

Phase 1: An Introduction to the ALMA Observing Tool

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EUROPEAN ARC
ALMA Regional Centre

Introduction/Concepts

Phases of Proposal Submission

- Requesting ALMA time has two phases
 - Phase I: Proposal submission
 - Phase II: Submission of observing program
- Observing Tool (OT) is used for both
 - Fill in usual PI/co-I, etc. information
 - Attach scientific/technical justification (single PDF)
 - Define Science Goals
 - Submit!
 - If awarded time, generate Scheduling Blocks from Science Goals and submit

What is a Science Goal?

- Scientific requirements of the observations
- A user must enter:
 - Science targets (including mapping area, velocities)
 - Spectral line and/or continuum frequencies
 - Angular resolution, largest source angular scale
 - Required sensitivity (**NOT TIME!**)
- SBs are generated from the above information
 - Contain the technical details required to operate the array
 - This is done automatically – no user input required

What is a Science Goal?

- Scientific requirements of the observations
- A user must enter:

No detailed knowledge of radio astronomy or interferometry should be necessary!

- Science targets (including mapping area, velocities)
 - Spectral line and/or continuum frequencies
 - Angular resolution, largest angular scale
 - Required sensitivity
- Output
 - Array configurations
 - Time on source
 - Calibration sources and strategy

What is a Scheduling Block?

- A self-contained definition of an observation
 - SBs are what are executed at the telescope
- It contains:
 - Information from the Science Goal
 - positions, frequencies, sensitivity, angular resolution
 - Enormous amounts of technical information
 - e.g. correlator and backend parameters
 - Approximate time on source
 - Each SB will last ~1 hour
 - Dynamic scheduler will execute SB till σ is achieved

What is a Scheduling Block?

- A self-contained definition of an observation
 - Generated from the Science Goal automatically
 - Each will last 30-40 minutes i.e. repeated if necessary
- **“Phase2Group” currently responsible for ensuring that all SBs meet the PI’s needs**
 - Source information (science targets + calibrators)
 - Spatial setup
 - Observing parameters (time on source, cycle times, calibration tolerances)
 - The name of an observing script
 - This actually runs the observation!
- A user will not normally interact with an SB!

Time Estimates

- Time on source is only an estimate
 - Scheduler will run an SB in appropriate weather conditions
 - These may differ from those assumed by the OT
 - ALMA is still being characterised
 - Source emission not taken into account e.g. planets
 - Observations will proceed until sensitivity is reached
- Additional time can be requested
 - E.g. flux monitoring where sensitivity is not the main goal
 - Must justify in proposal

Calibration

- The observatory will provide all necessary calibration
 - Choose “system-defined” calibration (the default)
 - Calibrators will eventually be selected at run time
 - Cycle 0: selected by Phase2Group
- Specific calibrators can be requested
 - Must justify in proposal
 - Almost never necessary
- Observation/calibration sequence not chosen by PI
 - An observing script (Python) actually controls ALMA
 - Observing sequence is largely determined by this

Implementation

- The OT is a Java application
 - Java 6 must be installed on your computer
 - Version with built-in Java available (Linux only)
- Download and run locally
 - Web Start (recommended) and tarball versions
- Internet connection required intermittently
 - PI/co-I information from user database
 - Source catalogues and image servers
 - Spectral line catalogues
 - Submission

Layout of the OT

H0 to five decimal places - Observing Tool for ALMA, version Cycle0

File Edit View Tool Search Help Perspective 1

Project Structure

Proposal Program

Unsubmitted Proposal

- H0 to five decimal places
 - Proposal
 - Planned Observing
 - Science Goal
 - General
 - Field Setup
 - Spectral Setup
 - Calibration Setup
 - Control and Performance

Unsubmitted Proposal (read-only)

Template library. Turn the keys on the JTree below & re

- Proposal
 - Planned Observing
 - B3 spectral sweep CO (9-8): COSMOS SMGs
 - B7 continuum: COSMOS SMGs
 - B7 CO(9-8): Cosmic Eyelash (z=2.326)
 - B9 continuum: Cosmic Eyelash (z=2.326)
 - B3 spectral sweep: PKS1830-211 (z=0.9)
 - B3 continuum: GRB ToO: days 0 to 14
 - B6 continuum: GRB ToO: days 0 to 14
 - B7 continuum: GRB ToO: days 0 to 14
 - B6 continuum: GRB ToO: day 17
 - B3 continuum: GRB ToO: day 30
 - B6 12CO (2-1): NGC3256 mosaic
 - B6 13CO (2-1): NGC3256
 - B6 spectral line: Massive Protostellar Cluster
 - B9 spectral line: Massive Protostellar Cluster n
 - B3 continuum: Protostellar Disks
 - B6 continuum: Protostellar Disks
 - B7 continuum: Protostellar Disks

Editors

Spectral Spatial Proposal

Proposal Information

Proposal Title: H0 to five decimal places

Proposal Cycle: 2011.0

Abstract (max. 300 words): No, seriously!

