

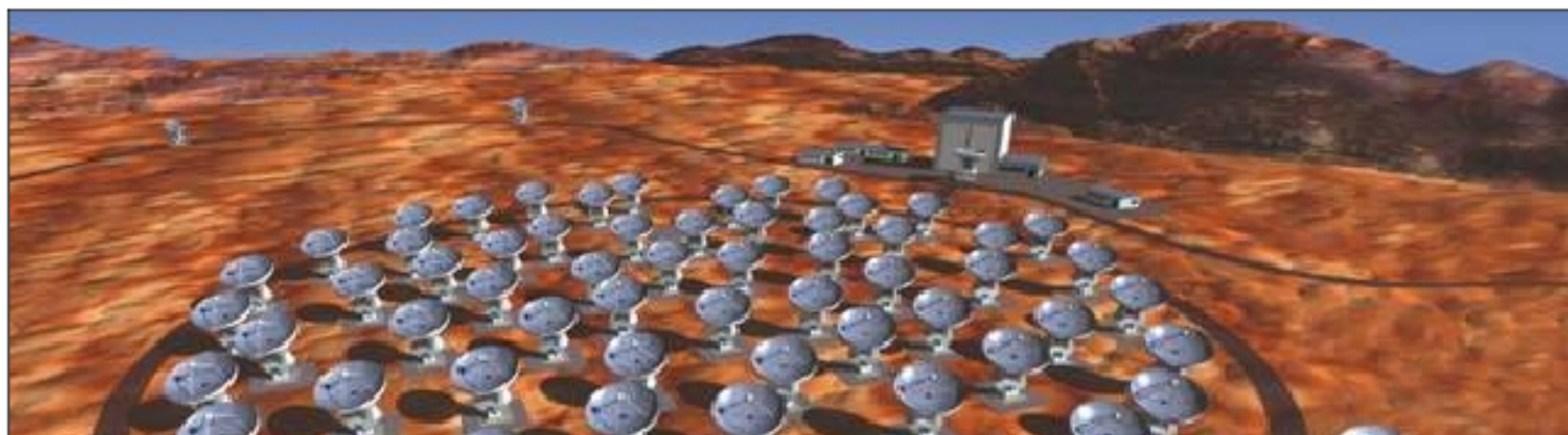


EUROPEAN ARC
ALMA Regional Centre || IRAM



ALMA

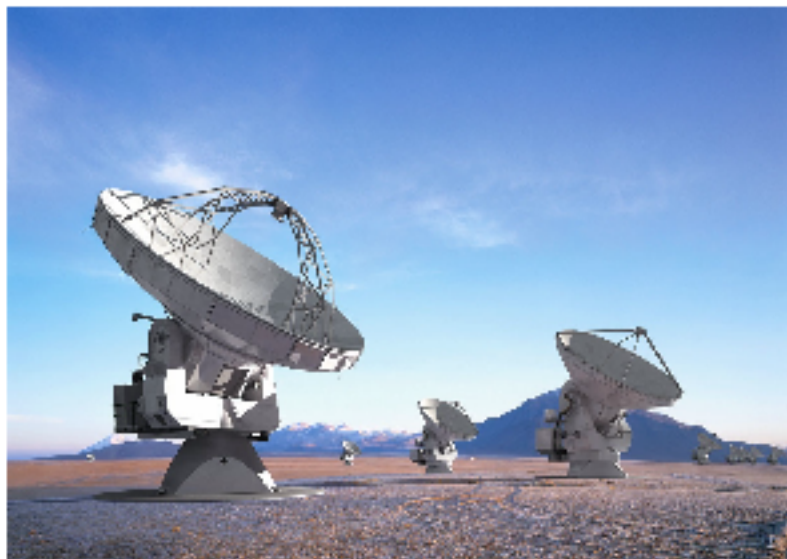
Frédéric Gueth, IRAM Grenoble
ALMA Science Advisory Committee
IRAM node of the ALMA Regional Center

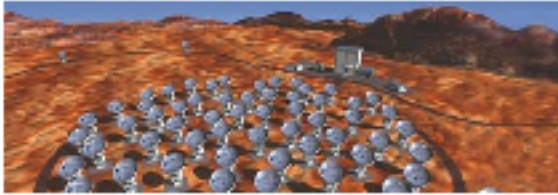




Preparing for ALMA

- **The ALMA project**
- ALMA construction : status as of Sept. 2010
- ALMA Operations & Early Science
- The IRAM ARC node

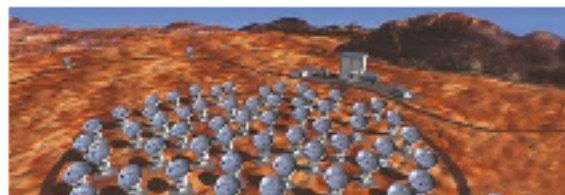




ALMA

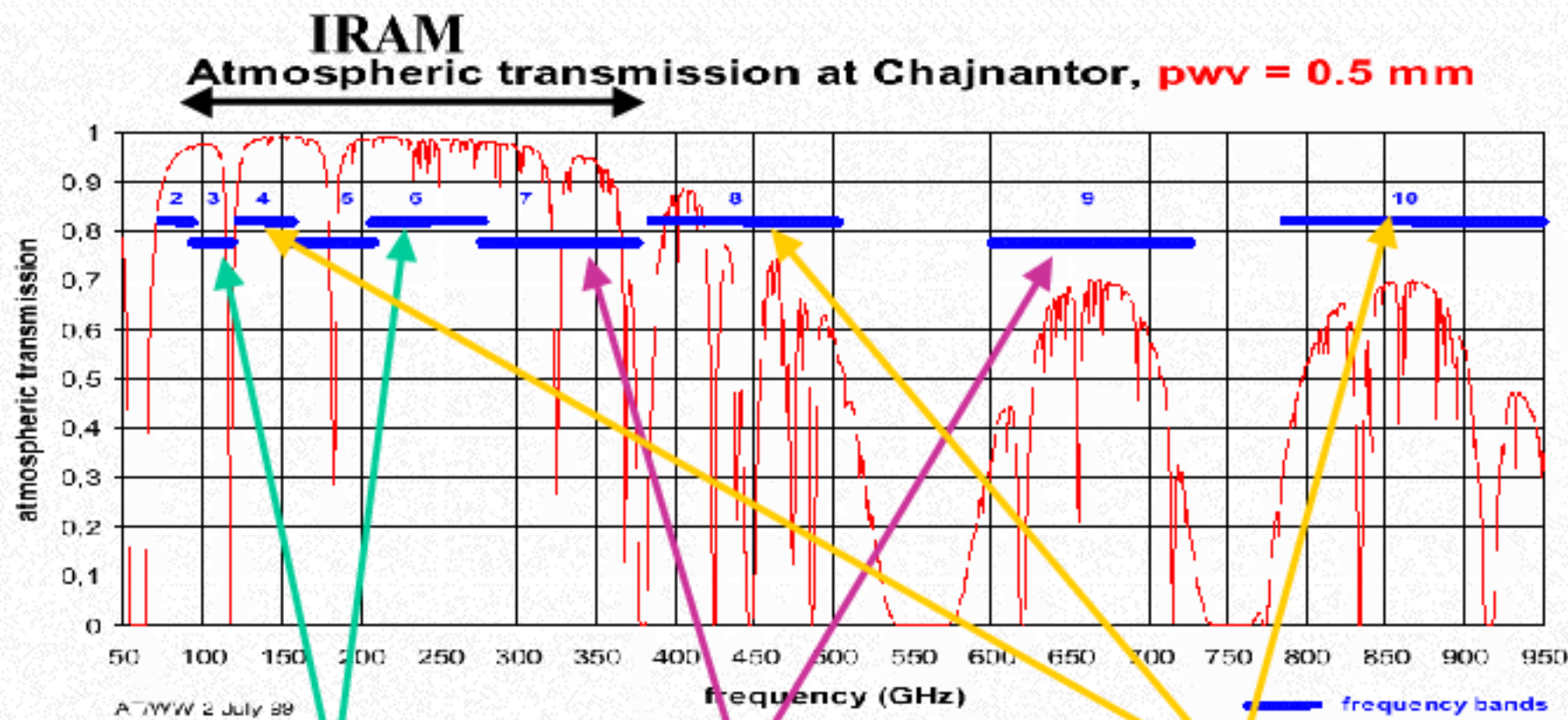
- **Atacama Large Millimeter/Submillimeter Array**
- World-wide collaboration between Europe (**ESO**) – North America (USA, Canada, Taiwan) – Eastern Asia (Japan, Taiwan) – Chile

- Main array: 50 X 12 m antennas
- ALMA Compact Array (ACA): 4x12m + 12x7m
- Frequency range: 30—900 GHz (0.3—10 mm)
- 16 km max. baseline (<10 mas ang. resolution)
- ALMA is a spectro-imager instrument providing data cubes



Level 0 requirements

1. The ability to **detect spectral line emission from CO or CI** in a normal galaxy like the Milky Way at a **redshift of 3**, in less than 24 hours of observation.
2. The ability to **image the gas kinematics in protostars and protoplanetary disks** around young Sun-like stars at a distance of 150 pc.
3. Provide **precise images at 0.1 arcsec resolution**.



North America

Band 3 (84-116 GHz)
 Band 6 (211-275 GHz)

Europe

Band 7 (275-373 GHz)
 Band 9 (602-720 GHz)

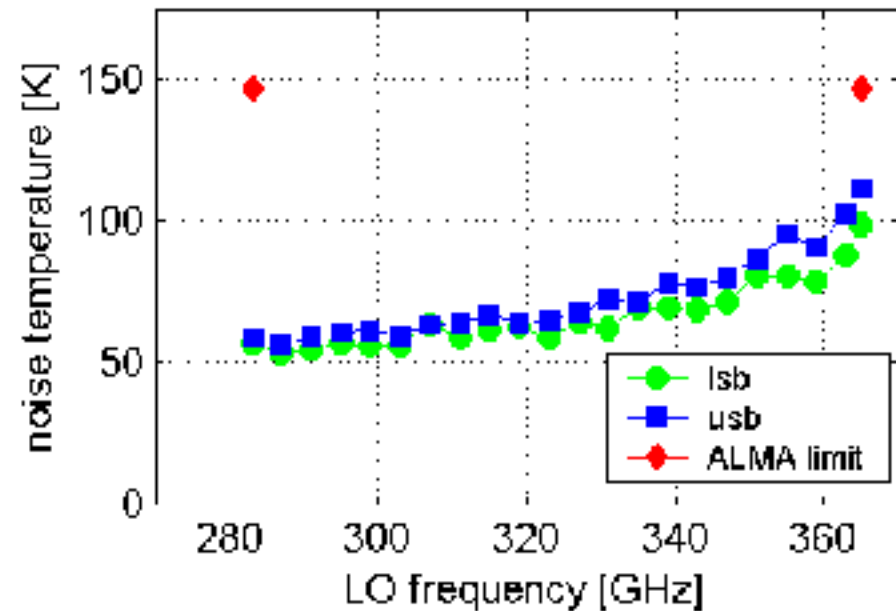
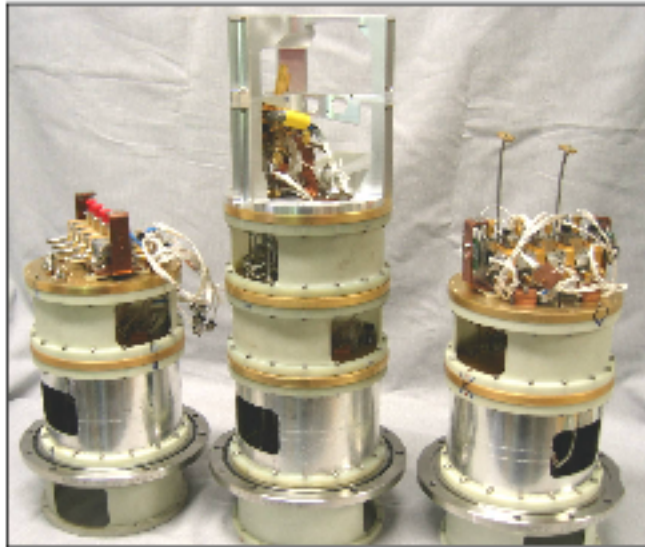
Japan

Band 4 (125-163 GHz)
 Band 8 (385-500 GHz)
 Band 10 (787-950 GHz)

