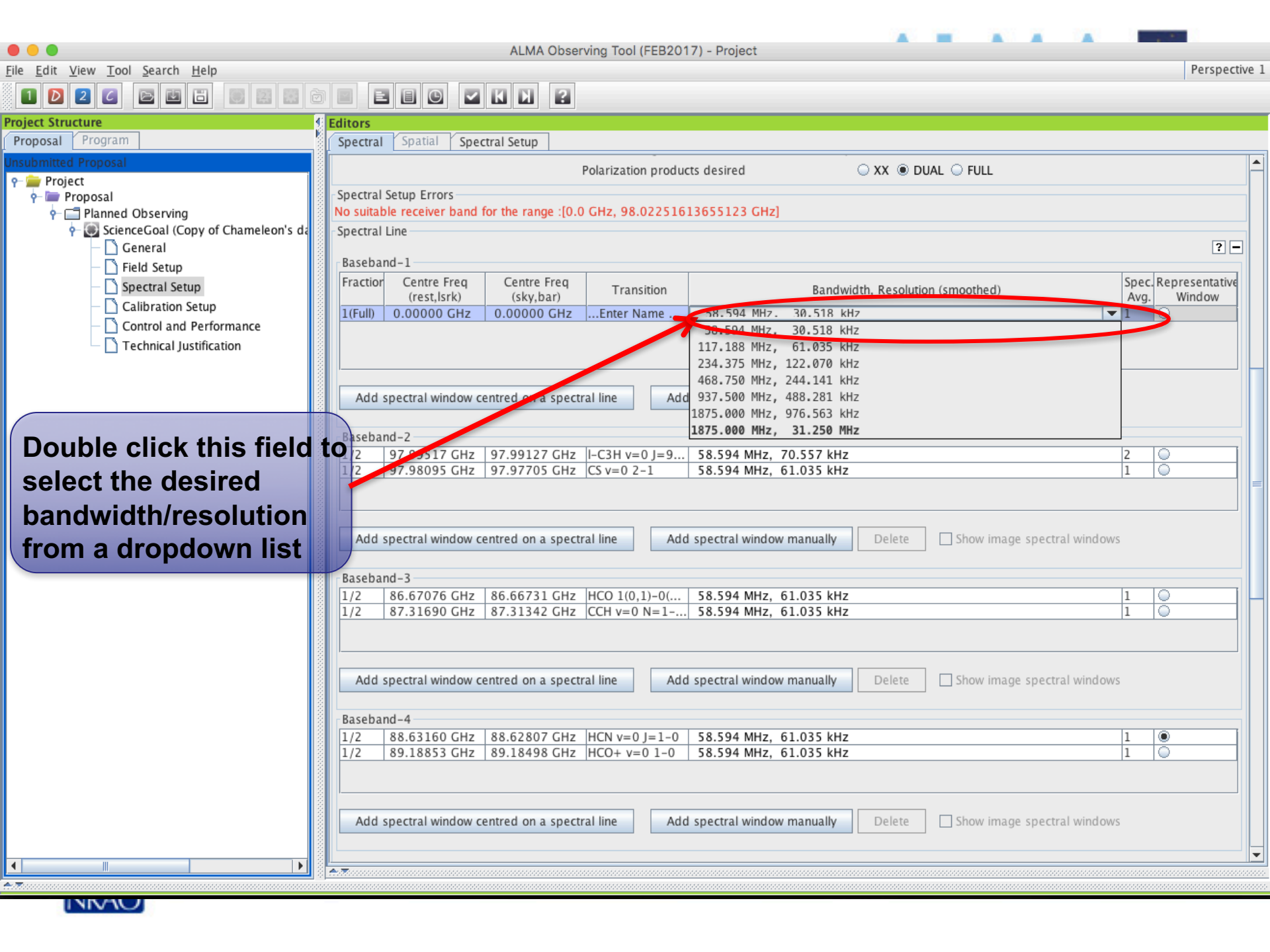

Select Spectral Lines
Transition Filter
CO*
Include description
Frequency Filters
ALMA Band
1 2 3 4 5 6 7 8 9 10
Sky Frequency (GHz)
Min 31.3 Max 950
Receiver/Back End Configuration
Hide unobservable lines
Filtering unobservable lines
Maximum Upper-state Energy (K)
0 20 40 60 80 100 ∞
Molecule Filter / Environment
Show all atoms and molecules
Can't find the transition you're looking for in the offline pool? Find more in the online Splatalogue.
Find More...
Reset Filters
Transitions matching your filter settings:
(double-click column header for primary sort, single-click subsequent columns for secondary sorting. Single clicks will reverse sort order of alread
Transition | Description | Rest Frequency | Sky Frequency | Upper-state Energy | Lovas Intensity
CO v=2 1-0 | Carbon Monoxide | 113.172 GHz | 113.172 GHz | 6134.675 K | 0.01
CO v=1 1-0 | Carbon Monoxide | 114.222 GHz | 114.222 GHz | 3089.154 K | 0.01
CO v=0 1-0 | Carbon Monoxide | 115.271 GHz | 115.271 GHz | 5.532 K | 60 | 0.01
CO v=2 2-1 | Carbon Monoxide | 226.34 GHz | 226.34 GHz | 6145.538 K | 0.02
CO v=1 2-1 | Carbon Monoxide | 228.439 GHz | 228.439 GHz | 3100.118 K | 0.62 | 0.02
CO v=0 2-1 | Carbon Monoxide | 230.538 GHz | 230.538 GHz | 16.596 K | 70 | 0.02
CO+ J=2-1, F=5/2-3/2 | Carbon Monoxide Ion | 236.063 GHz | 236.063 GHz | 0.1 | 1.2
CO v=2 3-2 | 339.5 GHz | 339.5 GHz | 6161.831 K | 0.03
CO v=1 3 | 342.648 GHz | 342.648 GHz | 3116.561 K | 0.71 | 0.03
CO v=0 3 | 345.796 GHz | 345.796 GHz | 33.192 K | 70 | 0.03
CO+ J=3 | 353.741 GHz | 353.741 GHz | 0.1 | 1.2
CO+ J=3-2, F=7/2-5/2 | 354.014 GHz | 354.014 GHz | 0.18 | 1.71
CO v=2 4-3 | Carbon Monoxide | 452.645 GHz | 452.645 GHz | 6183.555 K | 0.04
CO v=1 4-3 | Carbon Monoxide | 456.843 GHz | 456.843 GHz | 3138.486 K | 0.04
CO v=0 4-3 | Carbon Monoxide | 461.041 GHz | 461.041 GHz | 55.317 K | 60 | 0.04
CO v=2 5-4 | Carbon Monoxide | 565.774 GHz | 565.774 GHz | 6210.707 K | 0.06
CO v=1 5-4 | Carbon Monoxide | 571.021 GHz | 571.021 GHz | 3165.891 K | 0.06
CO v=0 5-4 | Carbon Monoxide | 576.268 GHz | 576.268 GHz | 82.974 K | 0.06
678.88 GHz | 6243.288 K | 0.07
685.176 GHz | 3198.774 K | 0.07
691.473 GHz | 116.159 K | 100 | 0.07
791.96 GHz | 6281.296 K | 0.08
CO v=1 7-6 | Carbon Monoxide | 799.306 GHz | 799.306 GHz | 3237.134 K | 0.08
CO v=0 7-6 | Carbon Monoxide | 806.652 GHz | 806.652 GHz | 154.872 K | 110 | 0.08
CO v=2 8-7 | Carbon Monoxide | 905.009 GHz | 905.009 GHz | 6324.729 K | 0.09
Add to Selected Transitions
Selected transitions
Transition | Description | Rest Frequency | Sky Fre
CO v=0 2-1 | 230.538 GHz | 230.538 GHz
Remove from Selected Transitions
Select a line from the list
Filters can be used to narrow the search



Sky frequency shown in barycentric frame so rest and sky frequency differ even when $V_{lsrk}=0$

Default spectral binning is 2

Once a window is defined with a rest frequency within, the window must always thereafter contain that rest frequency or the OT will complain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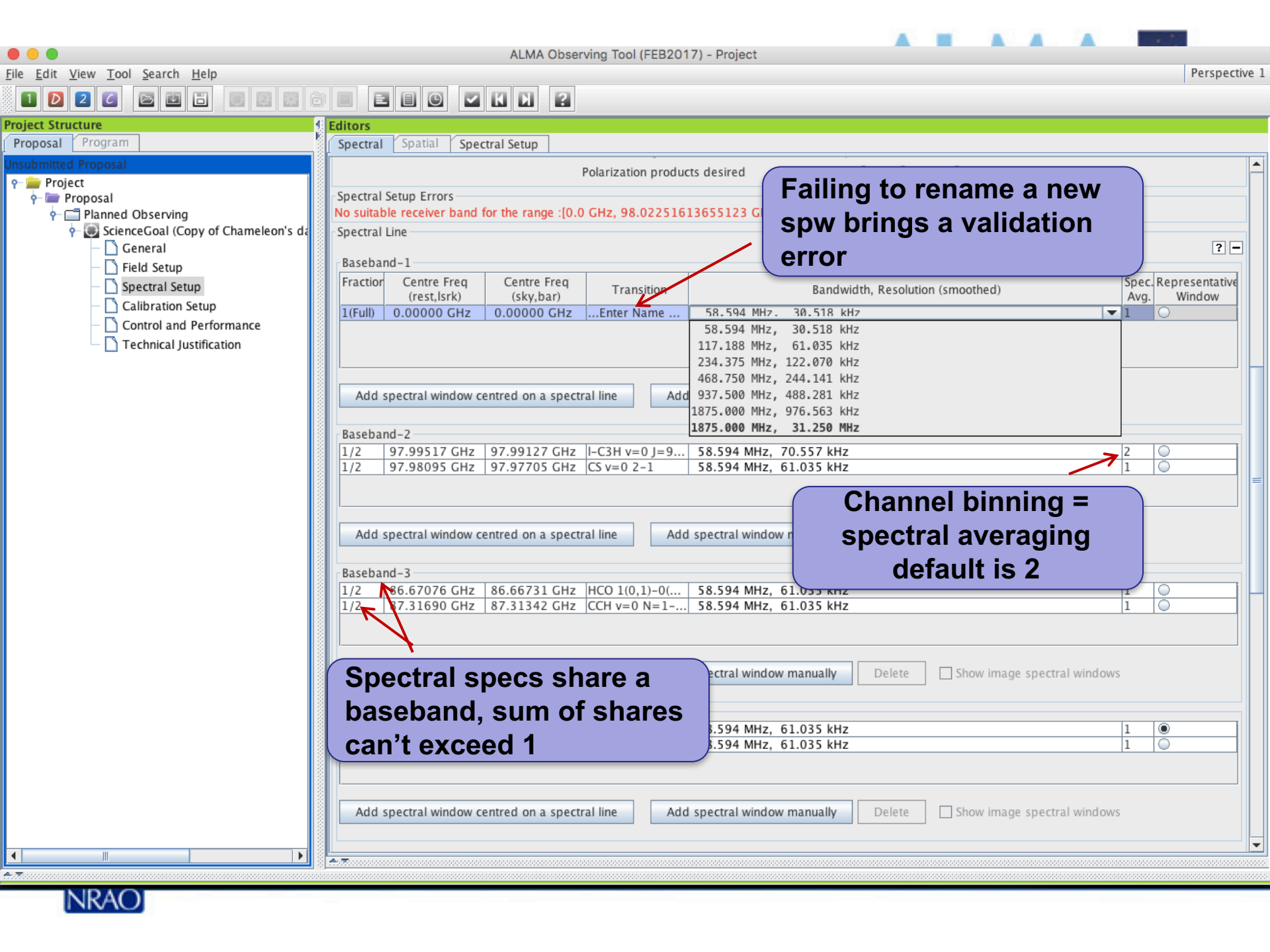
Polarization products desired
XX DUAL FULL
Spectral Setup Errors
No suitable receiver band for the range :[0.0 GHz, 98.02251613655123 GHz]
Spectral Line
Baseband-1
Fraction
Centre Freq (rest,lsrk)
Centre Freq (sky,bar)
Transition
Bandwidth, Resolution (smoothed)
Spec. Avg.
Representative Window
1(Full)
0.00000 GHz
0.00000 GHz
...Enter Name ...
58.594 MHz, 30.518 kHz
58.594 MHz, 30.518 kHz
117.188 MHz, 61.035 kHz
234.375 MHz, 122.070 kHz
468.750 MHz, 244.141 kHz
937.500 MHz, 488.281 kHz
1875.000 MHz, 976.563 kHz
1875.000 MHz, 31.250 MHz
Add spectral window centred on a spectral line
Add spectral window manually
Delete
Show image spectral windows
Baseband-2
1/2
97.99127 GHz
97.97705 GHz
l-C3H v=0 J=9...
58.594 MHz, 70.557 kHz
CS v=0 2-1
58.594 MHz, 61.035 kHz
Baseband-3
1/2
86.67076 GHz
86.66731 GHz
HCO 1(0,1)-0(...
58.594 MHz, 61.035 kHz
87.31690 GHz
87.31342 GHz
CCH v=0 N=1-...
Baseband-4
88.63160 GHz
88.62807 GHz
HCN v=0 J=1-0
89.18853 GHz
89.18498 GHz
HCO+ v=0 1-0
Double click this field to select the desired bandwidth/resolution from a dropdown list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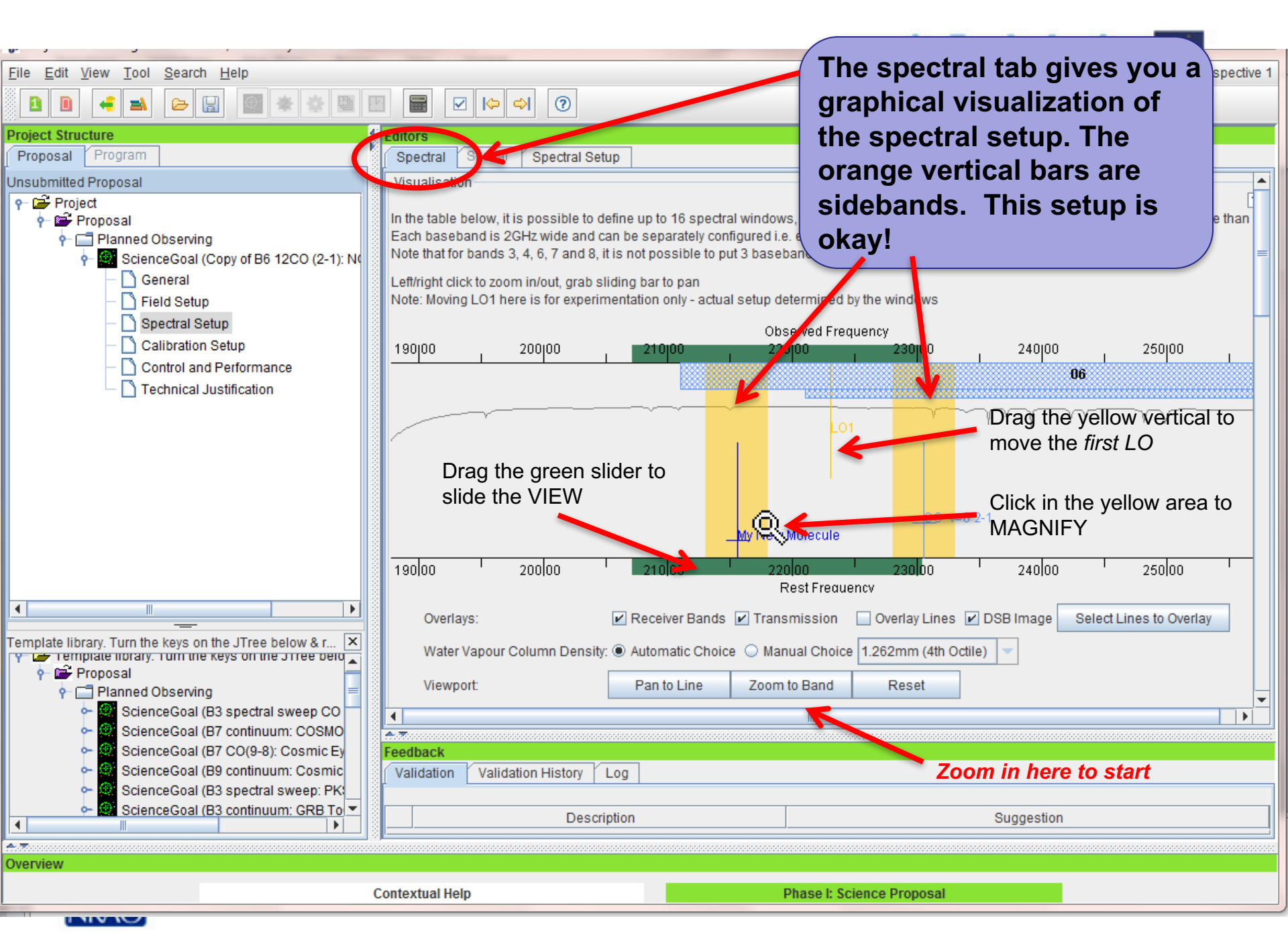
Spectral Spatial Spectral Setup
Polarization products desired
Spectral Setup Errors
No suitable receiver band for the range :[0.0 GHz, 98.02251613655123 G
Spectral Line
Baseband-1
Fraction
Centre Freq (rest,lsrk)
Centre Freq (sky,bar)
Transition
Bandwidth, Resolution (smoothed)
Spec. Avg.
Representative Window
1(Full) 0.00000 GHz 0.00000 GHz ...Enter Name ... 58.594 MHz, 30.518 kHz 1
58.594 MHz, 30.518 kHz
117.188 MHz, 61.035 kHz
234.375 MHz, 122.070 kHz
468.750 MHz, 244.141 kHz
937.500 MHz, 488.281 kHz
1875.000 MHz, 976.563 kHz
1875.000 MHz, 31.250 MHz
Add spectral window centred on a spectral line
Add
Baseband-2
1/2 97.99517 GHz 97.99127 GHz l-C3H v=0 J=9... 58.594 MHz, 70.557 kHz 2
1/2 97.98095 GHz 97.97705 GHz CS v=0 2-1 58.594 MHz, 61.035 kHz 1
Add spectral window centred on a spectral line
Add spectral window m
Baseband-3
1/2 86.67076 GHz 86.66731 GHz HCO 1(0,1)-0(... 58.594 MHz, 61.035 kHz 1
1/2 87.31690 GHz 87.31342 GHz CCH v=0 N=1-... 58.594 MHz, 61.035 kHz 1
ectral window manually
Delete
Show image spectral windows
8.594 MHz, 61.035 kHz 1
8.594 MHz, 61.035 kHz 1
Add spectral window centred on a spectral line
Add spectral window manually
Delete
Show image spectral windows
Failing to rename a new spw brings a validation error
Channel binning = spectral averaging default is 2
Spectral specs share a baseband, sum of shares can't exceed 1
NRAO


