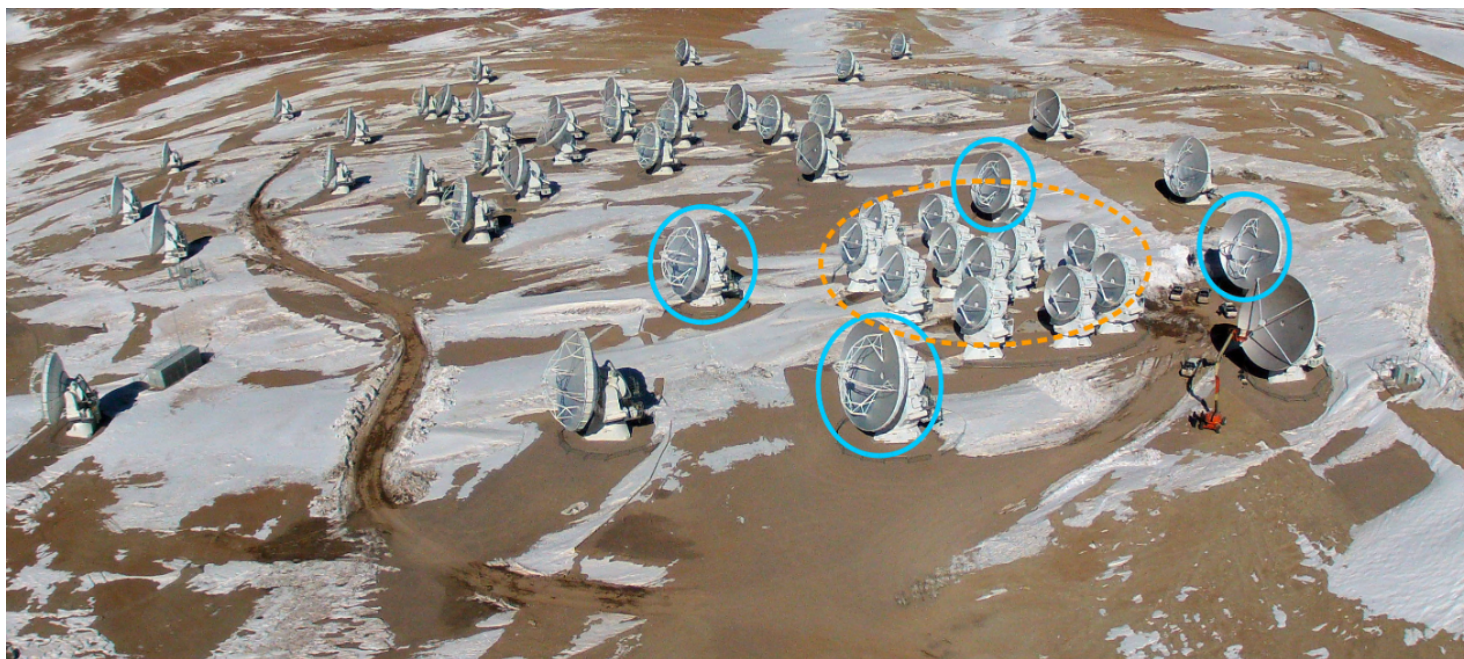


ALMA Capability

Atacama Large Millimeter/submillimeter Array



Chile



50 x 12m

12 x 7m

4 x 12m TP

ALMA antennas on the Chajnantor Plateau

latitude = -23° (upper declination limit for ALMA = $+47^\circ$)