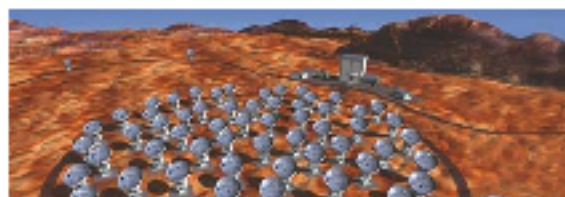
Freq. coverage: 30—900 GHz
Bandwidth: 8 GHz x 2 polarizations



Band 7 @ IRAM

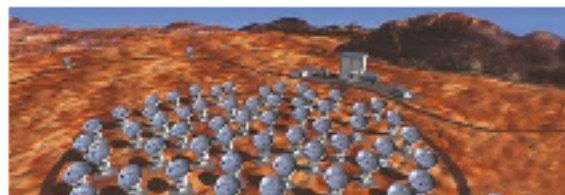


← All bands installed in one single cryostat (Front-End integration Centers)



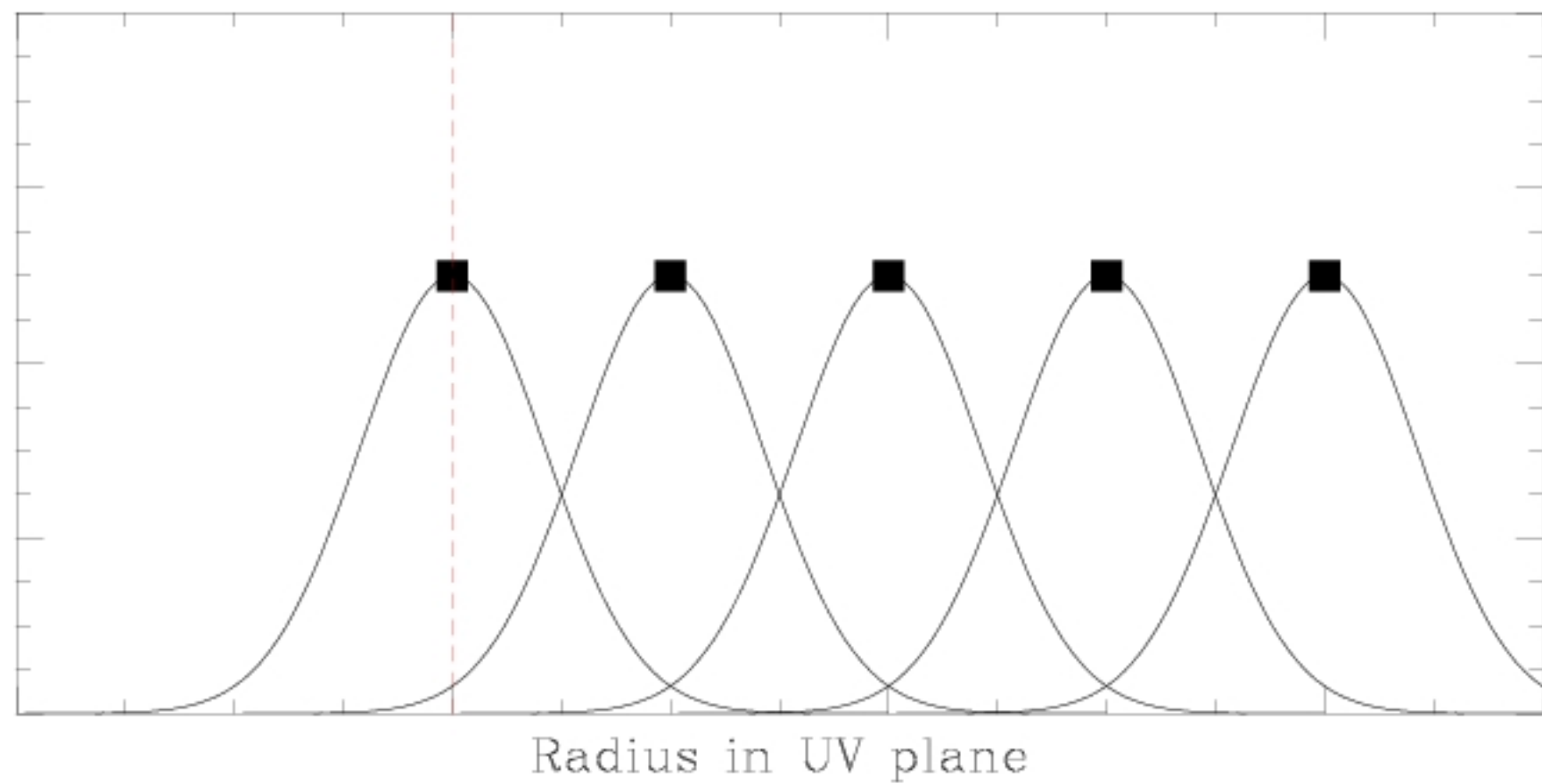
Correlator

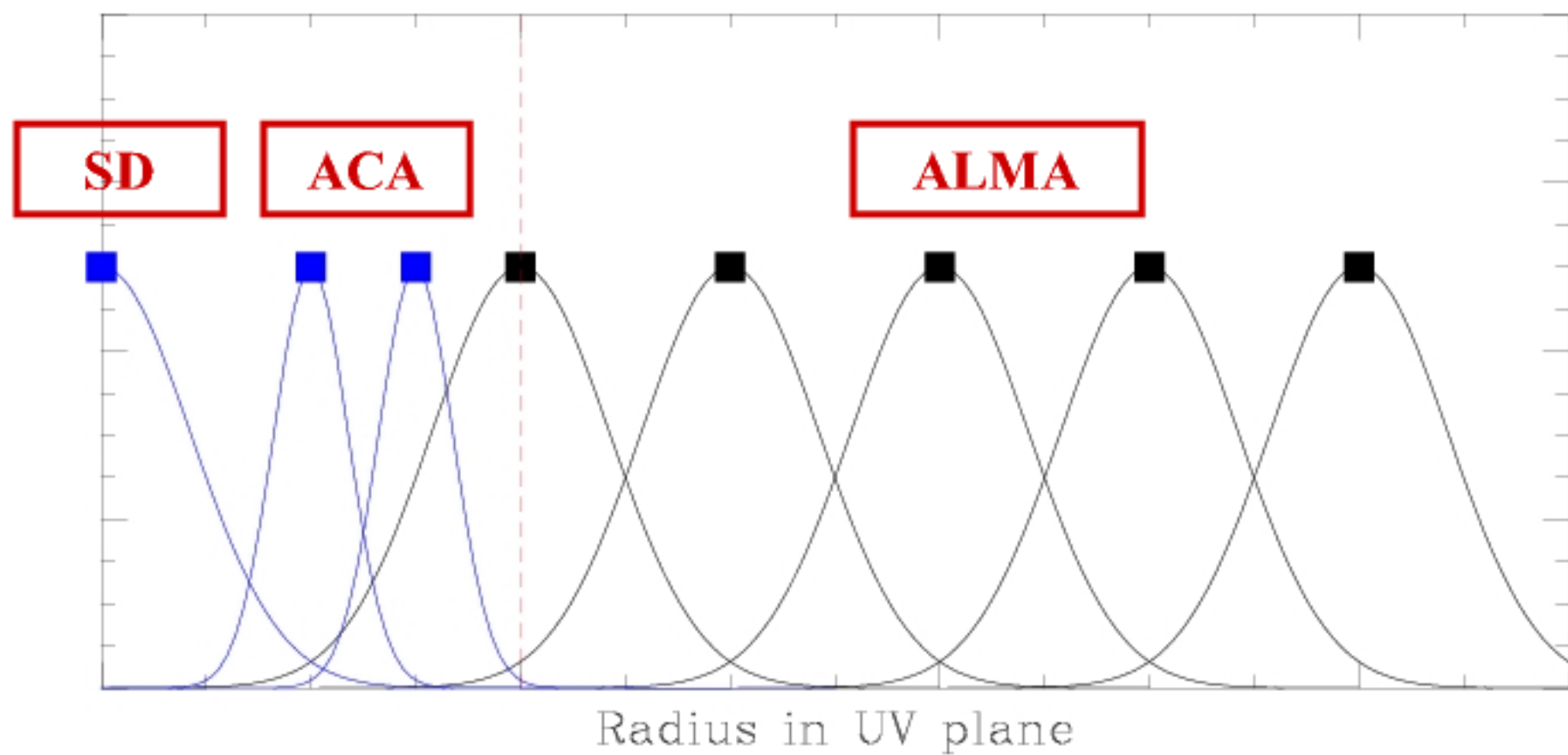
- The ALMA correlator provides ~ 70 modes
 - Process 8 GHz bandwidth x 2 polarizations
 - One, two, or four polarization products
 - Various sampling options
- Usual **tradeoff bandwidth vs. resolution**
 - 4x2 GHz bandwidth @ 244 kHz resolution
 - 4x32 MHz bandwidth @ 3.8 kHz resolution
(0.005 km/s @ 230 GHz)

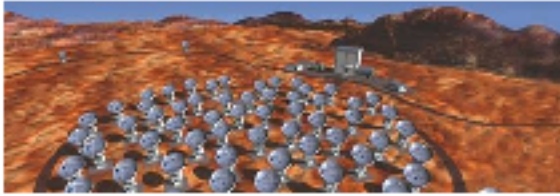


Imaging

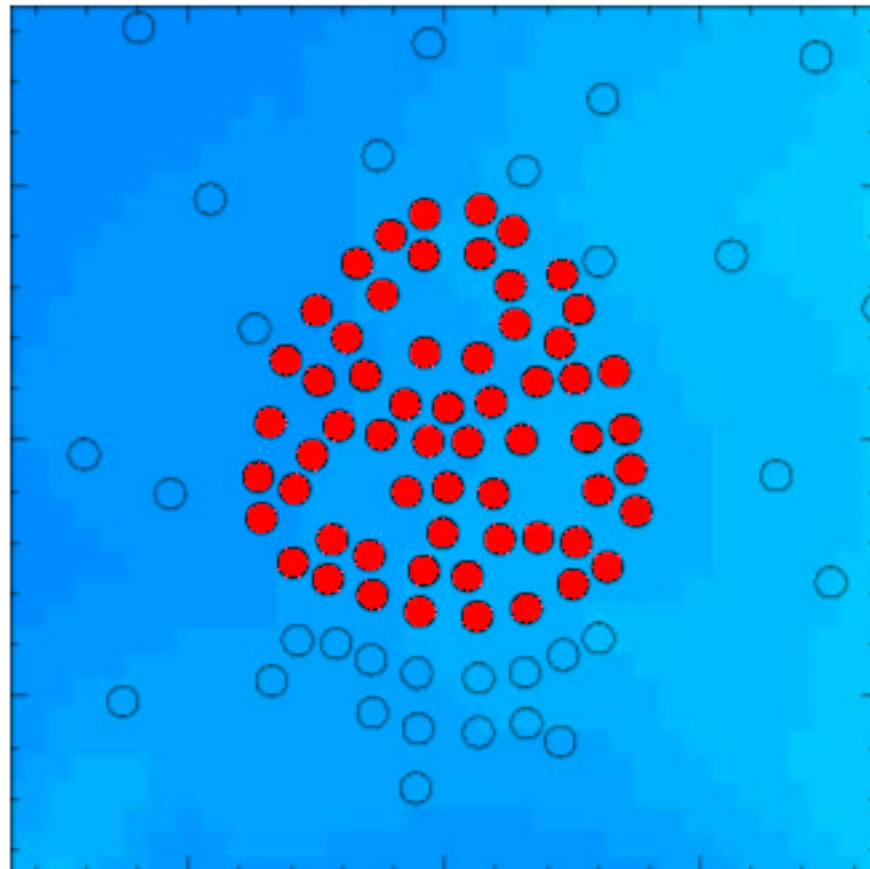
- 50 antennas, 1225 baselines
 - ALMA imaging simulator in GILDAS and CASA
- **28 different antenna configurations, from compact to ~ 16 km, continuous reconfiguration**
 - Angular resolution λ/B down to 40 mas (100 GHz), 5 mas (900 GHz)
- **Short spacings: ACA** observations + 4 single-dish antennas
- Caution: not all projects can have ACA data!**

