

# Planning ALMA Observations

## Atacama Large mm/sub-mm Array



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North American ALMA Science Center



Atacama Large Millimeter/submillimeter Array  
Expanded Very Large Array  
Robert C. Byrd Green Bank Telescope  
Very Long Baseline Array



- **ALMA Overview and Status**
- The Key Decisions When Proposing for ALMA

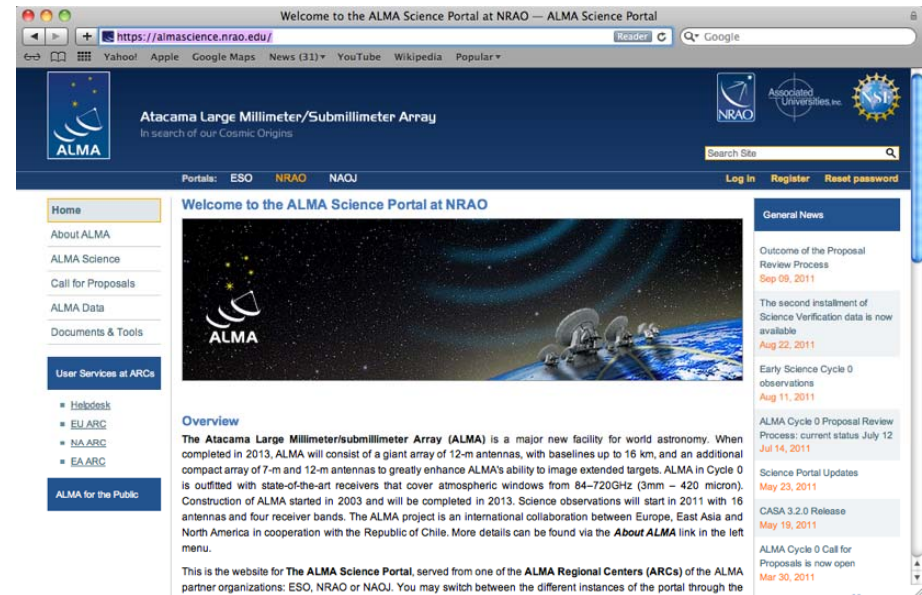
# The ALMA Science Portal

<https://almascience.nrao.edu>



*Hub for project-wide material.*

- Observing Tool
- Sensitivity Calculator
- Proposer's Guide
- Technical Handbook
- Science Verification Data
- CASA & Simulations
- Tutorials
- Helpdesk



*Registration required to propose for PIs and cols.*



# ALMA Basics



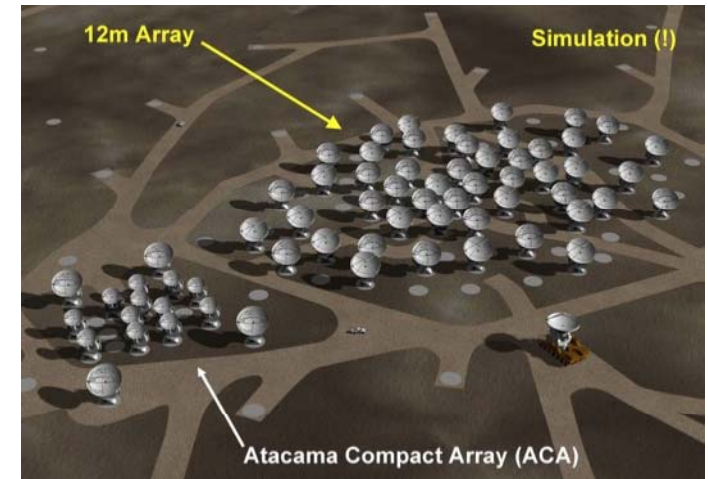
- Global partnership (shared cost ~1.3 billion 2006\$):
  - North America (US, Canada, Taiwan)
  - Europe (ESO)
  - East Asia (Japan, Taiwan)
  - In collaboration with Chile
- Unique high, dry site:
  - 5000m (16,500 ft) in Chilean Atacama desert
- At least 66 submillimeter/millimeter telescopes:
  - 12-m Array – 50 x 12-m
  - Atacama Compact Array (ACA) - 12x7-m, 4x12-m
- On budget and on time for completion in 2013



# ALMA Basics



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4x12-m
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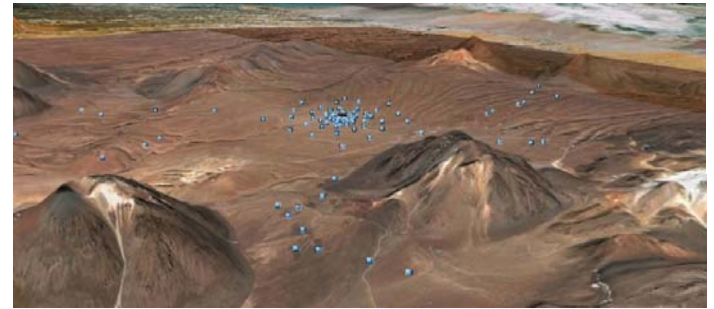


# Full Science Capabilities

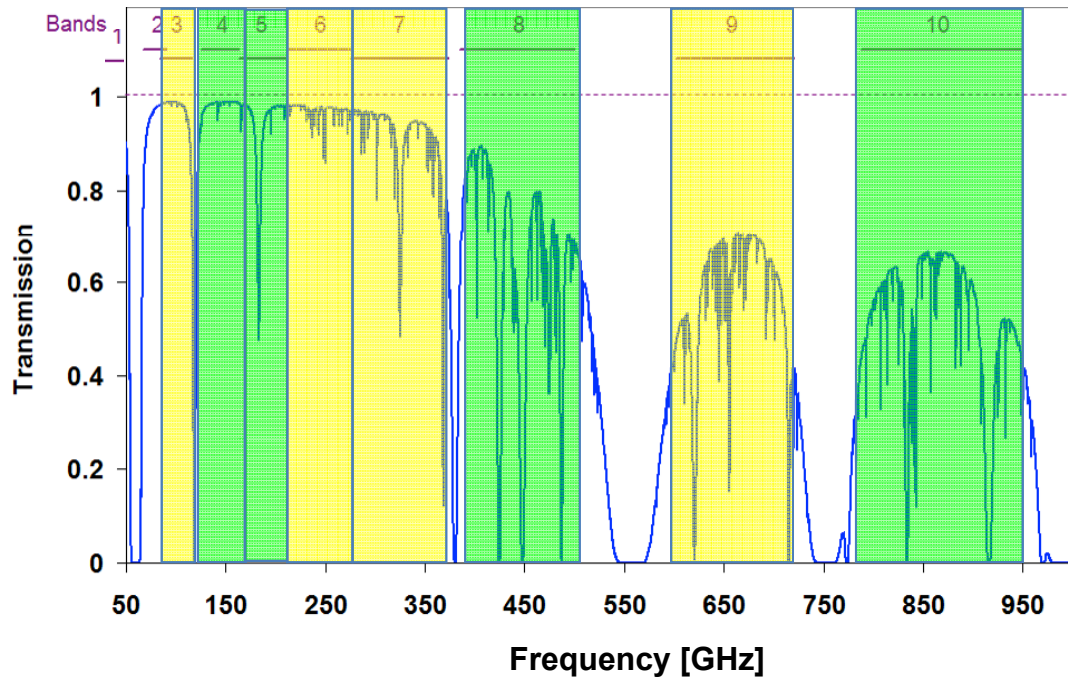
*10-100× better sensitivity and resolution than current mm arrays.*

- Baselines to **~15 km** (0.015" at 300 GHz) in “zoom lens” configurations
- Sensitive, precision imaging 84 to 950 GHz (3 mm to 315 μm) employing state-of-the-art low-noise, wide-band SIS receivers (8 GHz bandwidth per polarization)
- Flexible correlator with high spectral resolution at wide bandwidth
- Full polarization capabilities
- Development Program: Future upgrades (B1, B2, B5, ?)

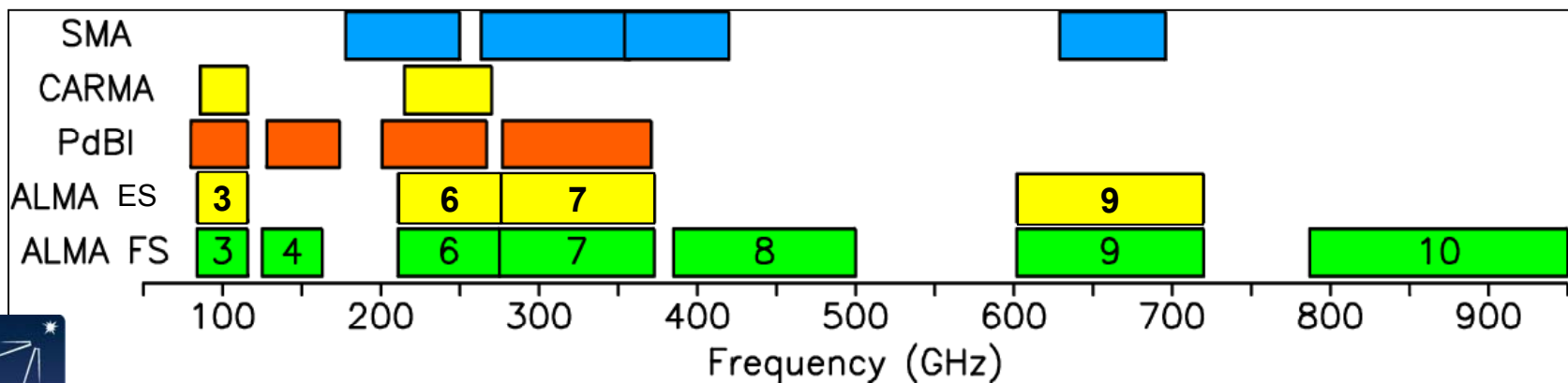
ALMA 



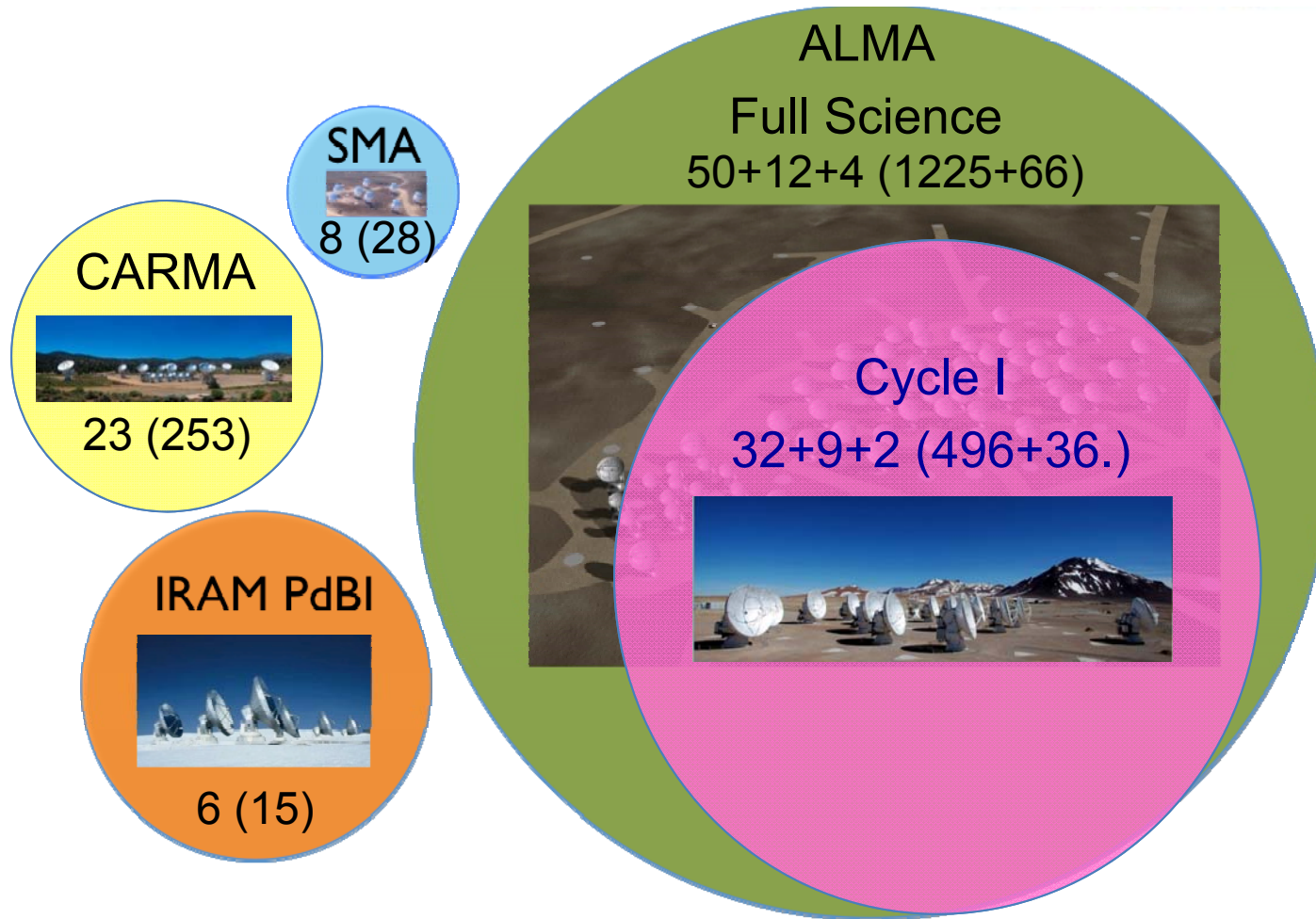
# Frequency Coverage



Early Science (now)
Full Operations



# Collecting Area & Baselines



**Circles Show Collecting Area (sensitivity)**

**Captions give # of antennas and # of baselines (fidelity)**





# Current Status

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- Cycle 0 observing began 30 Sep '11.
- Cycle 1 call for proposals out (12 July)
- Data delivered to PIs.
- Commissioning ongoing.
- 31+ antennas at high site.
- Correlators (ACA and main) working.
- All antennas: B3, 6, 7, and 9 receivers.
- Science verification ongoing, data publicly available.



