

# ALMA Cycle 9 Call for Proposals

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ALMA group, KASI



Figure 1.1: ALMA antennas on the Chajnantor Plateau.



# ALMA Telescope

## ALMA Full Operations Specifications

	Specification
Number of Antennas	50×12 m (12-m Array), plus 12×7 m & 4×12 m (ACA)
Maximum Baseline Lengths	0.16 - 16.2 km
Angular Resolution (")	$\sim 0.2'' \times (300/\nu \text{ GHz}) \times (1 \text{ km} / \text{maximum baseline})$
12 m Primary beam (")	$\sim 19.4'' \times (300/\nu \text{ GHz})$
7 m Primary beam (")	$\sim 33.3'' \times (300/\nu \text{ GHz})$
Number of Baselines	Up to 1225 (ALMA correlators can handle up to 64 antennas)
Frequency Coverage	All atmospheric windows from 84 GHz - 950 GHz (with extension to 35 GHz when Bands 1 and 2 are deployed)
Correlator: Total Bandwidth	16 GHz (2 polarizations × 4 basebands × 2 GHz/baseband)
Correlator: Spectral Resolution	As narrow as $0.008 \times (300/\nu \text{ GHz}) \text{ km/s}$
Polarimetry	Full Stokes parameters

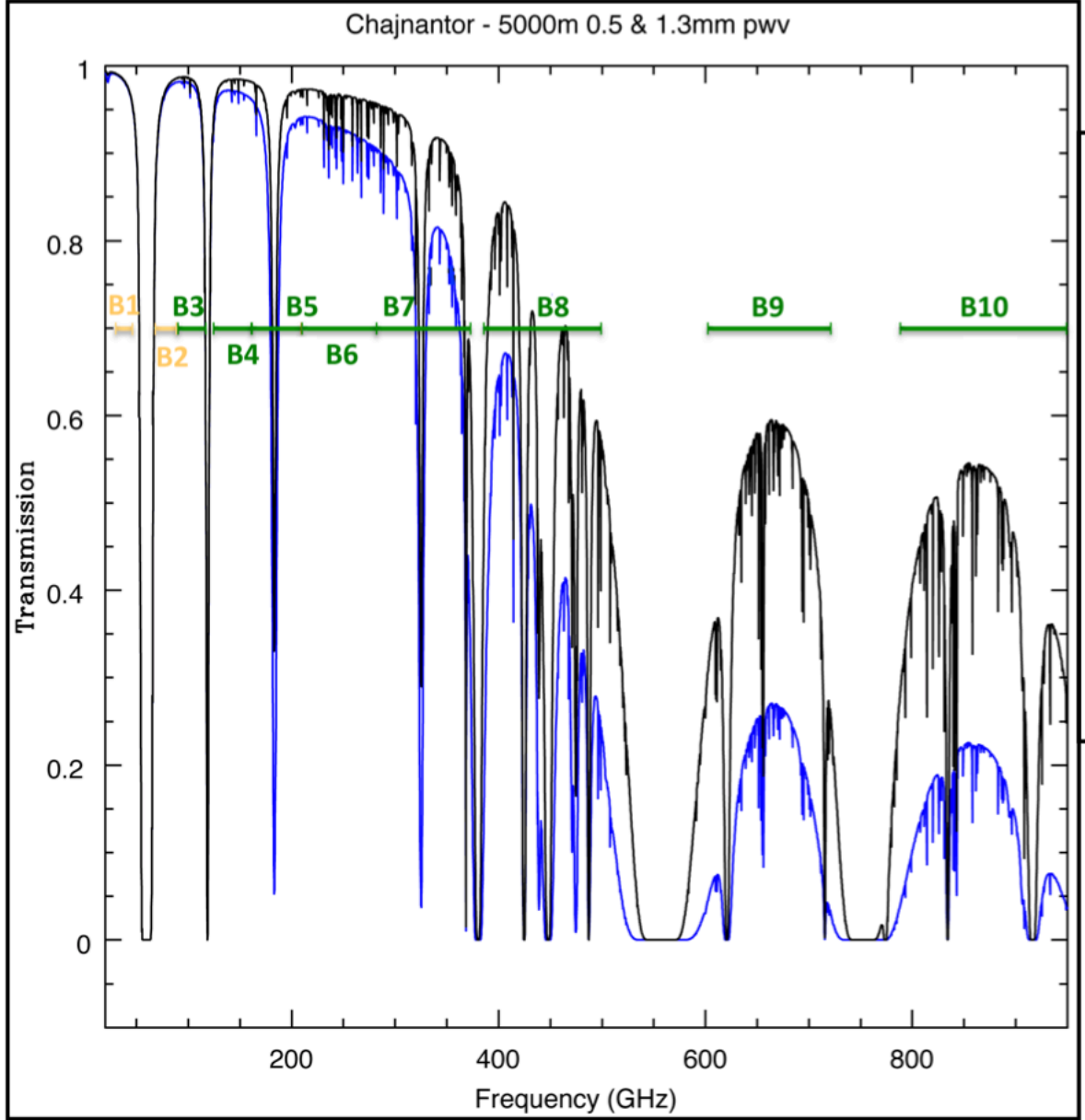
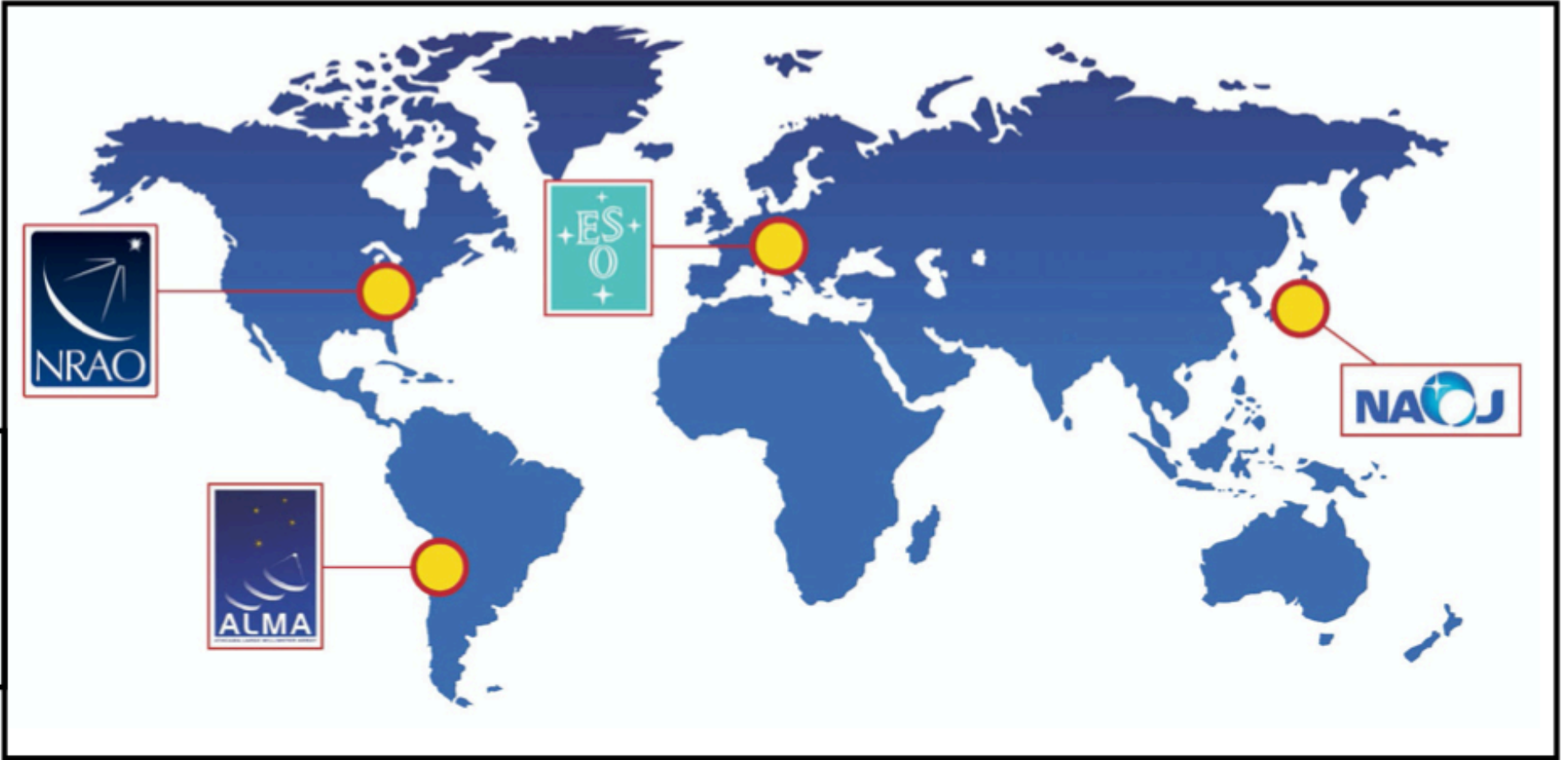