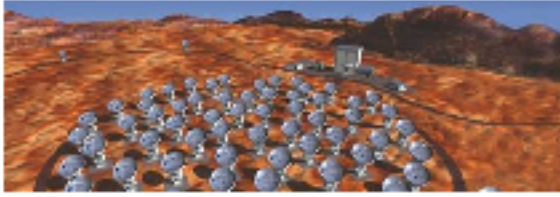




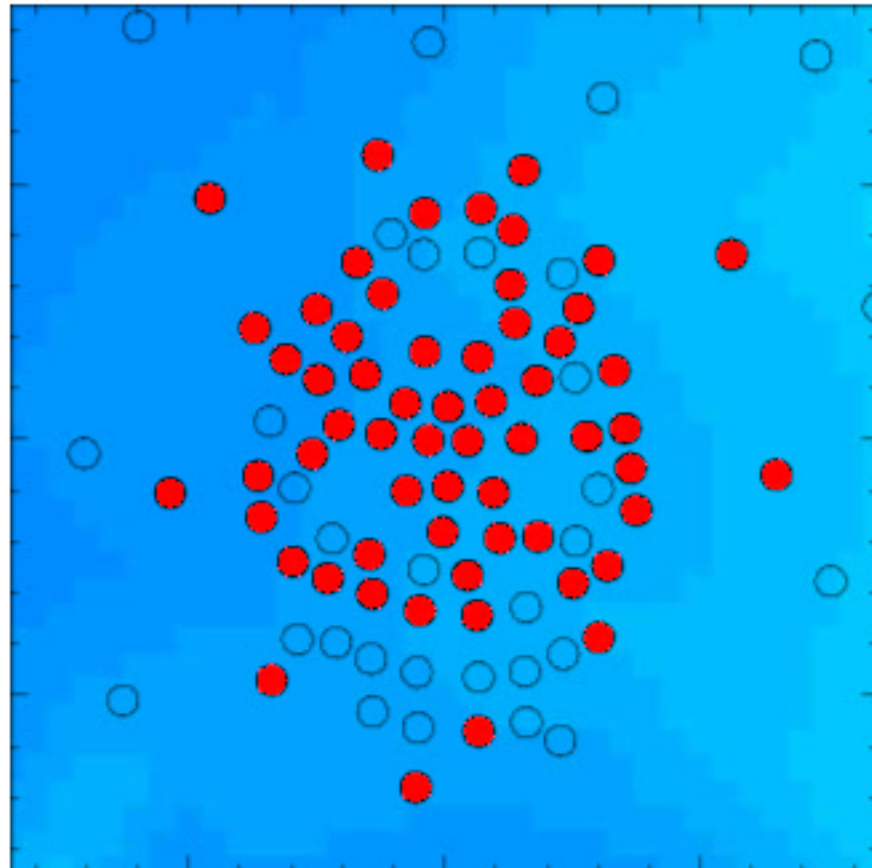


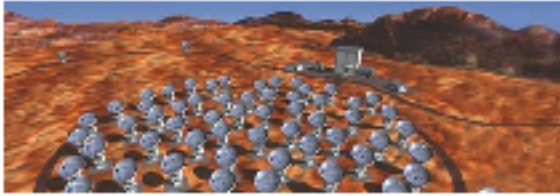
Configurations ALMA



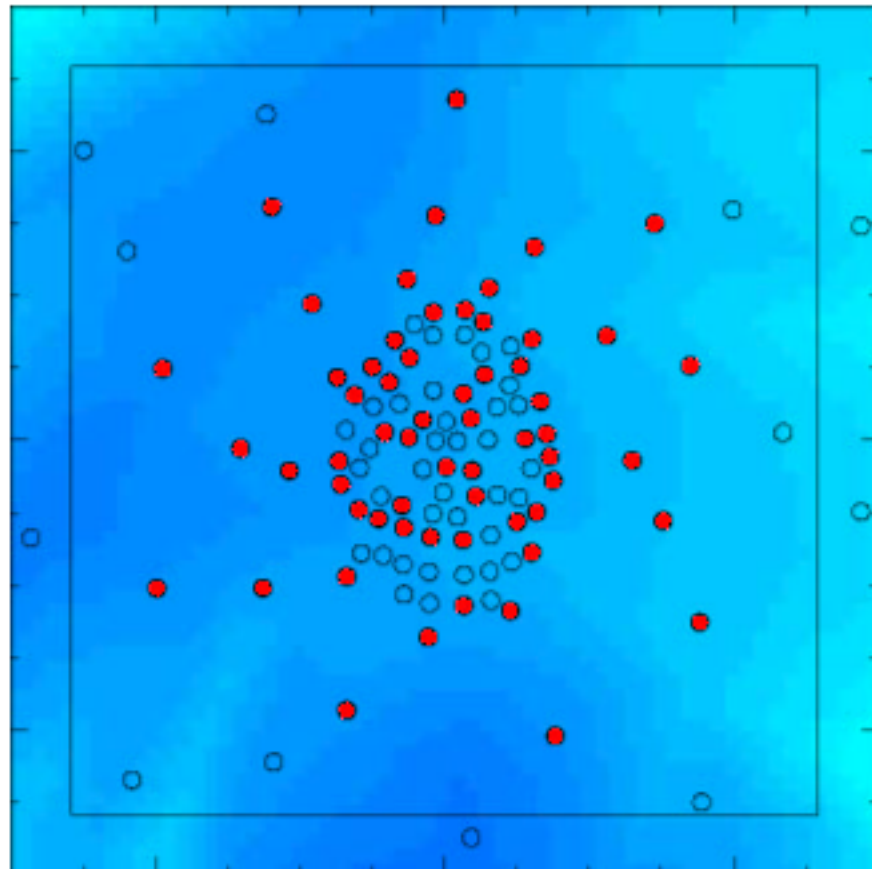


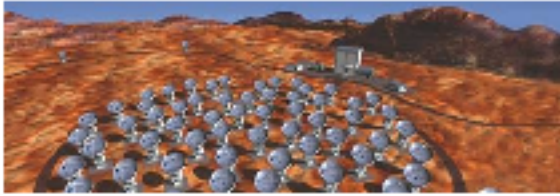
Configurations ALMA



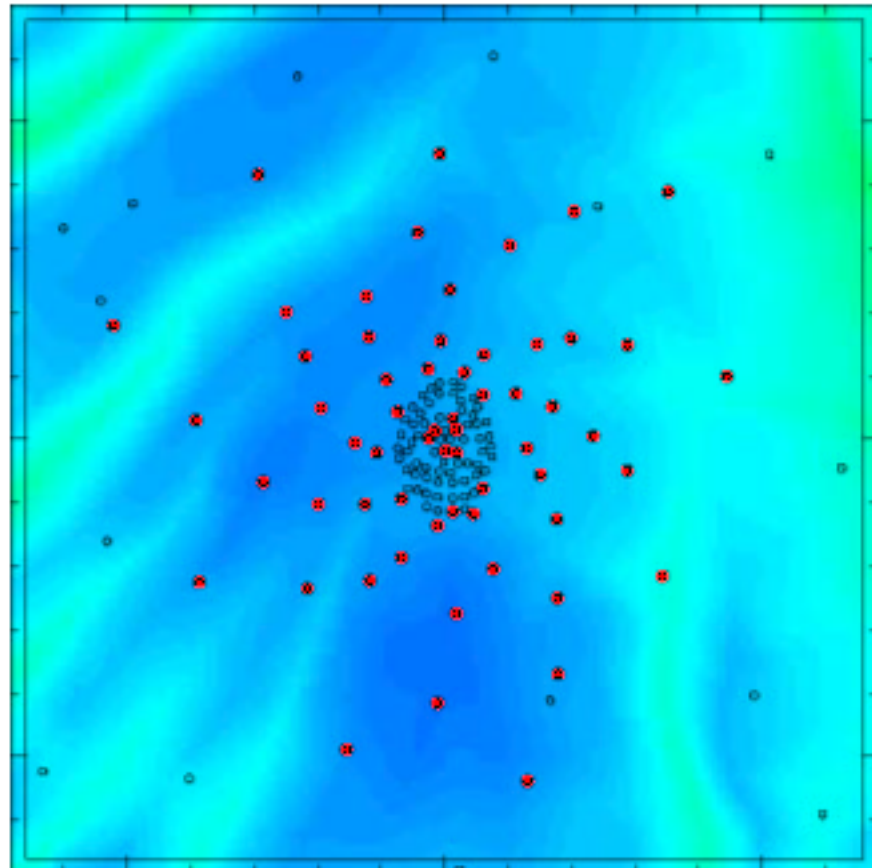


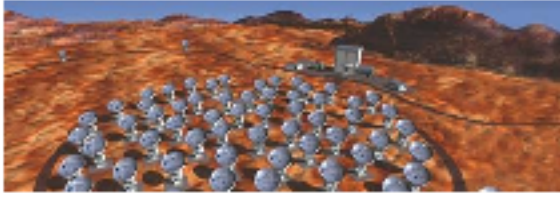
Configurations ALMA



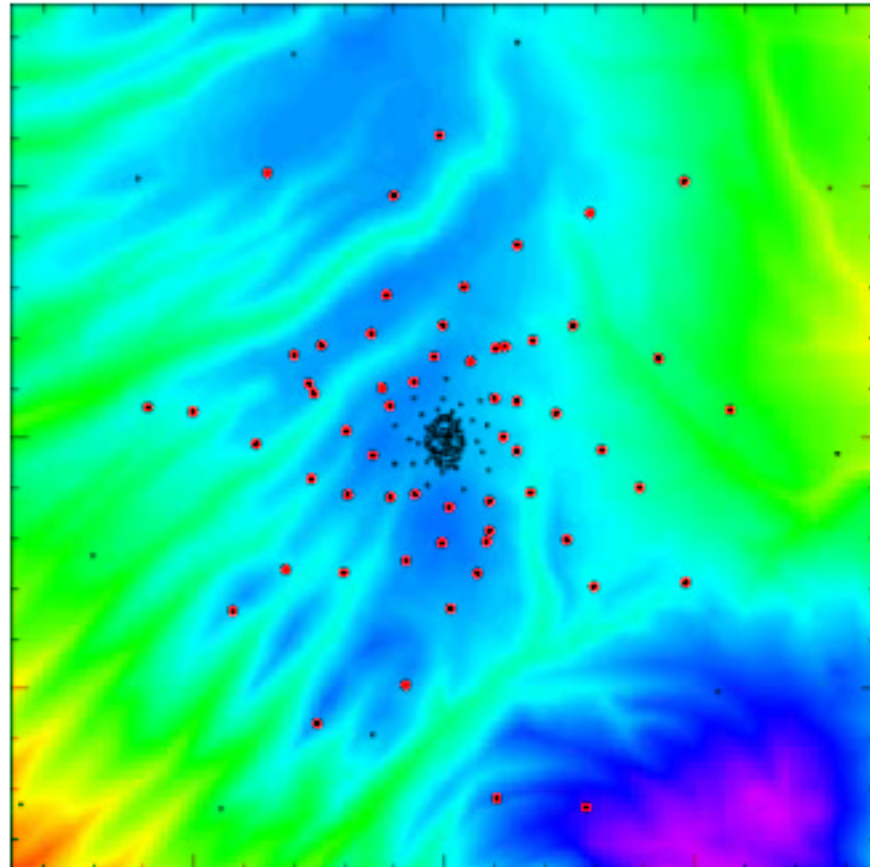


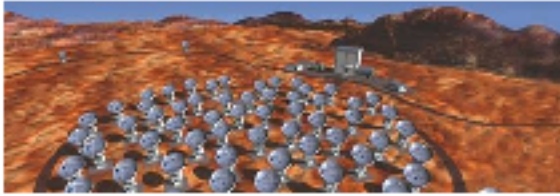
Configurations ALMA



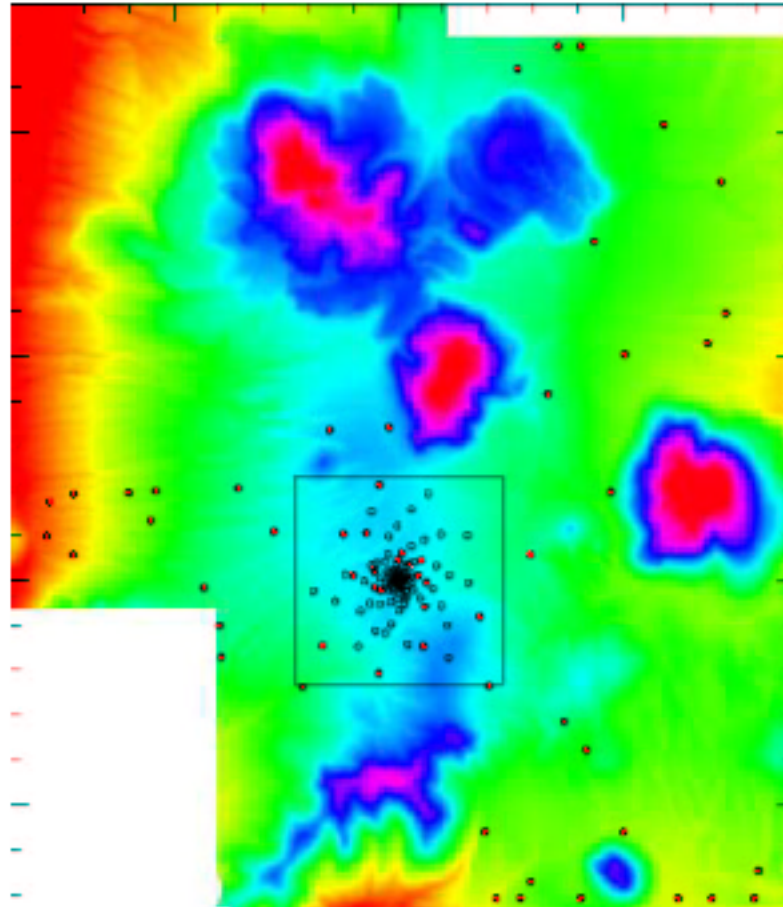


Configurations ALMA





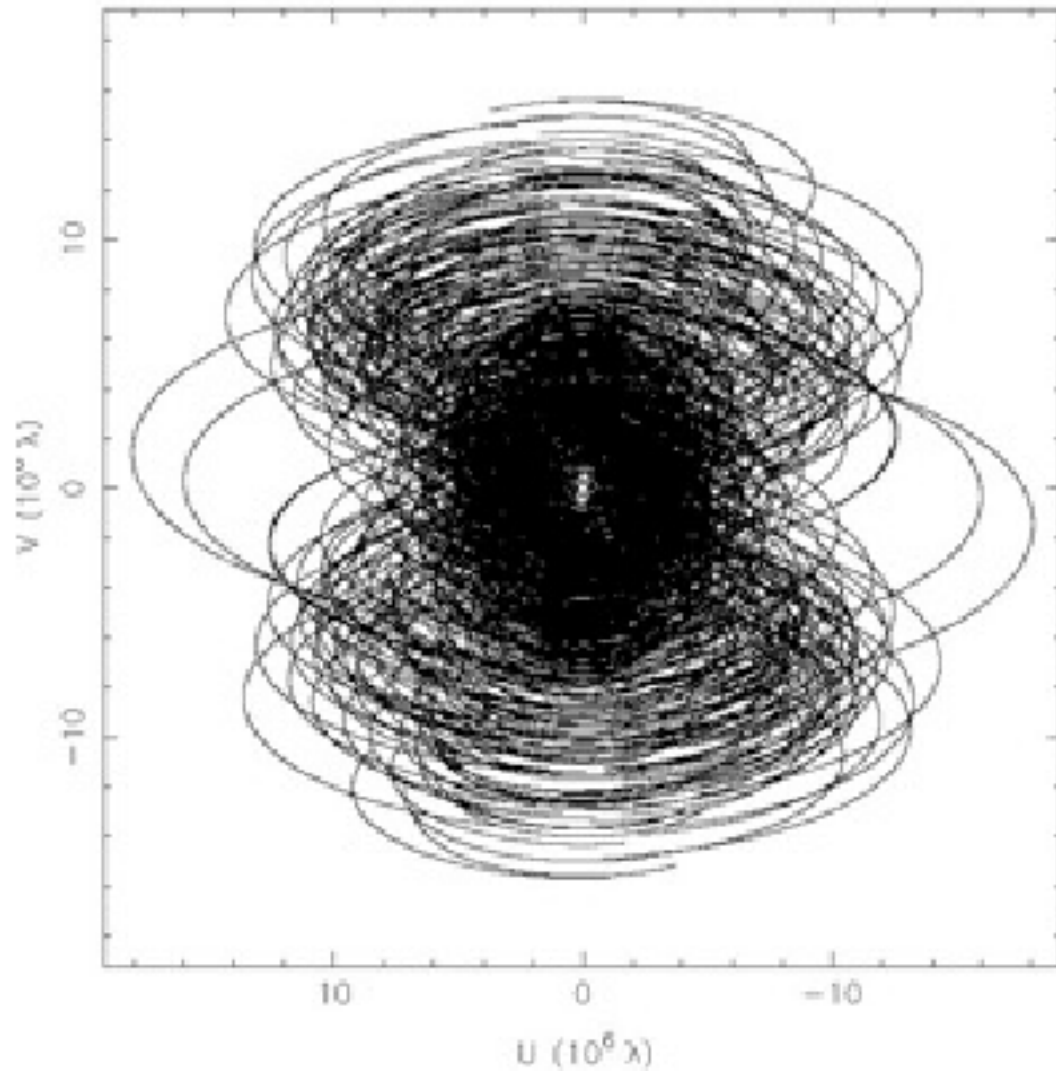
Configurations ALMA

