

The ALMA Observing Tool

Andy Biggs

ALMA Regional Centre, ESO



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 scale baselines
- 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, σ , 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)
 - Observing parameters
 - 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
 - Observations will proceed until sensitivity is reached
- Additional time can be requested
 - (u,v) coverage may be insufficient
 - Must justify in proposal
 - Almost never necessary – 32 12-m antennas at Cycle 1!

Calibration

- The observatory will provide all necessary calibration
 - Choose “system-defined” calibration (the default)
 - Sources 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 now 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

Editors

Spectral Spatial Proposal

Proposal Information

Proposal Title:

Proposal Cycle:

Abstract (max. 300 words):

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	

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 r
 - 📄 B3 continuum: Protostellar Disks
 - 📄 B6 continuum: Protostellar Disks
 - 📄 B7 continuum: Protostellar Disks

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

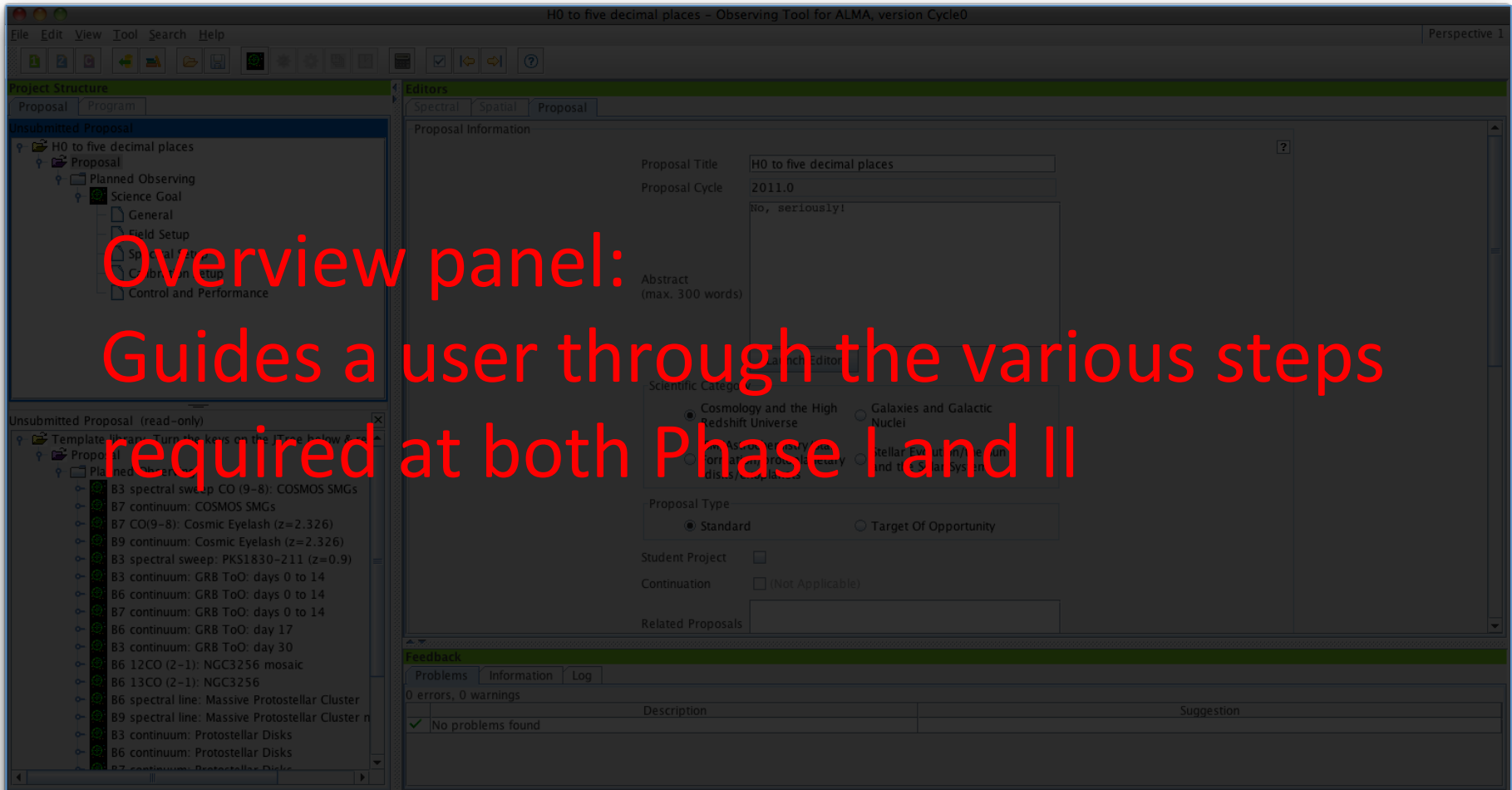
Click on the overview steps to view the contextual help

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

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

File Edit View Tool Search Help

Perspective 1

Project Structure

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 - 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!