Launch Editor

Scientific Category

Cosmology and the High Redshift Universe Galaxies and Galactic Nuclei

ISM/Astrochemistry/Star Formation/protoplanetary disks/exoplanets Stellar Evolution/the Sun and the Solar System

Proposal Type

Standard Target Of Opportunity

Student Project

Continuation (Not Applicable)

Related Proposals

Feedback

Problems Information Log

0 errors, 0 warnings

Description	Suggestion
✓ No problems found	

Overview

Contextual Help

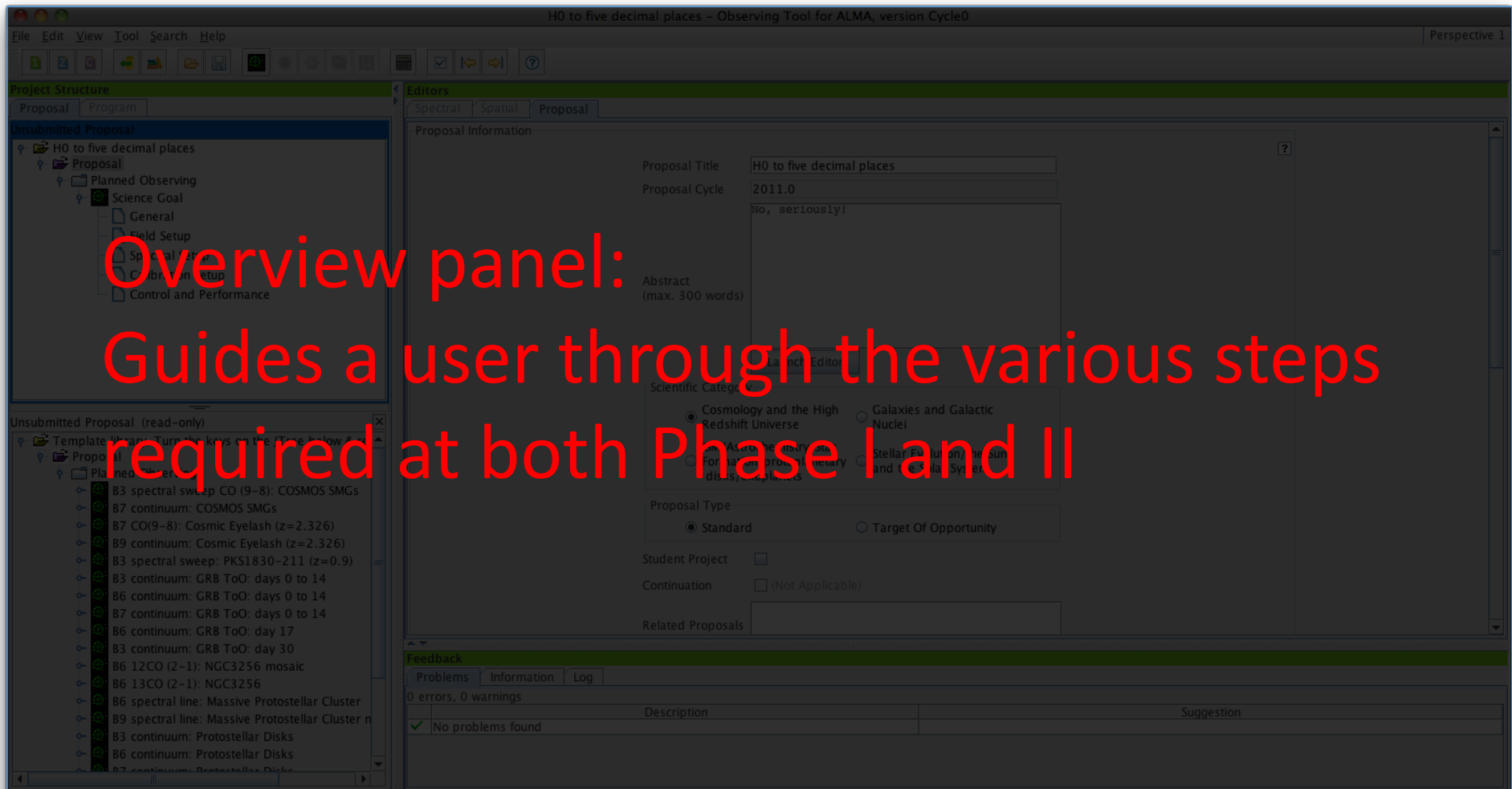
- Please ensure you and your Co-Is are registered with the [ALMA Science Portal](#)
- Create a new proposal by either:
 - Selecting *File > New Proposal*
 - Clicking on the icon in the toolbar
 - Or clicking on this [link](#)
- Click on the proposal tree node and complete the relevant fields.

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



Overview panel:
 Guides a user through the various steps
 required at both Phase I and II

Overview

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Phase I: Science Proposal

Click on the overview steps to view the contextual help

The Project Tree:
Shows the structure of your proposal/project including the template library (optional)

Project Structure

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 - B7 continuum: Protostellar Disks

Proposal Information

Proposal Title: H0 to five decimal places

Proposal Cycle: 2011.0

Abstract (max. 300 words): No, seriously!

