

Observing Tool for ALMA Cycle 5

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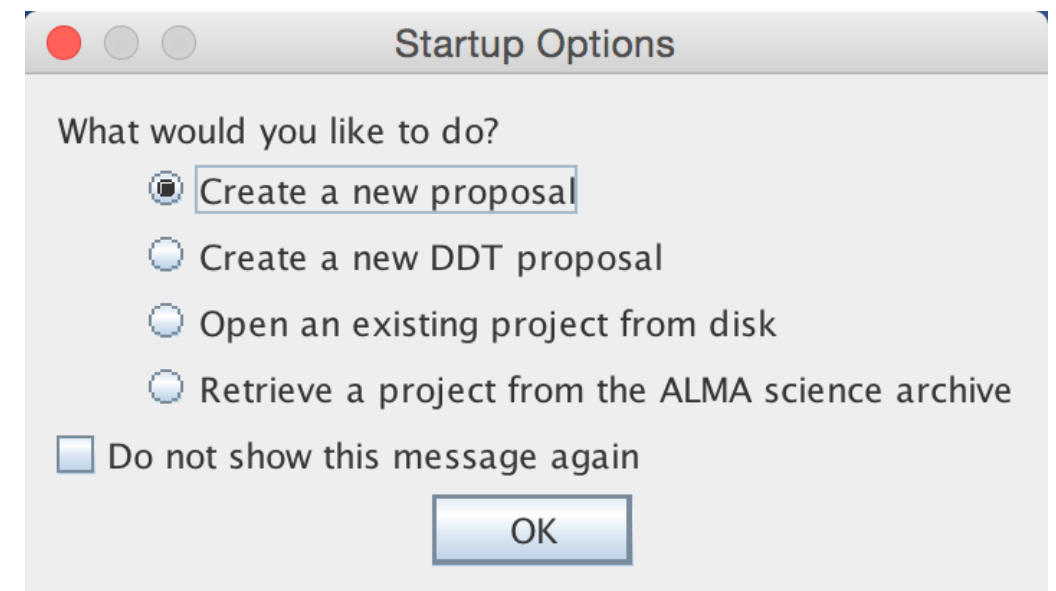
Observing Tool (OT) for ALMA Cycle 5

- java-based tool retrievable from [almascience](http://almascience.nrao.edu/OT/) website
 - ✓ webstart version (always updated)
 - ✓ tarball version (offline working, might be outdated)
- the *only* way to submit your ALMA proposal
- the OT offers a visualization of spatial setting (e.g., pointings in a mosaic), spectral settings (correlator tuning), time estimator, sensitivity calculator, and messages when settings incompatible

