# Recent EA-ARC Activities and Preliminary New Functions/Capabilities in Cycle 6

Hiroshi Nagai (NAOJ)

# Global Collaboration

# EA-ARC

- 10 Staff in NAOJ
- 9 in ASIAA, Taiwan
- 7 in KASI, Korea

# Recent Personnel Change in EA-ARC

- Ken Tatematsu who was EA-ARC manager left.
  - Misato Fukagawa will become a new manager. Until she will arrive, Hiroshi Nagai takes as an interim manager.
- Left: Erik Muller, Kana Morokuma, Naslim Neelamkodan, Toshiki Saito
- New comer
  - NAOJ: Yu-Ting Wu (Taiwan -> Japan), Daniel Tafoya (Sweden -> Japan)
  - ASIAA: Yusuke Aso (Japan -> Taiwan)

# WG/Subsystem Cognizant Leads and deputies in EA

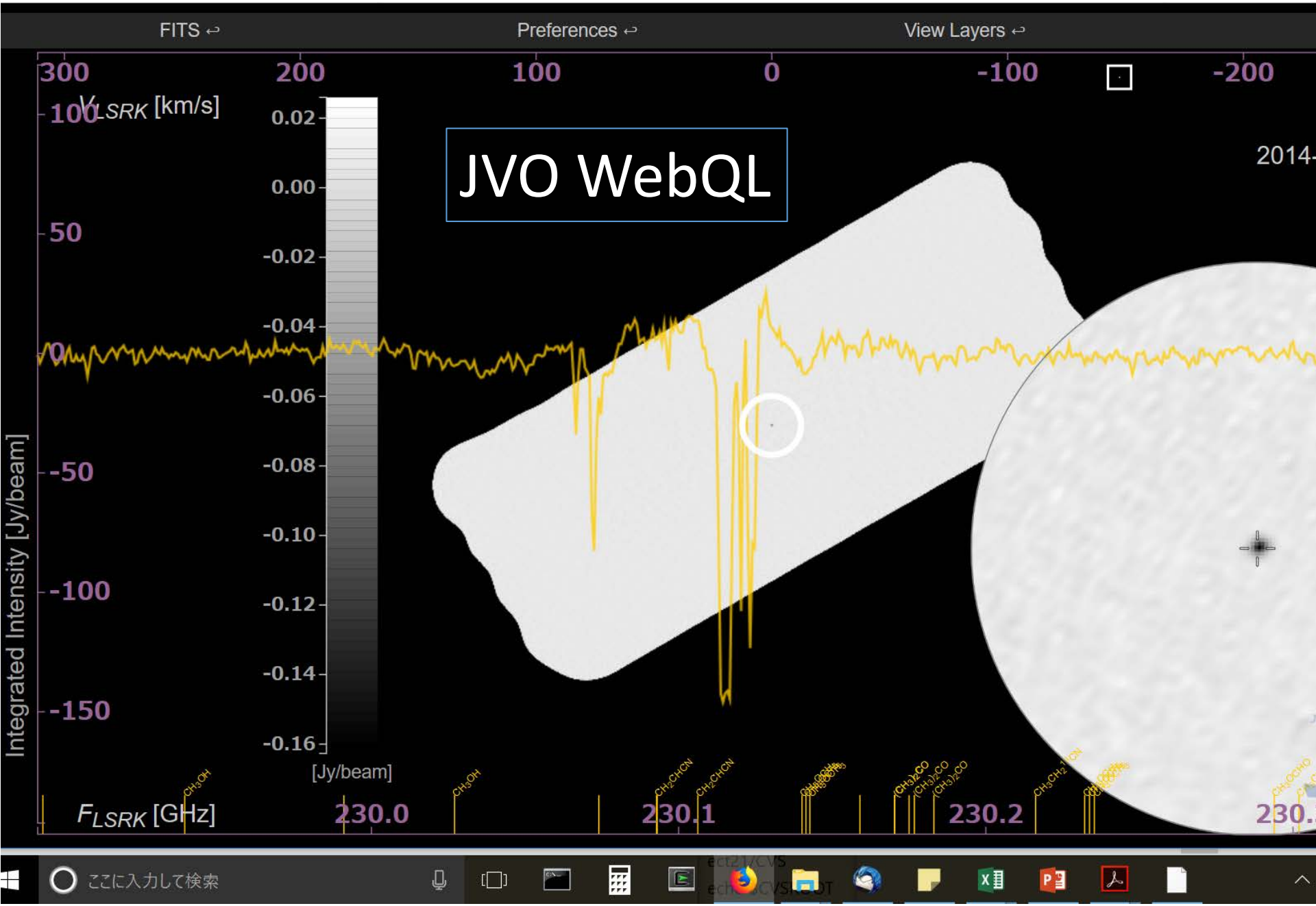
- ARC managers: H. Nagai (interim), Aran Lyo (Korean node), Yu-Nung Su (Taiwanese node)
- P2G WG: D. Espada
- Data Reduction WG: K. Nakanishi, A. Trejo, (H. Nagai)
- Pipeline WG: F. Egusa (interferometry), D. Espada (interferometry), R. Miura (single dish) -> D. Tafoya
- Helpdesk: K. Saigo, F. Egusa
- Archive: K. Nakanishi, K.-S. Wang
- CASA single dish: D. Tafoya
- AQUA: E. Akiyama
- OT: D. Espada

