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National Radio Astronomy Observatory

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

Preparing for ALMA

http://science.nrao.edu/alma

National Radio Astronomy Observatory

North America ALMA Science Center

Charlottesville, Virginia U.S.

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The Current Status of ALMA

Alison Peck
Joint ALMA Observatory

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ALMA Specifications

- 54 12-m antennas, 12 7-m antennas, at 5000m site
- Surface accuracy <25 μm, 0.6" reference pointing in 9m/s wind,
  2" absolute pointing all-sky
- Array configurations between 150m and ~15-18km
- Angular resolutions ~40mas at 100 GHz (5mas at 900GHz)
- 10 bands in 31-950 GHz + 183 GHz WVR.
- 8 GHz BW, dual polarization.
- Interferometry, mosaicing & total-power observing.
- Correlator: 4096 channels/IF (multi-IF), full Stokes.
- Data rate: 6MB/s average; peak 64 MB/s.
- All data archived (raw + images), pipeline processing.

ALMA Sensitivity

50 antennas, 1-σ, 1 minute; AM=1.3; water values correspond roughly to the quartiles

Frequency GHz	Zenith Water mm	Continuum mJy	Line 1km/s * mJy
110	2.3	0.05	7
140	2.3	0.06	8
230	2.3	0.1	11
345	1.2	0.2	18
410	1.2	0.4	31
675	0.5	0.7	41
850	0.5	1.4	72

* Spectral line sensitivity scales inversely with square root of velocity resolution.
So for 25km/s, which might for example be used for a galaxy, divide by 5.

Early Science Capabilities

- At least 16 antennas with 4 receiver bands
  Number of antennas available will build up quite fast through 2011 and 2012. (Sensitivity goes as N, imaging complexity as N^2 .)

- Baselines of at least 250m (1km goal) to start with, moving on to long baselines in 2012.

- Interferometry in single field or pointed mosaic mode, single-dish OTF mapping for zero spacing.

- Proper systems for user support in place:
  - proposal process
  - tools for preparing observations
  - data reduction package (CASA)
  - support from ALMA Regional Centers

New Santiago Central Office

Completion expected Aug 2010

Current Shape of the OSF

Seen from the holography tower

Control Room - OSF

(evening shift)

MEICo Antennas - three 12m and one 7m

AEM Antenna Assembly at the OSF

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Teams Trained for Panel Setting

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DV01 makes the climb from the OSF to the AOS (2009)

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Correlator First Quadrant at AOS

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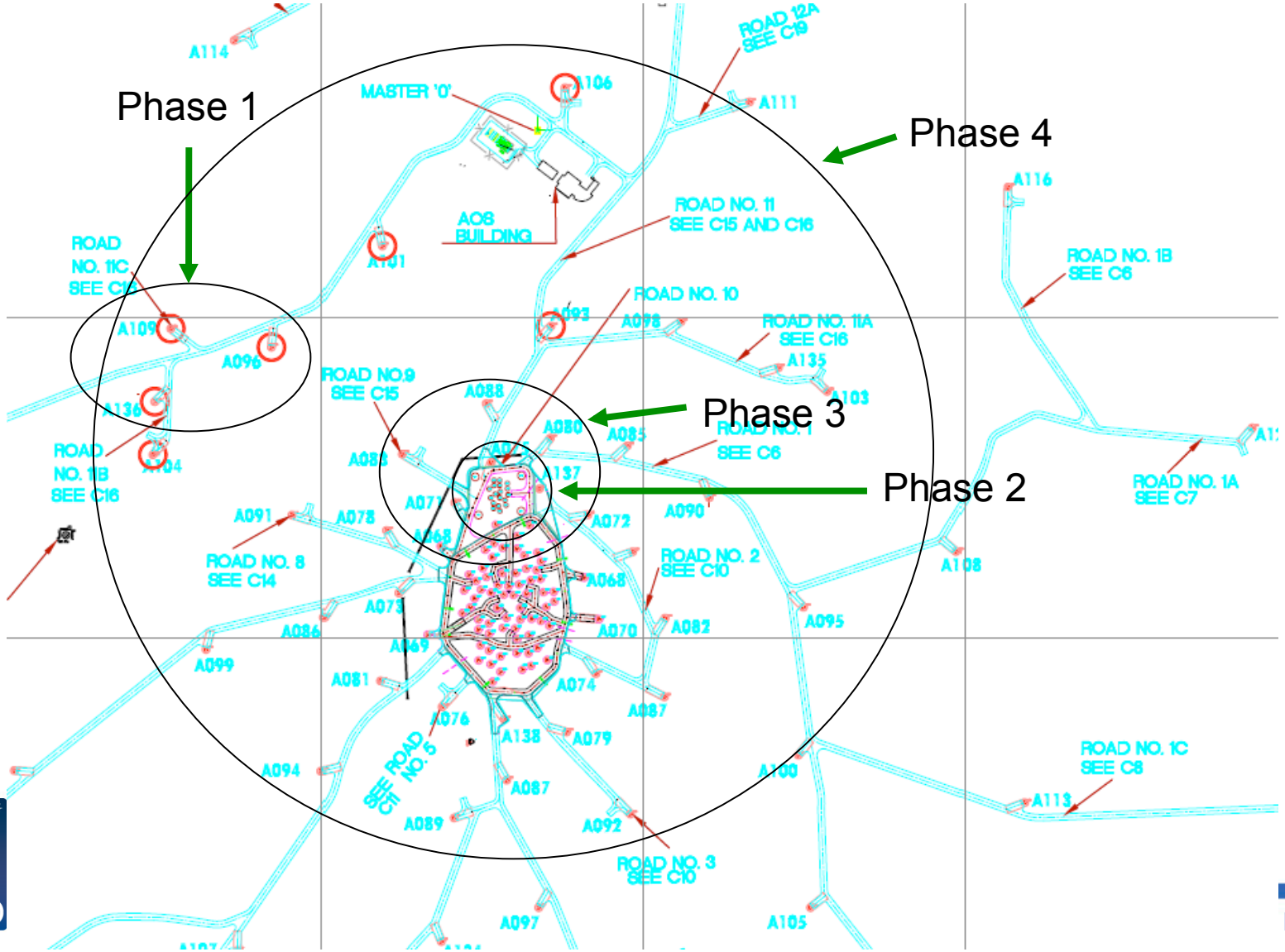
Configurations Leading to Inauguration

