

# The Current Status of ALMA



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Atacama Large Millimeter/submillimeter Array  
Expanded Very Large Array  
Robert C. Byrd Green Bank Telescope  
Very Large Baseline Array



# Location of ALMA

(5000m elevation in northern Chile)



# ALMA Site

To Array Operation Site (43km)



Operations Support Facility Site (15km)



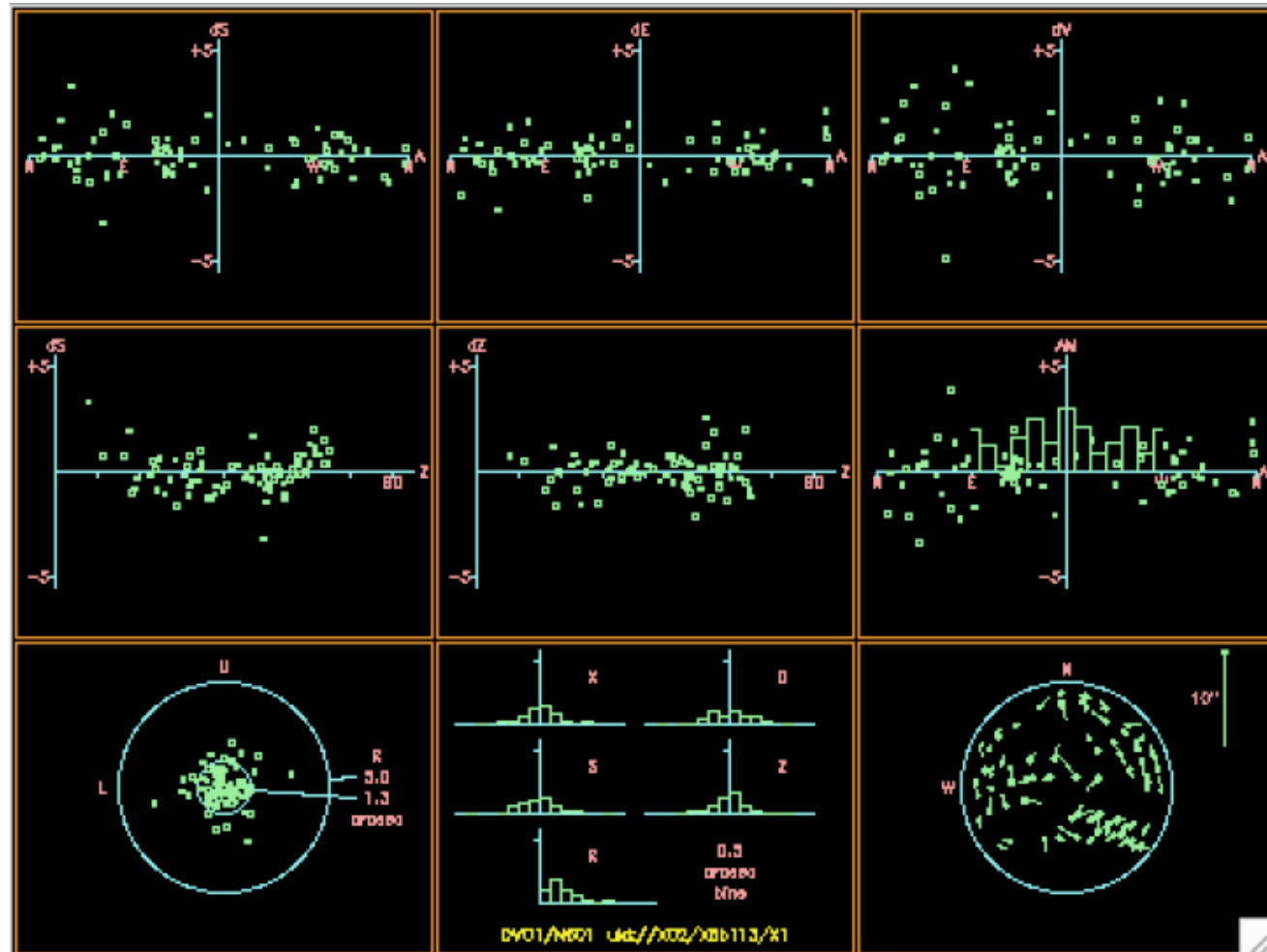
Guardhouse



# CSV Tasks:

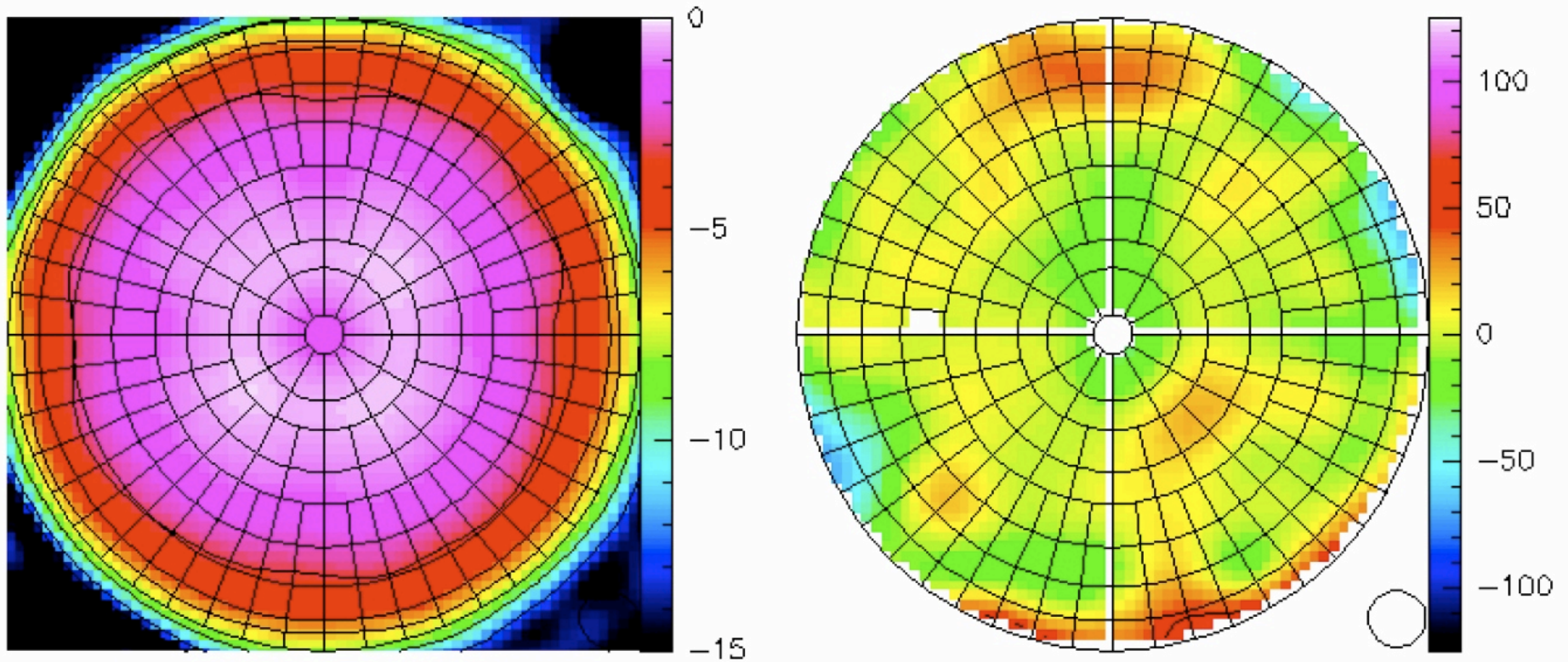
## Establish and monitor pointing models