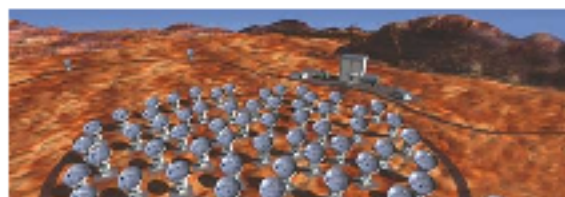




UV coverage

900GHz_50pc_ws_8 at 896.000 GHz in xx 2012 Jun 21





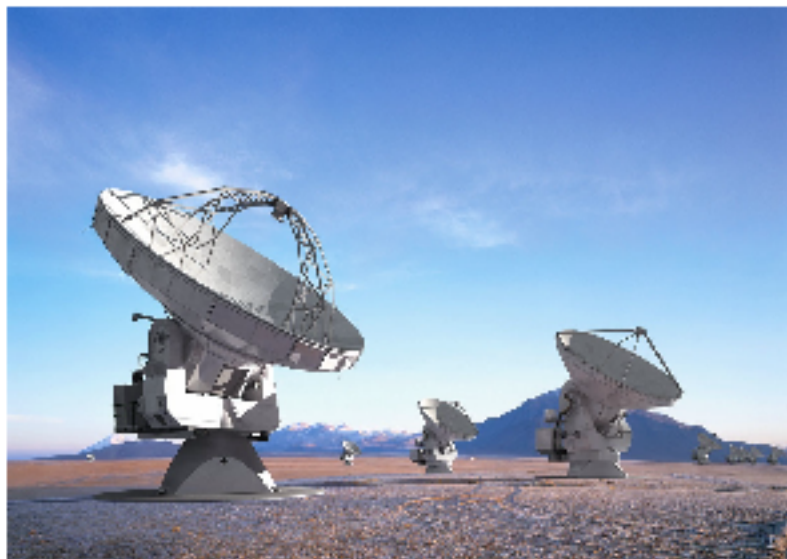
Sensitivity

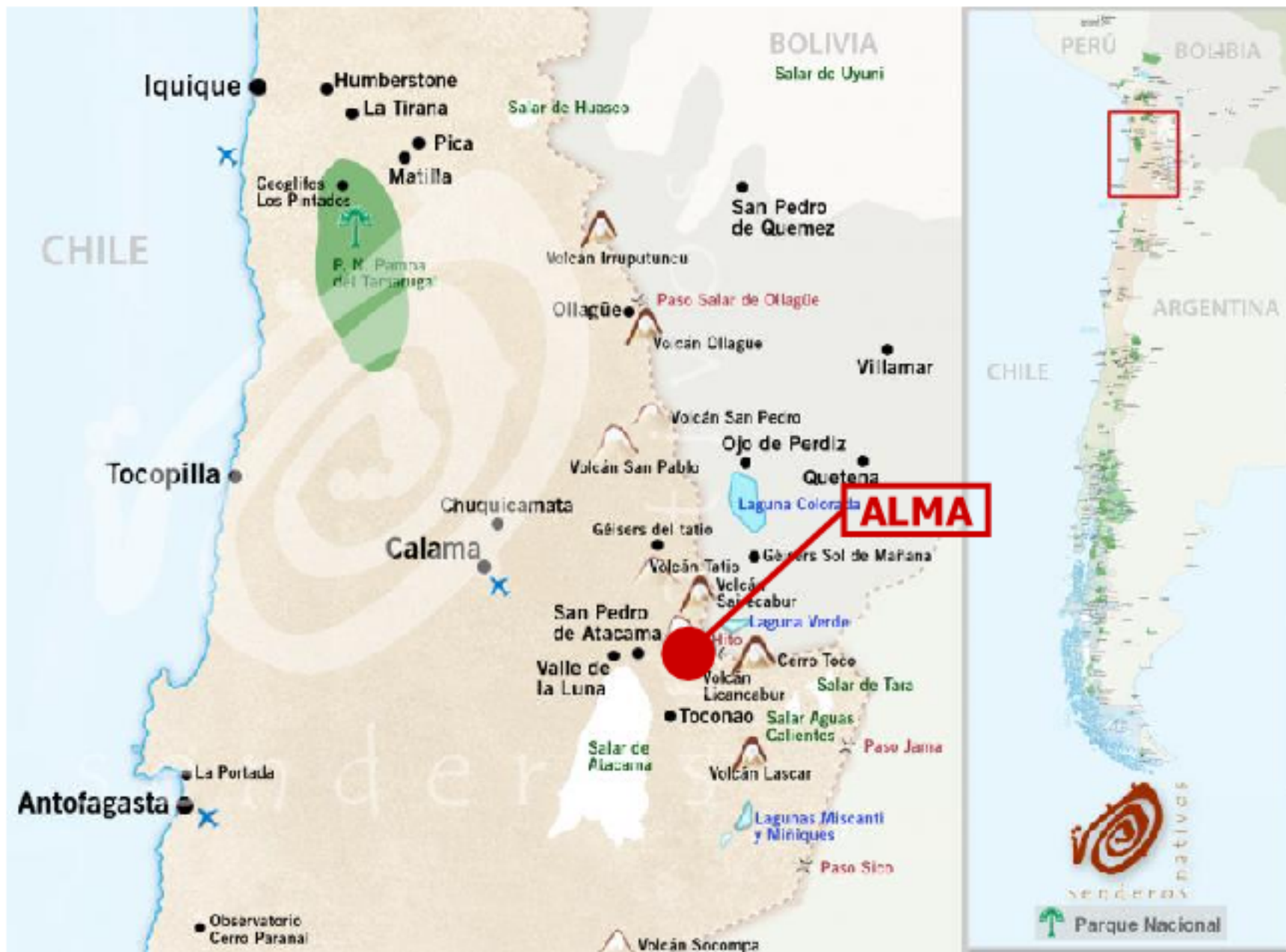
- Collecting area = 7200 m^2 ($\sim 5x$ Bure), excellent site
 - Ex: rms = $8 \mu\text{Jy}$ in 6h (8 GHz continuum, 230 GHz)
 - On-line sensitivity estimator:
<http://www.eso.org/projects/alma/science/bin/sensitivity.html>
- Point-source sensitivity: gain of <1 order of magnitude compared to current PdBI
- Resolution: gain of >1 order of magnitude vs. PdBI
- Surface brightness sensitivity: **depends on angular resolution**