- Phase 0 Sep '09 1 pad for antenna checkout
- Phase 1 Oct '09 3 pads for first fringes / closure
- Phase 2 Jan '10 10 ACA pads - initial commissioning
- Phase 3 Jul '10 add 6 inner array pads
- Phase 4 Mar '11 for Early Science - central cluster plus 20 inner array pads
- Phase 5 Oct '11 high resolution – baselines to ~ 4km
- Phase 6 Apr '12 goal for completion of outer array

Antenna Station Locations



Long Baselines in Phase I Array

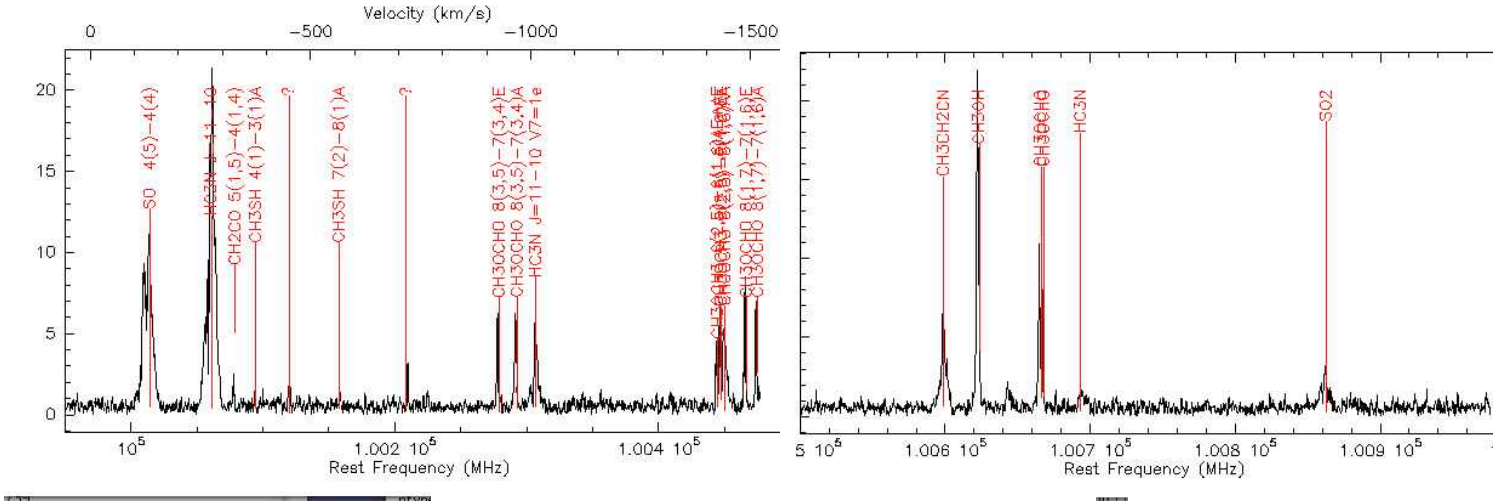
Construction of ACA Stations (2009)

No joke!