DV01  
rms=1.8''

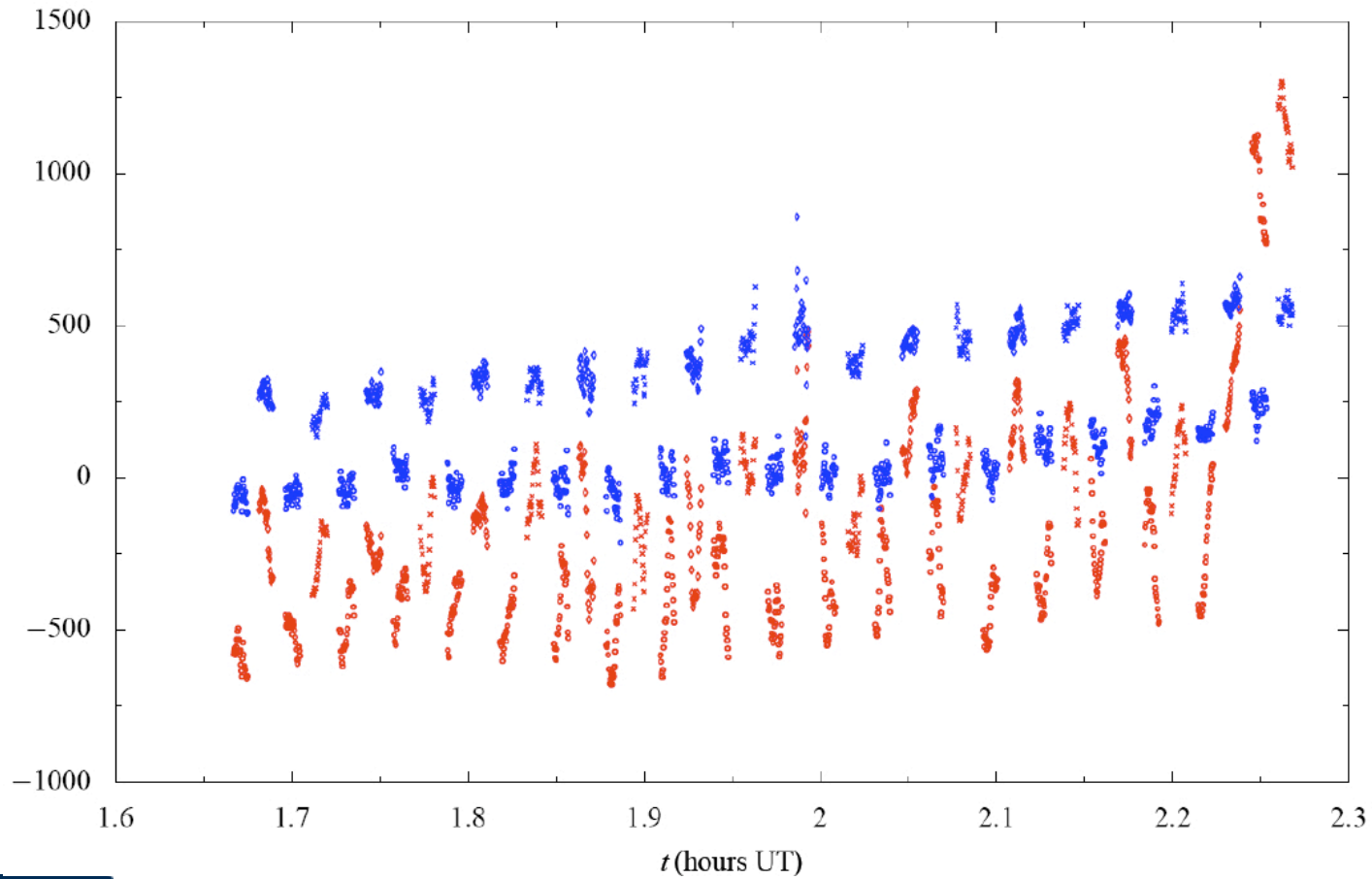


# CSV Tasks: Monitor Surface Accuracy

Astronomical Holography using 3C279 at high elevation



# Water Vapor Correction: Cycling between 3C273, 3C279, Pluto; blue=corrected



# Correlator first quadrant at AOS

Correlator room is oxygenated!



