

# ALMA

The Atacama Large Millimeter/submillimeter Array



Alison Peck

North American ALMA Science Center



Atacama Large Millimeter/submillimeter Array

Karl G. Jansky Very Large Array

Robert C. Byrd Green Bank Telescope

Very Long Baseline Array

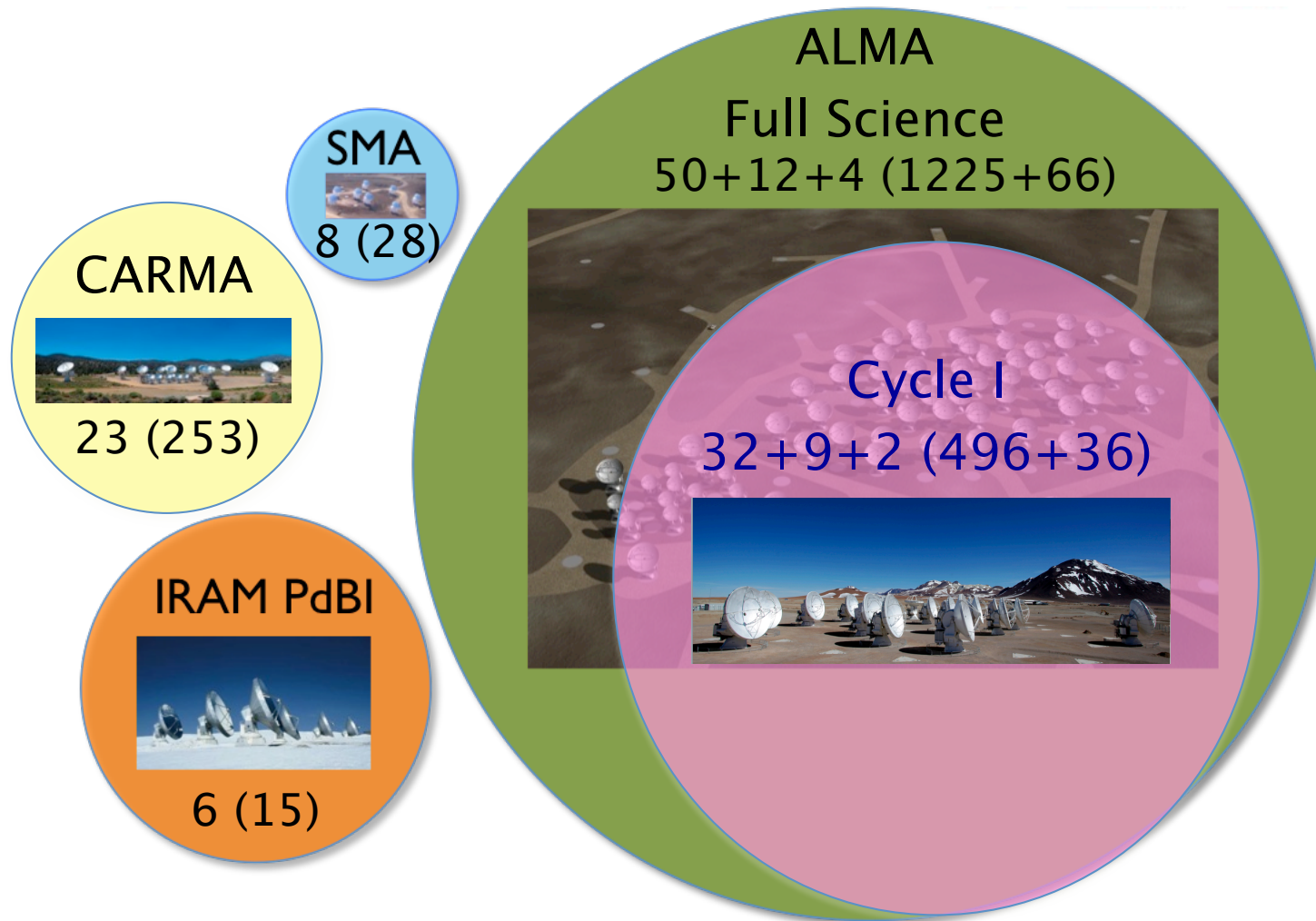




# ALMA Specifications

- 54 (43) 12-m antennas, 12 (11) 7-m antennas, at 5000m site
- ✓ Surface accuracy  $<25 \mu\text{m}$ , 0.6" reference pointing in 9m/s wind, 2" absolute pointing all-sky
- Array configurations between 150m and ~15-18km (1 km) + ACA.
- Angular resolutions ~40mas at 100 GHz (5mas at 900GHz)
- 10 bands in 31-950GHz (B3, B4, B5, B6, B7, B8, B9) + 183GHz WVR.
- ✓ 8 GHz BW, dual polarization
- ✓ Interferometry, mosaicing & zero-spacing observing
- ✓ Correlator: 4096 channels/IF (multi-IF) +ACA
- Data rate: 6MB/s average; peak 64 MB/s
- All data archived (raw + images), pipeline processing