Scientific Category:

- Cosmology and the High Redshift Universe
- Galaxies and Galactic Nuclei
- Star Formation
- Stellar Evolution/the Sun and the Solar System
- Formation/protoplanetary disks/exoplanets

Proposal Type:

- Standard
- Target Opportunity

Student Project:

Continuation: (Not Applicable)

Revised Proposals:

Feedback

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0 errors, 0 warnings

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Contextual Help

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Phase I: Science Proposal

```

    graph LR
      A[New Science Proposal] --> B[Create Science Goals]
      B --> C[Validate Science Proposal]
      C --> D[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](#)

Editor window:
Enter your information here

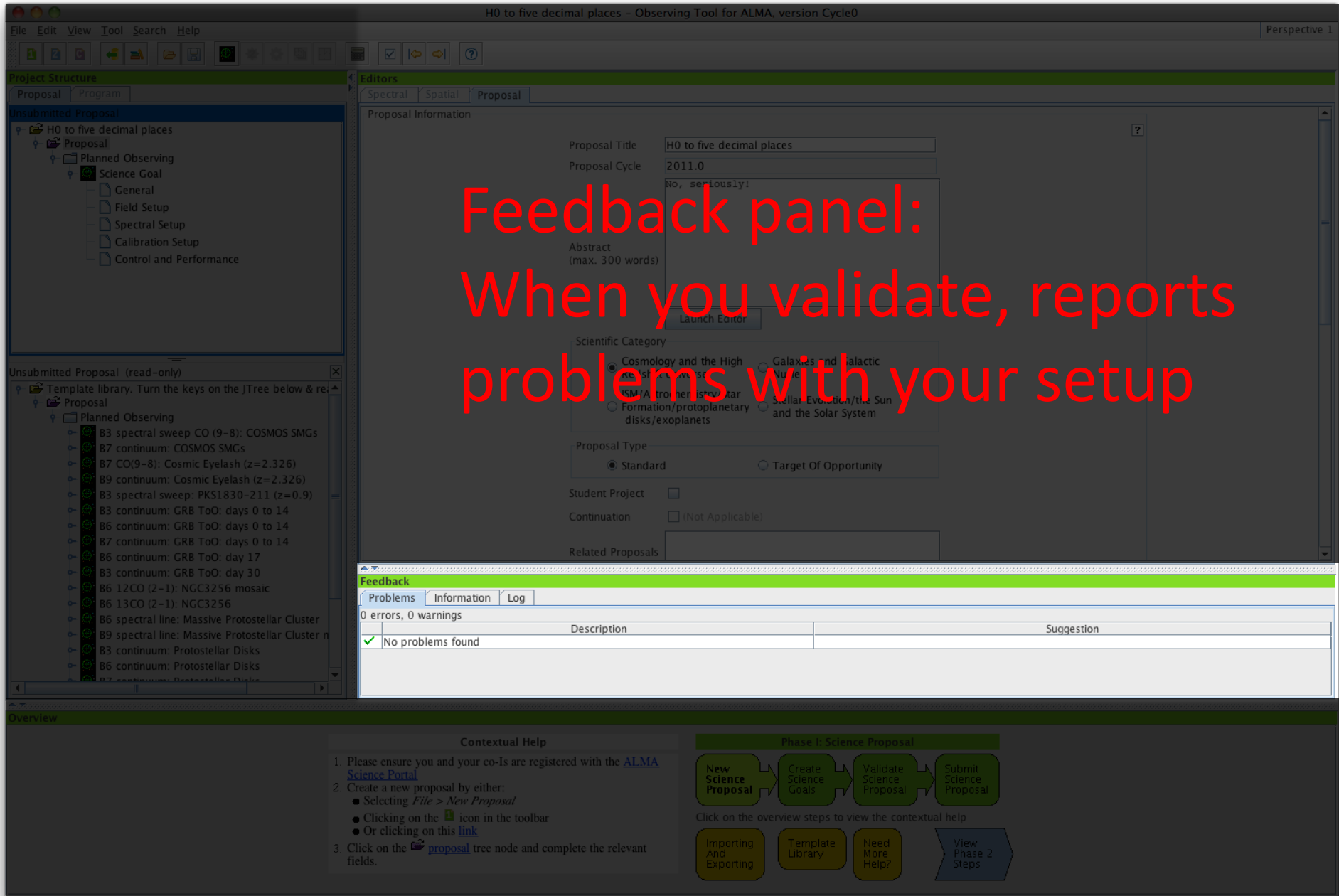
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Editors - Proposal Information:
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 Standard
 Target Of Opportunity
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 Related Proposals:

Feedback:
 Problems Information Log
 0 errors, 0 warnings
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Overview:
 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
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 3. Click on the proposal tree node and complete the relevant fields.

Process Flow:
 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



H0 to five decimal places - Observing Tool for ALMA, version Cycle0

File Edit View Tool Search Help

Perspective 1

**Menus and Toolbar
(commonly used functions)**

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Abstract (max 300 words)

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Scientific Category

- Cosmology and the High Redshift Universe
- Galaxies and Galactic Nuclei
- ISM/Astrochemistry/Star Formation/protoplanetary disks/exoplanets
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Proposal Type

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Feedback



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Phase I: Science Proposal