Scientific Category

- Cosmology and the High Redshift Universe
- Galaxies and Galactic Nuclei
- ALMA or other Interstellar Medium
- Stellar Evolution, Planets and the Solar System
- Formation/protoplanetary disks/exoplanets

Proposal Type: Targeted Opportunity

Student Project:

Continuation: (Not Applicable)

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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

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

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

File Edit View Tool Search Help

Perspective 1

Project Structure

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Unsubmitted Proposal (read-only)

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

Proposal

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Editors

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Proposal Title: H0 to five decimal places

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Launch Editor

Scientific Category

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

Proposal Type

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 Target Of Opportunity

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Continuation: (Not Applicable)

Related Proposals

Feedback

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**Editor window:
Enter your information here**

Overview

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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

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Editors

Spectral Spatial Proposal

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 Nurseries
- ISM/Astrophysical Processes
- 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: [Empty field]

Feedback

Problems Information Log

0 errors, 0 warnings

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Overview

Contextual Help

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Phase I: Science Proposal

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

File Edit View Tool Search Help Perspective 1

Project Structure

- Proposal
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Editors

Spectral Spatial Proposal

Proposal Information

Proposal Title: H0 to five decimal places

Proposal ID: 2011.0

Abstract (up to 300 words)

Launch Editor

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Proposal Type

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Student Project

Continuation (Not Applicable)