# First 7 12m antennas (on Atacama Compact Array pads)

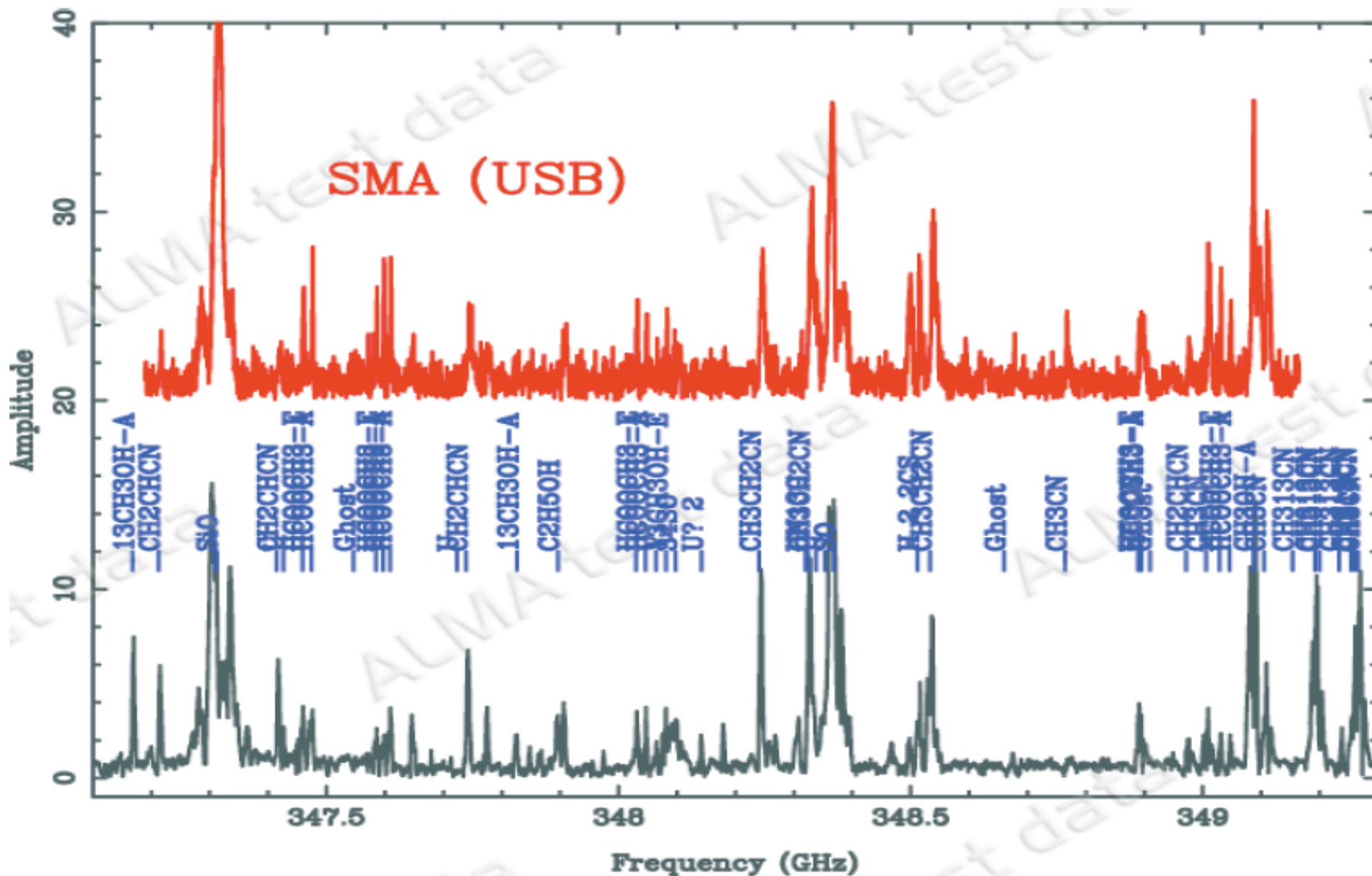




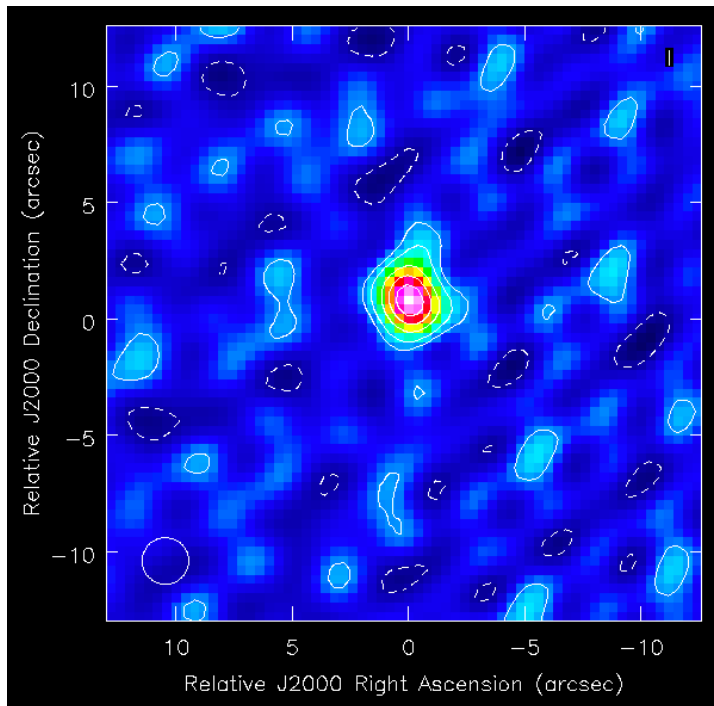
# Early test observations: Orion at Band 7, compared to SMA

Red=SMA (Beuther et al.)

