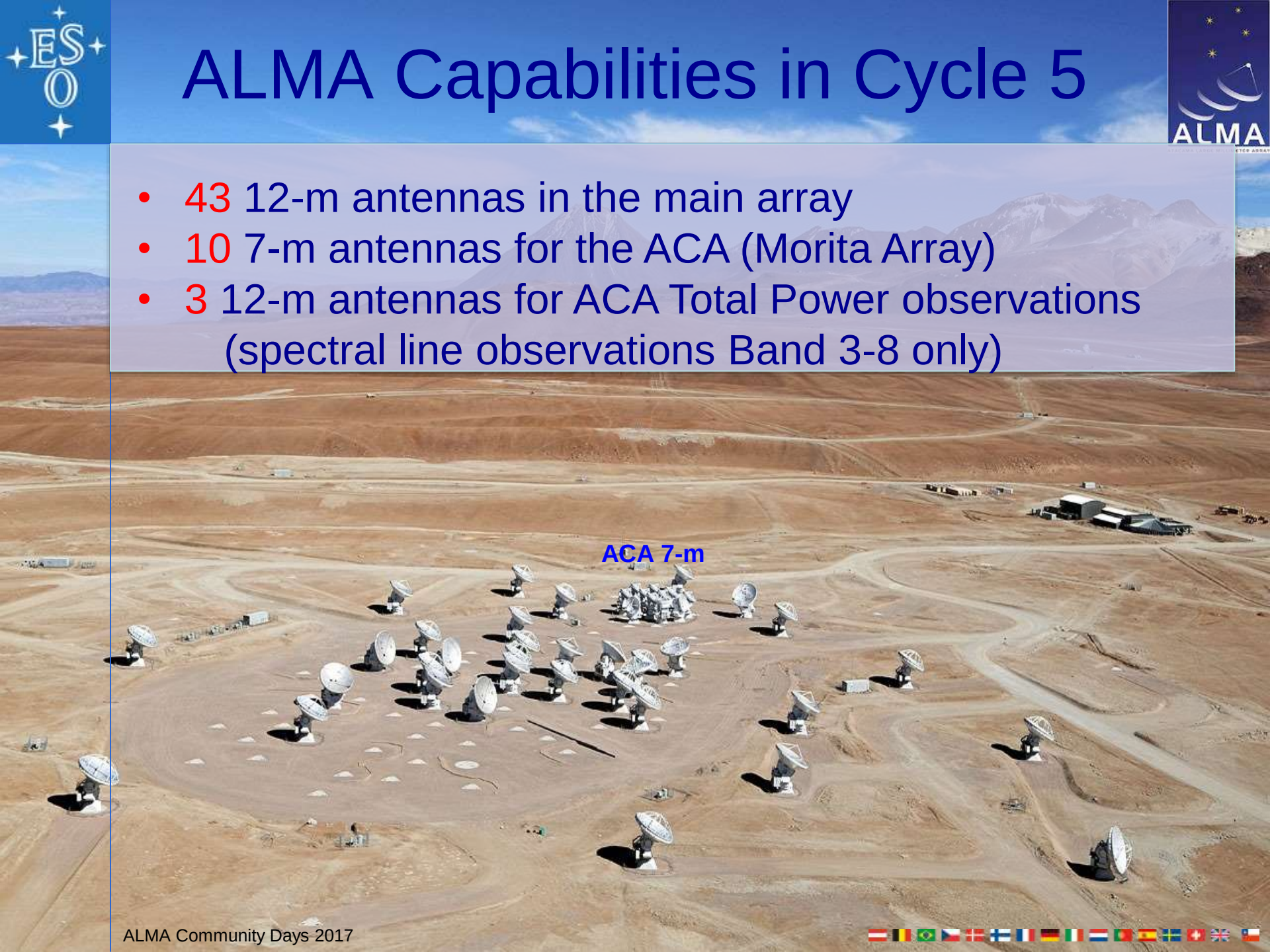
ALMA in Cycle 5

Suzanna Randall (ESO ARC)

ALMA Capabilities in Cycle 5

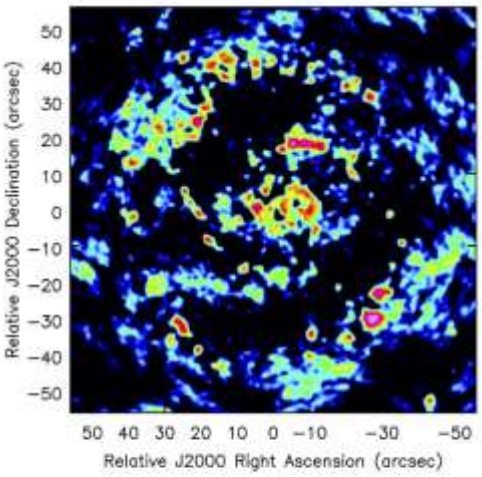
- 43 12-m antennas in the main array
- 10 7-m antennas for the ACA (Morita Array)
- 3 12-m antennas for ACA Total Power observations
  (spectral line observations Band 3-8 only)



