ALMA CYCLE 4 CAPABILITIES

(slides kindly stolen from Sebastian Muller of the Nordic ARC node).

Resources

- ALMA Science Portal *almascience.eso.org*

  Call for Proposals

  Documents:
  - Cycle 4 capabilities
  - Proposer's Guide
  - Technical Handbook

  Observing Tool

  Helpdesk

- Contact your favorite ARC node

Important Dates

- 22 March 2016: release of Call for Proposals
- 21 April 2016 15:00 UT Deadline for submission
- August 2016: Proposal review outcome notifications
- October 2016: Start of Cycle 4
- September 2017: End of Cycle 4

Overview of capabilities

- Forty 12m-antennas in the 12m-array
- Ten 7m-antennas in the Compact Array (ACA)
- Three 12m-antenna in Total Power (TP, only for B3~8, spectral mode)

- Receiver bands 3, 4, 6, 7, 8, 9, and 10 (12m, ACA)

- Observing modes: single field, mosaic, spectral scan
- Mixed correlator modes
- Polarization (full, linear, B3,6,7)

- Baselines up to 12.6 km (B3–6), 6.8 km (B7), and 3.7 km (B8–10)

- ~ 3000 h of observing time over the 12 months of Cycle 4
- October 2016 to September 2017
- Incl. uncompleted (carried over) A-ranked proposal from Cycle 3

- Standard projects = calibrated with the ALMA pipeline
- Non standard projects = manual calibration by ALMA staff

New to Cycle 4

- 3000 hours of observing time (vs ~2000 for c3)
- Large programs (>50 hours/project, up to 15% of science time)
- Extended configurations in standard for B3~6
- ACA in stand-alone mode
- Polarization, full spectral resolution
- VLBI
- Solar observations

Proposal types

- Regular
- Target of Opportunity (ToO)
  - Be clear about the trigger
  - ALMA will attempt to observe within 48h of the trigger.
  - But longer ”reaction time” might occur
- VLBI
- Large program (> 50h of observing time)
- Director Discretionary Time (DDT)
  - Can be submitted any time
  - Need *exceptionally strong* science case
  - Sudden and unexpected astronomical event
  - An additional time of ~150h of 12m-array, ~90h of ACA

Standard vs Non Standard modes

- Standard modes
  - modes used in previous cycles, can be reduced by the pipeline

- Non standard modes
  - Will be limited to up to 20% of the total observing time
  - Will be reduced manually by ALMA staff
  - Bands 8, 9, and 10 observations
  - Long baseline configuration >6 km for B7
  - Full polarization observations
  - Spectral scans
  - Bandwidth switching (aggregate BW < 1GHz)
  - Non-standard calibration (user-defined)
  - Solar observations
  - VLBI observations

Large programs (LP)

- Projects with >50h of observing time (12m array, 12m+ACA, or ACA alone)
- Standard mode only (ToO, time-critical observations not permitted in c4)
- Science justifications = 6pages pdf
  - (inc. Scientific justifications, fig., tab., a description of data products, and a management plan)
- Possibility for co-PIs (time share among partners)
  - ~ 15% of total science time available
  - (ie ~450h 12m-array; ~270h ACA-alone)
- Must be A-grade
- Some scheduling constraints on time allocated to LP:
- < 33% of available time for a given LST range on configuration with baselines > 5km
- < 50% of available time for a given LST range on configuration with baselines < 5km

Receiver Bands

Band	Frequency (GHz)	IF range (GHz)	Type	Estimated fraction of suitable time
B3	84 – 116	4 – 8	2SB	100 %
B4	125 – 163	4 – 8	2SB	90 %
B6	211 – 275	5 – 10	2SB	70 %
B7	275 – 373	4 – 8	2SB	40 %
B8	385 – 500	4 – 8	2SB	20 %
B9	602 – 720	4 – 12	DSB	10 %
B10	787 - 950	4 – 12	DSB	<10 %