The spectral tab gives you a graphical visualization of the spectral setup. The orange vertical bars are sidebands. This setup is okay!
Drag the yellow vertical to move the first LO
Drag the green slider to slide the VIEW
Click in the yellow area to MAGNIFY
Zoom in here to start
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Spectral Setup
Visualisation
In the table below, it is possible to define up to 16 spectral windows,
Each baseband is 2GHz wide and can be separately configured i.e.
Note that for bands 3, 4, 6, 7 and 8, it is not possible to put 3 baseban
Left/right click to zoom in/out, grab sliding bar to pan
Note: Moving LO1 here is for experimentation only - actual setup determined by the windows
Observed Frequency
190|00
200|00
210|00
220|00
230|00
240|00
250|00
06
LO1
Rest Frequency
Overlays:
Receiver Bands
Transmission
Overlay Lines
DSB Image
Select Lines to Overlay
Water Vapour Column Density:
Automatic Choice
Manual Choice
1.262mm (4th Octile)
Viewport:
Pan to Line
Zoom to Band
Reset
Feedback
Validation
Validation History
Log
Description
Suggestion
Template library. Turn the keys on the JTree below & r...
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ScienceGoal (B3 spectral sweep CO
ScienceGoal (B7 continuum: COSMO
ScienceGoal (B7 CO(9-8): Cosmic Ey
ScienceGoal (B9 continuum: Cosmic
ScienceGoal (B3 spectral sweep: PK
ScienceGoal (B3 continuum: GRB To
Overview
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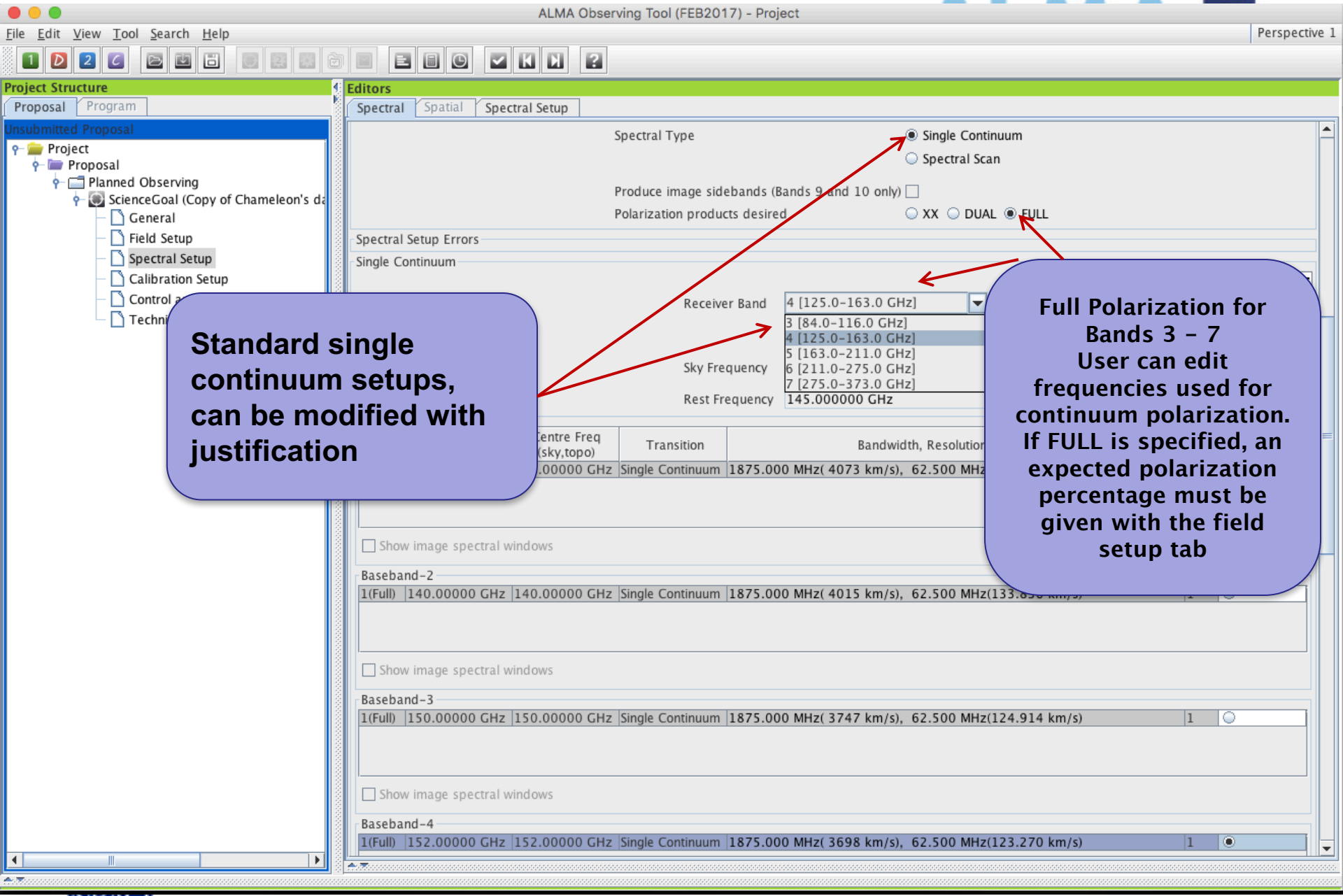
Phase I: Science Proposal

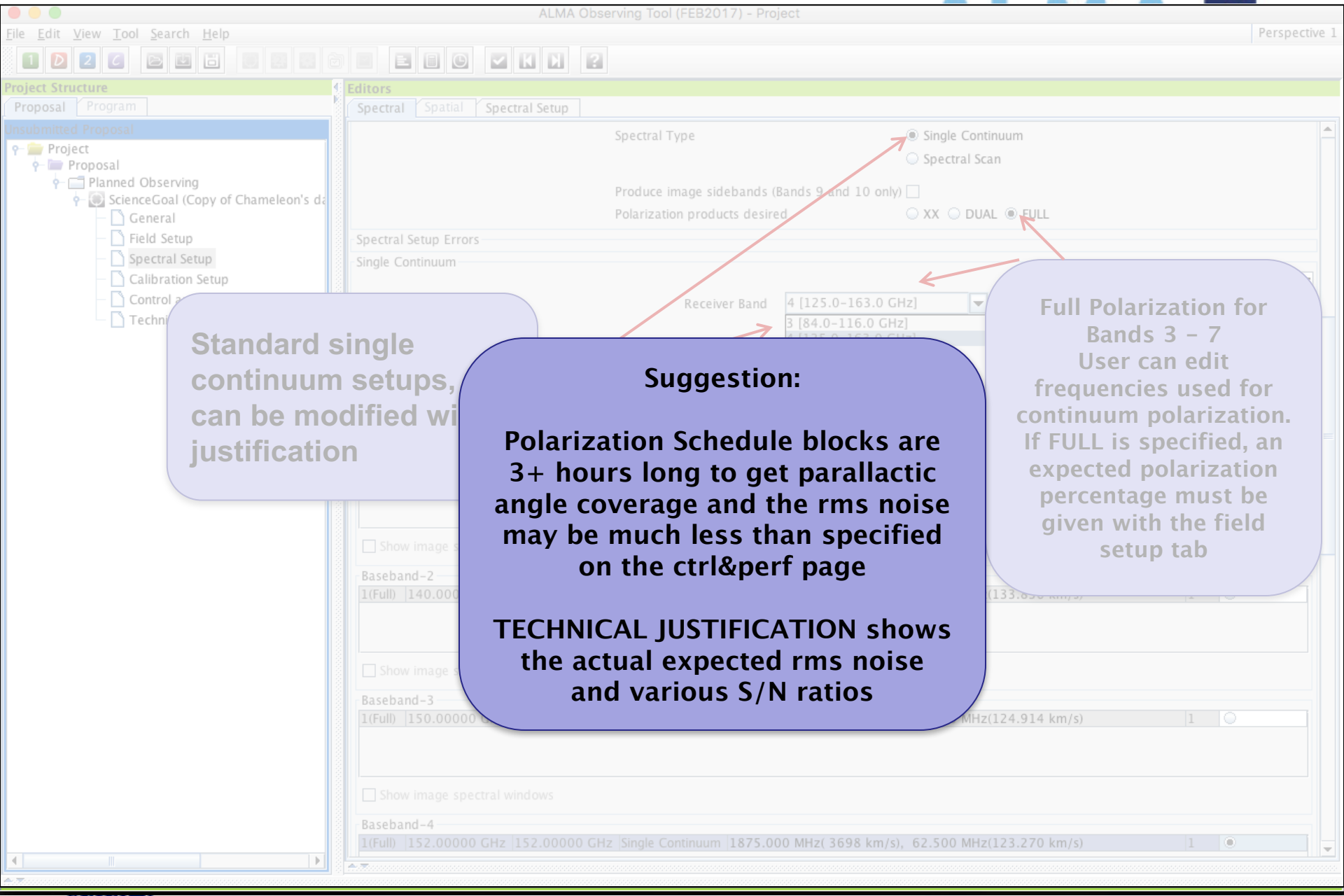
Full Continuum & Polarization



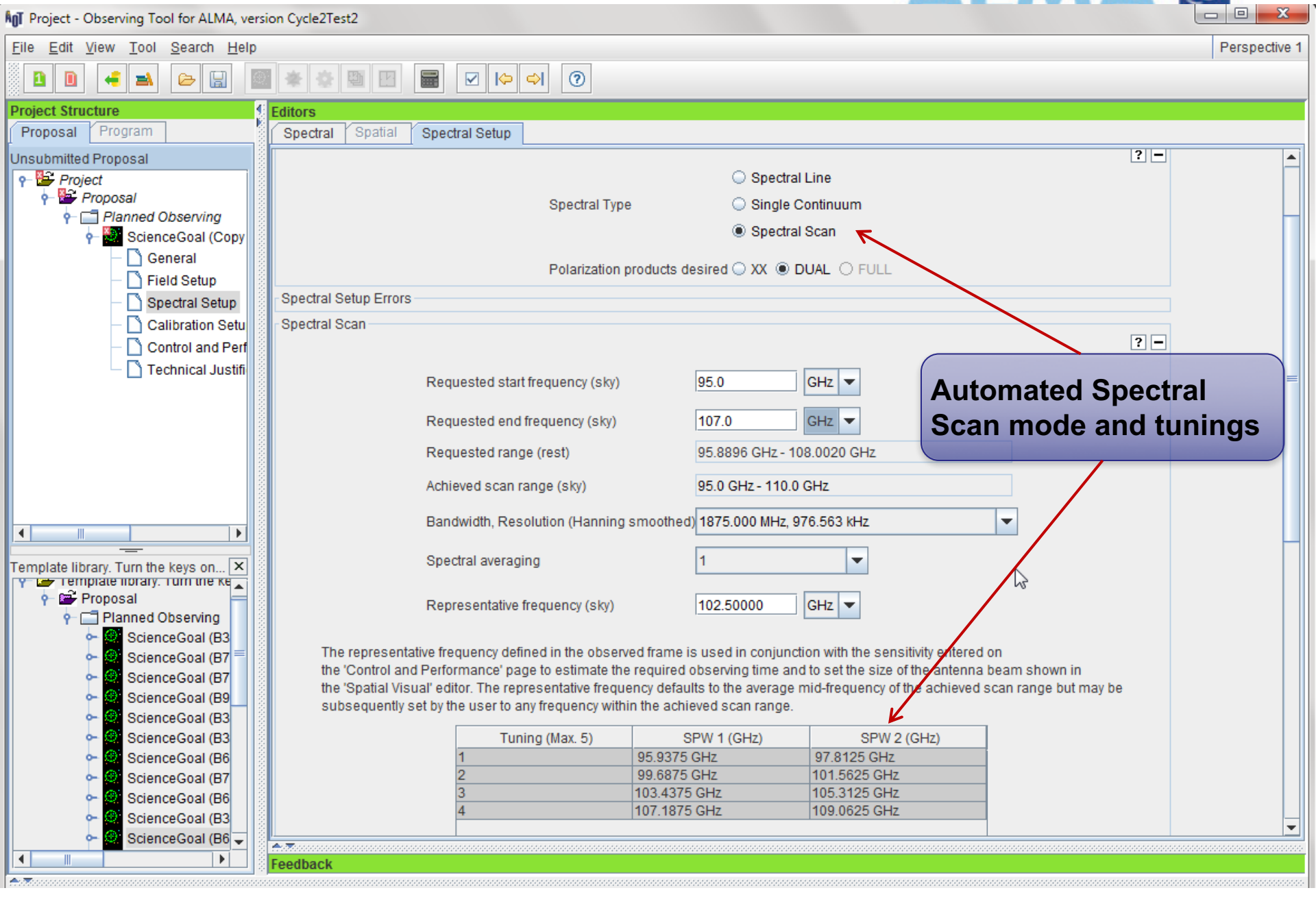
Standard single continuum setups, can be modified with justification

Full Polarization for Bands 3 – 7
User can edit frequencies used for continuum polarization. If FULL is specified, an expected polarization percentage must be given with the field setup tab