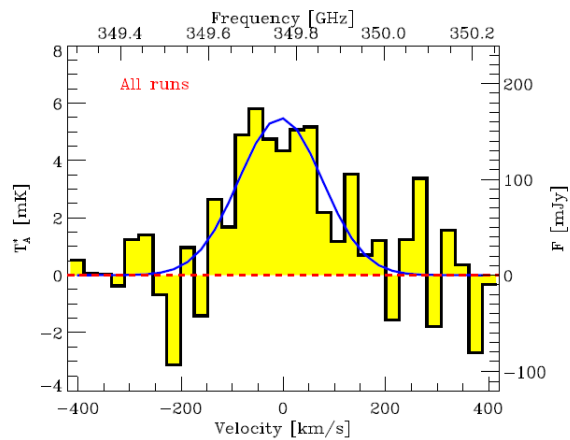
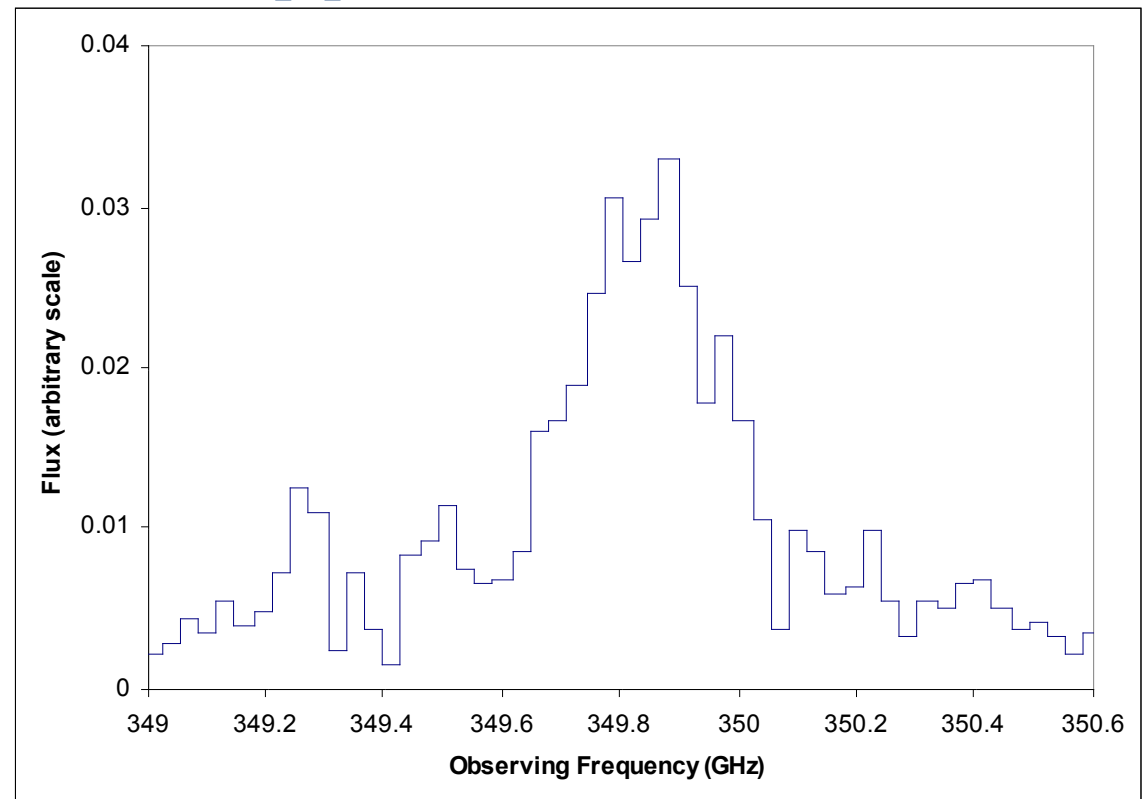
Black=ALMA – 14 mins with 7 antennas



# Early test observations: High Redshift Line Sources



**C[II] line in BRI 0952 at  $z=4.4$**

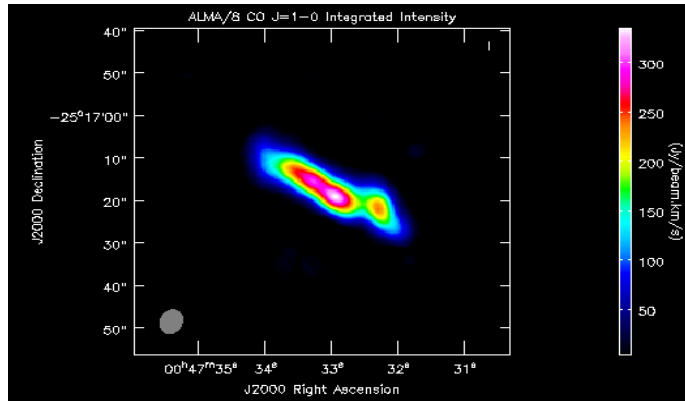


Band 7 16<sup>th</sup> Nov 2010 ↑ 8 Antennas, 1 hour  
← APEX

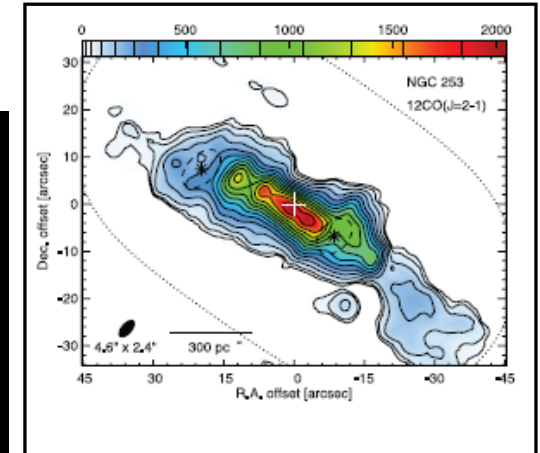
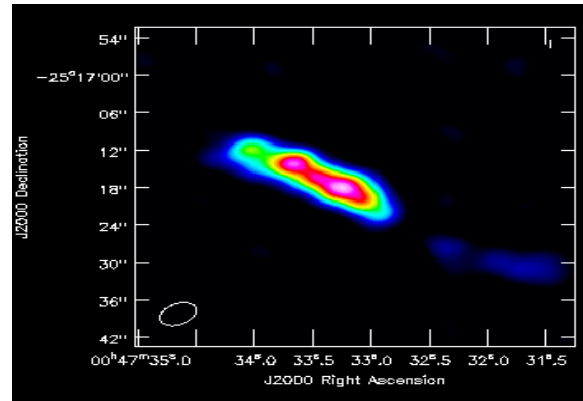
# Early test observations:

## NGC253: a starburst galaxy in 4 transitions

NGC 253 – B3 – CO J=1-0

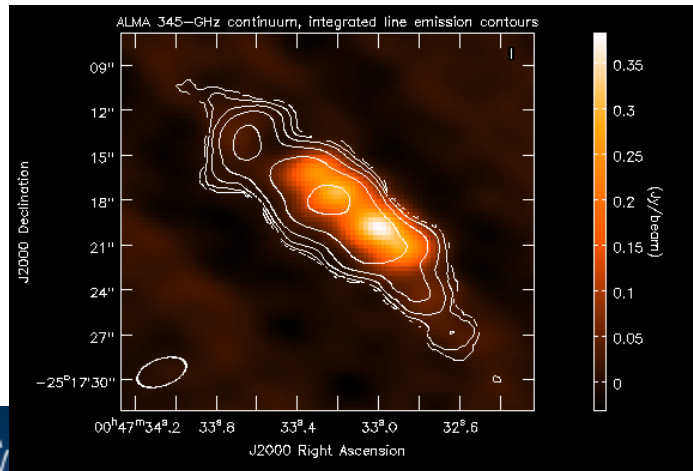


NGC 253 – B6 – CO J=2-1

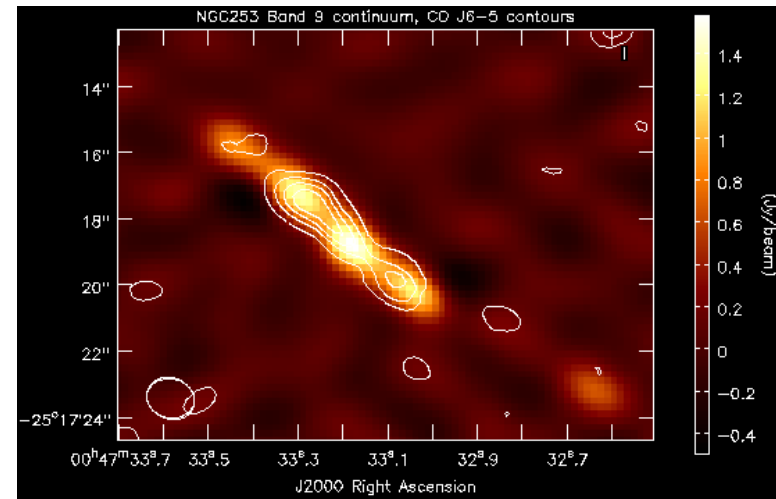


(Sakamoto et al, 2006)