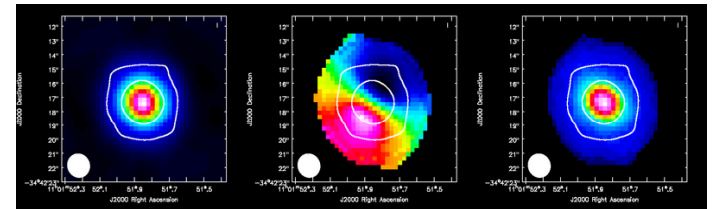
# Science Verification Data



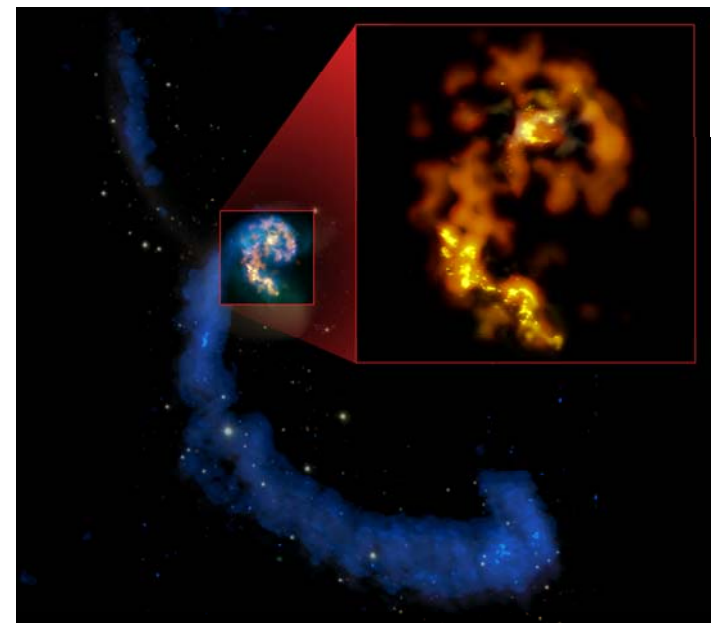
- ALMA data released for:
  - BR1202 (HIGH REDSHIFT QUASAR)
  - THE ANTENNAE GALAXIES\*
  - NGC 3256\*
  - M100
  - SGR A-STAR
  - ORI B6 SPECTRAL SCAN
  - IRAS 16923 (B9\*)
  - TW HYDRA\*

- Calibrated & uncalibrated data, images, periodically augmented
- download from ALMA Science Portal  
<http://almascience.org/>
- \* - CASA guide available at  
<http://casaguides.nrao.edu>

HCO+ J=4-3 in TW Hya



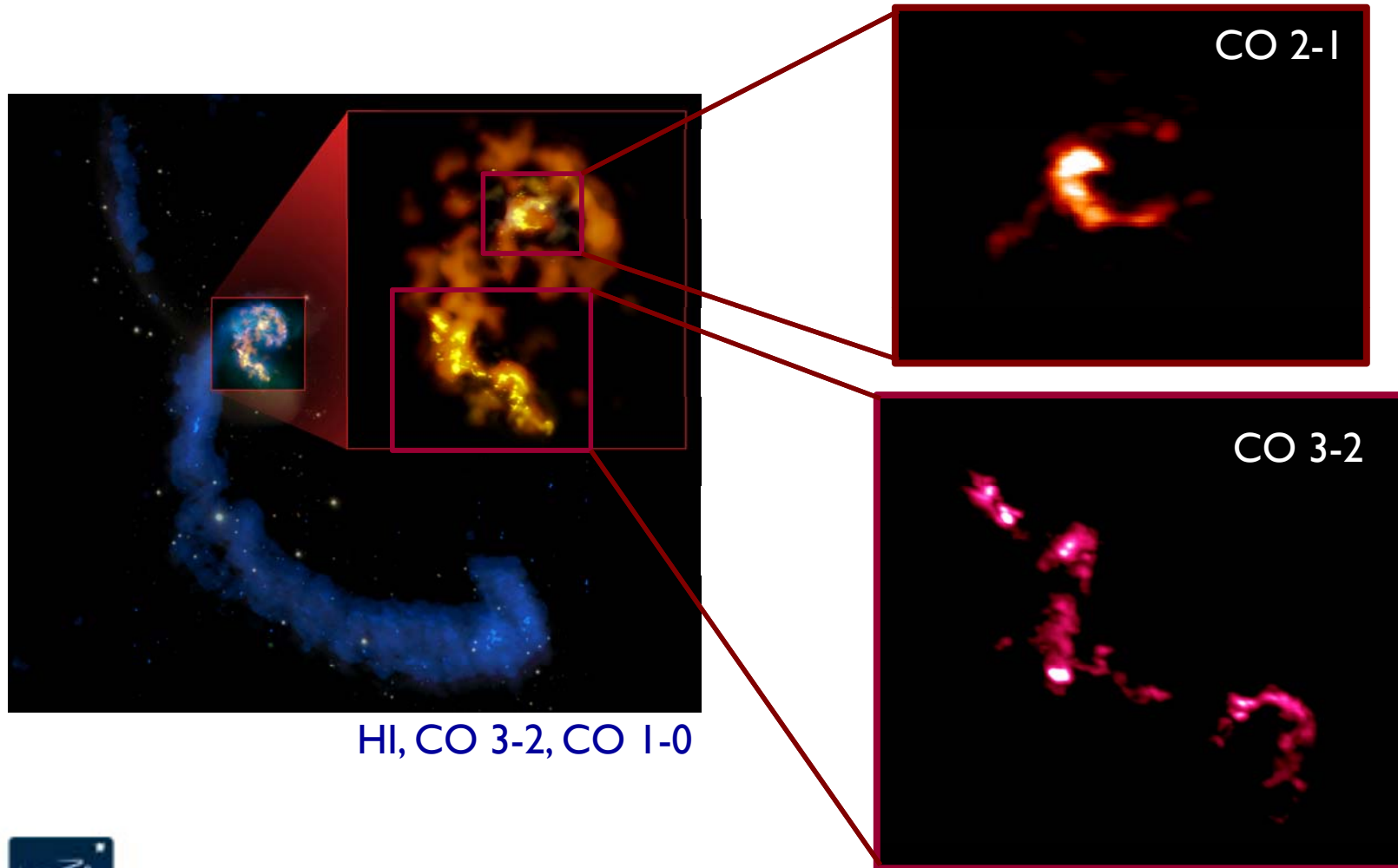
CO J=3-2 in the Antennae



# ALMA Images Nearby Galaxies



- Science verification imaging of the Antennae Galaxies

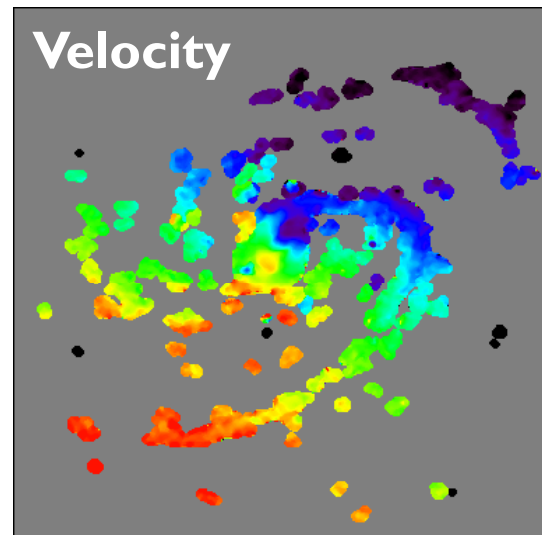
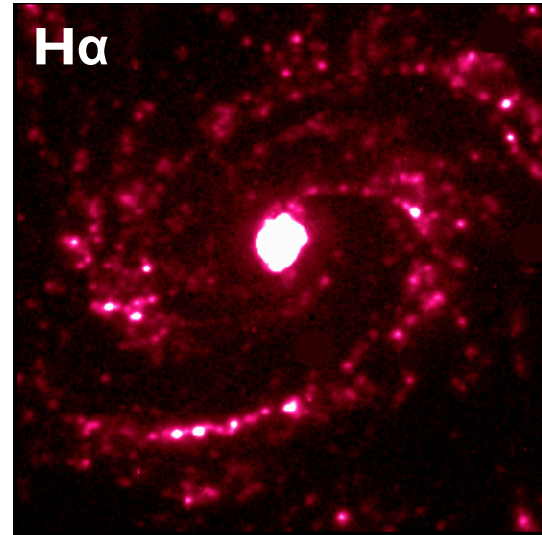
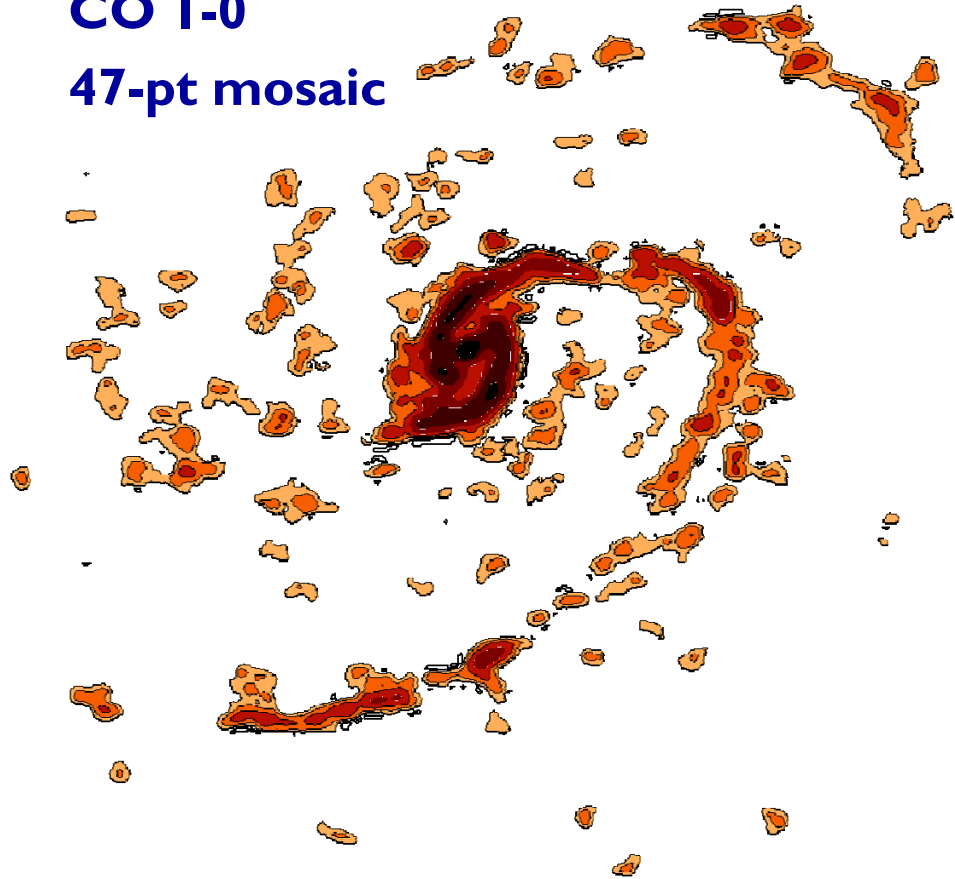


