



EUROPEAN ARC
ALMA Regional Centre || Italian



ALMA REGIONAL CENTRE ITALY
is Bologna

Introduction to ALMA

preparing for Cycle7 and statistics

Jan Brand – ALMA Regional Centre, Italian node



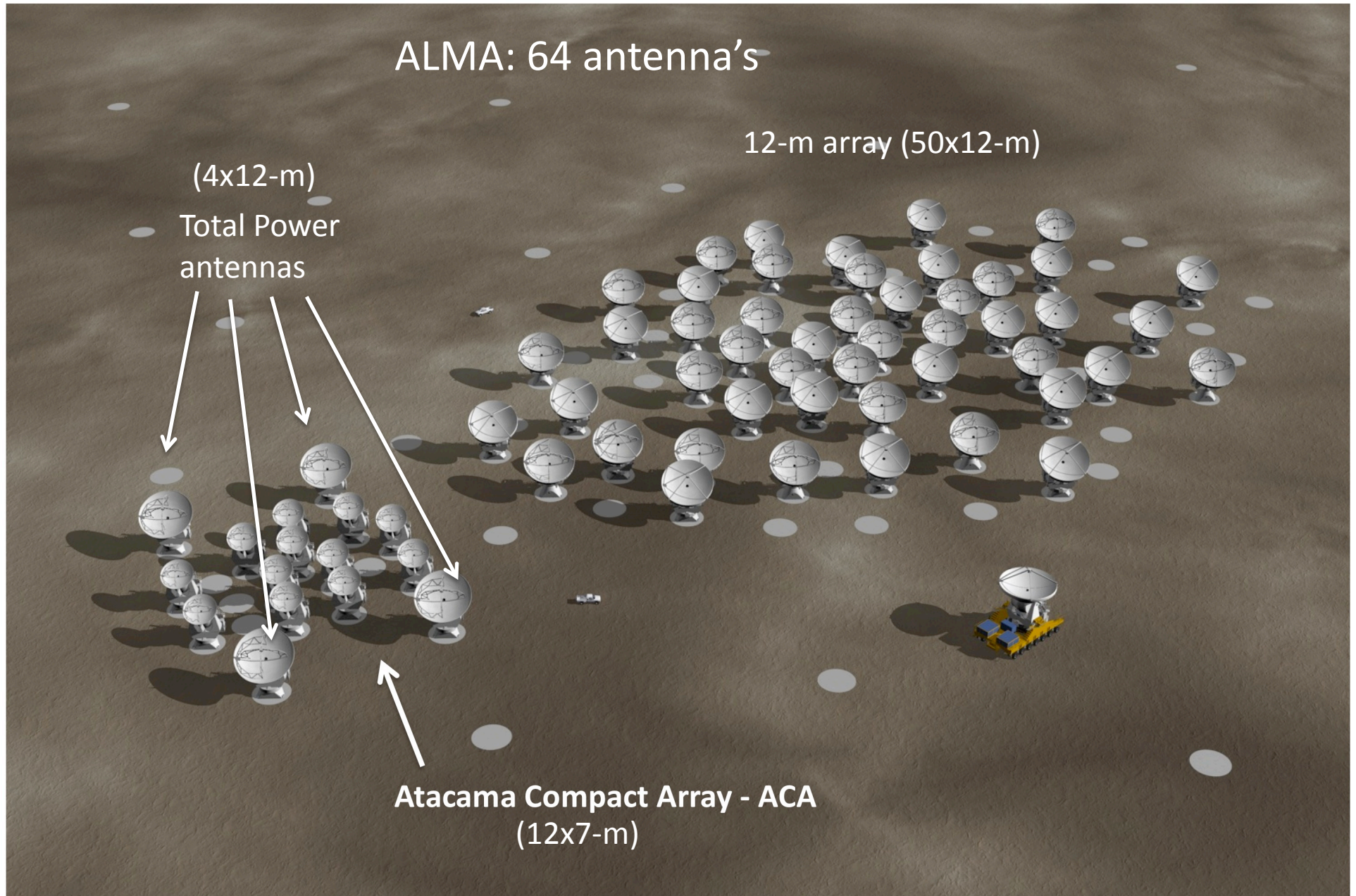
ALMA: 64 antenna's

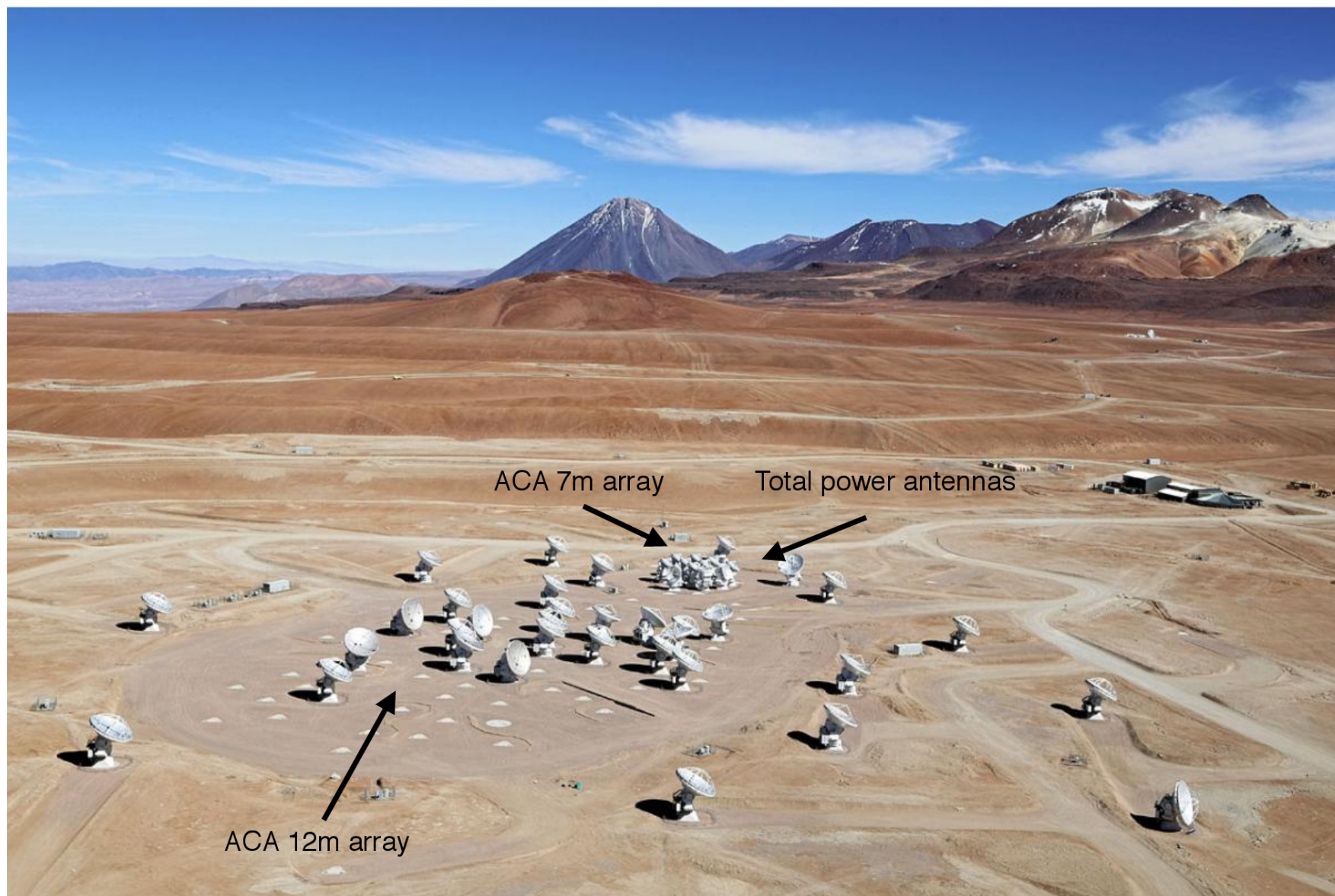
12-m array (50x12-m)

(4x12-m)

Total Power
antennas

Atacama Compact Array - ACA
(12x7-m)





ACA 7m array

Total power antennas

ACA 12m array

THE AMBITIOUS ALMA PROJECT

- # Dry site (low pwv)
- # low T_{sys}
- # $> 6500 \text{ m}^2$ effective area
- # 1225 baselines (main array)
- # short spacings with ACA, TP-ants.



Excellent instantaneous uv-coverage
and high sensitivity:
 $< 0.05 \text{ mJy @ } 100 \text{ GHz in } 1 \text{ hr}$