Figure 3: Map of Chile, showing the location of ALMA (red star).





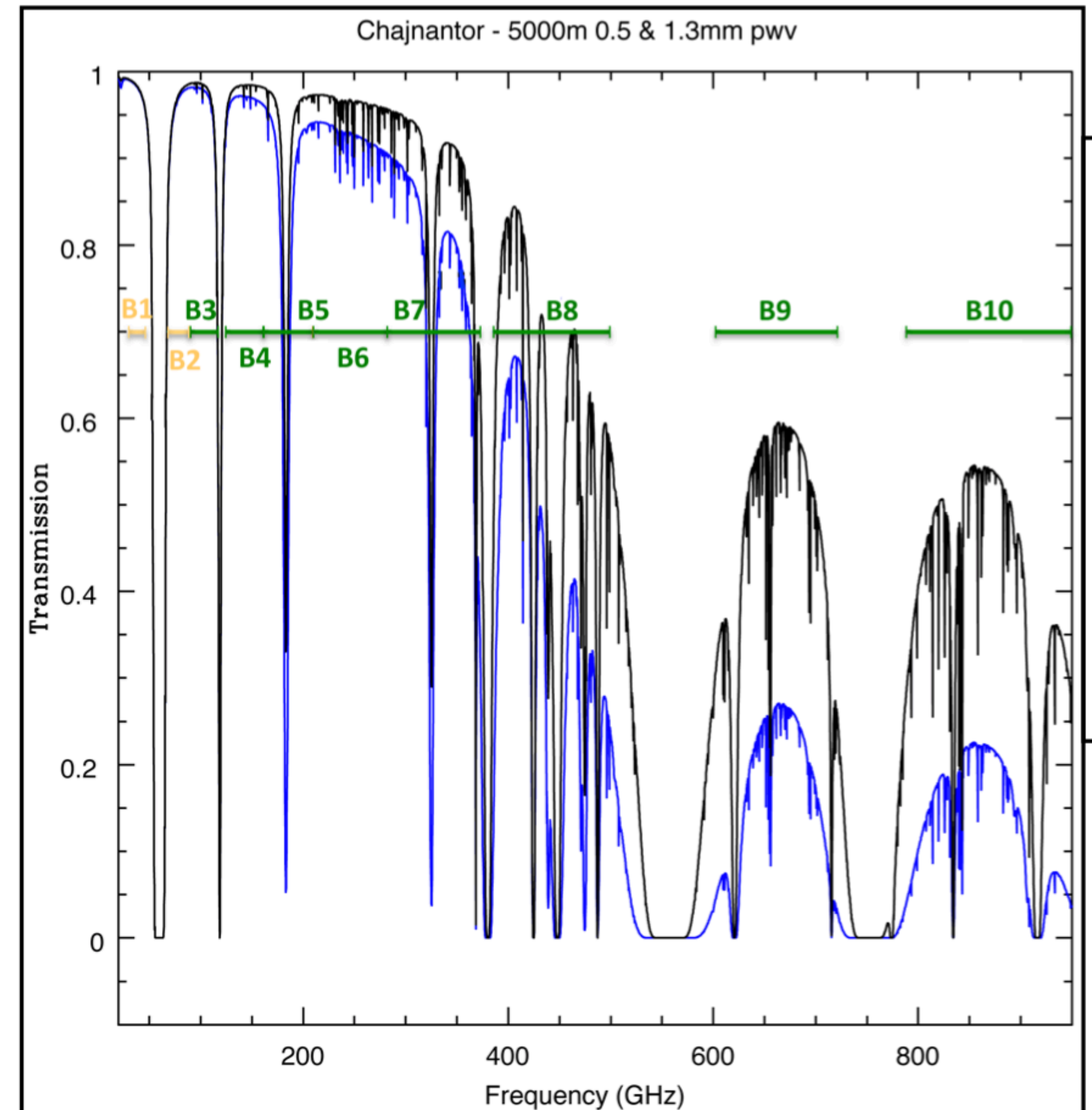
# ALMA Telescope

- 10 receiver band (Currently 3 - 10 available)
- 84-950 GHz

## Frequency Resolution

Table A-4: Properties of ALMA Cycle 9 Correlator Modes, dual-polarization operation <sup>1,2</sup>

Bandwidth (MHz)	Channel spacing <sup>(3)</sup> (MHz)	Spectral resolution (MHz)	Number of channels	Correlator mode <sup>(4)</sup>
1875	15.6	31.2	120	TDM
1875	0.488	0.976	3840	FDM
938	0.244	0.488	3840	FDM
469	0.122	0.244	3840	FDM
234	0.061	0.122	3840	FDM
117	0.0305	0.061	3840	FDM
58.6	0.0153	0.0305	3840	FDM



# Cycle 9 Schedule

Date	Milestone
24 March 2022 (15:00 UT)	Release of Cycle 9 CfP, Observing Tool, and supporting documents, and opening of the Archive for proposal submission
21 April 2022 (15:00 UT)	Proposal submission deadline for Cycle 9 proposals
August 2022	Announcement of the outcome of the proposal review process
October 2022	Start of ALMA Cycle 9 science observations
September 2023	End of ALMA Cycle 9

- Emergency Department in the Helpdesk : 8:00 KST on April 19.
- Helpdesk tickets will be taken care of by ARC staff globally, urgently depending on the time of ticket submission.
- If you submit tickets to the usual department, those will be handled in a usual way



# New Capabilities in Cycle 9 includes :

- **Fast Regional Mapping (FRM) for solar Total Power observations.** The size of the field of view for solar Total Power observations can be specified by the PI.
- **Spectral line Very Long Baseline Interferometry (VLBI).** This capability is offered in Band 3 only, in conjunction with the Global Millimeter VLBI Array (GMVA).
- **Submillimeter VLBI.** A continuum VLBI capability will be offered for Band 7 (0.87 mm) in conjunction with the Event Horizon Telescope (EHT).
- **Longer baseline high-frequency observations: Band 8 up to C-10, Band 9 up to C-9, and Band 10 up to C-8.** The band-to-band (B2B) calibration mode<sup>1</sup> may be triggered by the OT for long baseline high frequency observations in order to find a suitably close and strong phase calibrator. Some science targets, particularly at the highest frequencies and longest baselines, may not be possible even with B2B (see Section A.9.6).