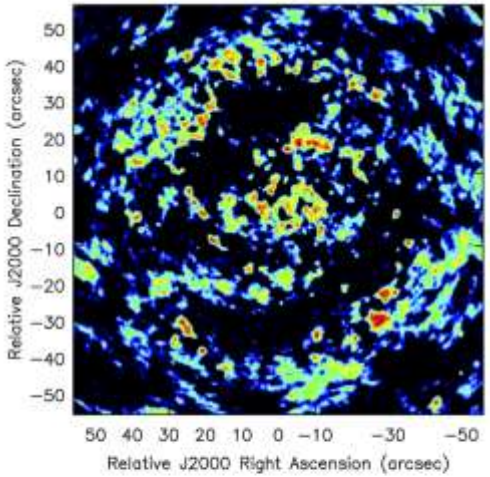
Configurations

- 10 12-m array configurations, C43-1 to C43-10
- 1 ACA configuration

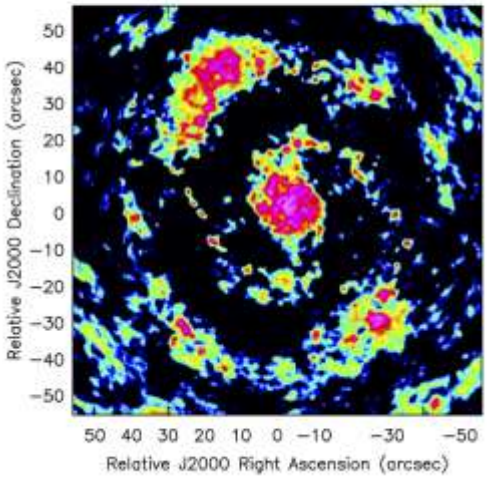
C43-3



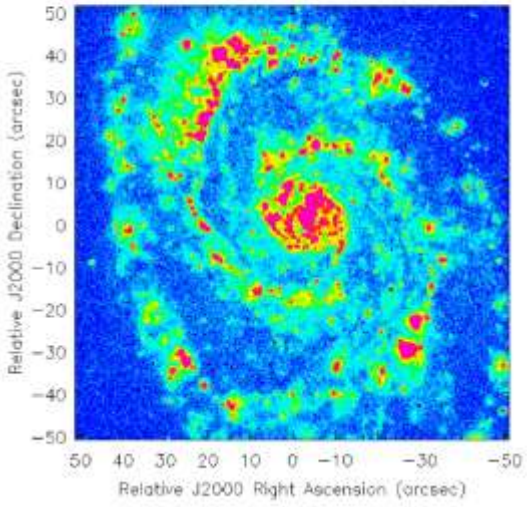
C43-3+C43-6



C43-3+C43-6+7-m



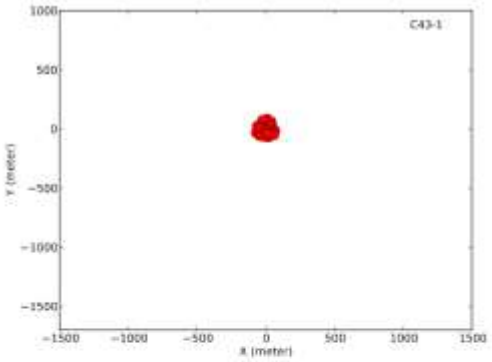
model

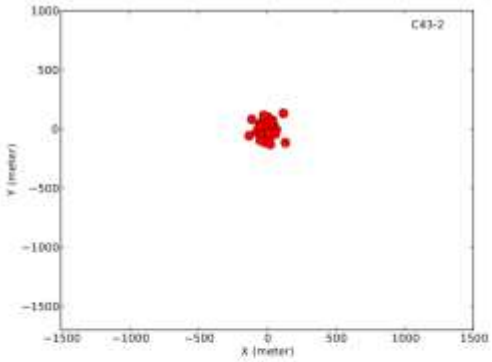


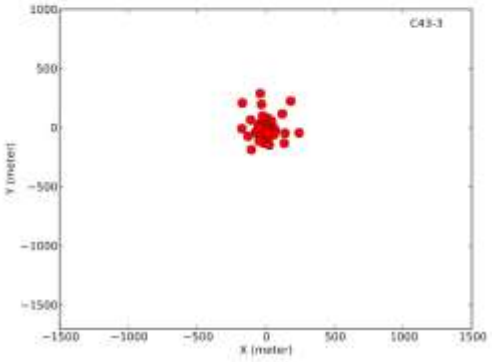
Combine different configurations to image different angular scales!

Configurations

- 10 12-m array configurations, C43-1 to C43-10
- 1 ACA 7-m configuration







Baselines from
15 – 500 m

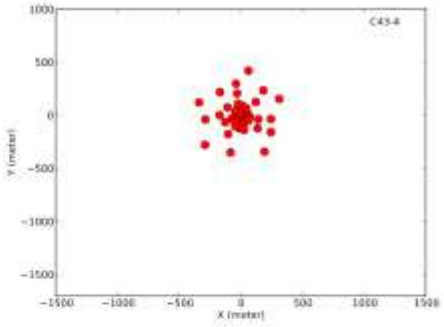
Compact Configurations:
C43-1 – C43-3

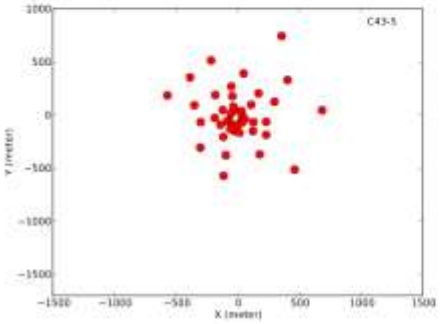
- Can be paired directly with ACA
- Angular resolution ~0.4-1” (B7)
- All bands offered
- Solar & VLBI

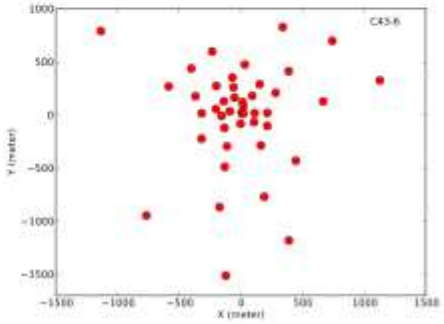
Configurations

- 10 12-m array configurations, C43-1 to C43-10
- 1 ACA configuration

Baselines from
15 m – 2.5 km



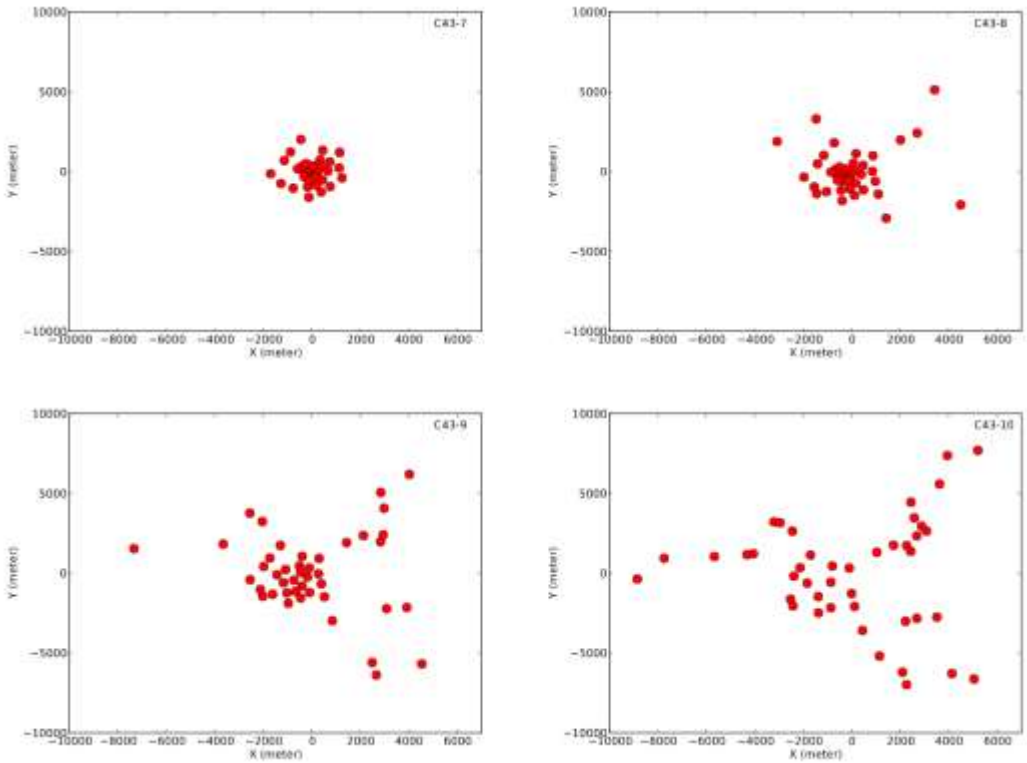




Intermediate Configurations: C43-4 – C43-6

- Can be paired with one of the compact 12-m configurations
- Can then also use ACA
- Angular resolution ~0.09-0.3” (B7)

Configurations



Baselines from
64 m – 16.2 km

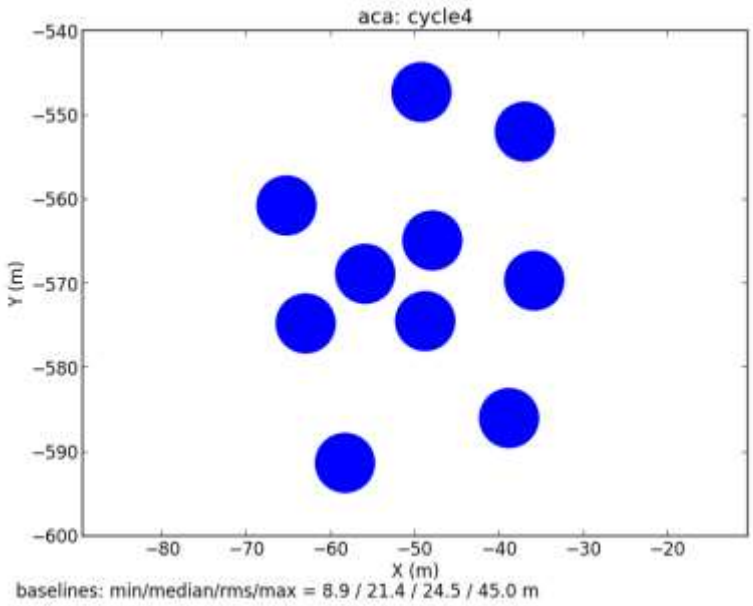
Band 5 not offered in any of the extended configurations due to the configuration schedule!!!