# ALMA Images Nearby Galaxies



- Science verification imaging of M100

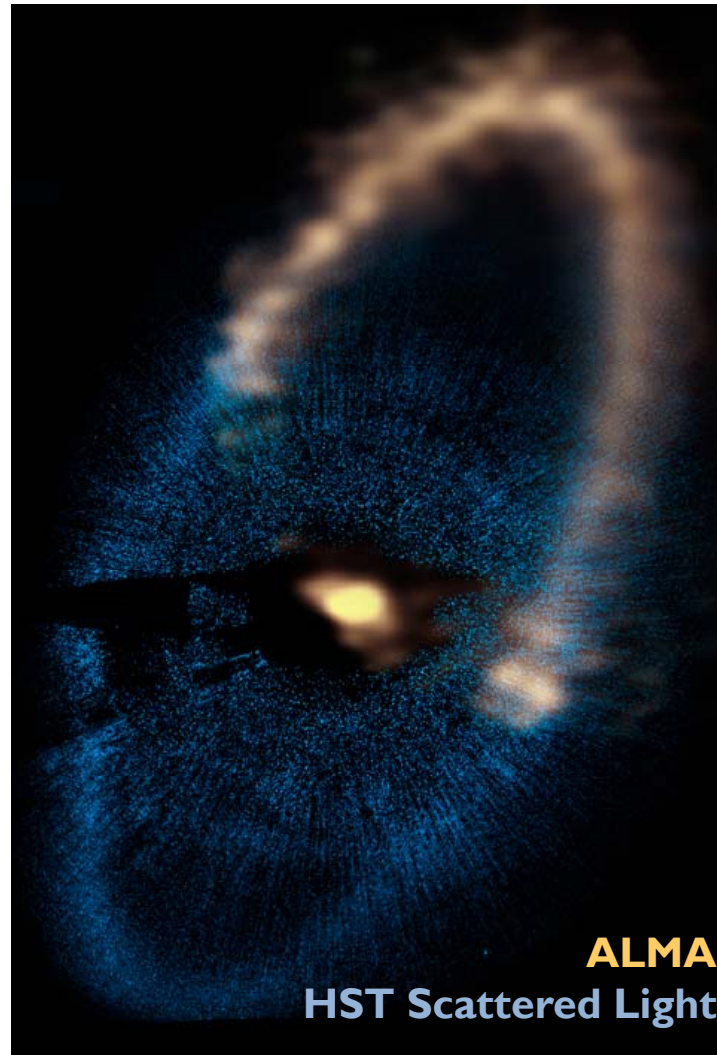
**CO 1-0**  
**47-pt mosaic**



# ALMA Images Debris Disks



- PI Boley (U. Florida) Data on Fomalhaut Debris Disk



# ALMA Cycle 1

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- Proposals due July 12  
OBSERVING PERIOD COVERS ~10 MONTHS
- 32 12-m Antennas (“Twelve Meter Array”)
- ACA: Nine 7-m Antennas, Two “Total Power” 12-m Antennas  
ACA OBSERVATIONS MAY BE REQUESTED TO SUPPLEMENT 12-M WITH “SHORT SPACINGS”
- Maximum baselines 160-m to 1-km
- Receiver Bands 3, 6, 7, and 9
- Mosaics up to 150 pointings
- About 800 hours of 12-m array time available  
UP TO ~ ONE-THIRD OF TIME MAY HAVE ACA OBSERVATIONS



- ALMA Overview and Status
- **The Key Decisions When Proposing for ALMA**

# Practical Introduction



- Video Tutorials and Quickstart Guides
- <https://almascience.nrao.edu/call-for-proposals/observing-tool/video-tutorials>

A screenshot of the ALMA website header. The top navigation bar is dark blue with the ALMA logo on the left, the text "Atacama Large Millimeter/submillimeter Array" and "In search of our Cosmic Origins" in the center, and logos for NRAO, Associated Universities, Inc., and NSF on the right. Below the navigation bar is a search bar and a "Search Site" button. A secondary navigation bar contains links for "ESO", "NRAO", and "NAOJ", along with "Log in", "Register", "Reset Password", and "Forgot Account". A breadcrumb trail reads "You are here: Home &gt; Call for Proposals &gt; Observing Tool &gt; OT Video Tutorials". The main content area is titled "OT Video Tutorials" and includes a sub-header "The OT video tutorials provide an audio-visual demonstration of different aspects of the ALMA OT and proposal preparation:".





- **Framework: Science Goals**
- Spectral Setup
- Spatial Setup
- Control and Performance Specifications
- Logistics

# Science Goal (Cycle I)

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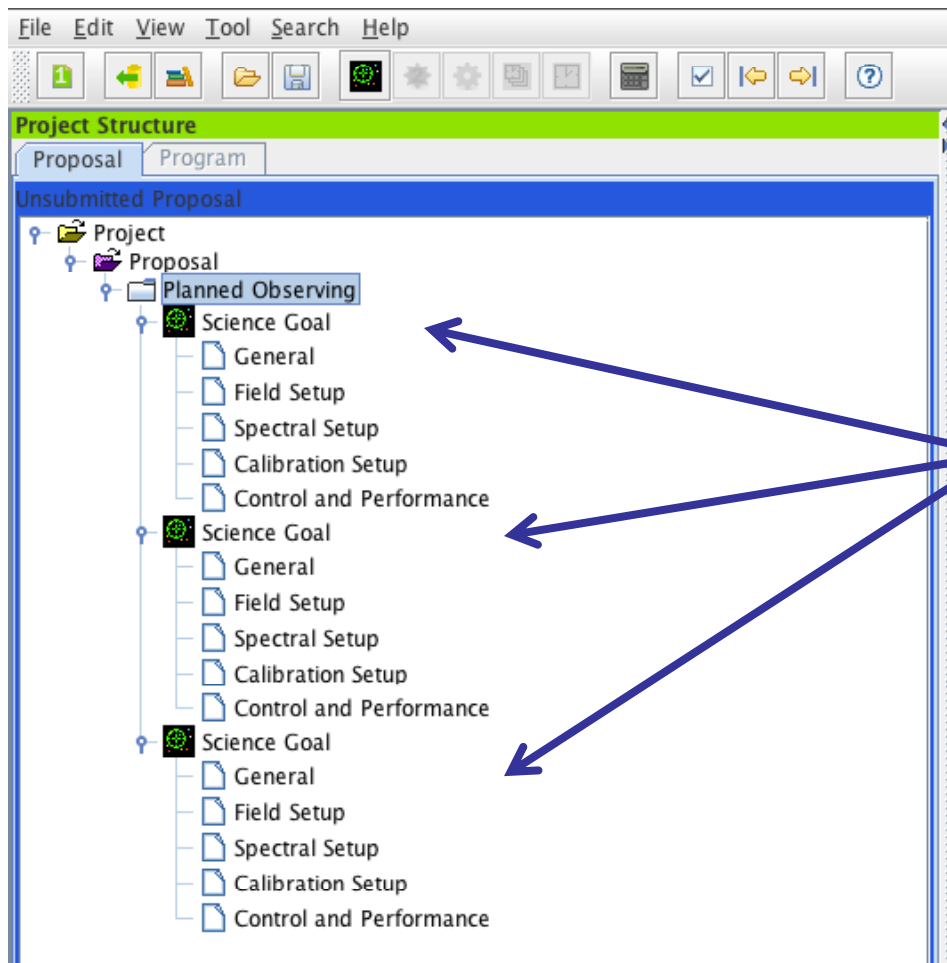
- One correlator + front end setup in one ALMA band  
SPECTRAL WINDOWS, REST FREQUENCY, POLARIZATION, LINE VS. CONTINUUM
- Subject to one set of control parameters  
SPATIAL RESOLUTION, LARGEST ANGULAR SCALE, SENSITIVITY, DYNAMIC RANGE
- Using one mapping strategy  
MOSAIC, OFFSETS, SINGLE FIELDS
- Using one calibration strategy  
SYSTEM OR USER DEFINED
- Applied to Sky Targets within  $15^\circ$   
UP TO 15 PER SCIENCE GOAL OR 150 FIELDS PER MOSAIC, UP TO 5 DIFFERENT VELOCITIES



# Science Goal (Cycle I)



- Fundamental unit (below proposal) in the ALMA OT
- **Five Science Goals** allowed per proposal in Cycle 1



In practice:

- Up to 5 Science Goals
- Specify control & performance, spectral setup, field setup for each



# Key Proposal Factors

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- Framework: Science Goals
- **Spectral Setup**
- Spatial Setup
- Control and Performance Specifications
- Logistics



# Spectral Setup: Receiver



- Four receiver “bands,” set spectral coverage  
OBSERVING FREQUENCY ALSO AFFECTS RESOLUTION, PRIMARY BEAM

Band	Frequency (GHz)	Primary beam (arcsec)	Angular Resolution (arcsec)	Continuum Sensitivity (mJy min <sup>1/2</sup> )
3	84 - 116	62	0.6 - 4.1	0.09
6	211 - 275	25	0.3 - 1.7	0.14
7	275 - 373	19	0.2 - 1.2	0.25
9	602 - 720	9	0.1 - 0.6	2.5





