ALMA Cycle 3 Capabilities

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NRAO/ALMA at the January 2015 AAS

• Next Generation VLA Workshop
https://science.nrao.edu/science/meetings/2015/aas225/next-gen-vla/
Sunday, 4 January, 9 am – 6 pm, Convention Center, Rooms 616/617

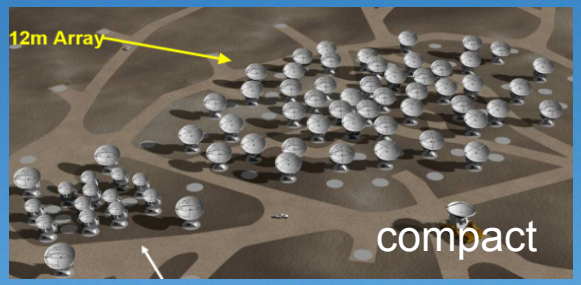
• Splinter Session: New Capabilities at the NRAO
https://science.nrao.edu/science/meetings/2015/aas225/new-capabilities
Tuesday, 6 January, 1:30 – 3:30 pm, Convention Center, Room 303
→ *ALMA focus: Cycle 3 capabilities (JDM)*

• NRAO Town Hall
https://science.nrao.edu/science/meetings/2015/aas225/townhall/
Tuesday, 6 January, 6:30 – 8:30 pm PST, Convention Center, Room 6A
→ *ALMA focus: Recent achievements and capabilities in Cycle 4+ (S. Corder)*

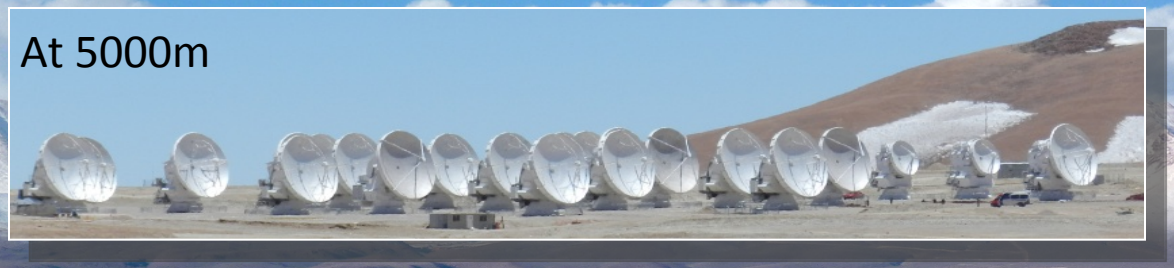
• Invited Plenary Session: ALMA Presents a Transformational View of the Universe, Al Wootten
https://science.nrao.edu/science/meetings/2015/aas225/alma_plenary
Thursday, 8 January, 11:40 am – 12:30 pm, Convention Center, Room 6E
→ *ALMA focus: Groundbreaking science results!*

ALMA

An array of **66 antennas,**
using *aperture synthesis*, *as a* "zoom telescope"
over the *entire accessible mm/submm* wavelength range up to
1 THz