Starting up the OT

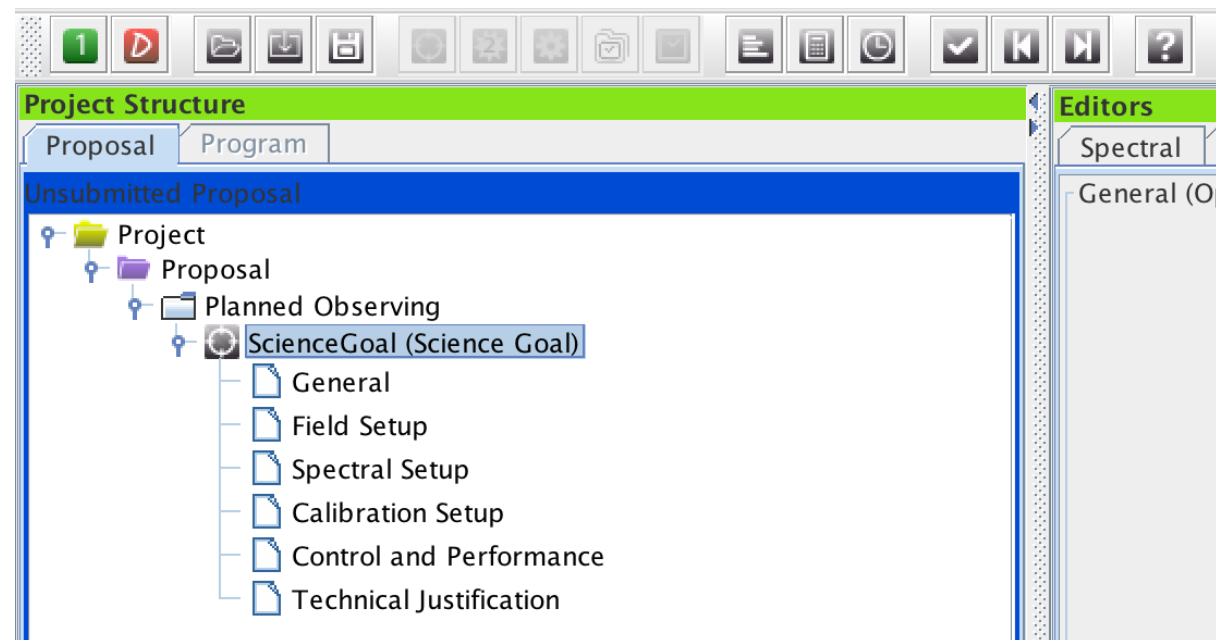


Click logo to start.



- PI/Col have to registered on almascience website
- select proposal type (regular, VLBI, ToO, large program)
- select scientific category
- if resubmission of previous Cycle, enter the project ID
- if resubmitting an already submitted Cycle 5 project, make sure that you it contains the project ID on the Project Tab to avoid duplication

Science Goals



- For sources distributed widely in the sky the SG will be split by the OT into different “clusters”.
- Each grouping all sources within 10 degrees.
- No restriction on the total number of sources in a SG, but for each grouping within the SG, the total number of pointings must be less than or equal to 150.
- Max 5 tunings per given group of sources (spectral scan)

Field setup

- Resolve by Source Name (NED, Simbad)
- SSO incl. Sun (tick box, select object, *Sun, Ephemeris: upload ephemeris file*)
- upload Sources from file (see help for file format)

❖ **important: expected source properties**