Korea ALMA Project

<http://alma.kasi.re.kr>

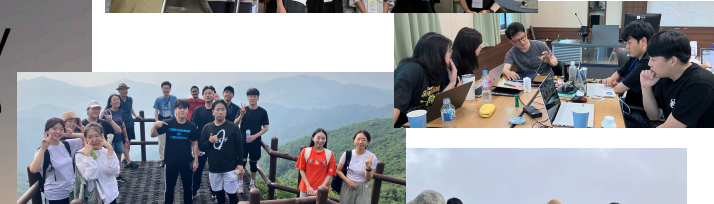
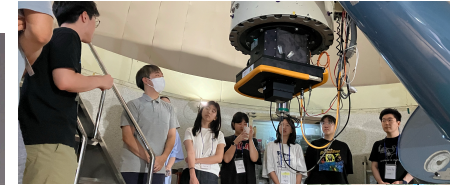
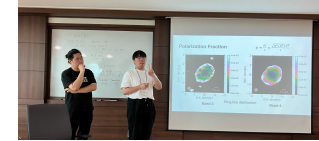
한국천문연구원 전파천문본부 ALMA 그룹



2023.04 11-13, AOS, Chile
GPU Spectrometer training for JAO engineers



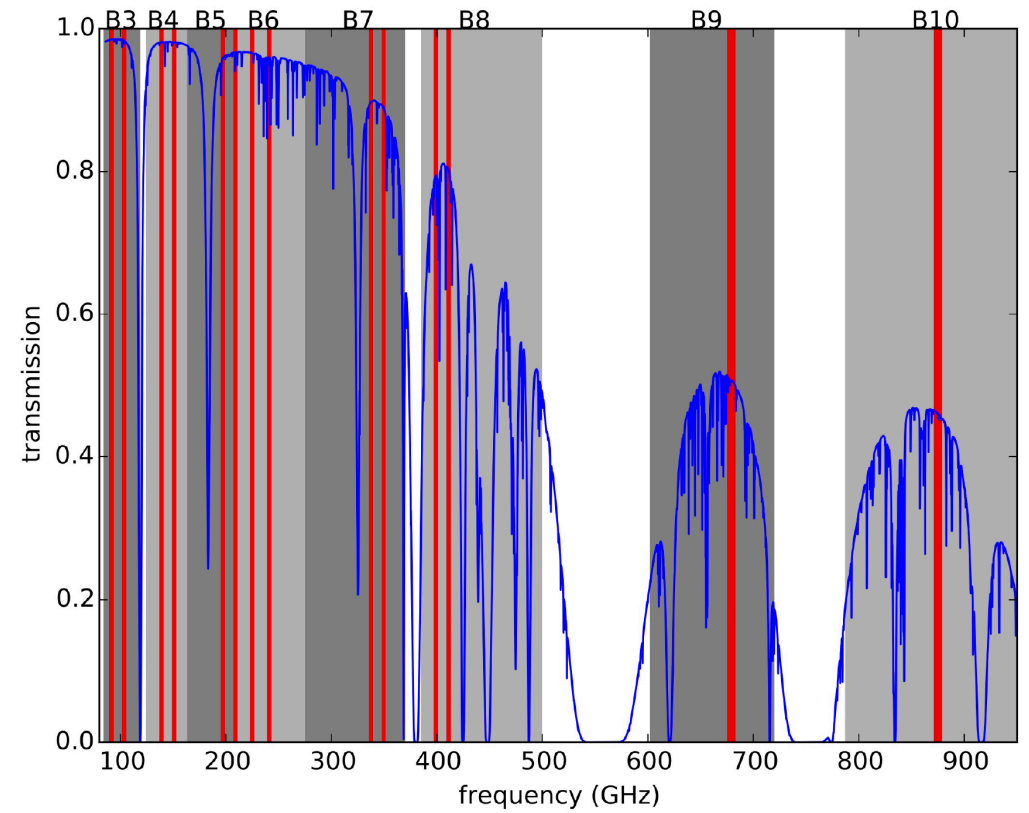
2023.05 OSF, Chile



2023.07.31-08.04 Summer school,
Sobaeksan

ALMA receiver Bands

| Band | Frequency range (GHz) | Wavelength range (mm) | IF range (GHz) | Type |
|------|--------------------------|--------------------------|-------------------|------|
| 1 | 35 – 50 | 8.5 – 6 | 4 – 12 | SSB |
| 3 | 84 – 116 | 3.6 – 2.6 | 4 – 8 | 2SB |
| 4 | 125 – 163 | 2.4 – 1.8 | 4 – 8 | 2SB |
| 5 | 158 – 211 | 1.9 – 1.4 | 4 – 8 | 2SB |
| 6 | 211 – 275 | 1.4 – 1.1 | 4.5 – 10 | 2SB |
| 7 | 275 – 373 | 1.1 – 0.8 | 4 – 8 | 2SB |
| 8 | 385 – 500 | 0.78 – 0.60 | 4 – 8 | 2SB |
| 9 | 602 – 720 | 0.50 – 0.42 | 4 – 12 | DSB |
| 10 | 787 – 950 | 0.38 – 0.32 | 4 – 12 | DSB |



Configuration

C43-1, C43-2, C43-10



Compact configuration



Extended configuration



ALMA antenna in transit on board of the transporter

Configuration & angular resolution

| Config. | Band | | 1 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---------|------------------|-------------------------|------|-------|-------|-------|-------|-------|--------|--------|--------|
| | L _{max} | Freq. (GHz) | 40 | 100 | 150 | 185 | 230 | 345 | 460 | 650 | 870 |
| | L _{min} | | | | | | | | | | |
| 7-m | 45 m | θ_{res} (arcsec) | 31.5 | 12.5 | 8.35 | 6.77 | 5.45 | 3.63 | 2.72 | 1.93 | 1.44 |
| | 9 m | θ_{MRS} (arcsec) | 167 | 66.7 | 44.5 | 36.1 | 29.0 | 19.3 | 14.5 | 10.3 | 7.67 |
| C-1 | 161 m | θ_{res} (arcsec) | 8.45 | 3.38 | 2.25 | 1.83 | 1.47 | 0.98 | 0.74 | 0.52 | 0.39 |
| | 15 m | θ_{MRS} (arcsec) | 71.2 | 28.5 | 19.0 | 15.4 | 12.4 | 8.25 | 6.19 | 4.38 | 3.27 |