F

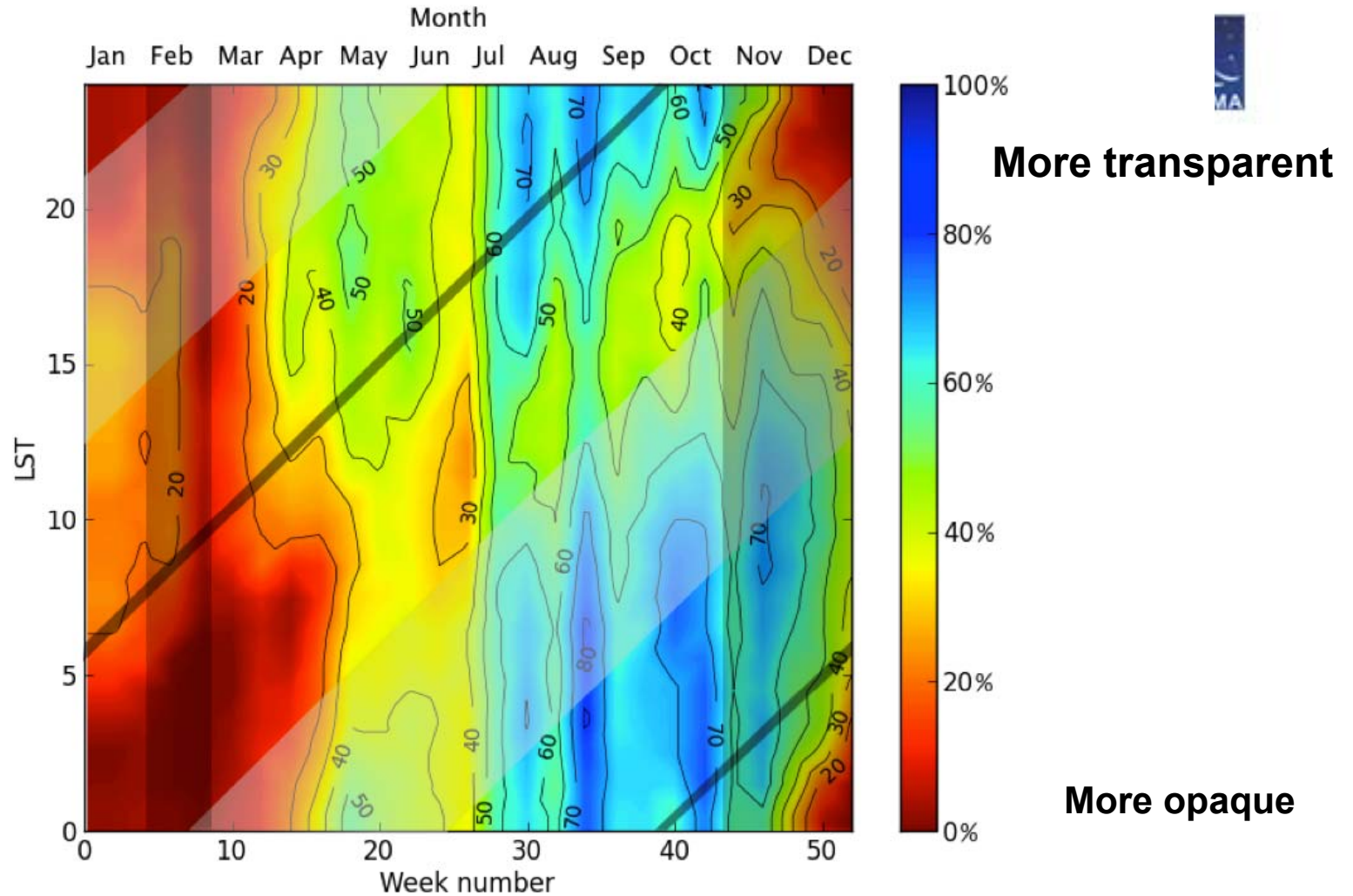


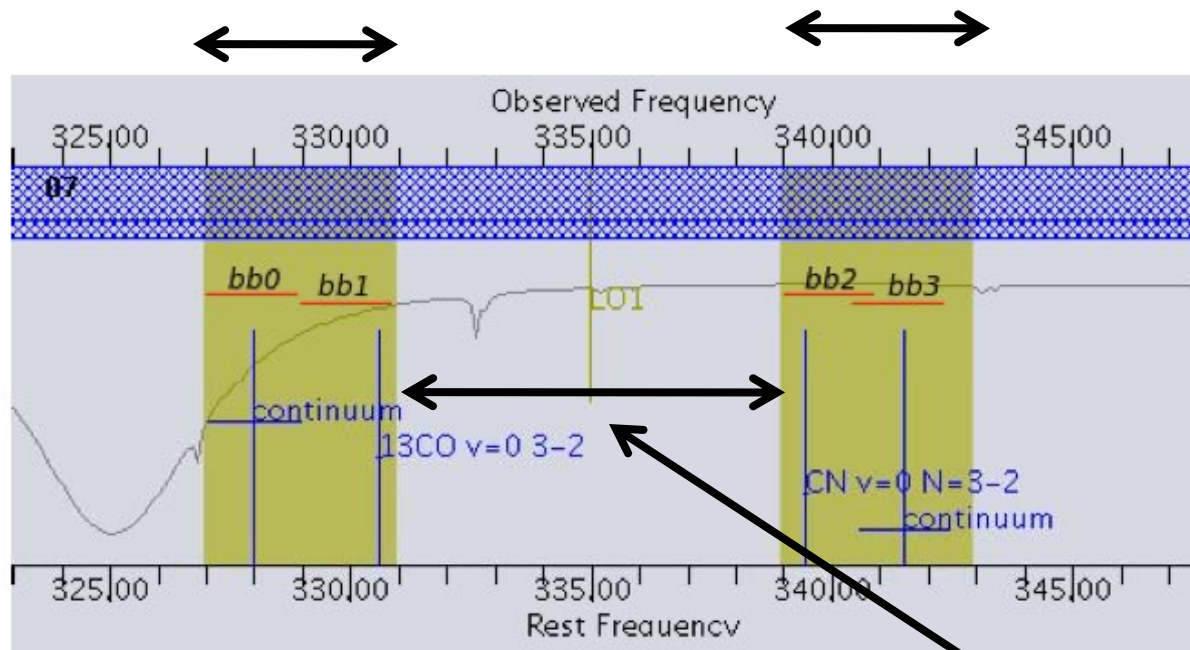
Figure 1. The numbers indicate the percentage of time when the pwv is below 1 mm as a function of Local Sidereal Time (LST) and week number beginning with January 1, 2013. Red indicates times with very little time available at low PWV and therefore less suitable for high frequency observing, while blue indicates times with a large fraction of time available at low PWV. The data were obtained with the APEX radiometer in the years 2007-2011 (5 years). The thin dark grey lines show local midnight, and the thick light grey bands show the ALMA engineering time, which normally is unavailable for Early Science observations. The vertical darker grey bands show the anticipated February shutdown and the end of Cycle 1 in November.

# Sidebands

- Receivers sensitive to two separate ranges of sky frequency: **sidebands**

**Sideband width** varies by receiver band

Band 3: 4 GHz, Band 6: 5 GHz, Band 7: 4 GHz, Band 9: 8 GHz

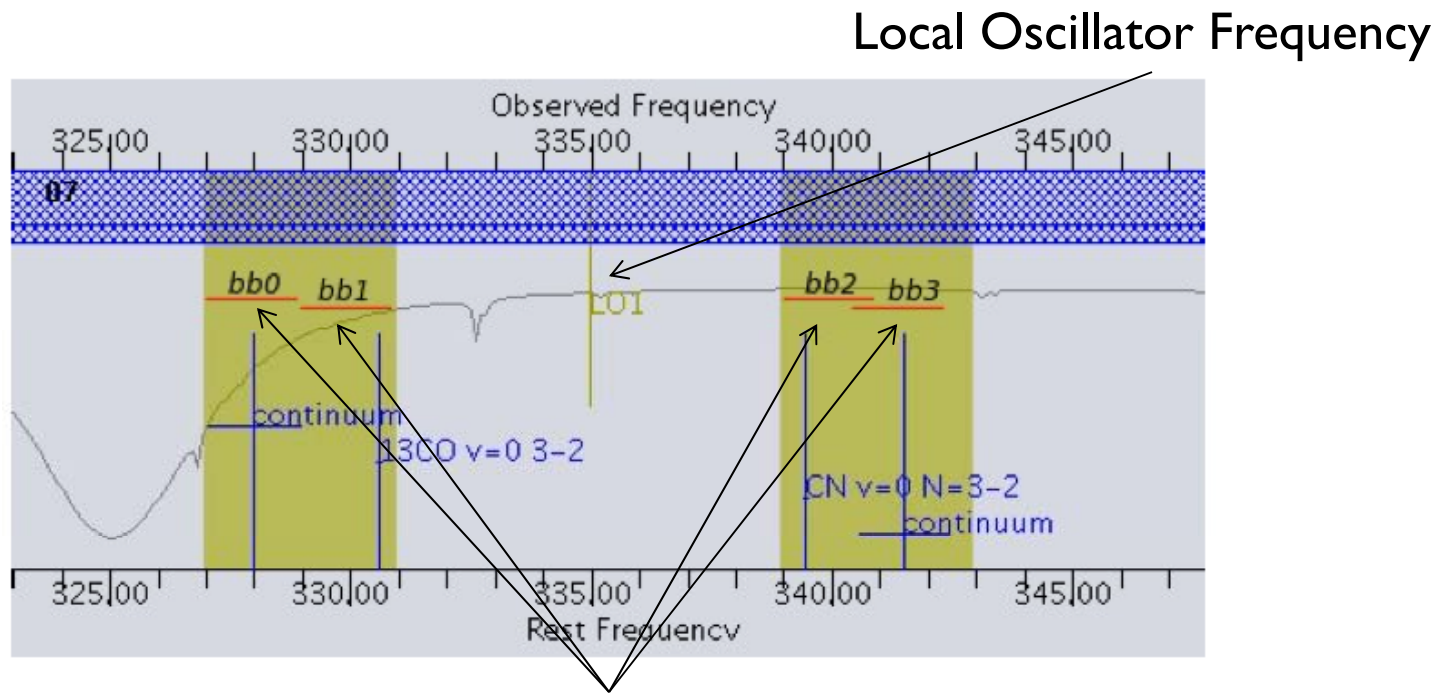


**Fixed separation** between sidebands  
Bands 3, 7, 9: 8 GHz, Band 6: 10 GHz

# Basebands



- Each antenna has 4 digitizers which can each sample 2 GHz of bandwidth
- These 2 GHz chunks are termed **basebands** (they may overlap)
- Basebands must be distributed in the frequency covered by the sidebands (all 4 in one sideband, or two in each; Band 9 does not have this restriction)



2 GHz Basebands

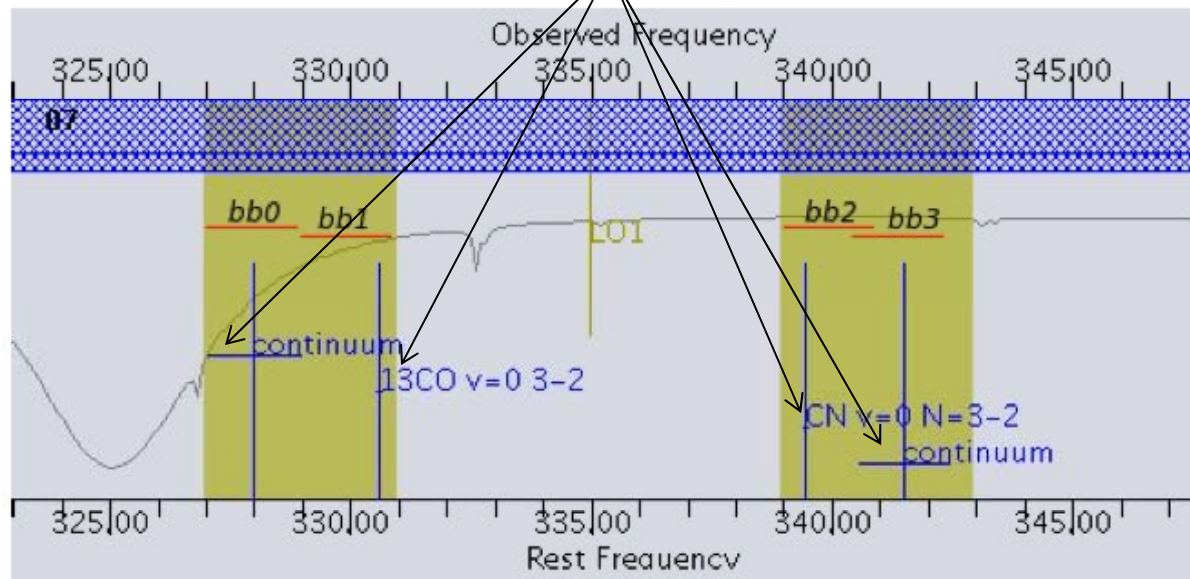


# Spectral Windows



- To collect data, you set up a **spectral window** in one or more basebands
- These regions of the spectrum are processed by the correlator
- The correlator allows tradeoff of frequency resolution and bandwidth
- In Cycle 1, 4 spectral windows are available.
- Spectral windows must lie within the baseband, sideband, receiver range.

## Spectral Windows



# In Practice



- Pick a frequency (by hand or source + line) for each SPW
  - Splatalogue may help guide choice of lines
- Pick a correlator mode for each SPW
- The OT will configure the LO and basebands to match (if possible)

Spectral Line

Baseband-0

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Channel Spacing	Representative Window
----------	--------------------	-------------------	------------	----------------------------	-----------------------

Select Lines to Observe in Baseband-0...

↑  
Select a line, with your source velocity, this defines a frequency.

↙  
Add a spectral window by hand.



e.g. Type  
in “H<sub>2</sub>O”  
A window  
that can  
search  
Splatalogue  
will open.

**Species Filter**

e.g. CO\*2-1 or \*oxide

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**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

Transition $\Delta$	Description	Rest Frequency $\Delta$	Sky Frequency	Upper-state Energy	Lovas Intensity	Sij $\mu^2$	Catalog
H2O v=0 10(2,9)-9(3,6)	Water	321.226 GHz	321.221 GHz	1861.24 K	3	1 D <sup>2</sup>	Offline
CH2NH 5(2,3)-4(2,2)	Methanimine	322.162 GHz	322.157 GHz	77.78 K	1.1	7.37 D <sup>2</sup>	Offline
CH3OHv t=0 9(1,8)-9(0,9)+	Methanol	322.239 GHz	322.235 GHz	119.88 K	5.5	17.98 D <sup>2</sup>	Offline
H218O v=0 5(1,5)-4(2,2)	Water	322.465 GHz	322.461 GHz	467.91 K	0.5	0.29 D <sup>2</sup>	Offline
HDCO 5(4,2)-4(4,1)	Formaldehyde	322.496 GHz	322.492 GHz	173.65 K	1	9.77 D <sup>2</sup>	Offline
HDCO 5(4,1)-4(4,0)	Formaldehyde	322.496 GHz	322.492 GHz	173.65 K	1	9.77 D <sup>2</sup>	Offline
CH3OCHO v=0 25(6,19)-24(6,18)A	Methyl Formate	322.522 GHz	322.517 GHz	219.3 K	0.5	62.42 D <sup>2</sup>	Offline
CH2CHCN v=0 38(4,35)-38(3,36)	Vinyl Cyanide	322.531 GHz	322.527 GHz	372.67 K	1	50.29 D <sup>2</sup>	Offline

Add to Selected Transitions

Selected transitions

Transition $\Delta$	Description	Rest Frequency $\Delta$	Sky Frequency
H218O v=0 5(1,5)-4(2,2)		323.153 GHz	323.149 GHz

# In Practice



- Pick a frequency (by hand or source + line) for each SPW
- **Pick a correlator mode for each SPW**  
THIS INVOLVES TRADING OFF BETWEEN RESOLUTION AND BANDWIDTH.
- The OT will configure the LO and basebands to match (if possible)