Extended Configurations

- C43-7 – C43-9 can be paired with one of the intermediate 12-m configurations
- C43-10 cannot be paired at all
- No ACA
- Angular resolution ~0.02-0.09” (B6)
- C43-7: all bands
- C43-8: B3-7
- C43-9/10: B3-6

Configurations

- 10 12-m array configurations, C43-1 to C43-10
- 1 ACA configuration



7-m array: Baselines from 9 – 45 m

ACA

- Consists of 7-m array and TP if necessary for requested LAS
- Can be paired with 12-m array or used in stand-alone mode
- TP is available ONLY together with 7-m array and ONLY for spectral line observations B3-8
- Angular resolution ~3.6” (B7)

ALMA Bands

- Bands 3, 4, 6 (84-275 GHz) offered for all configurations
- Band 5 (NEW!) (163-211 GHz) for C43-1 to C43-5
- Band 7 (275-373 GHz) for C43-1 to C43-8
- Bans 8, 9, 10 (385-950 GHz) for C43-1 to C43-7

Band 3	Band 6	Band 7	Band 9	Band 4	Band 8	Band 10	Band 5
HIA	NRAO	IRAM	NOVA	NAOJ	NAOJ	NAOJ	GARD+

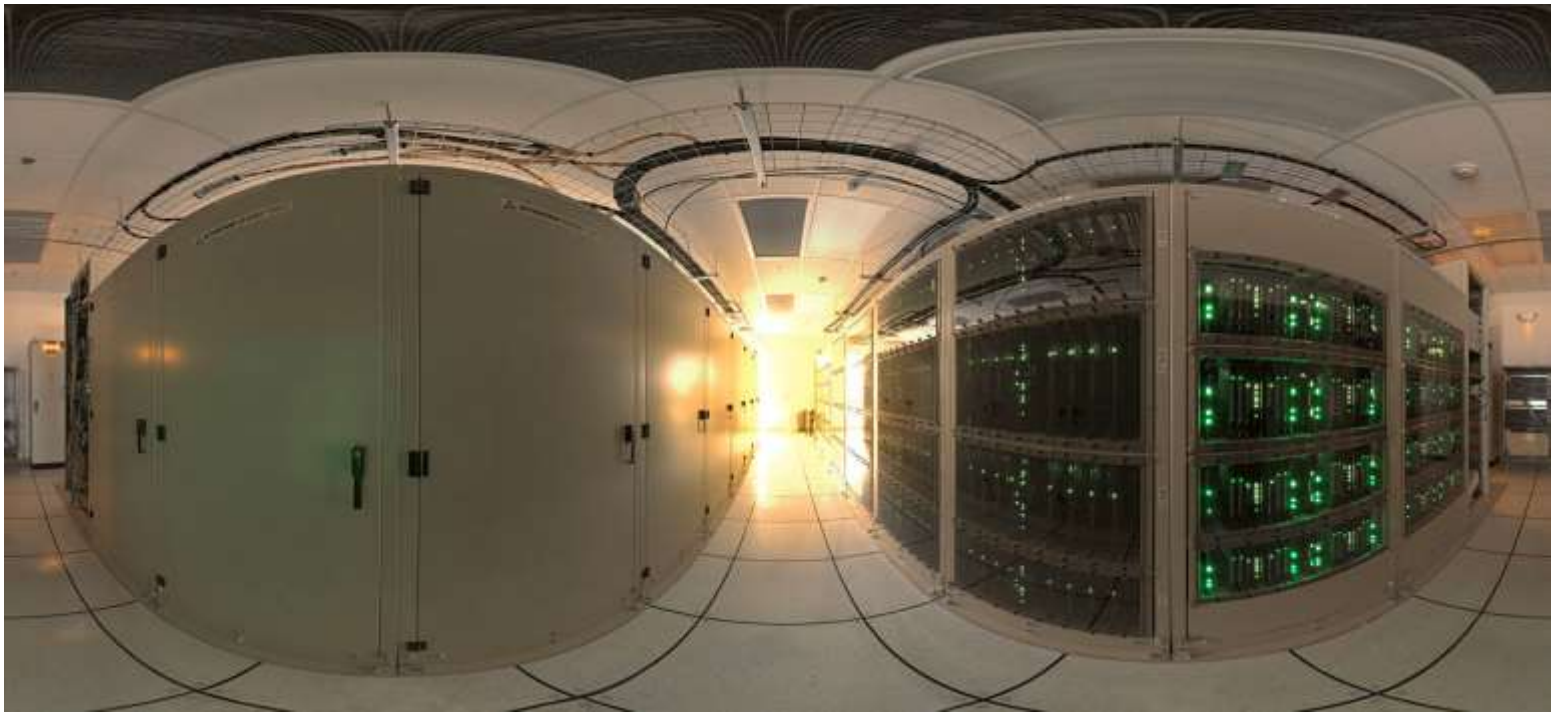
ALMA Bands

Band	Frequency range[1] (GHz)	Wavelength range (mm)	IF range (GHz)	Type
3	84 – 116	3.6 – 2.6	4 – 8	2SB
4	125 – 163	2.4 – 1.8	4 – 8	2SB
5	163 – 211	1.8 – 1.4	4 – 8	2SB
6	211 – 275	1.4 – 1.1	5 – 10	2SB
7	275 – 373	1.1 – 0.8	4 – 8	2SB
8	385 – 500	0.78 – 0.60	4 – 8	2SB
9			4 – 12	DSB
10			4 – 12	DSB

NEW: Walsh switching enabled for B9 and 10! This means the data from the “image” or “mirror” spectral windows can now be recovered!

Spectral capabilities

- 6 FDM correlator modes (3840 channels, spectral line)
- Spectral resolution up to 0.03 MHz (Dual Polarization)
- 1 TDM correlator mode (128 channels; continuum)
- 7.5 or 15 GHz total continuum bandwidth (15 GHz with Walsh switching enabled for B9 and 10)

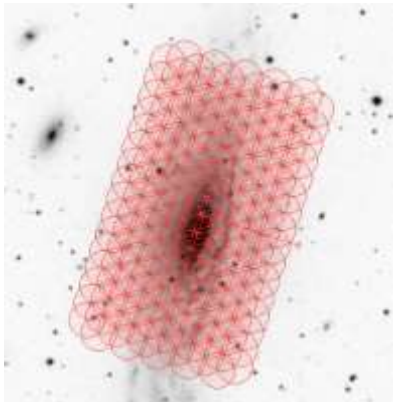


Spectral capabilities

- 4 basebands with up to 4 spectral windows each
- Different correlator modes possible in different basebands
- Single polarization for best spectral resolution (0.015 MHz)
- Full polarization measurements offered for TDM and FDM modes
  - Offered for Bands 3, 4, 5, 6, 7
  - On-axis sources only
  - Single pointings only
  - Minimum 3 hours
- Spectral dynamic range offered:
  - 1000 for Bands 3, 4, 6
  - 500 for B 5, 400 for B 7, 250 for B 8, 170 for B 9, 150 for B 10