Configurations

Nine configurations of the 12m-array will be used

From most compact: max baseline of ~155 m

To most extended: max baseline of 3.7 km in B8~10; 6.8 km in B7; 12.6 km in B3~6

	Band	3	4	6	7	8	9	10
	Frequency (GHz)	100	150	230	345	460	650	870
Configuration								
7-m	θ_{res} (arcsec)	12.5	8.4	5.4	3.6	2.7	1.9	1.4
	θ_{MRS} (arcsec)	66.7	44.5	29.0	19.3	14.5	10.3	7.7
C40-1	θ_{res} (arcsec)	3.7	2.5	1.6	1.1	0.80	0.57	0.42
	θ_{MRS} (arcsec)	29.0	19.4	12.6	8.4	6.3	4.5	3.3
C40-2	θ_{res} (arcsec)	2.4	1.6	1.0	0.69	0.52	0.37	0.27
	θ_{MRS} (arcsec)	22.1	14.8	9.6	6.4	4.8	3.4	2.5
C40-3	θ_{res} (arcsec)	1.5	0.97	0.63	0.42	0.32	0.22	0.17
	θ_{MRS} (arcsec)	13.7	9.1	5.9	4.0	3.0	2.1	1.6
C40-4	θ_{res} (arcsec)	0.93	0.62	0.40	0.27	0.20	0.14	0.11
	θ_{MRS} (arcsec)	8.9	5.9	3.9	2.6	1.9	1.4	1.0
C40-5	θ_{res} (arcsec)	0.54	0.36	0.23	0.16	0.12	0.083	0.062
	θ_{MRS} (arcsec)	6.0	4.0	2.6	1.7	1.3	0.93	0.69
C40-6	θ_{res} (arcsec)	0.35	0.23	0.15	0.10	0.076	0.054	0.040
	θ_{MRS} (arcsec)	3.1	2.1	1.3	0.90	0.67	0.48	0.36
C40-7	θ_{res} (arcsec)	0.21	0.14	0.090	0.060	0.045	0.032	0.024
	θ_{MRS} (arcsec)	1.8	1.2	0.77	0.52	0.39	0.27	0.20
C40-8	θ_{res} (arcsec)	0.12	0.079	0.052	0.034	-	-	-
	θ_{MRS} (arcsec)	1.3	0.87	0.57	0.38	-	-	-
C40-9	θ_{res} (arcsec)	0.066	0.044	0.029	-	-	-	-
	θ_{MRS} (arcsec)	0.78	0.52	0.34	-	-	-	-

θ_{res} (arcsec)	θ_{LAS} (arcsec)	Array combination	Time ratios	Total Time
0.066	< 0.78	C40-9	1	$1.0 \times \Delta_{extended}$
0.066	0.78-3.1	C40-9 + C40-6	1 : 0.3	$1.3 \times \Delta_{extended}$
0.066	> 3.1	-	-	-
0.12	< 1.3	C40-8	1	$1.0 \times \Delta_{extended}$
0.12	1.3-6.0	C40-8 + C40-5	1 : 0.3	$1.3 \times \Delta_{extended}$
0.12	> 6.0	-	-	-
0.21	< 1.8	C40-7	1	$1.0 \times \Delta_{extended}$
0.21	1.8-8.9	C40-7 + C40-4	1 : 0.3	$1.3 \times \Delta_{extended}$
0.21	> 8.9	-	-	-
0.35	< 3.1	C40-6	1	$1.0 \times \Delta_{extended}$
0.35	3.1-13.7	C40-6 + C40-3	1 : 0.3	$1.3 \times \Delta_{extended}$
0.35	13.7-66.7	C40-6 + C40-3 + 7-m	1 : 0.3 : 0.4	$1.7 \times \Delta_{extended}$
0.35	> 66.7	C40-6 + C40-3 + 7-m + TP	1 : 0.3 : 0.4 : 0.68	$1.98 \times \Delta_{extended}$
0.54	< 6.0	C40-5	1	$1.0 \times \Delta_{extended}$
0.54	6.0-22.1	C40-5 + C40-2	1 : 0.3	$1.3 \times \Delta_{extended}$
0.54	22.1-66.7	C40-5 + C40-2 + 7-m	1 : 0.3 : 1.4	$2.7 \times \Delta_{extended}$
0.54	> 66.7	C40-5 + C40-2 + 7-m + TP	1 : 0.3 : 1.4 : 2.38	$3.68 \times \Delta_{extended}$
0.93	< 8.9	C40-4	1	$1.0 \times \Delta_{extended}$
0.93	8.9-29.0	C40-4 + C40-1	1 : 0.3	$1.3 \times \Delta_{extended}$
0.93	29.0-66.7	C40-4 + C40-1 + 7-m	1 : 0.3 : 3	$4.3 \times \Delta_{extended}$
0.93	> 66.7	C40-4 + C40-1 + 7-m + TP	1 : 0.3 : 3 : 5.1	$6.4 \times \Delta_{extended}$
1.5	< 13.7	C40-3	1	$1.0 \times \Delta_{extended}$
1.5	13.7-66.7	C40-3 + 7-m	1 : 1.4	$2.4 \times \Delta_{extended}$
1.5	> 66.7	C40-3 + 7-m + TP	1 : 1.4 : 2.38	$3.38 \times \Delta_{extended}$
2.4	< 22.1	C40-2	1	$1.0 \times \Delta_{extended}$
2.4	22.1-66.7	C40-2 + 7-m	1 : 5	$6.0 \times \Delta_{extended}$
2.4	> 66.7	C40-2 + 7-m + TP	1 : 5 : 8.5	$9.5 \times \Delta_{extended}$
3.7	< 29.0	C40-1	1	$1.0 \times \Delta_{extended}$
3.7	29.0-66.7	C40-1 + 7-m	1 : 5	$6.0 \times \Delta_{extended}$
3.7	> 66.7	C40-1 + 7-m + TP	1 : 5 : 8.5	$9.5 \times \Delta_{extended}$
12.5	< 66.7	7-m	1	$1.0 \times \Delta_{extended}$
12.5	> 66.7	7-m + TP	1 : 1.7	$1.7 \times \Delta_{extended}$