The screenshot shows a 'Source' configuration window with the following fields and options:

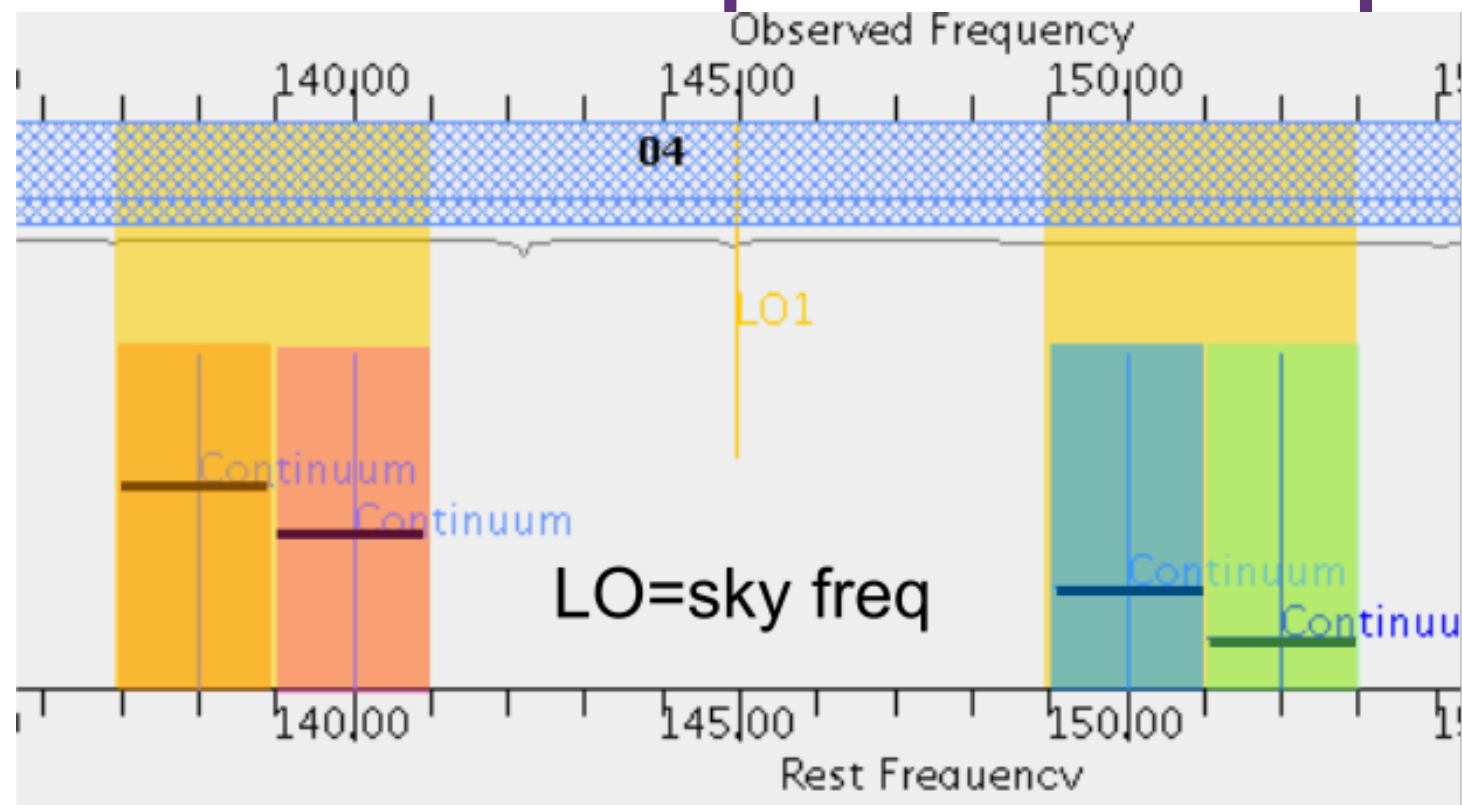
- Source Name:** A text input field with a 'Resolve' button to its right.
- Choose a Solar System Object?:** An unchecked checkbox.
- Name of object:** A dropdown menu currently showing 'Unspecified'.
- System:** A dropdown menu showing 'FK5 J2000'.
- Sexagesimal display?:** A checked checkbox.
- Source Coordinates:**
 - RA:** A text input field with '00:00:00.0000'.
 - Dec:** A text input field with '00:00:00.000'.
 - Parallax:** A text input field with '0.00000' and a unit dropdown set to 'mas'.
 - PM RA:** A text input field with '0.00000' and a unit dropdown set to 'mas/yr'.
 - PM DEC:** A text input field with '0.00000' and a unit dropdown set to 'mas/yr'.
- Source Radial Velocity:** A text input field with '0.000', a unit dropdown set to 'km/s', and a 'lsrk' dropdown.
- z:** A text input field with '0.000000000'.
- Doppler Type:** A dropdown menu set to 'RADIO'.
- Target Type:** Two radio buttons: 'Individual Pointing(s)' (selected) and '1 Rectangular Field'.