- # baselines up to $b_{\text{max}} = 16 \text{ km}$

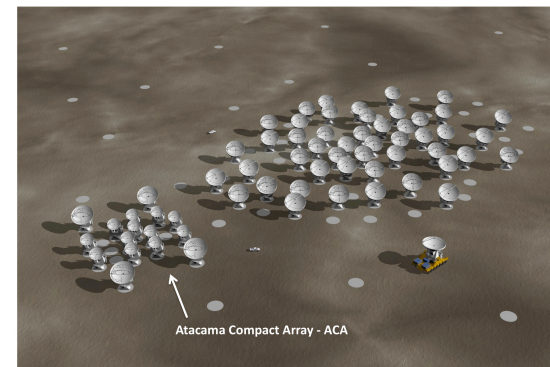


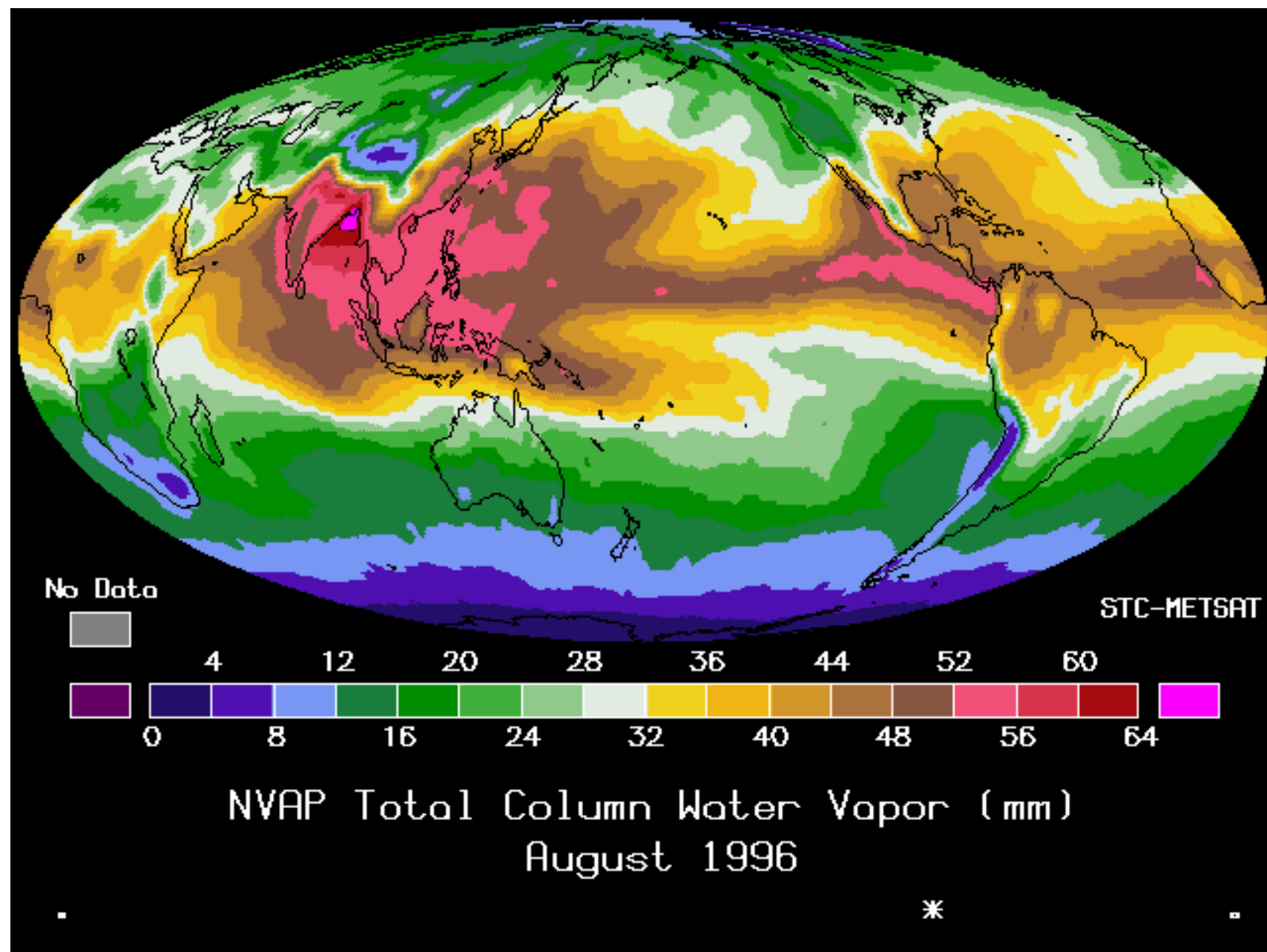
Sub-arcsec resolution:
 $40 \text{ mas @ } 100 \text{ GHz}$
 $5 \text{ mas @ } 900 \text{ GHz}$