```

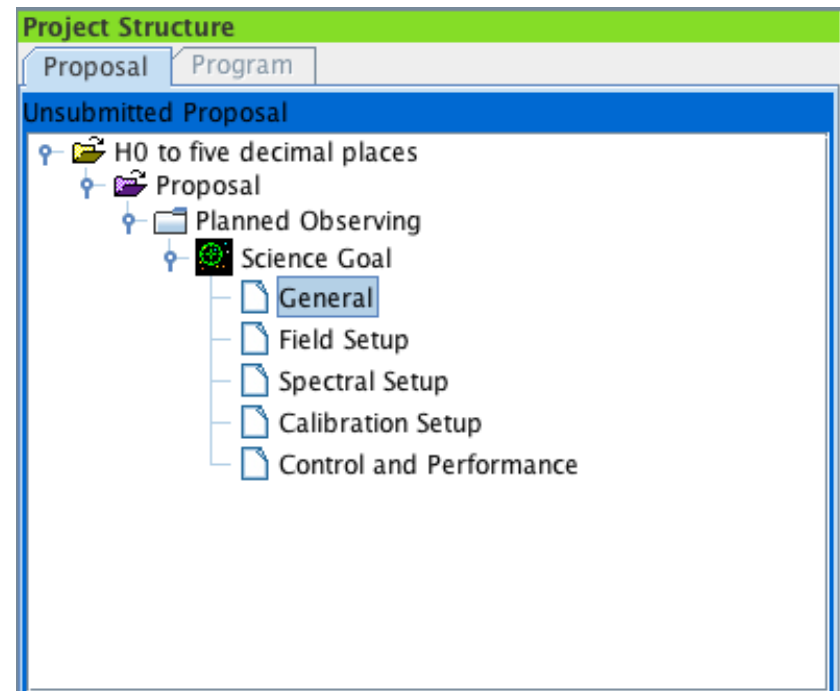
graph LR
    A[New Science Proposal] --> B[Create Science Goals]
    B --> C[Validate Science Proposal]
    C --> D[Submit Science Proposal]
  
```

Click on the overview steps to view the contextual help

Importing And Exporting | Template Library | Need More Help? | View Phase 2 Steps

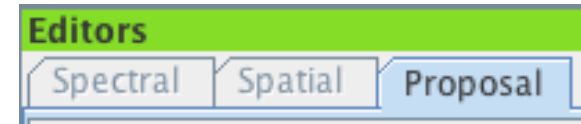
Project navigation

- Navigate through project using the Project Tree
- Content of Editor panel will change depending on which “node” you are in
- Two tabs
 - Proposal (Phase I)
 - No SBs here, only Science Goals
 - Program (Phase II)
 - Not available at Phase I
 - SBs are generated here



Tools

Editors



- Three kinds of editor are available
 - Forms
 - Basic textual input – always available
 - Name reflects which node in the Project Tree is currently selected
 - Spectral
 - Visualiser tool – only available with Spectral Setup
 - Also includes Forms editor
 - Spatial
 - Visualiser tool – only available with Spatial Setup
 - Also includes Forms editor

Spatial Visual Editor

- Downloads and displays an image of the sky
 - Image servers include DSS, 2MASS, NVSS, FIRST...
 - Local image files (FITS) can also be displayed
- Rectangular mapping regions can be defined
 - Mosaic patterns are calculated and displayed
 - Maximum 150 mosaic pointings for Cycle 1
 - ALMA and ACA pointings are shown

Spatial Visual Editor

M100

Source

Source Name: M100 [Resolve]

Choose a Solar System Object? Name of object: Unspecified

Source Coordinates

System: J2000 Sexagesimal display? Parallax: 0.00000 mas

RA: 12:22:54.8990 PM RA: 0.00000 mas/yr

Dec: 15:49:20.572 PM Dec: 0.00000 mas/yr

Source Velocity: 1570.000 km/s hel z: 0.005250741 Doppler Type: RELATIVISTIC

Target Type: Multiple Pointings 1 Rectangular Field

Expected Source Properties

Peak Continuum Flux Density per Beam: 0.50000 mJy

Peak Line Flux Density per Beam: 3.00000 mJy

Polarisation Percentage: 0.0 %

Line Width: 10.00000 km/s

Rectangle

Coords Type: ABSOLUTE RELATIVE

Field Center Coordinates

System: J2000

Offset(Longitude): 0.00000 arcsec

Offset(Latitude): 0.00000 arcsec

p length: 260.00000 arcsec

q length: 260.00000 arcsec

Position Angle: 0.00000 deg

Spacing: 0.48113 fraction of main beam [Reset to Nyquist]

#Pointings: 12m Array: 126 7m Array: 39 [Export]

Add Source Load from File... Delete Source Delete All Sources

FOV Parameters

Representative Frequency (Sky): 114.669 GHz

Antenna Diameter: 12m 7m

Antenna Beamsize: 53.926 arcsec

Show FOV(circle):

Image Query

Image Server: Digitized Sky (Version II) at ESO

Image Size(arcmin): 10.0 [Query]

Spectral Visual Editor

- Gives overview of spectral setup
 - User defines spectral windows
 - OT calculates a tuning solution automatically
- Spectral Visual Editor displays:
 - Spectral windows
 - Sidebands
 - LO1
 - Atmospheric transmission
 - Other spectral lines...

Spectral Visual Editor

Visualisation