Spectral Line

Baseband-0

Fraction	Center Freq (Rest)	Center Freq (Sky)	Transition	Bandwidth, Channel Spacing	Representative Window
1(Full)	100.00000 GHz	100.00000 GHz	Manual window	58.594 MHz( 176 km/s), 15.259 kHz( 0.046 km/s)	<input checked="" type="radio"/>
				58.594 MHz( 176 km/s), 15.259 kHz( 0.046 km/s)	
				117.188 MHz( 351 km/s), 30.518 kHz( 0.091 km/s)	
				234.375 MHz( 703 km/s), 61.035 kHz( 0.183 km/s)	
				468.750 MHz( 1405 km/s), 122.070 kHz( 0.366 km/s)	
				937.500 MHz( 2811 km/s), 244.141 kHz( 0.732 km/s)	
				1875.000 MHz( 5621 km/s), 488.281 kHz( 1.464 km/s)	
				2000.000 MHz( 5621 km/s), 15.625 MHz( 46.843 km/s)	

Select Lines to Observe in Baseband-0... Add Delete



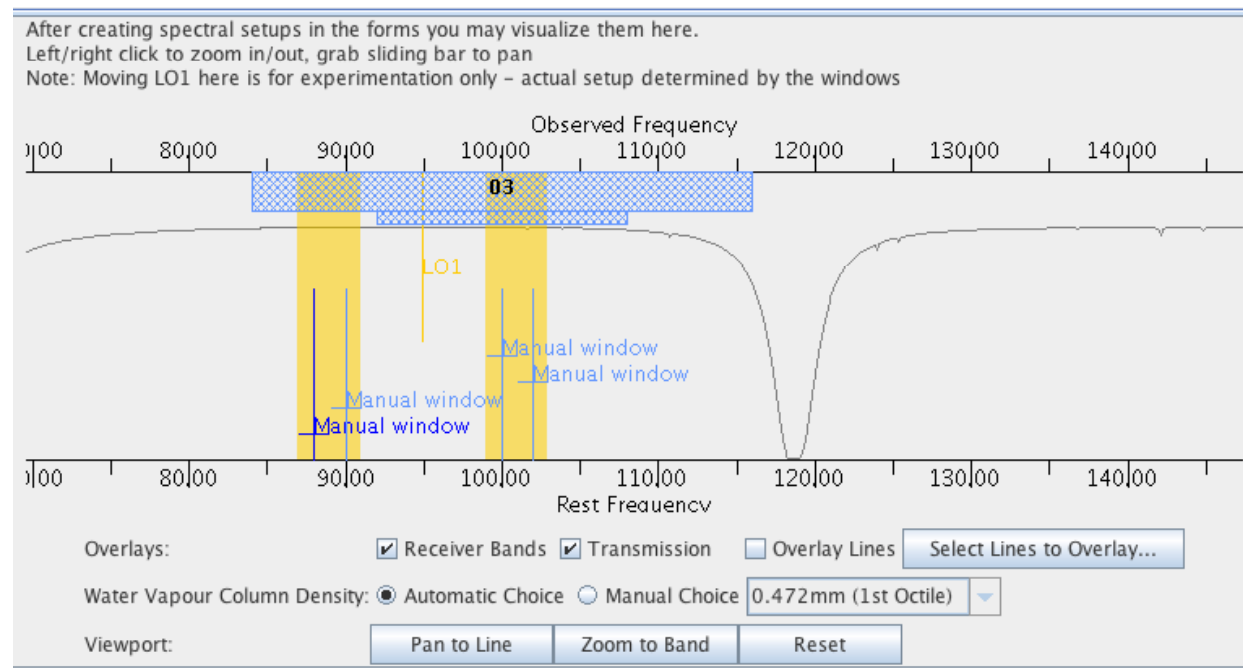
Pick a correlator mode from the drop-down menu.



# In Practice



- Pick a frequency (by hand or source + line) for each SPW
- Pick a correlator mode for each SPW
- **The OT will configure the LO and basebands to match (if possible)**



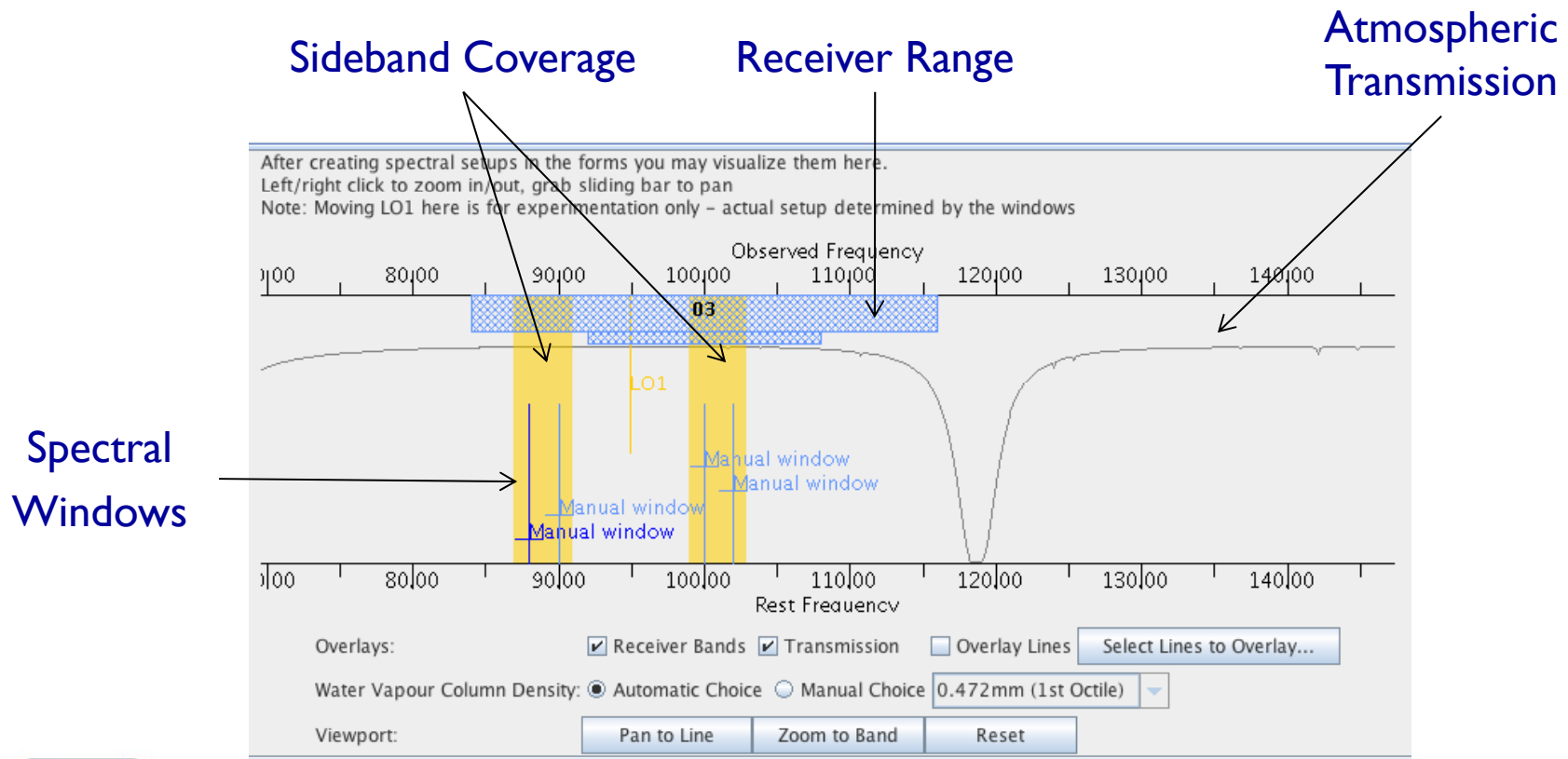
VISUALIZING THE SPECTRAL SETUP IN THE OT



# In Practice



- Pick a frequency (by hand or source + line) for each SPW
- Pick a correlator mode for each SPW
- **The OT will configure the LO and basebands to match (if possible)**



VISUALIZING THE SPECTRAL SETUP IN THE OT



# Key Proposal Factors

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- Framework: Science Goals
- Spectral Setup
- **Spatial Setup**
- Control and Performance Specifications
- Logistics



# Target Definition



- **Single field**

UP TO 15 INDIVIDUAL FIELDS IN ONE SCIENCE GOAL IF THEY ARE WITHIN 15°  
UP TO 5 DIFFERENT VELOCITIES IN EACH SCIENCE GOAL

- **Mosaic**

OFFSETS ARE MOSAICS, MOSAICS TRADE EFFICIENCY FOR IMAGING QUALITY  
UP TO 150 POINTS (TOTAL: MOSAIC, OFFSET) PER PROPOSAL

The screenshot shows the 'Editors' window with the 'Field Setup' tab selected. The 'Source' section is active, showing the following fields:

- Source Name: Beta Pictoris
- Choose a Solar System Object?:
- Name of object: Unspecified
- System: J2000
- Sexagesimal display?:
- Parallax: 51.44000 mas
- Source Coordinates: RA 05:47:17.0877, Dec -51:03:59.441
- PM RA: 4.65000 mas/yr
- PM Dec: 83.10000 mas/yr
- Source Velocity: 20.000 km/s, hel, z 0.000066715, Doppler Type: RELATIVISTIC
- Target Type:  Multiple Pointings,  1 Rectangular Field

Multiple sources in one Science Goal

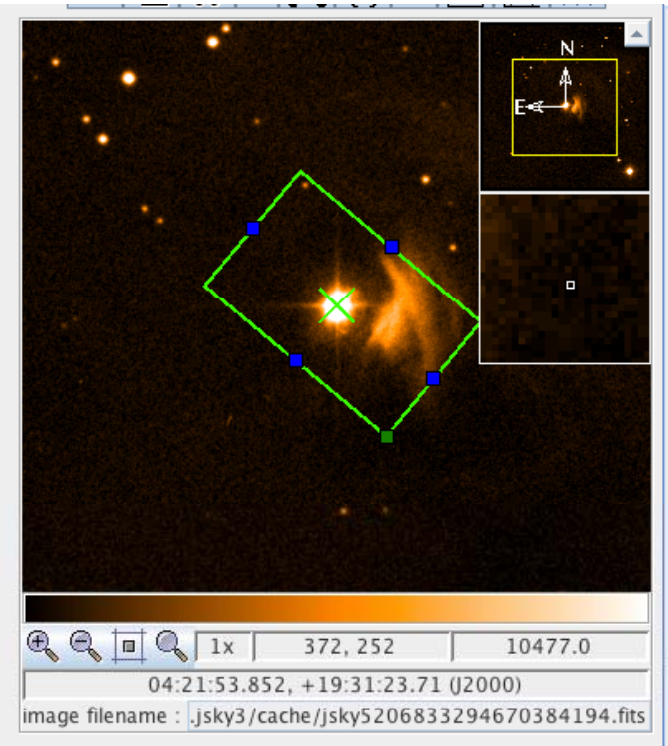




# Target Definition



- Single field  
UP TO 15 INDIVIDUAL FIELDS IN ONE SCIENCE GOAL IF THEY ARE WITHIN 15°  
UP TO 5 DIFFERENT VELOCITIES IN EACH SCIENCE GOAL
- Mosaic  
OFFSETS ARE MOSAICS, MOSAICS TRADE EFFICIENCY FOR IMAGING QUALITY  
UP TO 150 POINTS (TOTAL: MOSAIC, OFFSET) PER PROPOSAL



Rectangle

Coords Type  ABSOLUTE  RELATIVE

System

Field Center Coordinates  
Offset(Longitude)

Offset(Latitude)

p length

q length

Position Angle

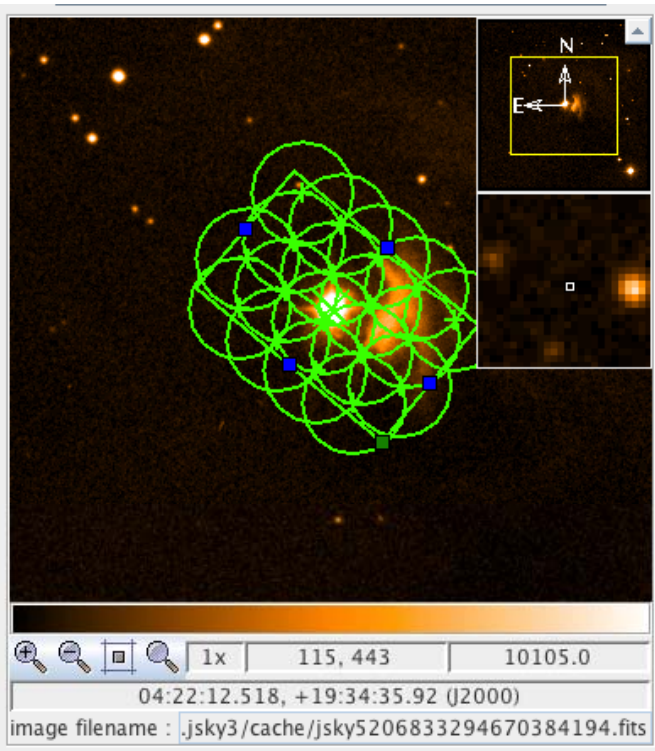
Spacing

#Pointings 12m Array  7m Array

# Target Definition



- Single field  
UP TO 15 INDIVIDUAL FIELDS IN ONE SCIENCE GOAL IF THEY ARE WITHIN 15°  
UP TO 5 DIFFERENT VELOCITIES IN EACH SCIENCE GOAL
- Mosaic  
OFFSETS ARE MOSAICS, MOSAICS TRADE EFFICIENCY FOR IMAGING QUALITY  
UP TO 150 POINTS (TOTAL: MOSAIC OR OFFSETS) PER PROPOSAL