Field setup capabilities

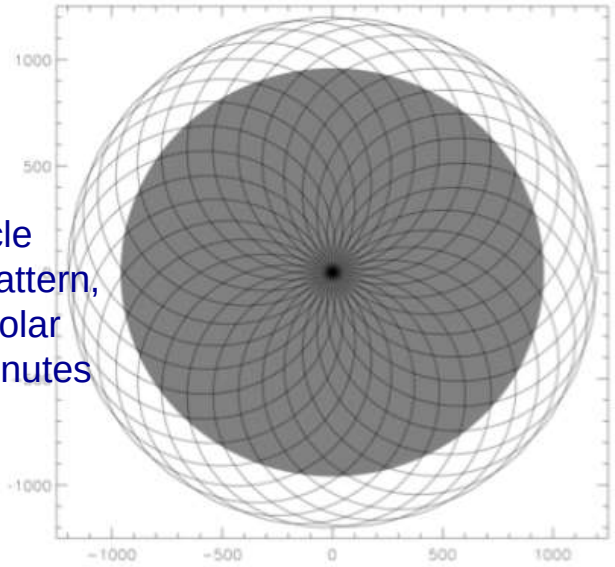
- Sources up to declination of +47° possible, but declinations less than +37° preferable
- Mosaics and overlapping offset pointing patterns allowed
- New: non-overlapping pointings not allowed within one source definition
- No mosaics for Band 10
- Maximum number of 12-m pointings to be observed and imaged together (in one source cluster) is 150
- Imaging dynamic range up to ~100 in Bands 3-7
- closer to 50 in Bands 8-10 and for baselines > 2 km
- Astrometric accuracy typically ~ angular resolution/20 with a minimum of 0.003”

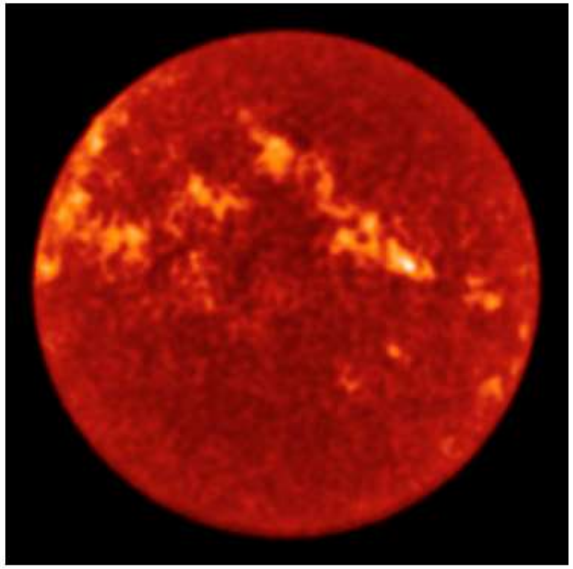


Solar observations

- Conducted in campaign mode during one of the 3 most compact 12-m array configurations
- Only Band 3 and 6 pre-defined continuum setups
- No full polarization
- Special interferometric array comprising 12-m array and 7-m antennas
- Contemporaneous TP observations always included

Double-circle scanning pattern, can scan Solar disk in 7 minutes

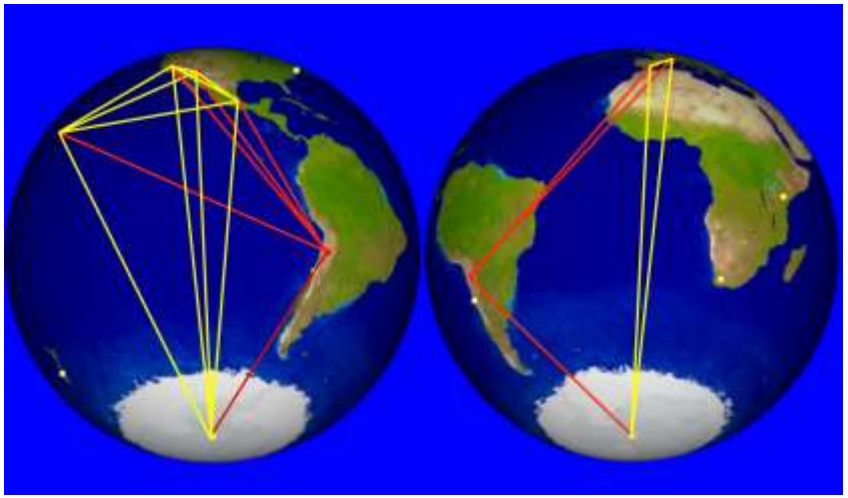




Real TP map of the Sun!

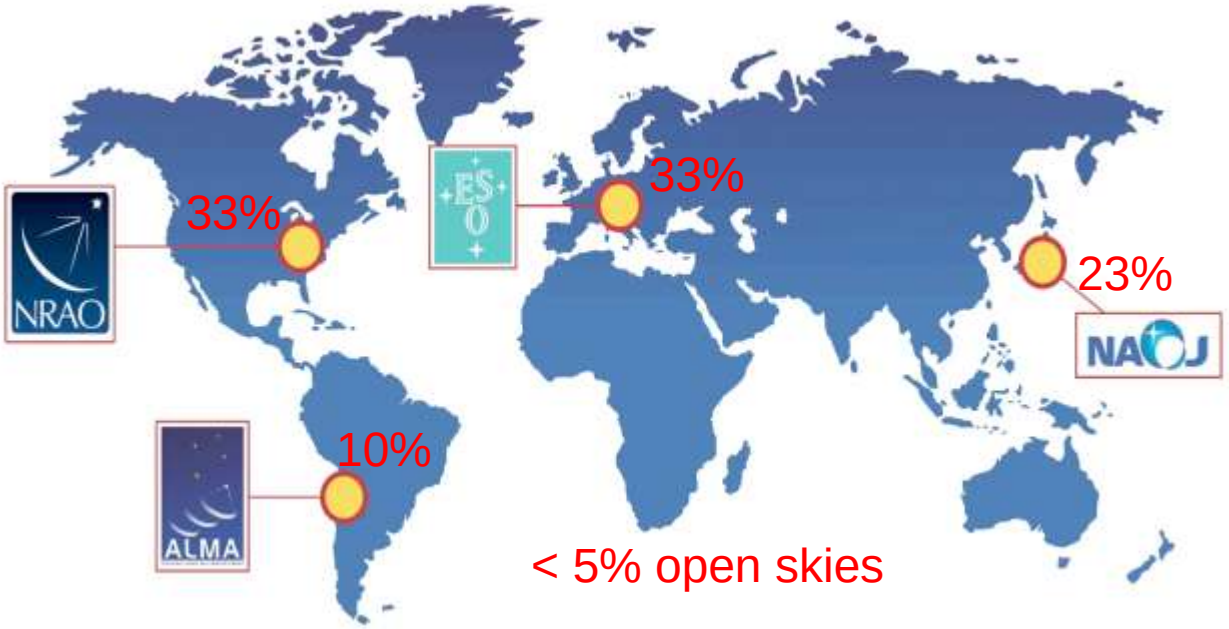
VLBI

- Conducted in campaign mode during one of the most compact 12-m array configurations
- Phased-up ALMA array will be used as a single dish
- Only targets with flux > 0.5 Jy on baselines out to 1 km allowed
- Only Band 3 and 6 pre-defined continuum setups
- For Band 3 proposals must have also been submitted to GMVA (deadline was on Feb 1)
- For Band 6 ALMA will forward the proposals to the EHTC network – PIs need to submit a proposal only to ALMA!
- Co-PIs are allowed



Large Programs

- More than 50 h of 12-m array or more than 150 h of Standalone-ACA time
- Standard modes only, no time-critical or ToO programs
- Allows time-intensive observing programs to be split across executives of the PI and (multiple) co-PI s
- Data products to be delivered to ALMA within 1 year of data delivery