# Collecting Area & Baselines



**Circles Show Collecting Area (sensitivity)**

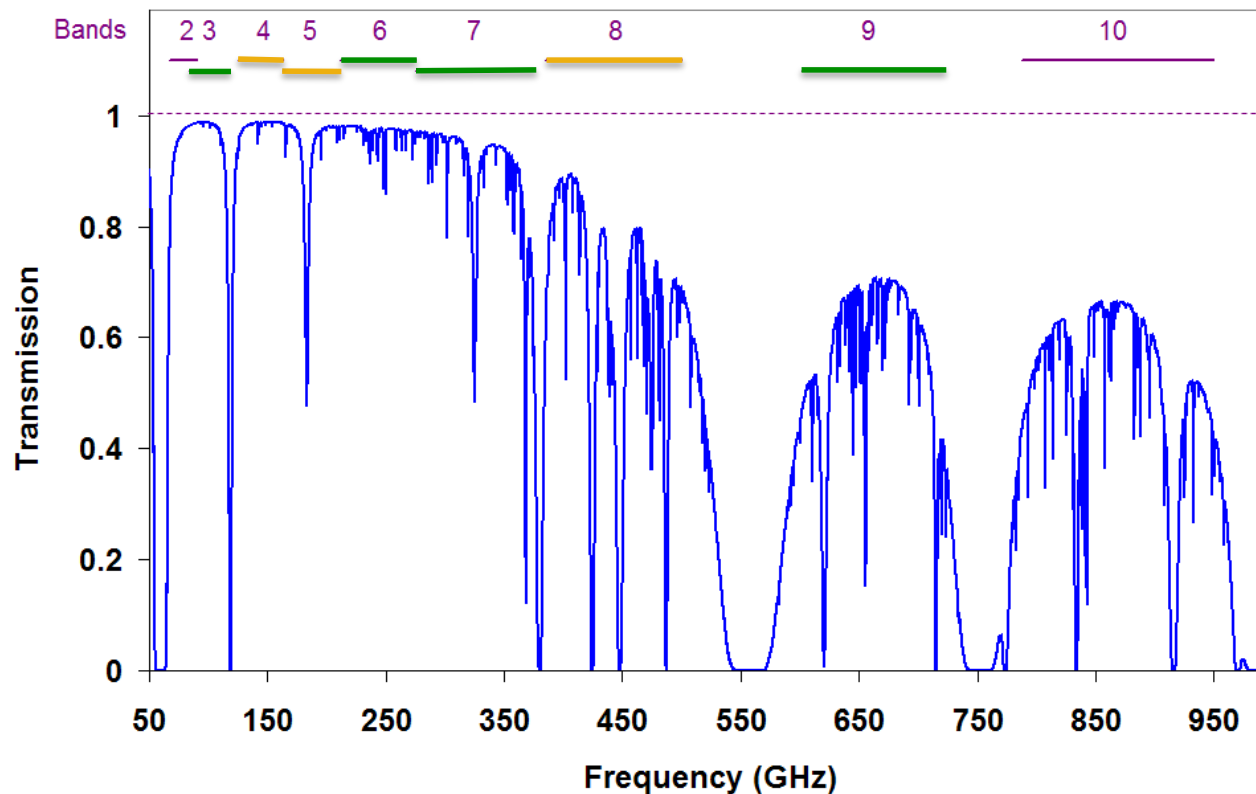
**Captions give # of antennas and # of baselines (fidelity)**





# Atmospheric Transmission in the mm/ submm wavelength range

Chajnantor - 5000m, 0.25mm pwv



Earth's atmospheric lines block access to some spectral regions except at Earth's highest driest site. ALMA's spectral range covers all mm/submm windows for which transmission is better than 50%