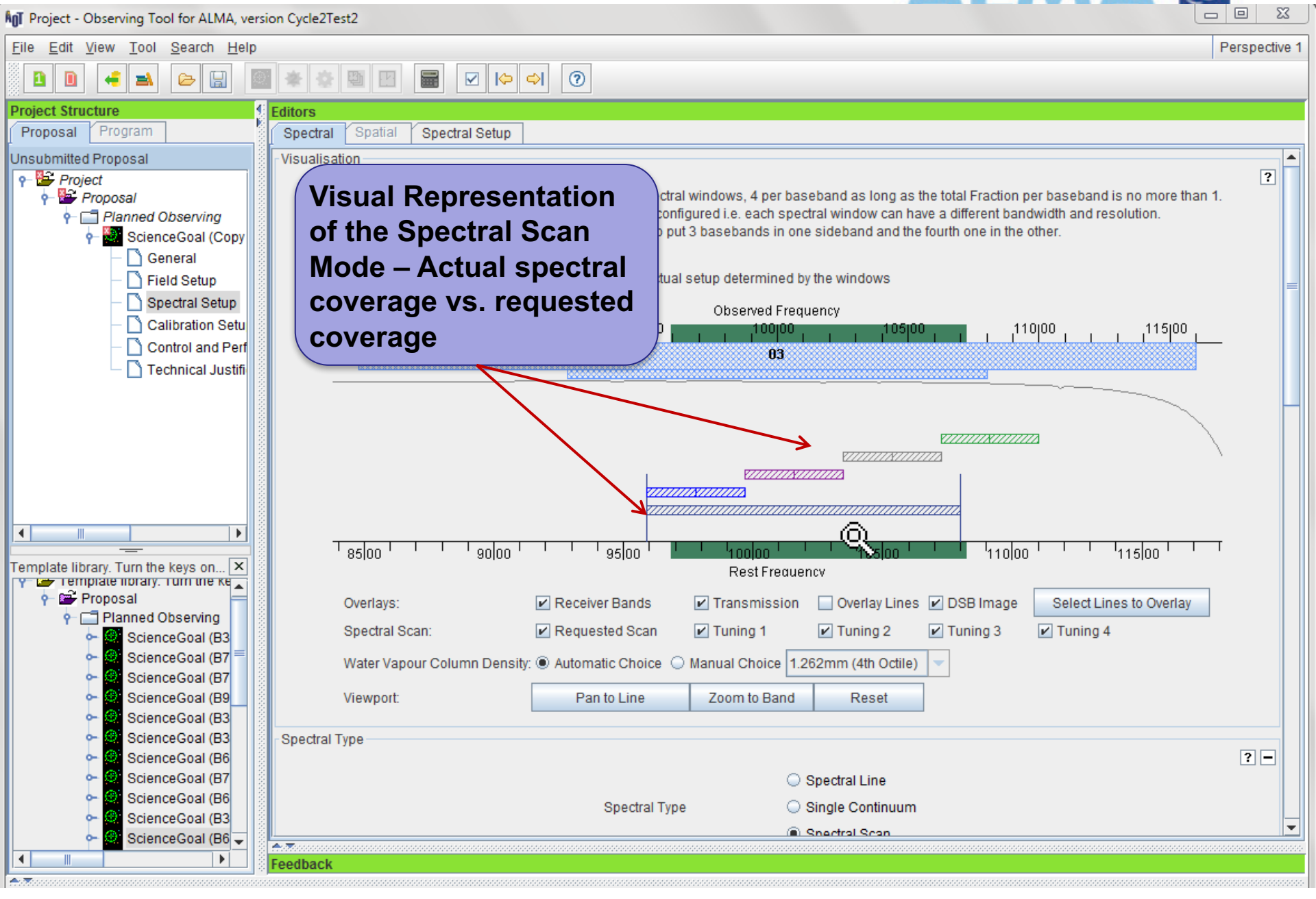
Full Continuum & Polarization



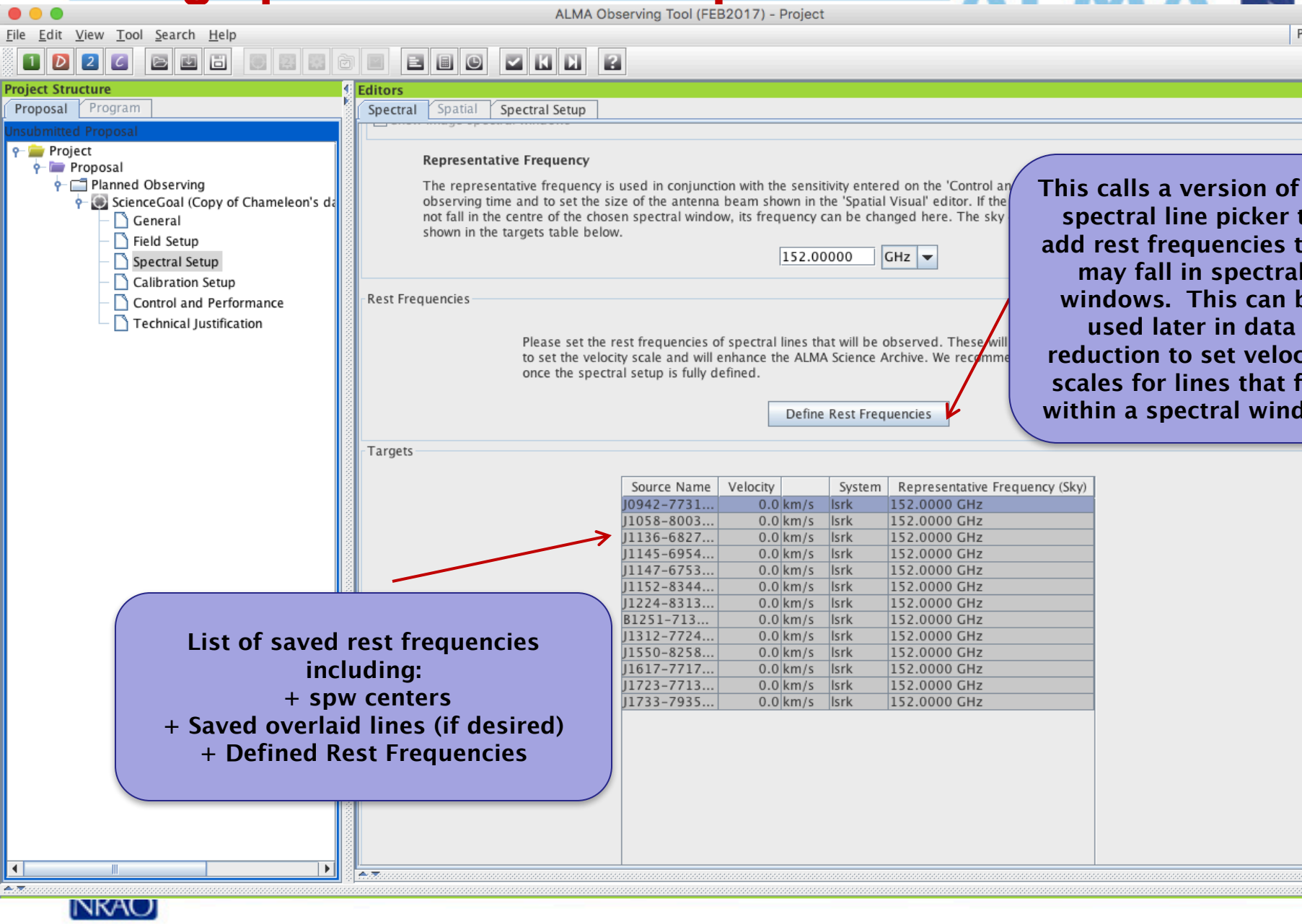
Automated spectral scan - I



Automated spectral scan - II



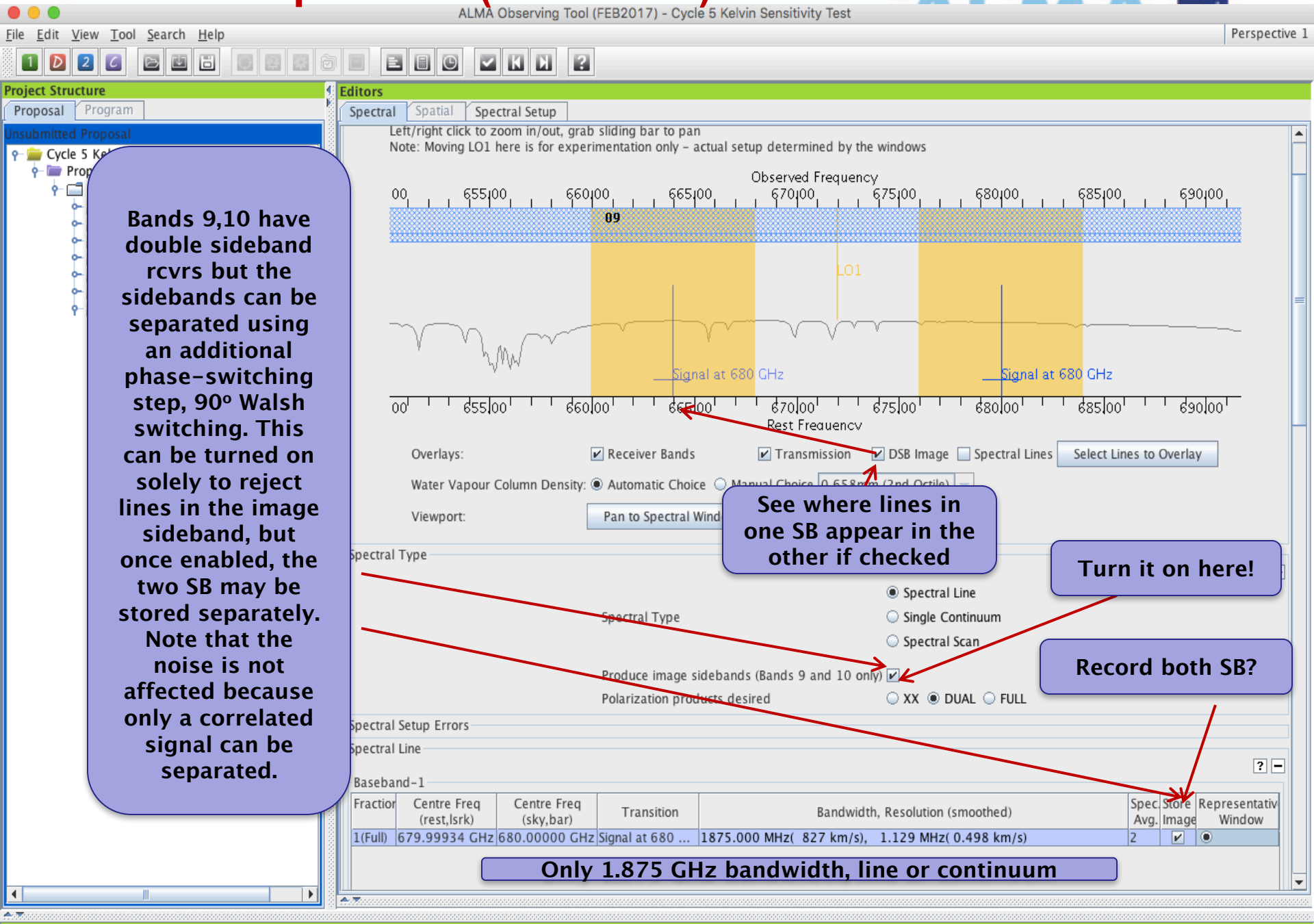
Saving spw & line rest frequencies

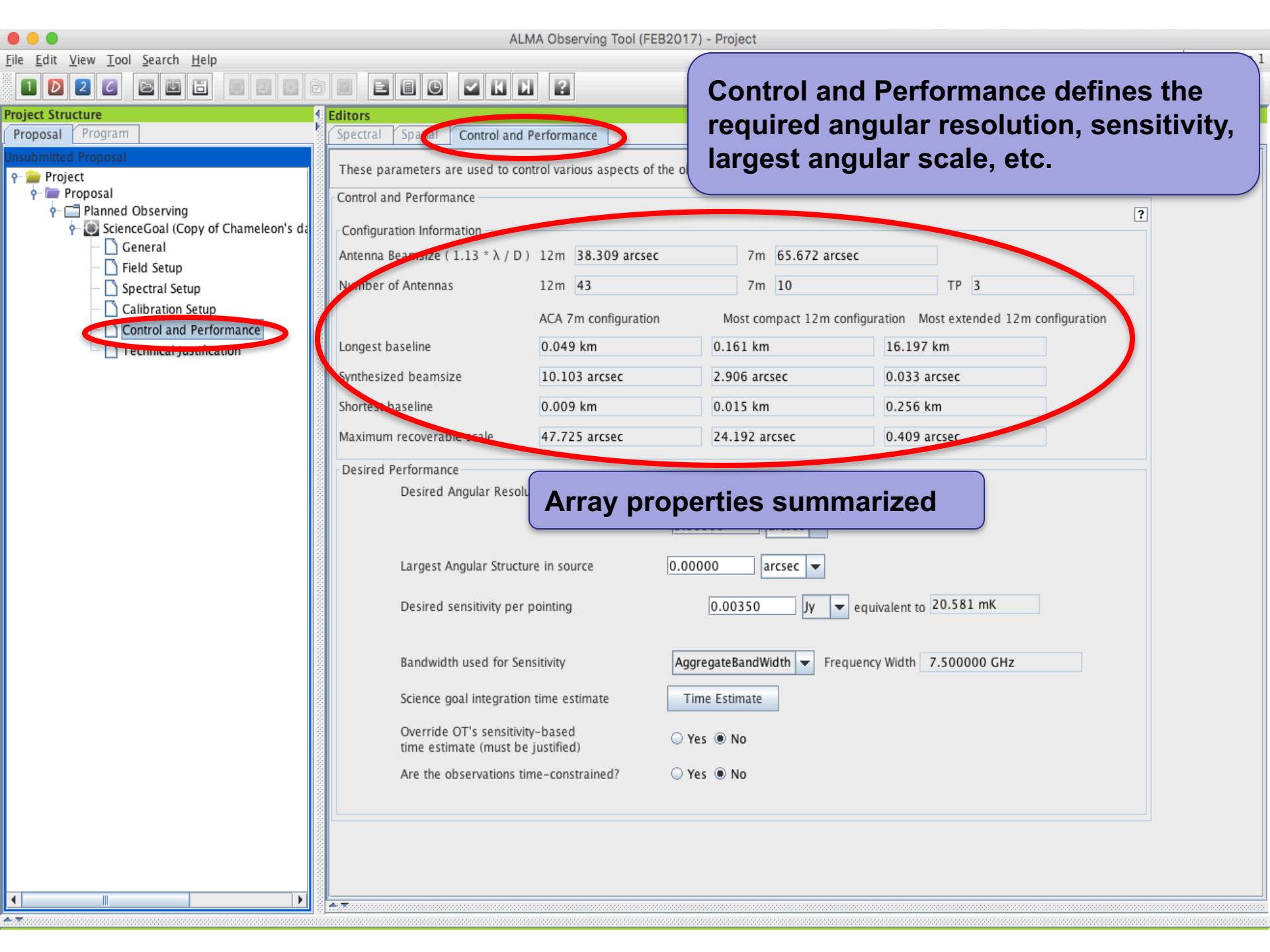


This calls a version of the spectral line picker to add rest frequencies that may fall in spectral windows. This can be used later in data reduction to set velocity scales for lines that fall within a spectral window

List of saved rest frequencies including:
+ spw centers
+ Saved overlaid lines (if desired)
+ Defined Rest Frequencies

Sideband separation (90º Walsh)