NGC 253 – B7 – CO=3-2



NGC 253 – B9 – CO=6-5

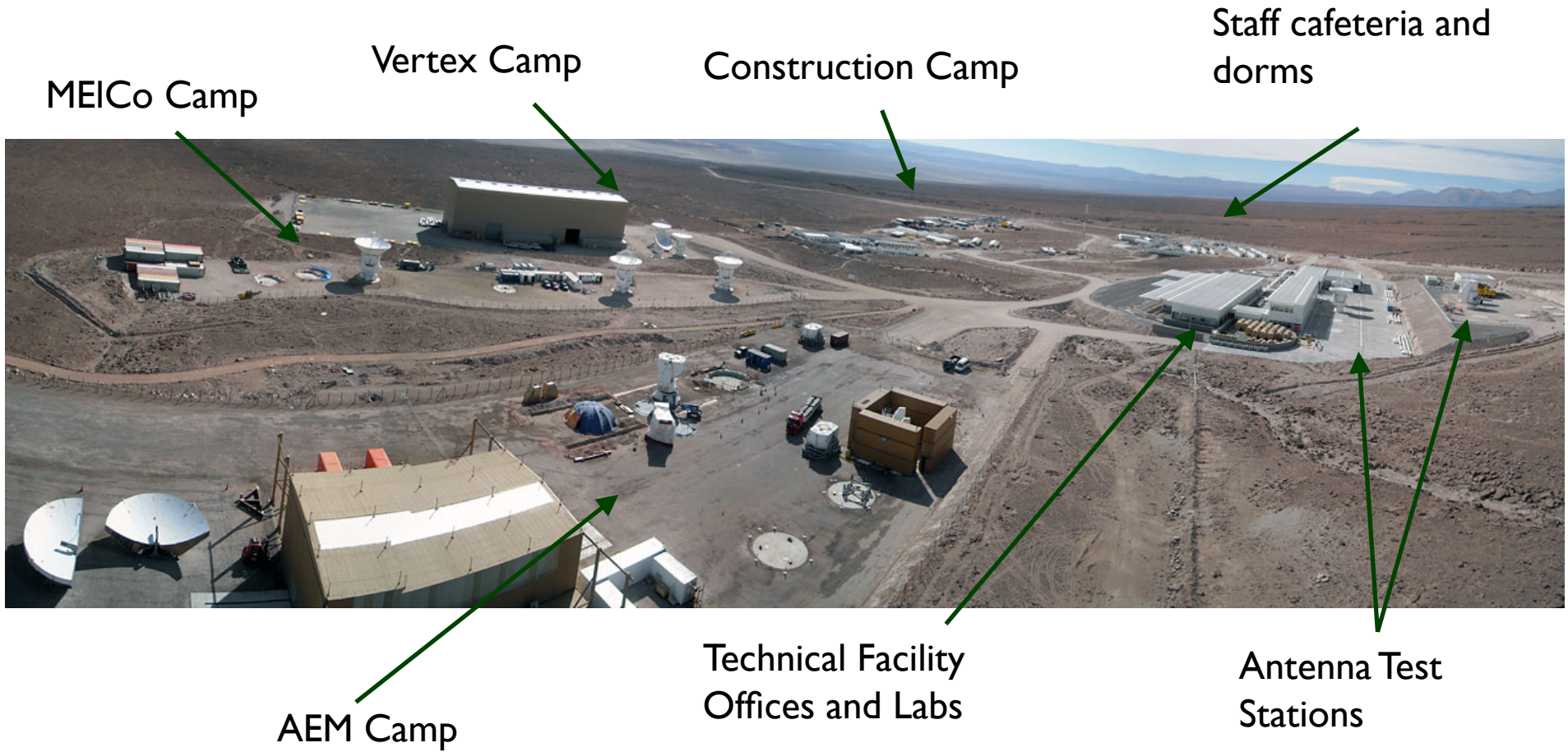


Band 3 → 2 nights, 5&8 antennas, 10 hours  
 Band 7 → 7 antennas, 7 hours

Band 6 → 7 antennas, 12 hours  
 Band 9 → 4 antennas, 6 hours



# The OSF in early 2011:



# The OSF in late 2014?



# In the meantime:

all test pads now filled with antennas being integrated



# Who is carrying out CSV?

Science Team comprises about 30-35 members in Chile in any given month

- Santiago-based CSV Scientists (15)
- Operations Astronomers (11)
- ESO ALMA Fellows in Santiago (3)
- ARC Liaisons (3 FTEs - shortest trip ~3 months)
- Secondments (ie IRAM) (shortest trip ~3 months)
- Visitors Program (shortest trip ~3 months)
- Additional specialized ARC staff (1 to 3 turnos per trip)
- Non-resident postdocs (1 to 3 turnos per trip)

Visits of 3 months or longer by experienced astronomers are extremely successful, we actively encourage interested parties to join us! For more information, email [apec@alma.cl](mailto:apec@alma.cl)



# Control Room -- night shift, 2011





# Current Status

- 26 12m antennas (all antenna types represented)
- 5 7m antennas (can be used with ACA or BL correlators)
- 2 quadrants of the BL correlator in use, as well as ACA
- 30% of the available time used for Early Science Cycle 0,
  - Rest used for continuing CSV activities and testing

# Capabilities to test for Cycle I (and beyond!)

- Mixed correlator resolution modes
- Spectral window offsetting
- Polarization
- Addition of ACA 7m data to main array
- Addition of zero spacing data to interferometric data

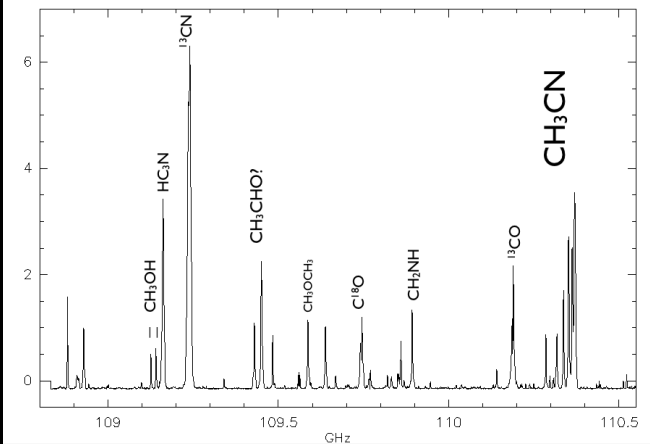
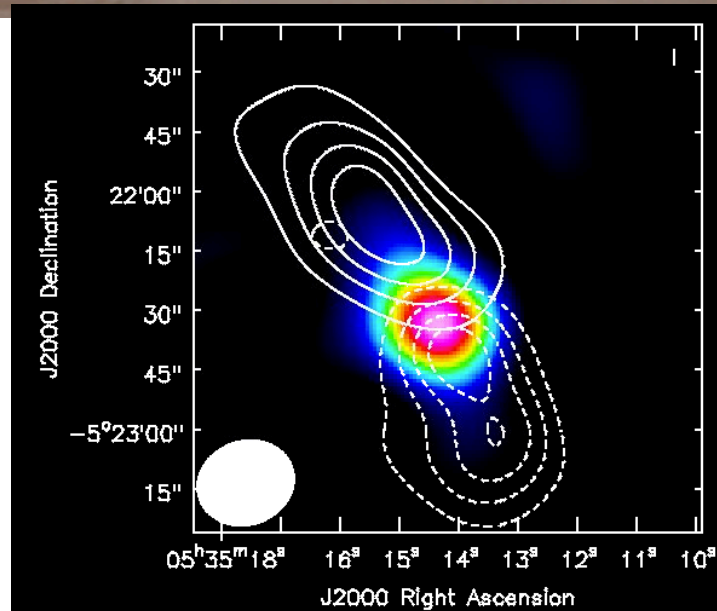


