ALMA CYCLE 2

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ALMA
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General information

ALMA Early Science Cycle 2 is expected to start in June 2014 and to span 17 months. During this period a significant amount of time will be reserved for engineering and commissioning work to realize the full suite of ALMA capabilities. It is anticipated that approximately 2000 hours of both 12-m Array and ACA time will be available.

Any astronomer may submit a proposal in response to the ALMA Early Science Cycle 2 Call for Proposals. Successful proposers will share risk with ALMA: it cannot be guaranteed that projects will be completed or that the characterization and quality of the data and data reduction will meet the standards expected when ALMA is in full scientific operations.

ALMA Cycle 2 – Key Dates

- **Early October 2013**: Publication of Cycle 1 status report on the Science Portal.
- **10 October 2013, 15:00 UT**: Deadline for Notices of Intent.
- **24 October 2013**: Call for Proposals for ALMA Early Science Cycle 2, release of Observing Tool, and opening of Archive for proposal submission.
- **5 December 2013**: Proposal Deadline.
- **Mid April 2014**: Result of the proposal review process sent to PIs.
- **June 2014**: Start of ALMA Cycle 2 observing.
- **October 2015**: End of ALMA Cycle 2 observing.

ALMA Cycle 2 – Anticipated Capabilities

Detailed information on Cycle 2 capabilities will be published in the Call for Proposals. As of the date of this pre-announcement, the ALMA Early Science Cycle 2 anticipated capabilities comprise:

- Thirty four 12 m antennas in the main array (12 m Array), and nine 7 m antennas (7 m Array, for short baselines) and two 12 m antennas (Total Power Array, for making single-dish maps), which together constitute the Atacama Compact Array.
- Receiver bands 3, 4, 6, 7, 8 & 9 (wavelengths of about 3.1, 2.1, 1.3, 0.87, 0.74 and 0.44 mm).
- Both single field interferometry and mosaics.
- Spectral-line observations with all Arrays and continuum observations with the 12 m Array and the 7 m Array.
- Polarization (on-axis, continuum, selected frequencies in Band 3, 6 and 7, no ACA, no mosaics).
- Mixed correlator modes (both high and low frequency resolution in the same observation).
- Baselines up to 1 km for Bands 8 & 9.
- Baselines up to 1.5 km for Bands 3, 4, 6, & 7.

ALMA Cycle 2 – Anticipated Capabilities

Use of the ACA for short baseline interferometry and single-dish observations will only be offered to complement observations with the 12-m Array, and not as a stand-alone capability. Single dish use will be limited to spectral line observations in Bands 3 to 8.

The number of array elements available for science observing is less than the number available overall. This is because some of them must be reserved to commission the full science observing modes (additional receiver bands, longer baselines etc).

ALMA Full Array Specifications

Number of Antennas	50 × 12 m (12 m Array), plus 12 × 7 m & 4 × 12 m (ACA)
Maximum Baseline Lengths	0.15 – 16 km
Angular Resolution (“)	~0.2” × (300/v GHz) × (1 km / max. baseline)
12 m Primary beam (“)	~20.6” × (300/v GHz)
7 m Primary beam (“)	~35” × (300/v GHz)
Number of Baselines	Up to 1225
Total Bandwidth	16 GHz (2 polarizations × 4 basebands × 2 GHz/baseband)
Velocity Resolution	As narrow as 0.008 × (v/300 GHz) km/s
Polarimetry	Full Stokes parameters

ALMA Full Operations

- Fifty 12-meter antennas (12-m Array) for sensitive, high-resolution, high fidelity imaging.
- Four additional 12-meter antennas providing total power (TP Array) and twelve 7-meter antennas comprising the ACA, enhancing the fidelity of wide field imaging.
- Imaging ability in all atmospheric windows from 3.5 millimeters to 300 microns (84 – 950 GHz), with coverage extending to 10 millimeters (30 GHz) possible through future receiver development.
- 12-m Array configurations with maximum baselines from 150 m to 16 km.
- ACA configurations with baselines ranging from 9 m to 50 m.
- Ability to image sources many arcminutes across (i.e. accurately recover structures up to arcminutes in size) at sub-arcsecond resolution.
- Angular resolution as small as 5 milliarcseconds at 950 GHz.
- Flexible spectrometer (correlator) modes, with as many as 32 separate spectral windows within the 8 GHz passband (per polarization).
- Velocity resolutions as fine as 8 m/s (× 300/ν GHz).
- Ability to "split" the array into several sub-arrays, which could observe different frequencies/targets simultaneously.
- Full Stokes polarization capability.

ALMA – Full Array Specifications

Full Science Capabilities			Most Compact	Most Extended
Band	**Frequency [GHz]**	**Primary Beam [FOV; “]**	**Resolution [“]**	**Resolution [“]**
1*	31.3 – 45	145 – 135	13 – 9	0.14 – 0.1
2*	67 – 90	91 – 68	6 – 4.5	0.07 – 0.05
3	84 – 116	72 – 52	4.9 – 3.6	0.05 – 0.038
4	125 – 163	49 – 37	3.3 – 2.5	0.035 – 0.027
5	163 – 211	37 – 29	**	**
6	211 – 275	29 – 22	2.0 – 1.5	0.021 – 0.016
7	275 – 373	22 – 16	1.5 –1.1	0.016 – 0.012
8	385 – 500	16 – 12	1.07 – 0.82	0.011 – 0.009
9	602 – 720	10 – 8.5	0.68 – 0.57	0.007 – 0.006
10	787 – 950	7.7 – 6.4	0.52 – 0.43	0.006 – 0.005

* To be developed in the future.
**Available on a limited number of antennas.

Science with ALMA

While ALMA will revolutionize many areas of astronomy, the ALMA Project has three Level One Science Aims for Full Operations that drive its technical requirements:

- The ability to detect spectral line emission from CO or C+ in a normal galaxy like the Milky Way at a redshift of z = 3, in less than 24 hours of observation.
- The ability to image gas kinematics in a solar-mass protostellar/protoplanetary disk at a distance of 150 pc (roughly, the distance of the star-forming clouds in Ophiuchus or Corona Australis), enabling one to study the physical, chemical, and magnetic field structure of the disk and detect the tidal gaps created by planets undergoing formation.
- The ability to provide precise images at an angular resolution of 0.1″. Here the term "precise image" means an accurate representation of the sky brightness at all points where the brightness is greater than 0.1% of the peak image brightness. This requirement applies to all sources visible to ALMA that transit at an elevation greater than 20 degrees.