# Review Processes

## 1.2.1 Distributed peer review

ALMA is using a distributed peer review system for proposals requesting less than 50 hours on the 12-m Array and for ACA stand-alone proposals requesting less than 150 hours on the 7-m Array (i.e., for all proposals except Large Programs and Director's Discretionary Time). For each proposal submitted, the PI or a designee from the list of investigators will review and rank 10 submitted proposals from this Call. Review assignments will be made based on the expertise of the designated reviewer, specified by including one or more scientific keywords on their ALMA [user profile](#). Additionally, in Cycle 9 reviewers are allowed to provide a list of their conflicts of interests; if this list is provided, reviewers will not be assigned to review proposals on which the PI or one of the co-Is is in their list of conflicts. **Reviewers are advised to update their user profiles as necessary in the Science Portal, paying special attention to the specification of their expertise.** The deadline to provide scientific expertise is 26 April 2022. See Section 5.7.1 for more information on distributed peer review.

## 1.2.2 Large Programs review


Proposals for Large Programs will be reviewed by a single panel, the ALMA Proposal Review Committee (APRC). Large Programs will also be reviewed by external Science Assessors, who will provide written reviews to the APRC but will not participate in the APRC meeting.

## 1.3 Observing Tool Installation - Seokho's talk in this afternoon



<https://almascience.nao.ac.jp>

# Update your expertises : login - preference



Atacama Large Millimeter/submillimeter Array  
In search of our Cosmic Origins

☐ only in current section

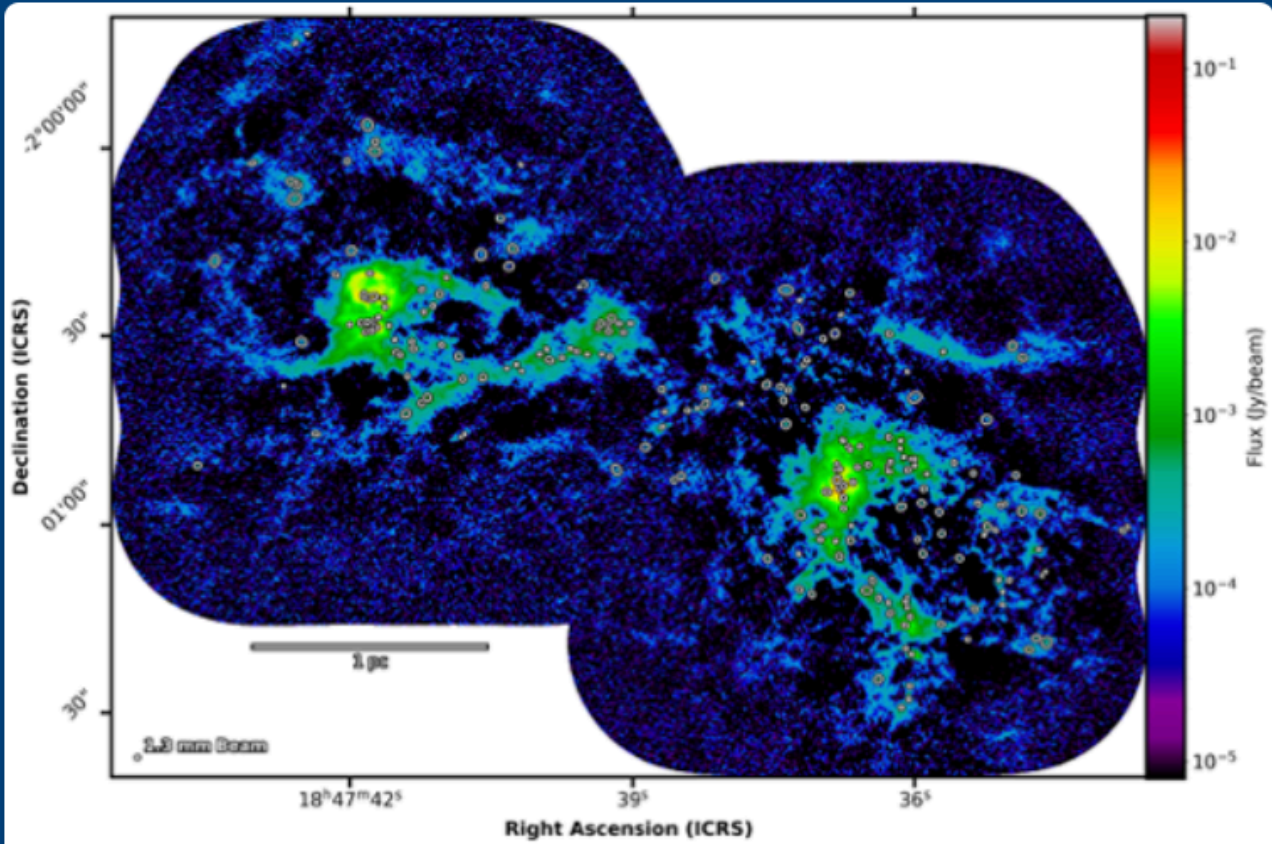
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### Science Highlight

Top-heavy Core Mass function revealed by ALMA-IMF: a challenge to the IMF universality



The W3-MM2&MM3 protocluster cloud, as imaged at 1.3 mm by the ALMA 12 m array. White ellipses outline the size of the 208 compact cores of few thousand AU size extracted by the core extraction algorithm getsf.