# ARC Core Functionalities

- Support of Observation Proposal
- Support of Observing SB preparation for successful proposal
- Manual/pipeline data reduction instead of PI and Quality Assurance
  - ALMA for non radio astronomers, even biochemists can use it!
  - ALMA is the first radio telescope, quality assured
- Data delivery to PI
- Data Archive and support of Archive Astronomy

# East Asia specific functionalities

- Software development and maintenance
  - Control software for ACA antennas and correlator
  - CASA single dish function (including pipeline) for ALMA TP data and other radio telescope (Nobeyama, ASTE…)
- Laboratory Molecular Line Catalog with Toyama University (K. Kobayashi) to be compared with ALMA observations
- Collaboration with Japanese Virtual Observatory (JVO)


FITS
Preferences
View Layers
JVO WebQL
$V_{LSRK}$ [km/s]
Integrated Intensity [Jy/beam]
[Jy/beam]
$F_{LSRK}$ [GHz]
230.0
230.1
230.2
2014-

# Major Updates and News in WGs/Subsystems (last ~6 montsh)

# Helpdesk

- Both users and staff can post a reply via email (started on Dec. 01, 2016)
- Reconfiguring Knowledgebase articles
- New workflow for ToO, TC, and Solar projects with Helpdesk. PI submits the trigger via Helpdesk and AoDs and/or JAO staff can directly contact PI.
- New department for proprietary period extension requests.

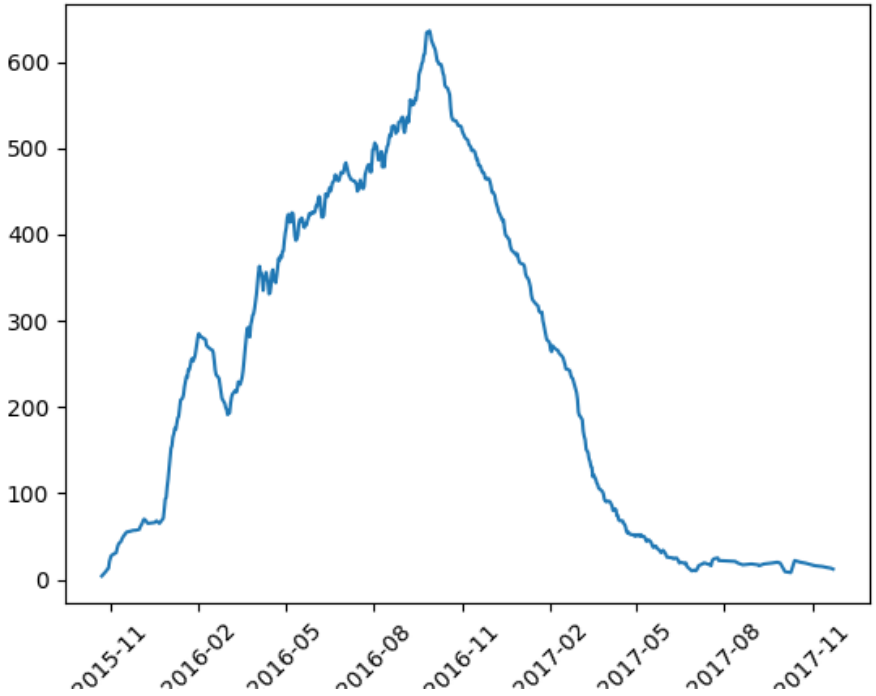
# Data Reduction / Quality Assurance

- Pipeline operation (including imaging) started at NAOJ in March 2017
- Three data analysts by contract in addition to ARC staff
- New data WF using AQUA (ALMA QUality Assurance system) has started from Cy5
- First solar data were delivered in July (thanks to the help by M. Shimojo and solar team)
- A few Cy3/4 projects have not been delivered and the data reduction is underway. A few Cy5 data was recently delivered using new WF system.

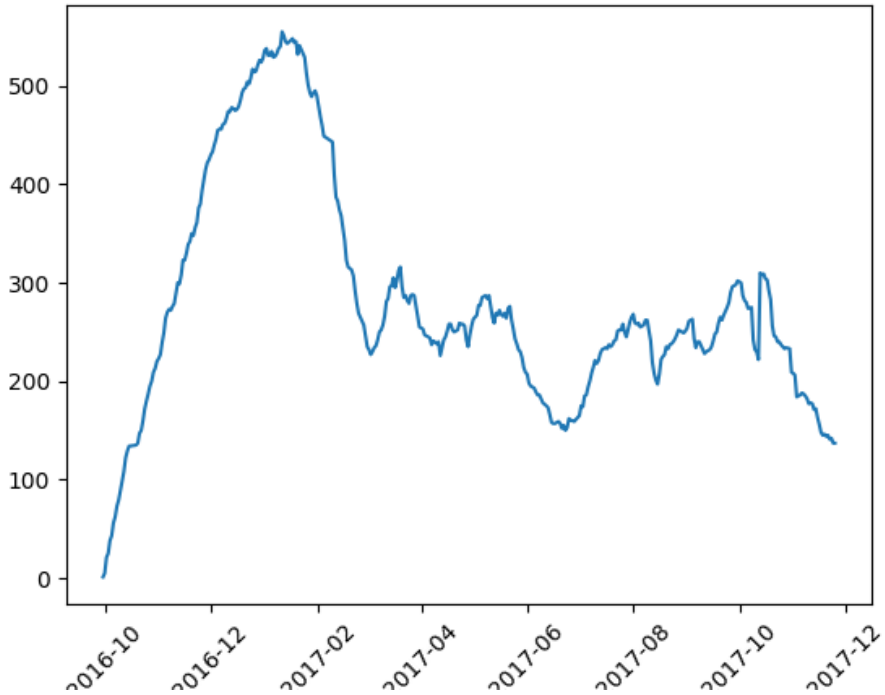
# Delivery backlogs (all regions)