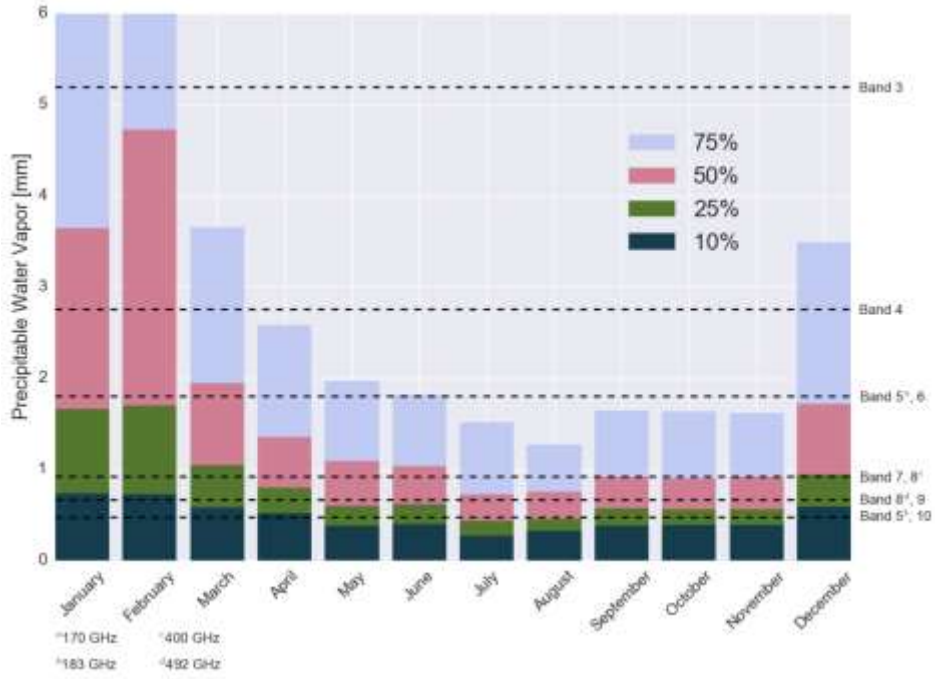


Observing Time available

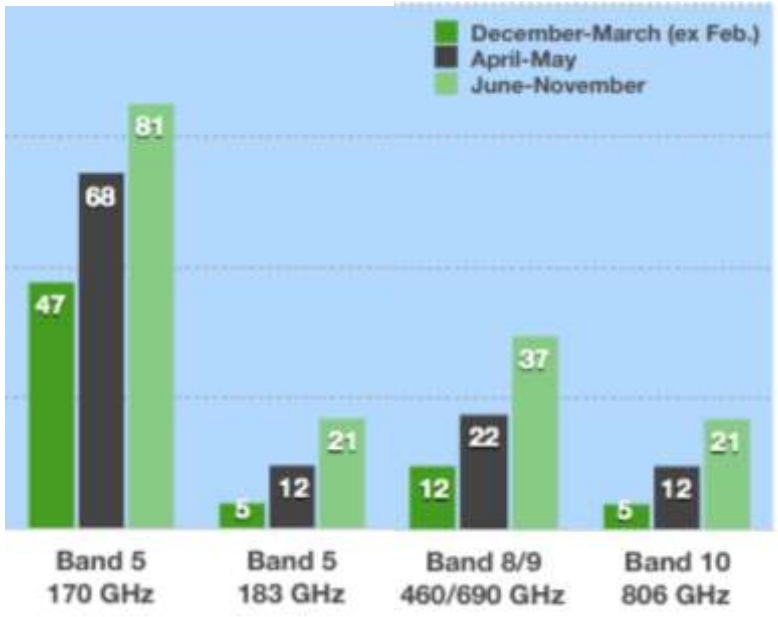
- Up to 4000 hours offered on the 12-m Array and up to 3000 hours on the ACA
- Maximum of 20% for non-standard observing modes:
  - High frequency (Bands 8, 9, 10)
  - Band 7 observations with maximum baselines > 5 km
  - Full polarization
  - Spectral scans
  - Bandwidth switching projects (< 1GHz aggregate bandwidth)
  - Non-standard calibrations (user-defined calibrations selected in OT)
  - Solar & VLBI
  - Astrometric observations (require user-defined calibrations)
- Large Programs limited to 15%, VLBI and DDT observations to 5% (each) of the total available time

Scheduling science observations

- Scheduling priority (in decreasing order): weather, requested AR/LAS, target elevation, project's priority rank, project completion
- Priority: Cycle 4 A-rank (carry-over), Cycle 5 A, Cycle 5 B, Cycle 5 C
- Solar & VLBI observations have priority during the campaigns



Fraction of time that the PWV falls below a given value over a year



B5 water line, B8/9 and B10 observations possible only ~10-20% of the time, mostly in June-November

Duplications & Resubmissions

- Duplications are not permitted unless scientifically justified
- PIs need to check proposed observations against the archive and the list of Cycle-4 accepted programs
- NEW: Text field in OT for justifying duplications
- NEW: Re-submissions are now determined by the observatory on a per-SG basis
- To be classed as a re-submission, the Cycle-5 SG is
  - a duplication of an active (Cycle-4) SG

  AND
  - the PI of the corresponding Cycle-4 project is PI or co-I on the Cycle-5 project OR the Cycle-5 PI is a co-I on the Cycle-4 project

Phase-2 preparation by PIs

- PIs will need to review and submit their Phase-2 material by the Phase-2 submission deadline
- After notification of grades, PIs with A, B or C grades must download their accepted project
- Minor changes can be made directly by the PI
- Major changes require a change request (via Helpdesk); the necessary changes can only be made by an ALMA staff member, who will submit the project on behalf of the PI
- NEW: in Cycle 5, PIs will not create SBs - this will be done by ALMA after the Phase-2 deadline

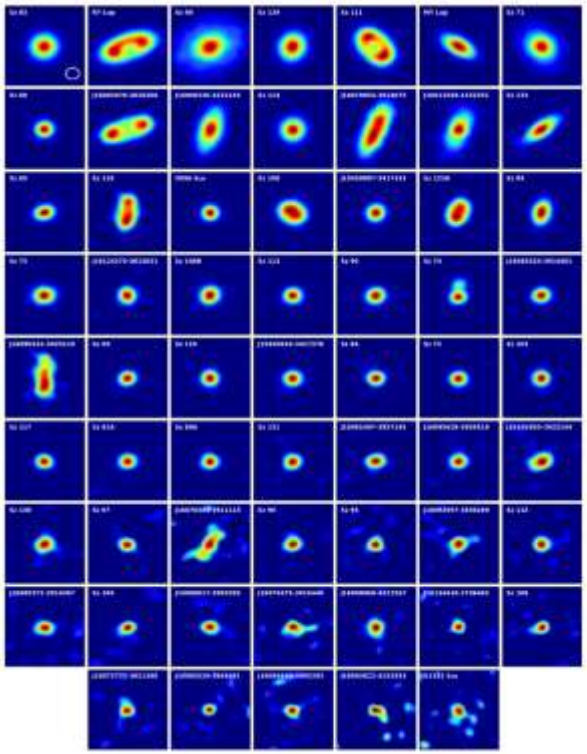
Cycle-5 Timeline

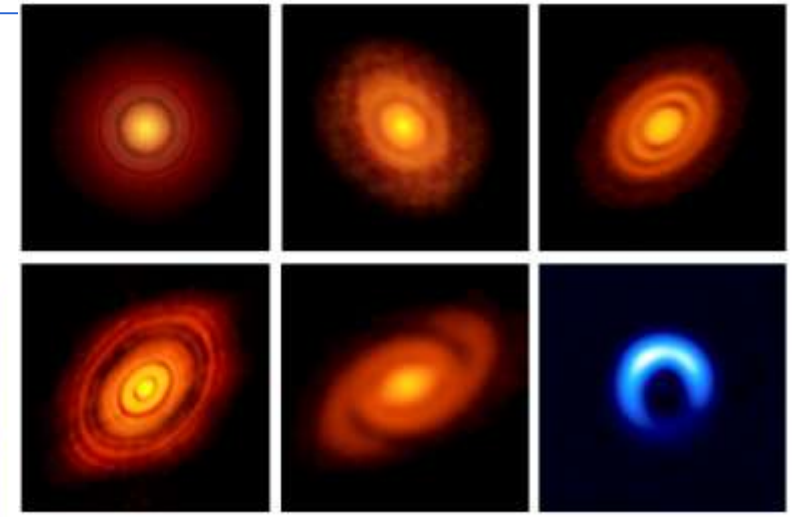
- Call for Proposals: March 21, 2017
- Proposal Deadline: 15:00 UT on April 20, 2017
- Announcement of the PRP outcome: late-July 2017
- Submission of Phase 2 by PIs: September 2017
- Start of observations: October 2017
- Nominal duration of Cycle 5 is 12 months