The ALMA-IMF Large Program aims to answer the

### Observatory News

ALMA Cycle 9 Call for Proposals is Now OPEN!  
Mar 24, 2022

ALMA Science Archive previews  
Feb 14, 2022

QA0+ results now available from SnooPI  
Jan 31, 2022

ALMA Cycle 9 Pre-Announcement  
Dec 15, 2021

ALMA Science Archive object-type

[More...](#)

### NAOJ News

ALMA Cycle9 2022 Proposal Preparation Meeting  
Mar 22, 2022

East Asian ALMA Science Workshop 2022  
Jan 19, 2022

FY2021 ALMA/45m/ASTE Users Meeting  
Dec 23, 2021

Synergies between ALMA and wide-field high-cadence multi-wavelength surveys  
Dec 22, 2021

[More...](#)

### ALMA Status

Configuration Schedule

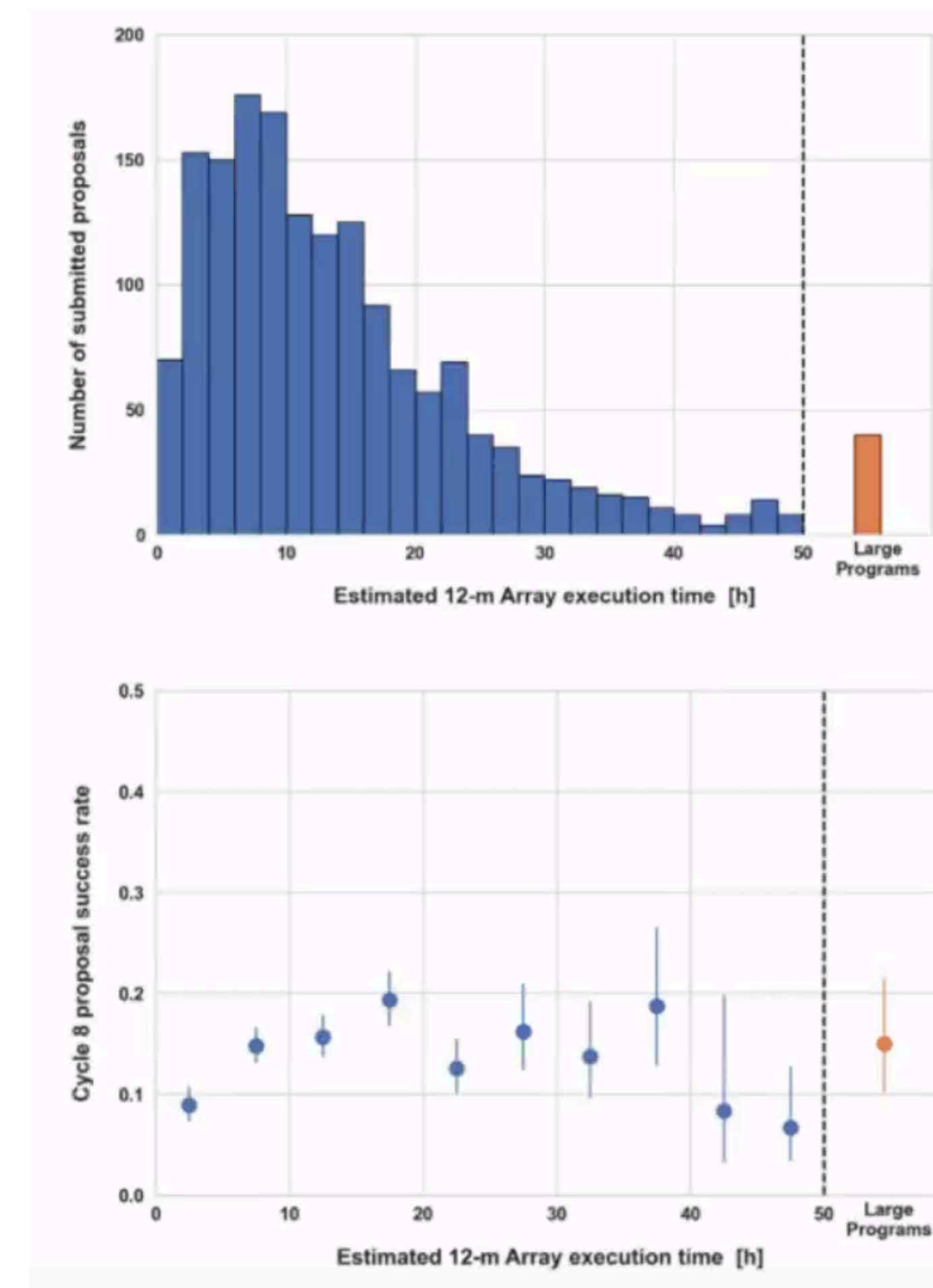
Refereed publications: 2750  
Last observed source: M87  
Current configuration: C-2

[More...](#)



# Proposal Type

- Main Call :
  - **Regular proposal** : < 50h in 12-array, < 150h in 7-m array stand alone, including time-critical, multi-epoch, monitoring
  - **Target of Opportunity proposals (ToO)** : triggered when an event occurs
  - **Large Programs (LP)** : major advance or breakthrough science, not reproducible by combination of Regular proposal. No time involving project, No solar, No full polarization, No VLBI, No Astrometry (up to 33% at HF, 50%)
  - **mm-VLBI & Phase Array proposals** : GMVA at 3mm (Band 3) + spectral line, EHT at 1.3 mm (Band 6) + 0.87 mm (band 7)
- **Director's Discretionary Time proposals (DDT)** : unexpected ToO nature, urgency for breakthrough discovery, risky nature of large impact + small time to test feasibility





# Proposal Planning

## 4.1 Time available in Cycle 9

Cycle 9 will span 12 months, starting in 2022 October and finishing in 2023 September.

The JAO anticipates allocating 4300 hours on each of the 12-m, 7-m, and TP arrays for successful PI programs, including DDT proposals as well as Cycle 8 2021 grade A proposals that are carried over. VLBI and DDT projects are limited to a maximum of 5% each of the available time (Sections 3.4 and 3.5). There is no overall cap on Large Programs, but they may fill no more than 33% of the time at a given LST for configurations C-9 and C-10 and no more than 50% of the time at a given LST for the remaining configurations (ACA and C-1 through C-8; see Section 3.3).



# Proposal Planning

## 4.2 Summary of capabilities offered in Cycle 9

The Cycle 9 capabilities are described in Appendix A. In summary, they are:

### Number of antennas

- At least forty-three antennas in the 12-m Array.
- At least ten 7-m antennas (for short baselines) and three 12-m antennas (for single-dish maps) in the ACA.

### Receiver bands

- Receiver Bands 3, 4, 5, 6, 7, 8, 9, and 10 (wavelengths of about 3.0, 2.0, 1.6, 1.3, 0.85, 0.65, 0.45, and 0.35 mm, respectively).

### 12-m Array Configurations

- Cycle 9 includes configurations C-1 through C-10.
- Maximum baselines between 0.16 km and 16.2 km depending on array configuration and subject to the following restrictions:
  - The maximum possible baseline for Bands 3, 4, 5, 6, 7, and 8 is 16.2 km.
  - The maximum possible baseline for Band 9 is 13.9 km.
  - The maximum possible baseline for Band 10 is 8.5 km.