Orientation and Extent

Field Spacing

Rectangle

Coords Type  ABSOLUTE  RELATIVE

System

Field Center Coordinates

Offset(Longitude)

Offset(Latitude)

p length

q length

Position Angle

Spacing

#Pointings 12m Array  7m Array

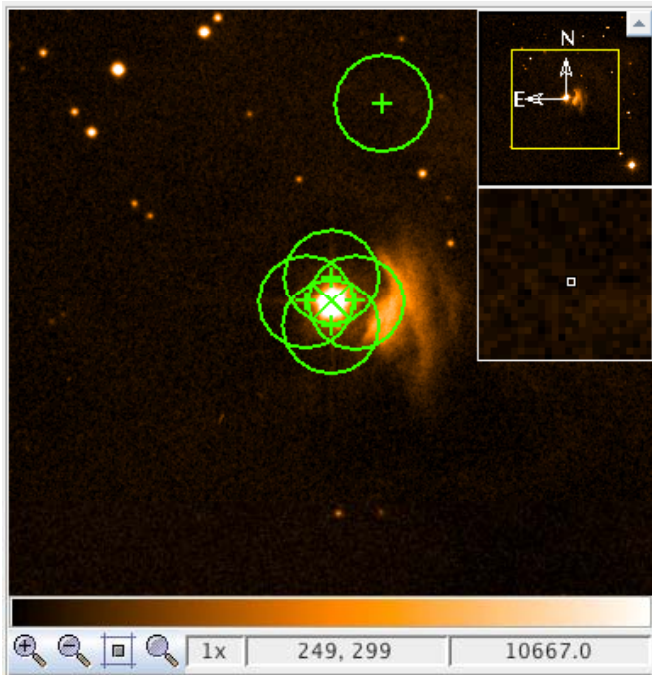
Number of Fields



# Target Definition



- Single field  
UP TO 15 INDIVIDUAL FIELDS IN ONE SCIENCE GOAL IF THEY ARE WITHIN 15°  
UP TO 5 DIFFERENT VELOCITIES IN EACH SCIENCE GOAL
- Mosaic  
**OFFSETS** ARE MOSAICS, MOSAICS TRADE EFFICIENCY FOR IMAGING QUALITY  
UP TO 150 POINTS (TOTAL: MOSAIC, **OFFSET**) PER PROPOSAL



Field Center Coordinates

PointingPattern : Offset

Offset Unit : arcmin

#Pointings : 5

RA [arcmin]	Dec [arcmin]
-0.50000	2.00000
0.00000	0.25000
0.00000	-0.25000
-0.25000	0.00000
0.25000	0.00000

Add Delete

Individual Offset  
Field Centers



# Key Proposal Factors



- Framework: Science Goals
- Spectral Setup
- Spatial Setup
- **Control and Performance Specifications**
- Logistics



- Target angular resolution  
CONSTRAINS TELESCOPE CONFIGURATION ALLOWED WHEN DATA ARE TAKEN
- Target RMS noise  
FOR A FIDUCIAL FREQUENCY AND BANDWIDTH (BOTH USER SPECIFIED)
- Request for ACA observations  
LARGEST ANGULAR SCALE + TARGET ANGULAR RESOLUTION WILL RECOMMEND

# Sensitivity



- Target RMS noise  
FOR A FIDUCIAL FREQUENCY AND BANDWIDTH (BOTH USER SELECTED)

Sensitivity Calculator

Common Parameters

Dec	00:00:00.000	
Polarization	Dual	
Observing Frequency	345.00000	GHz
Bandwidth per Polarization	0.00000	GHz
Water Vapour Column Density	<input checked="" type="radio"/> Automatic Choice <input type="radio"/> Manual Choice	
tau/Tsky	0.913mm (3rd Octile)	
Tsys	tau=0.158, Tsky=44.400 K	
Tsys	153.577 K	

Individual Parameters

	12m Array	7m Array	Total Power Array
Number of Antennas	32	9	2
Resolution	0.00000 arcsec	5.974554 arcsec	17.923662 arcsec
Sensitivity(rms)	0.00000 Jy	0.00000 Jy	0.00000 Jy
(equivalent to)	Infinity K	0.00000 K	0.00000 K
Integration Time	0.00000 s	0.00000 s	0.00000 s

Integration Time Unit Option: Automatic

Calculate Integration Time    Calculate Sensitivity    Close



# Sensitivity



- Target RMS noise  
FOR A FIDUCIAL FREQUENCY AND BANDWIDTH (BOTH USER SELECTED)

Cycle I  
Capabilities

Common Parameters	
Dec	00:00:00.000
Polarization	Dual
Observing Frequency	345.00000 GHz
Bandwidth per Polarization	0.00000 GHz
Water Vapour Column Density	0.913 mm (3rd Octile)
tau/Tsky	tau=0.158, Tsky=44.400 K
Tsys	153.577 K

Individual Parameters			
	12m Array	7m Array	Total Power Array
Number of Antennas	32	9	2
Resolution	0.00000 arcsec	5.974554 arcsec	17.923662 arcsec
Sensitivity(rms)	0.00000 Jy	0.00000 Jy	0.00000 Jy
(equivalent to)	Infinity K	0.00000 K	0.00000 K
Integration Time	0.00000 s	0.00000 s	0.00000 s

Fiducial  
Frequency

Fiducial  
Bandwidth



# Sensitivity



- Time Request

OT WILL CALCULATE A ROUGH TIME ESTIMATE, INCLUDING OVERHEADS

Desired Performance

Desired Angular Resolution: 2.0 arcsec

Largest Angular Structure in source:  Point Source  Extended Source 0.00000 arcsec

Desired sensitivity per pointing: 0.1 mJy equivalent to 0.00267 K

Bandwidth used for Sensitivity: AggregateBandWidth Frequency Width 7.500000 GHz

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

Control and Performance

ALMA OT - Information

Estimated time

Requested sensitivity	0.1000 mJy
Bandwidth used for sensitivity	7.500 GHz
Representative frequency (sky, first source)	107.00 GHz
Precipitable water vapour (first source)	2.748mm (6th Octile)

**ALMA 12m Array**

Array configuration	C32-2
Time on source per pointing	1.24 min
Total number of pointings (all sources)	1
Total time on source	1.24 min
Total time on calibrators	2.35 min
Total overheads	7.33 min
Total 12m array time (inc. calibration & overheads)	10.92 min

**Calibration Breakdown**

Estimated number of tunings required	1
1 x Bandpass (inc. AtmosphericCal)	26.84 s
3 x Pointing	54.00 s
1 x Amplitude (inc. AtmosphericCal)	26.03 s
1 x Phase	8.00 s
1 x Atmospheric	26.00 s
Additional calibration overheads	4.67 min

**Achievable Sensitivity**

Single Continuum with 12m Array	0.1000 mJy
Single Continuum with 12m Array	0.0974 mJy
Single Continuum with 12m Array	0.0926 mJy
Single Continuum with 12m Array	0.0924 mJy

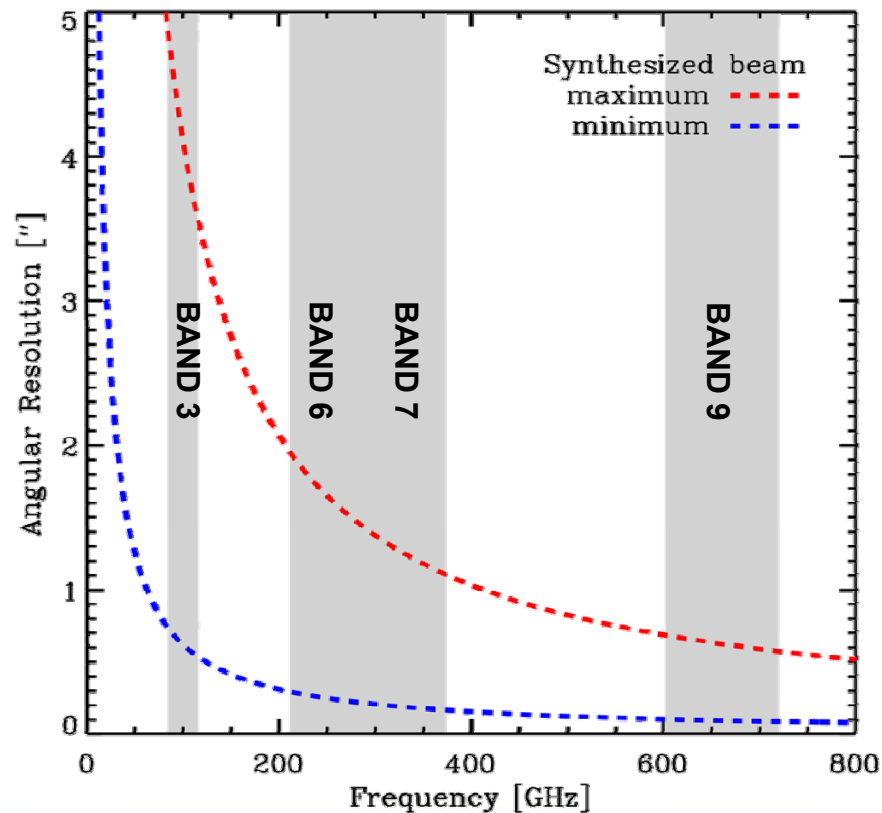
Estimated total time for science goal 10.92 min





# Resolution

- Target angular resolution  
CONSTRAINS TELESCOPE CONFIGURATION ALLOWED WHEN DATA ARE TAKEN
- High resolution leads to lower surface brightness sensitivity  
RMS PROPORTIONAL TO BEAMWIDTH<sup>2</sup> HOLDING ALL OTHER FACTORS FIXED.



# Maximum Angular Scale



- Maximum angular scale (MAS) recovered by array

Band	Frequency (GHz)	Primary beam (")	Range of Scales (")	
			C32-1	C32-6
3	84-116	72 - 52	4.2 - 24.6	0.7 - 15.1
6	211-275	29 - 22	1.8 - 10.7	0.3 - 6.6
7	275-373	22 - 16	1.2 - 7.1	0.2 - 4.4
9	602-720	10 - 8.5	0.6 - 3.6	0.1 - 2.2

- **Smooth** structures larger than MAS *begin* to be resolved out.
- All flux on scales larger than  $\lambda/B_{\min}$  ( $\sim 2 \times$  MAS) completely resolved out.  
NEED ADDITIONAL OBSERVATIONS WITH A SINGLE-DISH OR A COMPACT ARRAY OF SMALL TELESCOPES.



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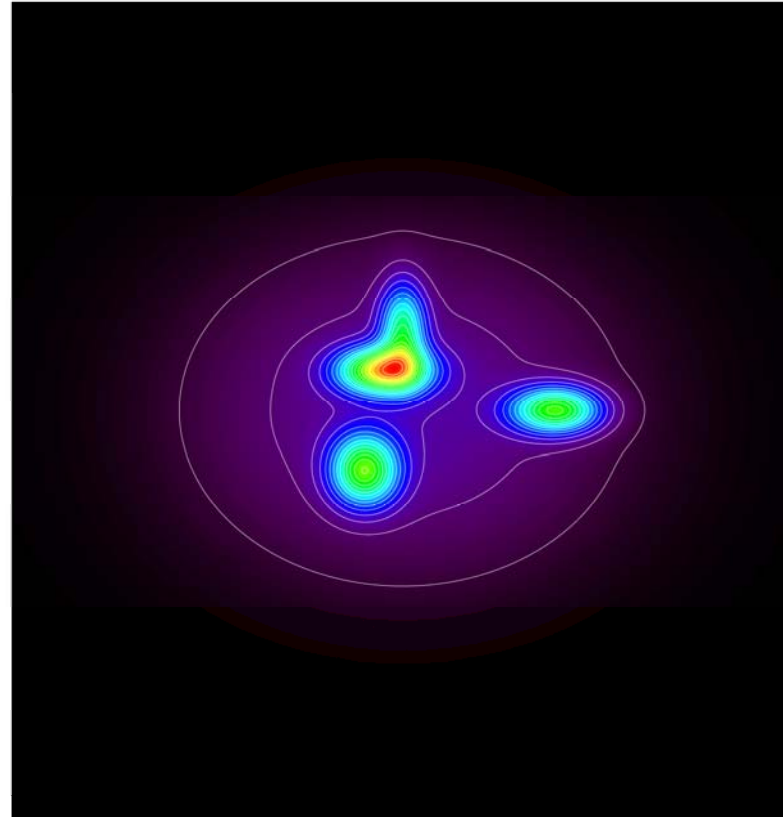
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NEED ADDITIONAL OBSERVATIONS WITH A SINGLE-DISH OR A COMPACT ARRAY OF SMALL TELESCOPES.