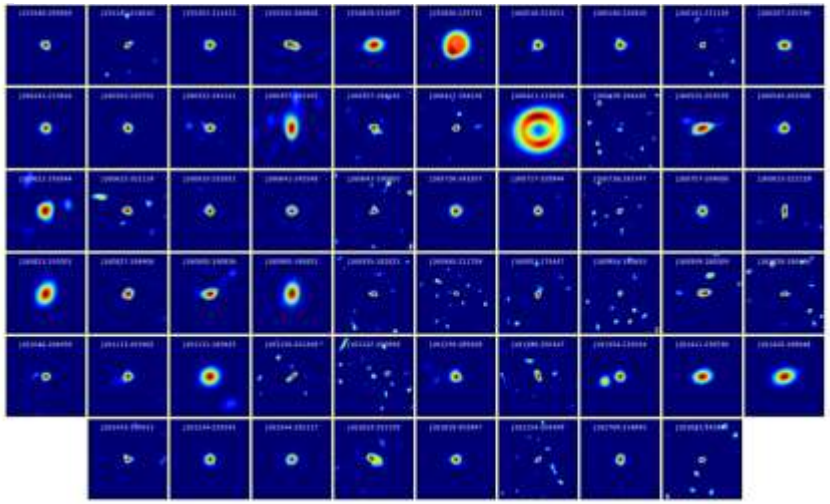
More information available on the Science Portal:

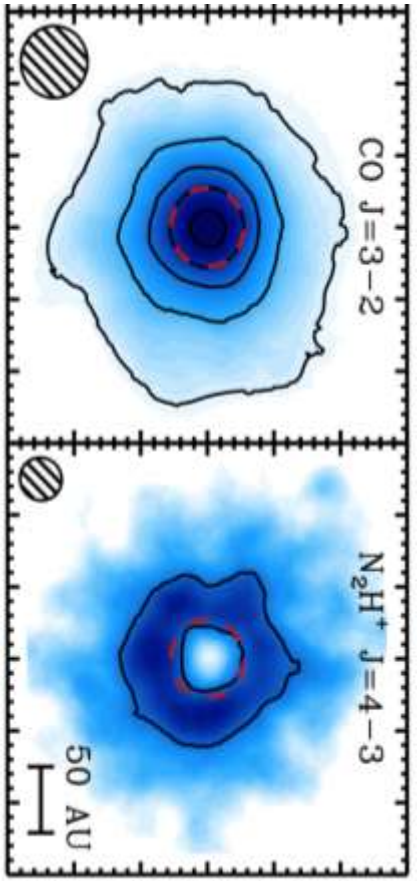
www.almascience.eso.org

Planet forming disks



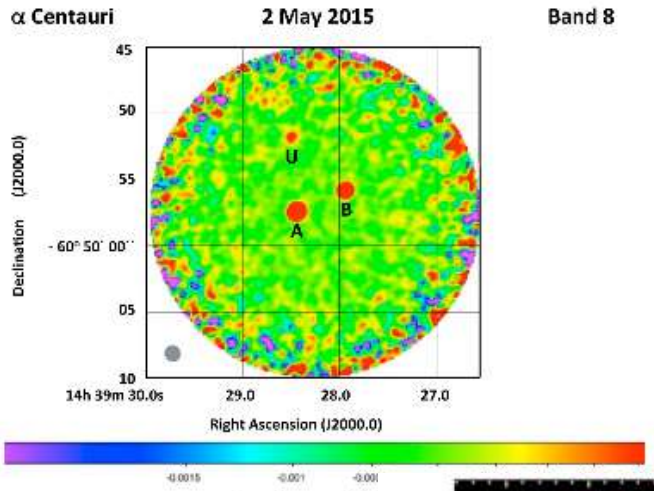


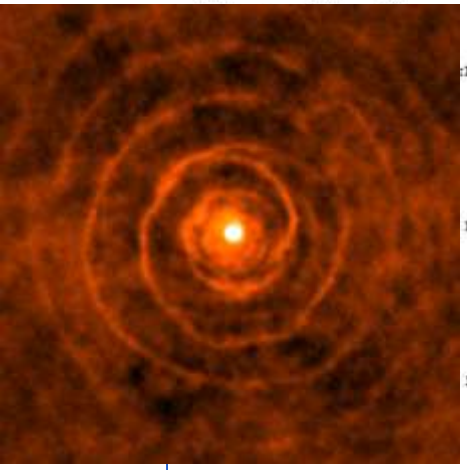


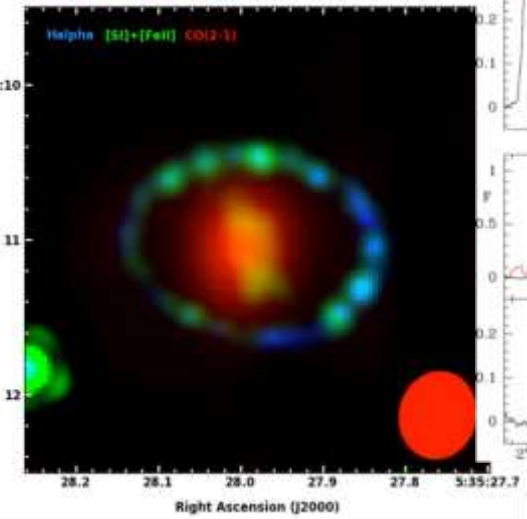


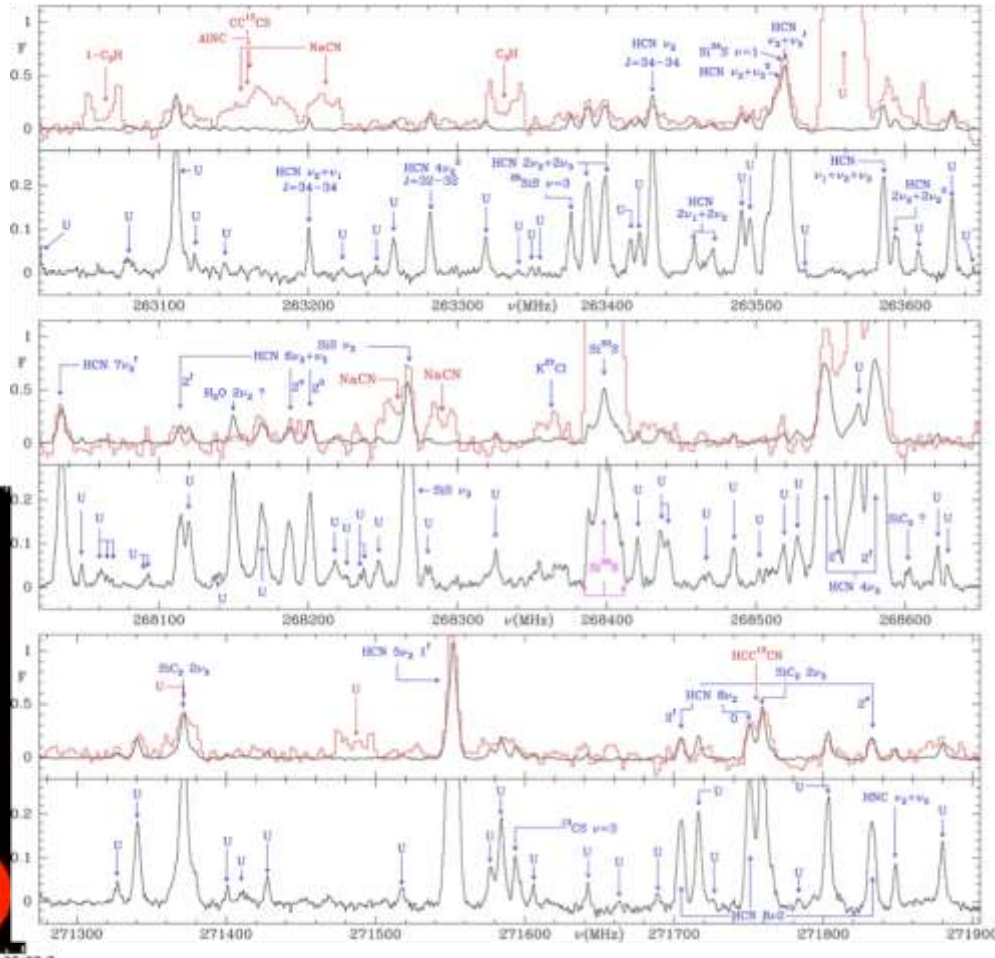
- Gaps, holes and asymmetries: the trademarks of planets
- Disk gas content: mass and chemical composition