Spectral setup

Continuum (single, dual, full pol)

Spectral line (single, dual, full pol)

Spectral scan (single, dual pol)



- 4 basebands (BBs), each max 2GHz, to be placed in two sidebands
- widths SB different per band (band 3,4,5,7,8: 4GHz; band 6: 5GHz; band 9,10: 8 GHz)
- ***carefully select the representative spw: will be used for all frequency/ spectral resolution dependent calculations, such as FOV, MRS, angular resolution, atmospheric opacity***

Spectral setup

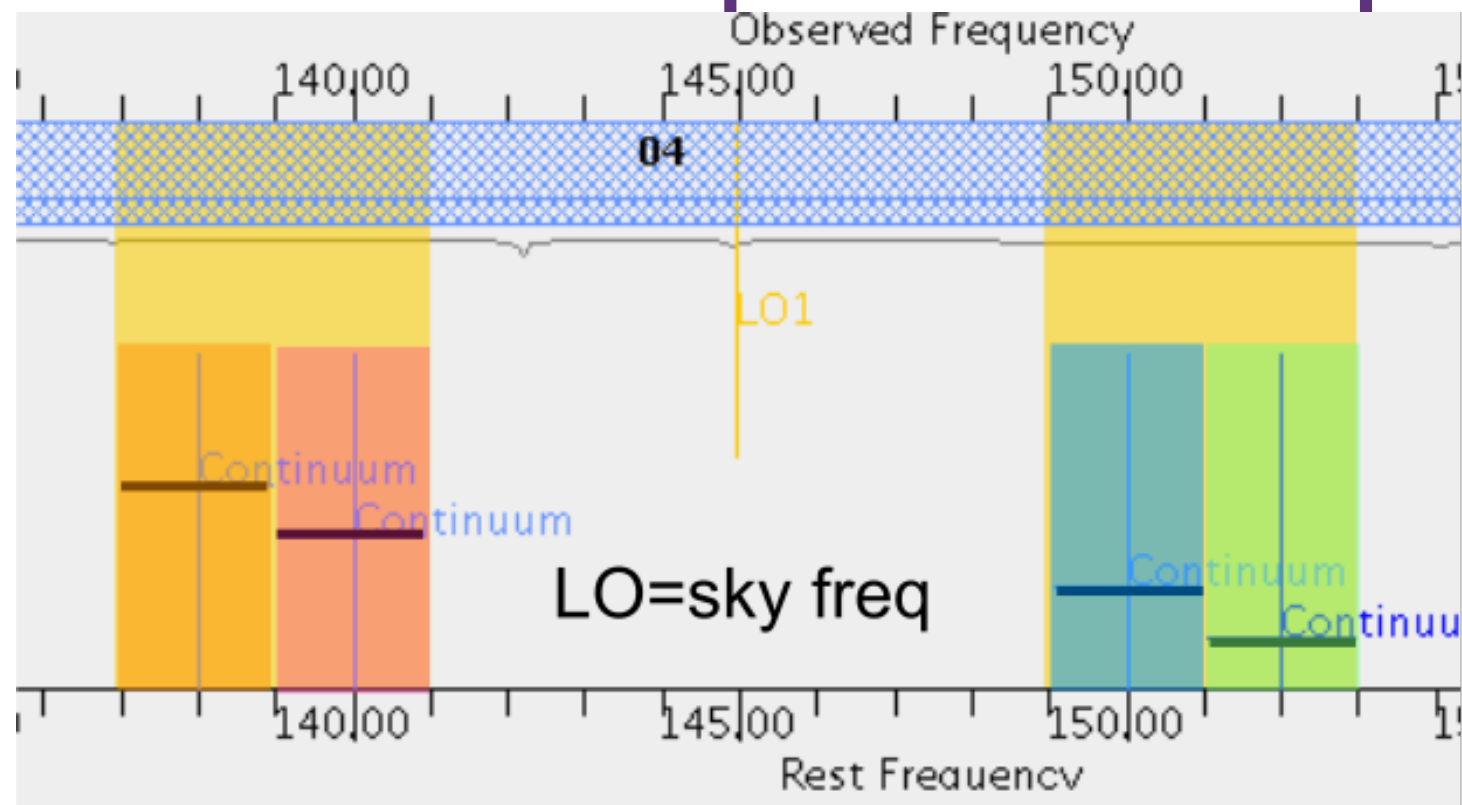
Continuum (single, dual, full pol)

Spectral line (single, dual, full pol)

Spectral scan (single, dual pol)

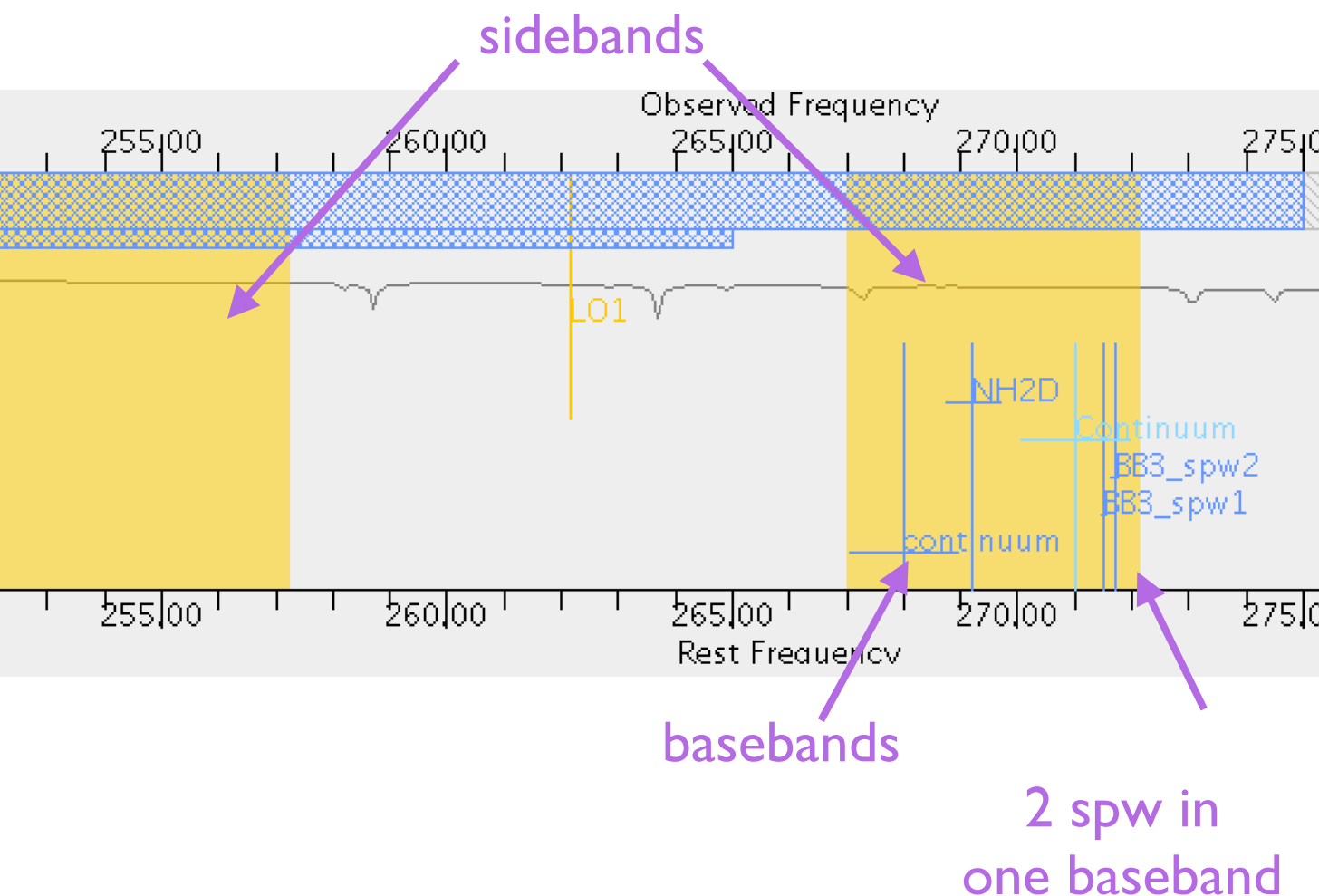
New!!