Related Proposals

Feedback



Problems Information Log

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Overview

Contextual Help




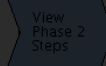
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Phase I: Science Proposal

```

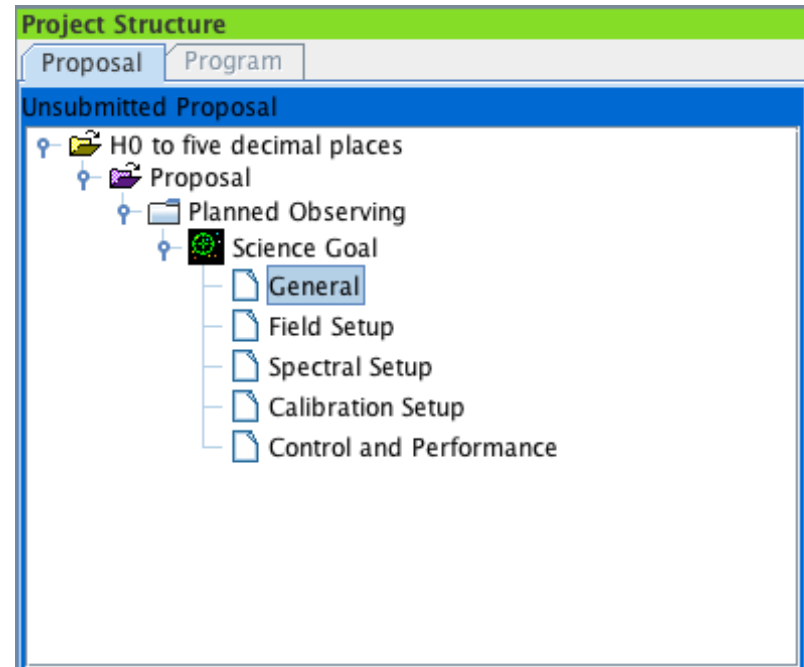
    graph LR
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Click on the overview steps to view the contextual help

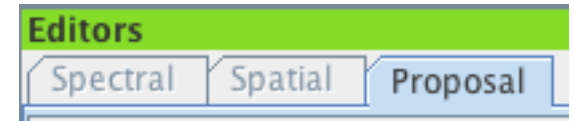
Project navigation

- 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

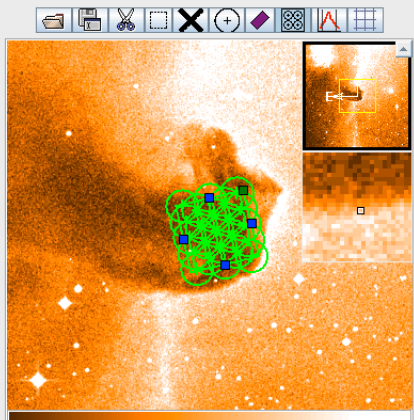
H0 to five decimal places - Observing Tool for ALMA, version Cycle0

File Edit View Tool Search Help

Perspective 1

Editors

Spectral Spatial Field Setup



horsehead nebula

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 (for Technical Assessment)

Peak Flux Density per Beam

Polarisation Percentage %

Line Width

Rectangle

Coords Type ABSOLUTE RELATIVE

Field Center Coordinates

Offset(Longitude)

Offset(Latitude)

p length

q length

Position Angle

Spacing

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

1x 521,466 8844.0

05:41:00.018, -02:29:19.09 (J2000)

image filename : jsky3/cache/jsky3437604889851319811.fits

FOV Parameters

Frequency used Refresh

(taken from) Science Goal:representativeFrequency

Antenna Diameter 12m 7m

Main beam size

Show FOV(circle)

Image Query

Image Server

Image Size(arcmin) 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

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

File Edit View Tool Search Help

Perspective 1

Editors

Spectral Spatial Spectral Setup

Visualisation

After creating spectral setups in the forms you may visualize them here.
 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

Frequency in Target Frame

Overlays: Receiver Bands Transmission Overlay Lines

Viewport:

Spectral Type

Spectral Type: Choose the type of spectral observation you wish to make

- Up to 4 spectral windows
- More than 4 spectral windows
- Single continuum (average frequency)
- Spectral scan

Polarization Products desired SINGLE-X DUAL

Up to 4 spectral windows

Center Freq Rest	Center Freq Sky	Transition	Bandwidth, Channel Spacing	Process As Continuum
1036.91239 GHz	212.91835 GHz	CO v=0 9-8	2000.000 MHz(2816 km/s), 15.625 MHz(22.000 km/s)	<input type="checkbox"/>
1046.90000 GHz	214.96920 GHz		2000.000 MHz(2789 km/s), 15.625 MHz(21.790 km/s)	<input checked="" type="checkbox"/>
1113.90000 GHz	228.72690 GHz		2000.000 MHz(2621 km/s), 15.625 MHz(20.480 km/s)	<input checked="" type="checkbox"/>
1123.90000 GHz	230.78029 GHz		2000.000 MHz(2598 km/s), 15.625 MHz(20.297 km/s)	<input checked="" type="checkbox"/>

Spectral Setup Errors

Targets

Source Name	Velocity	System
APM 08279+52...	1160196.8124... km/s	hel

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.)
 - Sideband (do the lines all fit?)

Spectral Line Picker

Select Spectral Lines

Filter / Species

HCN

Include description in search

ALMA Band

1 2 3 4 5 6 7 8 9 10

Sky Frequency (GHz)

Min 312 Max 373

Sideband Filter

Enable sideband filter (recommended)

Filtering lines outside sidebands