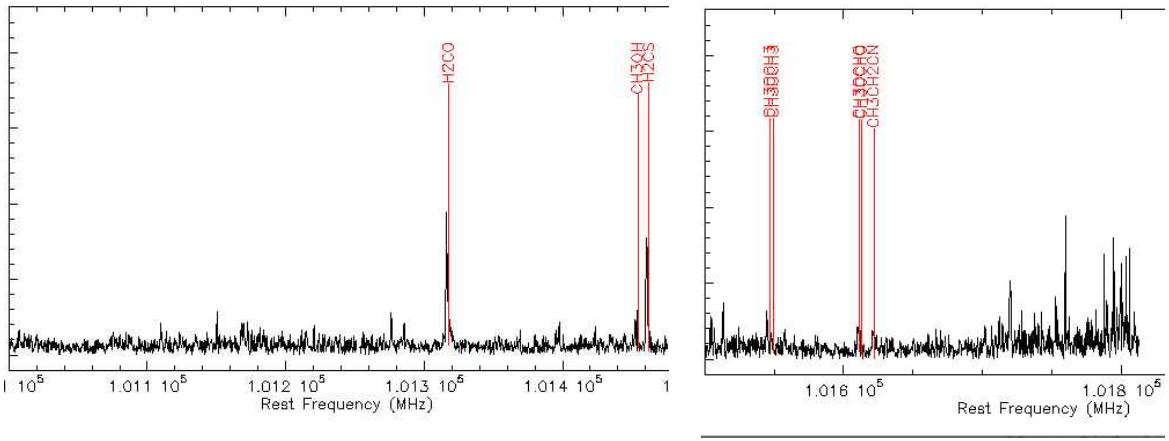
Third antenna joins the Compact Array on April 1, 2010

Interferometric spectrum:

Orion - 101 GHz, April 2008

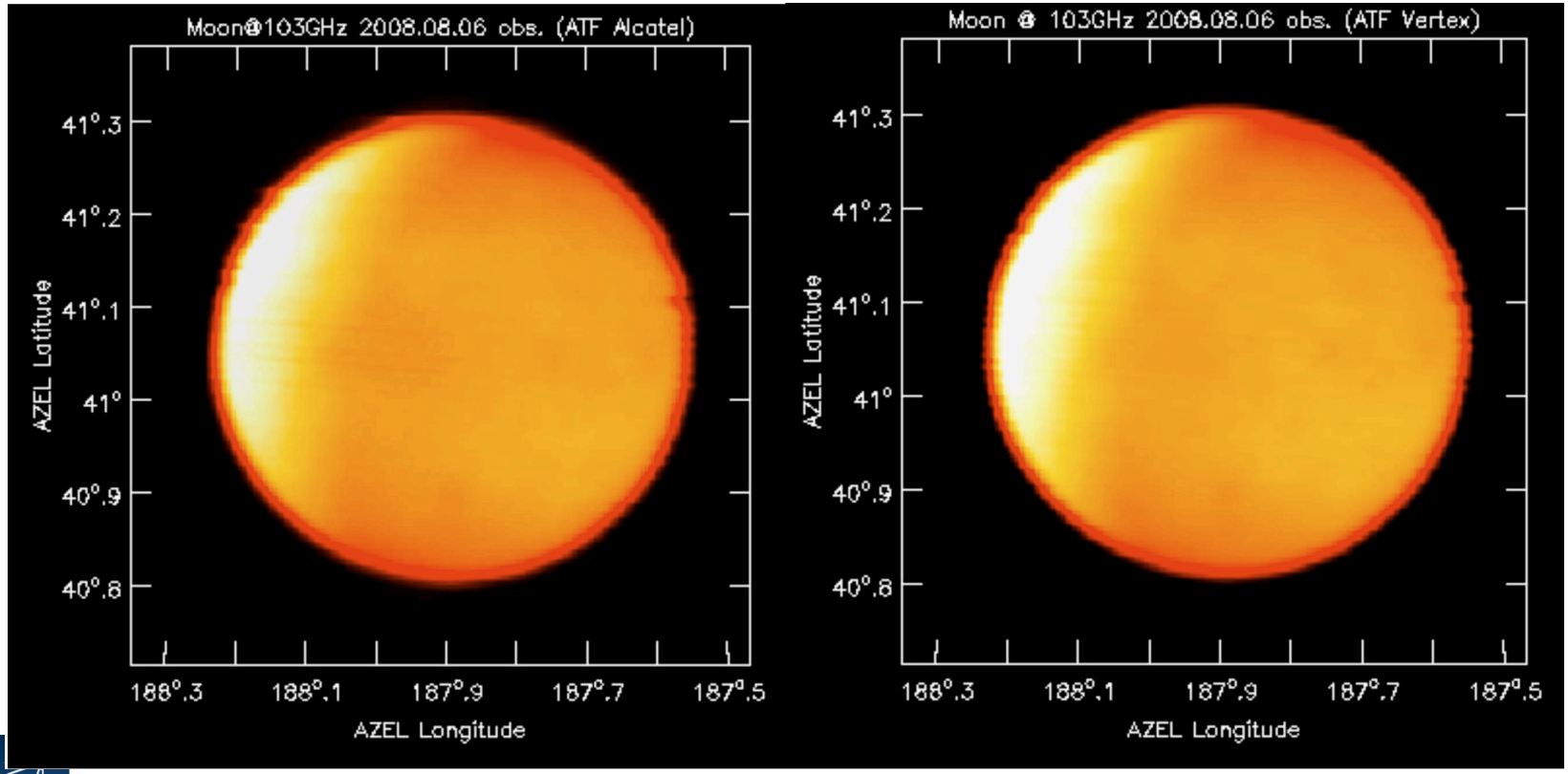


Taken at ATF, not using production receivers, but verifying software for control, tuning, correlator and data reduction