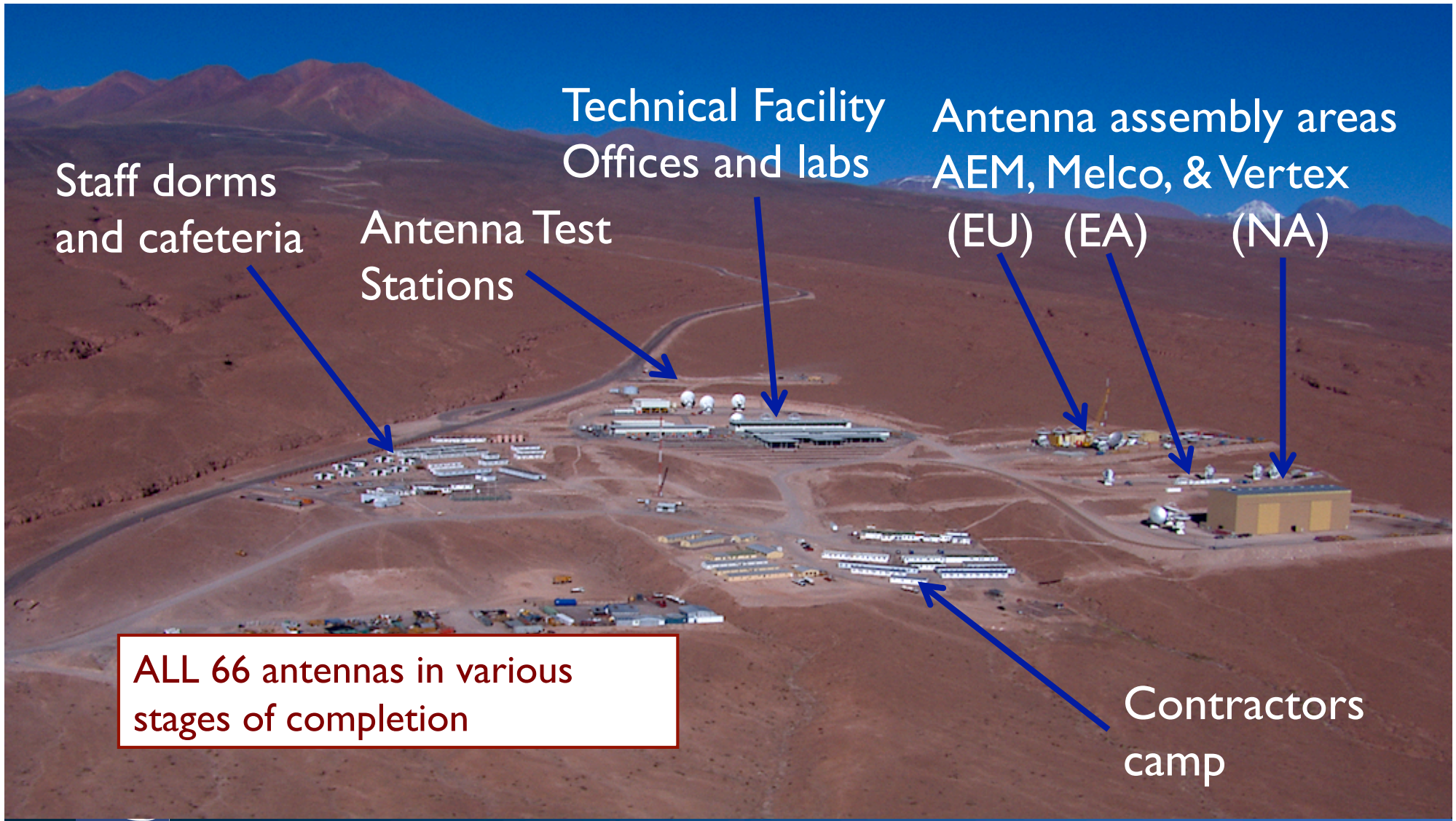
# ALMA Location: High Altitude Desert



San Pedro de Atacama,  
Atacama Desert, Northern Chile



# Operations Support Facility (2900m level)





# All Testing Stations at the OSF are occupied





# Control Room -- night shift

One station for AOS, 3 for OSF, 1 for software

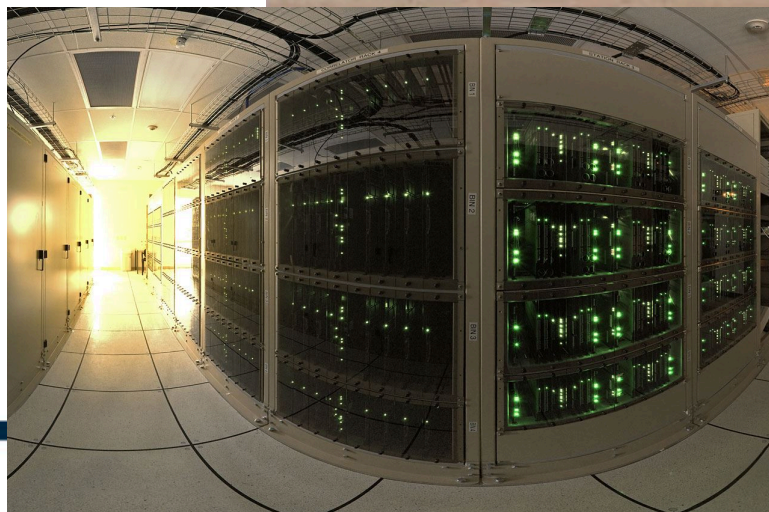


---