- Band 5 is now offered
 - be careful H₂O atmospheric line
 - only available from March 2018 (no warning from the OT)
- 90-degree Walsh switching Band 9 and 10
 - 16 GHz instantaneous bandwidth could be available with some spectral setup
- define rest frequencies of lines
 - information is used for QA2



Spectral line setups

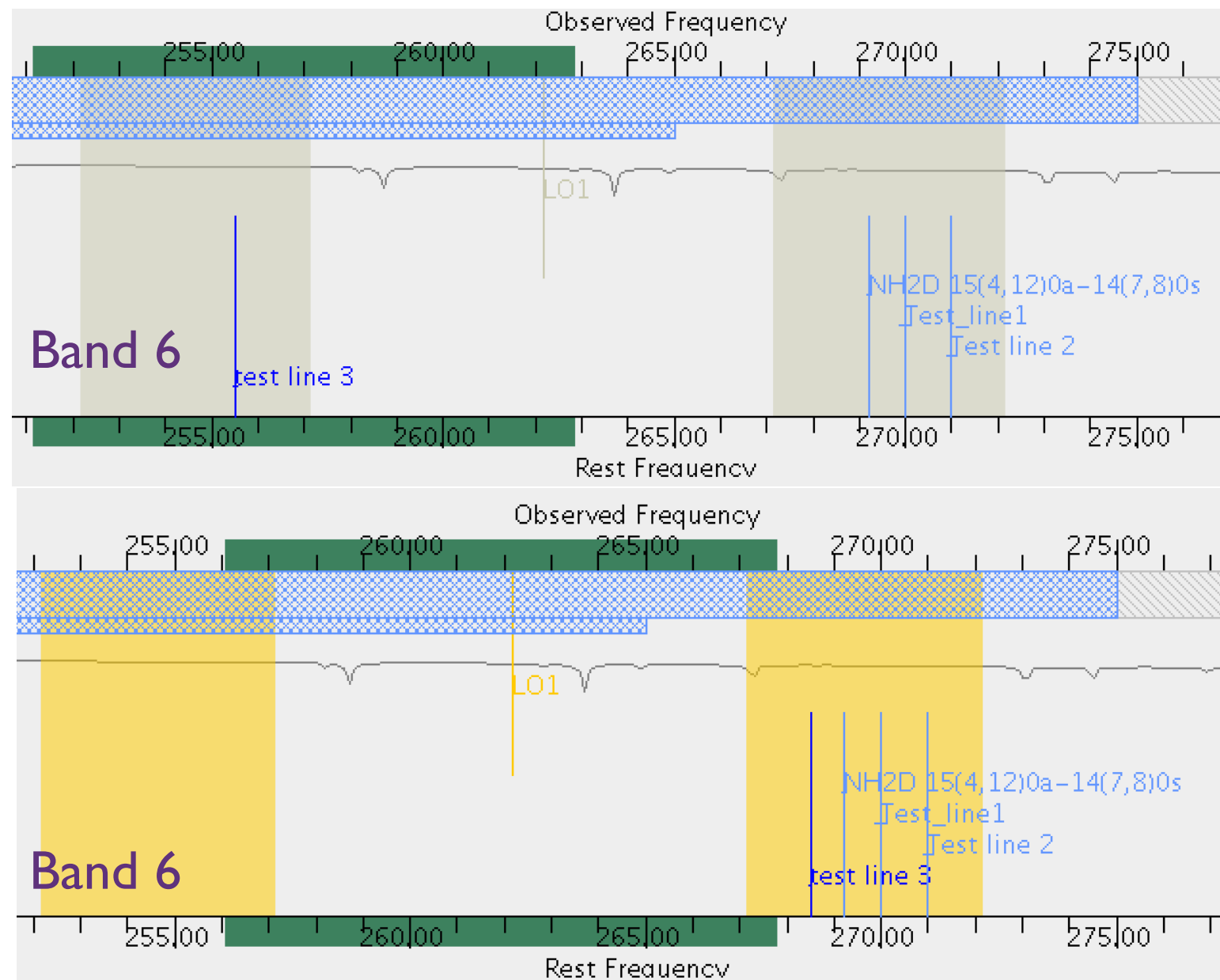
- Use the ALMA spectral line database
- Continuum BB and spectral line can be mixed (Spectral line mode)
- Set unused spws to continuum to help with calibration and continuum removal, in particular if you have narrowband spw