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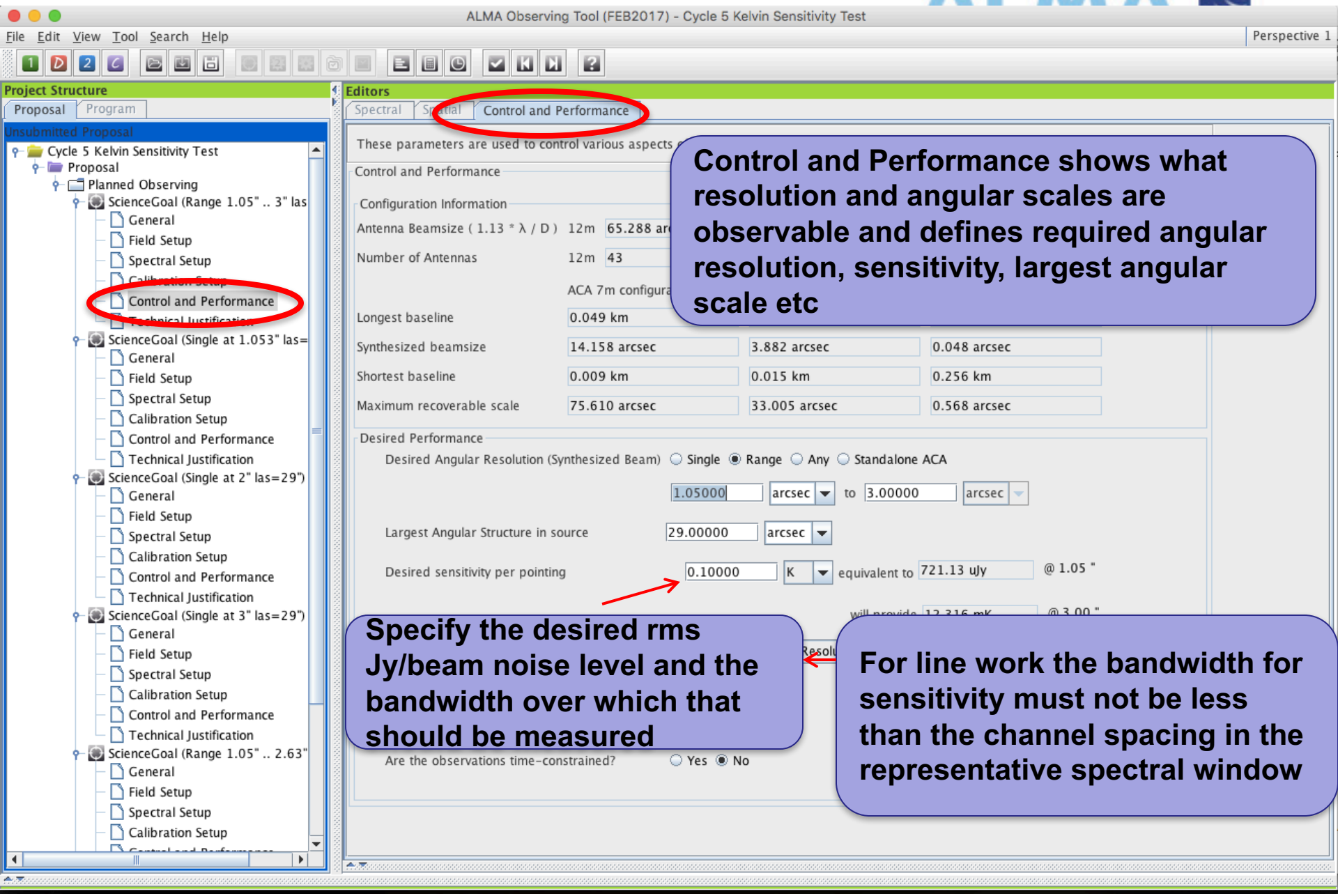
These parameters are used to control various aspects of the o
Control and Performance
Configuration Information
Antenna Beamsize (1.13 * λ / D) 12m 38.309 arcsec 7m 65.672 arcsec
Number of Antennas 12m 43 7m 10 TP 3
ACA 7m configuration
Most compact 12m configuration
Most extended 12m configuration
Longest baseline 0.049 km 0.161 km 16.197 km
Synthesized beamsize 10.103 arcsec 2.906 arcsec 0.033 arcsec
Shortest baseline 0.009 km 0.015 km 0.256 km
Maximum recoverable scale 47.725 arcsec 24.192 arcsec 0.409 arcsec
Desired Performance
Largest Angular Structure in source 0.00000 arcsec
Desired sensitivity per pointing 0.00350 Jy equivalent to 20.581 mK
Bandwidth used for Sensitivity AggregateBandWidth Frequency Width 7.500000 GHz
Science goal integration time estimate Time Estimate
Override OT's sensitivity-based time estimate (must be justified) Yes No
Are the observations time-constrained? Yes No
Control and Performance defines the required angular resolution, sensitivity, largest angular scale, etc.
Array properties summarized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Technical Justification
ScienceGoal (Single at 2" las=29")
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Calibration Setup
Control and Performance
Technical Justification
ScienceGoal (Single at 3" las=29")
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ScienceGoal (Range 1.05" .. 2.63"
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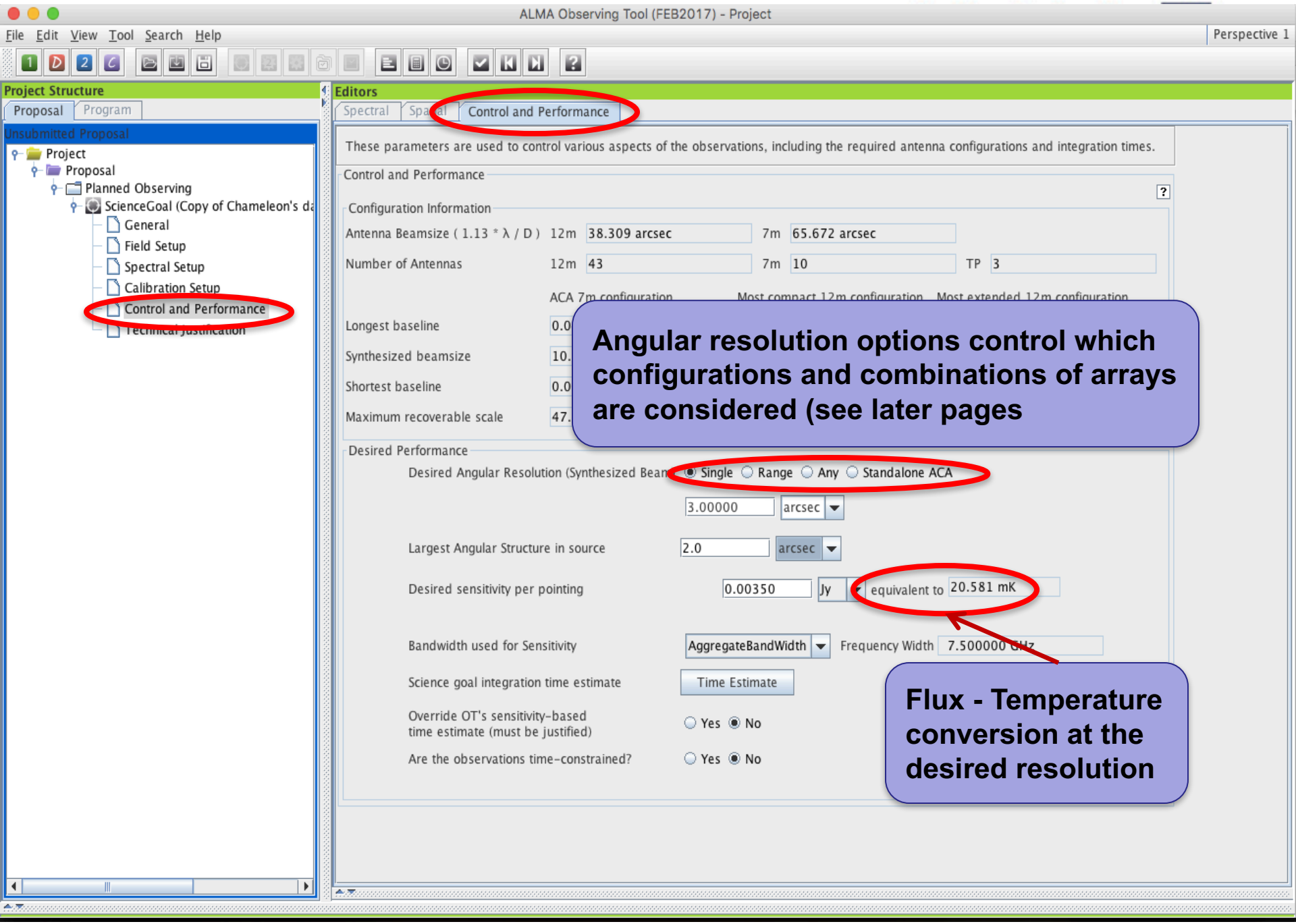
Control and Performance
These parameters are used to control various aspects
Control and Performance
Configuration Information
Antenna Beamsize (1.13 * λ / D) 12m 65.288 ar
Number of Antennas 12m 43
ACA 7m configura
Longest baseline 0.049 km
Synthesized beamsize 14.158 arcsec 3.882 arcsec 0.048 arcsec
Shortest baseline 0.009 km 0.015 km 0.256 km
Maximum recoverable scale 75.610 arcsec 33.005 arcsec 0.568 arcsec
Desired Performance
Desired Angular Resolution (Synthesized Beam) Single Range Any Standalone ACA
1.05000 arcsec to 3.00000 arcsec
Largest Angular Structure in source 29.00000 arcsec
Desired sensitivity per pointing 0.10000 K equivalent to 721.13 uJy @ 1.05 "
Are the observations time-constrained? Yes No
Control and Performance shows what resolution and angular scales are observable and defines required angular resolution, sensitivity, largest angular scale etc
Specify the desired rms Jy/beam noise level and the bandwidth over which that should be measured
For line work the bandwidth for sensitivity must not be less than the channel spacing in the representative spectral window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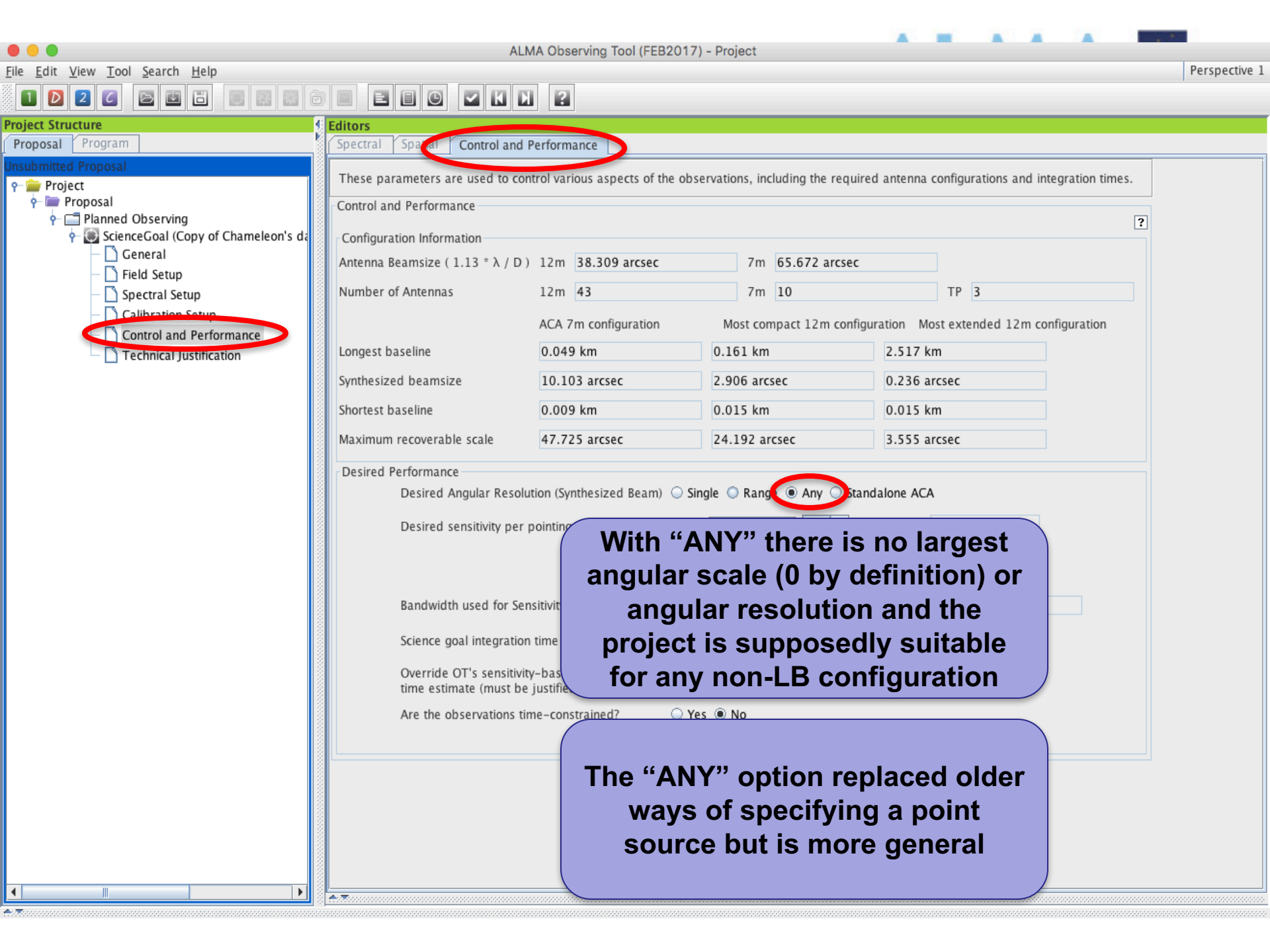
Spectral Spatial Control and Performance
These parameters are used to control various aspects of the observations, including the required antenna configurations and integration times.
Control and Performance
Configuration Information
Antenna Beamsize (1.13 * λ / D) 12m 38.309 arcsec 7m 65.672 arcsec
Number of Antennas 12m 43 7m 10 TP 3
ACA 7m configuration
Most compact 12m configuration
Most extended 12m configuration
Longest baseline
Synthesized beamsize
Shortest baseline
Maximum recoverable scale
Angular resolution options control which configurations and combinations of arrays are considered (see later pages
Desired Performance
Desired Angular Resolution (Synthesized Bean Single Range Any Standalone ACA
3.00000 arcsec
Largest Angular Structure in source 2.0 arcsec
Desired sensitivity per pointing 0.00350 Jy equivalent to 20.581 mK
Bandwidth used for Sensitivity AggregateBandWidth Frequency Width 7.500000 GHz
Science goal integration time estimate Time Estimate
Override OT's sensitivity-based time estimate (must be justified) Yes No
Are the observations time-constrained? Yes No
Flux - Temperature conversion at the desired resolution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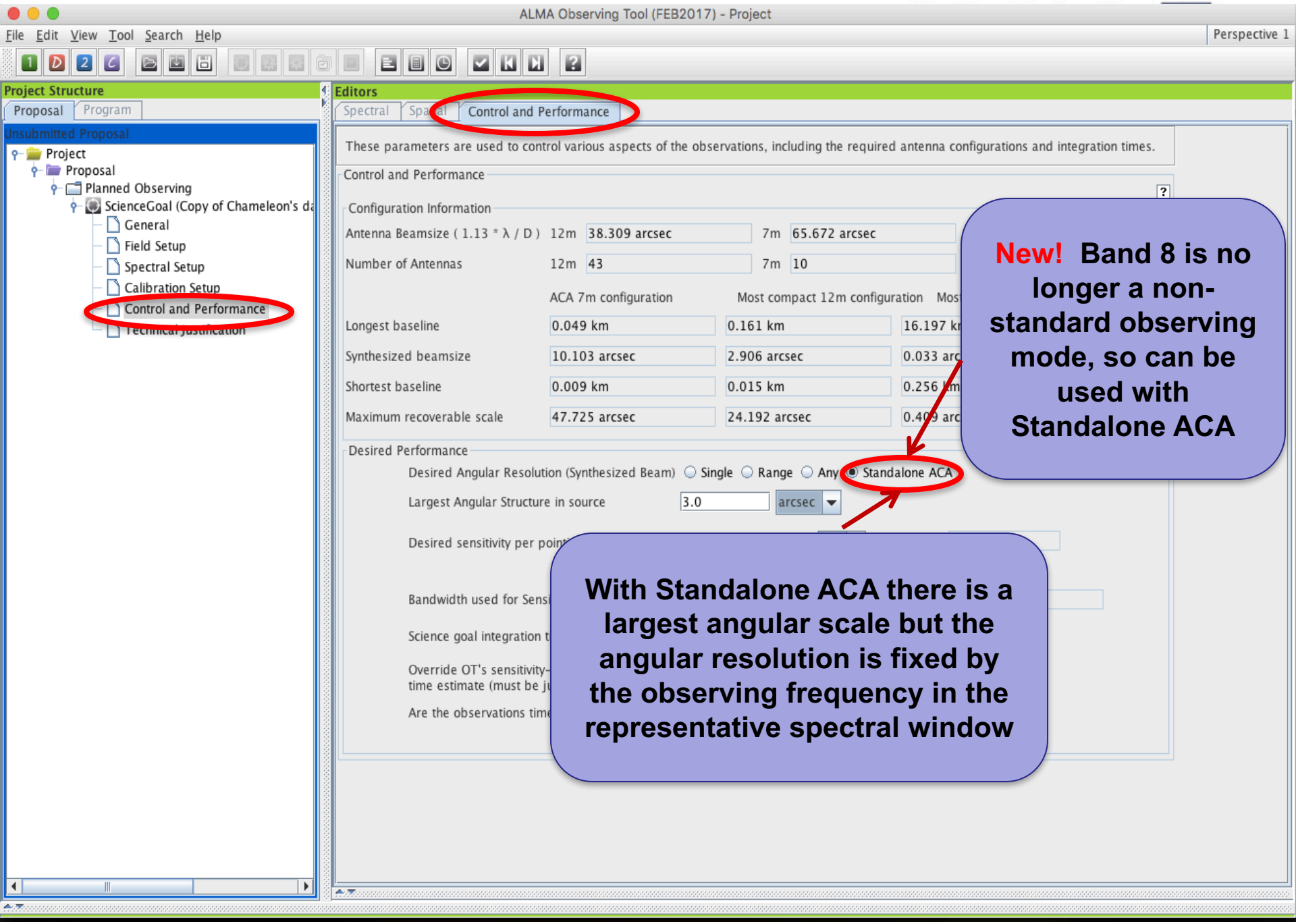
Spatial
Control and Performance
These parameters are used to control various aspects of the observations, including the required antenna configurations and integration times.
Control and Performance
Configuration Information
Antenna Beamsize (1.13 * λ / D) 12m 38.309 arcsec 7m 65.672 arcsec
Number of Antennas 12m 43 7m 10 TP 3
ACA 7m configuration
Most compact 12m configuration
Most extended 12m configuration
Longest baseline 0.049 km 0.161 km 2.517 km
Synthesized beamsize 10.103 arcsec 2.906 arcsec 0.236 arcsec
Shortest baseline 0.009 km 0.015 km 0.015 km
Maximum recoverable scale 47.725 arcsec 24.192 arcsec 3.555 arcsec
Desired Performance
Desired Angular Resolution (Synthesized Beam) Single Rang Any Standalone ACA
Desired sensitivity per pointing
Bandwidth used for Sensitivit
Science goal integration time
Override OT's sensitivity-bas
time estimate (must be justifie
Are the observations time-constrained? Yes No
With “ANY” there is no largest angular scale (0 by definition) or angular resolution and the project is supposedly suitable for any non-LB configuration
The “ANY” option replaced older ways of specifying a point source but is more general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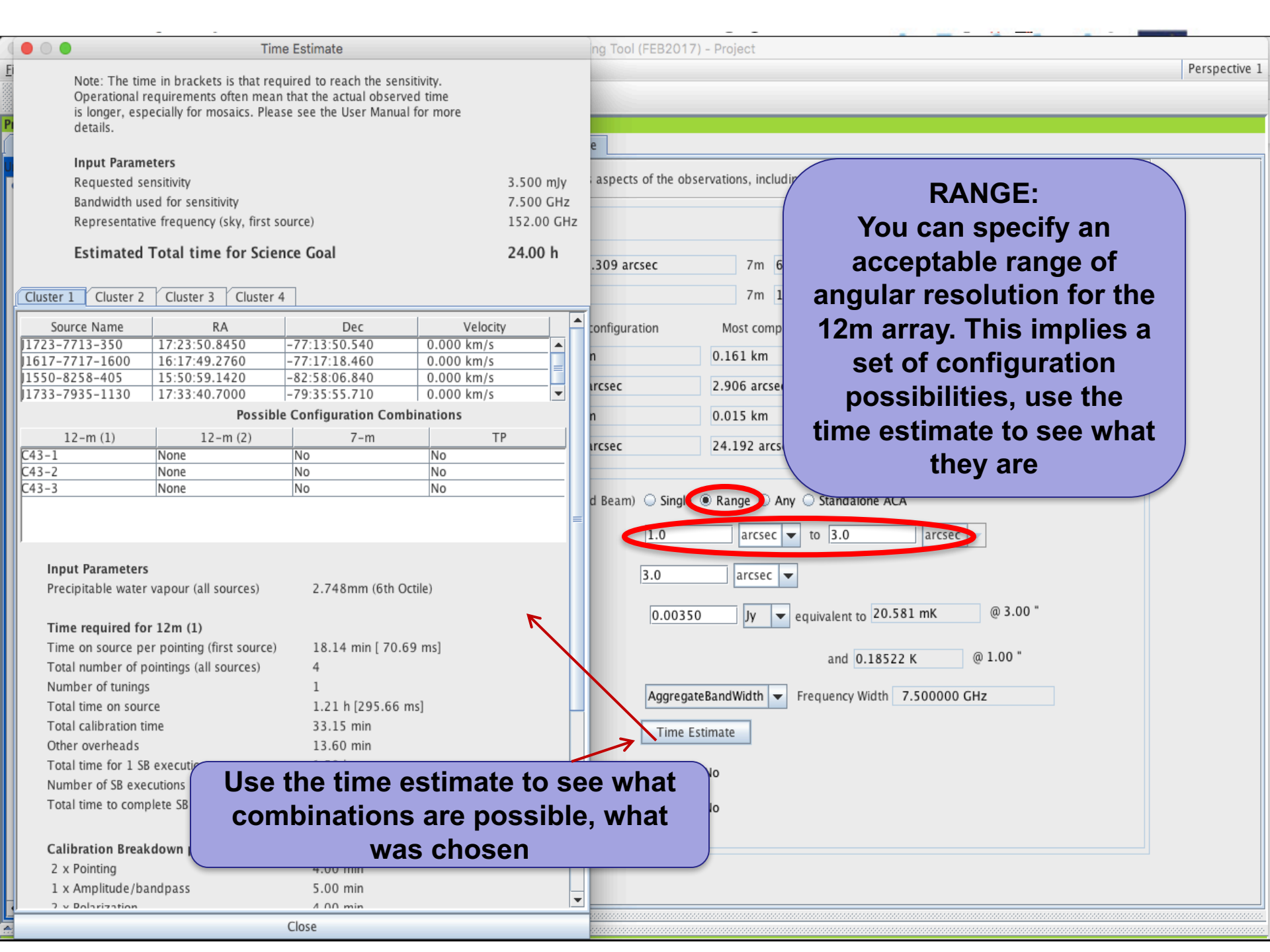
Spectral Spatial Control and Performance
These parameters are used to control various aspects of the observations, including the required antenna configurations and integration times.
Control and Performance
Configuration Information
Antenna Beamsize (1.13 * λ / D) 12m 38.309 arcsec 7m 65.672 arcsec
Number of Antennas 12m 43 7m 10
ACA 7m configuration
Most compact 12m configuration
Longest baseline 0.049 km 0.161 km
Synthesized beamsize 10.103 arcsec 2.906 arcsec
Shortest baseline 0.009 km 0.015 km
Maximum recoverable scale 47.725 arcsec 24.192 arcsec
Desired Performance
Desired Angular Resolution (Synthesized Beam) Single Range Any Standalone ACA
Largest Angular Structure in source 3.0 arcsec
Desired sensitivity per point
Bandwidth used for Sensi
Science goal integration t
Override OT's sensitivity-
time estimate (must be ju
Are the observations time
New! Band 8 is no longer a non-standard observing mode, so can be used with Standalone ACA
With Standalone ACA there is a largest angular scale but the angular resolution is fixed by the observing frequency in the representative spectral window


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 3.500 mJy
Bandwidth used for sensitivity 7.500 GHz
Representative frequency (sky, first source) 152.00 GHz
Estimated Total time for Science Goal 24.00 h
Cluster 1
Cluster 2
Cluster 3
Cluster 4
Source Name | RA | Dec | Velocity
J1723-7713-350 | 17:23:50.8450 | -77:13:50.540 | 0.000 km/s
J1617-7717-1600 | 16:17:49.2760 | -77:17:18.460 | 0.000 km/s
J1550-8258-405 | 15:50:59.1420 | -82:58:06.840 | 0.000 km/s
J1733-7935-1130 | 17:33:40.7000 | -79:35:55.710 | 0.000 km/s
Possible Configuration Combinations
12-m (1) | 12-m (2) | 7-m | TP
C43-1 | None | No | No
C43-2 | None | No | No
C43-3 | None | No | No
Input Parameters
Precipitable water vapour (all sources) 2.748mm (6th Octile)
Time required for 12m (1)
Time on source per pointing (first source) 18.14 min [70.69 ms]
Total number of pointings (all sources) 4
Number of tunings 1
Total time on source 1.21 h [295.66 ms]
Total calibration time 33.15 min
Other overheads 13.60 min
Number of SB executions
Total time to complete SB
Calibration Breakdown
2 x Pointing
1 x Amplitude/bandpass 5.00 min
Close
RANGE:
You can specify an acceptable range of angular resolution for the 12m array. This implies a set of configuration possibilities, use the time estimate to see what they are
Range
Any
Standalone ACA
1.0 arcsec to 3.0 arcsec
3.0 arcsec
0.00350 Jy equivalent to 20.581 mK @ 3.00 "
and 0.18522 K @ 1.00 "
AggregateBandWidth Frequency Width 7.500000 GHz
Time Estimate
Use the time estimate to see what combinations are possible, what was chosen
Perspective 1