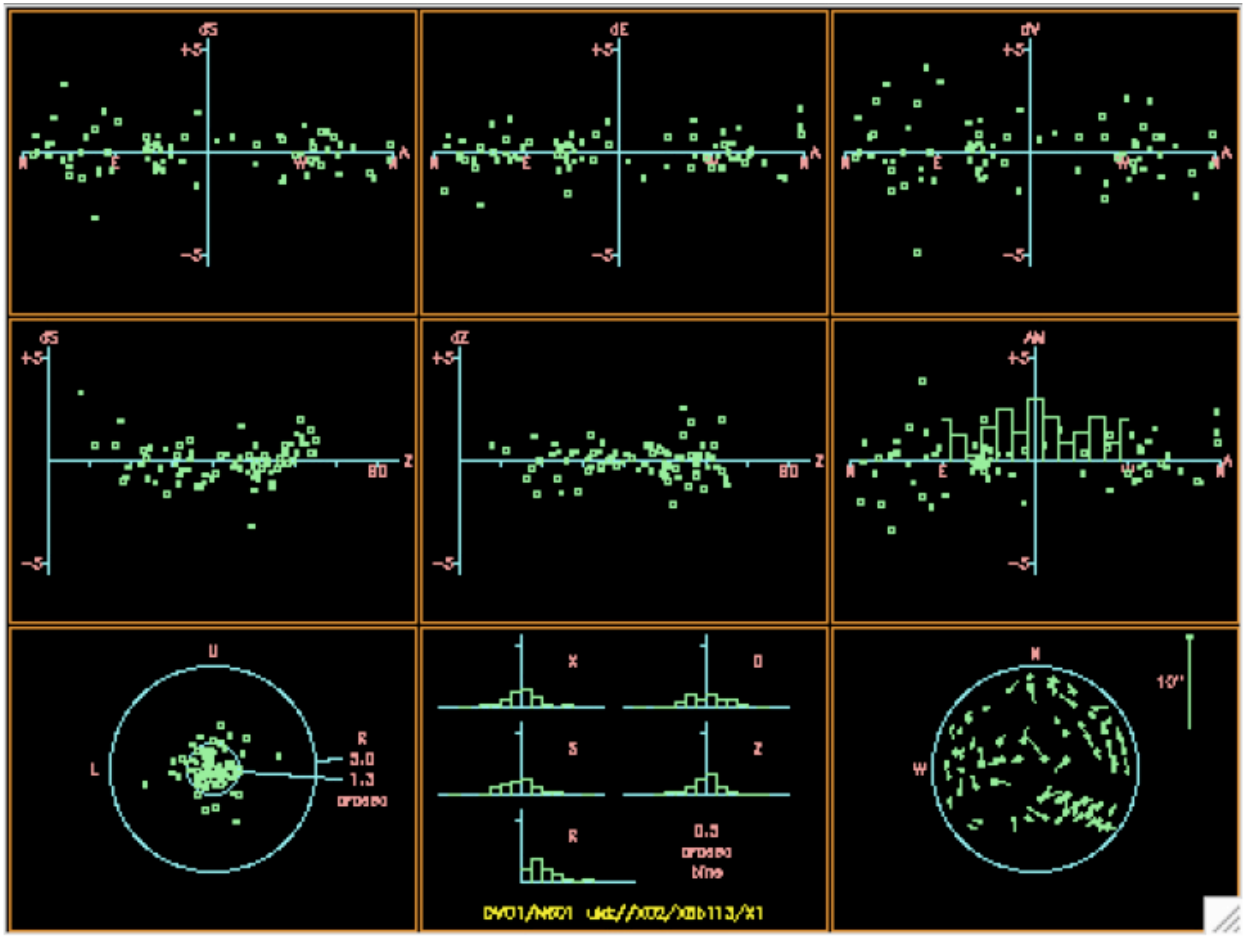
Single Dish On-the-Fly Mapping

Early e2e software test, Moon with 2 antennas simultaneously



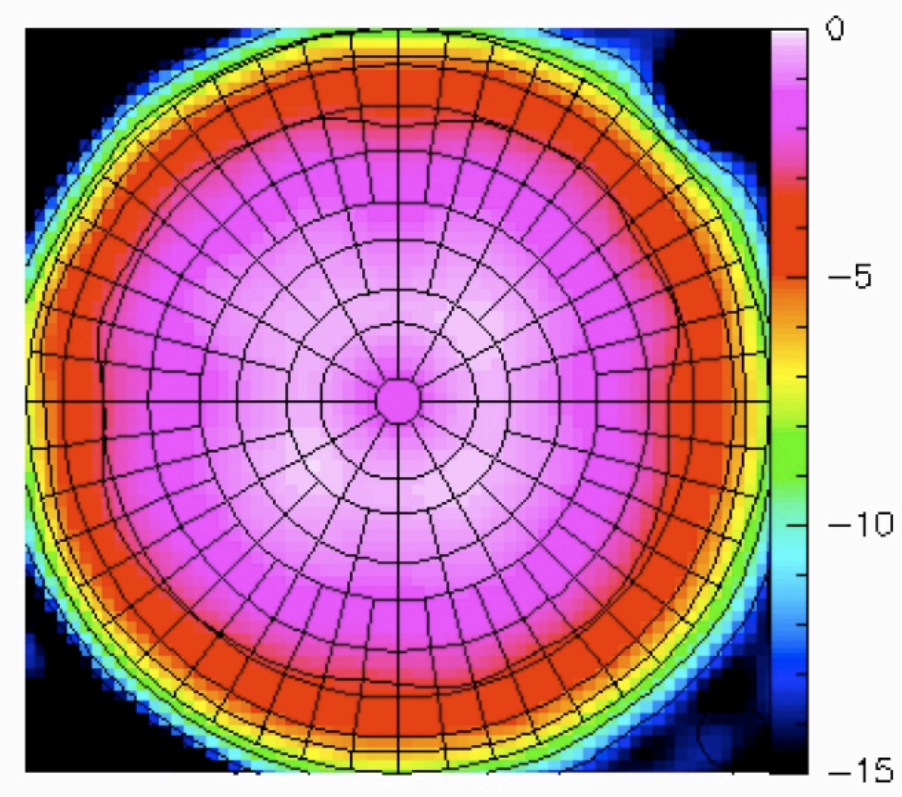
Weekly Pointing Monitoring

DV01
rms=1.8”