Stellar astrophysics



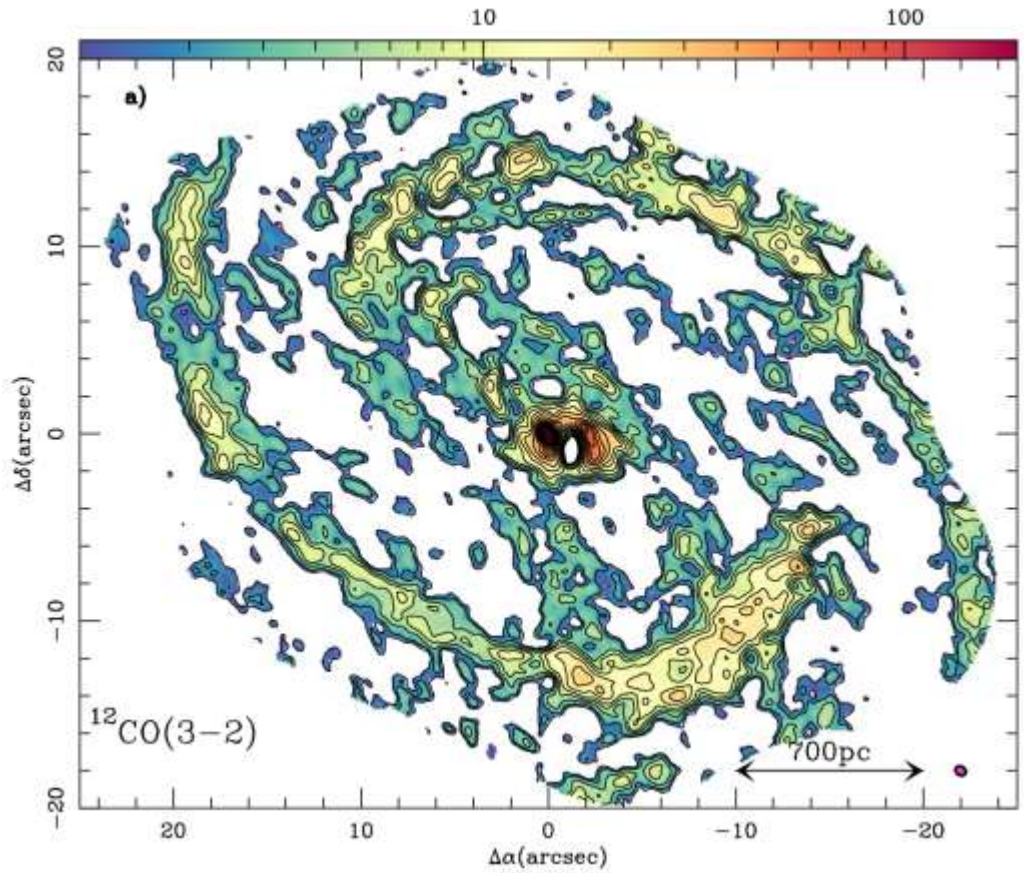


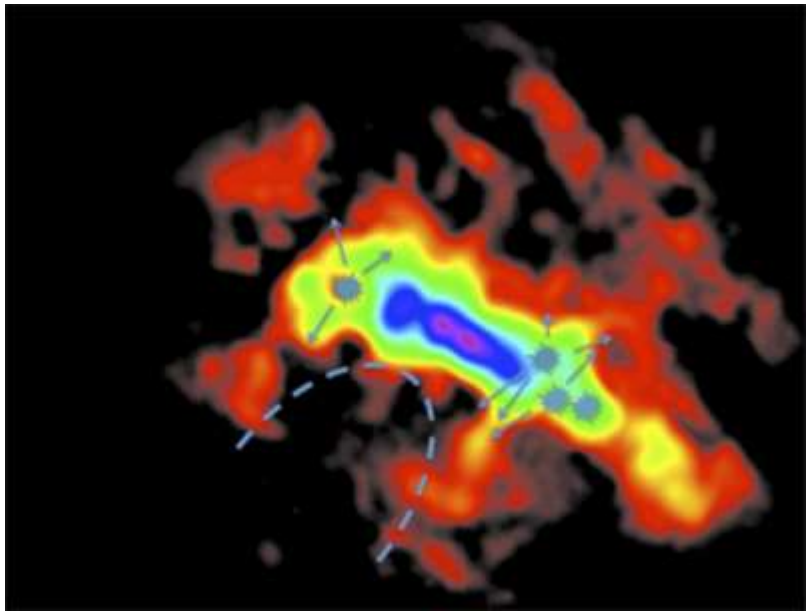




- The alpha-Cen system, SN 1987A
- Mass loss from AGBs, chemical richness

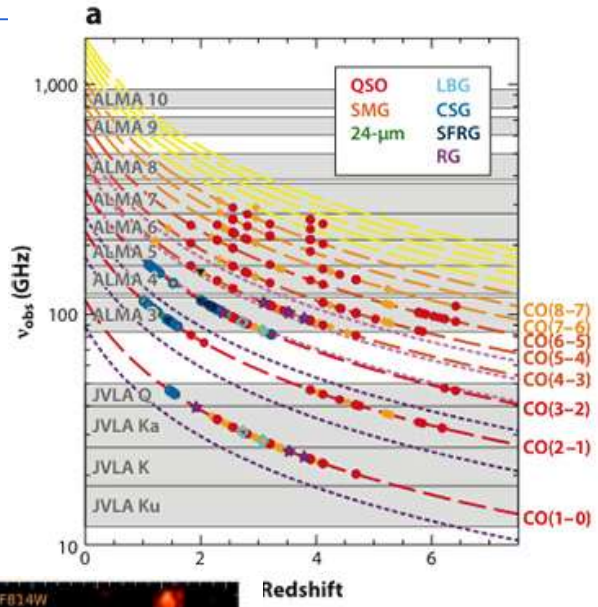
Galaxies and their nuclei

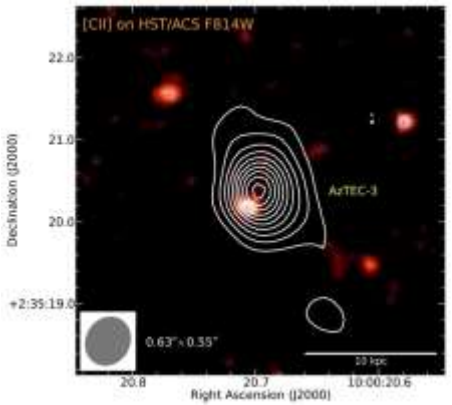


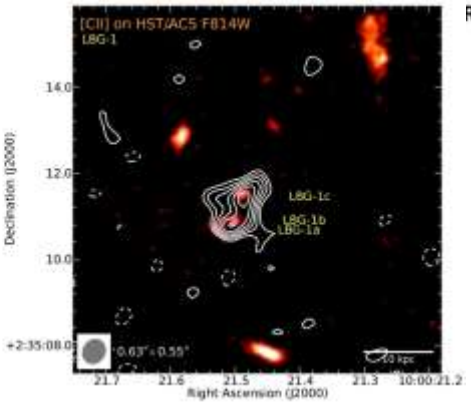


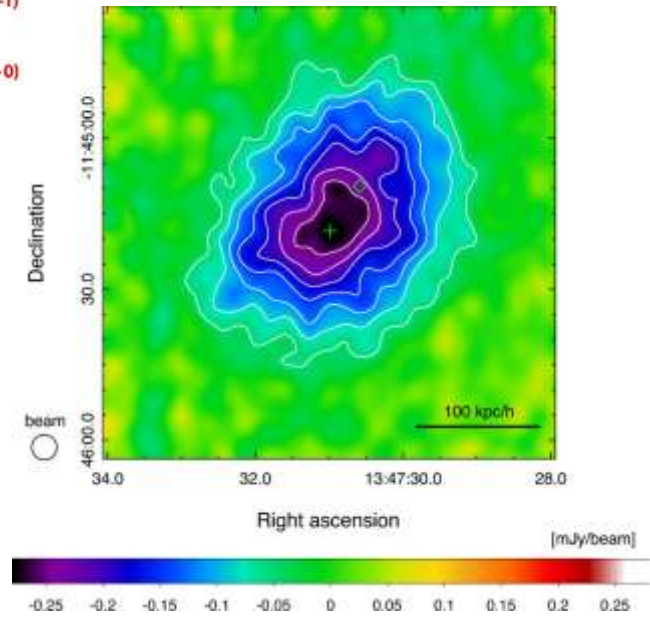
- Molecular clouds and AGN in NGC1068
- Star formation and galactic scale feedback in NGC253