Project Summary

Total and Calibration Times

Science Goal	12-m (1)		12-m (2)		12-m (1+2)		ACA 7-m		ACA TP		Overall		Non-standard Mode
	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	
At ar 1"	1.03 d	6.21 h	9.92 h	2.48 h	1.45 d	8.70 h	-	-	-	-	1.45 d	8.70 h	No
Overall	1.03 d	6.21 h	9.92 h	2.48 h	1.45 d	8.70 h	-	-	-	-	1.45 d	8.70 h	

Use Tool->display project time summary on the main menu to see these

Project Summary

Total and Calibration Times

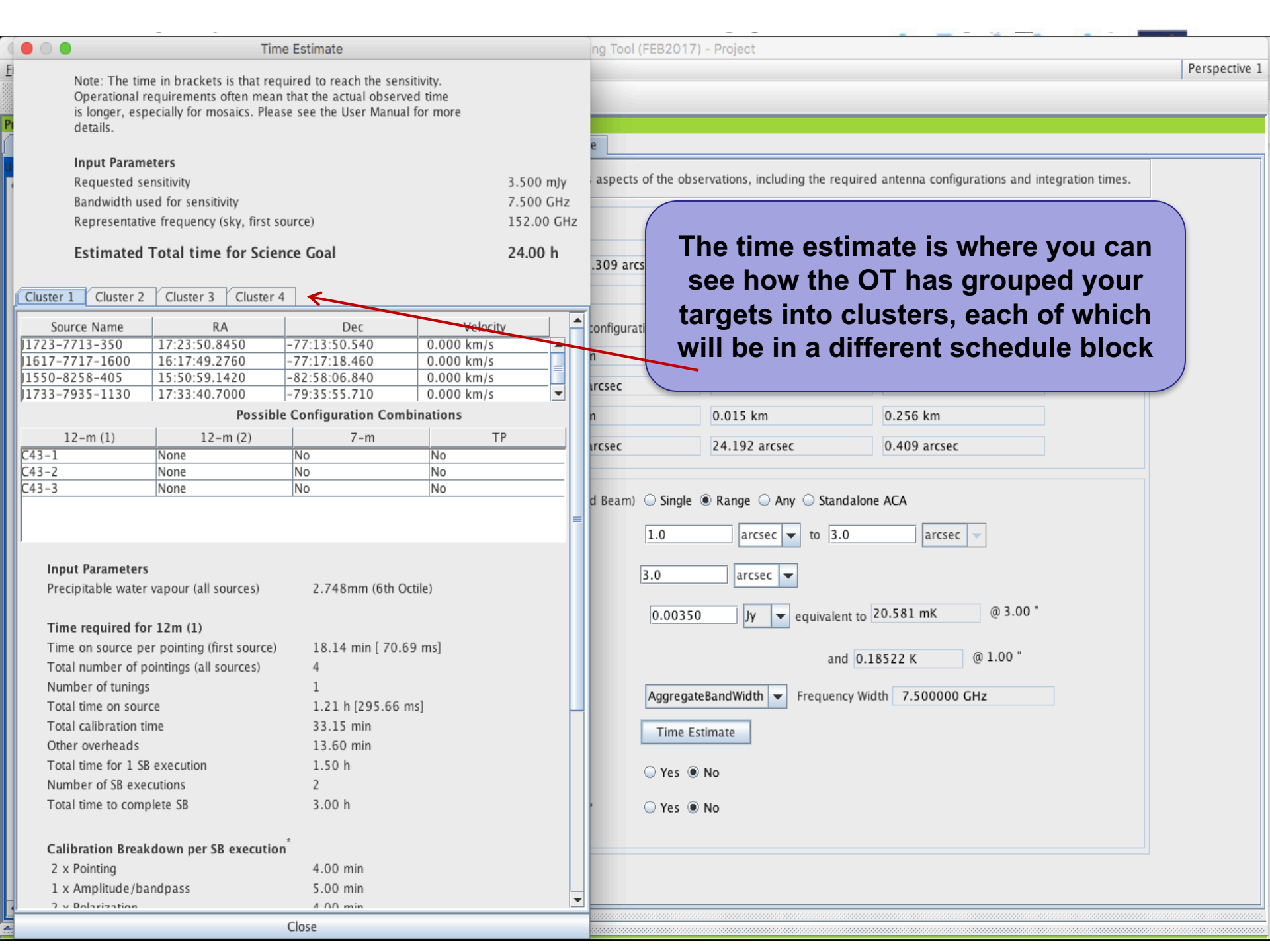
Science Goal	12-m (1)		12-m (2)		12-m (1+2)		ACA 7-m		ACA TP		Overall		Non-standard Mode
	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	
At ar 3"	31.53 min	13.83 min	-	-	31.53 min	13.83 min	2.63 h	1.15 h	-	-	3.15 h	1.38 h	No
Overall	31.53 min	13.83 min	-	-	31.53 min	13.83 min	2.63 h	1.15 h	-	-	3.15 h	1.38 h	

When using RANGE:

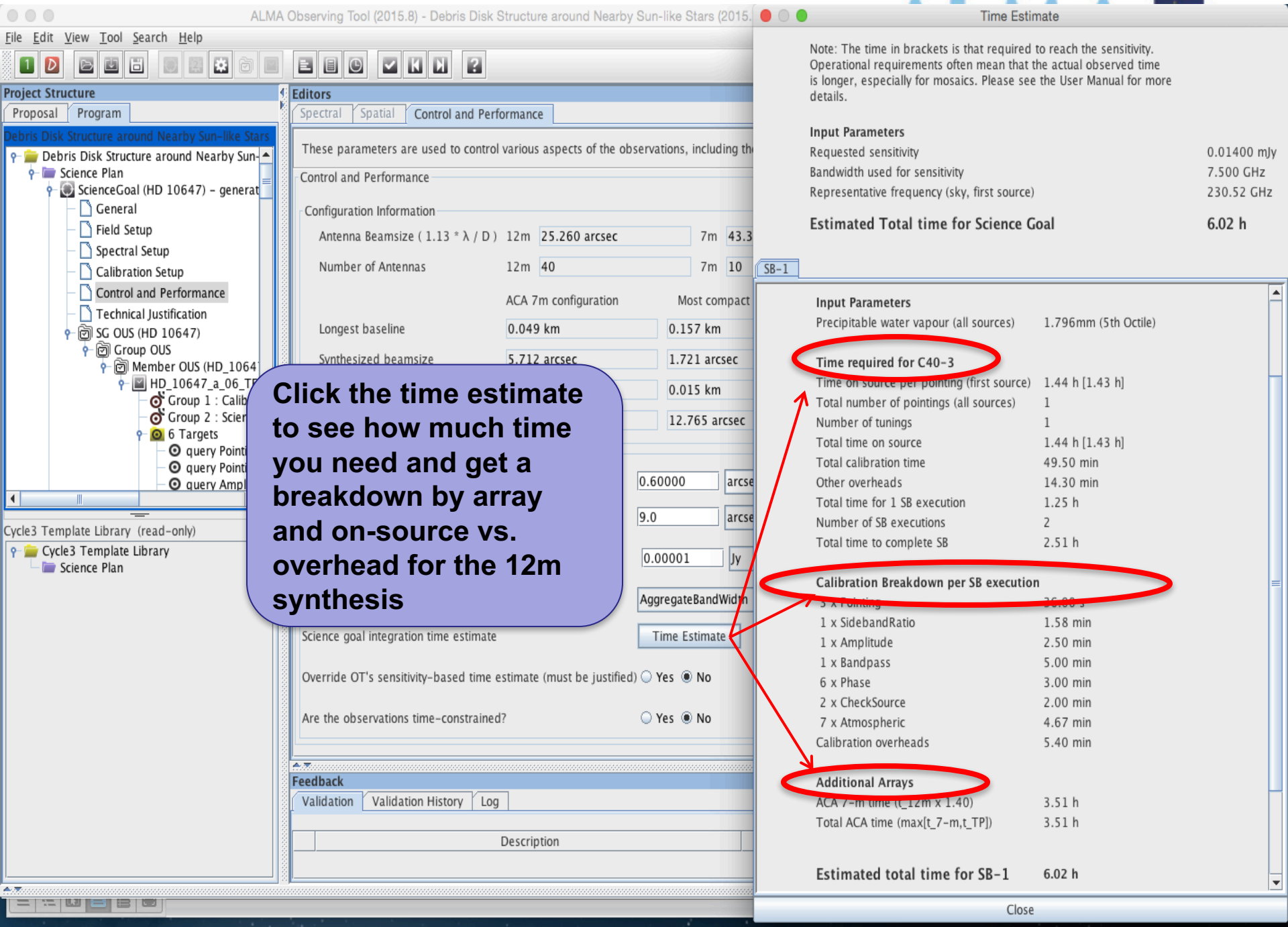
Rules are operating under the hood to choose among the possible configuration choices and they may be biased toward the low resolution end of a range because less 12m time is needed. See above for an example where is a factor 50 difference in 12m time for ar = 1" vs. ar = 3"

Be careful that the OT is not making choices for you that you would not make for yourself. Before submitting with a range, narrow it and use the project time summary to examine the choices the OT is making

NRAO

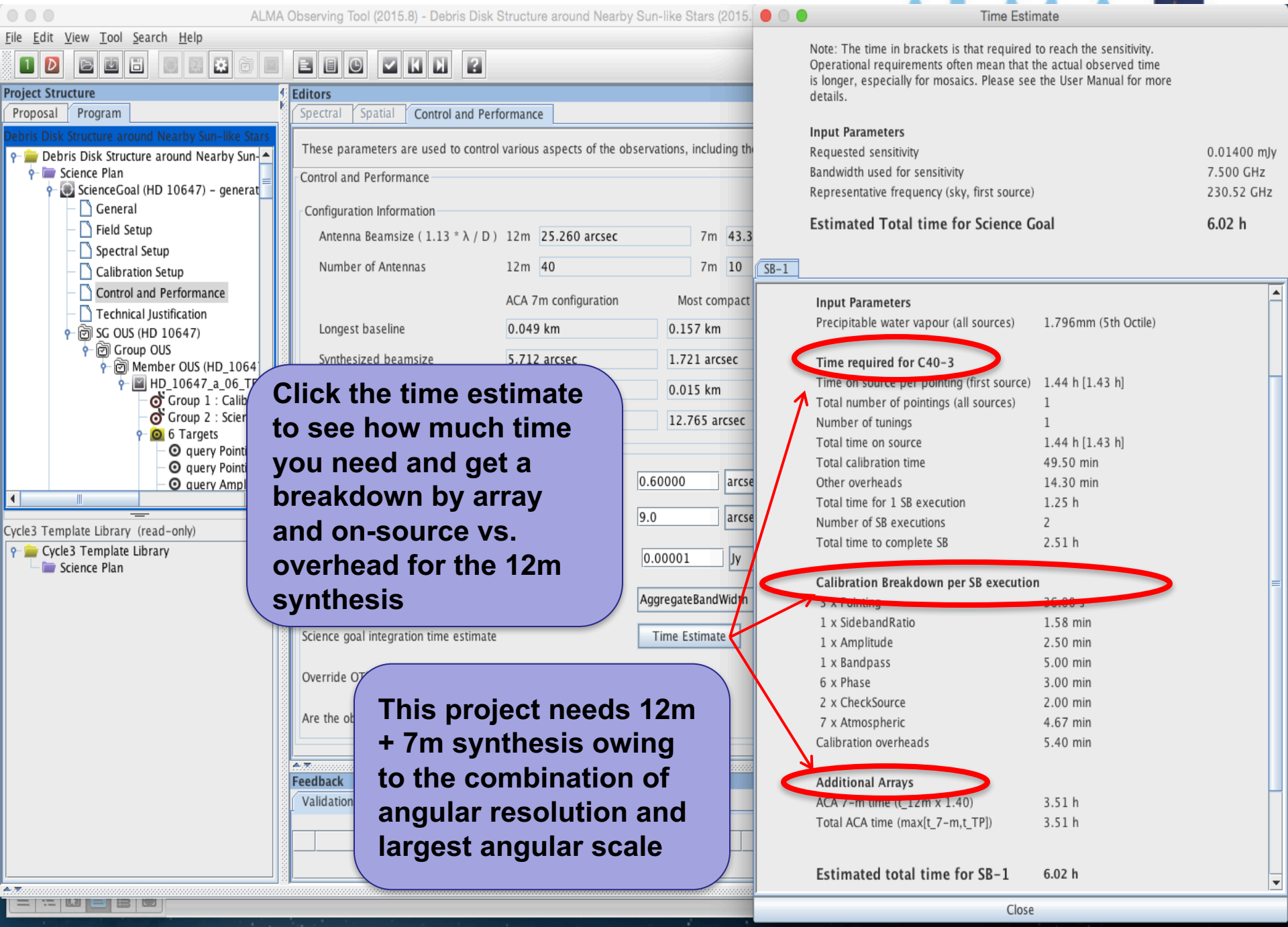

Time Estimate
Note: The time in brackets is that required to reach the sensitivity. Operational requirements often mean that the actual observed time is longer, especially for mosaics. Please see the User Manual for more details.
Input Parameters
Requested sensitivity 3.500 mJy
Bandwidth used for sensitivity 7.500 GHz
Representative frequency (sky, first source) 152.00 GHz
Estimated Total time for Science Goal 24.00 h
Cluster 1
Cluster 2
Cluster 3
Cluster 4
Source Name | RA | Dec | Velocity
J1723-7713-350 | 17:23:50.8450 | -77:13:50.540 | 0.000 km/s
J1617-7717-1600 | 16:17:49.2760 | -77:17:18.460 | 0.000 km/s
J1550-8258-405 | 15:50:59.1420 | -82:58:06.840 | 0.000 km/s
J1733-7935-1130 | 17:33:40.7000 | -79:35:55.710 | 0.000 km/s
Possible Configuration Combinations
12-m (1) | 12-m (2) | 7-m | TP
C43-1 | None | No | No
C43-2 | None | No | No
C43-3 | None | No | No
Input Parameters
Precipitable water vapour (all sources) 2.748mm (6th Octile)
Time required for 12m (1)
Time on source per pointing (first source) 18.14 min [70.69 ms]
Total number of pointings (all sources) 4
Number of tunings 1
Total time on source 1.21 h [295.66 ms]
Total calibration time 33.15 min
Other overheads 13.60 min
Total time for 1 SB execution 1.50 h
Number of SB executions 2
Total time to complete SB 3.00 h
Calibration Breakdown per SB execution*
2 x Pointing 4.00 min
1 x Amplitude/bandpass 5.00 min
Close
The time estimate is where you can see how the OT has grouped your targets into clusters, each of which will be in a different schedule block
Perspective 1
aspects of the observations, including the required antenna configurations and integration times.
0.015 km
0.256 km
24.192 arcsec
0.409 arcsec
Single
Range
Any
Standalone ACA
1.0
arcsec
to
3.0
arcsec
3.0
arcsec
0.00350
Jy
equivalent to
20.581 mK
@ 3.00 "
and
0.18522 K
@ 1.00 "
AggregateBandWidth
Frequency Width
7.500000 GHz
Time Estimate
Yes
No
Yes
No

SG Time Estimates

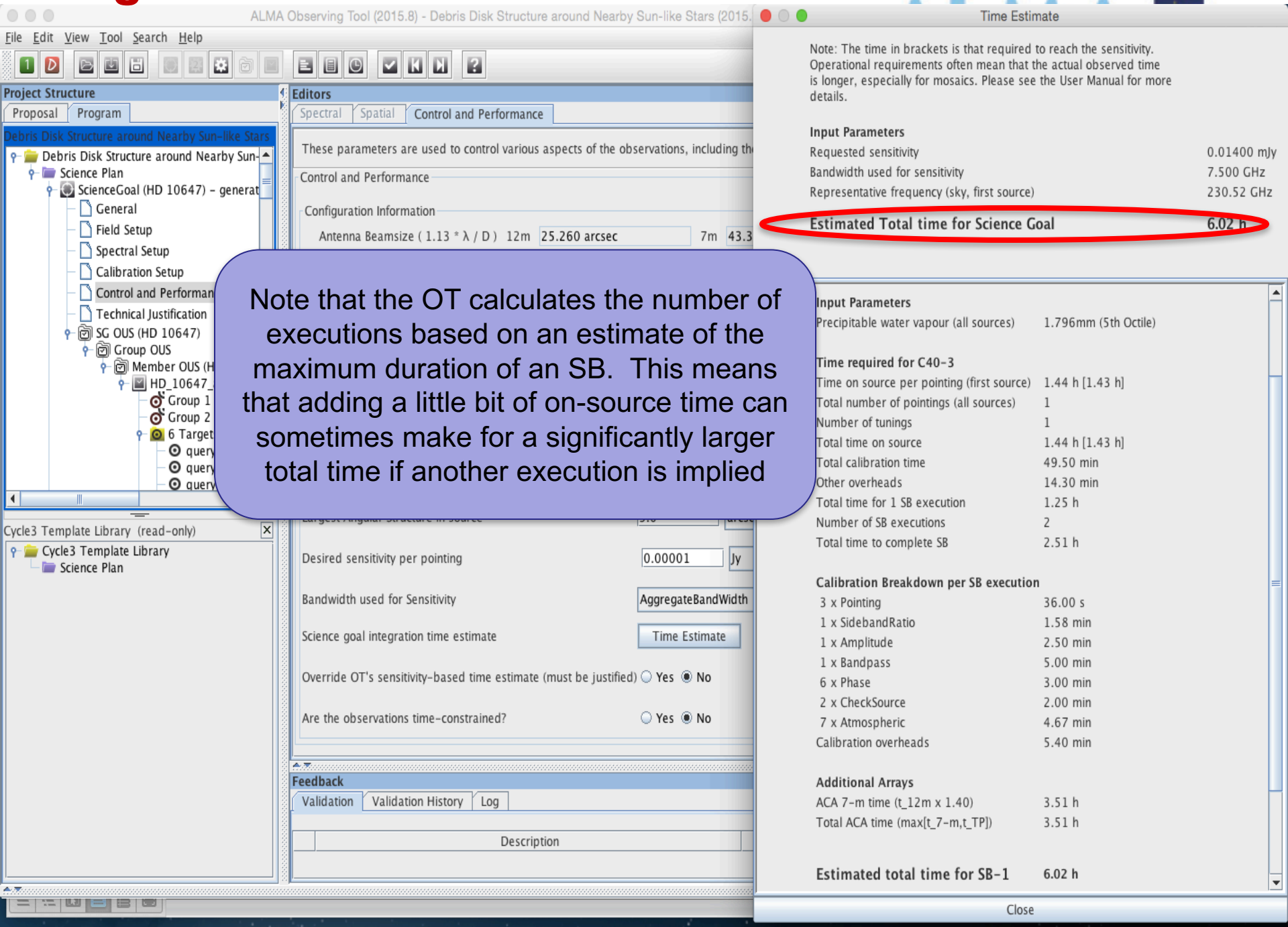


Click the time estimate to see how much time you need and get a breakdown by array and on-source vs. overhead for the 12m synthesis