**DV01 makes the climb from the Operations Support Facility (2900m) to the Array Operations Site (5000m)**



# AOS Technical Building (Correlator, offices, guards, emergency facilities)



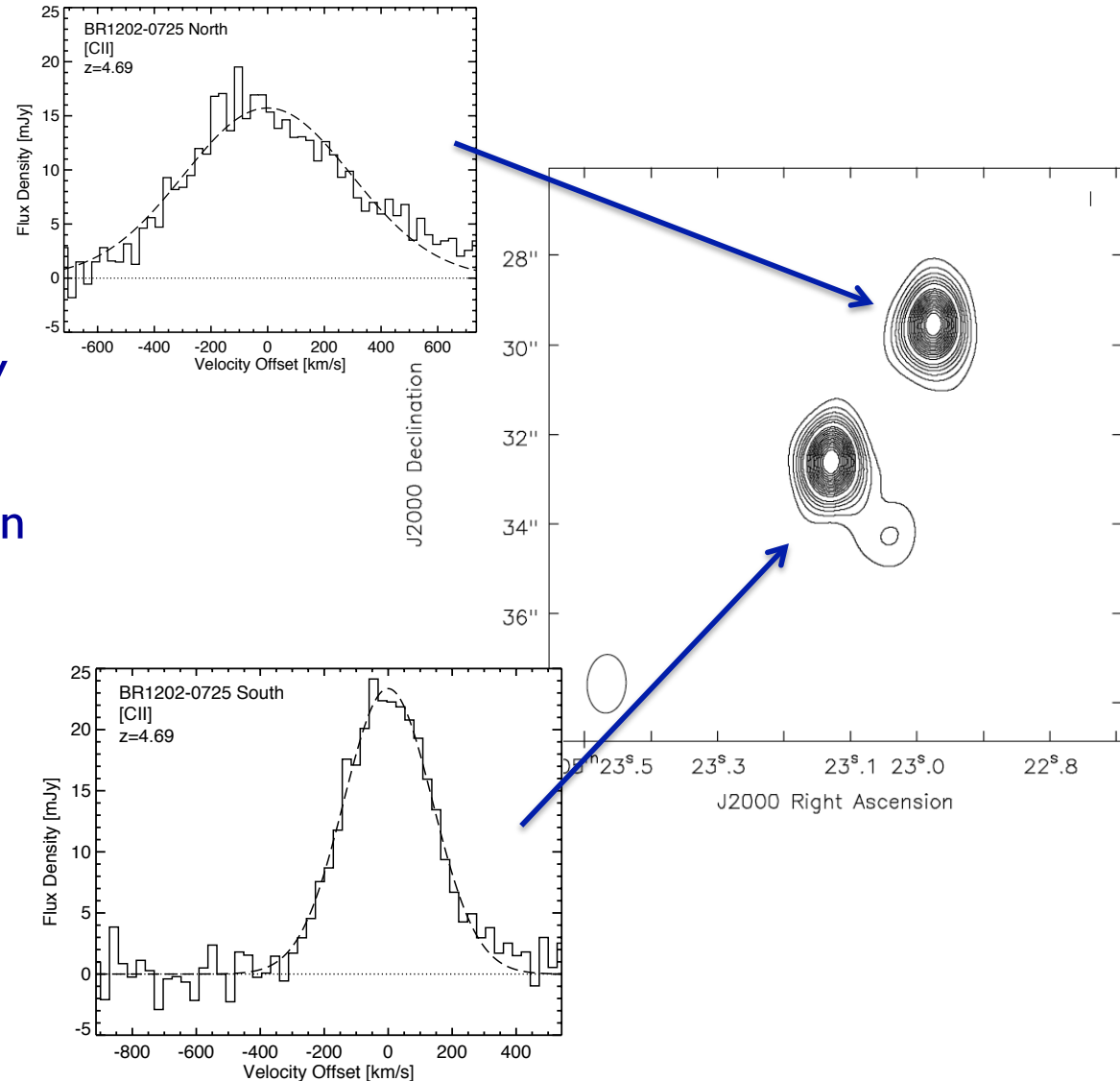
Baseline  
correlator



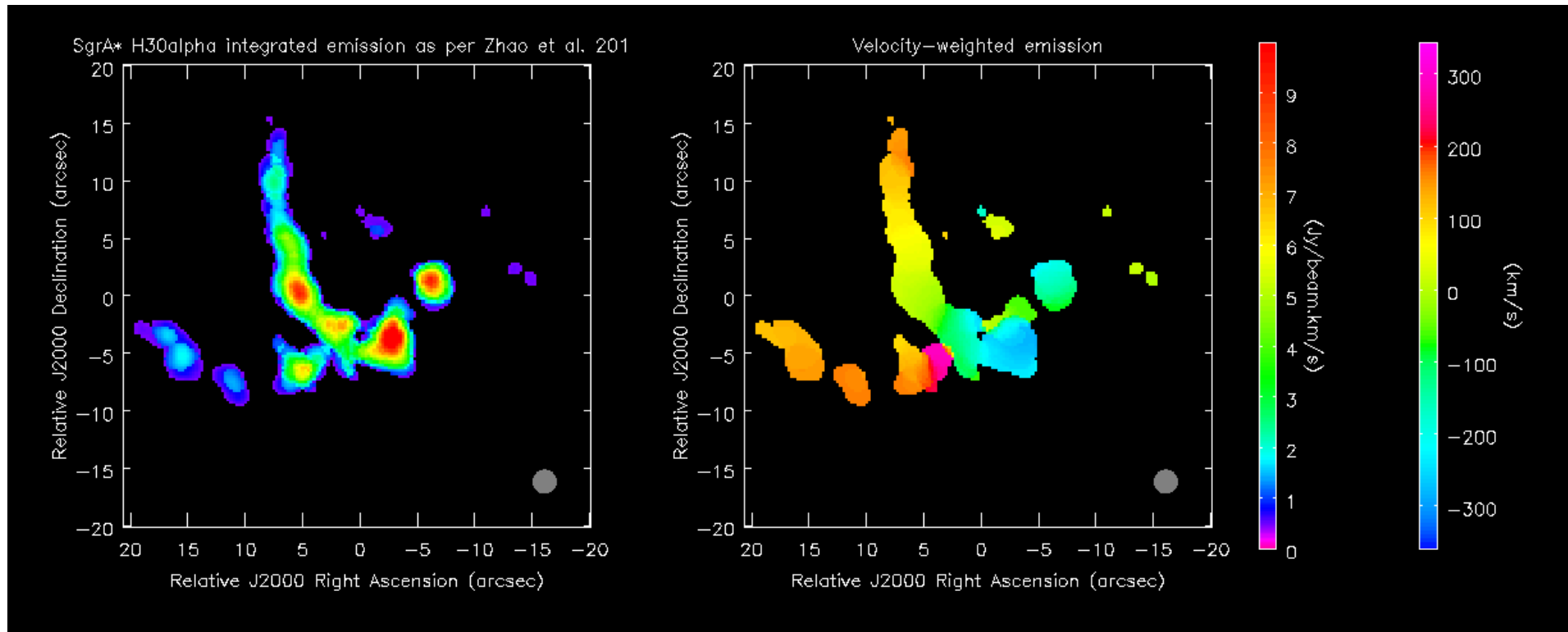
ce with ALMA: From Dust to

# Science Verification: [C II] at high $z$

- High redshift [C II] BR1202
  - 1.5 hrs; 50 hrs with SMA