In the table below, it is possible to define up to four spectral windows, one per baseband. Each baseband is 2GHz wide and can be separately configured i.e. each spectral window can have a different bandwidth and resolution. Note that for bands 3, 6 and 7, it is not possible to put 3 basebands in the same sideband.

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

Overlays: Receiver Bands Transmission Overlay Lines [Select Lines to Overlay...](#)

Water Vapour Column Density: Automatic Choice Manual Choice [?](#)

Viewport: [Pan to Line](#) [Zoom to Band](#) [Reset](#)

Spectral Type

Spectral Line [?](#)

Spectral Type Single Continuum Spectral Scan

Polarization Products desired XX DUAL

Spectral Setup Errors

Spectral Line

Baseband-0 [?](#)

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (Hanning smoothed)	Representative Window
1(Full)	115.27120 GHz	114.83638 GHz	CO v=0 1-0	58.594 MHz(153 km/s), 30.518 kHz(0.080 km/s)	<input checked="" type="radio"/>

[Select Lines to Observe in Baseband-0...](#) [Add](#) [Delete](#)

Yellow sidebands indicate that a valid tuning solution has been found

Spectral Line Picker

- The OT's interface to NRAO's Splatalogue
 - Online search of 5.8 million lines
 - The OT has a smaller internal version
- Lines can be filtered and sorted e.g. by
 - Name (text search with wildcards)
 - Strength
 - Maximum upper state energy
 - Location (hot cores, comets, dark clouds, etc.)
- Tuning filter also incorporated
 - Can a tuning solution be found for all the spectral windows?

Spectral Line Picker

Select Spectral Lines

Species Filter

H

Include description

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

Transition	Description	Rest Frequency	Sky Frequency	Upper-state Energy	Lovas Intensity	Sij μ^2	Catalog
HC3NV7=2 J=25-24, l=0	Cyanoacetylene	228.822 GHz	221.255 GHz	780.68 K	16.8	344.84 D ²	Offline
HC3NV7=2 J=25-24, l=2f	Cyanoacetylene	228.898 GHz	221.328 GHz	783.32 K	23.1	342.64 D ²	Offline
DNC 3-2	Hydrogen Isocyanide	228.91 GHz	221.34 GHz	21.97 K	0.23	27.91 D ²	Offline
H13CCCN J=26-25	Cyanoacetylene	229.203 GHz	221.623 GHz	148.51 K	20.7	362.07 D ²	Offline
H(30) α	Hydrogen Recombination Line	231.901 GHz	224.232 GHz				Offline
He(30) α	Helium Recombination Line	231.995 GHz	224.323 GHz				Offline
HCCCHO 22(2,21)-22(1,22)	2-Propynal	232.328 GHz	224.645 GHz	125.28 K	2.8	20.71 D ²	Offline

Add to Selected Transitions

Selected transitions

Transition	Description	Rest Frequency	Sky Frequency
CO v=0 2-1	Carbon Monoxide	230.538 GHz	222.914 GHz

Remove from Selected Transitions

Cancel Ok

Double click a column header to sort by it. Single clicking other columns provides secondary, tertiary, etc., sorts

ALMA Sensitivity Calculator

- Calculates sensitivity (or time) for all three arrays
- Available for experimentation
 - In both OT and Science Portal
- Weather is described in terms of PWV octiles
 - ASC can choose automatically based on frequency (default)
 - User can set manually