| C-2 | 314 m | θ_{res} (arcsec) | 5.75 | 2.30 | 1.53 | 1.24 | 1.00 | 0.67 | 0.50 | 0.35 | 0.26 |
| | 15 m | θ_{MRS} (arcsec) | 56.5 | 22.6 | 15.0 | 12.2 | 9.81 | 6.54 | 4.90 | 3.47 | 2.59 |
| C-3 | 500 m | θ_{res} (arcsec) | 3.55 | 1.42 | 0.94 | 0.77 | 0.62 | 0.41 | 0.31 | 0.22 | 0.16 |
| | 15 m | θ_{MRS} (arcsec) | 40.5 | 16.2 | 10.8 | 8.73 | 7.02 | 4.68 | 3.51 | 2.48 | 1.86 |
| C-4 | 784 m | θ_{res} (arcsec) | 2.30 | 0.92 | 0.61 | 0.50 | 0.40 | 0.27 | 0.20 | 0.14 | 0.11 |
| | 15 m | θ_{MRS} (arcsec) | 28.0 | 11.2 | 7.50 | 6.08 | 4.89 | 3.26 | 2.44 | 1.73 | 1.29 |
| C-5 | 1.4 km | θ_{res} (arcsec) | 1.38 | 0.55 | 0.36 | 0.30 | 0.24 | 0.16 | 0.12 | 0.084 | 0.063 |
| | 15 m | θ_{MRS} (arcsec) | 16.8 | 6.70 | 4.47 | 3.62 | 2.91 | 1.94 | 1.46 | 1.03 | 0.77 |
| C-6 | 2.5 km | θ_{res} (arcsec) | 0.78 | 0.31 | 0.20 | 0.17 | 0.13 | 0.089 | 0.067 | 0.047 | 0.035 |
| | 15 m | θ_{MRS} (arcsec) | 10.3 | 4.11 | 2.74 | 2.22 | 1.78 | 1.19 | 0.89 | 0.63 | 0.47 |
| C-7 | 3.6 km | θ_{res} (arcsec) | 0.53 | 0.21 | 0.14 | 0.11 | 0.092 | 0.061 | 0.046 | 0.033 | 0.024 |
| | 64 m | θ_{MRS} (arcsec) | 6.45 | 2.58 | 1.72 | 1.40 | 1.12 | 0.75 | 0.56 | 0.40 | 0.30 |
| C-8 | 8.5 km | θ_{res} (arcsec) | 0.24 | 0.096 | 0.064 | 0.052 | 0.042 | 0.028 | 0.021 | 0.015 | 0.011 |
| | 110 m | θ_{MRS} (arcsec) | 3.55 | 1.42 | 0.95 | 0.77 | 0.62 | 0.41 | 0.31 | 0.22 | 0.16 |
| C-9 | 13.9 km | θ_{res} (arcsec) | 0.14 | 0.057 | 0.038 | 0.031 | 0.025 | 0.017 | 0.012 | 0.0088 | 0.0066 |
| | 368 m | θ_{MRS} (arcsec) | 2.03 | 0.81 | 0.54 | 0.44 | 0.35 | 0.24 | 0.18 | 0.13 | 0.093 |
| C-10 | 16.2 km | θ_{res} (arcsec) | 0.11 | 0.042 | 0.028 | 0.023 | 0.018 | 0.012 | 0.0091 | 0.0065 | 0.0048 |
| | 244 m | θ_{MRS} (arcsec) | 1.25 | 0.50 | 0.33 | 0.27 | 0.22 | 0.14 | 0.11 | 0.077 | 0.057 |