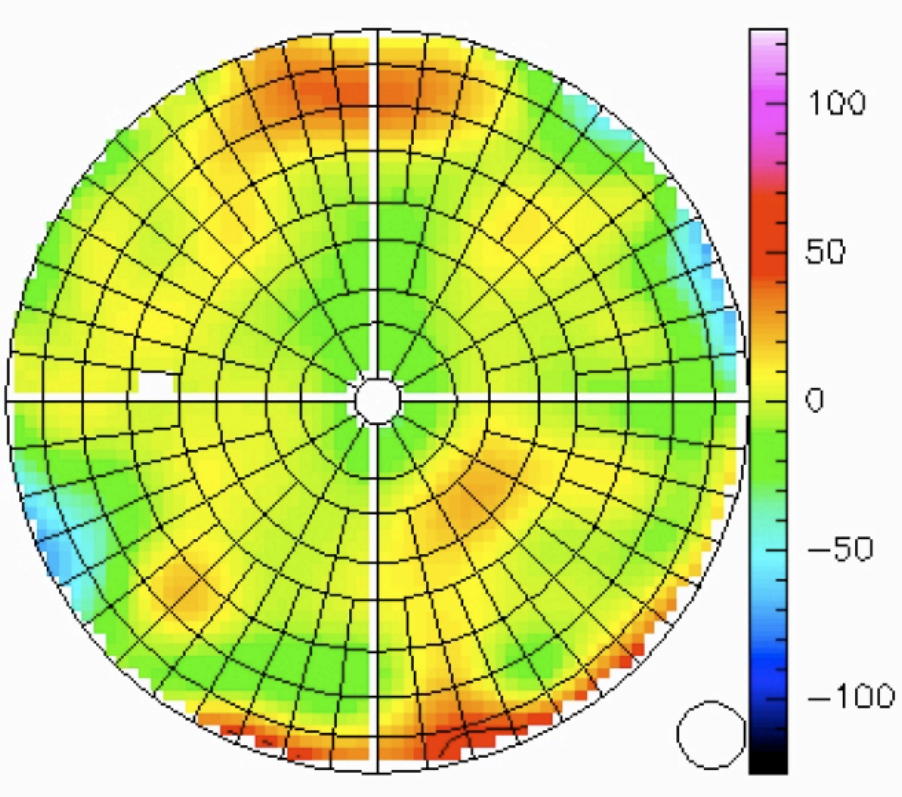


Astronomical Holography

3C279 at 81° elevation

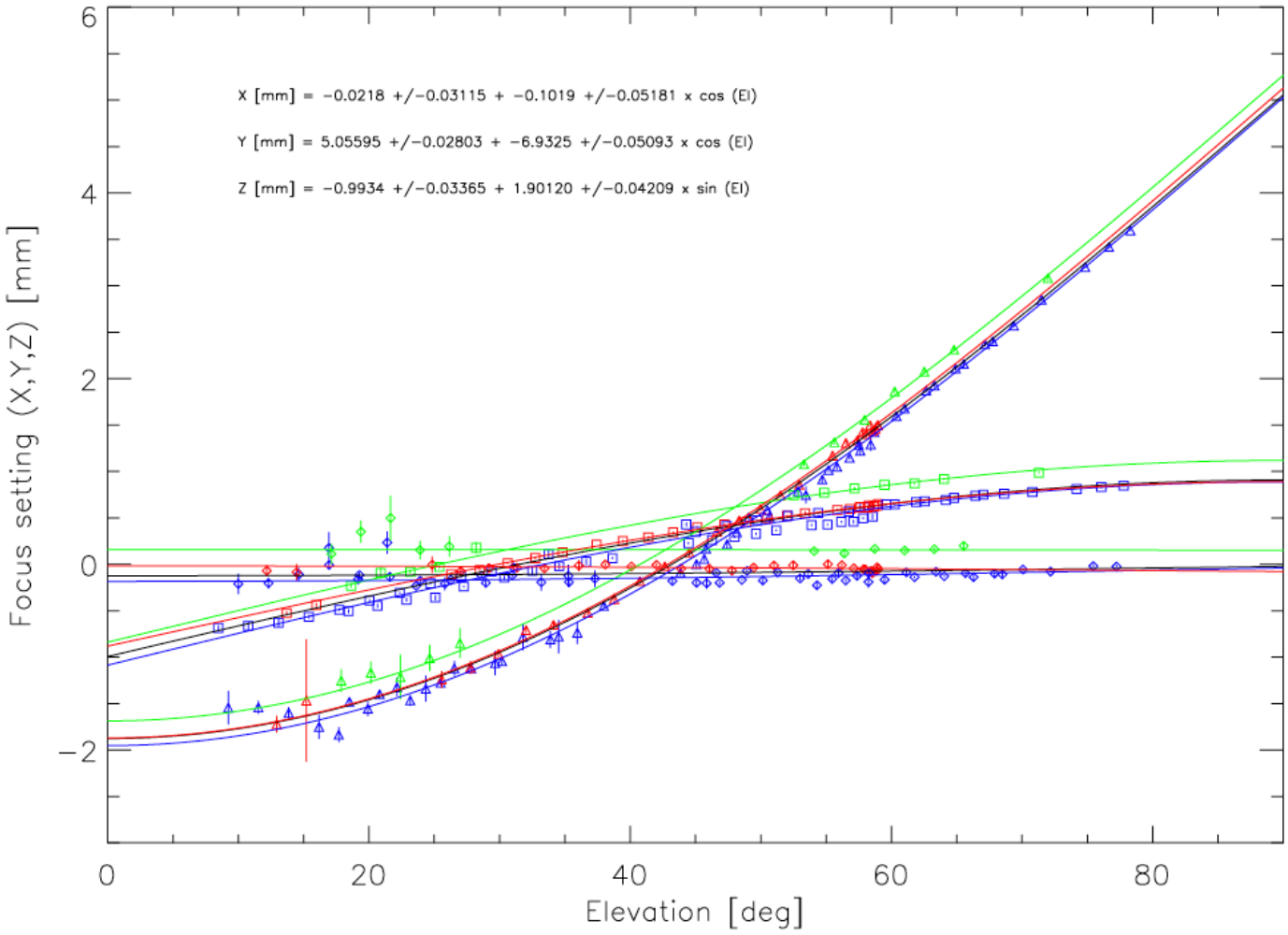