Maximum Upper-state Energy (K)

0 20 40 60 80 100 ∞

Molecule Filter / Environment

Show all atoms and molecules

Reset Filters Search Online

Notes

- The initial database is an offline database, containing selected transitions from the full spectral line catalogue.
- Additional transitions from the full catalogue can be found by clicking *Search Online*.
- *Search Online* is only enabled when a species is given and one ALMA band is selected.
- *Search Online* does not (yet) return all information for a transition.

Transitions matching your filter settings

Transition ^	Description	Rest Frequ...	Sky Freque...	Upper-state En...	Lovas Inten...	Sij μ^2
HCNv2=1 J=4-3, l=1e	Hydrogen Cyanide	354.46 GHz	354.46 GHz	1066.9 K	62.5	32.46 D ²
HCN v=0 J=4-3	Hydrogen Cyanide	354.505 GHz	354.505...	42.53 K	17.4	35.65 D ²
HCNv2=2 J=4-3, l=2f	Hydrogen Cyanide	356.135 GHz	356.135...	2095.18 K	5.2	25.21 D ²
HCNv2=2 J=4-3, l=2e	Hydrogen Cyanide	356.163 GHz	356.163...	2095.18 K	6.3	25.21 D ²
HCNv2=1 J=4-3, l=1f	Hydrogen Cyanide	356.256 GHz	356.256...	1067.12 K	72	32.46 D ²
HCNv2=2 J=4-3, l=0	Hydrogen Cyanide	356.301 GHz	356.301...	2073.45 K	9.4	33.61 D ²

Add to Selected Transitions

Selected transitions

Transition ^	Description	Rest Frequency ^	Sky Frequency	Upper-state Energy	Lovas Intensity	Sij μ^2
CO v=0 3-2	Carbon Monoxide	345.796 GHz	345.796 GHz	33.192 K	70	0.036 D ²

Remove from Selected Transitions

Close Dialog and Apply Selection

ALMA Sensitivity Calculator

- Available for experimentation
 - Both in OT and in Science Portal
- Calculates $\sigma(t)$ or $t(\sigma)$
 - Standard inputs:
 - Frequency
 - Bandwidth
 - Angular resolution (only for brightness temperatures)
 - Number of antennas
 - Source declination (transit assumed)
 - Precipitable Water Vapour (PWV)
- Details can be found in document in Science Portal

ALMA Sensitivity Calculator

Sensitivity Calculator

Common Parameters

Dec	15:00:00.000	
Polarization	Dual	
Observing Frequency	345.0	GHz
Bandwidth per Polarization	10.0	km/s
Water Vapour Column Density	Automatic Choice	
tau/Tsky	tau=0.119, Tsky=35.714 K	
Tsys	140.531 K	

Individual Parameters

	12m Array	7m Array	Total Power Array
Number of Antennas	32	6	1
Resolution	1.5 arcsec	5.974554 arcsec	17.923662 arcsec
Sensitivity(rms)	1e-3 Jy	0.00000 Jy	0.00000 Jy
(equivalent to)	0.00457 K	0.00000 K	0.00000 K
Integration Time	27.77564 min	Infinity d	Infinity d

Integration Time Unit Option: Automatic

Calculate Integration Time Calculate Sensitivity Close

Science Goal Sections

General

- Space for textual input
 - Optional description of Science Goal

The screenshot displays a software interface with two main panels. The left panel, titled 'Project Structure', shows a tree view under 'Unsubmitted Proposal' with the following hierarchy: Project > Proposal > Planned Observing > Science Goal > General. The right panel, titled 'Editors', has tabs for 'Spectral', 'Spatial', and 'General'. The 'General' tab is active and contains the following elements:

- A text area with the instruction: "Enter a name and description for the purpose of this science goal. This text is optional but you may find it useful to keep a note."