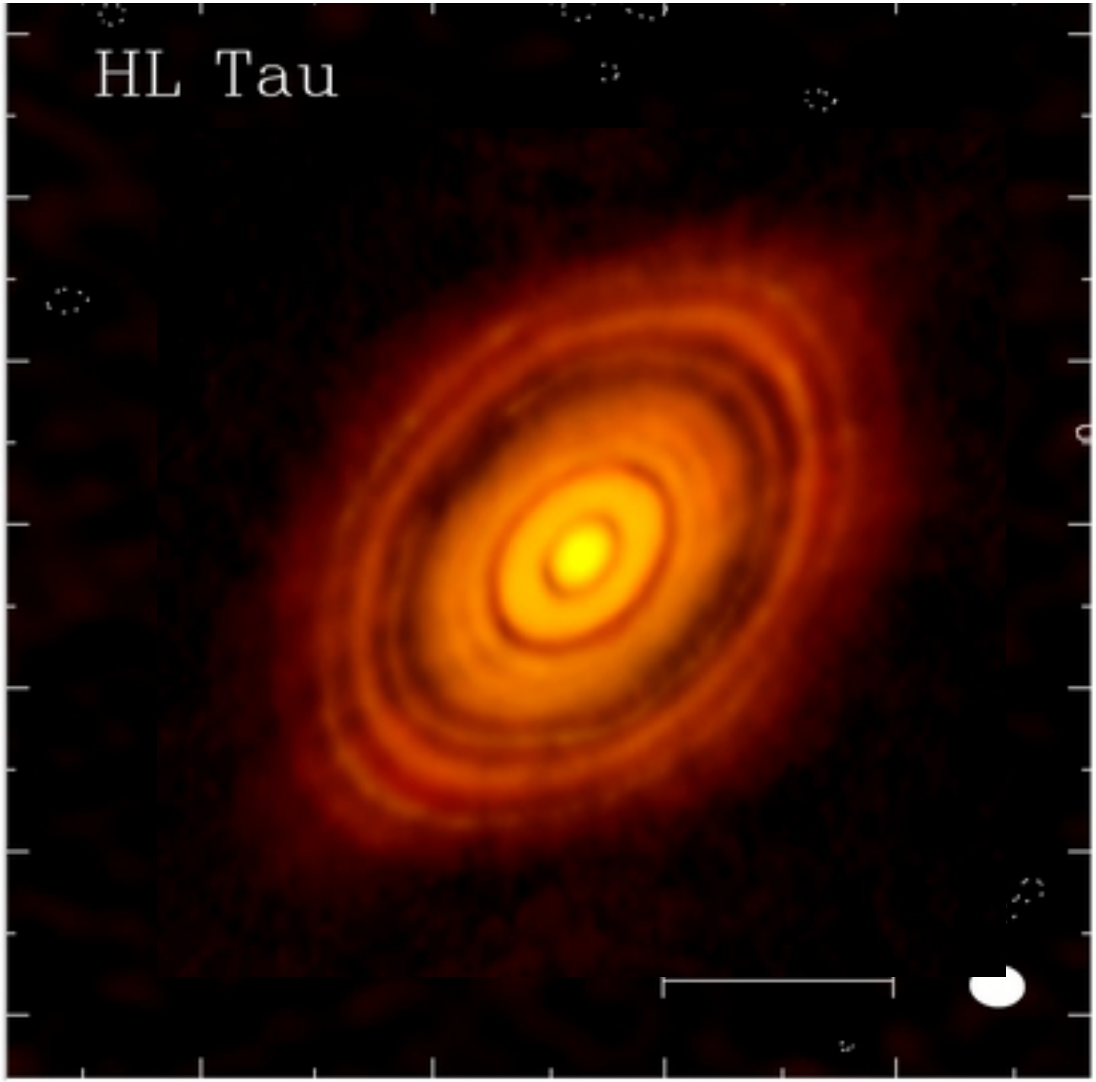


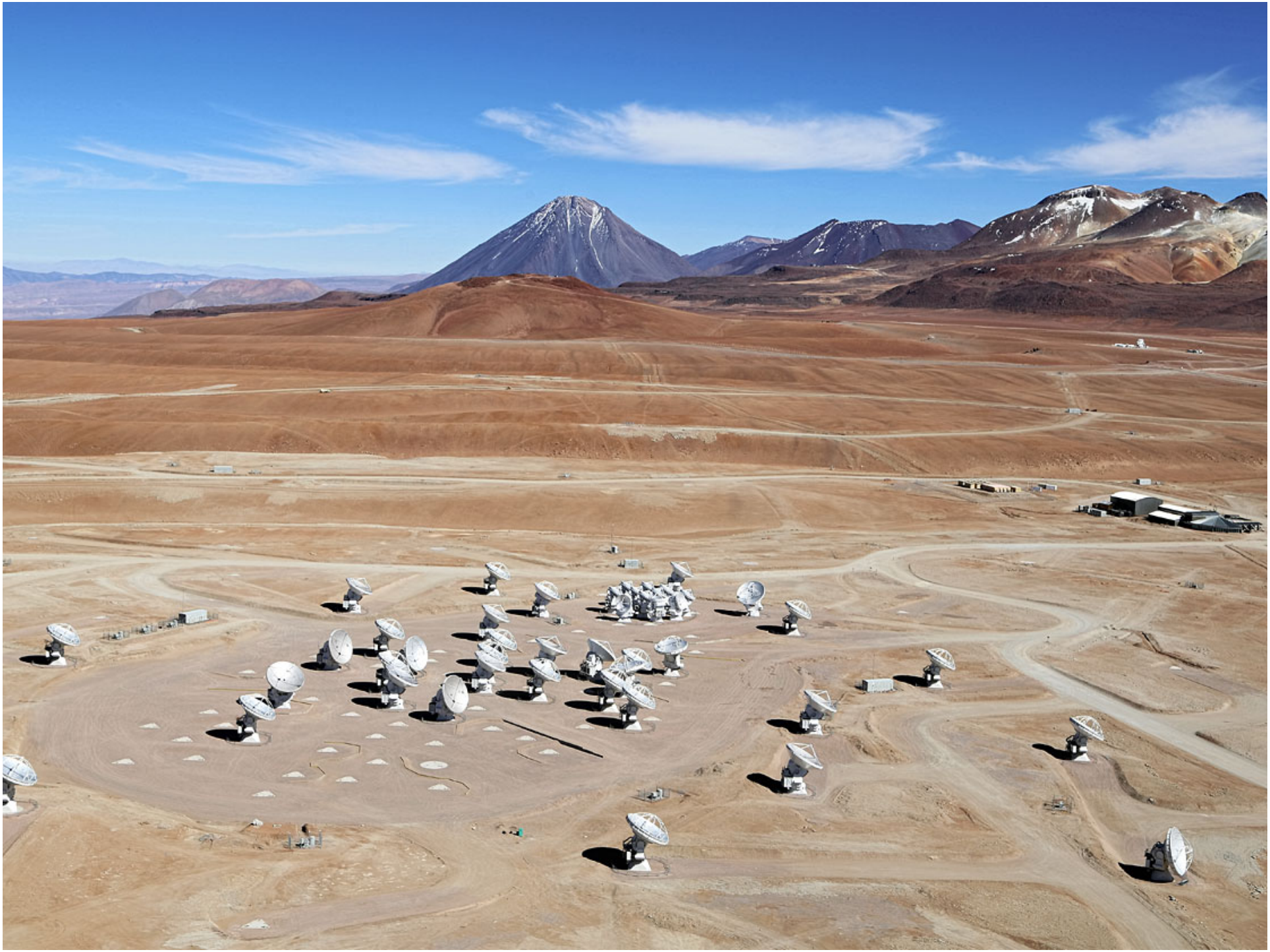
Built to operate
>30 years



Remotely operated from
OSF Control room

ALMA Long Baseline Campaign





ALMA Current Status

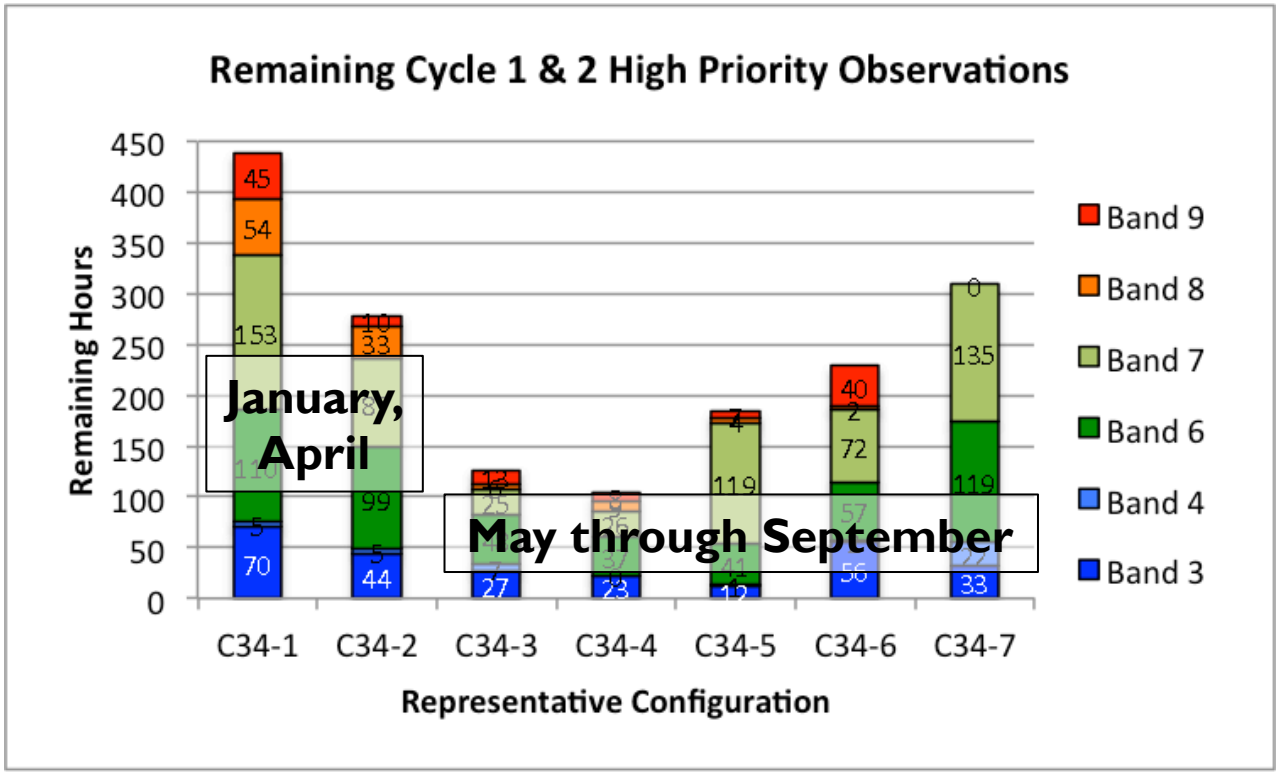
- Construction Project ended in September 2014
- Routine science observing has been limited to 1.5 km baselines (C34-7), but observations out to 15 km have been proven successful (thanks to the Long Baseline Campaign, ended December 2, 2014)
- **All 66 antennas accepted**
  - Currently 64 antennas are at the high site (AOS), of which ~47 on average (up to max ~54) are being used for Cycle 2 observations
  - Some construction and verification items remain to be finished (e.g., Bands 4, 8, 10; various observing modes)
- The ACA (Atacama Compact Array) or Morita-san Array – up to 12x7m antennas and 4x12m antennas for TP observations – has been accepted and is being used for Cycle 2 observations