 - **ALMA always chooses for you!**
- Version in OT is independent from SG inputs
- Described in ALMA Technical Handbook

ALMA Sensitivity Calculator

The screenshot shows the 'Sensitivity Calculator' window with the following parameters:

Common Parameters

- Dec: -17:35:02.400
- Polarization: Dual
- Observing Frequency: 345.0 GHz
- Bandwidth per Polarization: 7.5 GHz
- Water Vapour: Automatic Choice Manual Choice
- Column Density: 0.913mm (3rd Octile)
- tau/Tsky: tau0=0.158, Tsky=36.784
- Tsys: 151.779 K

Individual Parameters

	12m Array	7m Array	Total Power Array
Number of Antennas	32	9	2
Resolution	1.0 arcsec	5.974554 arcsec	17.923662 arcsec
Sensitivity(rms)	73.44625 uJy	0.76435 mJy	1.63573 mJy
(equivalent to)	0.75448 mK	0.21997 mK	0.05230 mK
Integration Time	10 min	10 min	10 min

Integration Time Unit Option: Automatic

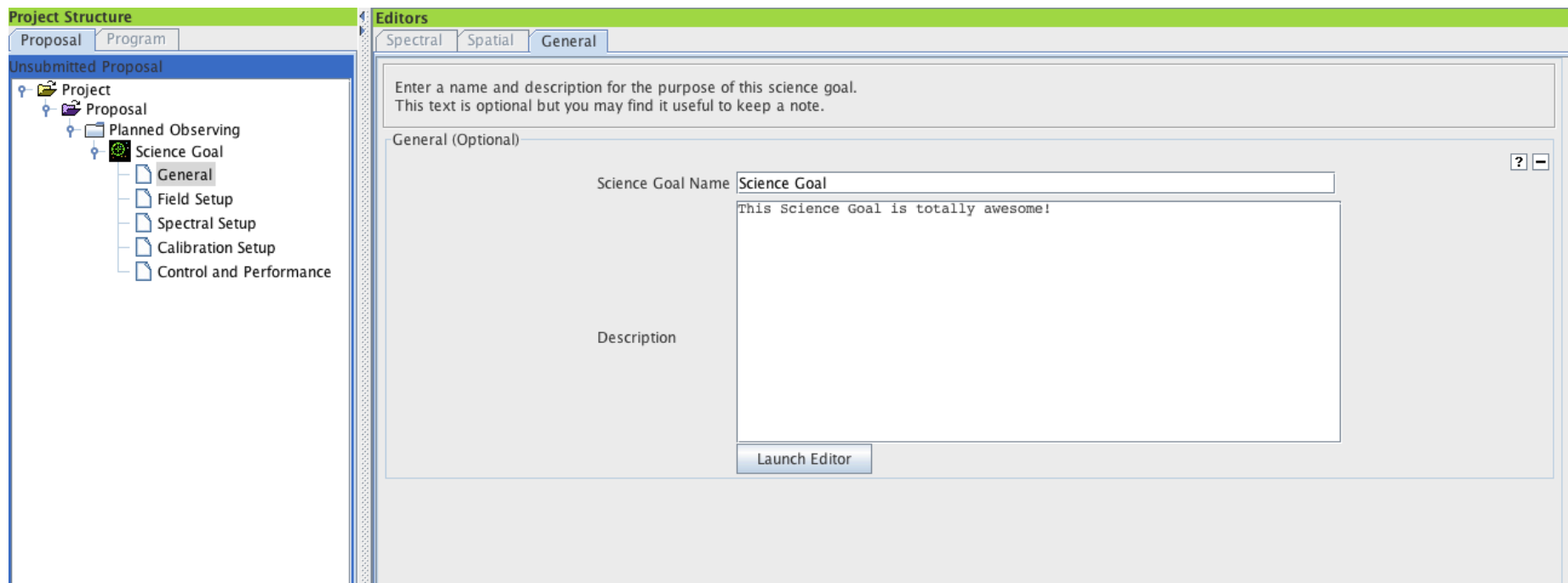
Buttons: Calculate Integration Time, Calculate Sensitivity, Close

Science Portal url - <http://almascience.eso.org/call-for-proposals/sensitivity-calculator>

Science Goal Sections

General

- Space for textual input
 - Optional description of Science Goal



Field Setup

- Telescope pointing parameters
 - Positions
 - Proper motions
 - Mapping areas
- Radial velocities
 - OT will Doppler shift spectral lines
- Fluxes and line widths
 - Currently only used for Technical Assessment
 - Might be used at Cycle 1 for imaging requirements

Field Setup

Project Structure

Proposal | Program

Unsubmitted Proposal

- Project
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 - Field Setup**
 - Spectral Setup
 - Calibration Setup
 - Control and Performance

Editors

Spectral | Spatial | **Field Setup**

Input the source you wish to look at and your mapping specification.
Alternatively you may define this with the Visual Editor – select the spatial tab.

Andy's source

Source

Source Name: Resolve

Choose a Solar System Object? Name of object:

Source Coordinates

System: Sexagesimal display?

RA: Parallax:

Dec: PM RA:

PM Dec:

Source Velocity: z: Doppler Type:

Target Type: Multiple single point fields 1 rectangular field

Expected Source Properties

Peak Continuum Flux Density per Beam:

Peak Line Flux Density per Beam:

Polarisation Percentage: %

Line Width:

Field Center Coordinates

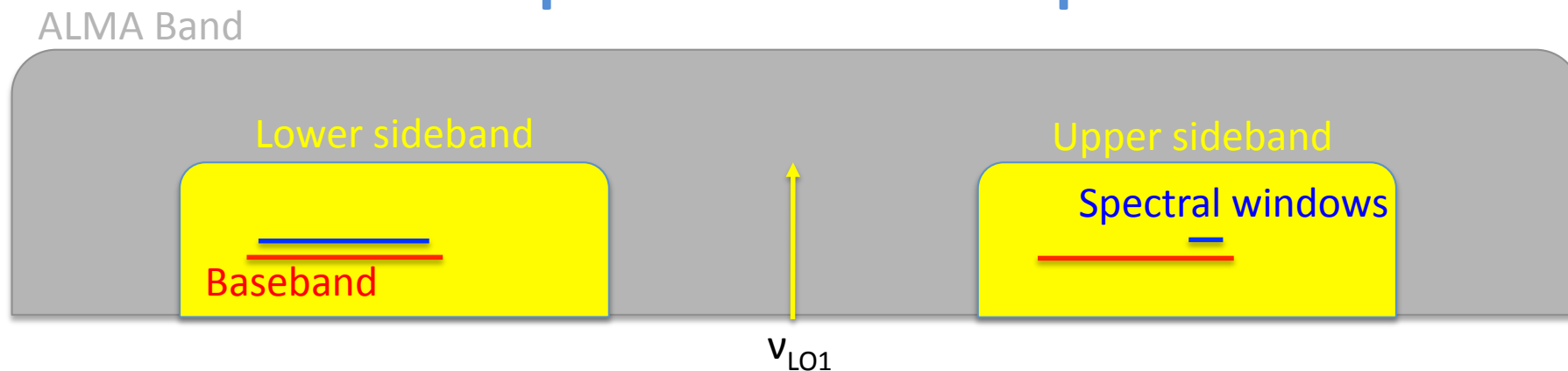
PointingPattern: Offset

Offset Unit:

#Pointings:

RA [arcsec]	Dec [arcsec]
0.00000	0.00000

Spectral Setup

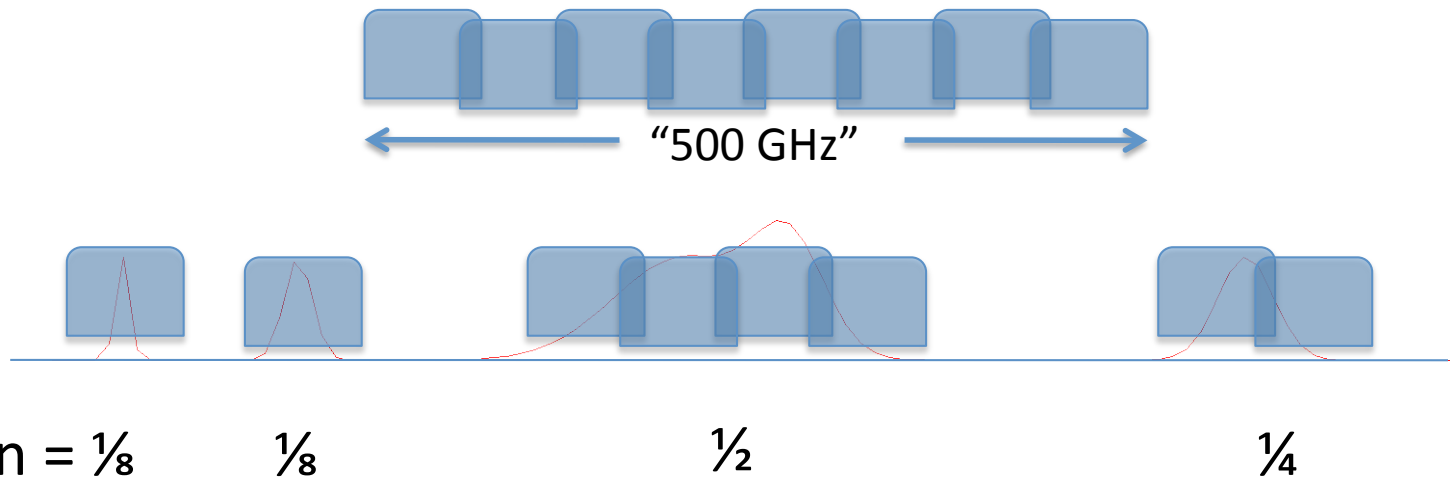


- ALMA bands have two sidebands (telescope output)
 - Widths and separations are band-dependent
 - Bands 3 and 7: each is 4 GHz wide
- Basebands sample the sideband signals
 - Each is 2-GHz wide and has two polarizations (X and Y)
- Spectral windows sample the baseband signals

Spectral Setup

- Each baseband can support one spectral window
 - A correlator mode must be chosen for each spw
 - Centre frequency, bandwidth, channel spacing & pol.