- in each BB can contain up to 4 spectral windows (spw)
- all spws in one BB should have the same resolutions
- better higher spectral resolution, but keep data rate $< 40\text{MB/s}$ — the default correlator setup for FDM modes averages every two channels **New!!**

Baseband limitations

- 2SB receivers (bands 3,4,5,6,7,8) cannot have 3 BBs in one sideband and 1 BB in the other
- DSB receivers (bands 9,10) have no BB/sideband restrictions



Bad spectral configuration

BBs stay gray in *spectral viewer*

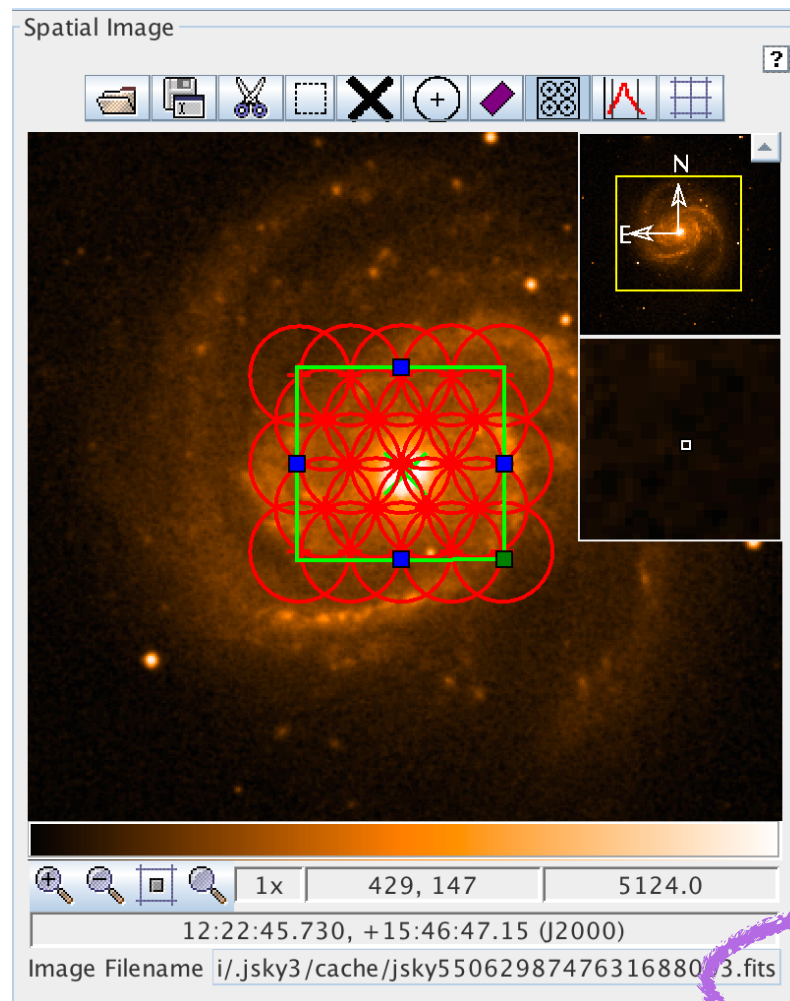
Bad spectral configuration gives
error messages in red