ALMA Receivers: Current Status

- Receiver bands currently installed on all antennas
  - Band 3, 3mm (84-116 GHz)
  - Band 6, 1mm (211-275 GHz)
  - Band 7, 850 μm (275-370 GHz)
  - Band 9, 450 μm (602-720 GHz)
- Receiver bands partially installed and currently undergoing verification
  - Band 4, 2mm (125-163 GHz) 56/66 antennas
  - Band 8, 650 μm (385-500 GHz) 53/66 antennas
  - Band 10, 350 μm (787-950 GHz) 43/66 antennas

Cycle 2: Current Snapshot

- 23 weeks of science observations remain for Cycle 2
  - January, April 2015: Compact Configurations (C34-1, C34-2)
  - February – March 2015: Engineering/Computing (during the Altiplanic Winter)
  - May – September 2015: Move to more extended configurations (C34-3 to C34-7)



-- from November 2014 ALMA Status Update, ALMA Science Portal

Timelines for Cycle 3

- Call for proposals: March 24, 2015
- Deadline for submission: April 23, 2015
- Proposal Review meetings: June 22-26, 2015
- Communication of Outcome of Review Process: August 2015
- Start of Cycle 3: October 1, 2015 – **12 months**

Capabilities for Cycle 3

- At least 36x12m antennas in the main array, and 10x7m antennas (for short baselines) and 2x12m antennas (for making single-dish maps) in the Morita-san Array (ACA)
- Receiver bands 3, 4, 6, 7, 8, 9, & 10
- Baselines up to 10 km for Bands 3, 4 and 6
- Baselines up to 5 km for Band 7
- Baselines up to 2 km for Bands 8, 9, and 10
- Both single-field interferometry and mosaics
- Spectral-line observations with all Arrays and continuum observations with the 12m Array and the 7m Array (except in Bands 9 and 10)
- Polarization at PI-specified frequencies (on-axis, continuum in Bands 3, 6 and 7 - no ACA, no mosaics, no spectral line, no circular polarization)
- Mixed correlator modes (both high and low frequency resolution in the same observation)

In Cycle 3, we expect that

- 75% of the time awarded will go to “standard modes”: projects with previously released capabilities with established reduction path through the pipeline
- 25% of the time awarded will go to “non-standard modes" - newly offered capabilities or modes not yet incorporated in the pipeline
  - this is data which cannot be processed by the pipeline at this time, which translates to manual data processing by ARC and JAO staff

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  - -- All observations in Bands 8, 9 & 10
    (and narrow [< 100 MHz] spectral window observations in Band 7)
  - -- Long baselines (> 2km)
  - -- Polarization
  - -- Spectral Scans
  - -- External ephemeris observations
  - -- Non-standard calibrations

ALMA Development Programs

- Optical Fiber project to connect OSF to Santiago
  - Completed as of the end of 2014
- ALMA Phasing Project (APP)
  - Full acceptance of all hardware in November 2014; commissioning observations to begin in 2015
- Production series for Band 5 (163-211 GHz)
  - Delivery of Band 5 receivers will begin in April 2015 (through 2017)
- Accepted and ongoing studies
  - Increased spectral coverage by designing, building and implementing a prototype receiver for ALMA Band 2 (67-90 GHz)
  - Prototype and production receiver for Band 1 (31-45 GHz)
  - Improved sensitivity and accuracy by decreasing gain variations in ALMA Band 3 receivers through modifications (magnets)
  - Increased flexibility through the addition of a 5th sub-array
  - ALMA usability increased through implementation of new tools for data exploration and visualization.
  - Improved solar observing strategies

A robust development program, which has begun even as the baseline project is being completed, will result in an ALMA that will produce transformational science for many decades to come.