Array config plan (or “plan”)

Start date	Config	Longest baseline (km)	LST for best observing conditions (h)	Estimated days available for science obseervations
2016 Oct 14	C40-7	3.7	22-11	13
2016 Nov 4	C40-6	1.8	23-12	11
2016 Nov 25	C40-5	1.1	1-13	7
2016 Dec 9	C40-4	0.7	2-14	7
2016 Dec 23	C40-3	0.5	3-15	11
2017 Jan 19	C40-2	0.3	4-17	9
2017 Feb 1-27	February maintenance period			
2017 Mar 16	C40-1	0.2	8-22	17
2017 Apr 6	C40-3	0.5	9-23	11
2017 Apr 27	C40-5	1.1	10-1	7
2017 May 11	Move to config C40-9			
2017 Jun 8	C40-9	12.6	12-3	16
2017 Jul 6	C40-8	6.8	14-5	22
2017 Aug 17	C40-7	3.7	17-8	23

Spectral Scan

- A set of contiguous spectral windows:
  - all targets within 10 degree area on the sky
  - one representative frequency (angular resolution, sensitivity)
  - no more than five frequency tunings (same band) / science goal
  - only one pointing per target (no mosaic/offset allowed)
  - only 12m-array (no ACA)
  - the sum for all targets of the number of separate tunings < 150 (e.g. 30 targets can be observed for 5 tunings)
  - no full polarization

Polarization

- Observing modes:
  - Dual polarization (”standard”)
  - Single polarization (need larger number of channels against sensitivity)
  - Full (linear) polarization = All correlation products
    - NON STANDARD
    - B3,6,7 – 12m array
    - Single pointing, on axis (compact sources < 1/3 primary beam)
    - Continuum and full spectral resolution

- Sufficient parallactic angle coverage required (3h, possible to add more sources < 10 deg)
- Minimum degree of polarization of 0.1% (TDM), 1% (FDM) for compact sources
- Respectively 0.3% / 3% for slightly extended sources

VLBI & ALMA

- 3mm-VLBI (GMVA): 2016 Feb 1st GMVA deadline is past
- 1mm-VLBI (EHT) : NRAO deadline on 2016 Apr 28

- Campaign mode in most compact configurations (Mar-Apr 2017)
- B3 and 6, fixed frequencies – full pola; FDM mode
- Only sources >0.5 Jy in intra-ALMA baseline <1km
- ~3h-long observations for parallactic angle coverage
- No LP
- No carry-over
- Cap of ~5% of total ALMA science time

Solar observations

- ”ALMA observations of the Sun in Cycle 4 and beyond”
- S. Wedemeyer et al astroph#1601.00587

- Campaign mode
- Special combined array, using both 12m and ACA antennas
- TP antennas (3) for fast scanning of whole solar disk
- Continuum only (TDM) in B3 or 6 (fixed frequencies)
- No polarization
- Mosaic up to 150 pointings
- Compact configurations: C40-1~3 (Dec-Apr)
- No WVR corrections possible