 - 14 modes are available at Cycle 1
 - [6 high-resolution (FDM) and 1 low-resolution (TDM)] x 2 pol.
 - OT will only let you choose a valid mode
- Basebands are independent
 - Different correlator modes in each (FDM or TDM)
- OT will try and calculate tuning solution
 - Errors will be reported

Multiple Region Modes



- FDM correlator modes can be split into >1 spws
 - Each is made up of multiple 62.5-MHz wide filters
 - Use the “fraction” parameter ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, etc.)
 - Spectral resolution in each must be the same

Representative Frequency

- Frequency used in sensitivity calculation
- Determines PWV octile – **user does not choose this!**
- Sets field of view displayed in Spatial Visual Editor
- User must select one of the spws
 - Centre frequency becomes RF
 - This default can be changed (within spw)

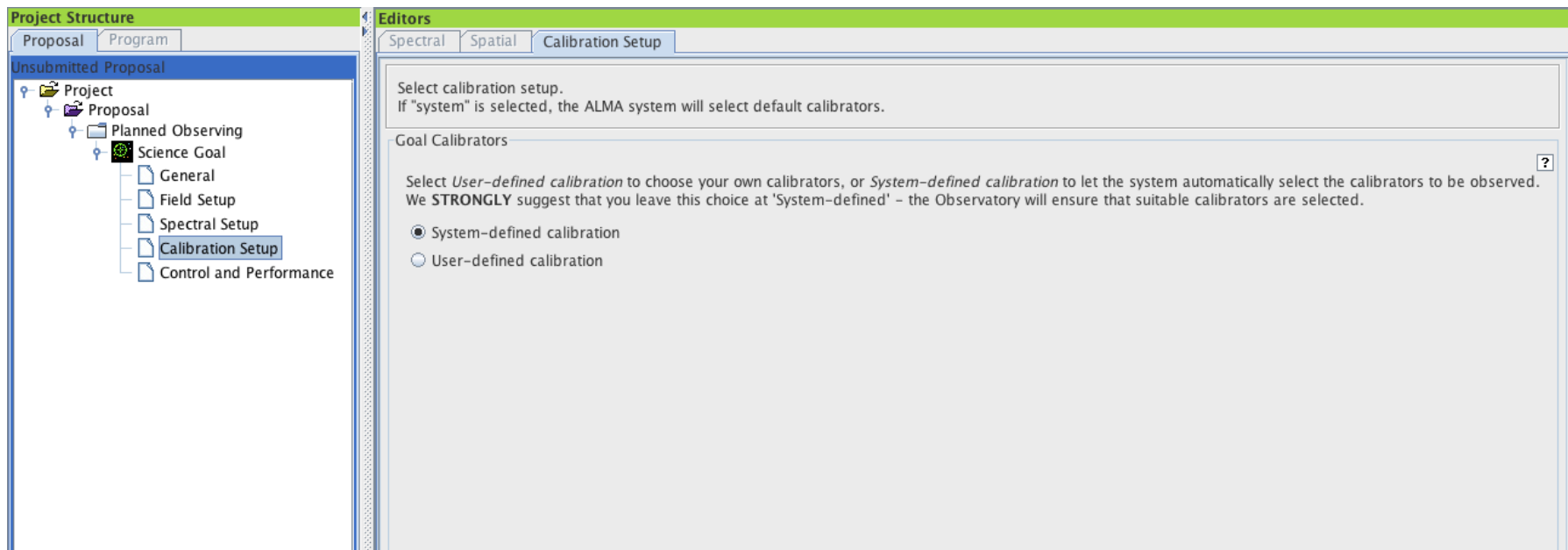
Baseband-0					
Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Resolution (Hanning smoothed)	Representative Window
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Select Lines to Observe in Baseband-0... <input type="button" value="Add"/> <input type="button" value="Delete"/>					
Baseband-1					
1(Full)	113.26726 GHz	112.84000 GHz		2000.000 MHz(4981 km/s), 31.250 MHz(83.025 km/s)	<input type="radio"/>
Select Lines to Observe in Baseband-1... <input type="button" value="Add"/> <input type="button" value="Delete"/>					

Multiple Spectral Setups

- Multiple spectral setups per SG not yet supported
 - Each must go in a separate Science Goal
 - Okay if they don't need to be observed simultaneously
- Multiple setups per SB must be done at Phase 2
 - Flux monitoring is an obvious science case
 - Simultaneity requirement must be justified
 - P2G member will manually combine SBs
- Spectral scans also not yet supported
 - Each tuning should go in a separate Science Goal

Calibration Setup

- As already explained, almost always not necessary



Control and Performance

- User inputs
 - Angular resolution (Θ)
 - Largest Angular Scale (that you want to map)
 - Required sensitivity
 - Bandwidth used for sensitivity
- ACA requirement will be based on Θ and LAS
 - User can sometimes override (must be justified)
 - Can't use ACA for 2 largest 12-m arrays (C32-5 & C32-6)
 - ACA time is three times that for 12-m array
 - Total Power array not available for continuum observations
- Time Estimate button gives detailed breakdown
 - Includes calibration and hardware/software overheads

Control and Performance

Control and Performance ?

Configuration Information

Antenna Beamsize ($1.2 * \lambda / D$)	12m <input type="text" value="53.848 arcsec"/>	7m <input type="text" value="92.310 arcsec"/>
	Most Extended Configuration Most Compact Configuration	
Longest baseline (L_{max})	<input type="text" value="1.091 km"/>	<input type="text" value="165.6 m"/>
Synthesized beamsize (λ/L_{max})	<input type="text" value="0.494 arcsec"/>	<input type="text" value="3.252 arcsec"/>