Spectral configuration OK

BBs become yellow

Spatial setup, once the spectral setup is done

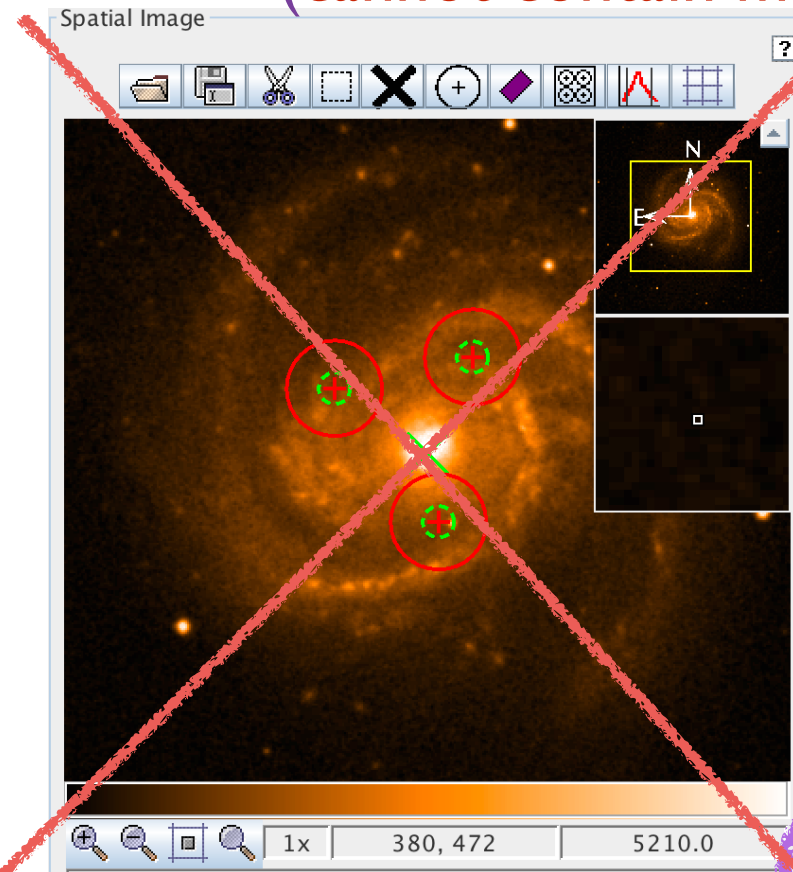
Rectangular field (mosaic)



Repr. freq from spectral setup

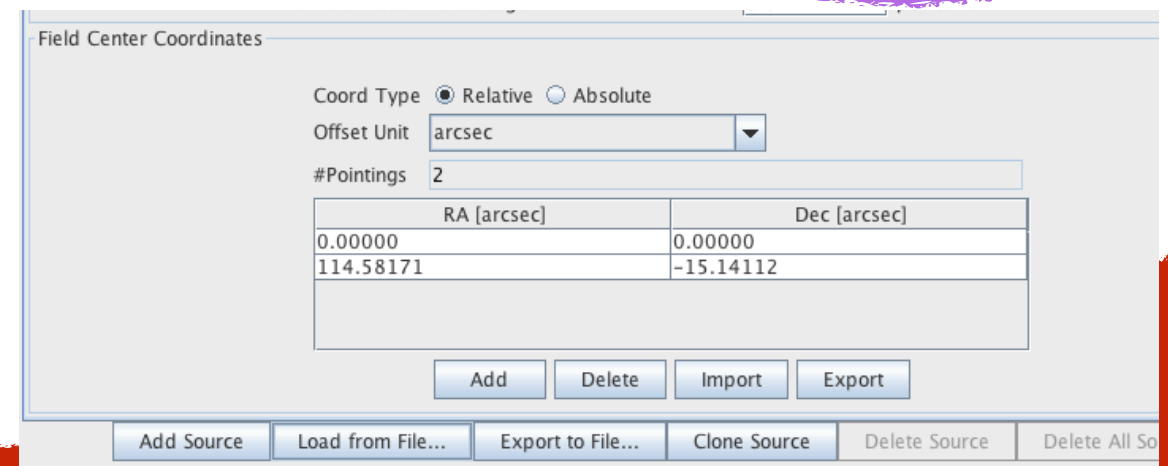
Primary beam or $\text{FOV} \sim \lambda/D$