- # 10 spectral bands 30-950 GHz
- # 70 correlator modes

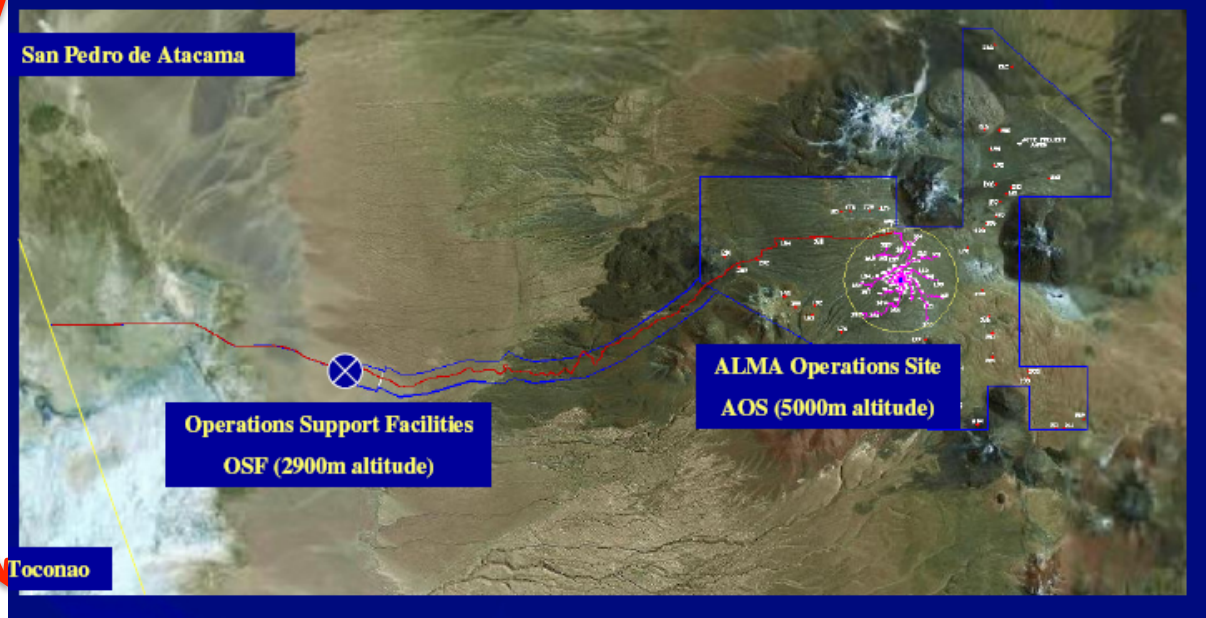


High flexibility in spectral studies

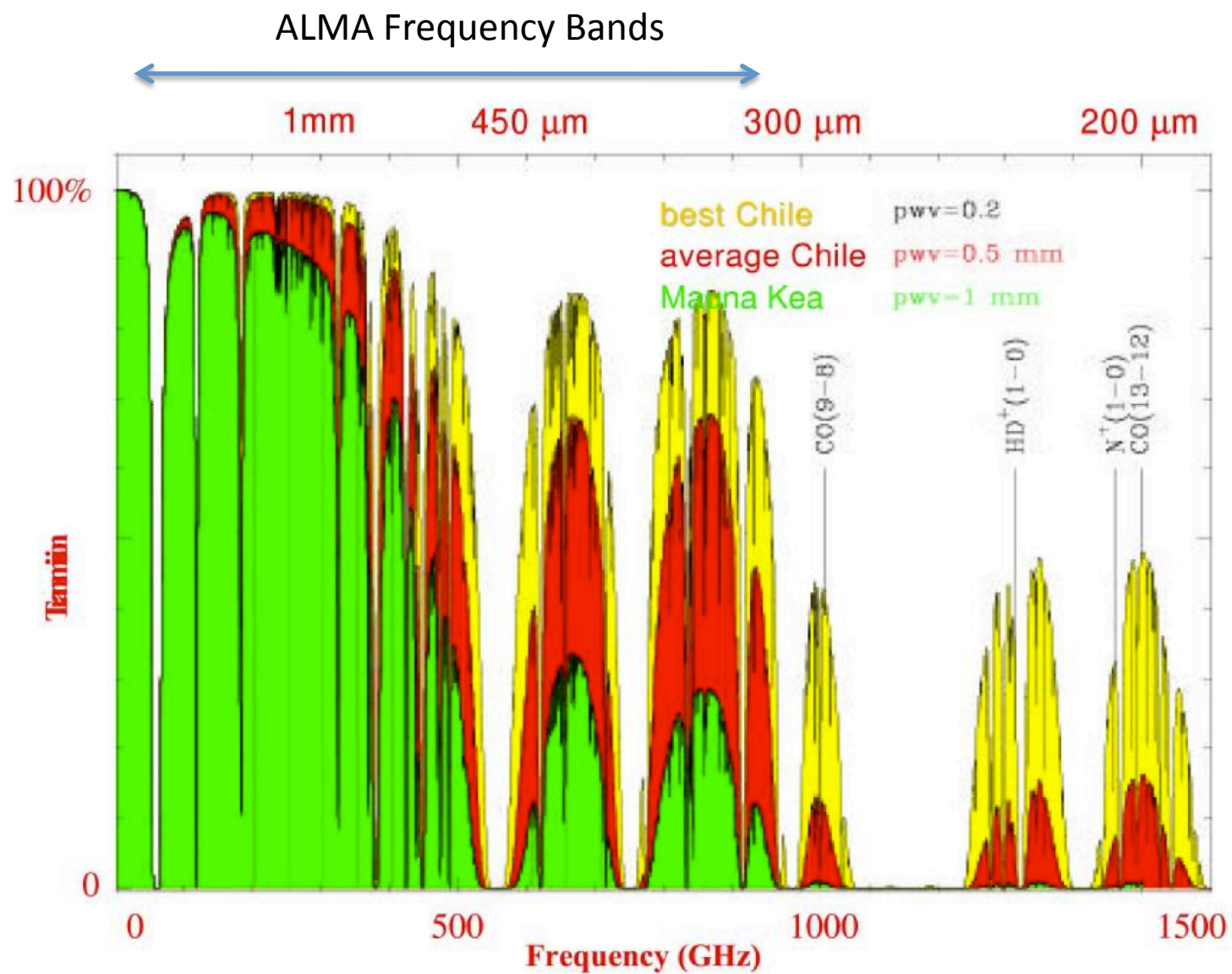




ALMA Site

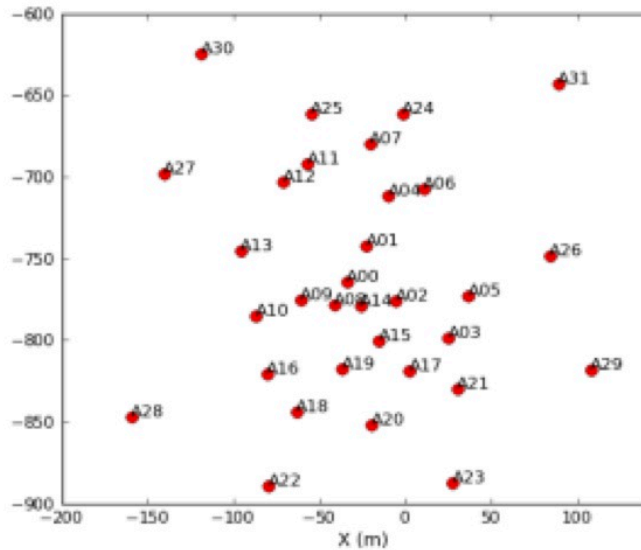


ATMOSPHERIC TRANSMISSION

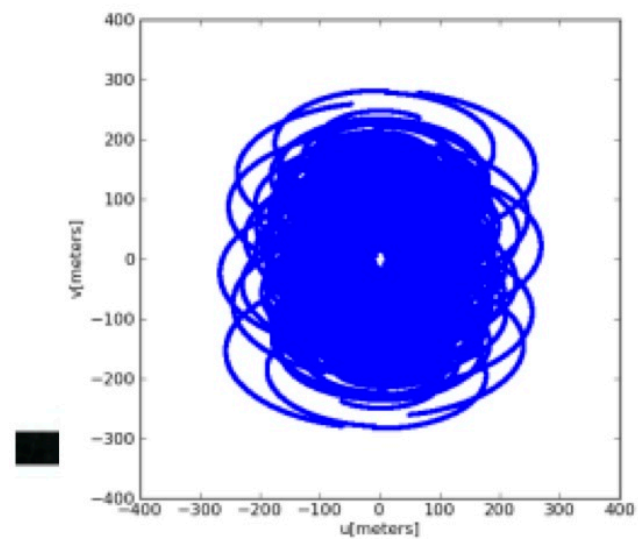
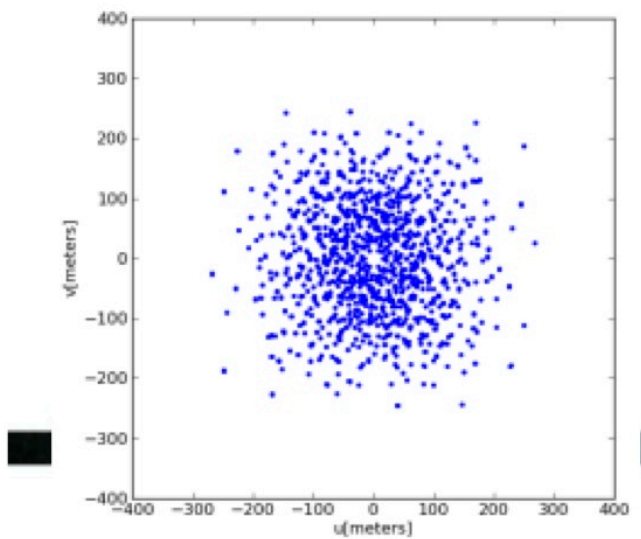
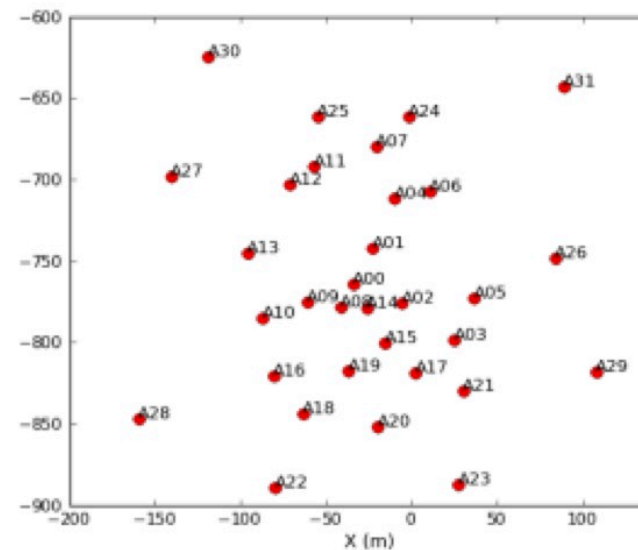