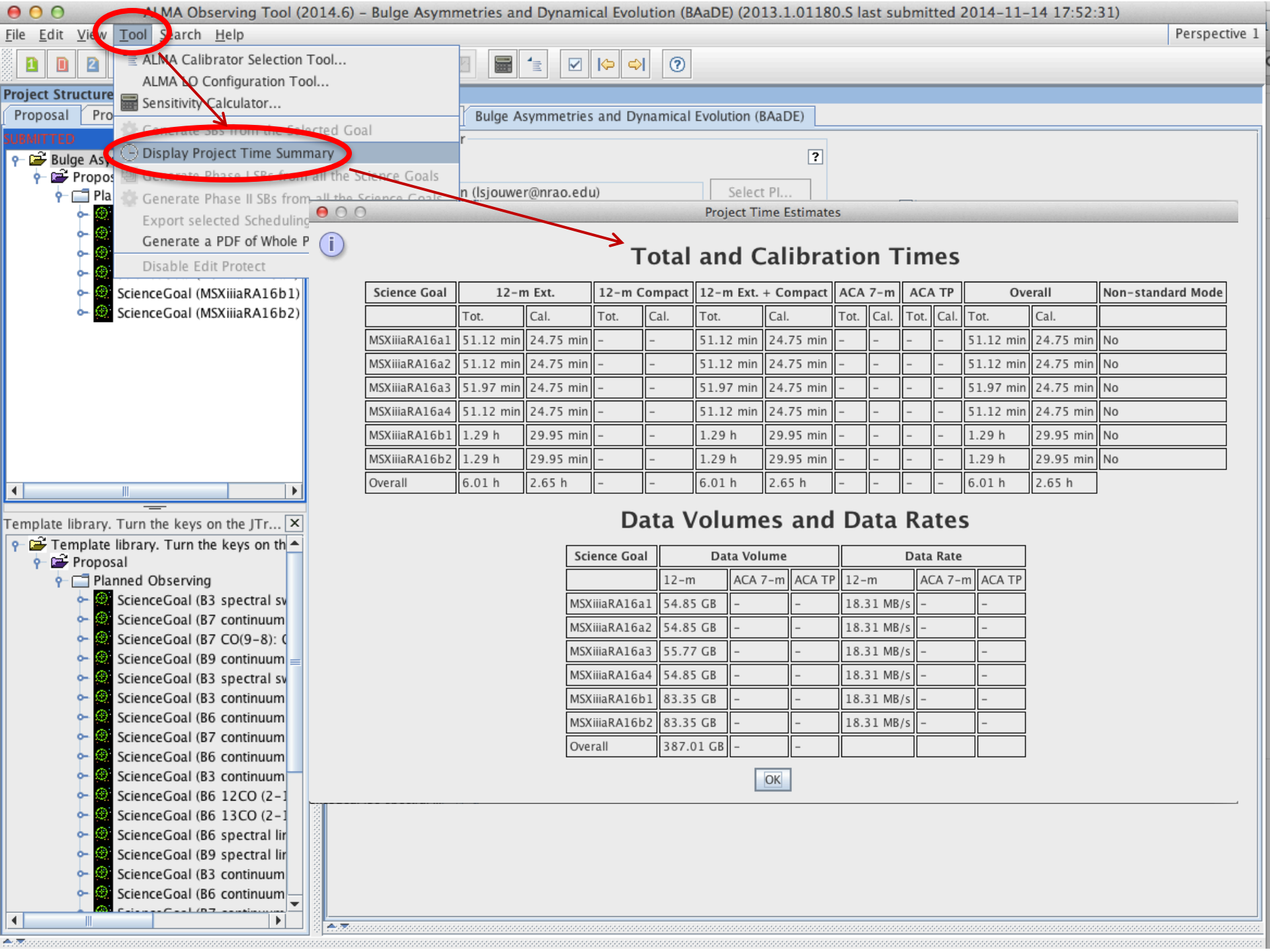
SG Time Estimates



Single source time estimates



Note that the OT calculates the number of executions based on an estimate of the maximum duration of an SB. This means that adding a little bit of on-source time can sometimes make for a significantly larger total time if another execution is implied



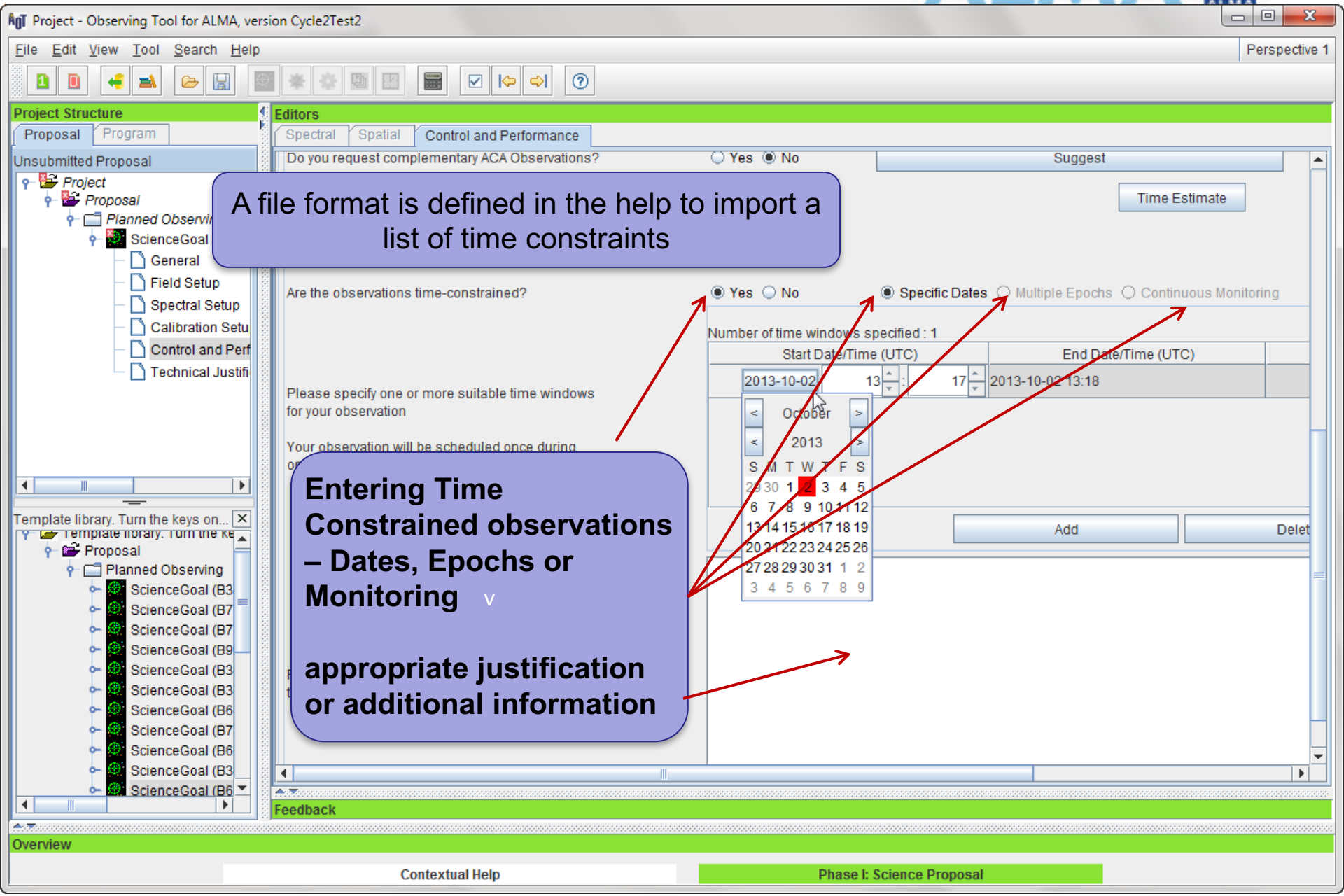
Total and Calibration Times

Science Goal	12-m Ext.		12-m Compact		12-m Ext. + Compact		ACA 7-m		ACA TP		Overall		Non-standard Mode
	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	Tot.	Cal.	
MSXiiiaRA16a1	51.12 min	24.75 min	–	–	51.12 min	24.75 min	–	–	–	–	51.12 min	24.75 min	No
MSXiiiaRA16a2	51.12 min	24.75 min	–	–	51.12 min	24.75 min	–	–	–	–	51.12 min	24.75 min	No
MSXiiiaRA16a3	51.97 min	24.75 min	–	–	51.97 min	24.75 min	–	–	–	–	51.97 min	24.75 min	No
MSXiiiaRA16a4	51.12 min	24.75 min	–	–	51.12 min	24.75 min	–	–	–	–	51.12 min	24.75 min	No
MSXiiiaRA16b1	1.29 h	29.95 min	–	–	1.29 h	29.95 min	–	–	–	–	1.29 h	29.95 min	No
MSXiiiaRA16b2	1.29 h	29.95 min	–	–	1.29 h	29.95 min	–	–	–	–	1.29 h	29.95 min	No
Overall	6.01 h	2.65 h	–	–	6.01 h	2.65 h	–	–	–	–	6.01 h	2.65 h	

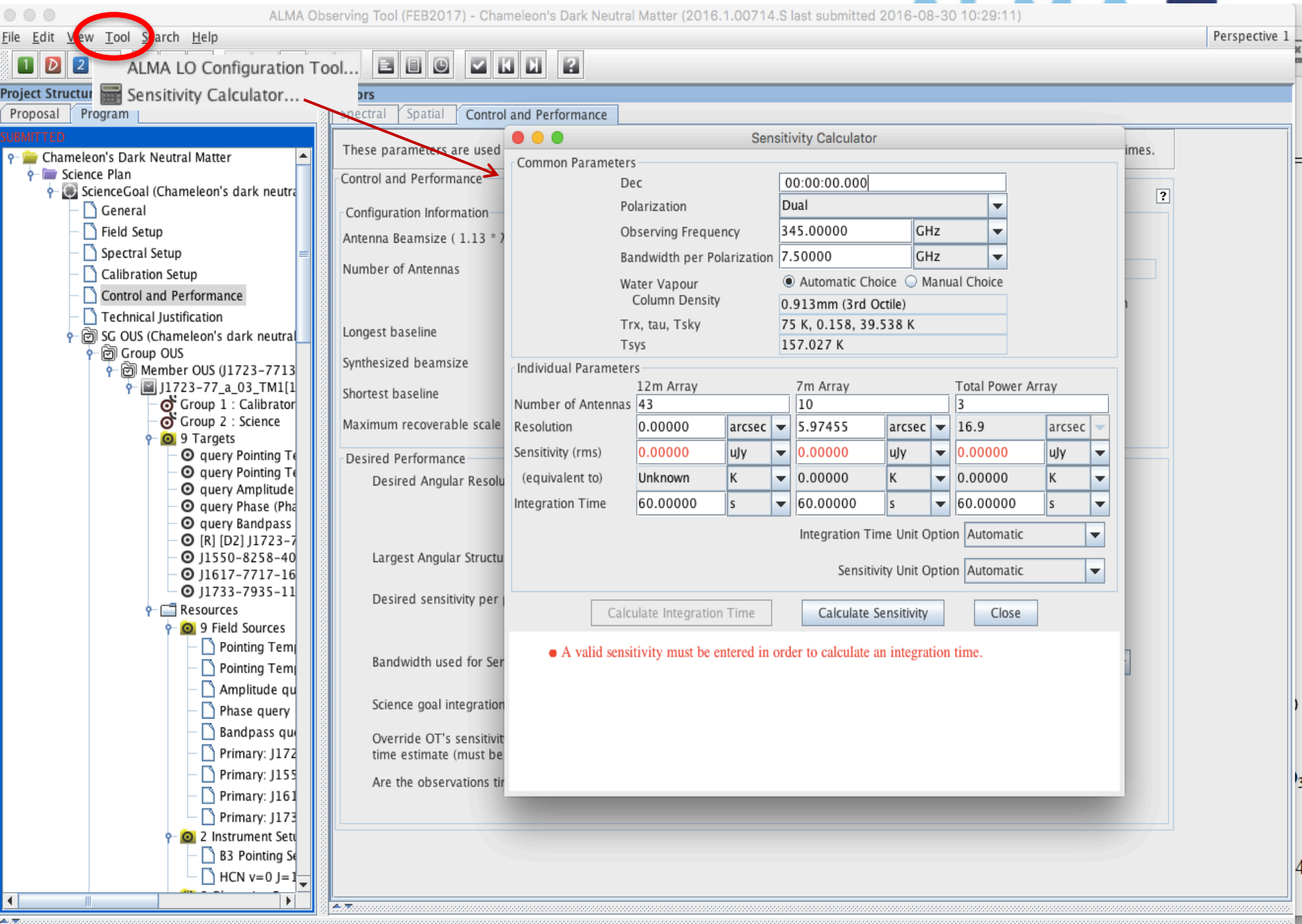
Data Volumes and Data Rates

Science Goal	Data Volume			Data Rate		
	12-m	ACA 7-m	ACA TP	12-m	ACA 7-m	ACA TP
MSXiiiaRA16a1	54.85 GB	–	–	18.31 MB/s	–	–
MSXiiiaRA16a2	54.85 GB	–	–	18.31 MB/s	–	–
MSXiiiaRA16a3	55.77 GB	–	–	18.31 MB/s	–	–
MSXiiiaRA16a4	54.85 GB	–	–	18.31 MB/s	–	–
MSXiiiaRA16b1	83.35 GB	–	–	18.31 MB/s	–	–
MSXiiiaRA16b2	83.35 GB	–	–	18.31 MB/s	–	–
Overall	387.01 GB	–	–			

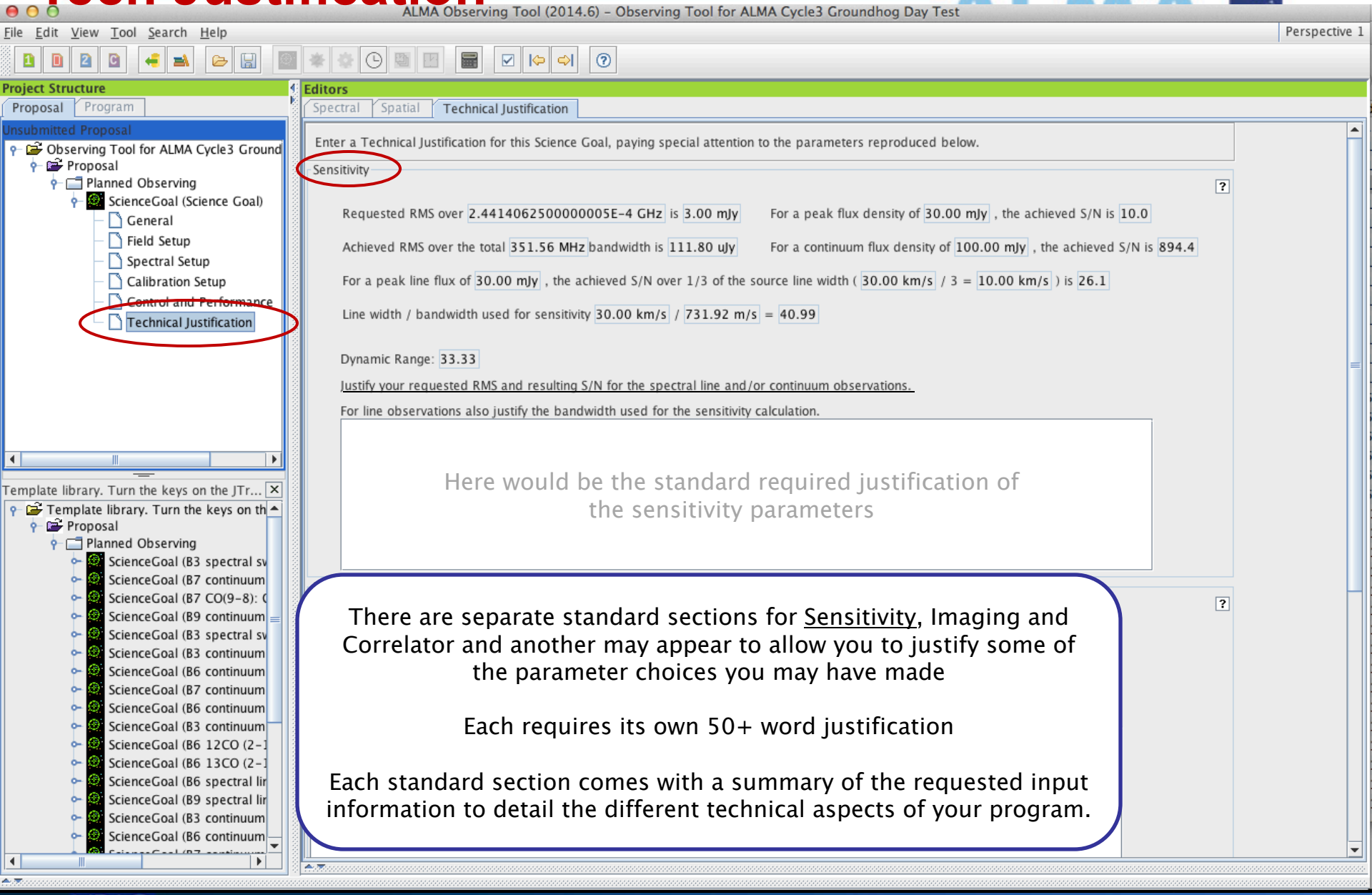
Time constrained observing



The sensitivity calculator is available separately in the OT (or on the web)