  - SCUBA flux of  $42 \pm 2$  mJy
  - ALMA flux of  $43 \pm 0.2$  mJy
  - [C II] agrees with Hi-J CO
  - 3<sup>rd</sup> source flux 1.4 mJy seen in Subaru image



# Science Verification: SgrA\* at B6

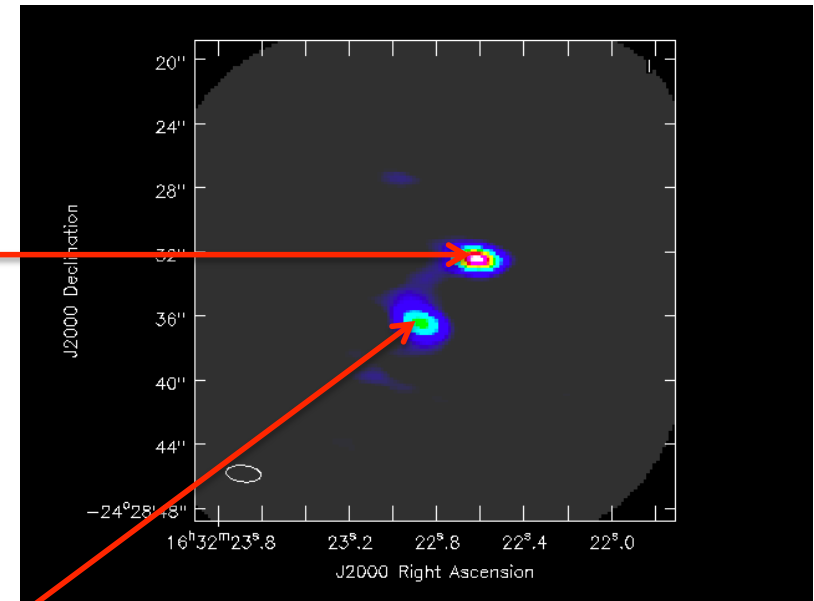
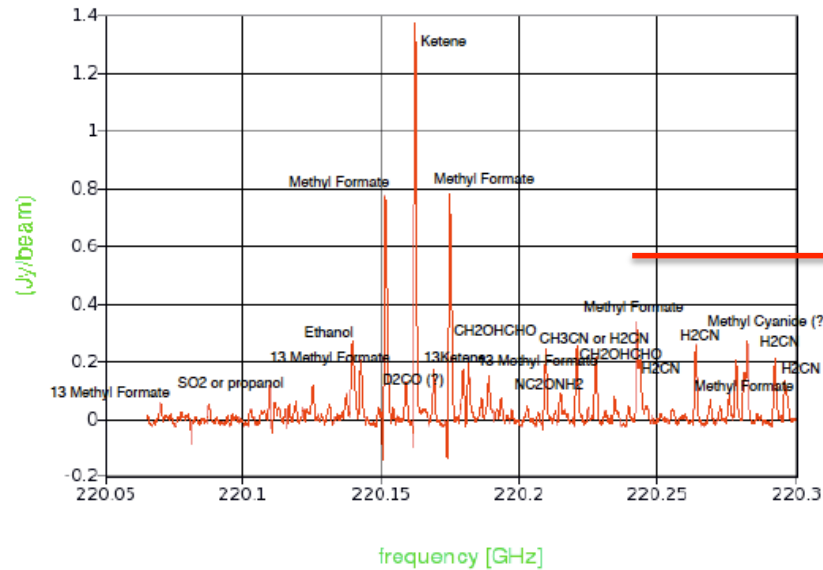


Seven point mosaic of H30 $\alpha$  made on June 28, 2011 using 11 antennas. About 3 hours on source.