Difference between Delivered SBs and FullyObserved SBs

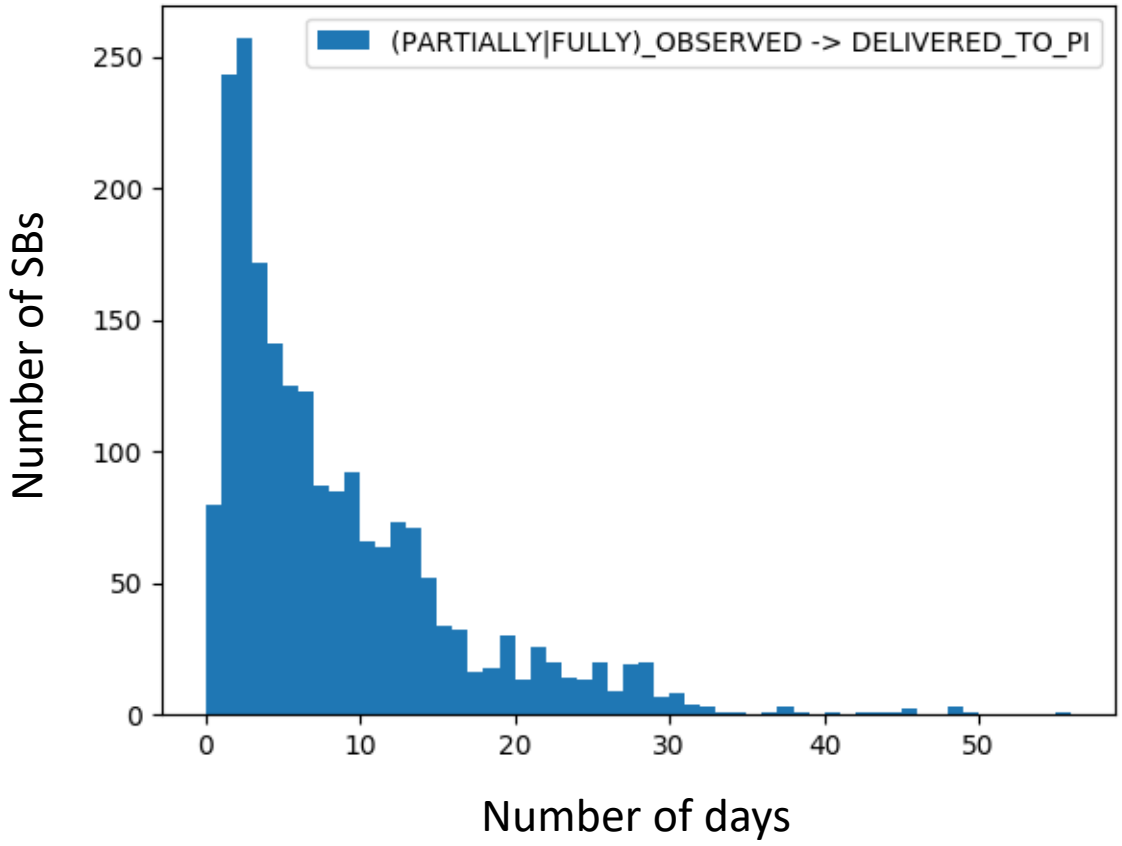
Cy3 data




Cy4 data

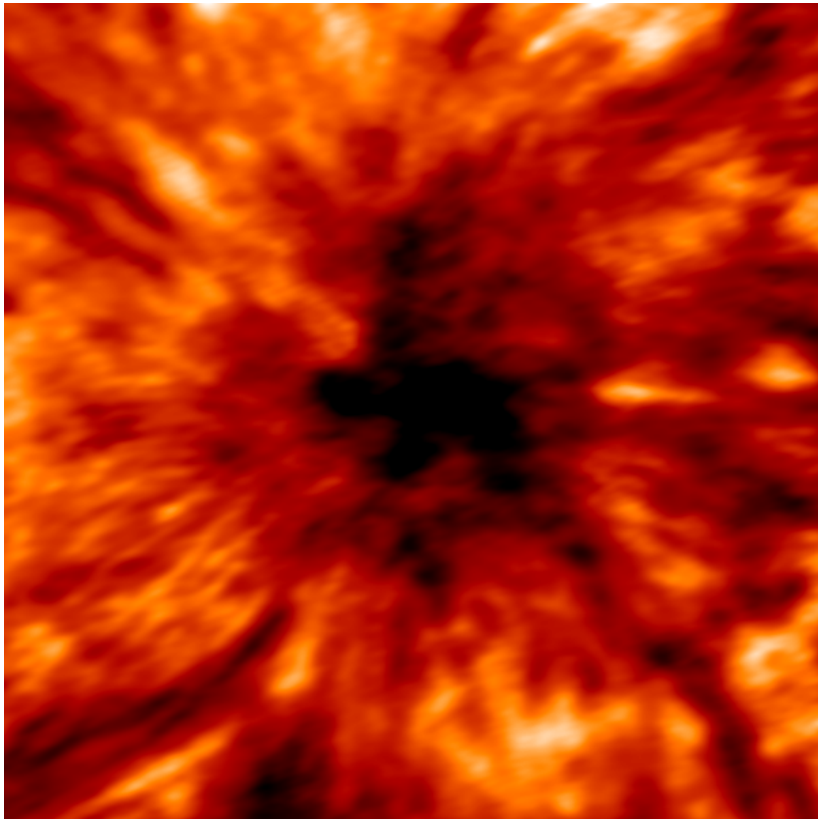


# Time spent for data delivery (Cy4)

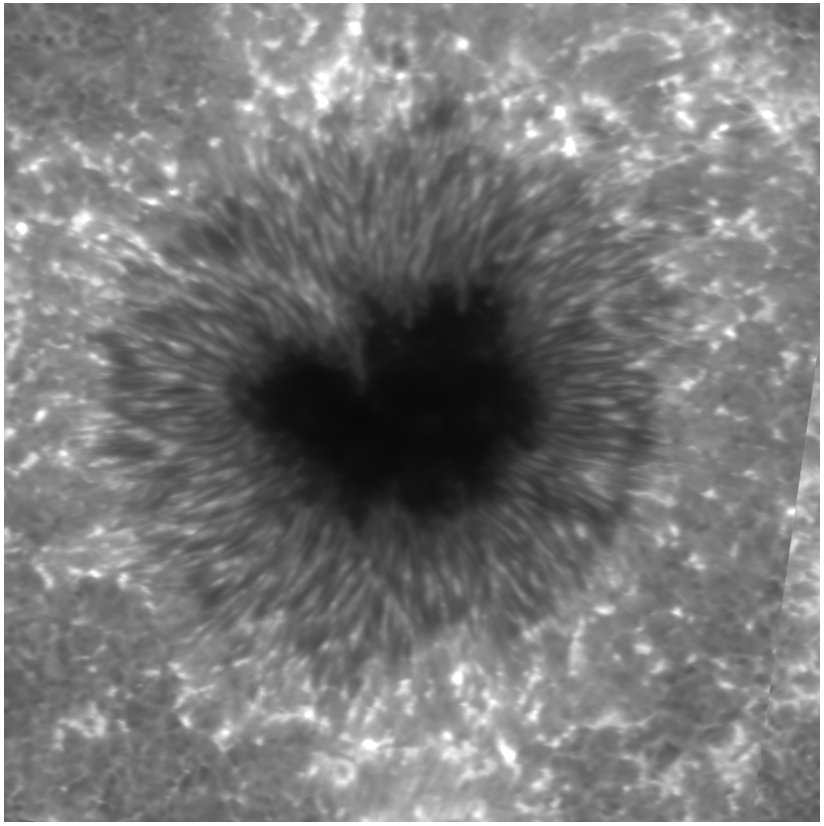


# The Joint Observation with ALMA-Band6 (129pt –MOSAIC) & Solar Optical Telescope (Ca II H) aboard Hinode satellite

ALMA 239 GHz 18-Dec-2015 19:39 -- 20:03 UT



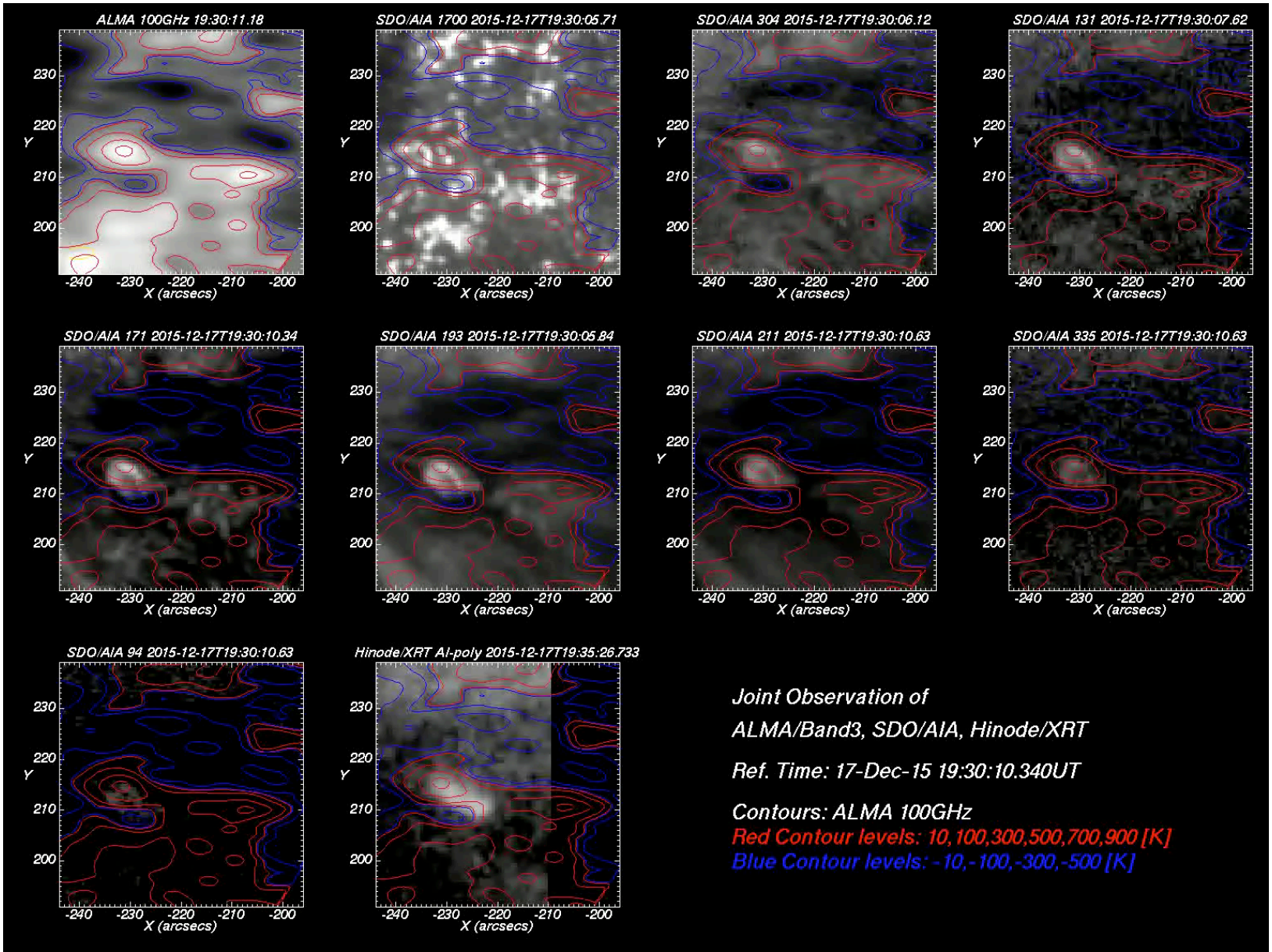
Hinode SOT Ca II H 18-Dec-2015 19:49:32.732 UT



The solar ALMA data is released as a part of Solar Science Verification data.
https://almascience.nao.ac.jp/alma-data/science-verification

Shimojo et al. 2017, *ApJL*, **841**, L5

# Jet and Plasmoid Eruption observed with ALMA/Band3(100 GHz), SDO/AIA (UV cont., EUV lines), and Hinode/XRT (X-ray)



# P2G/OT

- Supplemental Call for Proposals to use the 7-m Array in Cycle 4
  - 36 approved
- Configuration plan changed, especially at the end of cycle 4 and beginning of cycle 5 (long baseline period).