Shortest baseline (L_{min})	<input type="text" value="43.3 m"/>	<input type="text" value="15.1 m"/>
Maximum recoverable scale ($0.6\lambda/L_{min}$)	<input type="text" value="7.462 arcsec"/>	<input type="text" value="21.396 arcsec"/>

Desired Performance

Desired Angular Resolution

Largest Angular Structure in source Point Source Extended Source

Desired mosaic sensitivity equivalent to

Bandwidth used for Sensitivity Frequency Width

Do you request complementary ACA Observations? Yes No

Science goal integration time estimate

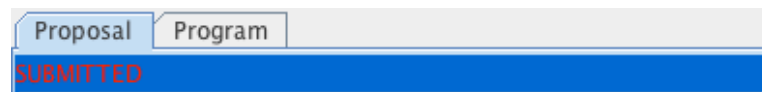
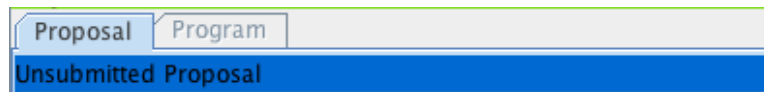
Does your setup need more time than is indicated by the time estimate? Yes No

Is this observing time constrained (occultations, coordinated observing,...)? Yes No

Proposal Submission

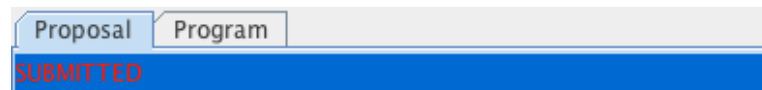
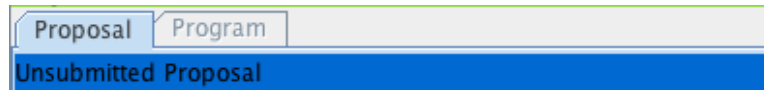
- When ready, validate your proposal
 - OT will check that all necessary information is present
 - Errors will appear in Feedback panel
 - A project cannot submit with validation errors
- Submit
 - Project code assigned at this point
- For your records...
 - Email will acknowledge submission (PIs and co-Is)
 - Printable summary of proposal can be produced
 - OT will ask you to save to disk at this point

Proposal Resubmission



- Resubmission is possible up to the deadline
 - Previous submission is overwritten
- Also possible with older versions (saved on disk)
 - This wasn't possible at Cycle 0
 - OT will issue a warning just in case
- Once submitted, resubmissions always overwrite
 - Change every detail of project – not a new submission!!!
 - Reuse old projects with “Use Project as Template”

Submission Dangers



- Using an old proposal as a template
 - This is very bad with an already submitted proposal
 - Other project will be overwritten
 - Read old proposal with “Use Project as Template”
- Resubmitting a locally-saved project that wasn't saved after submission
 - This will be a new submission i.e. new project code
- OT shows a project's submission status

Usage tips

- The OT shows a lot of information
 - Running it in full-screen mode is recommended
 - Panels can be hidden (e.g. Overview panel)
- Various default settings can be changed
 - Preferences dialogue is available through the File menu
- Extensive built-in help is available
 - Help menu (User Manual and Reference Manual)
 - Contextual help (Question Mark buttons)
 - Plus external videos and Quickstart guide (Science Portal)

Bugs, Features and Updates

- There are bugs!
- Listed in Science Portal under “Known Issues”
 - Look there before submitting Helpdesk tickets
- Troubleshooting guide also useful
 - Mainly for installation problems
- A Cycle-1 update has already been issued
 - Web Start users get this automatically
 - Tarball users must manually download and install
 - Other updates may follow

Happy proposal writing
for Cycle 1!