Absolute flux accuracy (8 solar system objects, 40 quasars)

- 5% for Band 1, 3, 4 & 5
- 10% for Band 6, 7 & 8
- 20% for Band 9 & 10

Total Power flux accuracy

- 5% for Band 1, 3, 5, 6, & 7
- 15% for Band 8

Astrometry accuracy

- nominal accuracy of the absolute position measurement (standard deviation) is at best **5%** (**0.0075 arcsec**) of the synthesized beam for angular resolutions **larger than about 150 mas**.
- At higher angular resolutions, the best absolute astrometric accuracy decreases to **10%** of the synthesized beam

Cycle-12 Configuration Schedule

| Start Date | Configuration | Longest baseline | LST: Best conditions |
|-------------|------------------------------------|------------------|----------------------|
| 1-Oct-2025 | C-8 | 8.5 km | 22-10 |
| 20-Oct-2025 | C-7 | 3.6 km | 23-11 |
| 10-Nov-2025 | C-6 | 2.5 km | 1-13 |
| 1-Dec-2025 | C-5 | 1.4 km | 2-14 |
| 20-Dec-2025 | C-4 | 0.78 km | 4-15 |
| 10-Jan-2026 | C-3 | 0.50 km | 5-17 |
| 1-Feb-2026 | No observations due to maintenance | | |
| 1-Mar-2026 | C-1 | 0.16 km | 8-21 |
| 26-Mar-2026 | C-2 | 0.31 km | 9-23 |
| 20-Apr-2026 | C-3 | 0.50 km | 11-0 |
| 10-May-2026 | C-4 | 0.78 km | 12-2 |
| 31-May-2026 | C-5 | 1.4 km | 13-4 |
| 23-Jun-2026 | C-6 | 2.5 km | 15-6 |
| 28-Jul-2026 | C-5 | 1.4 km | 17-7 |
| 18-Aug-2026 | C-4 | 0.78 km | 19-8 |
| 10-Sep-2026 | C-3 | 0.50 km | 20-9 |

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)

Receiver bands:

- Receiver Bands **1, 3, 4, 5, 6, 7, 8, 9, and 10** (7.0, 3.0, 2.0, 1.6, 1.3, 0.85, 0.65, 0.45, and 0.35 mm, respectively).