# Atacama Compact Array

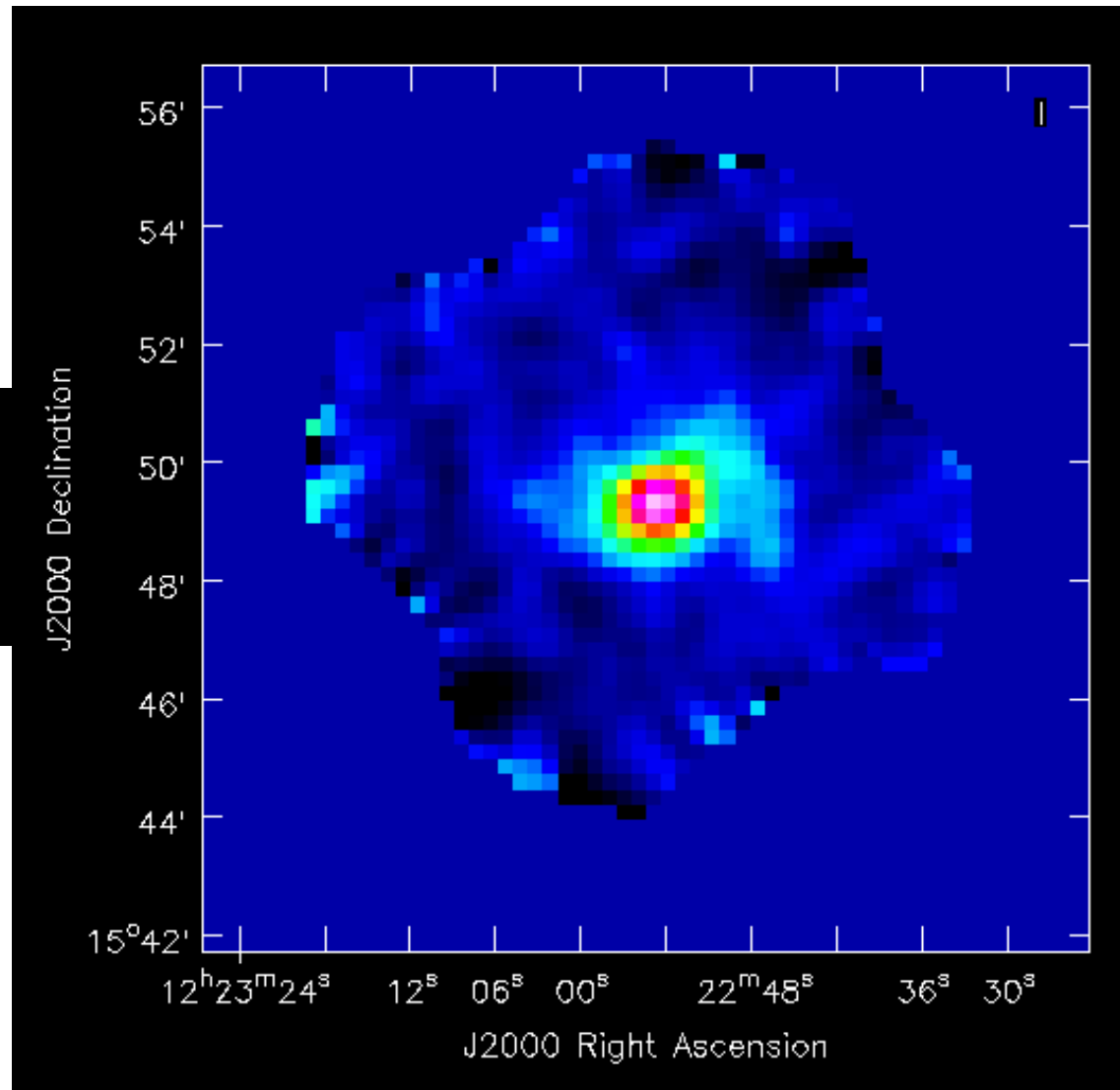
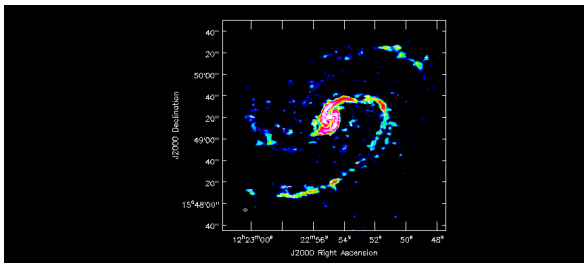
Now with ACA Correlator and 5 7m antennas



Preliminary! First image  
Orion  $^{13}\text{CO}$  and  
110 GHz continuum:  
3 hours on source in  
7mm pwv.



# Continuing Tests: Zero Spacing Data



# Recent image:

Last week, 26 antennas in bad weather



# What is Science Verification?

- Start with suggestions from outside users
- Create Scheduling Blocks using “Science Goals” in OT
- Run SBs in the most efficient way possible
- Fill data to CASA and reduce manually
- Determine whether appropriate sensitivity level reached
- Review calibration strategies
- Tweak up control scripts as necessary to deal with new observing modes and calibration strategies
- Provide additional feedback to Computing on OT and control scripts
- Release approved images through the EPO Group
- Release approved data through Science Portal



More popular than expected! Between Jan 3 and April 15, 2011, we received **103** suggestions