- PIs not generating SBs in Cycle 5, just revising SGs and submitting their projects again for confirmation. Observatory generating automatically SBs, then reviewed by ARC staff.

# Pipeline

- Cy4 PL operation had very good progress in the number of successful pipeline runs (successful rate >90%, both for IF and SD) thanks to flagging heuristics improvement, which helped to reduce QA2 backlog.
- Pipeline for Cycle 5 accepted and in operations.
  - What's new?
    - IF part: Auto-masking, images with PI’s freq. resolution, flagging heuristic and low SNR heuristic improvement
    - SD part: Band5 and single pol. data processing, restore task, performance improvement, report sensitivity with PI’s freq. resolution

# Archive

- All the archive contents have unique file names
  e.g., scriptForPI.py -> member.uid___A002_Xabc_X0123.scriptForPI.py
- AQUA report substitutes for README file. AQUA reports is now available just for the PI via SnooPI, but it will be available via the Archive in the near future.

QA2 Report

**Project information**

| | |
|---|---|
| **Name** | [redacted] |
| **Code** | [redacted] |
| **PI** | [redacted] |
| **Organization** | [redacted] |
| **Co-Is** | [redacted] |

**ObsUnitSet information**

| | |
|---|---|
| **Name** | Member OUS (1237652901832294517) |
| **QA2 Status** | ✔ Pass |
| **Member OUS Status ID** | uid://A001/X1284/X12e0 |
| **SchedBlock name** | 12376529_c_06_7M |
| **SchedBlock UID** | uid://A001/X1284/X1223 |
| **Array** | 7M |
| **Mode** | Standard |
| **Band** | ALMA_RB_06 |
| **Repr.Freq. (sky)** | 221.54 [GHz] |
| **Spectral setup** | ACA |
| **Sources** | [redacted] |
| **Other SBs in this Group OUS (Member OUS Status ID in brackets):** | |
| **Execution count** | 1.00 of 1 expected |

**Final QA2 comment**

Calibration and imaging was done with CASA 5.1.1-5 pipeline version of 40896 (Pipeline-CASA51-P2-B). No major issue is found in the calibration and imaging.