Tech Justification

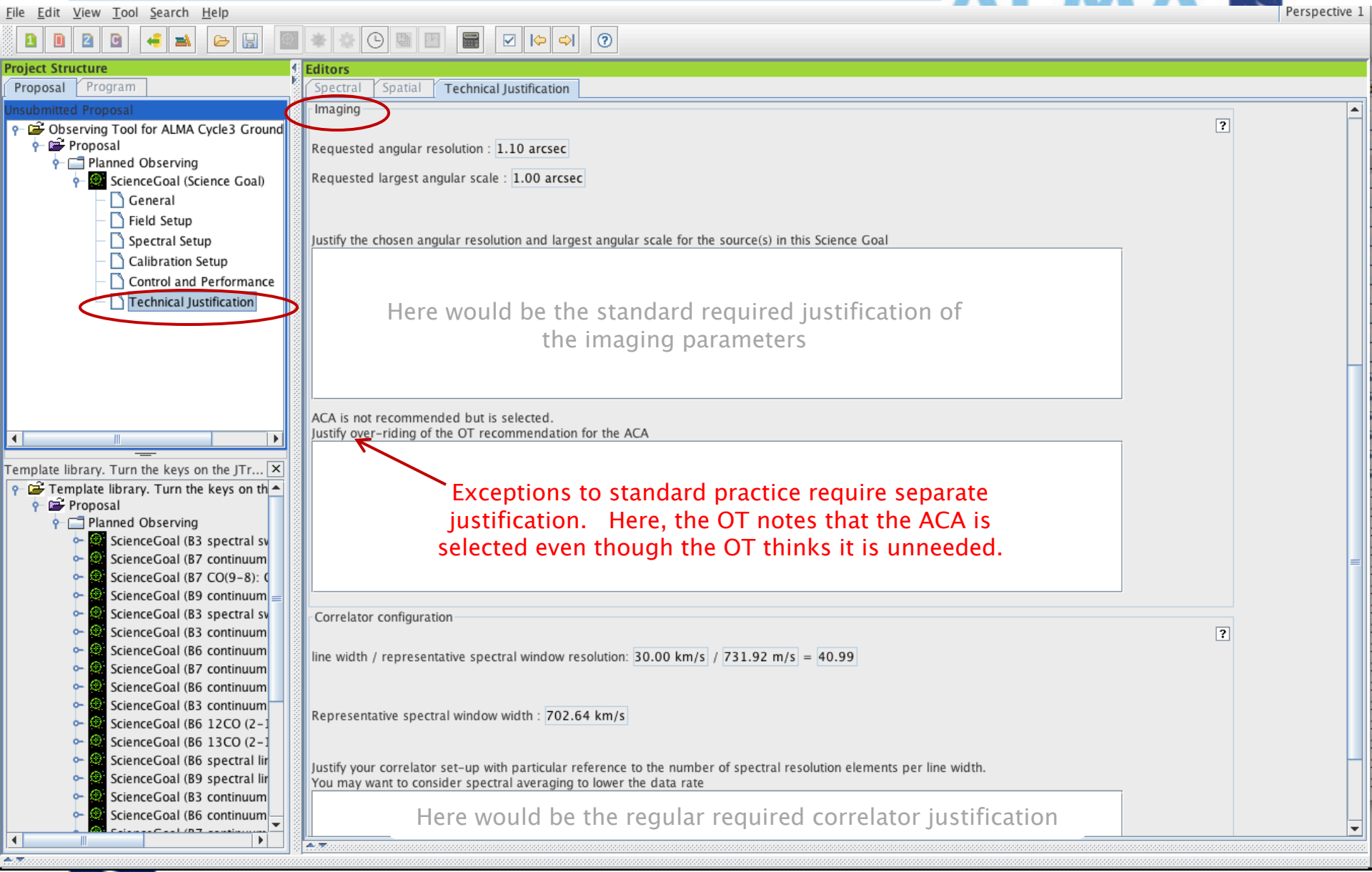


There are separate standard sections for Sensitivity, Imaging and Correlator and another may appear to allow you to justify some of the parameter choices you may have made

Each requires its own 50+ word justification

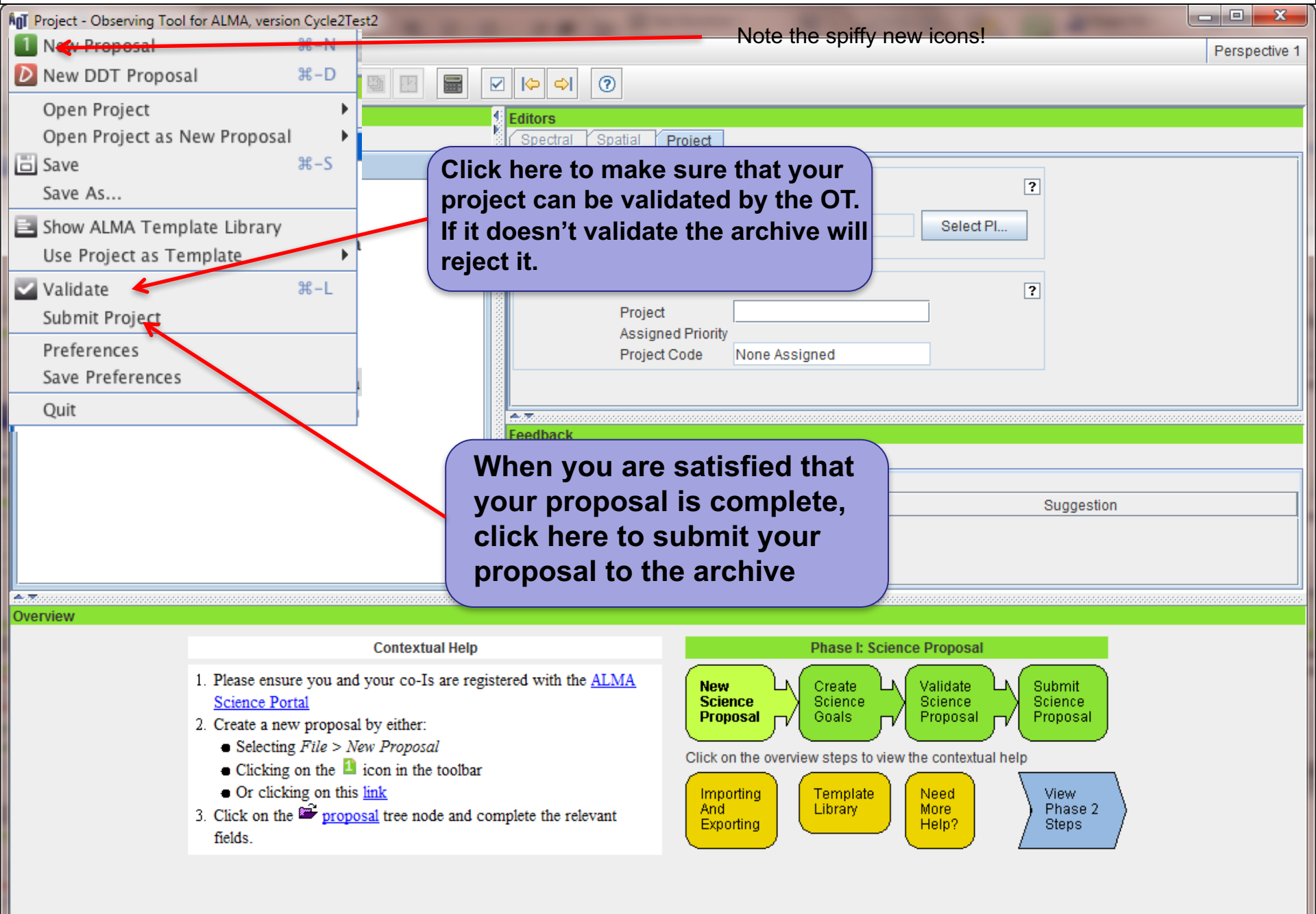
Each standard section comes with a summary of the requested input information to detail the different technical aspects of your program.

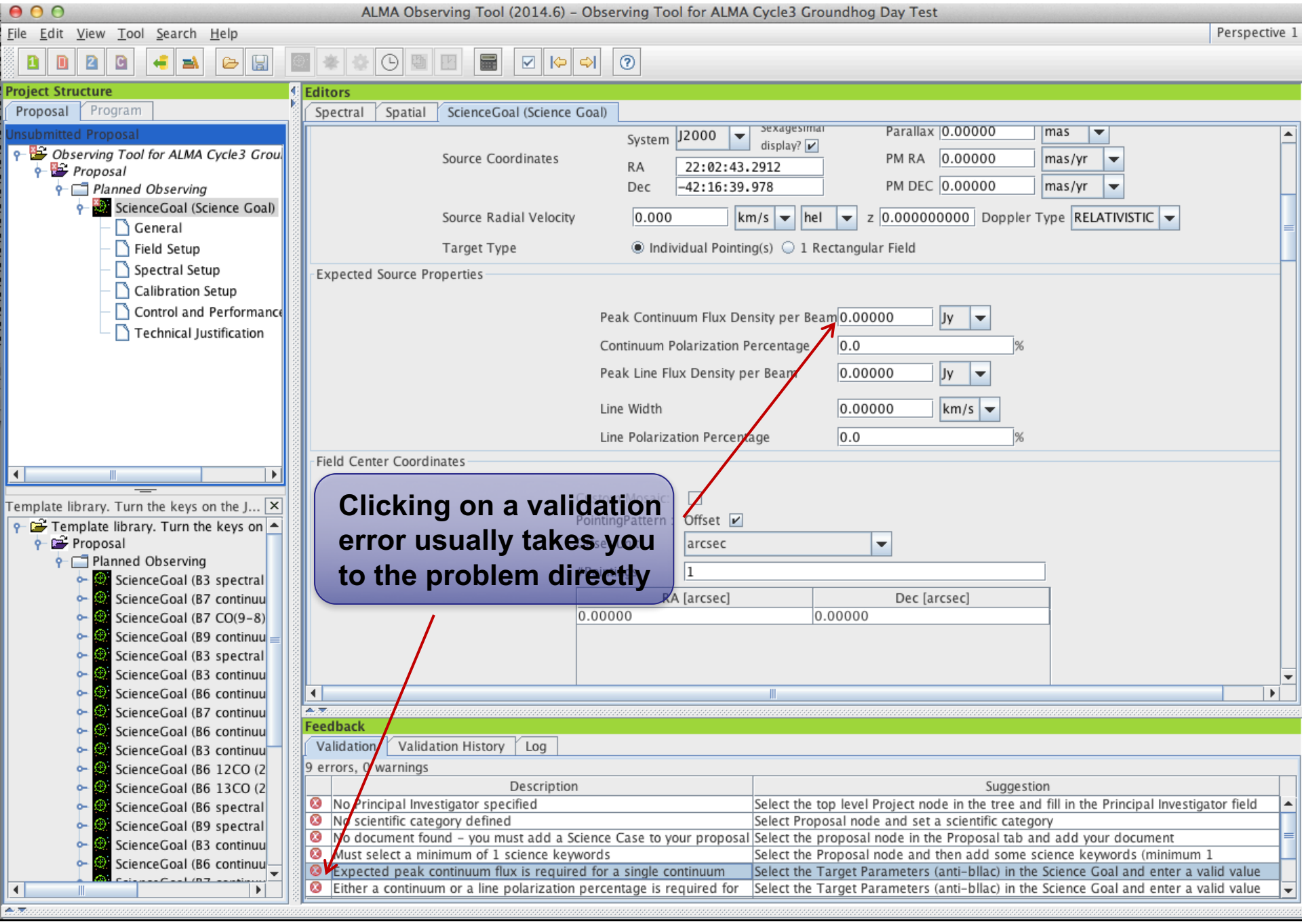
Tech Justification



NRAO

When the time is ripe … validate & submit




ALMA Observing Tool (2014.6) – Observing Tool for ALMA Cycle3 Groundhog Day Test
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Template library. Turn the keys on
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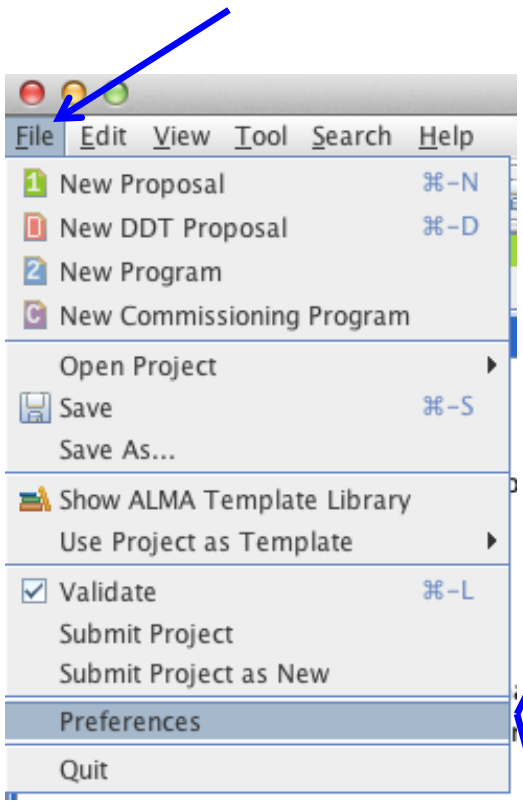
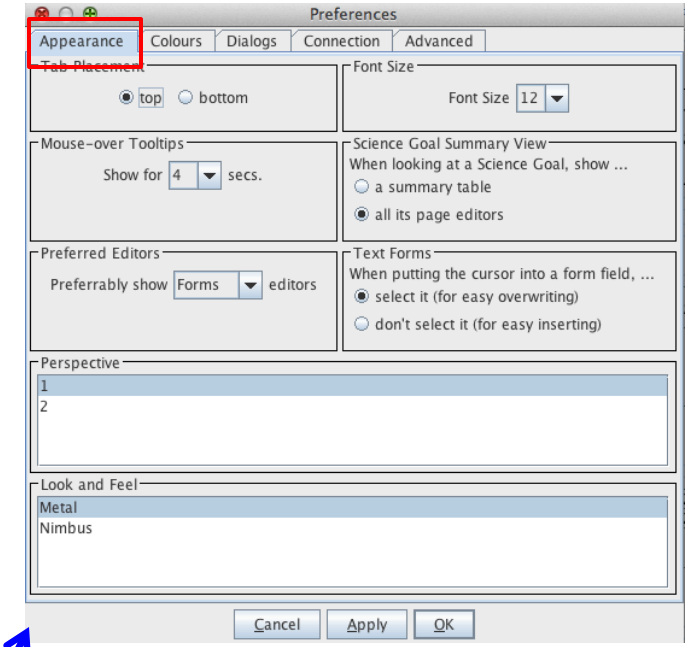
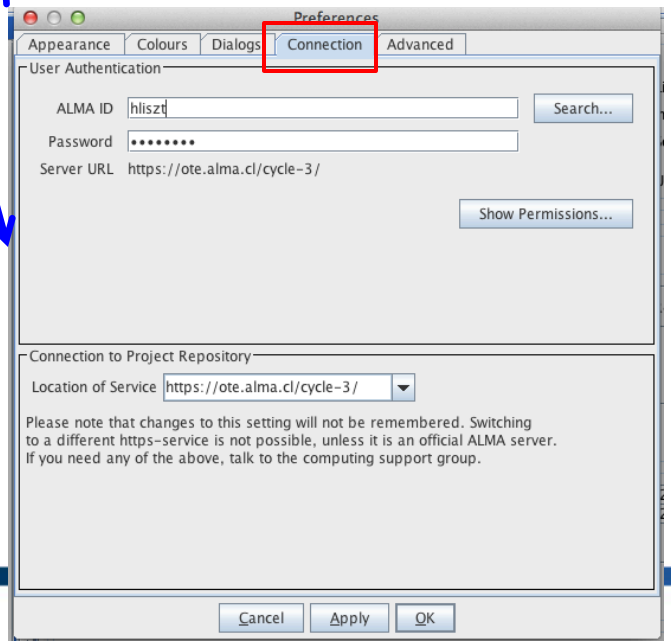
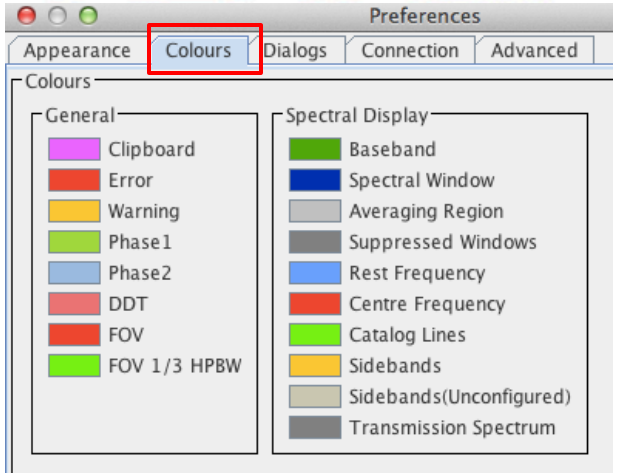
ScienceGoal (B7 continuu
ScienceGoal (B7 CO(9-8)
ScienceGoal (B9 continuu
ScienceGoal (B3 spectral
ScienceGoal (B3 continuu
ScienceGoal (B6 continuu
ScienceGoal (B7 continuu
ScienceGoal (B6 continuu
ScienceGoal (B3 continuu
ScienceGoal (B6 12CO (2
ScienceGoal (B6 13CO (2
ScienceGoal (B6 spectral
ScienceGoal (B9 spectral
ScienceGoal (B3 continuu
ScienceGoal (B6 continuu
Editors
Spectral Spatial ScienceGoal (Science Goal)
Source Coordinates
System J2000
Sexagesimal display?
RA 22:02:43.2912
Dec -42:16:39.978
Parallax 0.00000 mas
PM RA 0.00000 mas/yr
PM DEC 0.00000 mas/yr
Source Radial Velocity 0.000 km/s hel
z 0.000000000 Doppler Type RELATIVISTIC
Target Type
Individual Pointing(s)
1 Rectangular Field
Expected Source Properties
Peak Continuum Flux Density per Beam 0.00000 Jy
Continuum Polarization Percentage 0.0 %
Peak Line Flux Density per Beam 0.00000 Jy
Line Width 0.00000 km/s
Line Polarization Percentage 0.0 %
Field Center Coordinates
PointingPattern
Offset
arcsec
1
RA [arcsec]
Dec [arcsec]
0.00000
0.00000
Clicking on a validation error usually takes you to the problem directly
Feedback
Validation Validation History Log
9 errors, 0 warnings
Description
Suggestion
No Principal Investigator specified
Select the top level Project node in the tree and fill in the Principal Investigator field
No scientific category defined
Select Proposal node and set a scientific category
No document found – you must add a Science Case to your proposal
Select the proposal node in the Proposal tab and add your document
Must select a minimum of 1 science keywords
Select the Proposal node and then add some science keywords (minimum 1
Expected peak continuum flux is required for a single continuum
Select the Target Parameters (anti-bllac) in the Science Goal and enter a valid value
Either a continuum or a line polarization percentage is required for
Select the Target Parameters (anti-bllac) in the Science Goal and enter a valid value