ALMA – 32 antennas

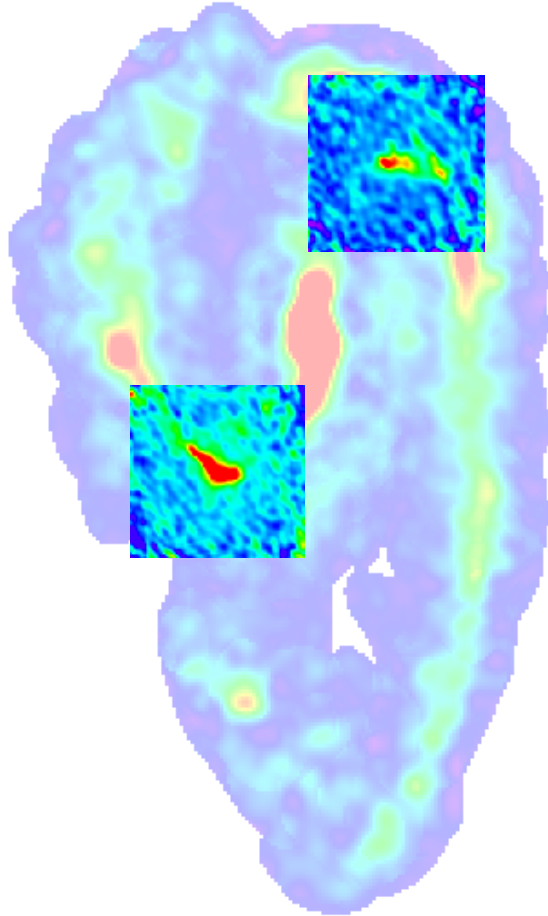
uv-distribution
instantaneous



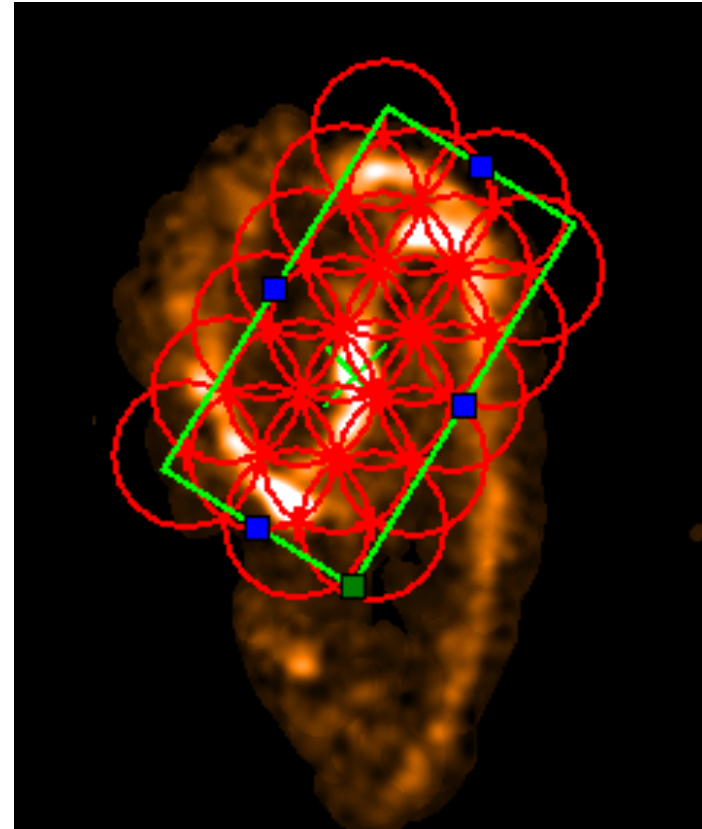
uv-distribution
after 8 hours



ALMA's incredible sensitivity: NGC3627 ALMA Cycle 3 proposal Rosita

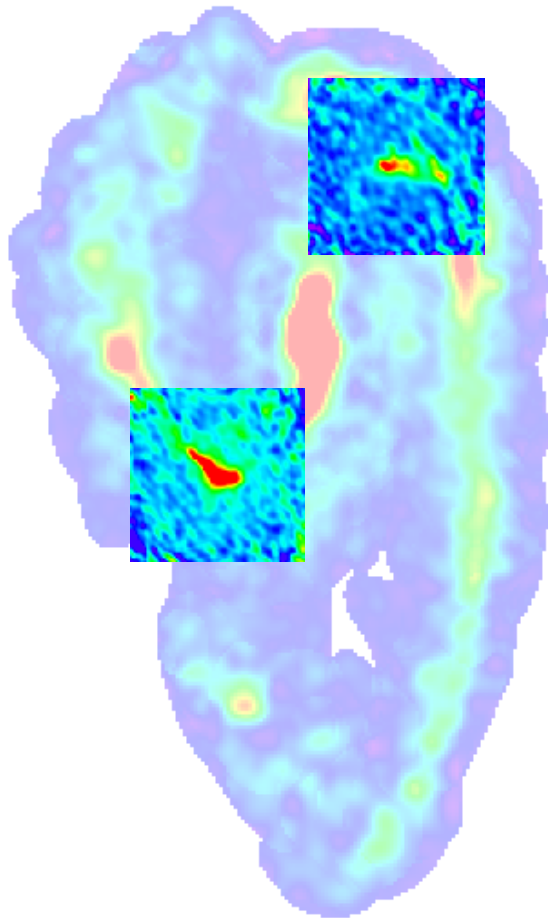


CO(1-0) with IRAM PdBI

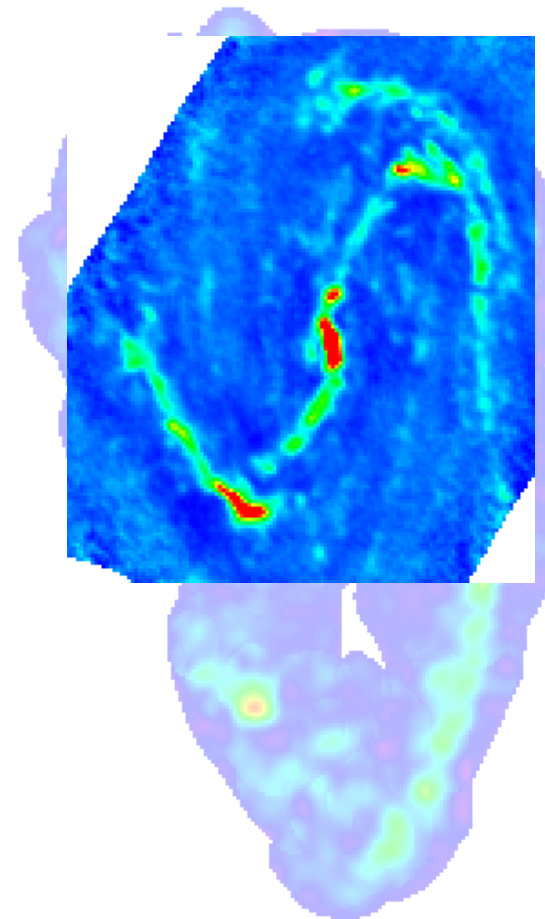


Proposal ALMA Cycle3
Mosaic of 22 pointings in band 3

NGC3627 ALMA compact configuration data



CO(1-0) with IRAM PdBI
Resolution ~ 2 arcsec ~ 100 pc
8 hrs per pointing



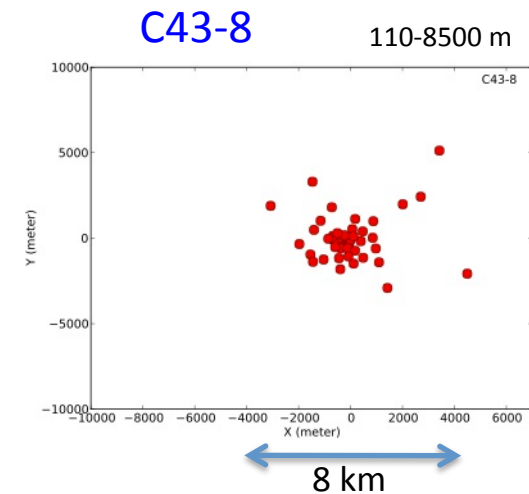
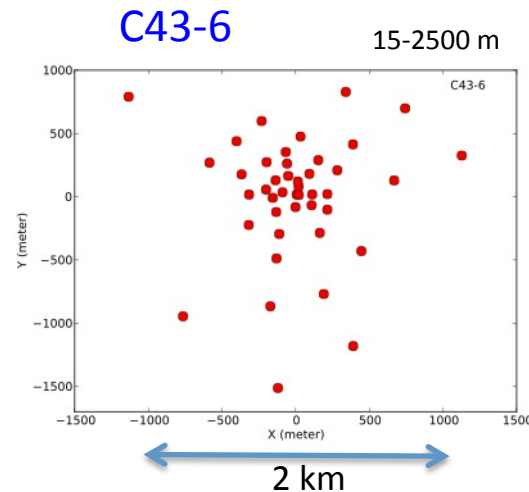
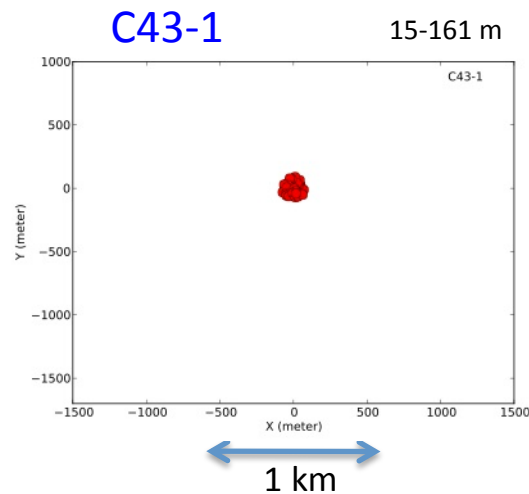
CO(1-0) with ALMA
Resolution ~ 2 arcsec ~ 100 pc
Observing time 1.5 hrs

Paladino et al.

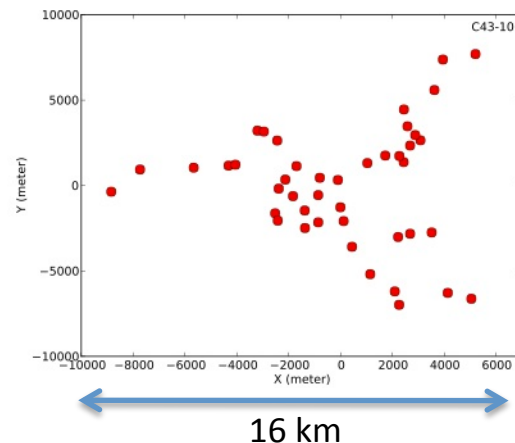
ARRAY CONFIGURATIONS

ALMA is a reconfigurable interferometer for (sub)mm astronomy.

There will be ca. 10 reconfigurations during Cycle7 at the end of which the array is expected to have imaging properties similar to one of the ten representative configurations used to characterize the advertised imaging capabilities and to estimate the observing times. Some configurations are visited more than once.



New configuration every
3-4 weeks.





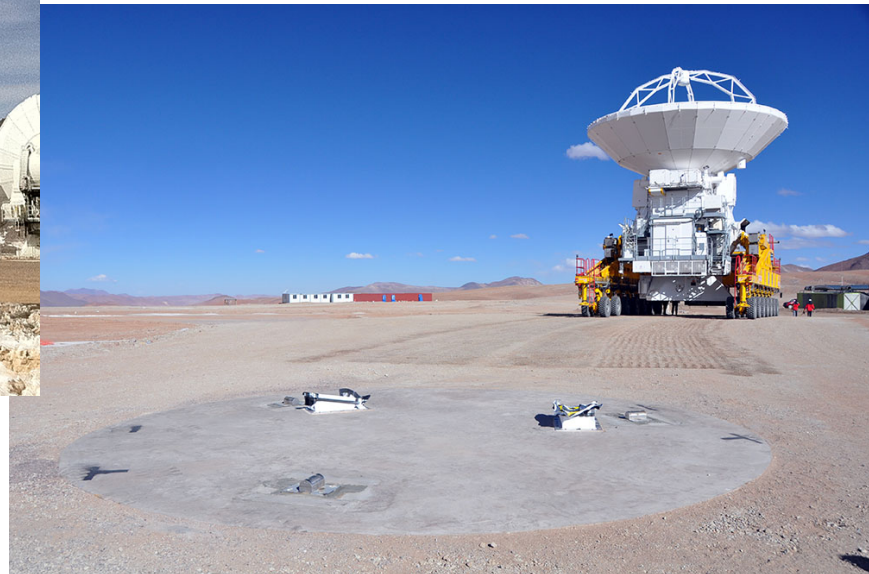
The ALMA Antenna Transporter

ESO Press Photo 45b/07 (5 October 2007)

This image is copyright © ESO. It is released in connection with an ESO press release and may be used by the press on the condition that the source is clearly indicated in the caption.







Bands 3 (84-116 GHz), 6 (211-275 GHz),
7 (275-373 GHz), and 9 (602-720 GHz) SIS “cartridges”



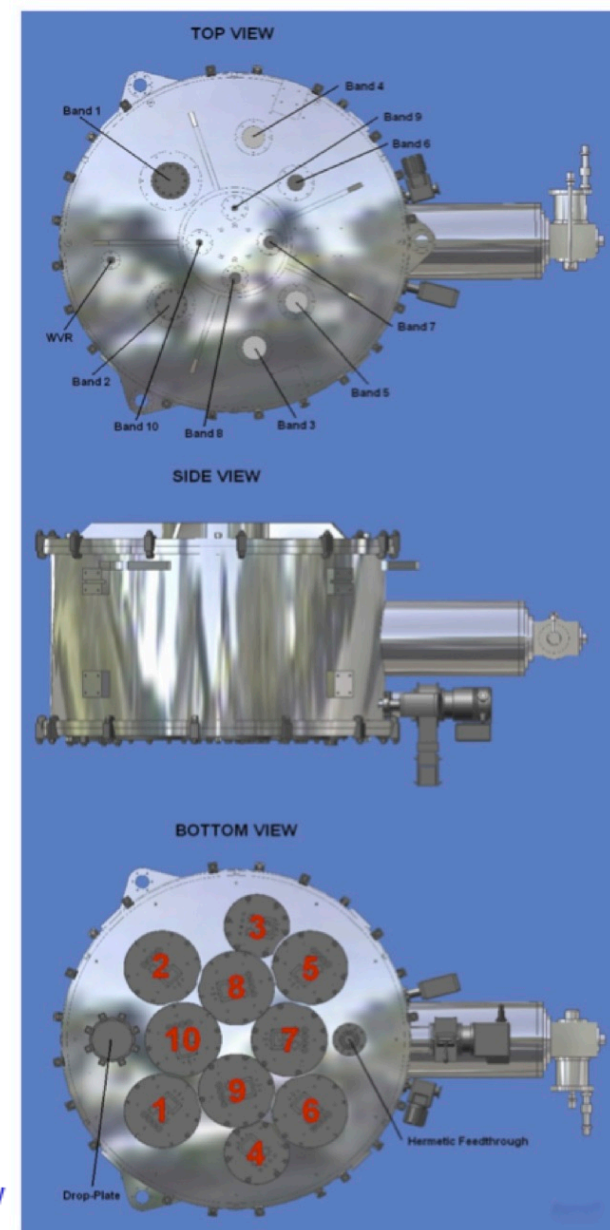
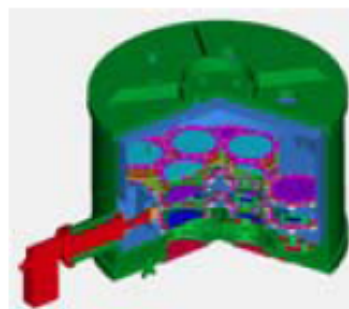
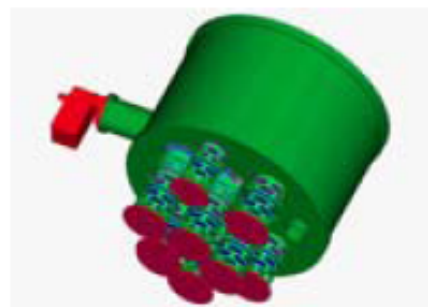


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Front End Design



- Diameter ~ 1 m
- External optics top of dewar
- 10 Cartridges plugged from bottom
- Each cartridge contains one frequency



Spectral setup: sidebands, basebands & spectral windows

Observed sky frequencies need to be down-converted before being sent to the correlator.

For this to occur, the signal from the source is mixed with that of a (set of) Local Oscillator(s) which results in the creation of 2 sidebands, 'upper' and 'lower':

For the lower sideband (LSB): $(F_{LO1} - IF_{lo})$ to $(F_{LO1} - IF_{hi})$

For the upper sideband (USB): $(F_{LO1} + IF_{lo})$ to $(F_{LO1} + IF_{hi})$

NB: for both polarizations!