12-m Array Configurations:

- Cycle 11 (**Cycle 12**) includes 12-m Array configurations **C-1** through **C-10 (C-8)**.
- Maximum baselines between 0.16 km and 16.2 km (**8.5km**) depending on array configuration.
longer than 3.6 km (i.e., C-7 through C-10, as offered in Cycle 11) are considered “long-baseline configurations”.

Spectral-line, continuum, and mosaic observations:

- Spectral-line and continuum observations with the 12-m Array and the 7-m Array in Bands 1 and 3 through 10.
- Single-field interferometry (Bands 1 and 3 through 10) and **mosaics (Bands 1 and 3 through 9) with the 12-m Array and the 7-m Array.**
- **Single-dish spectral-line observations in Bands 3 through 8.**

Polarization:

- **Single-pointing**, on-axis, full linear and circular polarization for both continuum and full spectral resolution observations in **Bands 1 and 3 through 7 on the 12-m Array.**
- **Single-pointing**, on-axis linear polarization on the stand-alone **7-m Array in Bands 1 and 3 through 7.** The field of view is limited to the inner one third of the primary beam.
- **Mosaics** are supported for **linear polarization continuum maps using the 12-m Array** but not yet for the standalone 7-m Array. The spectral setup for polarization mosaics is limited to the current default continuum frequency setups.

Total Power Array: TP Array can only be used for **spectral-line observations (not continuum) in Bands 3 through 8.**

Spectral scan mode: only **one point per target** is used (no mosaic)

Proposal Type

1. Regular proposal (“S”)

estimated execution time does not exceed 50 hours on the 12-m Array or 150 hours on the 7-m Array in stand-alone mode

2. Target of Opportunity proposal (“T”)

Targets and/or time of observation are not known in advance.

(Note: Regular proposals wrongly submitted by the PI as ToO proposals may be rejected on technical grounds)

PIs should specify the number of triggers needed

: to use a first epoch of observations to assess target properties (e.g., suitability for monitoring), it is recommended that PIs create single-visit Science Goals (SGs) for this purpose, separate from multi-visit SGs for any subsequent monitoring.

Trigger: *the Project Trigger Submission Page available at the ALMA [Helpdesk](#)*

3. Large program (“L”)

estimated execution time of greater than 50 hours on the 12-m Array (with or without accompanying ACA time) or 150 hours on the 7-m Array in stand-alone mode.

Large Programs **cannot** include time-critical or ToO observations, full polarization measurements, solar observations, VLBI, Phased Array mode, Astrometric observations or observations requiring band-to-band calibration or bandwidth switching calibration

4. mm-VLBI and Phased Array proposal

- VLBI (Campaign mode)
 - 7 mm (**Band 1**) or 3 mm (**Band 3**) for Global Millimeter VLBI Array (GMVA)
 - 1.3 mm (**Band 6**) or 0.87 mm (**Band 7**) for the Event Horizon Telescope (EHT) network
- Phased Array (“P”) : Band-1, 3, 6, & 7

5. Solar observation: only continuum at Band-3, 5, 6, & 7

6. Joint proposals (Joint Proposals accepted by ALMA will be assigned **Grade A**)

•PIs must submit their Joint Proposals [to the observatory that requires the most observing time](#). In the case of ALMA, the relevant time request will be the amount of time requested for the 12-m Array, or the 7-m Array in case of ACA stand-alone proposals.

| Partner | Maximum time ALMA can allocate on partner observatory | Maximum time partner observatory can allocate on each ALMA array |
|---------|---|--|
| JWST | 115 hours | 115 hours |
| VLA | 5% of available time | 50 hours |
| VLT | 50 hours | 50 hours |

Table 2: Amount of time that can be allocated by ALMA on partner observatories and the amount of time that can be allocated by partner observatories on each ALMA array (i.e., 12-m, 7-m, and TP).