Duplications

- Will be checked against:
  - Cycle 3 A-grade (high-priority) projects
  - Any Cycle >0 projects that have archived data
    - at the time of cycle 4 deadline
- Users may check: ALMA archives
  - Duplication checklists under the Science Portal
- Criteria:
  - Source:
    - single field: within the same beam
    - mosaic: overlap of > 50% (of the small one)
  - Highest angular resolution < factor 2
  - Spectral windows overlap > 50%, or >50% of spectral lines
  - Spectral resolution difference < factor 2
  - RMS sensitivity difference < factor 2

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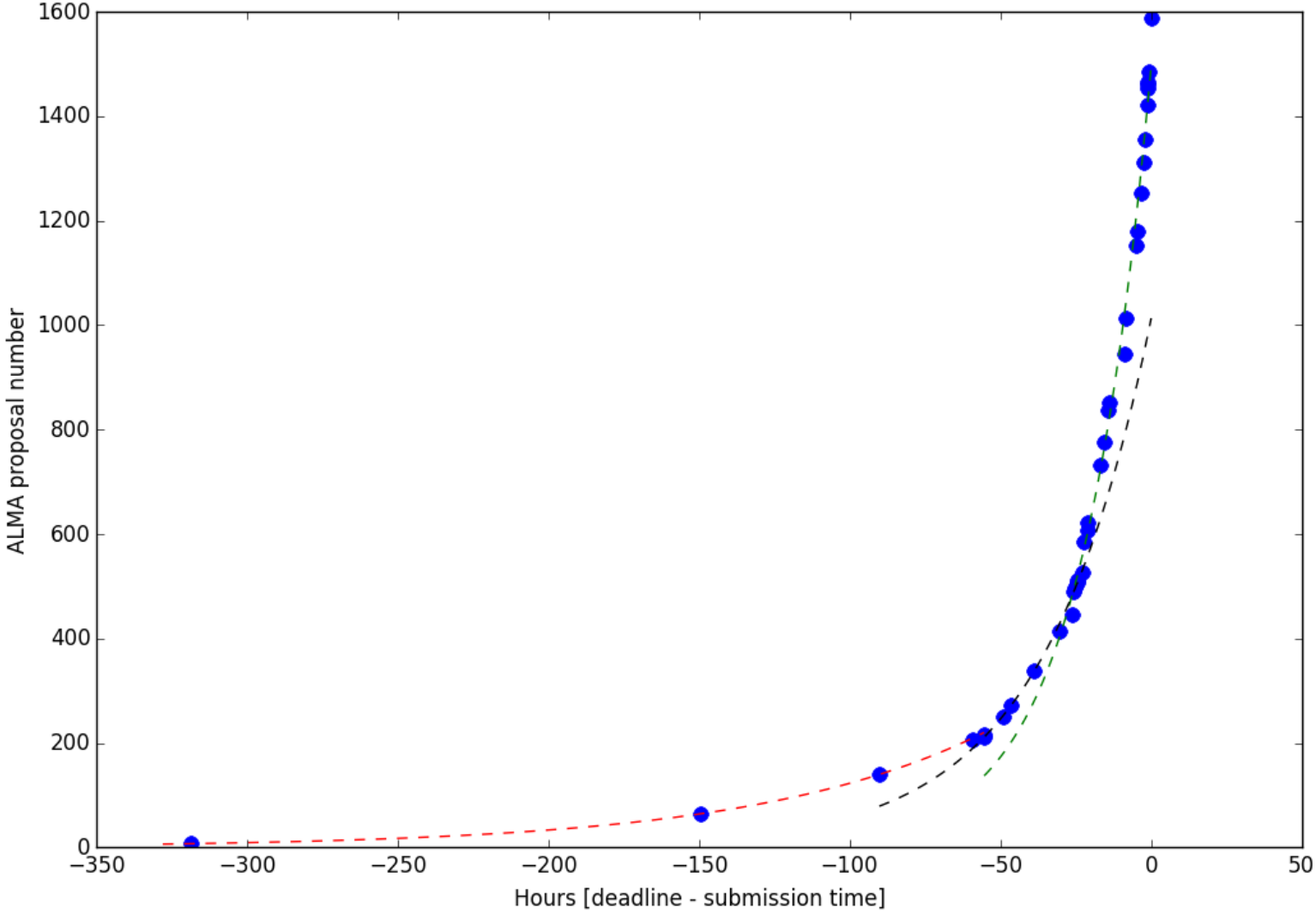
ALMA proposal number
Hours [deadline - submission time]
0
200
400
600
800
1000
1200
1400
1600
−350
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