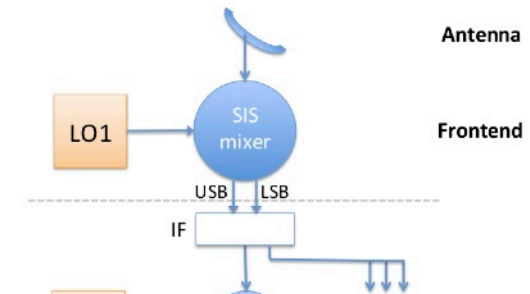
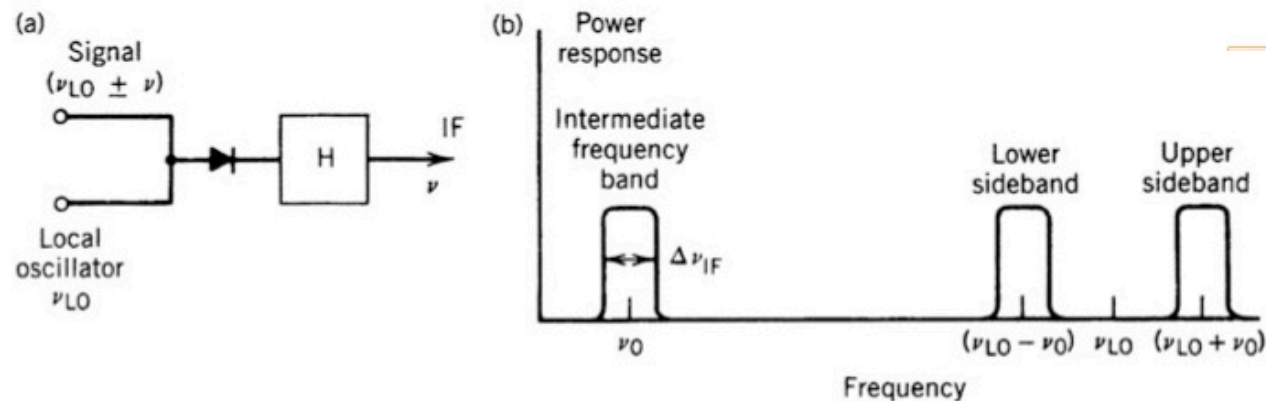


Fig. 6.1 Frequency conversion in a radio receiving system. (a) Simplified diagram of a mixer and a filter H that defines the intermediate-frequency (IF) band. The nonlinear element shown is a diode. (b) Signal spectrum showing upper and lower sidebands that are converted to the IF. Frequency ν_0 is the center of the IF band.

Spectral setup: sidebands, **basebands** & spectral windows

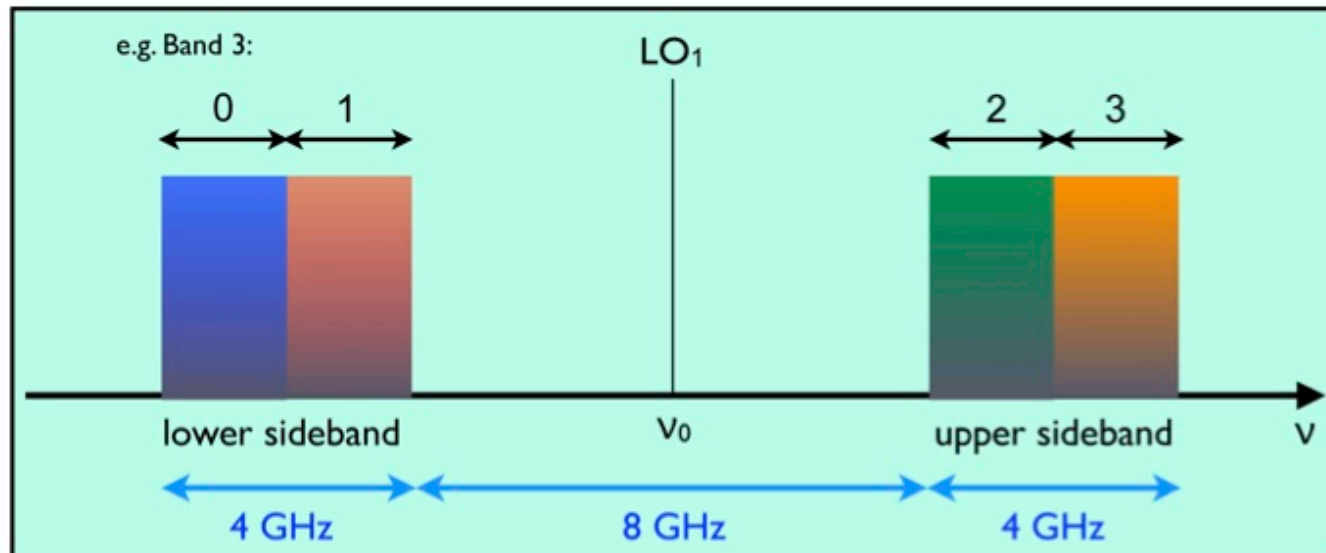


Figure 31: A graphical view of basebands and sidebands. Basebands may be tuned to overlap if the user wishes, or may be located so as to maximize the total bandwidth (as shown). Each baseband may be further subdivided into as many as 8 spectral windows. Up to four spectral windows per baseband will be available during Cycle 6.

Within these sidebands, ALMA produces 4 x 2 GHz basebands that can be placed inside each sideband.

NB: basebands are not independent: overlapping BBs do not reduce noise

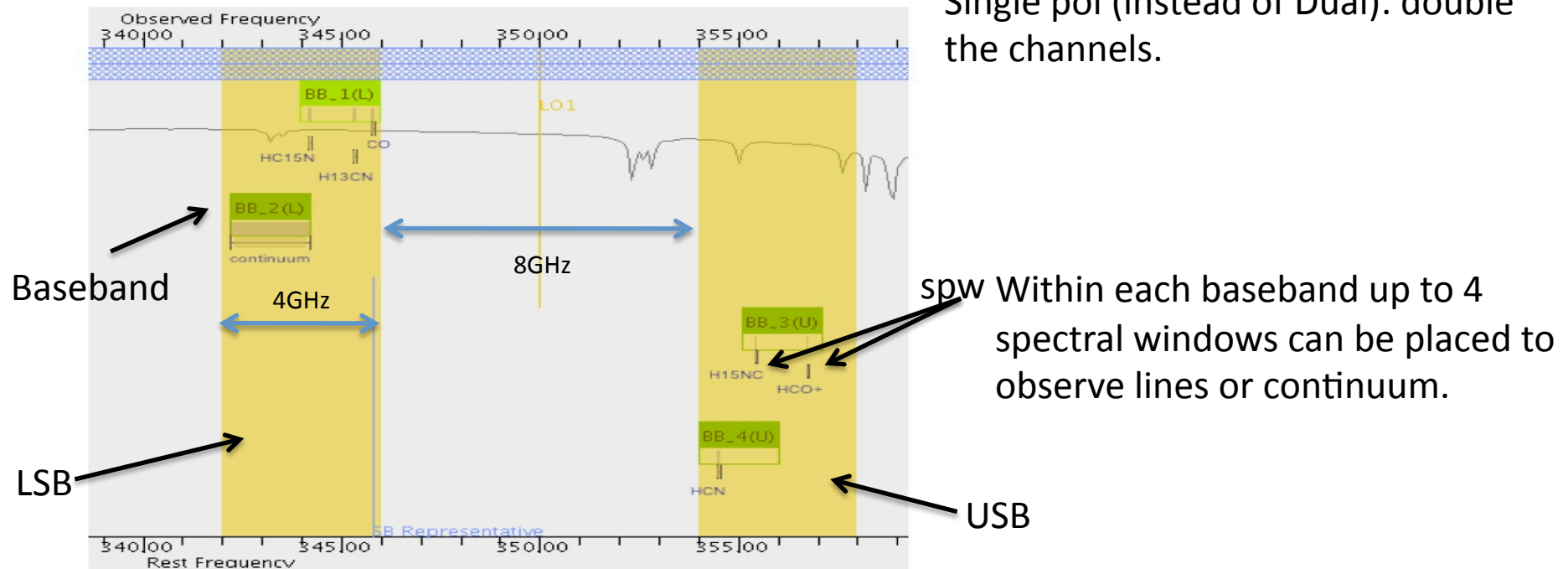
Spectral setup: sidebands, basebands & spectral windows

Bandwidth (MHz)	Spectral res (MHz)	Number of channels
1875	31.2	120
58.6	0.0305	3840
117	0.061	3840
234	0.122	3840
469	0.244	3840
938	0.488	3840
1875	0.976	3840

Continuum ($BW_{\text{tot}} = 7.5\text{GHz}$)

Spectral lines

Full Stokes => half the channels.
Single pol (instead of Dual): double the channels.



Cycle 7 -- Important dates

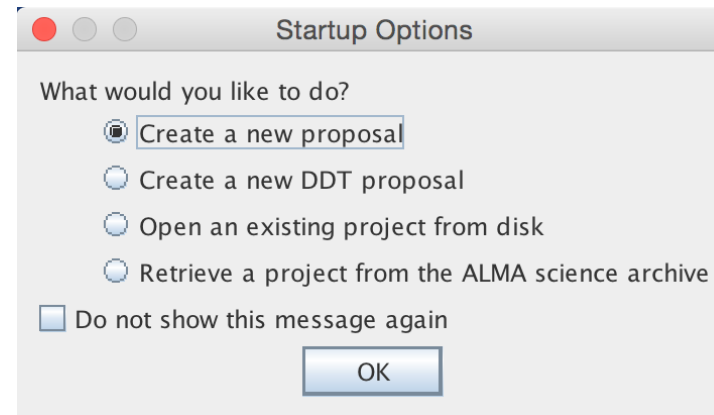
Date	Event
19 March 2019	Release Call for Proposals Cycle 7 + Documentation & Tools
17 April 2019	Proposal submission deadline
End of July 2019	Announcement outcome review process
September 2019	Submission Phase2 material by PI's Release ACA supplemental Call [3/9]
October 2019	Start observations Cycle 7 Deadline ACA supplemental Call [1/10]
September 2020	End of Cycle 7

Starting up the OT to write your proposal

<https://almascience.eso.org/proposing/observing-tool>



Click logo to start.