Table A-1: Angular Resolutions (AR) and Maximum Recoverable Scales (MRS) for the Cycle 9 configurations

Config	Lmax		Band 3	Band 4	Band 5	Band 6	Band 7	Band 8	Band 9	Band 10
	Lmin		100 GHz	150 GHz	185 GHz	230 GHz	345 GHz	460 GHz	650 GHz	870 GHz
7-m	45 m	AR	12.5''	8.35''	6.77''	5.45''	3.63''	2.72''	1.93''	1.44''
	9 m	MRS	66.7''	44.5''	36.1''	29.0''	19.3''	14.5''	10.3''	7.67''
C-1	161 m	AR	3.38''	2.25''	1.83''	1.47''	0.98''	0.74''	0.52''	0.39''
	15 m	MRS	28.5''	19.0''	15.4''	12.4''	8.25''	6.19''	4.38''	3.27''
C-2	314 m	AR	2.30''	1.53''	1.24''	1.00''	0.67''	0.50''	0.35''	0.26''
	15 m	MRS	22.6''	15.0''	12.2''	9.81''	6.54''	4.90''	3.47''	2.59''
C-3	500 m	AR	1.42''	0.94''	0.77''	0.62''	0.41''	0.31''	0.22''	0.16''
	15 m	MRS	16.2''	10.8''	8.73''	7.02''	4.68''	3.51''	2.48''	1.86''
C-4	784 m	AR	0.92''	0.61''	0.50''	0.40''	0.27''	0.20''	0.14''	0.11''
	15 m	MRS	11.2''	7.50''	6.08''	4.89''	3.26''	2.44''	1.73''	1.29''
C-5	1.4 km	AR	0.55''	0.36''	0.30''	0.24''	0.16''	0.12''	0.084''	0.063''
	15 m	MRS	6.70''	4.47''	3.62''	2.91''	1.94''	1.46''	1.03''	0.77''
C-6	2.5 km	AR	0.31''	0.20''	0.17''	0.13''	0.089''	0.067''	0.047''	0.035''
	15 m	MRS	4.11''	2.74''	2.22''	1.78''	1.19''	0.89''	0.63''	0.47''
C-7	3.6 km	AR	0.21''	0.14''	0.11''	0.092''	0.061''	0.046''	0.033''	0.024''
	64 m	MRS	2.58''	1.72''	1.40''	1.12''	0.75''	0.56''	0.40''	0.30''
C-8	8.5 km	AR	0.096''	0.064''	0.052''	0.042''	0.028''	0.021''	0.015''	0.011''
	110 m	MRS	1.42''	0.95''	0.77''	0.62''	0.41''	0.31''	0.22''	0.16''
C-9	13.9 km	AR	0.057''	0.038''	0.031''	0.025''	0.017''	0.012''	0.0088''	N/A
	368 m	MRS	0.81''	0.54''	0.44''	0.35''	0.24''	0.18''	0.13''	
C-10	16.2 km	AR	0.042''	0.028''	0.023''	0.018''	0.012''	0.0091''	N/A	N/A
	244 m	MRS	0.50''	0.33''	0.27''	0.22''	0.14''	0.11''		



# Proposal Planning

Spectral-line, continuum, and mosaic observations :available in all Band 3 - 10 with some exception

- Spectral-line and continuum observations with the 12-m Array and the 7-m Array in all bands.
- Single-field interferometry (all bands) and mosaics (Bands 3 to 9) with the 12-m Array and the 7-m Array.
- Single-dish spectral-line observations in Bands 3 to 8.

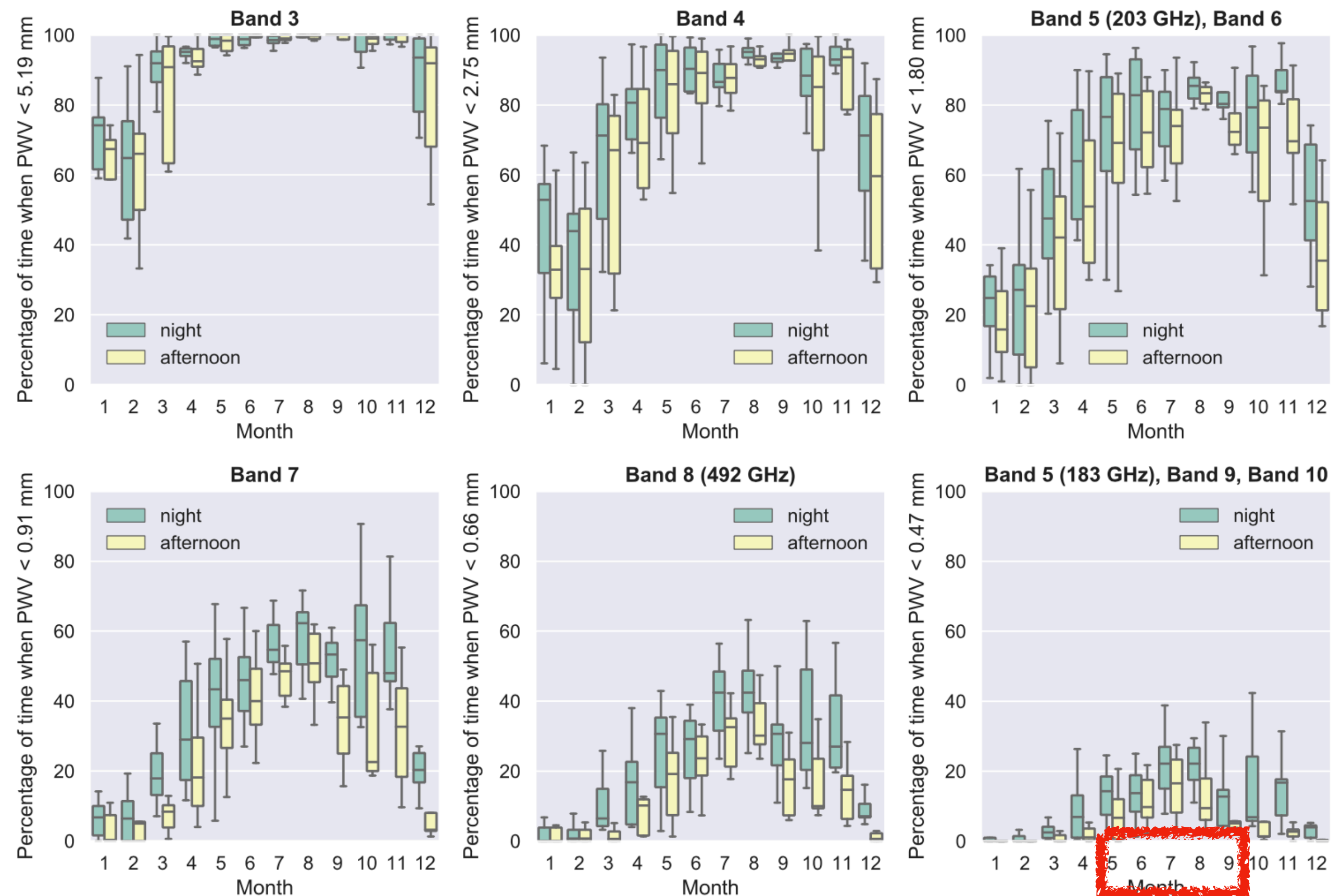
Polarization :available in all Band 3 - 7

- Single-pointing, on-axis, full linear and circular polarization for both continuum and full spectral resolution observations in Bands 3 to 7 on the 12-m Array. The field of view of linear and circular polarization observations is limited to the inner one third and the inner one tenth of the primary beam, respectively. The minimum detectable degree of circular polarization is 1.8% of the peak flux for both continuum and full spectral resolution observations
- Mosaics for continuum linear polarization observations for the 12-m Array in Bands 3 to 7.
- Single-pointing, on-axis linear polarization on the stand-alone 7-m Array in Bands 3 to 7. The field of view is limited to the inner one third of the primary beam. A maximum of 75 hours will be offered for this mode.