# Largest Angular Scale (LAS)



- Largest angular scale of interest for target  
DEPENDS ON SOURCE STRUCTURE AND SCIENCE AIMS

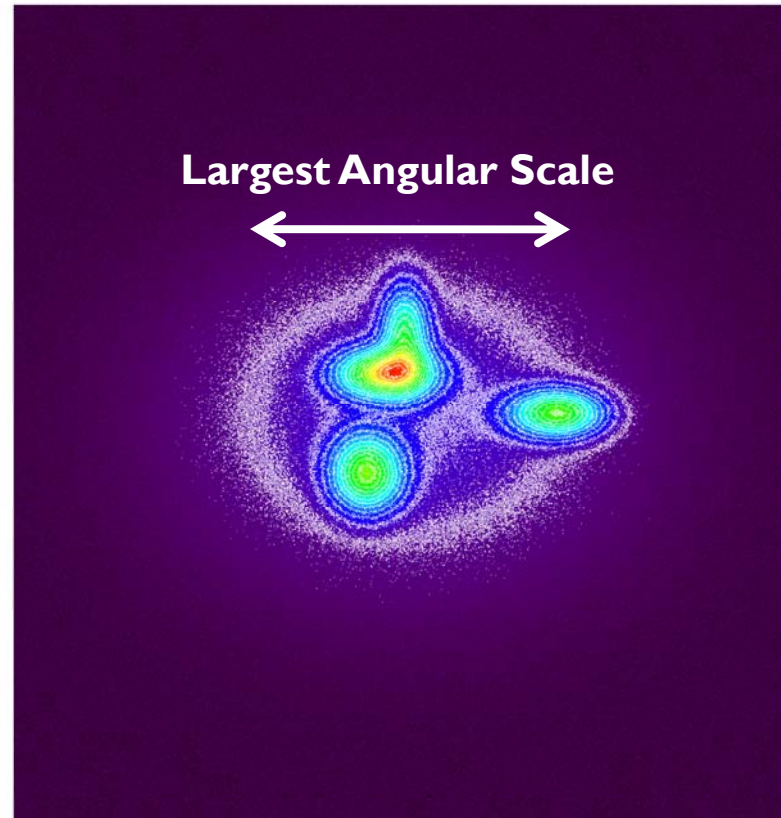


e.g., compact sources embedded in a smooth superstructure holding ~65% of flux  
(here with perfect S/N)



# Largest Angular Scale (LAS)

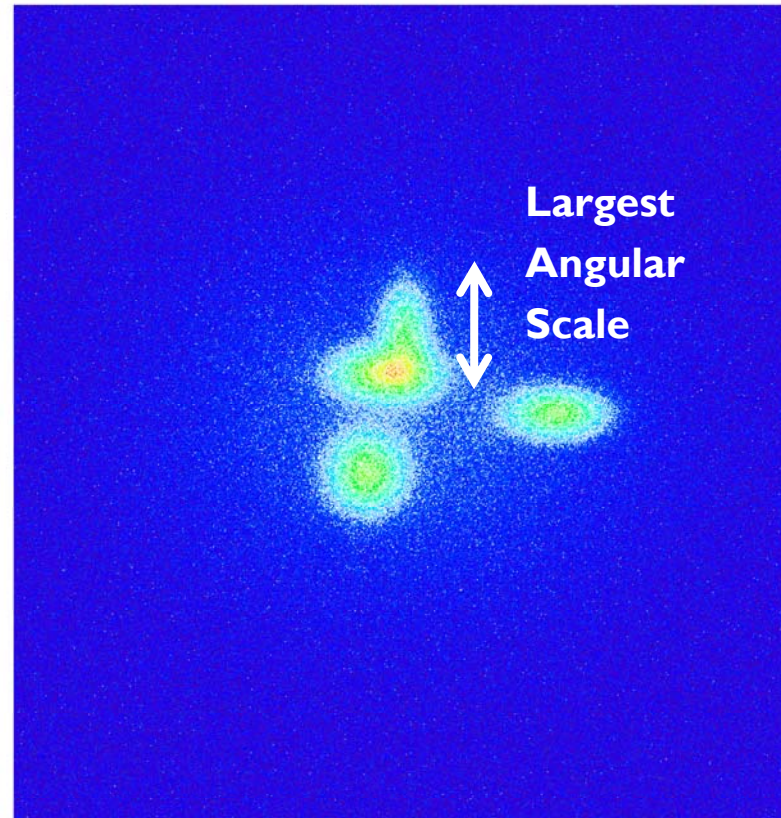
- Superstructure of scientific interest?  
THEN YOUR RMS AND LAS MUST REFLECT THAT.



RMS set to detect superstructure and LAS input to reflect size of structure.

# Largest Angular Scale (LAS)

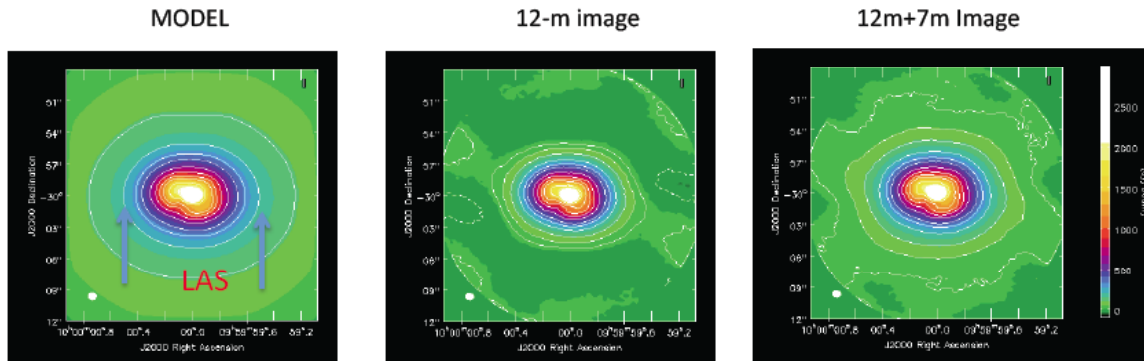
- Only embedded compact sources of interest?



RMS set to detect compact sources and LAS input to reflect compact source size.

# ACA Example (see Primer)

Images using 12-m C2 array with a resolution of 0.8"x0.7" in pa 80d

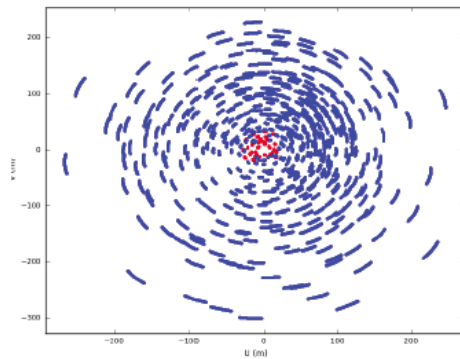


Restored flux 11000 Jy

7000 Jy

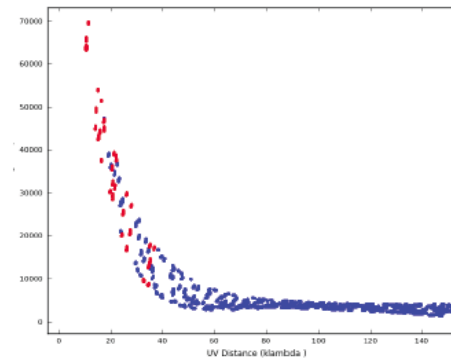
9000 Jy

Primary beam corrected: 20% cutoff: Contours: -20,20,50,100,200,300,400,600,800,1000,1200,1600,2000



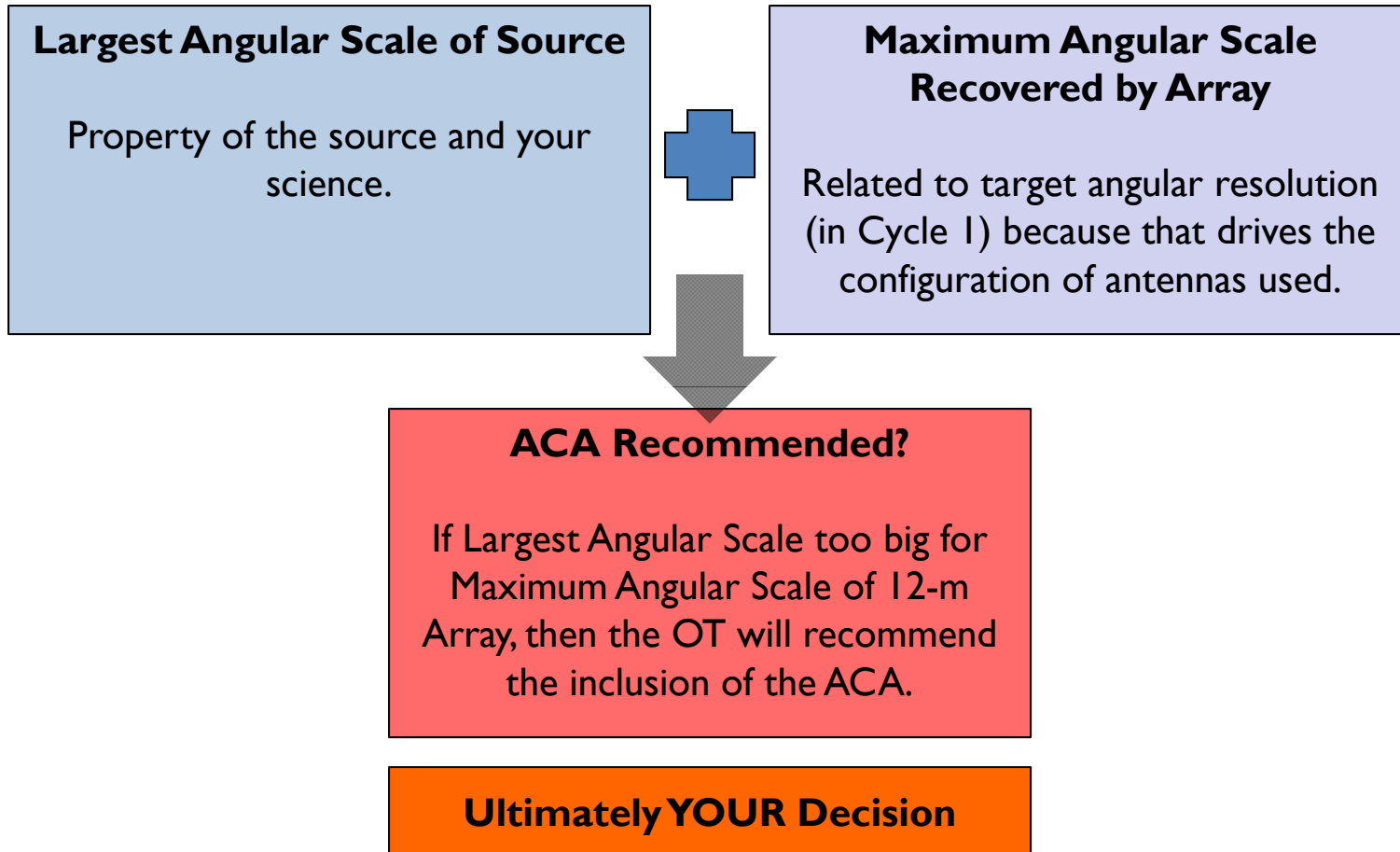
U-V coverage

(red=ACA, blue=ALMA12m)



Amplitude vs uv-distance

# To Use the ACA?

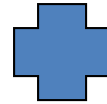


**ONLY ~250 hours (1/3 of total time) will go to projects needing ACA.**

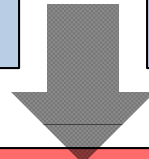


# To Use the ACA?

**Largest Angular Scale of Source**  
Property of the source and your science.



**Maximum Angular Scale Recovered by Array**  
Related to target angular resolution (in Cycle I) because that drives the configuration of antennas used.



**ACA Recommended?**  
If Largest Angular Scale too big for Maximum Angular Scale of 12-m Array, then the OT will recommend the inclusion of the ACA.