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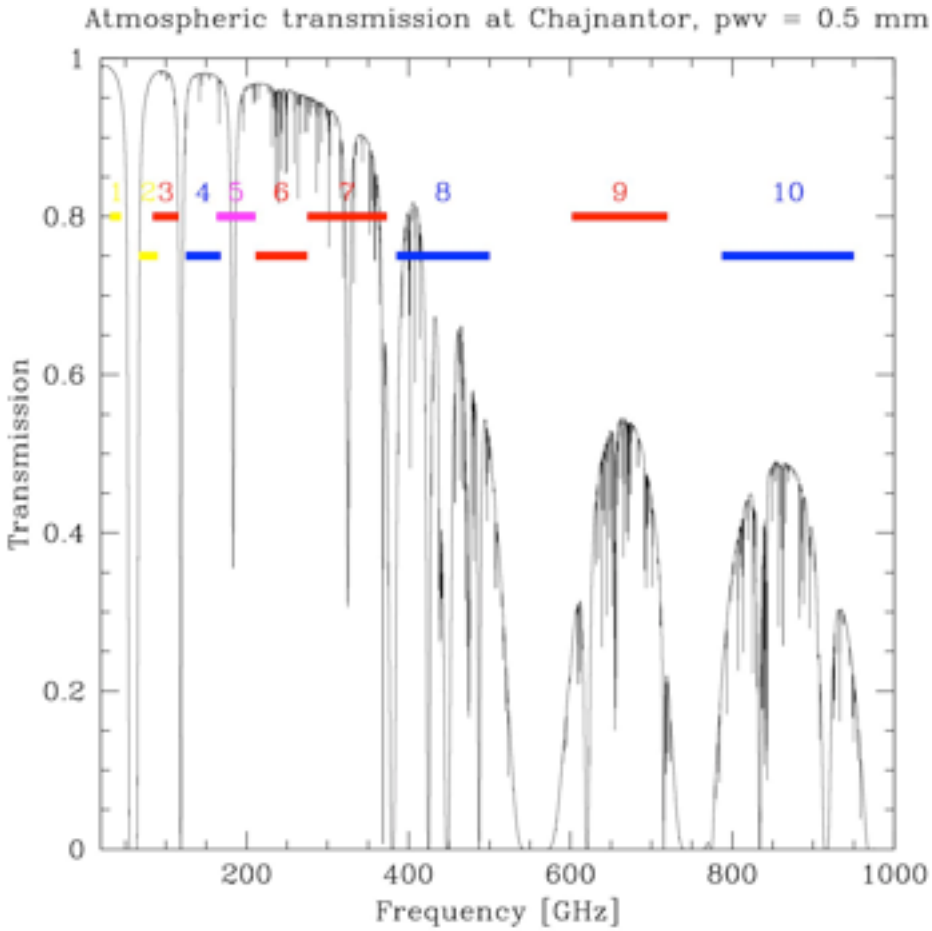
ALMA Bands and Atmospheric Transmission

Band	Frequency range (GHz)	Type
1	31.3– 45	SSB
2	67 – 90	SSB
3	84 –116	2SB
4	125 –163	2SB
5	163 –211	2SB
6	211 –275	2SB
7	275 –373	2SB
8	385 –500	2SB
9	602 –720	DSB
10	787 –950	DSB



ALMA, Cycle 0 and Cycle 1

- **Cycle 0: Sep 2011-Dec 2012 (990 proposals, 500h):**
  - 16 12-m antennas
  - Receiver Bands: 3, 6, 7 and 9
  - Highest angular resolution: 0.2”, longest baseline ~ 400 m
  - All data delivered

- **Cycle 1: Jan 2013-May 2014 (1131 proposals, 800h):**
  - 32 12-m antennas and ACA (9 7-m antennas, 2 Total Power antennas)
  - Receiver Bands: 3, 6, 7 and 9
  - Highest resolution 0.08”, longest baseline ~ 1 km
  - Data delivery in progress
  - Carry over to Cycle 2 ~ 460 hours

ALMA in Cycle 2

- June 2014 → October 2015
  - 1384 proposals received for a total of 2000 hours
  - 353 A & B rated proposals / 159 C rated proposals (fillers)
  - Carry-over from Cycle 1 of ~ 460 hours
  - 34 12-m antennas and ACA (9 7-m antennas, 2 Total Power antennas; this is the target, which is almost surpassed every night!
  - Receiver Bands: 3, 4, 6, 7, 8 and 9
  - Longest baseline 1.5 km