# Scheduling Considerations

- High Frequency observations :
  - Band 8/9/10 are strongly encouraged.
  - Be aware the available time range, because of the weather condition.
- Configuration schedule :
- Angular resolution





**Table 2: Planned 12-m Array Configuration Schedule for Cycle 9**

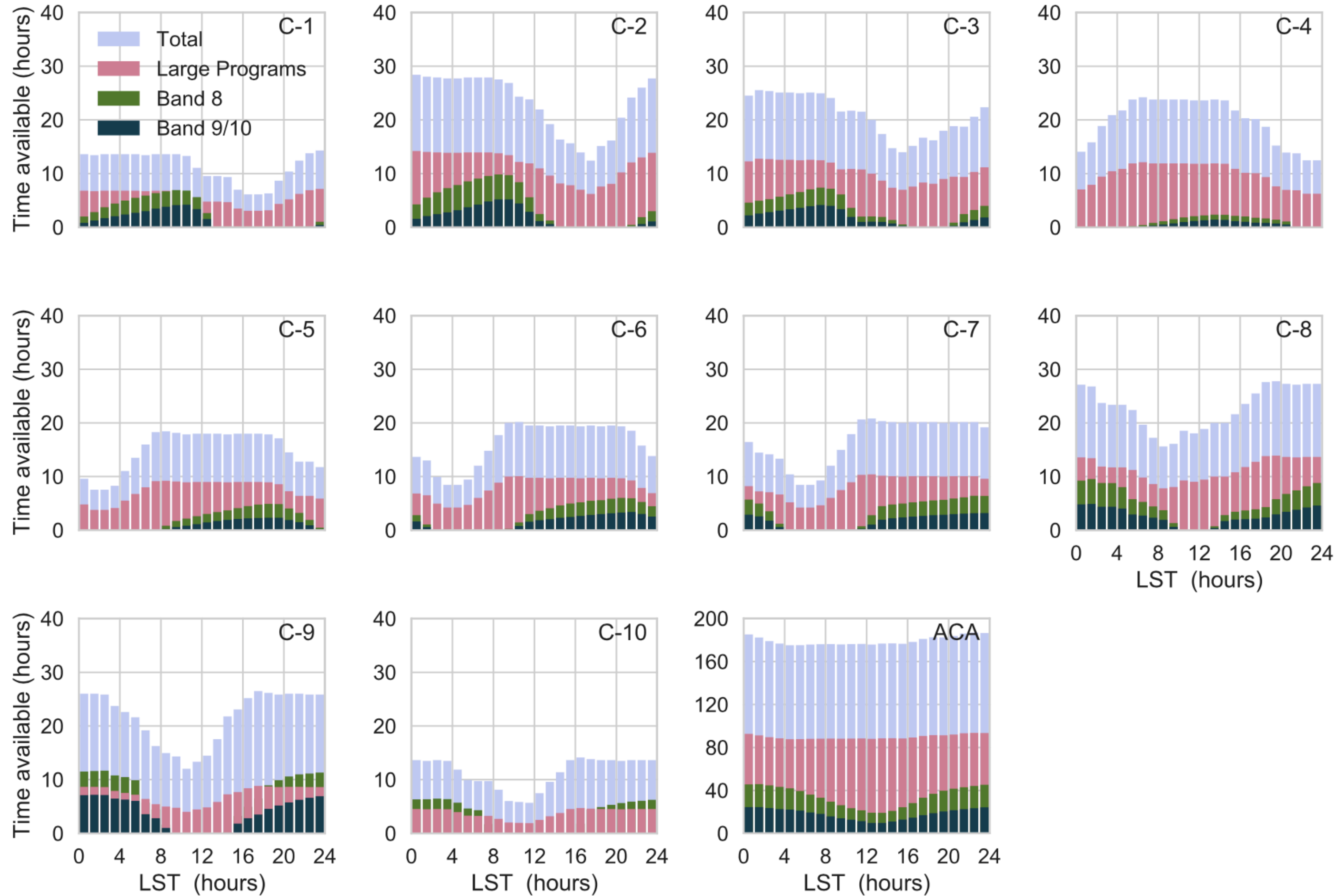
Start date	Configuration	Longest baseline	LST for best observing conditions
2022 October 1	C-3	0.50 km	~ 22—10 h
2022 October 20	C-2	0.31 km	~ 23—11 h
2022 November 10	C-1	0.16 km	~ 1—13 h
2022 November 30	C-2	0.31 km	~ 2—14 h
2022 December 20	C-3	0.50 km	~ 4—15 h
2023 January 10	C-4	0.78 km	~ 5—17 h
2023 February 1	<i>No observations due to maintenance</i>		
2023 March 1	C-4	0.78 km	~ 8—21 h
2023 March 20	C-5	1.4 km	~ 9—23 h
2023 April 20	C-6	2.5 km	~ 11—1 h
2023 May 20	C-7	3.6 km	~ 13—3 h
2023 June 20	C-8	8.5 km	~ 15—5 h
2023 July 11	C-9	13.9 km	~16—6 h
2023 July 30	C-10	16.2 km	~17—7 h
2023 August 20	C-9	13.9 km	~19—8 h
2023 September 10	C-8	8.5 km	~20—9 h

**Configuration schedule may  
Change,  
Will be announced  
once every 3 weeks  
In the SP**

**9h - 15h targets  
Not available for HF or LB**



# Available time vs LST in cycle9





# Scheduling Considerations

- High Frequency observations :
  - Band 8/9/10 are strongly encouraged.
  - Be aware the available time range, because of the weather condition.
- Configuration schedule :
- Angular resolution : wider AR range, more chance of observing
  - If the PI selects a single value for the angular resolution or a range narrower than 20% around its center value, a range of  $\pm 20\%$  around the single or center value specified will be enforced.
  - If the requested range (after applying the previous rule) does not include the resolution of at least one of the notional configurations, the range will be extended to include the resolution of the closest notional configuration.
  - *If the requested range includes both long-baseline and more compact configurations, only the latter will be considered.* An exception is constituted by ToO observations that can be triggered in any configuration if the angular resolution requested by the PI is “any” (see Section 3.2).



# Duplication Check & Resubmission

## 4.4.1 Checking for duplications

Duplicate observations of the same location on the sky with similar observing parameters (frequency, angular resolution, coverage, and sensitivity) are not permitted unless scientifically justified. Detailed criteria of what constitutes a duplicated observation are specified in Appendix A of the [Users' Policies](#).

PIs are responsible for checking their proposed observations against the [Archive](#) and the list of Grade A projects in the observing queue [provided on the Science Portal](#) to avoid duplicate observations. PIs proposing duplications of previous cycle observations will not have their proposals marked as duplications if they had no way to know about the previous cycle observations, using the resources listed above, by the release of the Call for Proposals. Information on checking for duplications is available on the [Duplicate Observations](#) page on the Science Portal.

The proposal cover sheet contains a section where PIs can justify observations known to be duplicate. PIs may wish to justify their proposed observations in cases where they are similar to previously executed or accepted programs but are not formal duplicates. This will help the reviewers understand why new observations are requested.