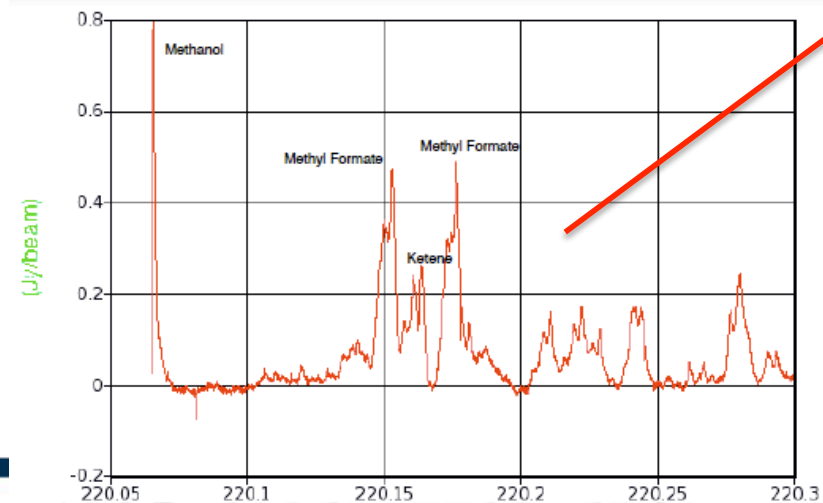
# Young Low Mass Stars: IRASI 6293

Band 6

IRAS 16293 - B



IRAS 16293 - A



Note narrow lines toward preprotostellar core B with infall apparent in methyl formate and ketene lines.

Note broad lines in core A1/A2.

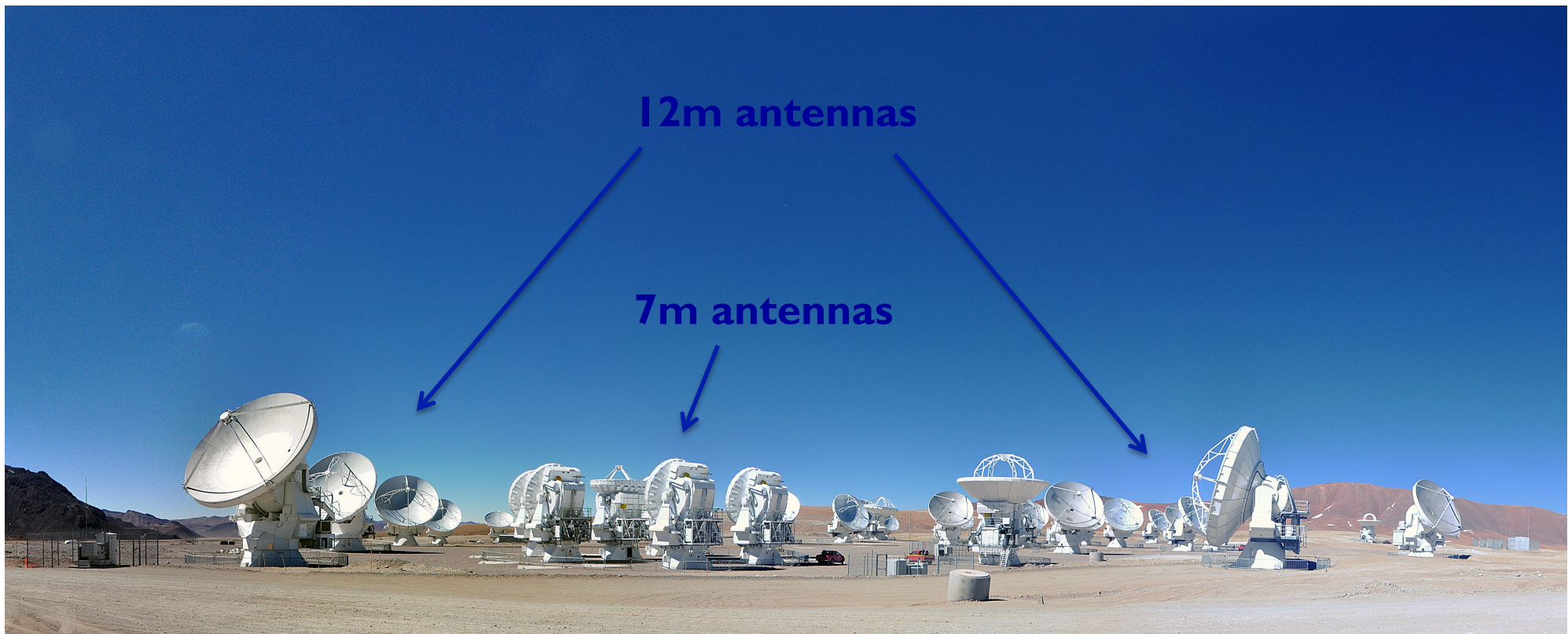


# Ready to observe with 43 antennas!



Photo credit: Pablo Carillo

# “Daytime Array”: still a lot of engineering work to do!





# ALMA Inauguration



Chilean President Sebastián Piñera  
and NSF Director Subra Suresh.  
Credit: C. Padilla, NRAO/AUI/NSF

# ALMA Inauguration: Astronauts!



Video of greeting from the Space Station will be shown in the coffee break



## Currently:

- Cycle I observations progressing slowly due to a few technical issues – priority has to be given to completion of array and infrastructure – but we persevere. PIs are being contacted to approve the “phasell” Scheduling Blocks to be sure we are ready, and they will be notified when the project is observed
- Cycle I may be extended until at least January 2014, and more information about Cycle 2 capabilities and timeline will be available soon.
- In the meantime...