**RMS and beam size at representative frequency**

| | | | |
|---|---|---|---|
| **Sensitivity goal** | 15.80000 [mJy] over bandwidth 15.07236 [MHz] | | |
| **Angular resolution goal** | 5.70994 [arcsec] | | |
| **Achieved RMS for desired bandwidth** | 6.80000 [mJy] | **for continuum** | 0.47000 [mJy] |
| **Achieved synthesized Semi-major axis (arcsec)** | 7.100 | **Semi-minor axis (arcsec)** 4.400 | **Position angle (deg)** -83.300 |

**Execution blocks summary**

| EB | N Ant. | Start Time | End Time | ToS (sec) | Avg. Elev. (deg) | Trans. Elev. (deg) | Mean PWV (mm) | Phase RMS (deg) | Min BL (m) | Max BL (m) | AR (") | MRS (") | EF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| uid://A002/Xc55c89/X244f | 11 | 2017-10-05 05:24: | 2017-10-05 05:51: | 1649 | 73.5 | 75.5 | 0.0 | 0.272 | 8.9 | 48.9 | 4.6 | 25.6 | 1.00 |

**Spectral Windows**

| Transition | Central Frequency (sky, bar, GHz) | Bandwidth (GHz) | N of channels |
|---|---|---|---|
| cont3 | 238.324 | 2.000 | 128 |
| cont2 | 236.402 | 2.000 | 128 |
| cont1 | 223.909 | 2.000 | 128 |

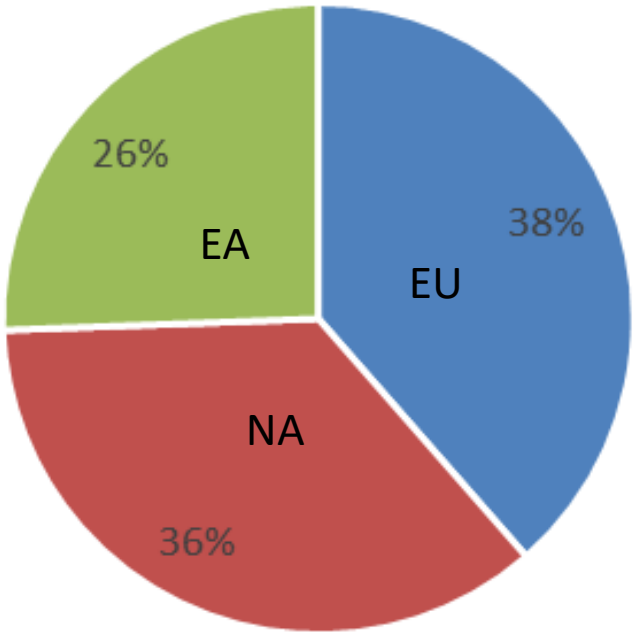
# CASA

- 5.1 has been released on Sep. 17. This is the official version for current Cy5 data reduction and imaging.
- Release notes
  - cvel2 & mstransform: regridding (regridms=True) has been corrected to follow the same procedure as in tclean. Note: cvel is not maintained anymore.
  - Strict reference antenna selection in gaincal: flag solutions timestamps (per spw) if the specified refant is unavailable (flagged or absent). Useful for polarimetry.
  - Automasking: The *growiterations* subparameter has been added for multithreshold automasking in tclean (usemask='auto-multithresh') to control the number of iterations used by binary dilation to expand the mask into low signal-to-noise regions.
  - An experimental feature has been added to auto-multithresh algorithm (*usemask='auto-multithresh'*) to mask absorption
- New CASA Users Committee member: Shige Takakuwa (Kagoshima U.), Youngjoo Yun (KASI)

# Publication and Proposal

# ALMA Publications
# (as of the end of Oct. 2017)

| | EU | NA | EA | ALL |
|---|---|---|---|---|
| total | 428 | 398 | 284 | 819 |
| citation total | 8,243 | 7,727 | 4,939 | 14,782 |