Illumination



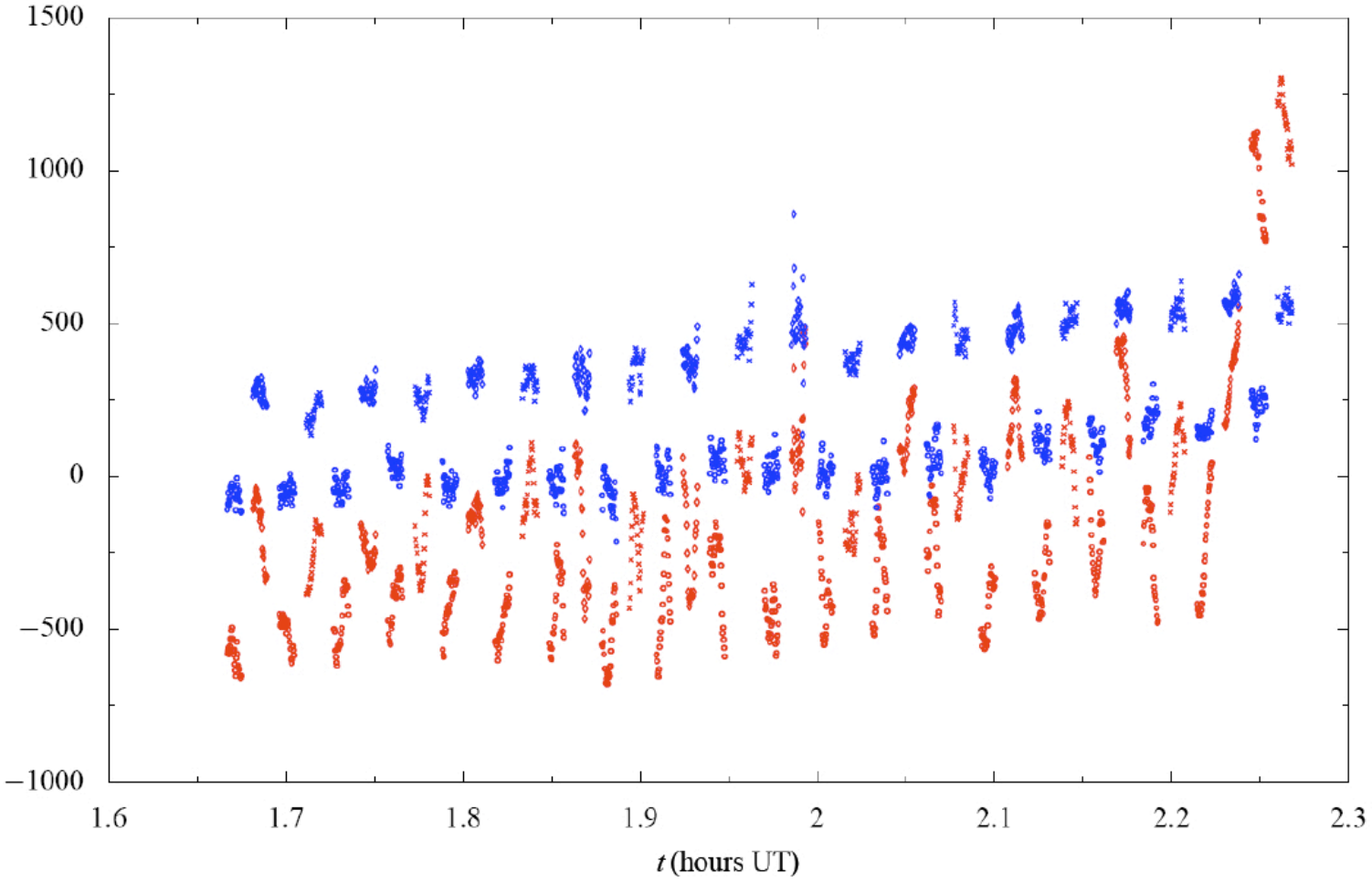
Surface

Measuring Focus Curves



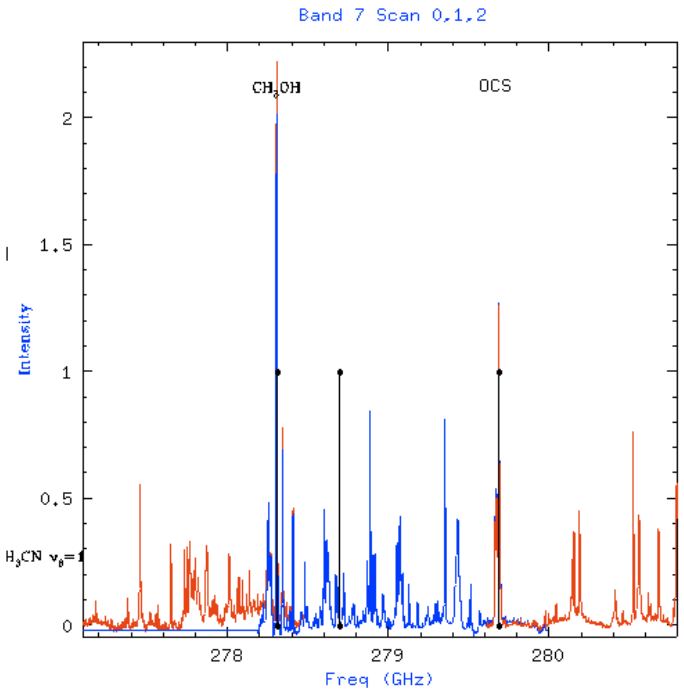