ACA not available for highest resolutions (not enough overlap in u-v coverage)

**Ultimately YOUR Decision**

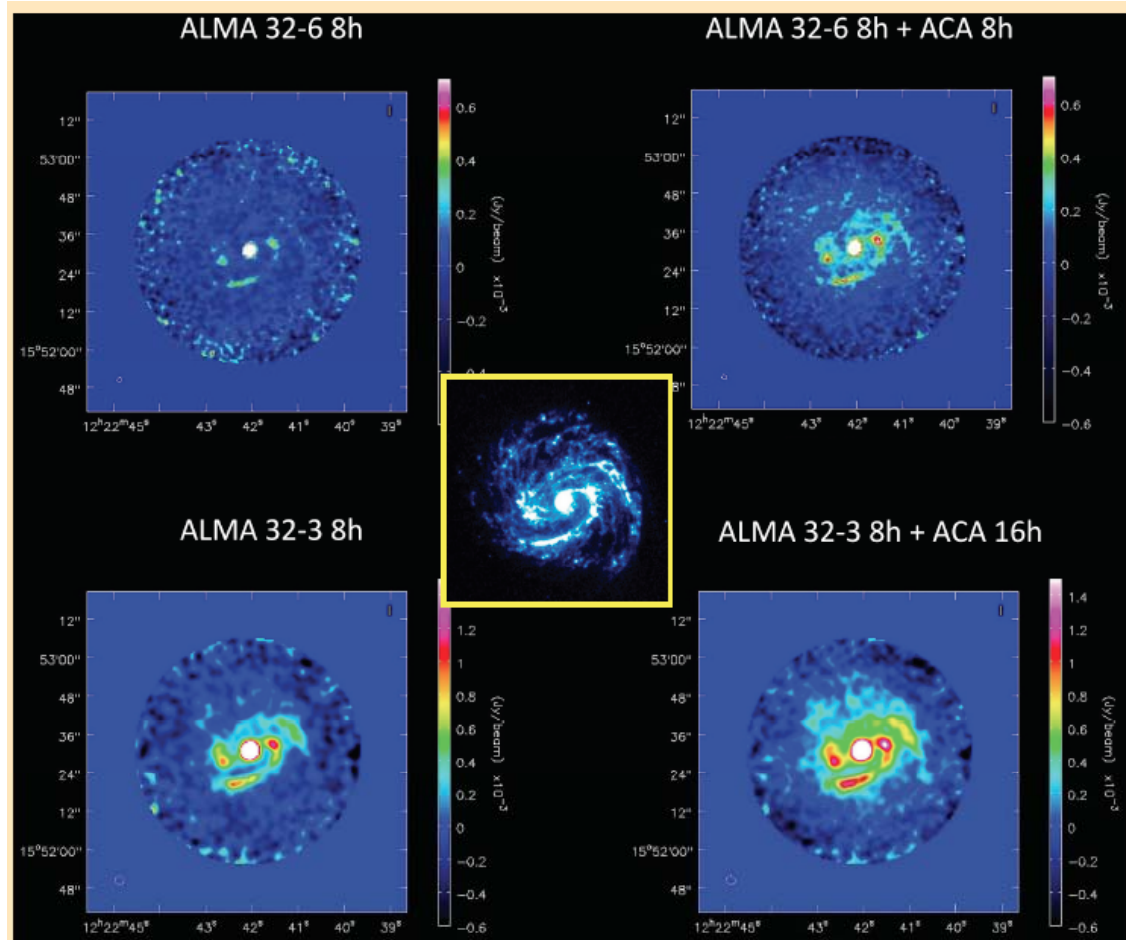
**ONLY ~250 hours (1/3 of total time) will go to projects needing ACA.**

# To Use the ACA?

A spiral galaxy where the model (center) is an IRAC 8 micron image as a proxy for CO.

In the top row, a simulated image reconstructed using a smaller LAS is shown; only compact bright features are present in the image on the left. On the right, the ACA was used to recover extended emission; the fidelity of the image is improved markedly.

In the bottom row, the image was reconstructed using a larger LAS is shown; compact structure is much better represented. Image fidelity is further improved through the use of the ACA.



# Key Proposal Factors



- Framework: Science Goals
- Spectral Setup
- Spatial Setup
- Control and Performance Specifications
- **Logistics**



# Proposal Checklist

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- Read Primer and Proposer's Guide
- Create an ALMA account by registering at the Science Portal**
- Download the Observing Tool (OT)**
- Familiarize yourself with the OT via the Quickstart Video
- Define your Science Goals within the OT**
  - use the OT to understand if your science goals match ALMA's capabilities
  - use CASA simdata for a more thorough exploration
  - take advantage of the TA Checklist generated by the OT
- Prepare the Science & Technical Justifications (one PDF file)**
  - Annotated LaTeX template available
- Make use of the Helpdesk & the Knowledgebase
- Submit!**

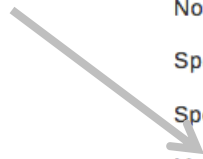
**Required Step**



# TA Checklist



Checklist of technical concerns generated by the OT as part of PDF output



F-1	
<b>Field Setup:</b>	
Target(s) max. elevation is low (< 20 degrees)	<input type="checkbox"/>
Target(s) max. elevation is high (> 84 degrees)	<input type="checkbox"/>
Non-zero proper motion of target(s)	<input checked="" type="checkbox"/>
Spatial dynamic range > 500 (on basis of peak flux to rms)	<input type="checkbox"/>
Spectral dynamic range > 1000 (B3, B6), 500 (B7), 100 (B9)	<input type="checkbox"/>
Mosaic pointing separation outside range $0.48 - 0.8 \cdot 1.2 \cdot \lambda/D$	<input type="checkbox"/>
Velocity frame is not LSR_K	<input checked="" type="checkbox"/>
Velocity definition is relativistic	<input checked="" type="checkbox"/>
<b>Spectral Setup:</b>	
Single Polarization selected	<input type="checkbox"/>
Linewidth > 90% spectral window width	<input type="checkbox"/>
Single spectral window only selected	<input type="checkbox"/>
<b>Calibration:</b>	
Any user calibration selected	<input type="checkbox"/>
<b>Control and Parameters:</b>	
Largest scale of interest > max. recoverable scale	<input checked="" type="checkbox"/>
Extra time selected	<input type="checkbox"/>
ACA request and necessity estimator disagreement	<input type="checkbox"/>



# Proposal Checklist

---



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**Required Step**



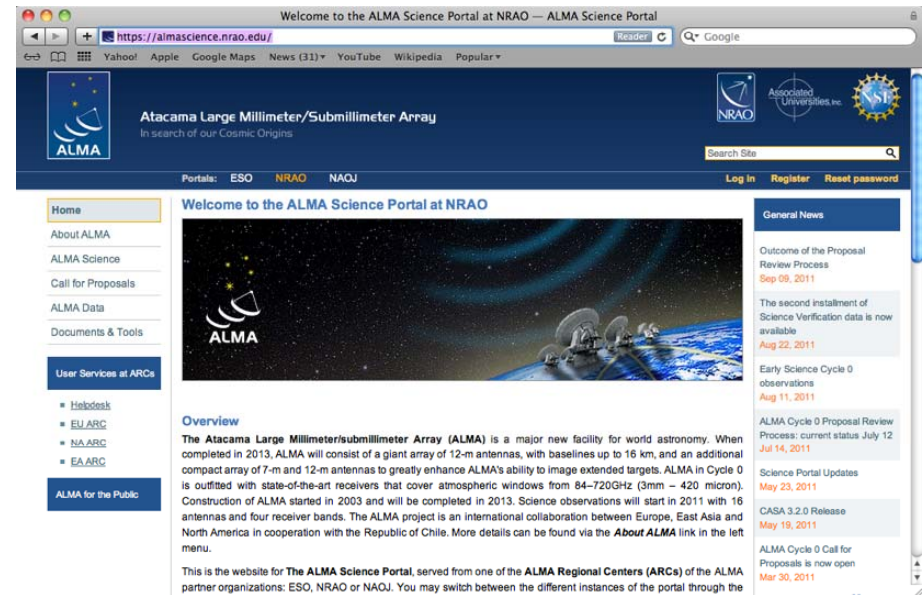
# The ALMA Science Portal

<https://almascience.nrao.edu>




*Hub for project-wide material.*

- Observing Tool
- Sensitivity Calculator
- Proposer's Guide
- Technical Handbook
- Science Verification Data
- CASA & Simulations
- Tutorials
- Helpdesk



*Registration required to propose for PIs and cols.*





The Atacama Large Millimeter/sub-millimeter 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, commissioning and operation of ALMA.



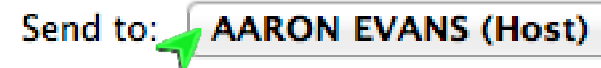
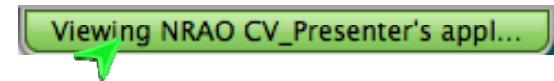
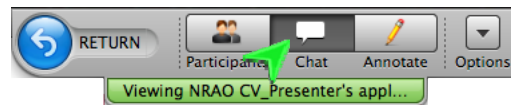
# NRAO Proposal Planning Webinar

## NEXT PRESENTATION: 18:30 UT

- 17:00 UT (1pm EDT) – Planning an ALMA Proposal
- **18:30 UT (2:30pm EDT) – Planning a GBT Proposal**
- 19:30 UT (3:30pm EDT) – Planning a JVLA/VLBA Proposal
- 21:00 UT (5:00pm EDT) – Open Questions & Answers

### Important information:

- Sound available only through voice bridge.
  - USA Toll Number : +1-210-835-9155
  - USA Toll Free Number : 866-815-0456
  - Participant Passcode: 3535975#
- Ask question through webinar “Chat” feature
  - Click green area in top center of your screen
  - Click on “Chat”
  - Select Send to: Aaron Evans (Host)



- Supporting Material: <https://science.nrao.edu/science/meetings/nrao-cde>

# To Use the ACA?

- When in doubt, simulate!  
“OBSERVE” A MODEL OF YOUR TARGET WITH 12-M AND 12-M+ACA, COMPARE

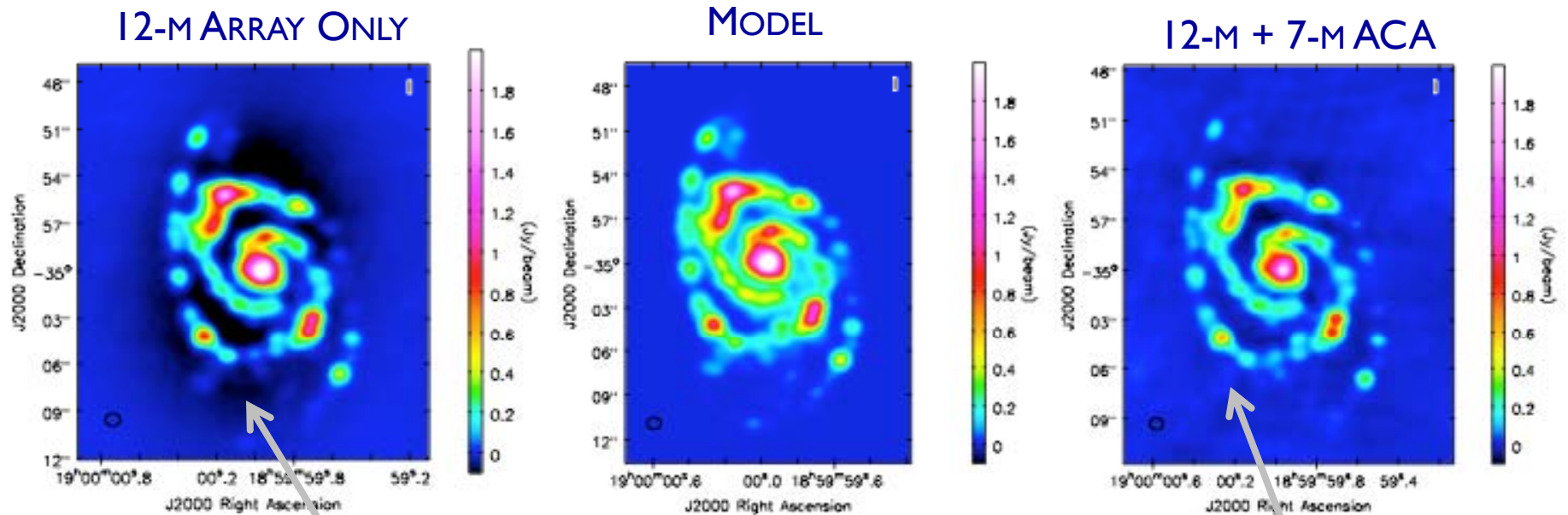


Image reconstruction artifact (“bowls”)

Not present when 7-m antennas included