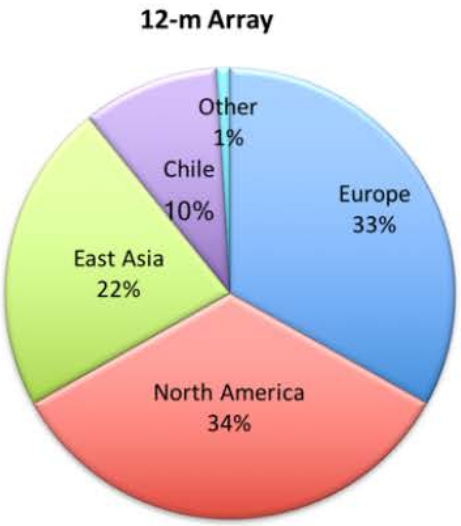
# Top 10 Citations

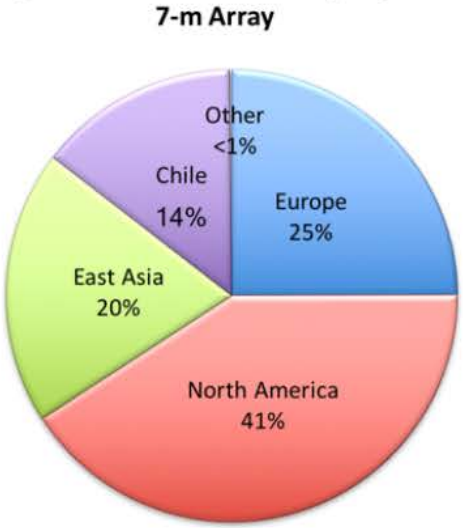
| BibCode | Citation | Title | Author |
|---|---|---|---|
| 2015ApJ...808L...3A | 235 | The 2014 ALMA Long Baseline Campaign: First Results from High Angular Resolution Observations toward the HL Tau Region | ALMA Partnership et al. |
| 2013Sci...340.1199V | 233 | A Major Asymmetric Dust Trap in a Transition Disk | van der Marel, N. et al. |
| 2013Natur.493..191C | 188 | Flows of gas through a protoplanetary gap | Casassus, Simon et al. |
| 2013Natur.495..344V | 164 | Dusty starburst galaxies in the early Universe as revealed by gravitational lensing | Vieira, J. D. et al. |
| 2013ApJ...773...44W | 145 | Star Formation and Gas Kinematics of Quasar Host Galaxies at z ~ 6: New Insights from ALMA | Wang, Ran et al. |
| 2013MNRAS.432....2K | 138 | An ALMA survey of submillimetre galaxies in the Extended Chandra Deep Field South: high-resolution 870 μm source counts | Karim, A. et al. |
| 2013ApJ...768...91H | 131 | An ALMA Survey of Submillimeter Galaxies in the Extended Chandra Deep Field South: Source Catalog and Multiplicity | Hodge, J. A. et al. |
| 2014A&A...567A.125G | 130 | Molecular line emission in NGC 1068 imaged with ALMA. I. An AGN-driven outflow in the dense molecular gas | Garcia-Burillo, S. et al. |
| 2014MNRAS.438.1267S | 128 | An ALMA survey of sub-millimetre Galaxies in the Extended Chandra Deep Field South: the far-infrared properties of SMGs | Swinbank, A. M. et al. |
| 2013ApJ...767...88W | 126 | ALMA Redshifts of Millimeter-selected Galaxies from the SPT Survey: The Redshift Distribution of Dusty Star-forming Galaxies | Weiss, A. et al. |

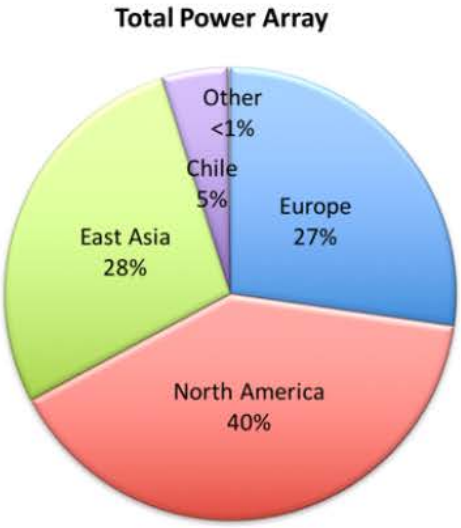
# Cy5 Proposal Statistics

- 1661 proposals submitted
  - 132 Grade A
  - 301 Grade B
  - 262 Grade C
  - Total 4000 hrs of 12-m array + 300-400 hr of Cy4 Grade A carried over