The high-z Universe



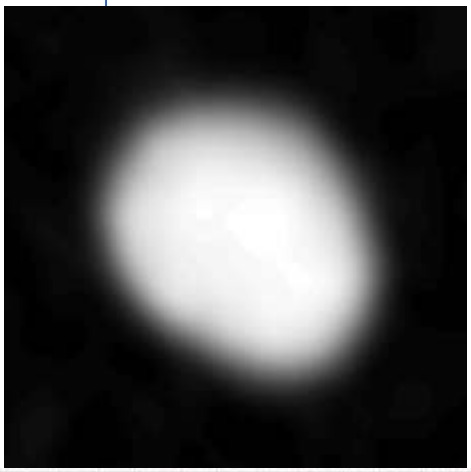


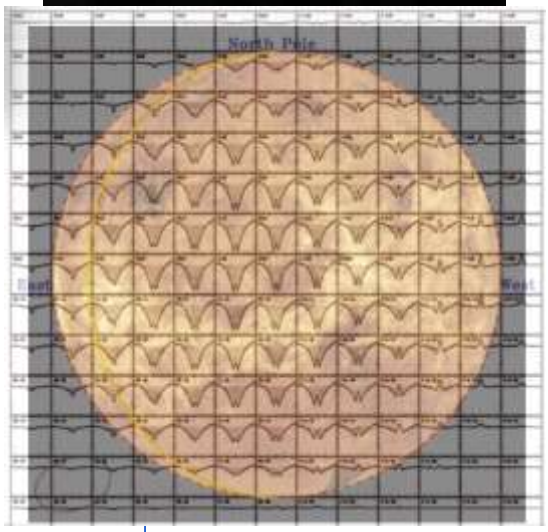


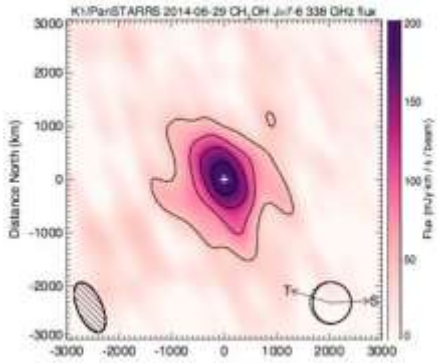


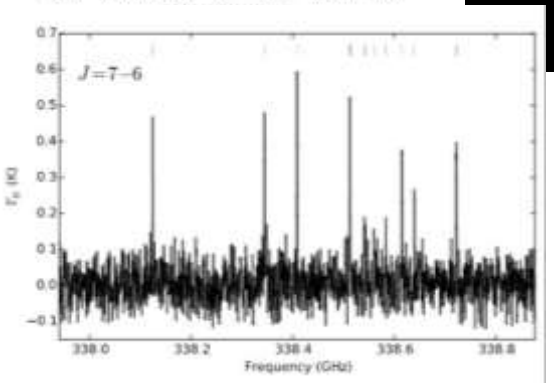
- Lensed star forming galaxies
- Atomic and molecular gas at high-z, the SZ effect

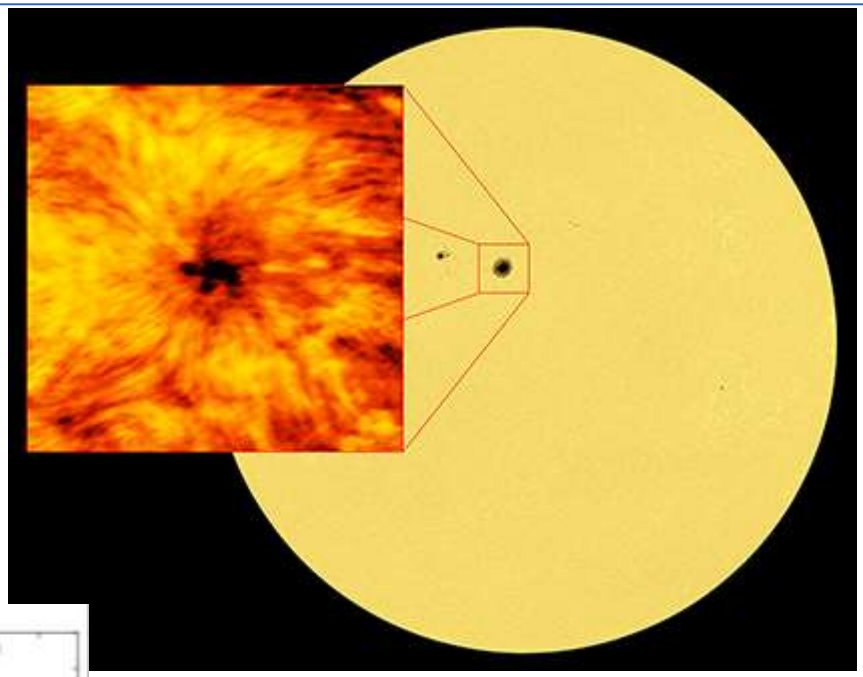
Solar System

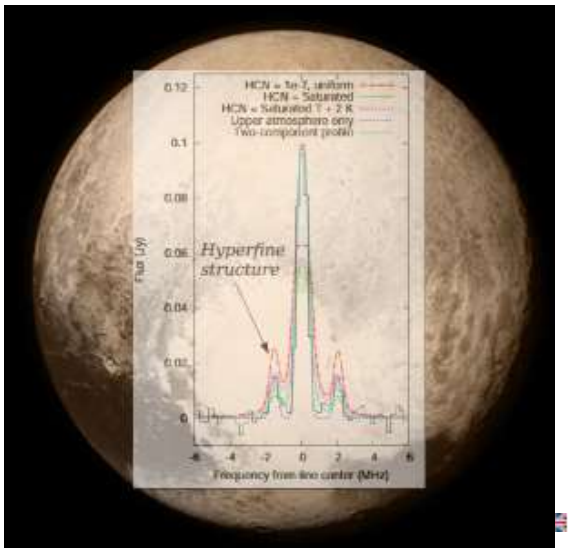












- Asteroids, planetary atmospheres
- Comets and the Sun