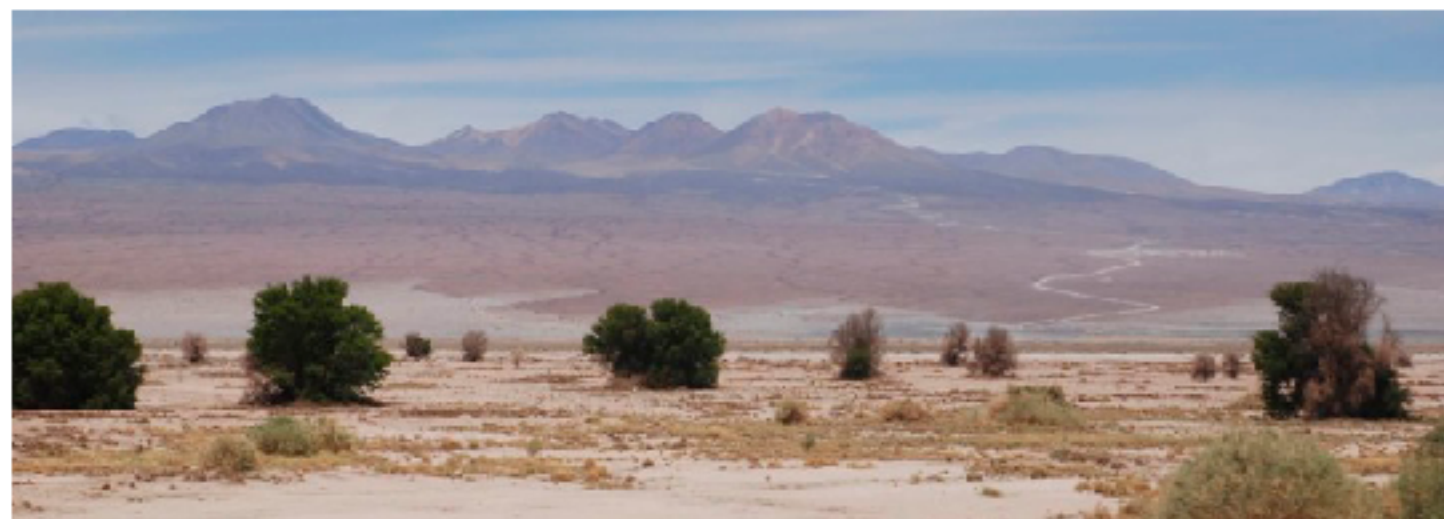
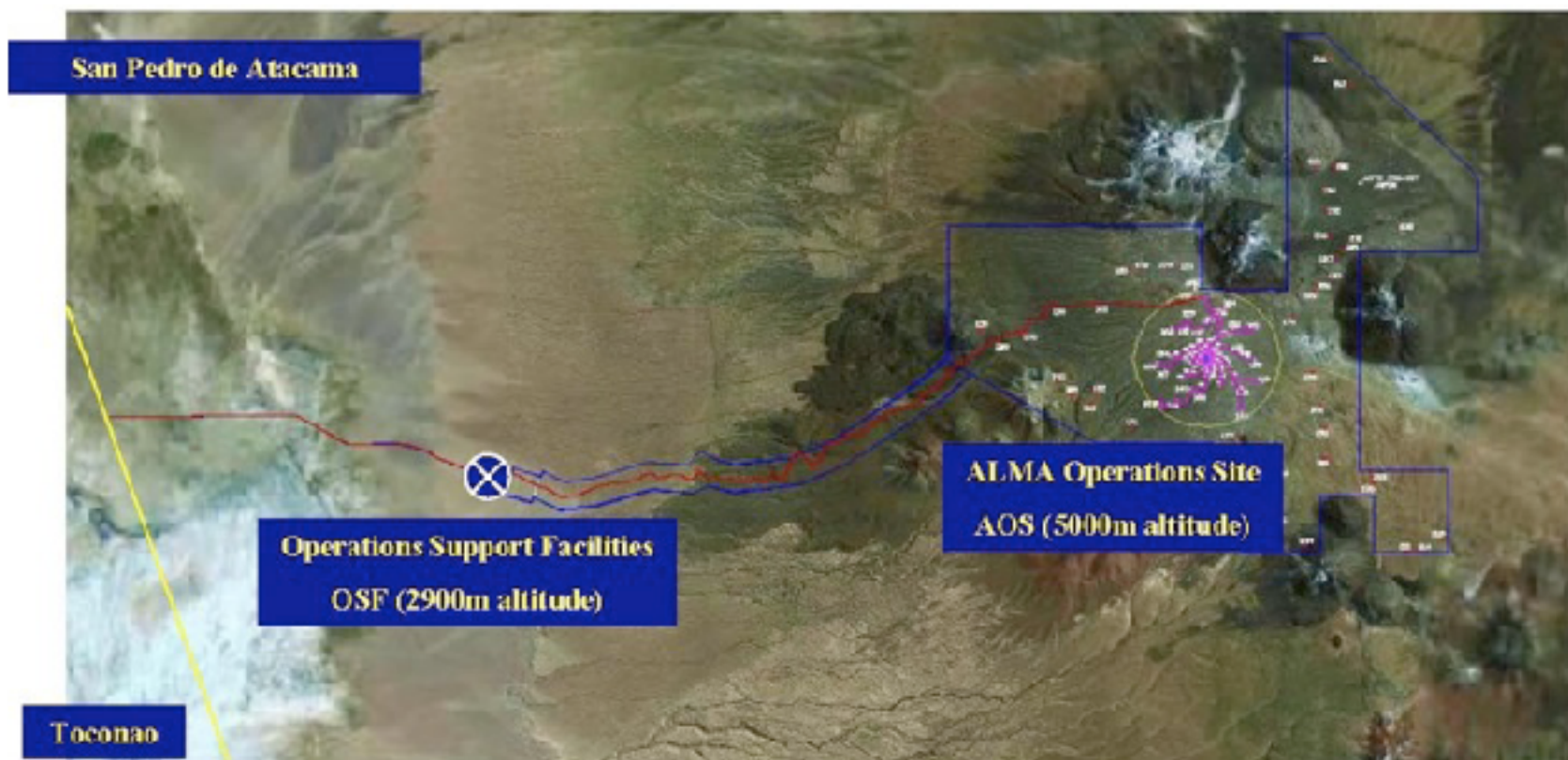