**Regions: Grade A and B projects**



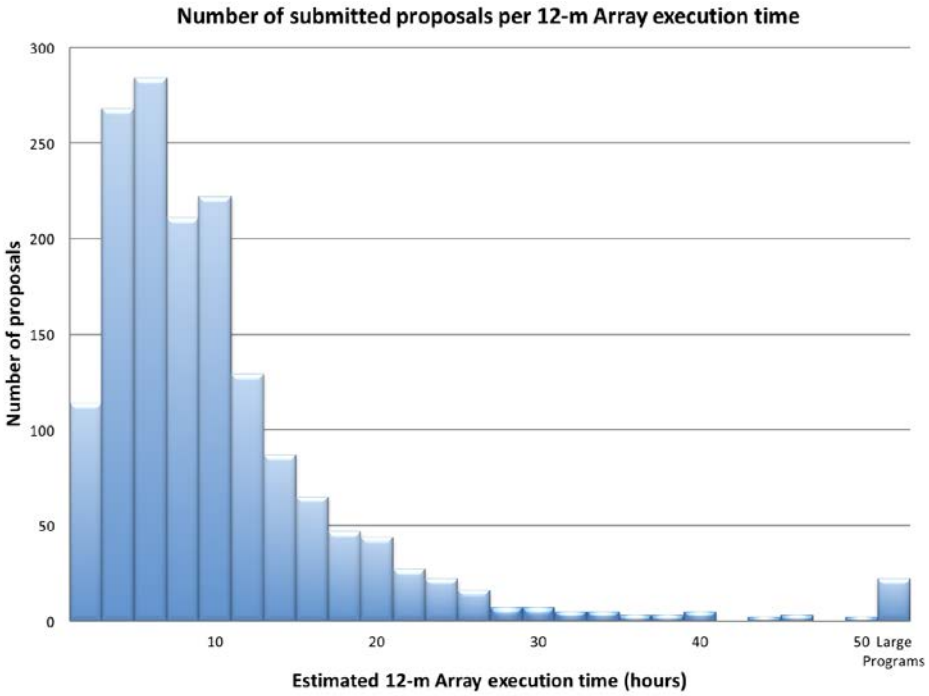



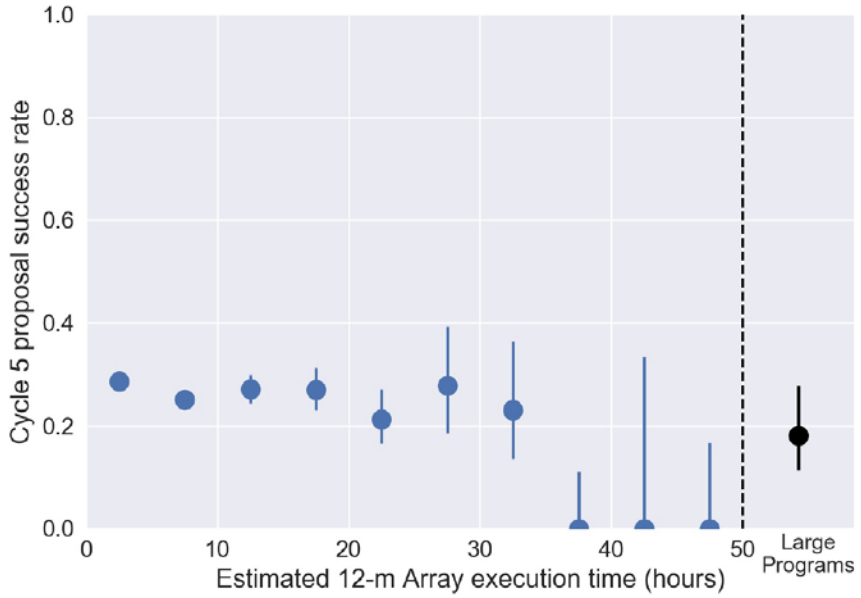



# Cy5 Proposal Statistics

| | Chile (CL) | East Asia (EA) | Europe (EU) | North America (NA) | Other | Total |
|---|---|---|---|---|---|---|
| **Submitted Proposals** | | | | | | |
| Number of proposals | 91 | 335 | 695 | 492 | 48 | 1661 |
| 12-m Array time (hours) | 975 | 3778 | 6384 | 4568 | 324 | 16029 |
| 7-m Array time (hours) | 591 | 3013 | 4106 | 3411 | 242 | 11362 |
| Total Power Array time (hours) | 307 | 2939 | 2391 | 1893 | 42 | 7572 |
| **Subscription rate** | | | | | | |
| 12-m Array (4000 h offered) | 2.4 | 4.2 | 4.7 | 3.4 | N/A | 4.0 |
| 7-m Array time (3000 h offered) | 2 | 4.5 | 4.1 | 3.4 | N/A | 3.8 |
| Total Power Array (3000 h offered) | 1 | 4.4 | 2.4 | 1.9 | N/A | 2.5 |

# Cy5 Proposal Statistics



# Cycle 5 Operation

# Configuration Schedule

# Data Delivery

- From Cy5, we have started to use new data work flow system using AQUA.
  - Busy for testing new workflow
  - Delivery backlog
    - Currently ~30 SBs: Needs ~1-1.5 month to clear up

# Compensation of Cy4 low execution rate

- Execution rate for EA projects in Cy4 was only ~17% (QA0 stats for Grade A and B). Even worse for Grade C project.
- JAO will try to compensate it in Cy5.

# Timeline for Cy6 Proposal

- Pre-announcement : Thursday, December 14
- Additional information : February 1 (configuration schedule)
- Call for Proposals : March 20
- Proposal deadline : April 19
- APRC meeting (*) : June 18-23
- PI notifications sent : By end of July

*New! ARC staff is now eligible for proposal reviewer

# Cy 5 and 6 Capabilities (preliminary)

| | Cycle 5 | Cycle 6 |
|---|---|---|
| Number of 12m antennas | 43 | 43 (?) |
| Number of 7m antennas | 10 | 10 |
| Number of TP antennas | 3 | 3 |
| Baseline length | 0.16 km (minimum)-16 km (maximum) | 0.16 km (minimum)-16 km (maximum) |
| Maximum baseline for B8, 9, 10 | 3.6 km | >3.6 km ? |
| Maximum baseline for B7 | 8.5 km | 16 km |
| Maximum baseline for B3, 4, 6 | 16 km | 16 km |
| Maximum baseline for B5 | 1.4 km | >1.4 km ? |
| polarization | B3,4,5,6,7, single pointing on axis (no circular) | B3,4,5,6,7, single pointing on axis (no circular)? |
| Single-dish spectral line observations | B3 to B8 | B3 to B8 |

# Polarization

- Circular polarization is the highest priority for Cy6. Wide-field is the next.
- Polarization commissioning team made test observations of some Zeeman/maser sources quasi-simultaneously with the KVN (Thank you, KVN team!).
  - Broadly consistent between the ALMA and KVN results in the Stokes V spectrum, but some discrepancies. See S. Kameno's talk on Wednesday.
  - ALMA also made test observations of continuum Stokes V source.
- Short calibration scheme will not be implemented in Cy6. Still need ~3-hrs for a single observation.

# “New” standard mode (preliminary)

- B7 observation with up to configuration 8 (8.5 km) will be standard.
- All available configuration at B8 will be standard.


# http://www.almaobservatory.org/en/home/

*The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership among Europe, Japan and North America, in cooperation with the Republic of Chile. ALMA is funded in Europe by the European Organization for Astronomical Research in the Southern Hemisphere, in Japan by the National Institutes of Natural Sciences (NINS) in cooperation with the Academia Sinica in Taiwan and in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC). ALMA construction and operations are led on behalf of Europe by ESO, on behalf of Japan by the National Astronomical Observatory of Japan (NAOJ) and on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI).*