(See talk by Giannetti & Marchili)

CYCLE 7: What's Available

Antennas: 43 in 12-m array
10 x 7-m + 3 x 12-m TP in ACA

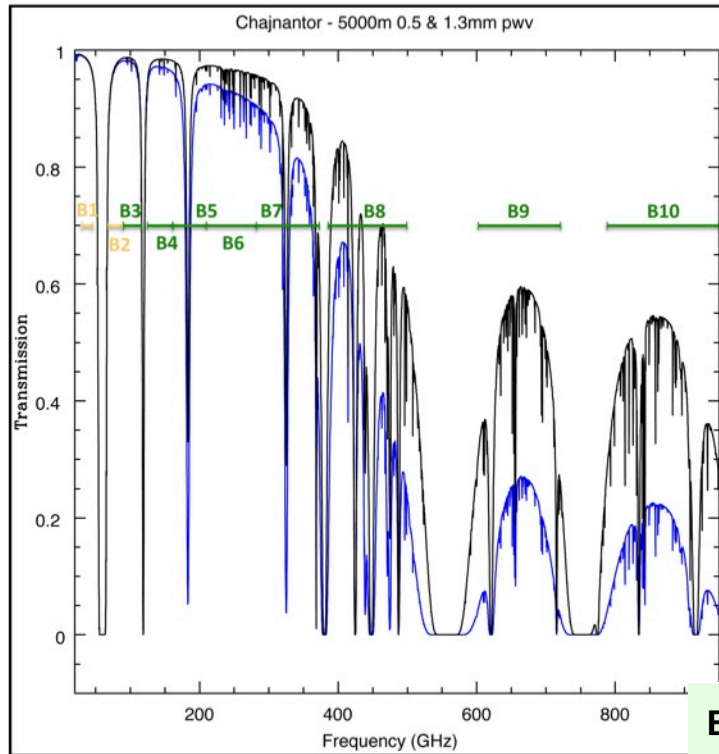
Receiver bands: 3, 4, 5, 6, 7, 8, 9, and 10

Time: 4300 hrs with 12-m array + (3000 + 750) hrs ACA
[PI+DDT+Cycle6 priority A carry-overs]
Feb 2020 not available

≤ 20% non-standard (including ≤ 5% mm-VLBI)

≤ 15% Large Programs (i.e. 645h 12-m array; 450h ACA stand-alone)

≤ 5% DDT



AVAILABLE RECEIVERS

Band	Frequency (GHz)	Wavelength (mm)	FOV (arcsec)	Cont Sens (mJy/beam)
3	84 – 116	2.6 – 3.6	73 – 53	0.088
4	125 – 163	1.8 – 2.4	49 – 38	0.12
5	163 – 211	2.4 – 1.1	38 – 22	0.12
6	211 – 275	1.1 – 1.4	29 – 22	0.12
7	275 – 373	0.8 – 1.1	22 – 16	0.22
8	385 – 500	0.6 – 0.8	16 – 12	0.42
9	602 – 720	0.4 – 0.5	10 – 8.5	2.0
10	787 – 950	0.3 – 0.4	7.8 – 6.5	4.6

CYCLE 7: observing modes

- **Spectral line and continuum observations in all bands**
with the 12-m Array and the 7-m Array
- **Standard mode for spectral scan (25% faster) NEW**
- **Single field interferometry (all bands)** with the 12-m Array and the 7-m Array
- **Mosaics (Bands 3 to 9)** with 12-m Array and the 7-m Array
- **Single dish spectral line observations in Bands 3 to 8**
No stand-alone TP-array (and no TP at all for B9, 10)
- **ACA stand-alone** (standard mode only).
- **Solar observing mode**; Bands 3, 6 and 7. Only scheduled in certain periods.
- **Simultaneous observations** ACA and main array

CYCLE 7 standard/non standard

Standard modes have been well characterized and the observations are calibrated with the ALMA data reduction pipeline. Non-standard modes are not as well characterized and require manual calibration by ALMA staff.

Up to 20% of the observing time in Cycle 7 will be allocated to proposals requesting **non-standard modes**, which include:

- **Band 9 and 10 observations**
- **Band 7 observations** with maximum baselines **> 5 km** if calib **> 5°** away
- **All polarization observations**
- **Bandwidth switching projects** (less than 0.9375 GHz aggregate bandwidths over all spectral windows)
- **Solar observations**
- **VLBI observations**
- **User-specified calibrations**
- **Astrometry**

How much time can you ‘safely’ ask for?

ALMA continues to encourage the community to submit Regular Proposals that request over 10 hours of 12-m Array time.

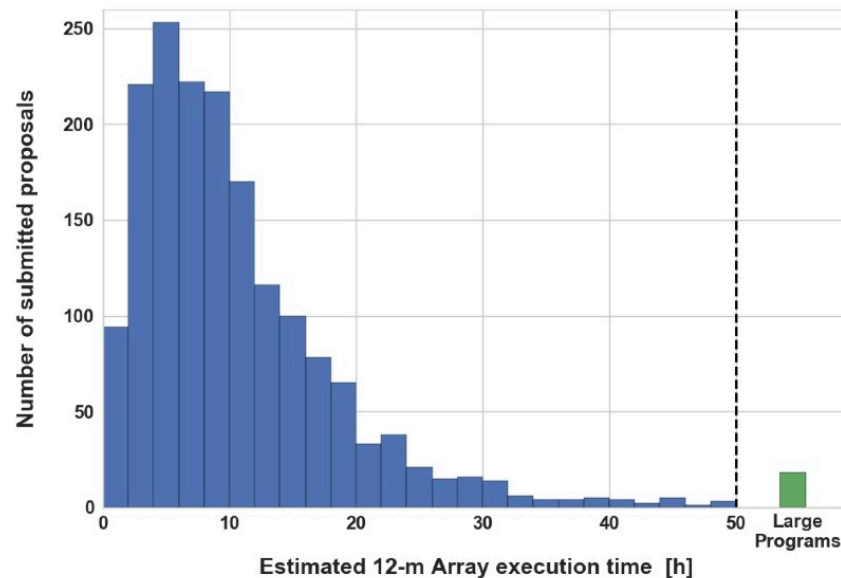
Cycle	Antennas	Hours	hours/ prop	50% asked for < than
6	>43	4000	10.7	10 hrs
5	>43	4000	9.65	9
4	>40	3100	7.8	6
3	>36	2100	5.6	5
2	>34	2000	n.a.	n.a.
1	>32	800	n.a.	n.a.
0	>12	800	n.a.	n.a.

CYCLE 7: PROPOSAL TYPES

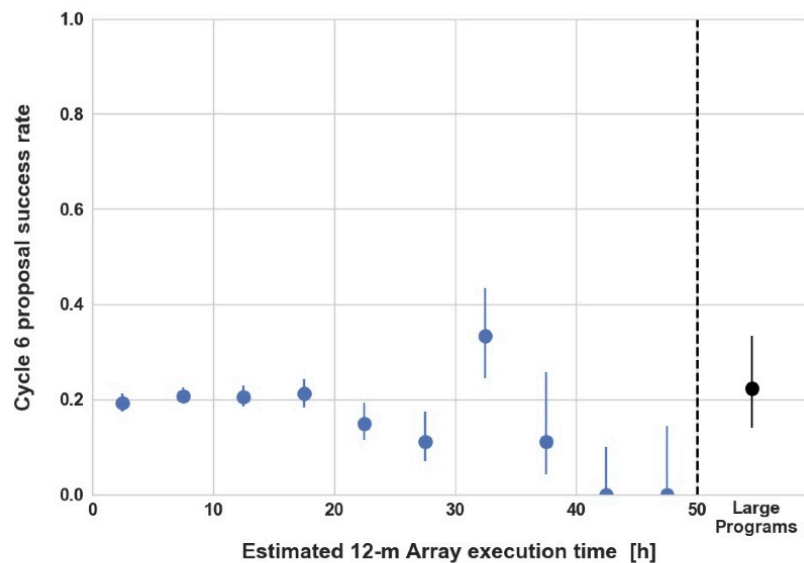
- **Regular proposals.**

< 50 hrs (12-m) or < 150 hrs (ACA standalone).

Can be standard & non-standard, time-critical, multi-epoch, monitoring.



The requested time of the majority of Cycle 6 proposals is between two and ten hours of 12-m Array time.



The success rate of proposals was roughly constant up to about 30-40 hours of requested 12-m Array time

CYCLE 7: PROPOSAL TYPES

- **Target of Opportunity (ToO)** As regular proposal, but the target list can be specified at the moment of triggering.
Submit at regular deadline.
- **Director's Discretionary Time (DDT)** Can be submitted any time; special policies.
< 5% of the available time
- **mm-VLBI**; Bands 3, 6; continuum only
Band 3 in concert with Global Millimeter VLBI Array (**proposal deadline 1/2/19**);
Band 6 in concert with the Event Horizon Telescope Consortium (**ALMA deadline**)
<5% total time (included in the 20% for non standard);
fixed period (March/April 2020, compact config: $b_{\max} < 700\text{m}$)
- **Large programs.** Cannot be done as series of normal proposals;
> 50 hrs on the 12-m Array (with or without accompanying ACA time)
> 150 hrs on the ACA in stand-alone mode
Only standard obs modes and no time-critical or ToO obs's
Contact ARC nodes
Up to 15% of the time may be allocated to Large Programs:
645 hrs for the 12-m Array and 450 hrs for ACA stand-alone
scheduling constraints based on LST and configs (**consult documentation**)

Be aware of

resubmissions – automatically recognized by OT

and

duplications.

To avoid duplications, consult the archive

See also <https://almascience.eso.org/proposing/duplications>

**For more on the archive and the analysis of archival data,
see talks by Massardi & Rygl and by Burkutean & Massardi**

Longest baselines (C-9 & C-10) are NOT offered in Cycle 8 [10/2010 – 9/2021]

Apply for them in Cycle 7 or wait until Cycle 9.