## 4.4.2 Resubmission of an unfinished proposal

A Scientific Justification must be provided if the proposers request one or more additional epochs of observations in Cycle 9 even if the Cycle 8 2021 observations are completed.



# Proposal Format

- Page limits
  - Total length: 4 pages for Regular, ToO, mm-VLBI and DDT proposals, 6 pages for Large Programmes (A4 or US Letter format)
- Font size: no smaller than 12 points including figure captions, tables and references
- Latex template is in the Science Portal and users can use it.



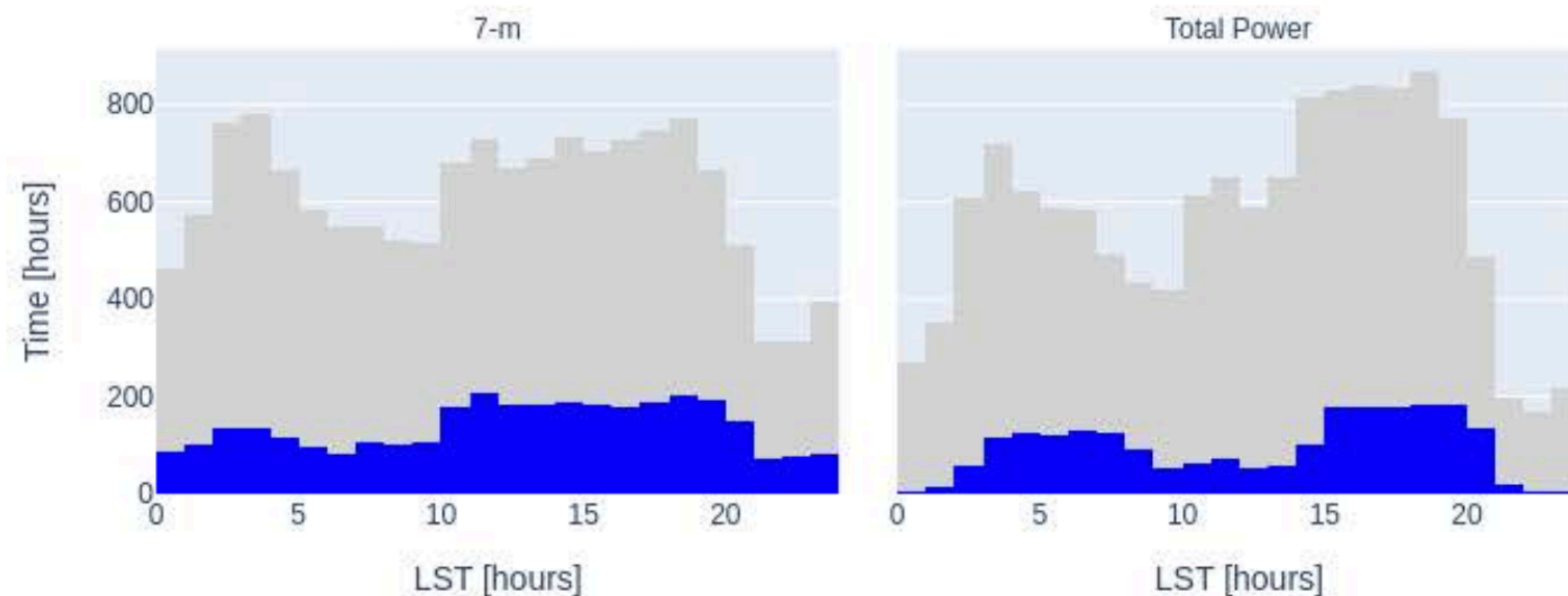
# Calibration Accuracies

- Image dynamic range ( $I_{\text{peak}}/\text{rms}$ )
  - ~100 for compact 12m arrays and ACA, ~50 for more extended than ~2km and at Bands 8,9, and 10 for nominal phase calibration.
  - Self-calibration will be required to achieve image DR of ~1000 or larger.
- Absolute flux accuracy
  - ~5% in Bands 3-5, ~10% in Bands 6-8, ~20% in Bands 9-10
- Astrometric accuracy
  - At best ~5% of synthesized beam for angular resolution > 150 mas, ~10% of synthesized beam for higher angular resolution.
  - Choose “enhanced position accuracy” in the OT if you need astrometric accuracy better than the nominal one.



# Notes for Cycle 9

- Do Not hesitate for submitting Large Program
- No Supplemental Call for Cycle 9 : ACA time LST 20h -15h
- Please submit proposals requiring High angular resolution in this Cycle : 2-year duration of scheduling.





# Supporting Tools and Documents

## ALMA OT - Seokho's talk in this afternoon



### Observing Tool

The ALMA Observing Tool (OT) is a Java desktop application used for preparing and submitting Director's Discreetary (DD) configurations for the present capabilities of ALMA as described in the ALMA OT User's Guide.

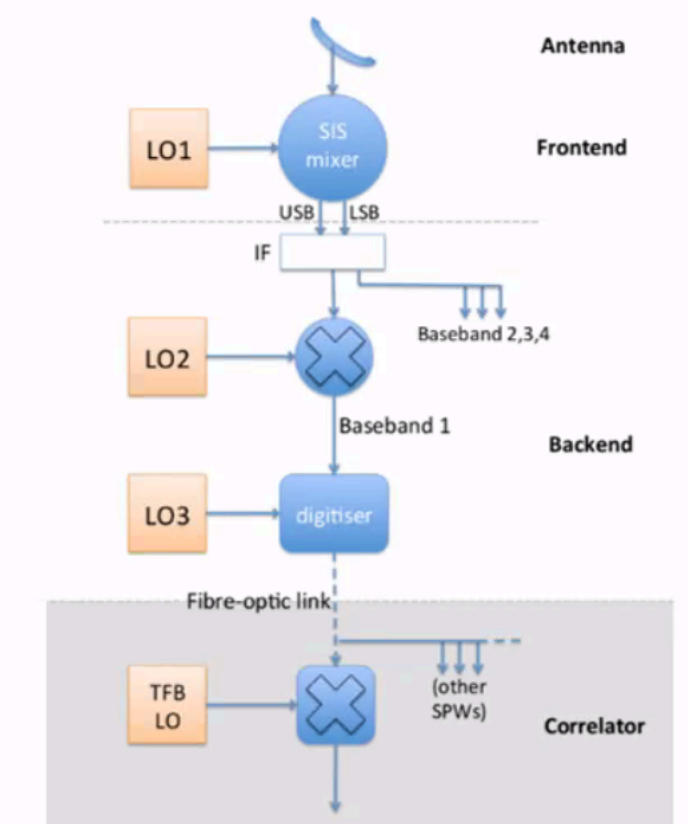
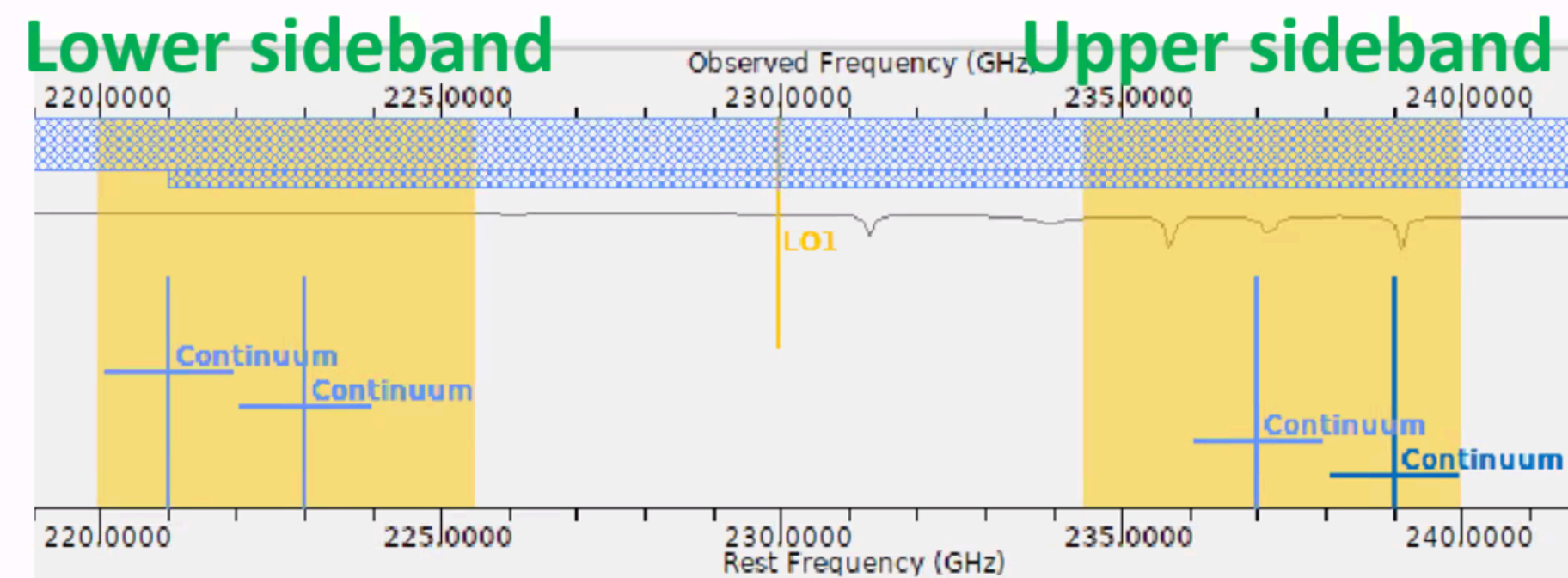
### Download & Installation