Proposal Preparation, submission, and review

1. Dual-Anonymous proposal review

: the proposal team does not know the identity of the reviewers and the reviewers do not know the identity of the proposal team

Proposals that do not follow the dual-anonymous guidelines may be subject to disqualification

General Guidelines pertaining to all Programs

(<https://almascience.nao.ac.jp/proposing/alma-proposal-review/dual-anonymous>)

2. Scientific Justification

- **one single PDF**, English, maximum file size is 20MB
(including figures, tables, and references)
-
- Proposal Latex format
(<https://almascience.nrao.edu/proposing/proposal-template>)
-
- Font size: no more than 15% of the text is smaller than **12 points**.
The proposal will be rejected
- **4 pages** : Regular, ToO, Solar, VLBI, Phased Array and DDT
- 6 pages : Large Programs
- Large Program management plan (a separated 1-page PDF)
 - include the description of the computing resources available to the team to reduce and analyze ALMA data

Science Case

- a brief justification of the requested sensitivity and angular resolution
(full details in the Technical Justification)
- **a knowledgeable but broad-based audience**
(since proposal reviewers are selected with expertise that covers the various topics within a proposal category)

Large Program

- An assessment of the scheduling feasibility: it should be completed within one cycle.
So the program must satisfy the configuration/LST restriction.
- A description of the data products (including any non-ALMA products) that will be delivered by the team for ingestion into the ALMA archive
- A publication plan

3. Technical Justification

- Sensitivity – source brightness, the requested sensitivity and S/N ratio
- Imaging and correlator configuratuon – angular resolution, maximum recoverable scale
- Spectral setup

If a proposal does not conform to the advertised capability, it can be declared technically infeasible either during the proposal review process or during the Phase 2.

Proposal validation, submission and withdrawal

- A proposal can be updated and submitted again to the ALMA Archive many time as needed by the PI before the proposal deadline.
- DDT proposals are not overwritten, only be submitted once

4. Proposal evaluation

DPR (Distributed Peer Review)

- PI proposals
- Maximum number of Proposals sets : 5 (recommended 3)
- If the **PI does not have a Ph.D. at the time of proposal submission**, the PI can still be the reviewer, but a **mentor must be identified** at the time of the proposal submission

APRC (ALMA Proposal Review Committee)

- Large Program
- 16-18 members of the scientific community drawn from the five ALMA science categories
- External reviews

5. Proposal Selection (22.5% EA)

Grade A : 33 %

Grade B : 67%

Basic rules

1. All participants in the review process must behave in an **ethical manner**. If it is found that a reviewer has not behaved in an ethical manner or did not complete their reviews in good faith, **the proposal(s) on which the reviewer is acting as the designated reviewer may be rejected.**

All participants in the review process are expected to behave in an ethical manner.

- Reviewers will judge proposals solely on their scientific merit.
- Reviewers will be mindful of bias in all contexts.
- Reviewers will declare all major conflicts of interest.
- The proposal reviews will be constructive and avoid any inappropriate language.

All proposal materials related to the review process are strictly confidential.

- The assigned proposals may not be distributed or used in any manner not directly related to the review process.
- Any data, intellectual property, and non-public information shown in the proposals may be used only for the purpose of carrying out the requested proposal review.
- The assigned proposals and the reviews may not be discussed with anyone other than the Proposal Handling Team, the APRC, or the assigned mentor when applicable.
- **All electronic and paper copies of the proposal materials must be destroyed** as soon as a reviewer completes the proposal review process.

6. Proposal Confidentiality

Proposal tile, abstract, name and region of the PI, and the names of Co-Is

- Grade A & B : public soon after PI are informed of the outcome of the Proposal review process
- Grade C : public as soon as its first data are archived

Proposal metadata (source position, frequency, integration time)

- Grade A : public soon after the proposal review process is completed
- Grade B & C : public as soon as the first data are archived