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OSF Site @ 2900 m altitude

San Pedro de Atacama



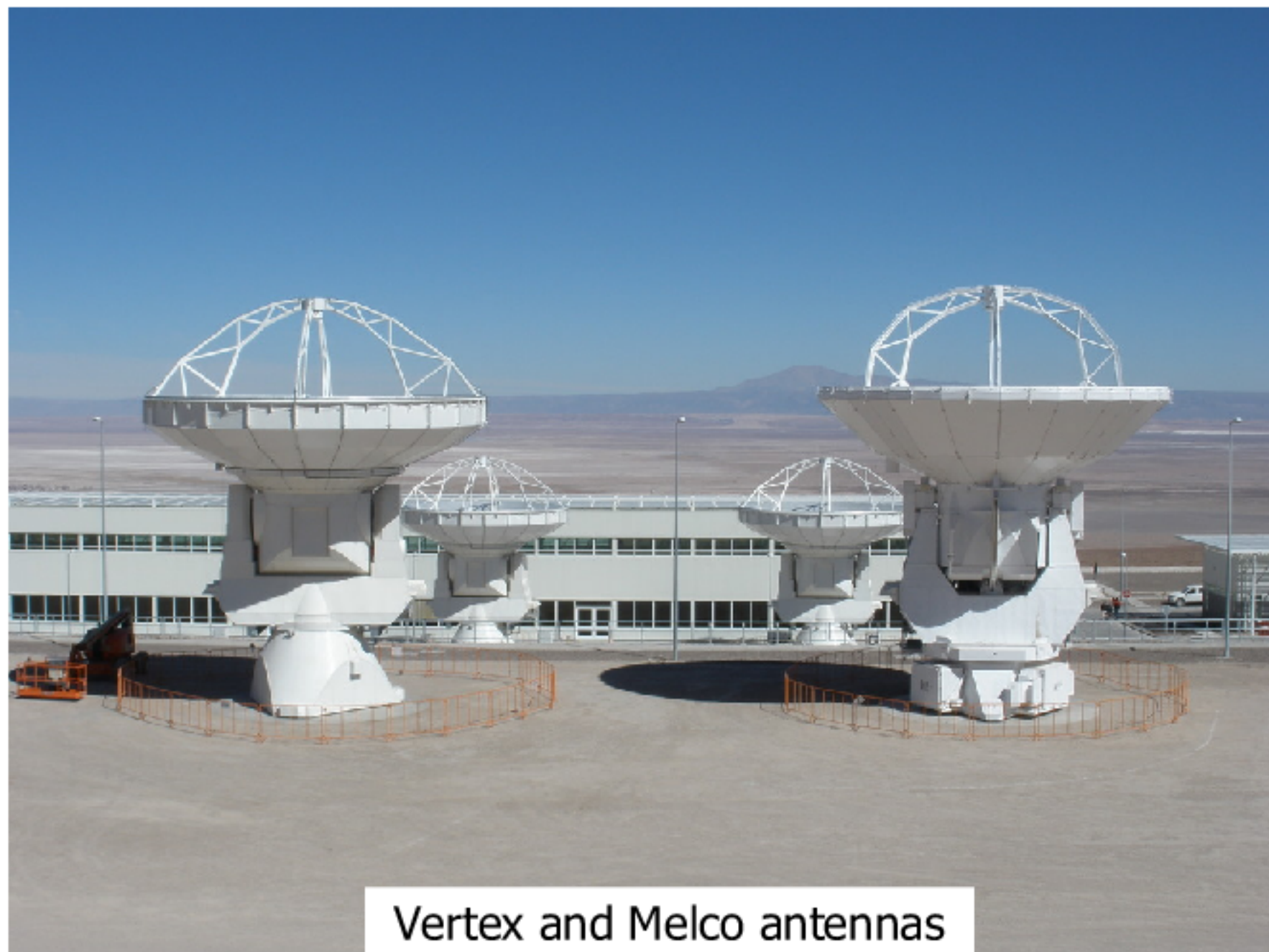
OSF Site @ 2900 m altitude

San Pedro de Atacama

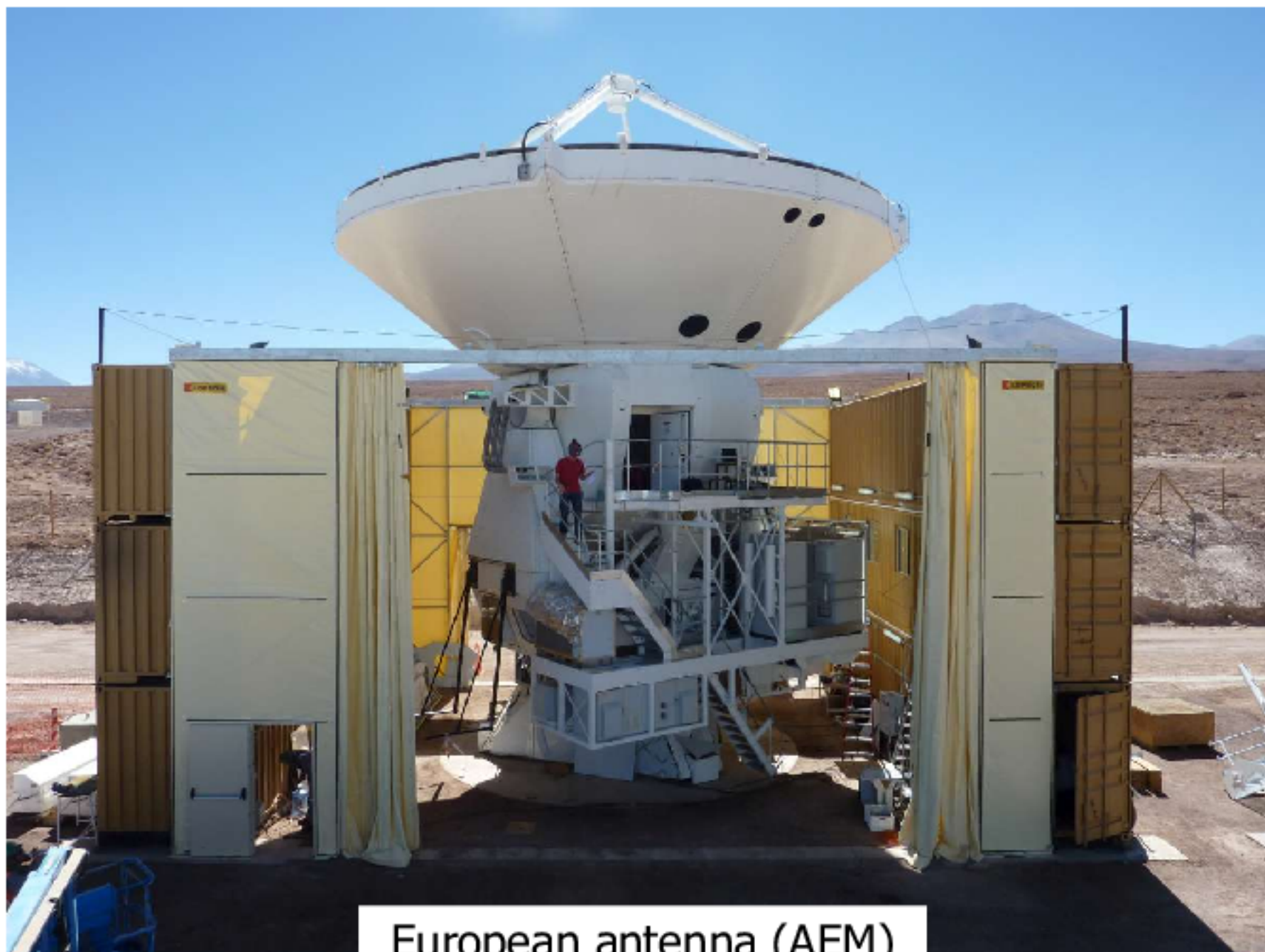


Antenna construction areas

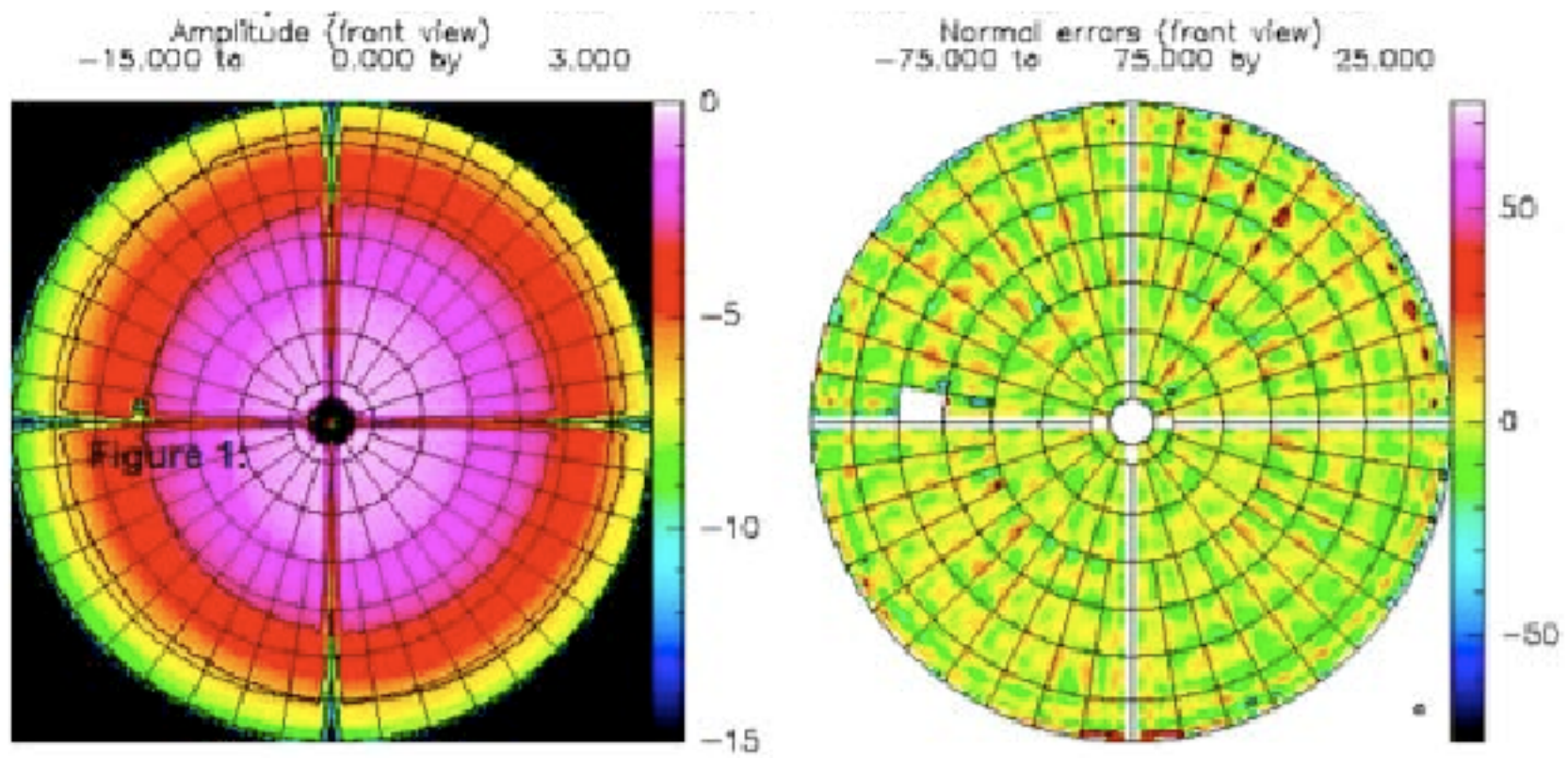
Main building: offices,
control room, archive,
technical labs



Vertex and Melco antennas



European antenna (AEM)



Antenna surface rms < 25 μm



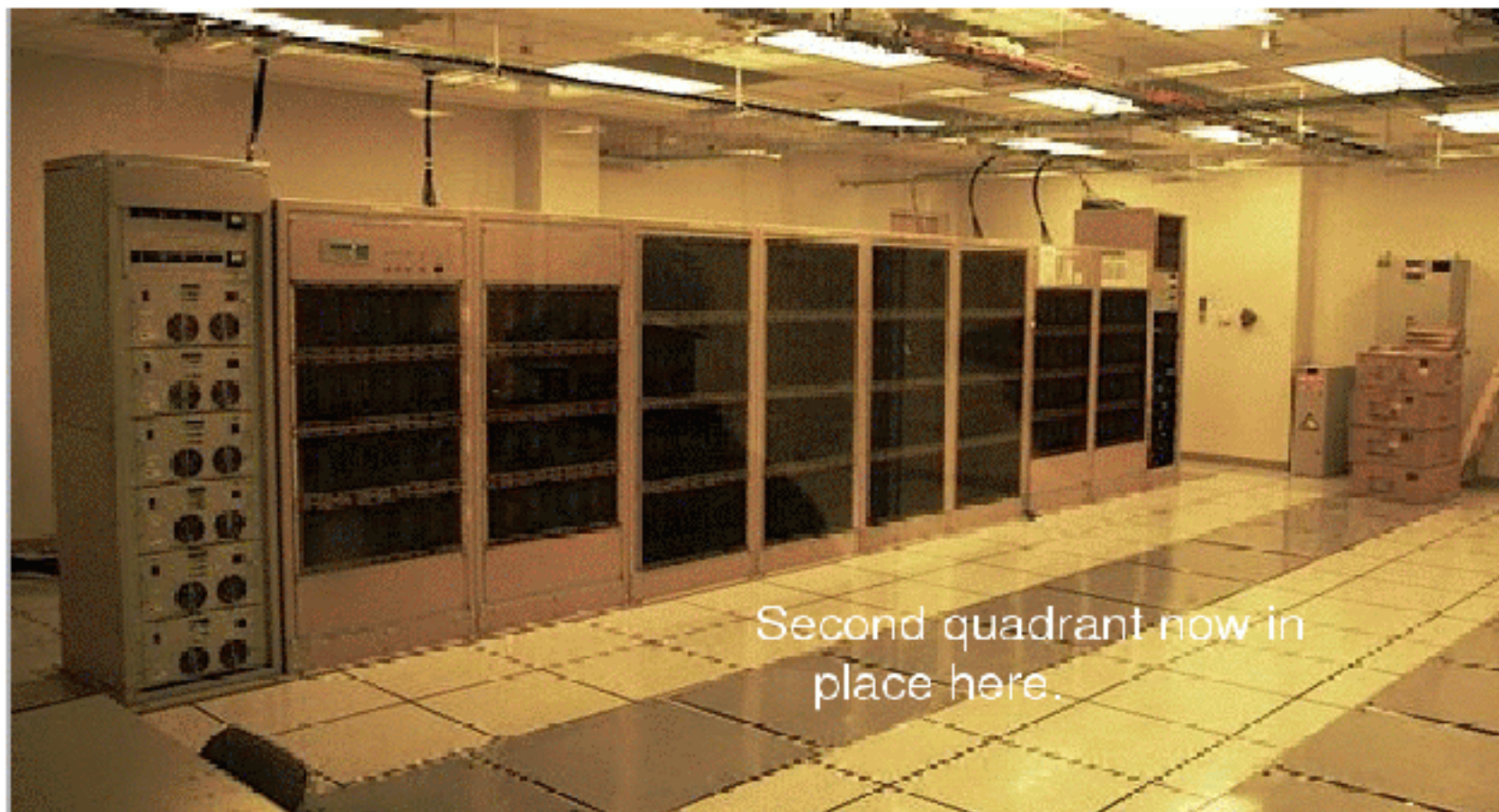






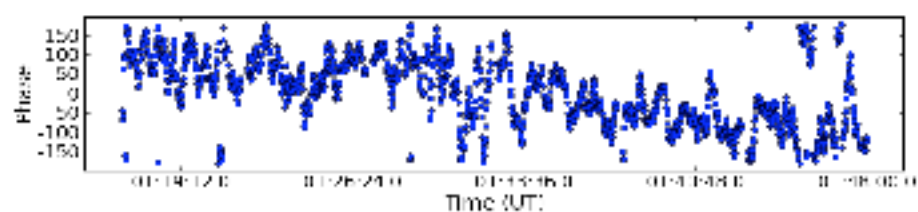
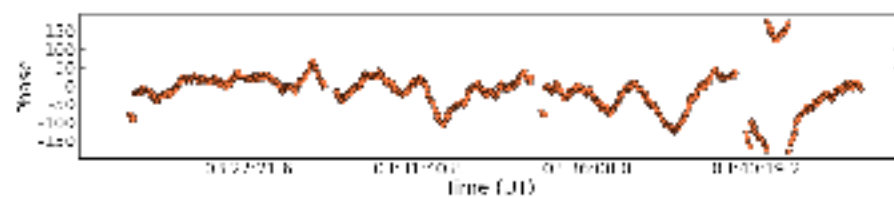
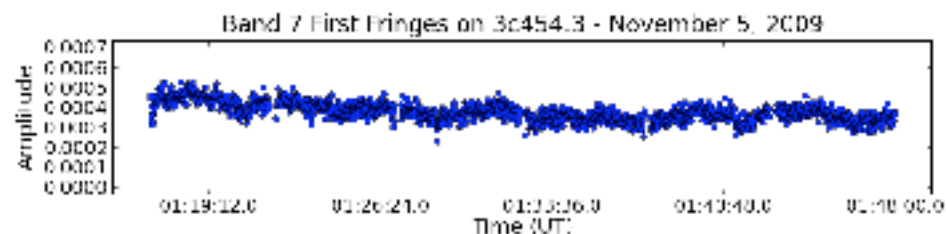
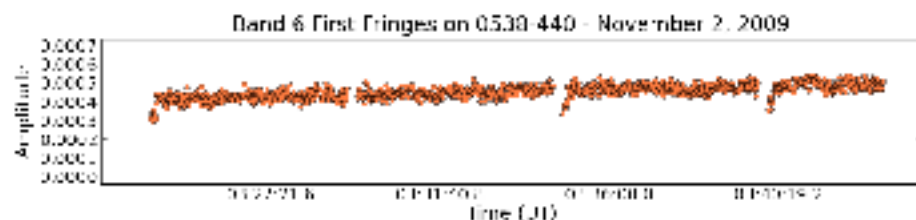
AOS – ALMA Operation Site (5000 m)