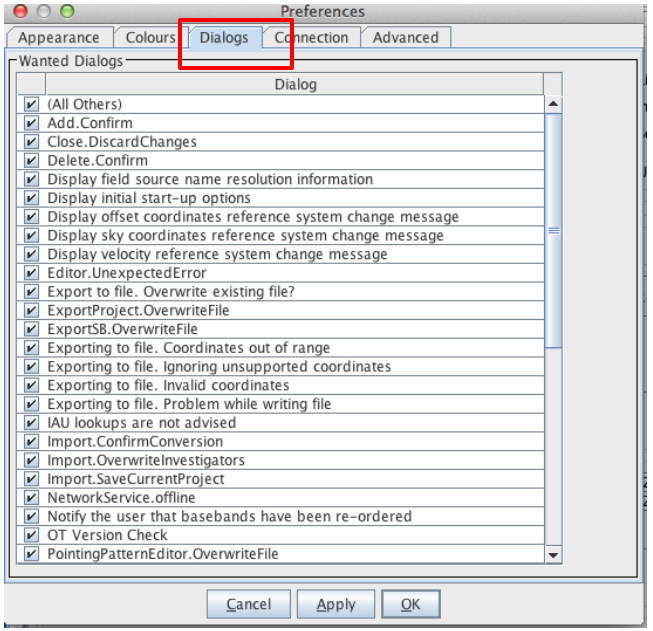
Use preferences to customize



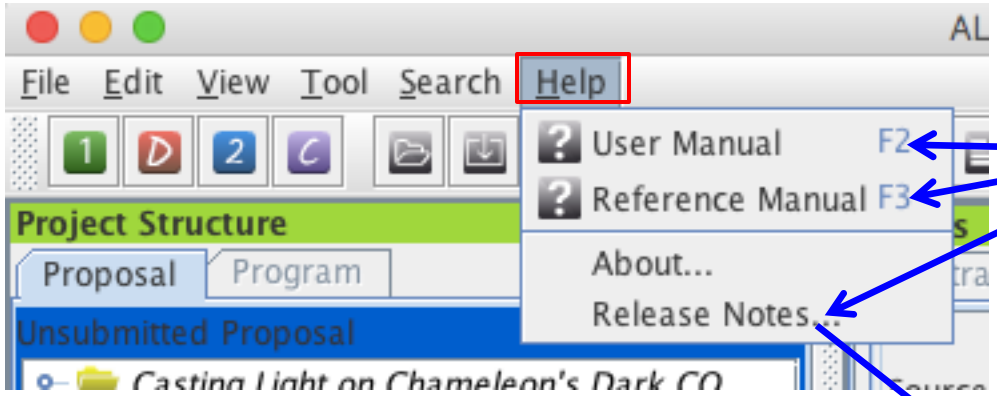


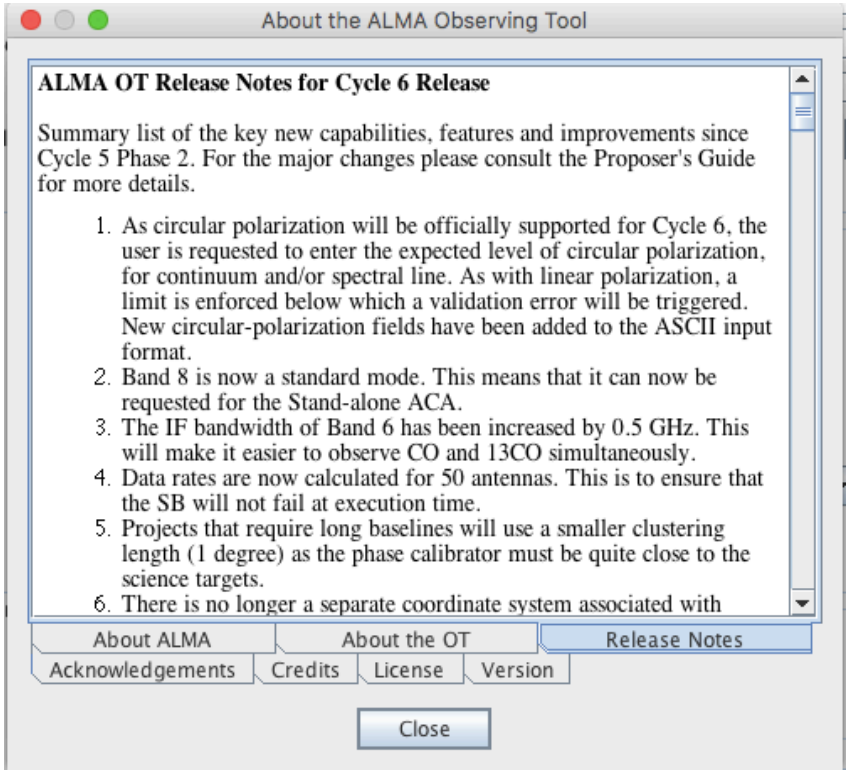




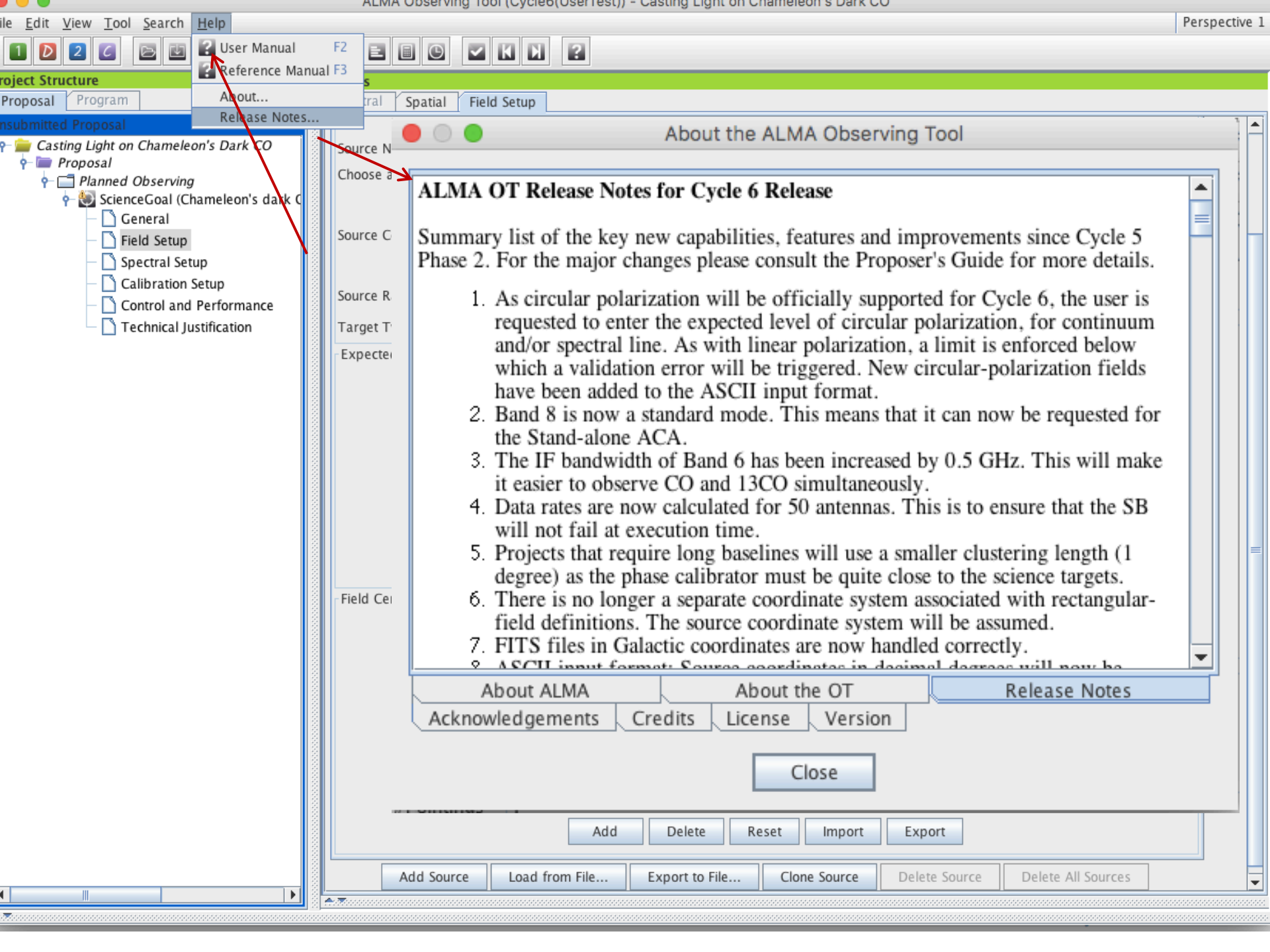


Don’t be afraid to ask for directions





Suggestion: input file formats are shown in the help sections that you invoke with the local ?


ALMA Observing Tool (Cycle6(UserTest)) - Casting Light on Chameleon's Dark CO
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About the ALMA Observing Tool
ALMA OT Release Notes for Cycle 6 Release
Summary list of the key new capabilities, features and improvements since Cycle 5 Phase 2. For the major changes please consult the Proposer's Guide for more details.
1. As circular polarization will be officially supported for Cycle 6, the user is requested to enter the expected level of circular polarization, for continuum and/or spectral line. As with linear polarization, a limit is enforced below which a validation error will be triggered. New circular-polarization fields have been added to the ASCII input format.
2. Band 8 is now a standard mode. This means that it can now be requested for the Stand-alone ACA.
3. The IF bandwidth of Band 6 has been increased by 0.5 GHz. This will make it easier to observe CO and 13CO simultaneously.
4. Data rates are now calculated for 50 antennas. This is to ensure that the SB will not fail at execution time.
5. Projects that require long baselines will use a smaller clustering length (1 degree) as the phase calibrator must be quite close to the science targets.
6. There is no longer a separate coordinate system associated with rectangular-field definitions. The source coordinate system will be assumed.
7. FITS files in Galactic coordinates are now handled correctly.
About ALMA
About the OT
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Export to File...
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Delete Source
Delete All Sources

A Few OT Tips…

- The same cut and paste commands you use outside the OT for text also work inside it since Cycle 5
- Ctrl-Z global shortcut will expand out all succeeding items in the J-tree (try it, you'll see what we mean)
- Holding down ALT when making choices in dropdown lists will convert to the unit or type of the new choice
  - Otherwise, only the description changes, not value
- OT does galactic-celestial conversion automatically
  - Cannot convert in other ways, eg not FK5 J2000 to ICRS. FK5 J2000 now deprecated

A Few More OT Tips…

- NEW In the J-tree: Holding down the alt key in combination with the up/down arrows will move from a node in one SG to the same node in the adjacent SG (try it when you have more than one SG)

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Observatory News

Additional Information for Cycle 5 Proposals
Feb 01, 2017

Release of a New Installment of Science Verification Data
Jan 18, 2017

RadioNet: Calls for financial support - OPEN
Jan 16, 2017

More news...

NRAO News

American Astronomical Society Meeting
Jun 04, 2017

2017 Astrobiology Graduate Conference
Jun 05, 2017

Women in Astronomy IV: The Many Faces of Women Astronomers
Jun 09, 2017

More...

Status

ALMA Cycle 5 Pre-Announcement

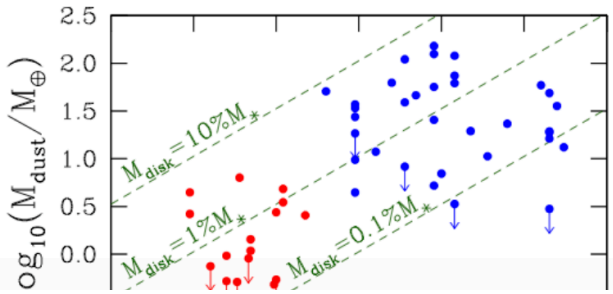
Refereed publications:

Last observed source:

Current configuration: C40-2

More...

Science Highlights - Possible Disk Truncation in Ophiuchus Brown Dwarfs



The sensitivity, resolution and the wavelength coverage of ALMA makes it an ideal tool for studying the properties of the cold outer disks of young stars and low mass objects. Such observations can aid us in understanding the formation of their central objects and their likelihood of ultimately hosting planets. In a recent Astronomy & Astrophysics paper, Dr. Testi and his collaborators made use of ALMA Band 7 to observe an unbiased sample of spectroscopically confirmed Ophiuchus brown dwarfs with infrared excesses.

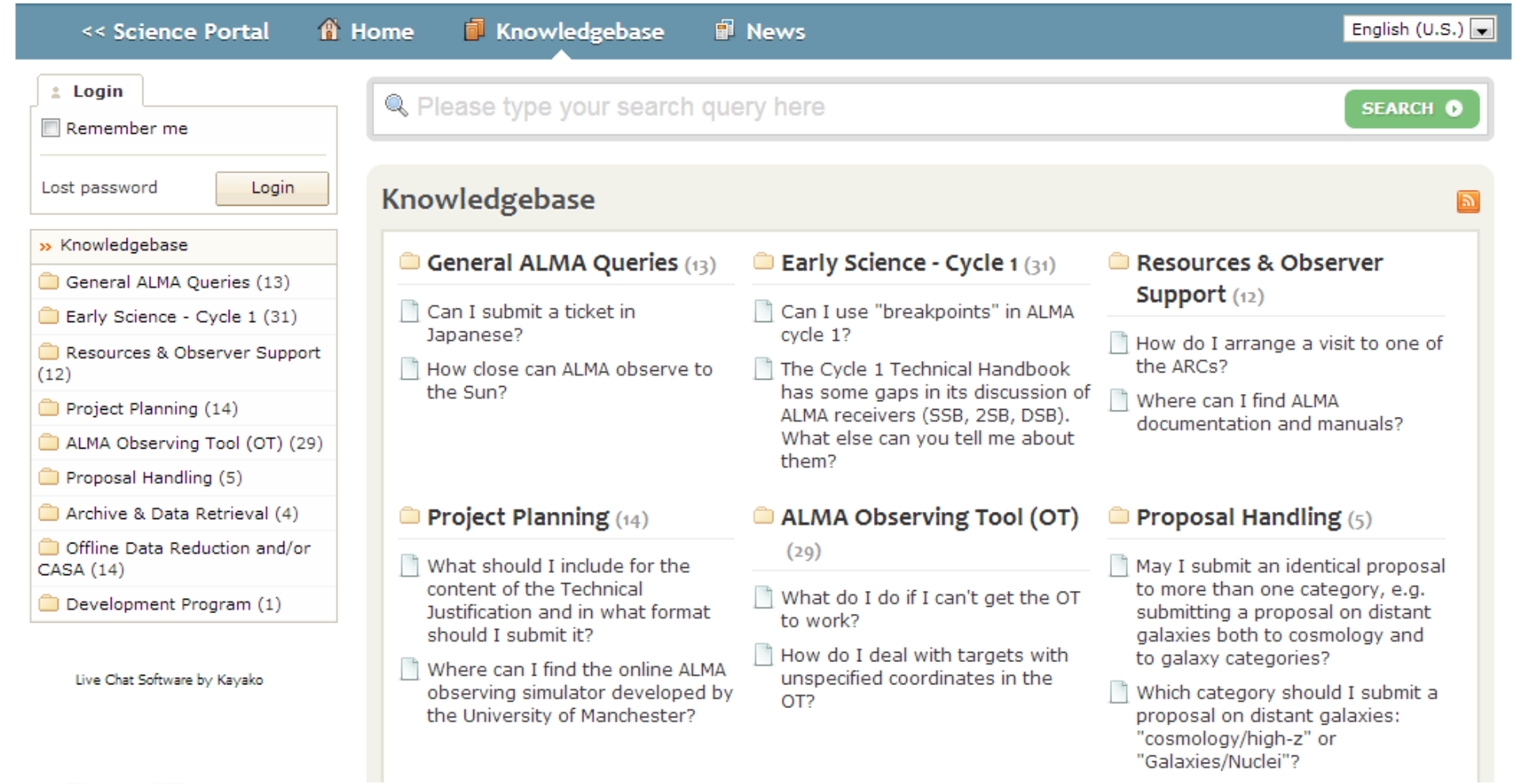
www.almascience.org

ALMA Science Portal @ NRAO

I could use a hand...

Have no fear, the ALMA Helpdesk is here...

ALMA



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ALMA

For more info:

https://almascience.nrao.edu/

The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile. ALMA is funded in Europe by the European Organization for Astronomical Research in the Southern Hemisphere (ESO), in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC) and the National Science Council of Taiwan (NSC), and in East Asia by the National Institutes of Natural Sciences (NINS) of Japan in cooperation with the Academia Sinica (AS) in Taiwan. ALMA construction and operations are led on behalf of Europe by ESO, on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI), and on behalf of East Asia by the National Astronomical Observatory of Japan (NAOJ). The Joint ALMA Observatory (JAO) provides the unified leadership and management of the construction and operation of ALMA.

NRAO