- A section header: "General (Optional)" with a help icon (?) and a collapse icon (-).
- A label "Science Goal Name" next to a text input field containing "Science Goal".
- A label "Description" next to a large text area containing "This Science Goal is totally awesome!".
- A "Launch Editor" button at the bottom.

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

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 - 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

System Sexagesimal display?

Source Coordinates

RA PM RA

Dec 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

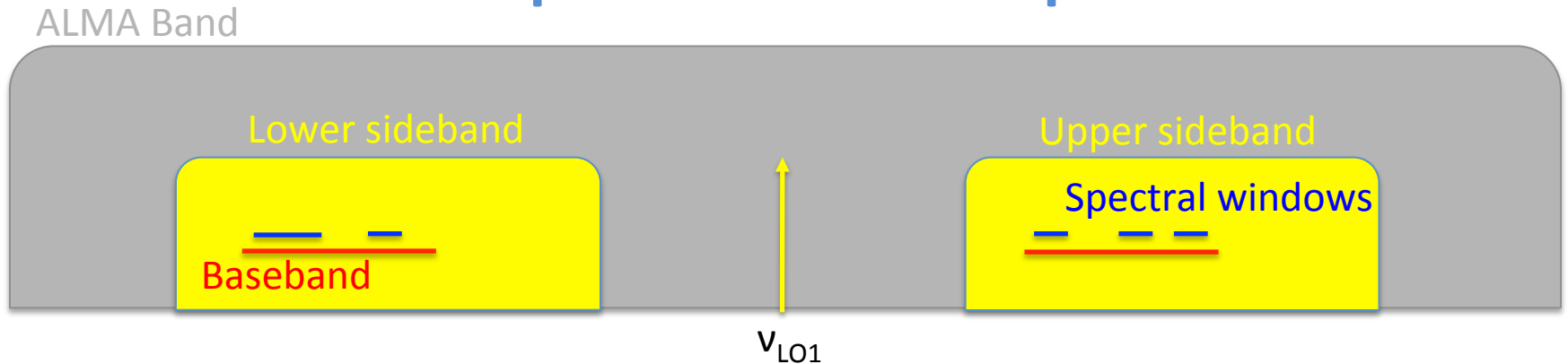
PointingPattern: Offset

Offset Unit

#Pointings

RA [arcsec]	Dec [arcsec]
0.00000	0.00000

Spectral Setup

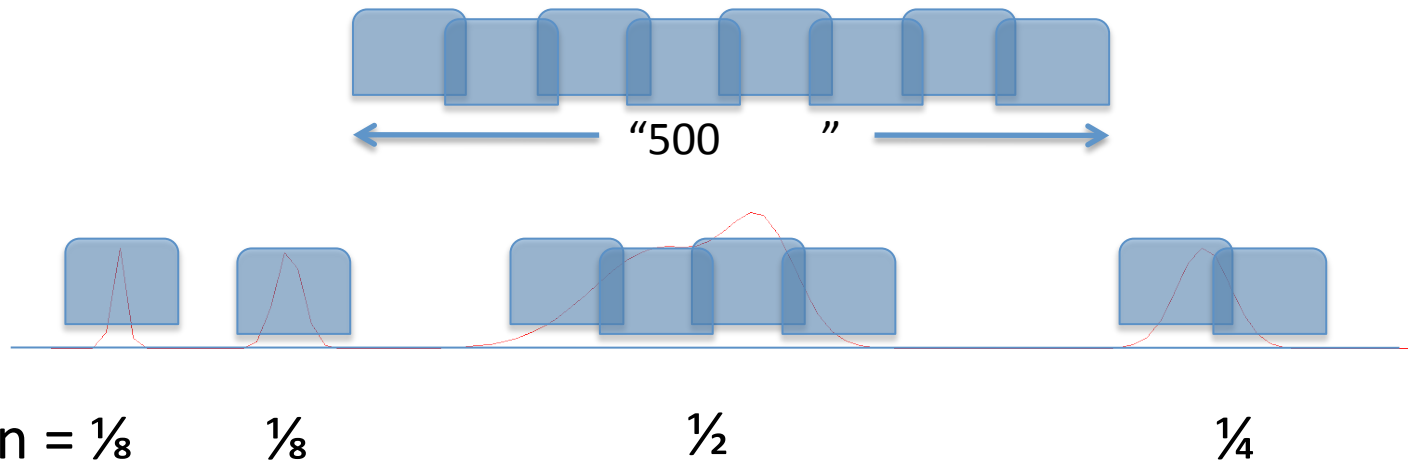


- ALMA bands have two sidebands (telescope output)
 - Widths and separations are band-dependent
 - Bands 3 and 7: each is 4 GHz wide
- Basebands sample the sideband signals
 - Each is 2-GHz wide and has two polarizations (X and Y)
- Spectral windows sample the baseband signals

Spectral Setup

- Each baseband can support one correlator mode
 - 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
 - Spectral Visual Editor very useful for identifying problems

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

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

Control and Performance

- Most important user inputs
 - Angular resolution (Θ)
 - Largest Source Angular Scale (LAS)
 - Required sensitivity (σ)
 - Bandwidth used for sensitivity
- ACA requirement will be based on Θ and LAS
 - User can override (must be justified)
- Time Estimate button gives detailed breakdown
 - Includes calibration overheads

Control and Performance

Control and Performance ?

Representative Frequency GHz

Antenna Beamsize (λ/D)

Early Science Extended Configuration:
Max Baseline(L) and corresponding beam size(λ/L)

Early Science Compact Configuration:
Max Baseline(L) and corresponding beam size(λ/L)

Desired Angular Resolution

Largest Angular Scale of source Point Source Extended Source

Desired Sensitivity per Pointing equivalent to

Bandwidth used for Sensitivity Frequency Width

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

ACA Use: (ACA Not yet available)

Proposal Submission

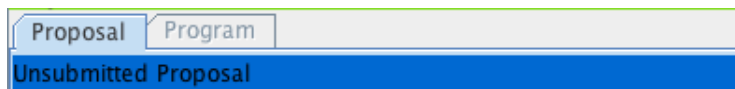
- When ready, validate your proposal
 - OT will check that all necessary information is present
 - Errors will appear in Feedback panel
 - A project cannot submit with validation errors
- Submit
 - Project code assigned at this point
- For your records...
 - Email will acknowledge submission
 - Printable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

Proposal Resubmission

- Resubmission is possible up to the deadline
 - Previous submission is overwritten
 - You can change almost every detail – still overwrites
 - Please save a local copy each time you submit
- Older (local) versions can now be resubmitted
 - This wasn't possible at Cycle 0

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)

Happy proposal writing
for Cycle 1!