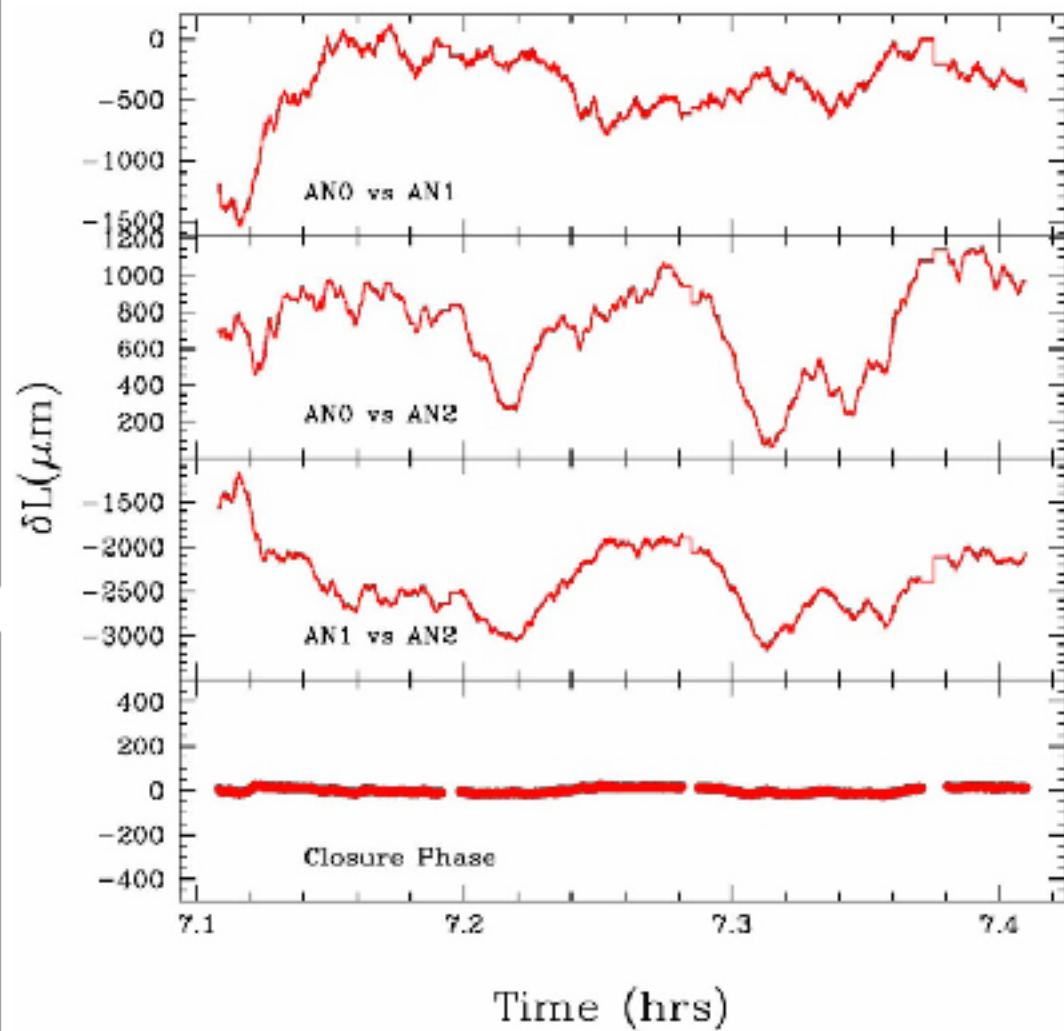


Correlator





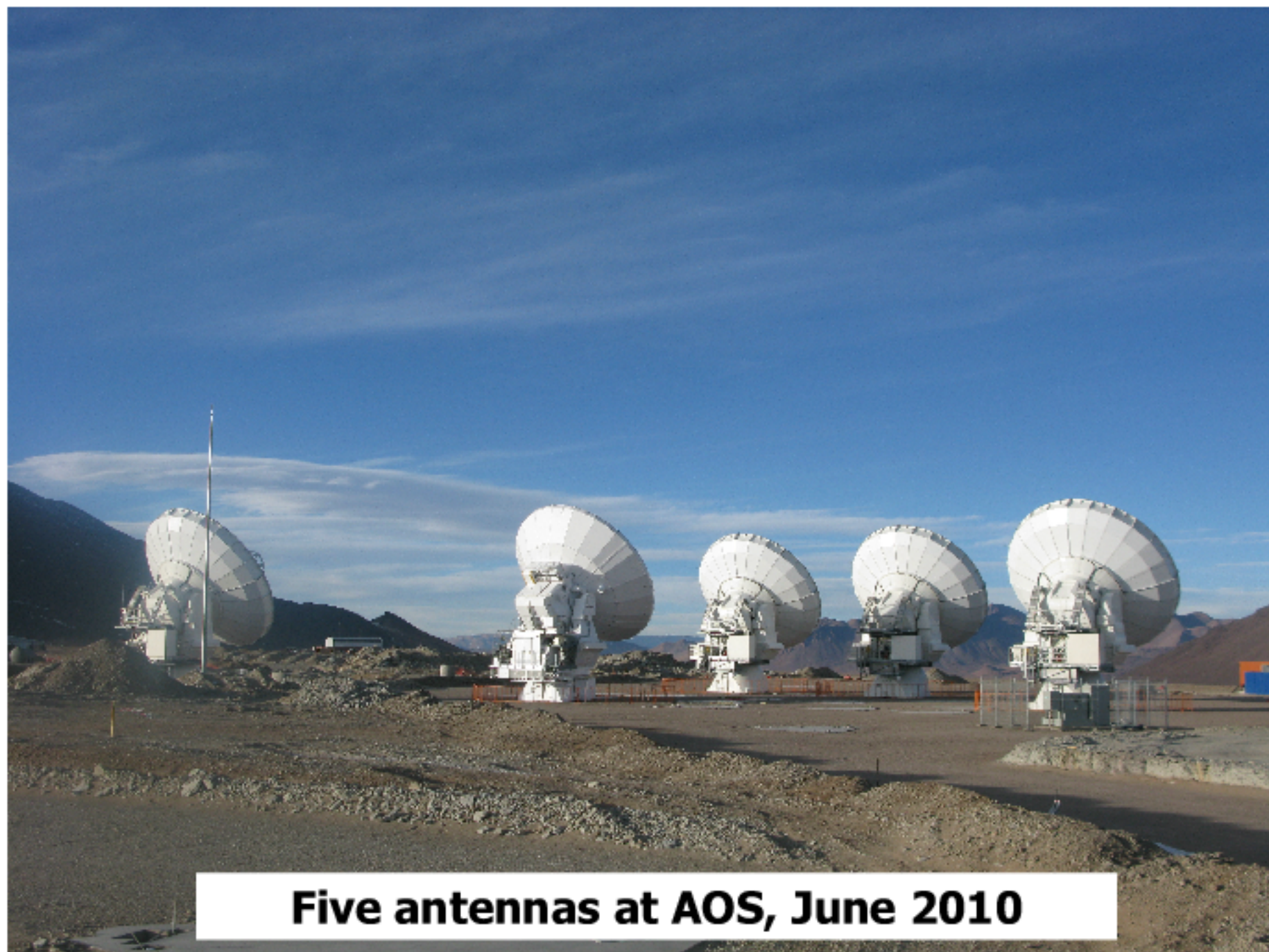
Two antennas interferometry (Nov. 2009)



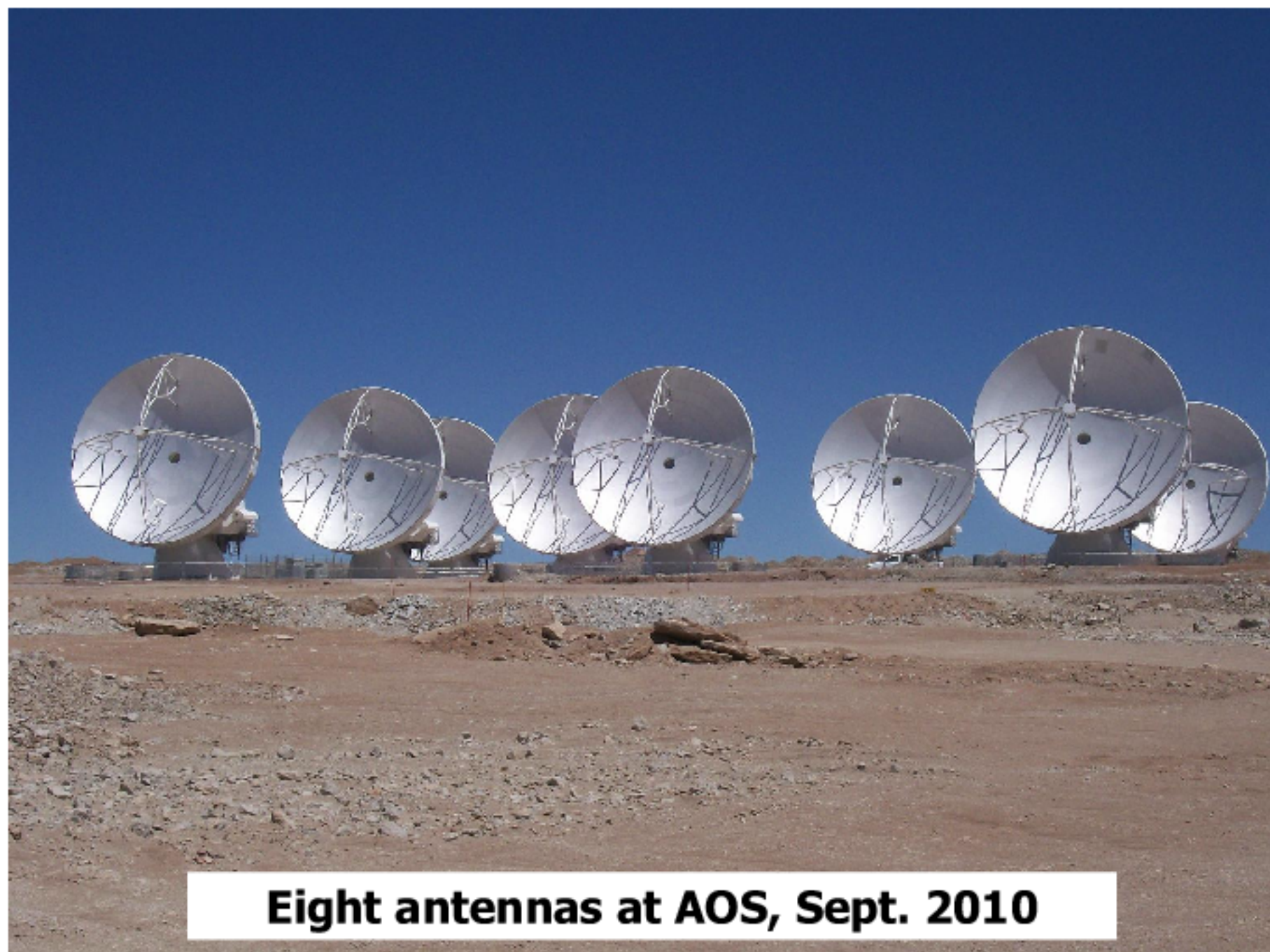
**Three antennas
interferometry (Dec. 2009)**



Arrival of DV03 at AOS, April 29th 2010



Five antennas at AOS, June 2010



Eight antennas at AOS, Sept. 2010

22/01/2010: Start of Commissioning & Science Verification (CSV)

2011: Early Science (16 antennas)

2012: Inauguration (50 antennas)

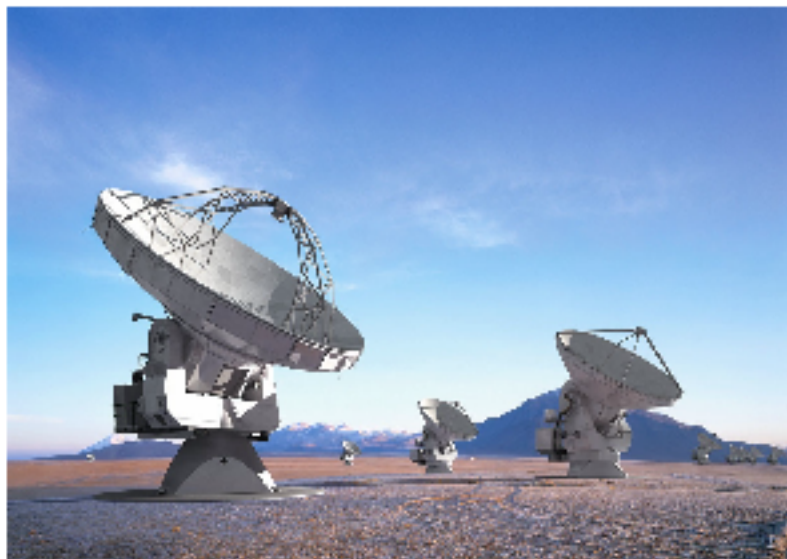
2013: Full operations

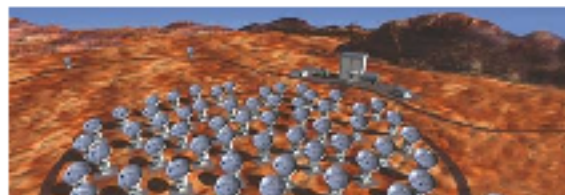




Preparing for ALMA

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ALMA Operations

- **One call for Proposals per year (TBC)**
- **One single Time Allocation Committee for NA+EU+EA**
- **Service observing**
 - PI not involved in the observations
- **Dynamic scheduling**
 - Best project in the queue determined every SB (hour scale)
 - Depends on weather + configuration + priority + balance between partners