In Cycle 7, C-9 & C-10 will be scheduled in July – August 2020

Cycle 7

Start date	Configuration	Longest baseline	LST: Best conditions
1-Oct-19	C-4	0.78 km	22-10
20-Oct-19	C-3	0.50 km	23-11
10-Nov-19	C-2	0.31 km	1-13
30-Nov-19	C-1	0.16 km	2-14
20-Dec-19	C-2	0.31 km	4-15
10-Jan-20	C-3	0.50 km	5-17
1-Feb-20	No observations due to maintenance		
1-Mar-20	C-4	0.78 km	8-21
20-Mar-20	C-5	1.4 km	9-23
20-Apr-20	C-6	2.5 km	11-1
20-May-20	C-7	3.6 km	13-3
20-Jun-20	C-8	8.5 km	15-5
11-Jul-20	C-9	13.9 km	16-6
30-Jul-20	C-10	16.2 km	17-7
20-Aug-20	C-9	13.9 km	19-8
10-Sep-20	C-8	8.5 km	20-9

Cycle 8

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

Cycle 9

Start date	Configuration	Longest baseline	LST: Best conditions
1-Oct-21	C-3	0.50	22-10
20-Oct-21	C-2	0.31	23-11
10-Nov-21	C-1	0.16	1-13
30-Nov-21	C-2	0.31	2-14
20-Dec-21	C-3	0.50	4-15
10-Jan-22	C-4	0.78	5-17
1-Feb-22	No observations due to maintenance		
1-Mar-22	C-4	0.78	8-21
20-Mar-22	C-5	1.4	9-23
20-Apr-22	C-6	2.5	11-1
20-May-22	C-7	3.6	13-3
20-Jun-22	C-8	8.5	14-5
11-Jul-22	C-9	13.9	16-6
30-Jul-22	C-10	16.2	17-7
20-Aug-22	C-9	13.9	19-8
10-Sep-22	C-8	8.5	20-9

Getting help

USER GUIDES

VIDEO TUTORIALS

Doc 7.8, ver. 7.0 | March 2019
Guide to the European ALMA Regional
Centre

Doc. 6.10, Ver. 1.0 | March 2018
ALMA Observing Tool Quickstart Guide

Doc 6.3, ver. 1.0 | 20 March, 2018
ALMA Cycle 6 Technical Handbook

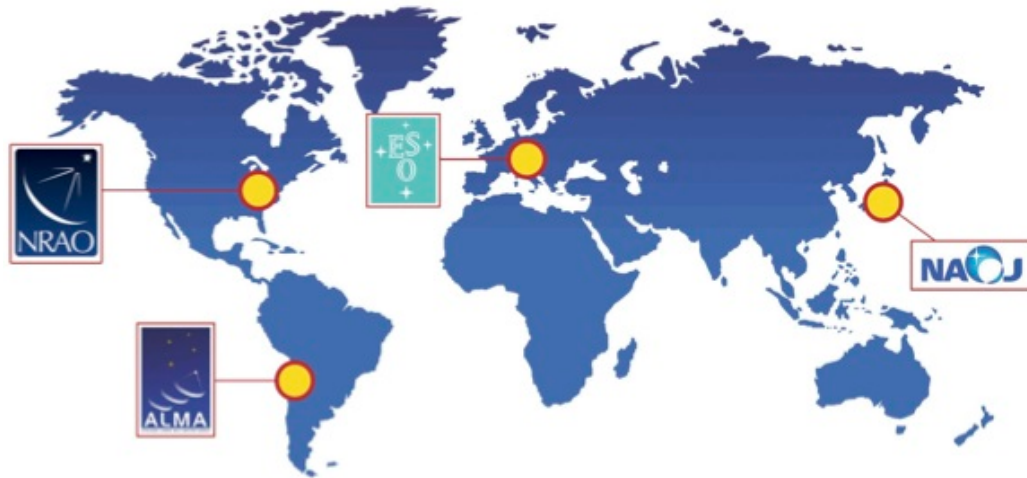
Doc 6.4, ver. 1 | March, 2018
Observing with ALMA – A Primer
(Cycle 6)

Doc 6.2, ver.1.0 | March 2018
ALMA Cycle 6 Proposer's Guide



Science Portal: <https://almascience.eso.org>

ORGANIZATIONAL STRUCTURE



Joint ALMA Observatory:

Europe (ESO): 33.75%
North America (NRAO): 33.75%
East Asia (NAOJ): 22.5%
Chile: 10%

In Europe:

A network of 7 ARC-nodes and
1 Centre of Expertise, coordinated
by the central node at ESO.

European ARC nodes



MEET YOUR ALMA REGIONAL CENTRE NODE ALMA-RELATED DEVELOPMENT PROJECTS AND SCIENCE AT THE ITALIAN ARC

1.

One of the core-tasks of the ALMA Regional Centre (ARC) in Bologna, and indeed of the EU-ARC network as a whole, is to provide support to the astronomical community with writing ALMA proposals, preparing observations, and with reducing (imaging) and, if needed, analyzing the data. Creating and sustaining a community and educating a new generation of astronomers working in the mm-wavelength range is another cornerstone of our existence. At the same time we are very much involved in technological and scientific ALMA-related projects, that aim to develop and move forward the ALMA project.

2.

The people at the ARC also carry out their own research projects. In this poster we introduce ourselves, the ALMA-related development projects that we are involved in, and the research topics that we are interested in.

3.

ARC-people: tasks, science



Jan Brand

ARC-coordinator (planning, funding, staffing)
Student supervision; AENEAS
Scientific interests:
Physics and chemistry of the galactic ISM;
Properties of molecular clouds and SF across the Galaxy, CMF, IMF;
Earliest phases massive star formation;
circumstellar envelopes: masers - variability; flares

ARI: Student supervision
Scientific interests:
Physics and chemistry of the galactic ISM;
Properties of SFRs across the Galaxy, CMF, IMF;
Earliest phases of massive star formation;
Chemical models;
Application of statistical methods to astronomical problems.



Andrea Giannetti

5.

ARC-people: tasks, science cont'd



Elisabetta Liuzzo

ARC manager
User support; QA2; Formation & Outreach; ARI; AENEAS
Student supervision
Scientific interests:
Galaxy formation & evolution; Extragalactic radio sources;
High-z galaxies; galaxy clusters and SZ effect;
Instrumental calibration.

User support; QA2; mm-VLBI; Software development; Formation & Outreach; Archive; Student supervision
Scientific interests:
AGN & AGN jets;
NIR properties of Quasars;
Extra-galactic radio sources



Marcella Massardi

7.

ALMA-related projects, developments

The ALMA Re-imaging (ARI) development study **Poster Massardi**
ALMA Upgrade proposal. Feasibility study to re-image Archival data (Massardi PI; Stöhr (ESO) Co-I; Giannetti (ARC). Incl. IT, UK, Nordic nodes).

Archive Key-word Filler (AKF) **See poster by Liuzzo et al.**
Liuzzo, Rygl, Massardi

Keywords of Archived FITS-images Exploder (KAFE) **Poster by Burkutean et al.**
All

Array and single dish combination
Burkutean

ALMACAL
Deep (sub)mm multi-freq survey using ALMA calibrator data.
Liuzzo, Bonato, Massardi

4.

ARC-people: tasks, science cont'd



Kazi Rygl

User support; QA2; mm-VLBI with ALMA; Archive
Scientific interests:
Low- and high-mass star formation;
Masers in SFRs; parallaxes;
GAIA astrometry of OB stars



Rossita Paladino

User support; polarimetry w. ALMA; QA2; Formation & Outreach;
Student supervision
Scientific interests:
Star formation in nearby galaxies;
Magnetic fields and cosmic rays in the ISM;
Environmental effects on the star formation processes.

6.

ARC-people: tasks, science cont'd



Sandra Burkutean

User support; QA2; SD/array combination; Software development; Archive
Scientific interests:
Galaxy clusters: SZ effect, X-ray observations;
Shocks in the ICM.



Claudia Mannino

User support; ALMA Archive; ARI
Scientific interests:
Galaxy formation & evolution; modeling
Statistical properties of galaxies



Matteo Bonato

Archive; ARI
Scientific interests:
AGN & AGN jets; Galaxy formation & evolution;
Extra-galactic radio sources

8.

ALMA-related projects, developments, cont'd

Polarimetry (guide, manual, calibration)
Paladino: casa guide, manual for QA2 analysts. Calibration strategy tests (with Fontont); calibrator pol. info from PI-data.

Advanced European Network of E-infrastructures for Astronomy with the SKA
INAF-IRA (Massardi) is leader of WP5 in this accepted H2020 proposal for a EU SKA Science Data Centre (Brand and Nanni IRA-participants; + Umana, Becciani, Costa (CT), Smaeglia, Knapic, Taffoni (TS)). **See poster Massardi**

BlackHoleCam entry imminent
Liuzzo, Rygl - writing pipeline for CASA

Contact us via our helpdesk:
helpdesk@alma.inaf.it

We provide support with writing your proposals.

We follow accepted projects as Contact Scientist and act as intermediate between PI and JAO.

We also assist with data reduction if requested.

Come find us also for science support and collaborations!