# Science Verification Data (FREE)



## ALMA data released for:

NGC 3256\*

TW HYDRA\*

THE ANTENNAE GALAXIES\*

M100

SGR A-STAR (B3, B6)

BR1202 (HIGH REDSHIFT QUASAR)

IRAS 16923 (B6, B9\*)

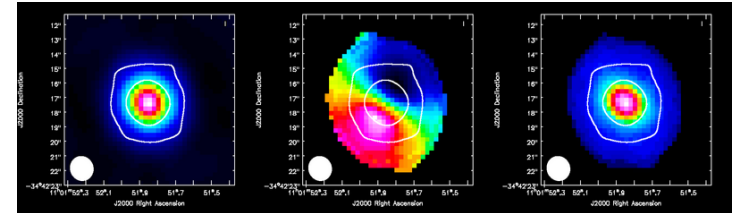
CENTAURUS A

ORI B6 SPECTRAL SCAN

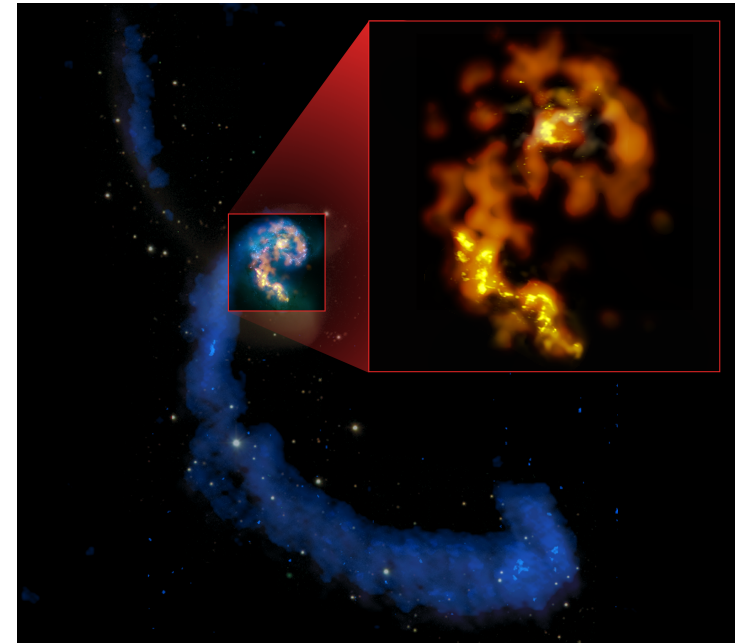
HD163296 (B6, B7)

- Calibrated & uncalibrated data, images, periodically augmented
- download from ALMA Science Portal <http://almascience.org/>
- \* - CASA guide available at <http://casaguides.nrao.edu>

## HCO+ J=4-3 in TW Hya



## CO J=3-2 in the Antennae

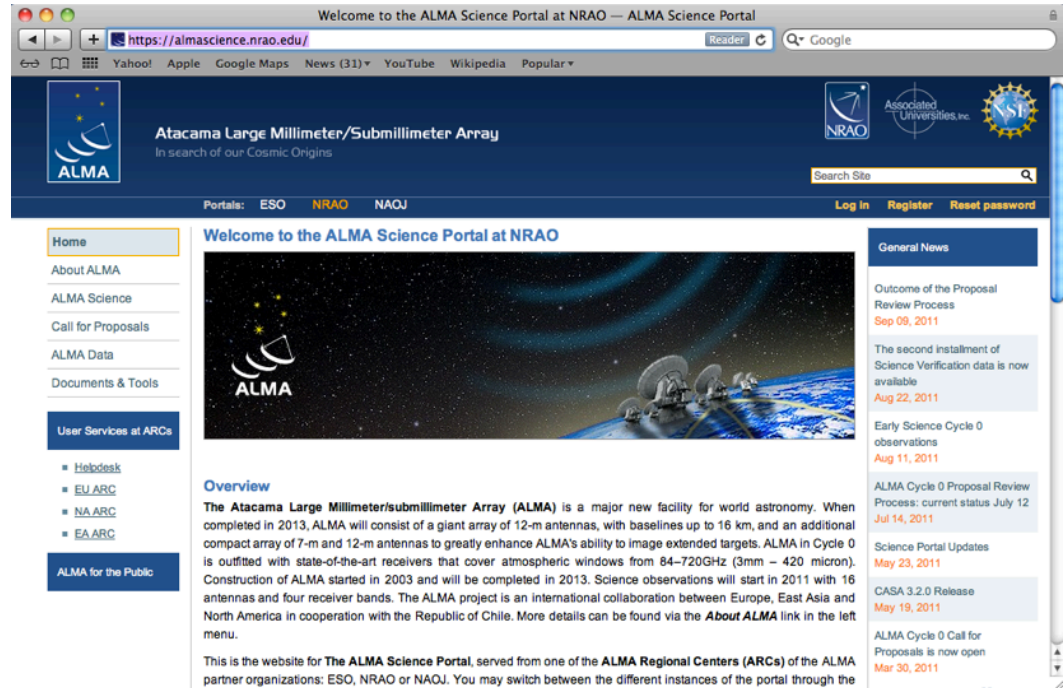


# The ALMA Science Portal

<https://almascience.org>

Hub for project-wide material:

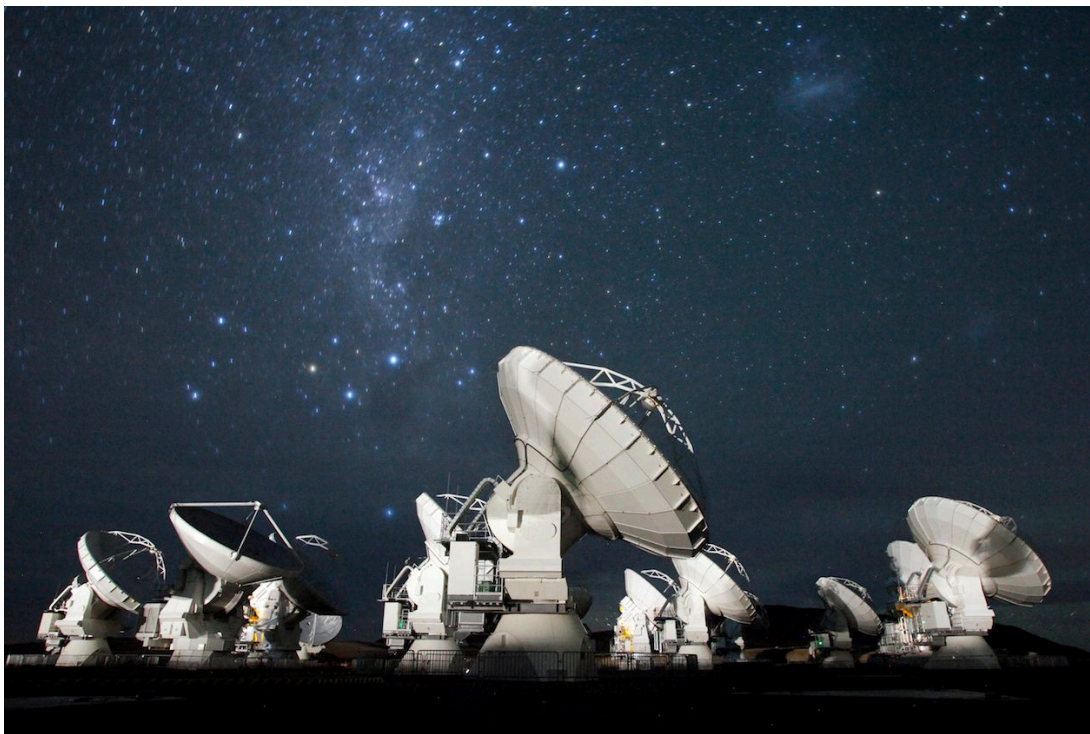
- Cycle 2 information (soon!)
- Observing Tool
- Sensitivity Calculator
- Proposer's Guide
- Technical Handbook
- Science Verification Data
- CASA & Simulations
- Tutorials
- Helpdesk



The screenshot shows the ALMA Science Portal website. The header includes the ALMA logo and the text "Atacama Large Millimeter/Submillimeter Array" and "In search of our Cosmic Origins". The navigation bar includes "Portals: ESO NRAO NAOJ" and "Log in Register Reset password". The main content area features a large image of the ALMA antennas and the text "Welcome to the ALMA Science Portal at NRAO". Below this is an "Overview" section with the text: "The Atacama Large Millimeter/submillimeter Array (ALMA) is a major new facility for world astronomy. When completed in 2013, ALMA will consist of a giant array of 12-m antennas, with baselines up to 16 km, and an additional compact array of 7-m and 12-m antennas to greatly enhance ALMA's ability to image extended targets. ALMA in Cycle 0 is outfitted with state-of-the-art receivers that cover atmospheric windows from 84–720GHz (3mm – 420 micron). Construction of ALMA started in 2003 and will be completed in 2013. Science observations will start in 2011 with 16 antennas and four receiver bands. The ALMA project is an international collaboration between Europe, East Asia and North America in cooperation with the Republic of Chile. More details can be found via the **About ALMA** link in the left menu." Below this is a note: "This is the website for The ALMA Science Portal, served from one of the ALMA Regional Centers (ARCs) of the ALMA partner organizations: ESO, NRAO or NAOJ. You may switch between the different instances of the portal through the". On the right side, there is a "General News" section with several news items, including "Outcome of the Proposal Review Process" (Sep 09, 2011), "The second installment of Science Verification data is now available" (Aug 22, 2011), "Early Science Cycle 0 observations" (Aug 11, 2011), "ALMA Cycle 0 Proposal Review Process: current status July 12" (Jul 14, 2011), "Science Portal Updates" (May 23, 2011), "CASA 3.2.0 Release" (May 19, 2011), and "ALMA Cycle 0 Call for Proposals is now open" (Mar 30, 2011).

**Registration required to propose**





ALMA



**For more info:**

<http://www.almaobservatory.org>

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