The OT should run on all common operating systems and depends on the version of Java installed, but the Cycle 9 version of the OT will run on Java 11. As Java 11 does not include Web Start, this version of the OT is not distributed.

It is recommended that the OT be installed using the ALMA OT Installer. The installer will set the OT to use the default settings, including the amount of memory the OT uses. Updates of the tool are no longer possible, but the OT will detect updates.

The **tarball** version must be installed manually and the instructions are available in the ALMA OT User's Guide.

### Instantaneous frequency coverage



- ALMA receives signals in two **sidebands** (green-ish color).
- Up to four **basebands** can be placed either in a sideband or two sidebands. (not possible to put 3 in one sideband and 1 in the other.)
- Possible to place up to four **spectral windows** (spws) within each of these basebands (blue-ish bars).
- Each spw forms a final contiguous spectrum (You will not receive data outside of spws)



# Archive & CARTA

## (Min-Young & Kuo-Song's talks in the afternoon)

### Archive updates/features

ALMA Science Archive in the Request Handler page

① Search the data as usual

② After choosing the data, click

③ Click "Request download"

④ Open the file tree by clicking ►

⑤ Click the link icon to CARTA as a viewer

Automatic search for similar proposals with a mouse over

Observations (26)	Projects (15)
<input type="checkbox"/> 2011.0.00465.S	HD 142527
<input type="checkbox"/> 2011.0.00465.S	HD 142527
<input checked="" type="checkbox"/> 2011.0.00318.S	HD 142527
<input type="checkbox"/> 2011.0.00465.S	HD 142527

File Name	Size	Status
member.uid_A001_X13d_X72_README.txt	11 KiB	
2013.1.00305.S_uid_A001_X13d_X72_001_of_001.tar	1 GiB	
member.uid_A001_X13d_X72_HD142527_13CO21_image.flux.fits.gz	52 MiB	✓
member.uid_A001_X13d_X72_HD142527_13CO21_image.image.fits	180 MiB	✓
member.uid_A001_X13d_X72_HD142527_13CO21_image.pbcor.fits	180 MiB	✓
member.uid_A001_X13d_X72_HD142527_C18O21_image.flux.fits.gz	52 MiB	✓
member.uid_A001_X13d_X72_HD142527_C18O21_image.image.fits	180 MiB	✓
member.uid_A001_X13d_X72_HD142527_C18O21_image.pbcor.fits	180 MiB	✓
member.uid_A001_X13d_X72_HD142527_CO21_image.flux.fits.gz	55 MiB	✓
member.uid_A001_X13d_X72_HD142527_CO21_image.image.fits	180 MiB	✓

A new webpage automatically opens in your browser! (You do not have to install CARTA desktop version).

You can check and analyze the images/cubes without downloading the data to your local disk. (e.g., you can generate and immediately check moment maps in CARTA)



# Documents and References

**Doc 9.2, ver.1.4** | 23 March 2022

## **ALMA Cycle 9 Proposer's Guide**

**Starting Document**

**Doc 9.1, ver. 1** | 10 Feb, 2022

## **Observing with ALMA – A Primer (Cycle 9)**

**For beginners**

**Doc 9.3, ver. 1.0** | March 14<sup>th</sup>, 2022

## **ALMA Cycle 9 Technical Handbook**

**Everything About ALMA & Cycle 9**

**ALMA Doc 9.16, ver.0.3** | March 2022

## **ALMA Users' Policies**





# ALMA

Atacama Large Millimeter/submillimeter Array



## ☆ News

○ Korean ARC Node

Staffs

Useful Links for Staff

○ Instrumentation

○ Summer Schools

○ Publication

## Announcements

2022-March-24

### Townhall Meeting for Cycle 9 Proposal Preparation

The ALMA Cycle 9 Call for Proposals was issued on March 24, 2022. The deadline for proposal submission is April 21, 2022. You can find details on the Call for Proposals in the [ALMA Science Portal](#).

To assist the submission of ALMA proposals, the ALMA group at KASI will host a townhall meeting on March 30, 2022. The program is given below. To encourage the participation of students, some lectures will be given in Korean. However, slides will be prepared in English, and questions in English are welcomed. The lecture for the review process will be given by the Proposal Handling Team at the ALMA observatory as a joint session with the EA ALMA community.

Program on March 30

- 9:30-10:00 am: EA ALMA joint session for the proposal review process (Andrea Corvillon; English)
- 10:20-10:50 am: Cycle 9 capability (Jihyun Kang; Korean)
- 10:50-11:30 am: Q&A for proposal review and Cycle 9 in general (Aran Lyo; Korean/English)
- 2:00-2:30 pm: ALMA archive (Min-Young Lee; Korean)
- 2:30-3:00 pm: CARTA (Kuo-Song Wang; English)
- 3:00-4:00 pm: Observing Tool hands-on session (Seokho Lee; Korean)