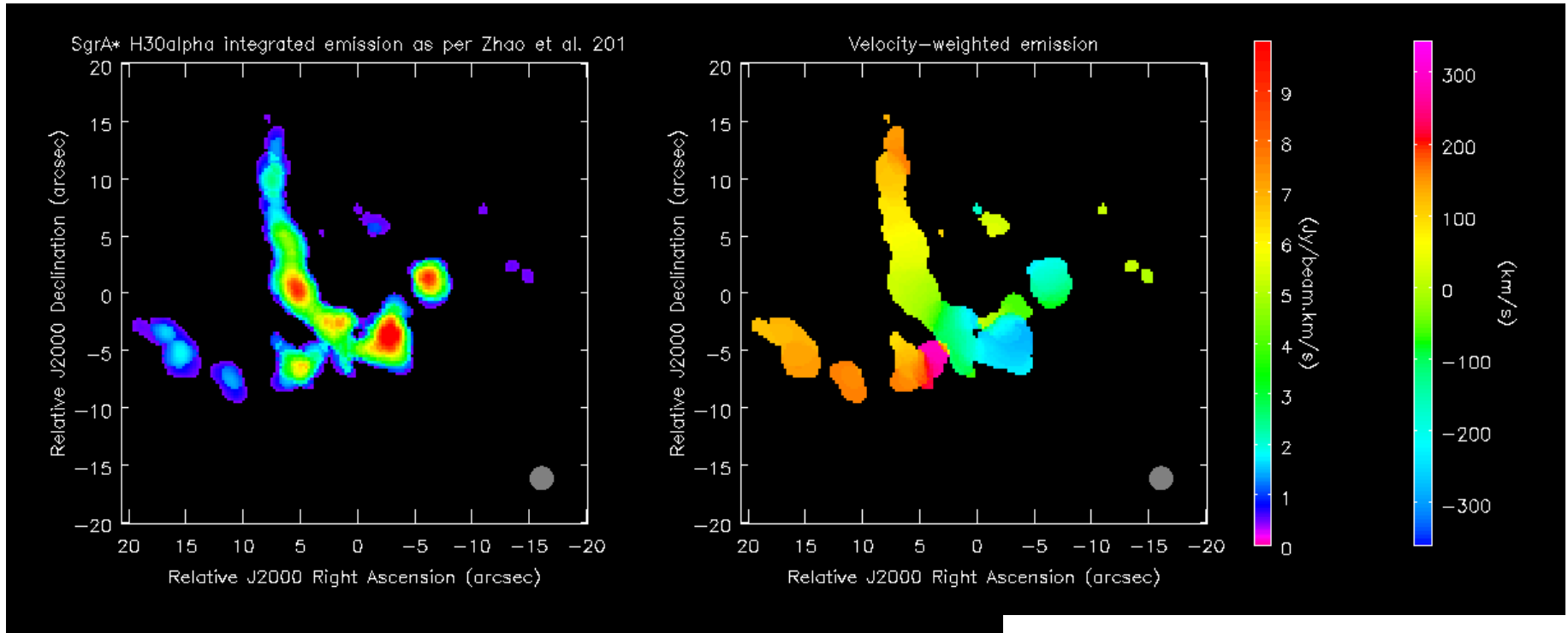
# Science Verification Targets

If your favorite source is used for Science Verification, there is no reason not to propose for Cycle 1! The Science Verification observations will be fairly short and simple, and you will have access to the data for free!

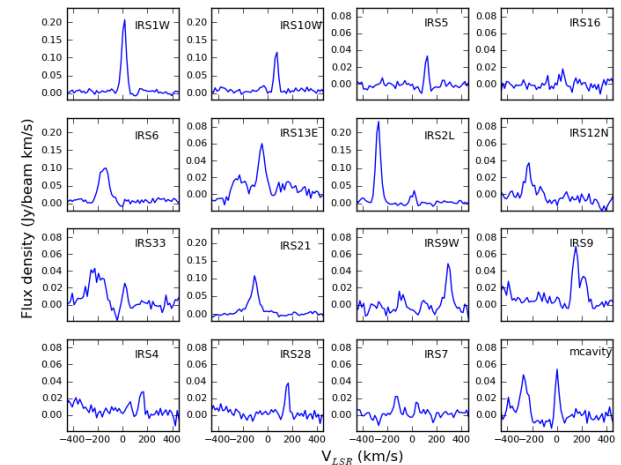
Target	RA	Dec	Transition	Corr Res	Reference
Io Atmosphere	ephem	ephem	SO, SO <sub>2</sub> (B7)	FDM	Moulet et al, 2010
Uranus, Neptune	ephem	ephem	CO,H <sub>2</sub> S,HCN, continuum (B6,7)	FDM	Hofstadter et al. 2009, Moulet et al (in prep)
IRAS16293-2422	16:32:23	-24:28:36	Multiple (B6)	FDM	✓ Bisschop et al. 2008, Yeh et al. 2008, Jorgensen et al. 2011
Orion (BN/KL and OMC1)	05:35:14	-05:22:23	Spectral survey (B3,6,7,9)	FDM	✓ Beuther et al. (2004, 2005,2006) Wright et al. 1996, Blake et al. 1995
NGC6334I	17:20:53	-35:46:58	CO, HCO <sup>+</sup> , HCN	FDM	Hunter et al. 2006, Beuther et al. 2007
HH114mms	05:18:15	07:12:00	<sup>12</sup> CO (1-0) , <sup>13</sup> CO (1-0),HCO <sup>+</sup> (1-0), CO(2-1), CO(3-2)	FDM	Arce & Sargent, 2006, Chen et al, 2011
R CrA Cloud Core	19:01:53	-36:57:21	HCO <sup>+</sup> (3-2)	FDM	Groppi et al 2007, Chen and Arce, 2010
TW Hya	11:01:51	-34:42:17	CO, HCO <sup>+</sup> , HCN etc (B 3,6,7,9)	FDM	✓ Qi et al. 2004, 2006, 2008; Hughes et al. 2011
HD163296	17:56:21	-21:57:22	Multiple (B6,7,9)	FDM	Hughes et al. (2008, 2011), Qi et al (2006, 2011)
HD 107146	12:19:07	16:32:54	Continuum (B6&7)	TDM	Corder et al. 2009, Hughes et al. (in prep)
Sgr A*	17:45:40	-29:00:28	Recomb lines B3&6, <sup>12</sup> CO (2-1)	FDM	✓ Kunneriath et al 2011, Zhao et al 2010
Grand Design Spirals	12:22:55, 13:38:03	15:49:21, -17:53:03	CO(1-0)	TDM	✓ Heifer et al 2003
NGC 4038/9 (mosaics)	12:01:53	-18:52:38	CO(1-0), (2-1), (3-2)	FDM	✓ Ueda et al (in prep), Wilson et al 2000
NGC 3256	10:27:51	-43:54:18	CO(1-0)	TDM	✓ Sakamoto, Ho & Peck, 2006
Centaurus A	13:25:27	-43:01:08	CO(2-1), (3-2)	FDM	✓ Espada et al (2009, 2010)
Arp220	15:34:57	23:30:11	CO(2-1), (3-2), (6-5)	FDM	Sakamoto et al (1999, 2008, 2009), Matsushita et al 2009, Martin et al 2010
Lensed Submm Galaxies J1/J2	14:01:05	02:52:23	CO(3-2), continuum	TDM	Frayer et al (1998, 1999), Weiss et al. 2009, Wardlow et al. 2010
BR1202-0725	12:05:23	-07:42:32	CII	TDM	Iono et al 2006



# Science Verification: SgrA\* at B6



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



# How you can be involved:

## Job opportunities:

- <http://hr.almaobservatory.org/jobs/international-opportunities/>
- <https://careers.nrao.edu/>
- <https://jobs.eso.org/>
- <http://www.nao.ac.jp/E/index.html>

Visitor's Program: email [apecck@alma.cl](mailto:apecck@alma.cl) or see me at this meeting





**For more  
information:**



**<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.*