Water Vapor Correction

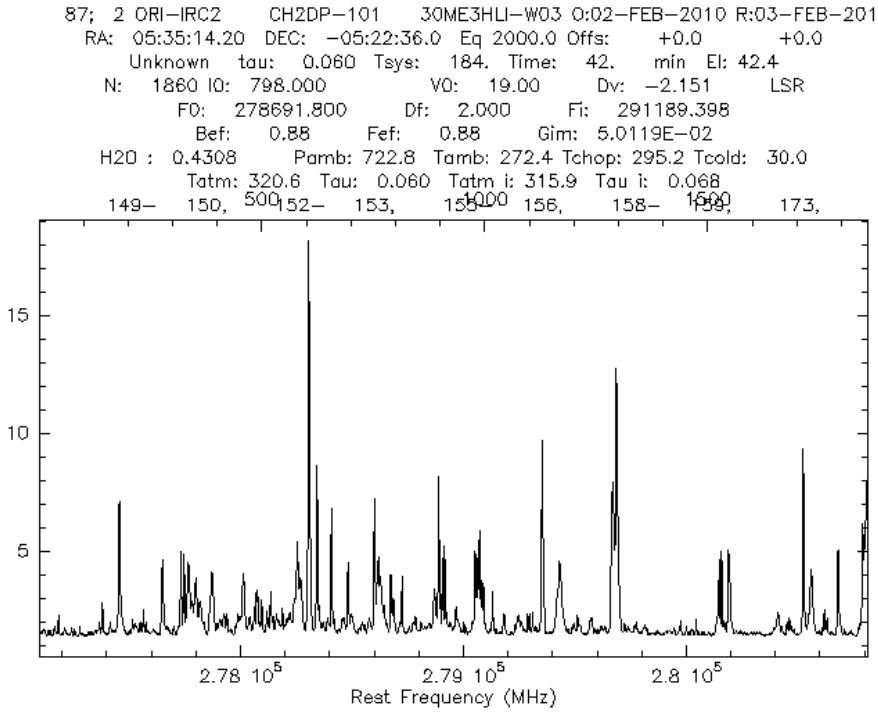
Cycling between 3C273, 3C279, Pluto; blue=corrected