Visit our webpages at:
<http://arc.ia2.inaf.it>

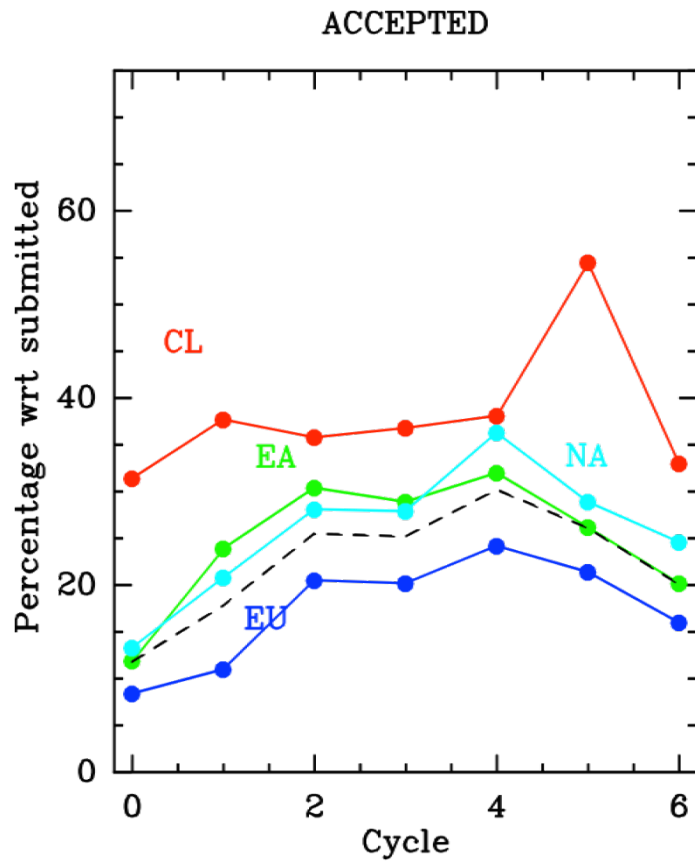
Proposal statistics per Executive / Partner

Europe: 33.75%

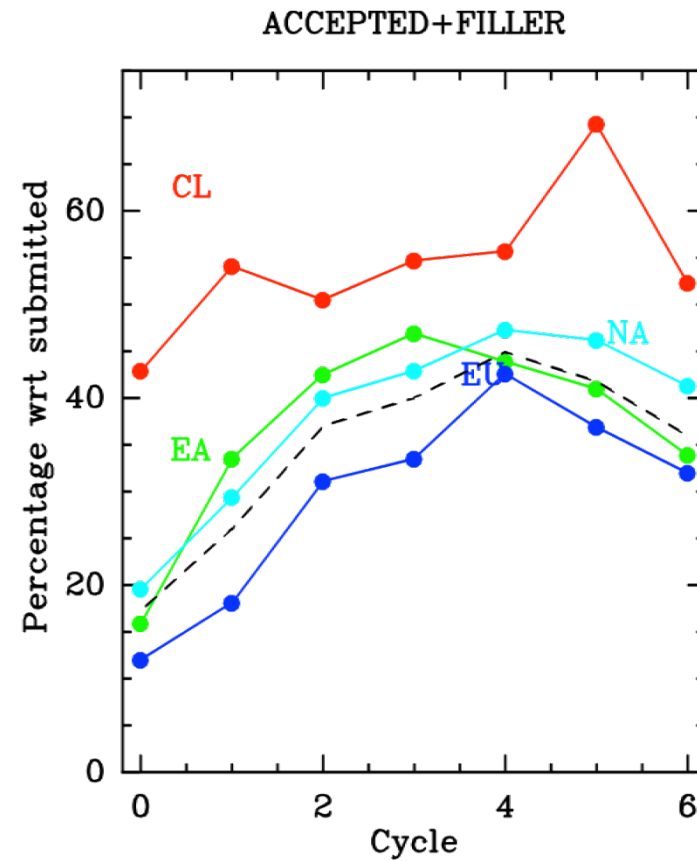
North America: 33.75%

East Asia: 22.5%

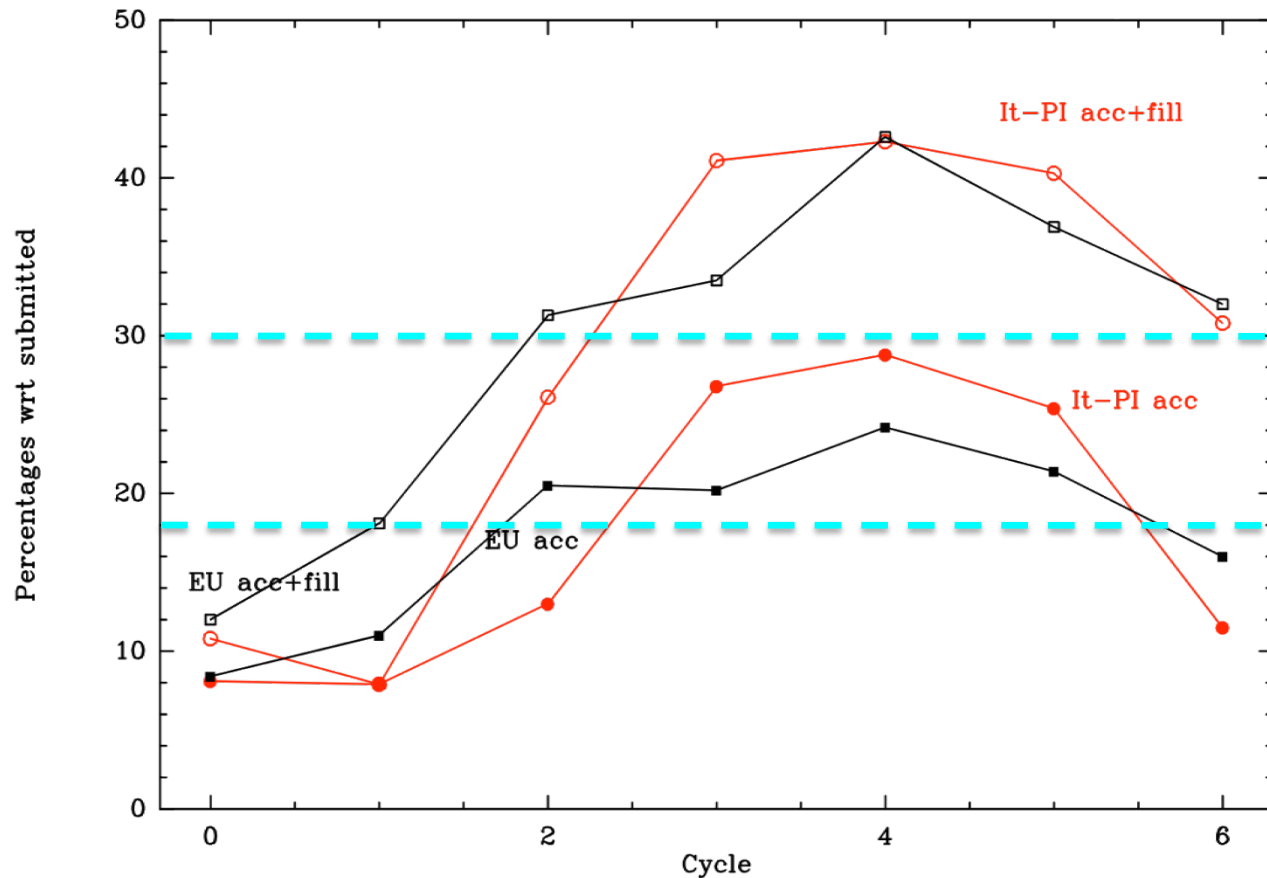
Chile: 10%



--- Global average



Proposal statistics for Europe and Italian PI's

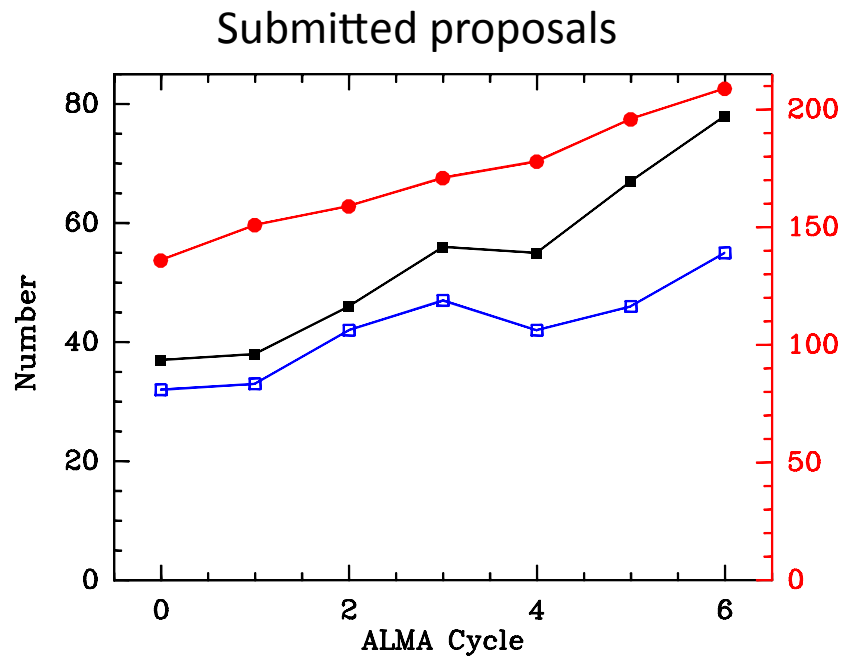


NB: people tend to ask more hours/proposal. Trend in hours is flatter.

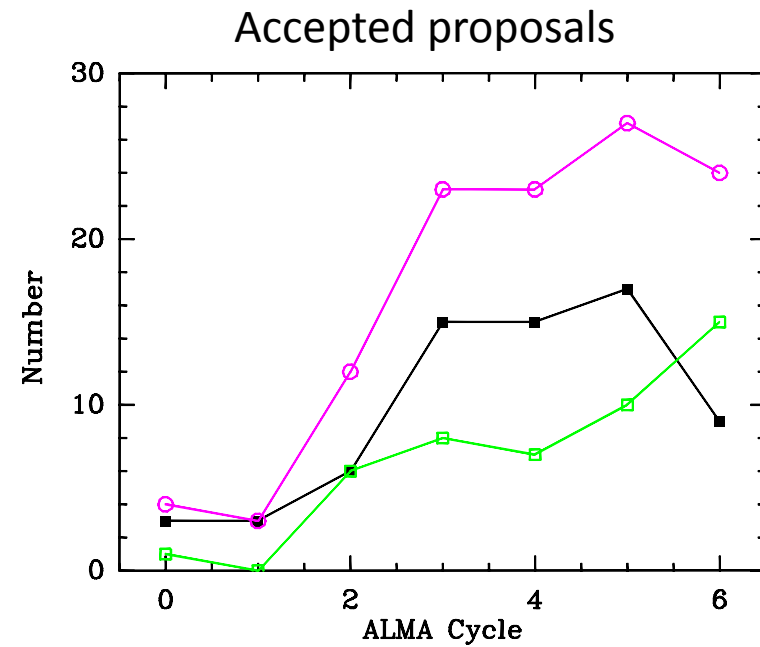
Over 7 Cycles: It-PI's got 17.4% of their proposals accepted A+B; 28.5% incl. C (31.9% excl. Cycle1)
For EU these numbers are 17.4% and 29.5%.

Over 7 Cycles: It-PI's submitted 8.7% of all EU proposals. Of all accepted EU proposals, 8.1% are with It-PI (8.8% excl. Cycle1)

Proposal statistics for Italian PI's



- Unique Co-I's
- Submitted proposals
- Unique PI's



- Accepted proposals (A+B+C)
- Accepted proposals (A+B)
- Accepted proposals (C)



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