ALMA Operations

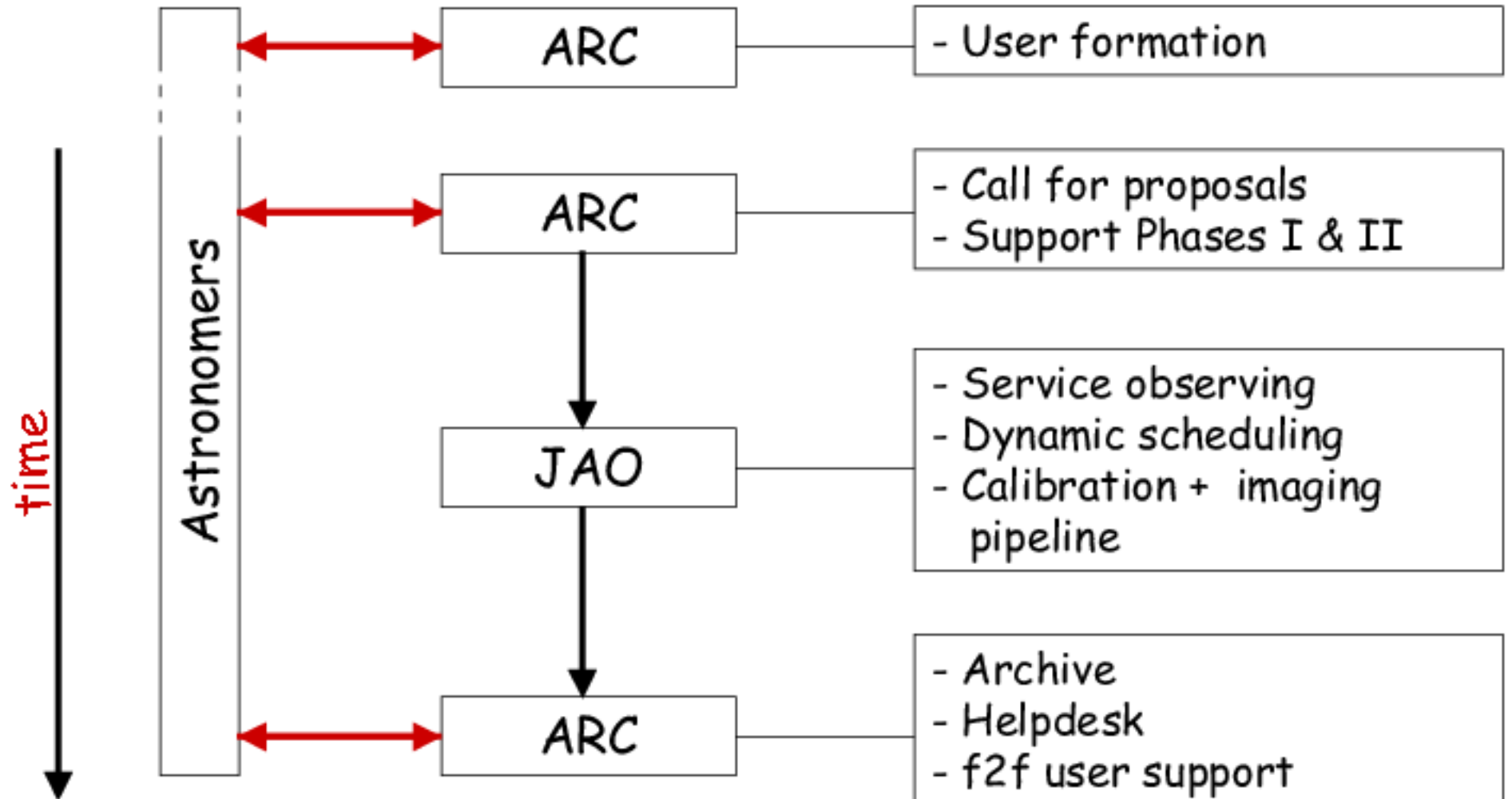
- **Calibration and imaging pipeline**
 - Final product = data cube
- **Archive**
 - Raw data + pipeline products
 - Public after 12 months
- **ALMA Regional Centers (ARC)**
 - Scientific operations & user support outside Chile
 - Contact point between users and ALMA
 - Three ARCs



EUROPEAN ARC
ALMA Regional Centre



ALMA Regional Center





European ARC

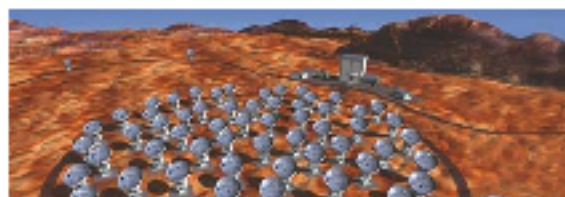
Core tasks → ESO Garching

- Call for proposals, Phase I, Phase II
- Basic user support (helpdesk)
- Data product support = delivering data and software
- ALMA archive operations

<http://www.eso.org/sci/facilities/alma/arc/>

Same services are provided at
Charlottesville (NAASC) and
Tokyo





European ARC

Additional tasks → ARC nodes

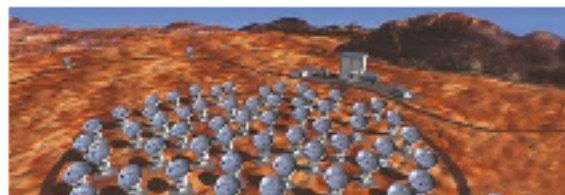
- User formation & community development
- Face-to-face support (core task)
- Special projects (extended archive & data reduction support)
- New developments

Seven ARC nodes in Europe

- INAF Bologna (I)
- Univ. Bonn (D)
- IRAM (F,D,E)
- Leiden Obs. (NL)
- Manchester Obs. (UK)
- Onsala Obs. (S,DK,SF)
- Prague (CZ)

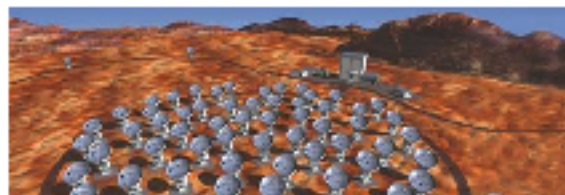
- All nodes open to all European scientists but target own community

- IRAM → French, German, and Spanish communities



ALMA observing time

- **No guaranteed time**
- **One single TAC for NA+EU+EA**
- **A world-wide collaboration**
 - EU 33.75%, NA 33.75%, EA 22.5%, Chile 10%
 - In ESO: D~21%, F~16%, E~9%
 - In ALMA: D~7%, F~5.5%, E~3%
- Whatever the actual numbers: expect **huge competition**
- Timescale: ALMA Early Science: 2011
Full operations: 2013



ALMA Early Science

ALMA Early Science

- 16 antennas
- 4 bands : B3, B6, B7, B9
- Baseline up to 250 m

ALMA	IRAM	GHz
B3	B1	84-116
B6	B3	211-275
B7	B4	275-373
B9	--	602-720

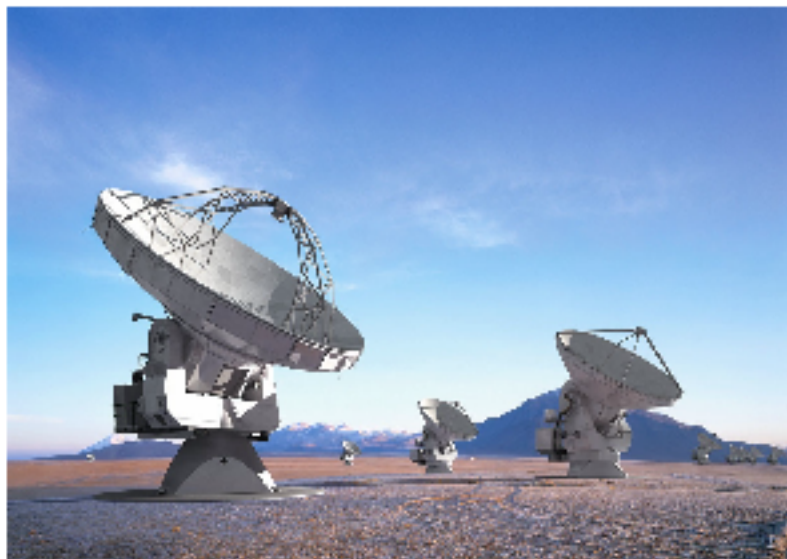
Limitations

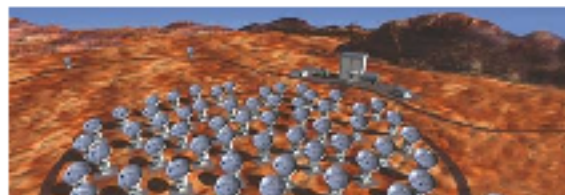
- Only ~30% observing time → **limited number of projects**
- No ACA, no short-spacings
- No pipeline
- Restrictions in terms of observing modes



Preparing for ALMA

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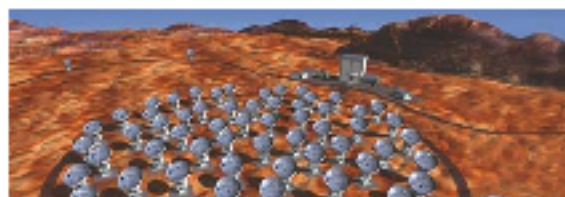




ARC node @ IRAM

Why an ARC node at IRAM?

- Strong IRAM involvement in ALMA construction
- **Already existing center of expertise** in mm interferometry
 - Expertise on pipeline, calibration, imaging, atmospheric phase correction, data analysis...
 - Close link with technical groups
- **Plateau de Bure user support** → **only delta effort**
- IRAM users are all potential ALMA users → **IRAM community in best possible position** to get time on ALMA



ARC node @ IRAM

User formation

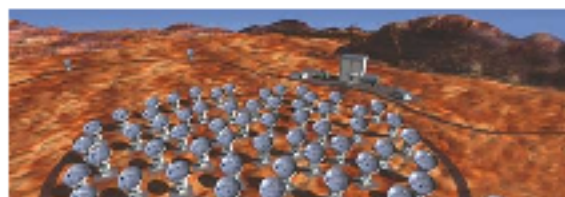
- Plateau de Bure
- Visitors
- Schools

Developments

- New algorithms & soft.
- ALMA software

User support

- Helpdesk
- f2f support



ARC node @ IRAM

User formation

- Plateau de Bure
- Visitors
- Schools

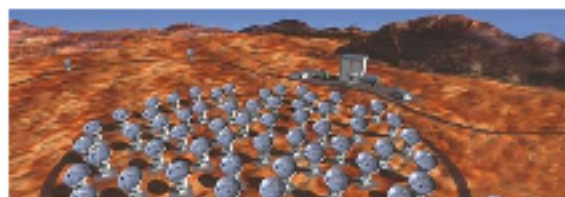
Developments

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Key goal



ARC node @ IRAM

User formation

- Plateau de Bure
- Visitors
- Schools

Developments

- New algorithms & soft.
- ALMA software

User support

- Helpdesk
- f2f support

Forming IRAM staff

- OT/CASA tests
- IRAM staff @ Chile

7th IRAM mm-interferometry school

- 4–8 October 2010
 - Same program as in 2008, more tutorials
 - Registration open
 - LOC: C.Berjaud, A.Castro-Carrizo, F.Gueth (chair), K.Zacher
- school2010@iram.fr

iram
Institut
de Radio-Astronomie
Millimétrique

**4- 8 October, 2010
Grenoble, France**

**7th IRAM millimeter
interferometry school**

RadioNet

Main topics:
Fundamentals of millimetric interferometry; Atmospheric and ground-based millimeter and submillimeter astronomy; The IRAM Plateau de Bure Interferometer (PdB); The Atacama Large Millimeter Array (ALMA)

Registration website: <http://www.iram.fr> and <http://www.iram.fr>



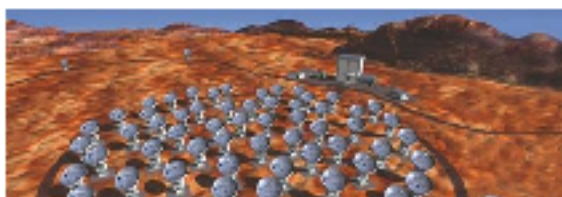
ALMA workshop

Observing with ALMA : Early Science

- 3 days workshop November 29th-December 1st 2010
- Goal: give practical information people need to submit a proposal

- ALMA construction status
- The ALMA Observing Tool
- CASA
- Details of the 1st Call for Proposals
- Correlator modes, configurations, short-spacings, observations mode, operation mode

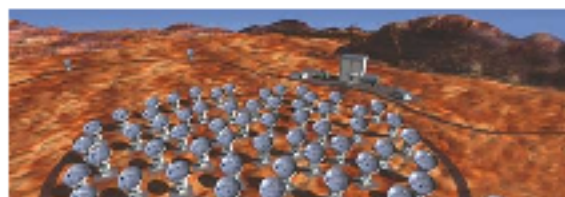
- Contact the LOC: alma2010@iram.fr



f2f support

- **Main goal of the ARC node**
- **Extend PdBI f2f support to ALMA**
 - Local contact assigned to each project
 - Use existing infrastructures and procedures
 - Travels to Grenoble will be funded by IRAM (same rules as PdBI)
 - Must be in place for Early Science = **end 2011**





f2f support

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<http://www.iram-institute.org> > **ARC Node**





Conclusions

- Progress in ALMA construction
 - First call for proposals ALMA Early Science: **end of 2010?**
 - Full ALMA operations: 2013
 - Expect huge competition
- Prepare for ALMA with IRAM
 - Plateau de Bure interferometer
 - ALMA user support (ARC node)