Individual pointing
(cannot contain multiple offsets)



New!!

clone source for multiple offsets



Control and performance

OT calculates the angular resolution/maximum recoverable scale (MRS) for the most extended and most compact 12m Array, and the ACA 7m array based on the frequency and the source declination

Enter the desired performance,
angular resolution, MRS,
sensitivity and the
bandwidth for sensitivity

Based on the user selected resolution and MRS the **OT will choose the most suitable array(s) (incl. ACA stand alone)**

OT Time estimation uses the sensitivity calculator to derive **the total time for the SG incl. calibration**. It will divide sources with large separations in clusters that have their own calibrators, and show the number of tunings per cluster.

Control and performance

New!!

Angular resolution interface is more flexible

- single/ range/ any / Standalone ACA
- possible configurations are given

Desired Performance

Desired Angular Resolution (Synthesized Beam) ☐ Single ☒ Range ☐ Any ☐ Standalone ACA

0.5 arcsec to 1.5 arcsec

Largest Angular Structure in source 15.0 arcsec

Desired sensitivity per pointing 1.00000 mJy equivalent to 12.322 mK @ 1.50 "

and 0.11090 K @ 0.500 "

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

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 1.000 mJy

Bandwidth used for sensitivity 7.500 GHz

Representative frequency (sky, first source) 210.00 GHz

Estimated Total time for Science Goal 2.35 h

Cluster 1

Source Name	RA	Dec	Velocity
M100	12:22:54.8989	15:49:20.569	1569.779 km/s

Possible Configuration Combinations

	12-m (1)	12-m (2)	7-m	TP
C43-2	None	Yes	No	No
C43-3	None	Yes	No	No

Input Parameters

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

Time required for 12m (1) [C43-3]

Time on source per pointing (first source) 2.52 min [972.60 ms]

Total number of pointings (all sources) 2

Number of tunings 1

Total time on source 5.04 min [1.95 s]

Total calibration time 13.17 min

Other overheads 5.25 min

Total time for 1 SB execution 23.46 min

Close

Other for Cycle 5

New!!

- Calibration Setup more flexible, but it will be a non-standard mode
- Time constrained observing more flexible
- Resubmissions now flagged by the observatory, duplications must be justified
- Full polarization available in all low-frequency bands (Bands 3-7)
- Overlaid lines are saved

Technical Justification

Justify your chosen sensitivity and bandwidth for sensitivity

OT gives a sensitivity summary: requested and achieved RMS and S/N in req. bandwidth

Spectral observations: OT gives S/N over 1/3 of the linewidth, and linewidth/bandwidth for sensitivity ratio, gives also the spectral dynamic range

Justify your angular resolution and MRS

OT repeats the angular resolution and MRS

Justify your spectral resolution and data rate

OT repeats linewidth/spectral resolution of representative spw, and gives bandwidth of representative spw

Technical Justification

Justify your chosen sensitivity and bandwidth for sensitivity 

Justify your angular resolution and MRS 

Justify your spectral resolution and data rate 

Numbers to be double checked
trigger a message in blue

Figures/Tables required for
Technical Justification have to be
present in Scientific Justification

Check the knowledgebase
if you encounter problems
or contact us!

Only spectral dynamic
range < 1000 (B3,4,6) /500
(B7,8,9,10) allowed

Completing the proposal

1. Validate your proposal

This brings up any problem, such missing Scientific Justification, or badly set spectral settings.

Only validated proposal can be submitted!



Validation errors are given in the
Feedback window

2. Display project time summary

*Gives an overview of observing time of all proposal and
the data rate plus expected data size*

3. Make a pdf overview and save the .aot file on your disk

OT documentation and Help

OT contains the ALMA
template library of aot
files for Cycle 5

OT Help includes the User manual and
reference guide

ALMA website contains the OT
quickstart guide, manual and
reference guide, Cycle 5 proposers
guide, and OT video tutorials

**Submit questions to the ALMA
Helpdesk or your ARC!**

Limitations for Solar and VLBI proposals

Solar observations: continuum mode (single or dual pol) in a predefined spectral range of band 3 and 6.



VLBI observations: continuum mode (full pol) in a predefined spectral range of band 3 and 6, and *require a separate proposal to the GMVA or EHT*

PI does not ask for a sensitivity,

but directly for observing time in limited time slots