Recent Band7 (345 GHz) Spectrum of Orion

Comparison with IRAM 30m



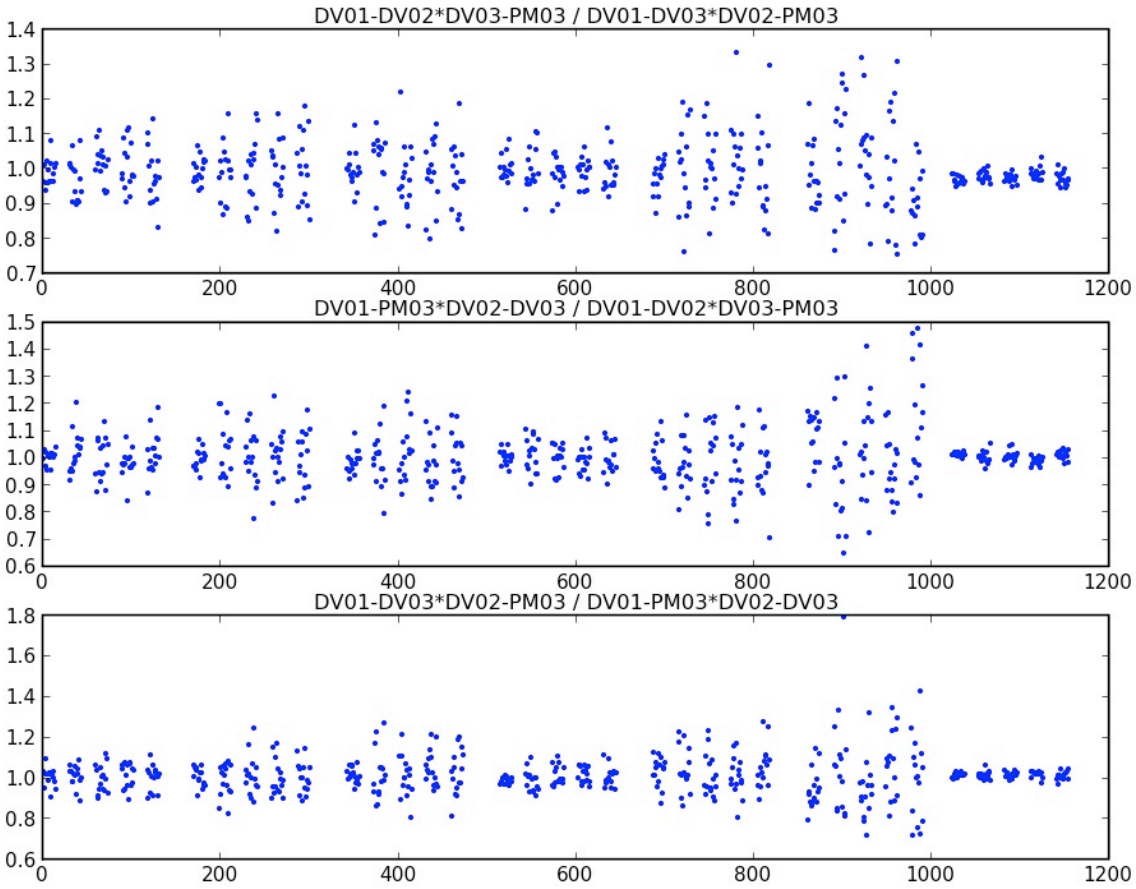


May 2010, AOS

First fringes using all 4 antennas May 21, 2010

Amplitude Closure!

Several sources, including Jupiter and qsos, data analysis has begun



Next Steps:

- Commissioning and Science Verification in full swing throughout 2010/11
  - 4+ antennas:
    - Further test observing modes:
      - Single field interferometry
      - Pointed mosaic
      - Single dish on-the-fly for zero spacing
      - Automated monitoring modes (pointing, calibrator survey)
  - 6+ antennas:
    - Refine calibration strategies
    - Better imaging
- **Call for proposals for Early Science end of 2010.**
- Early Science start in second half of 2011.

How you can be involved…

Current job advertisements:

https://careers.nrao.edu

http://hr.almaobservatory.org/jobs/opportunities/

Visitor's program:

- Some support (typically at least travel and lodging) for people who can take leave or sabbatical from their home institutions to participate in CSV.
- Open through 2011
- Stays of 3 months to 1 year recommended
- No proprietary data during this period
- Contact me for more information at apeck@alma.cl

ALMA

For more info on current status:

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.

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PREPARING FOR ALMA

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