




EUROPEAN ARC
ALMA Regional Centre || Italian

ALMA

and the Italian
ALMA Regional Centre (ARC)



Jan Brand
Coordinator Italian ARC

INAF - Istituto di Radioastronomia, Bologna

Oss. Trieste - 27 January 2010

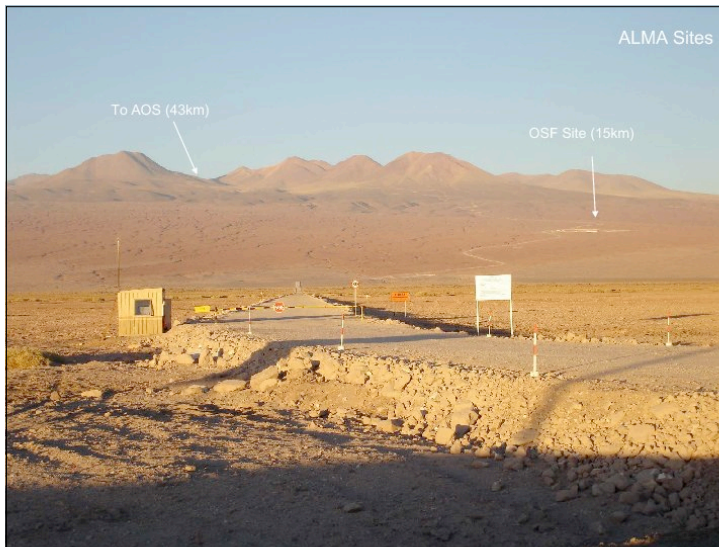
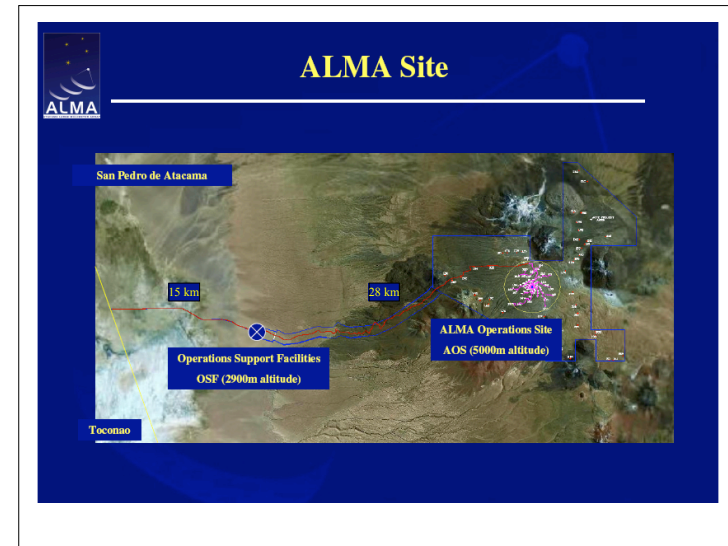
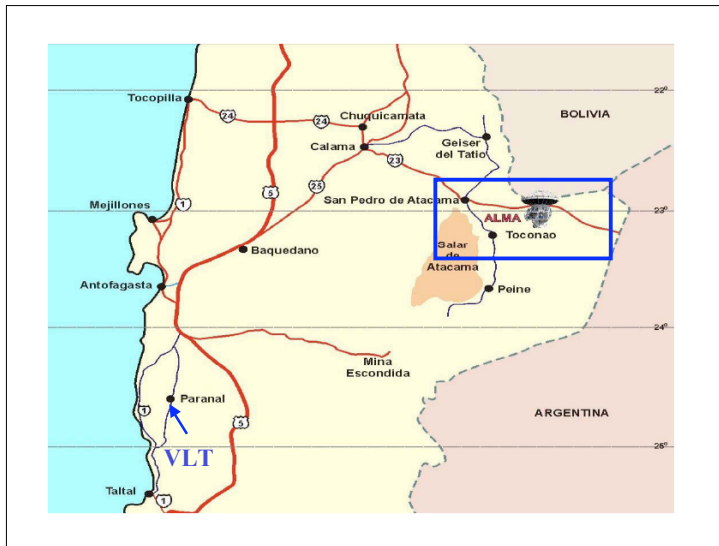



ALMA Project – Structure

- Partners:
 - Europe - *European Organization for Astronomical Research in the Southern Hemisphere - ESO.*
 - North America - *National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC) – AUI/NRAO*
 - Chile
 - Japan/Taiwan - *National Institutes of Natural Sciences (NINS), in cooperation with the Academia Sinica in Taiwan - NAOJ*

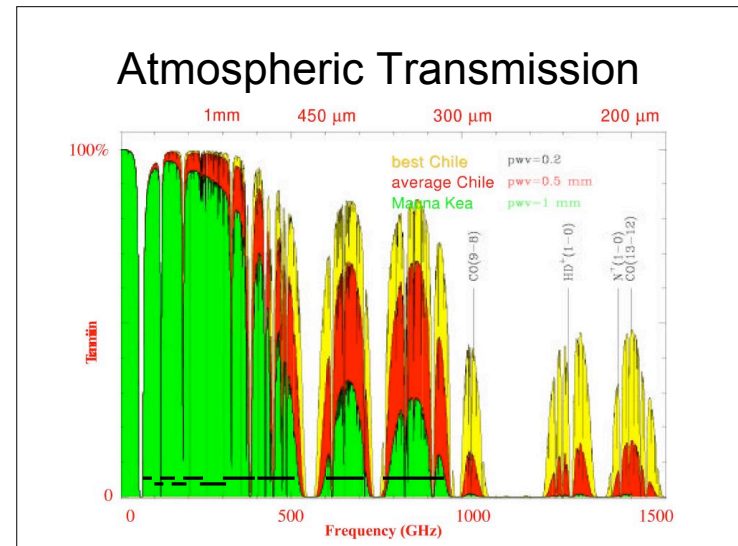
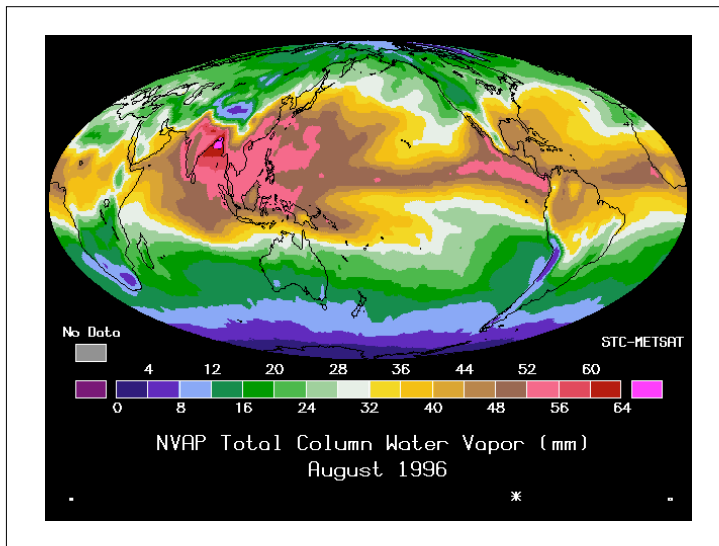
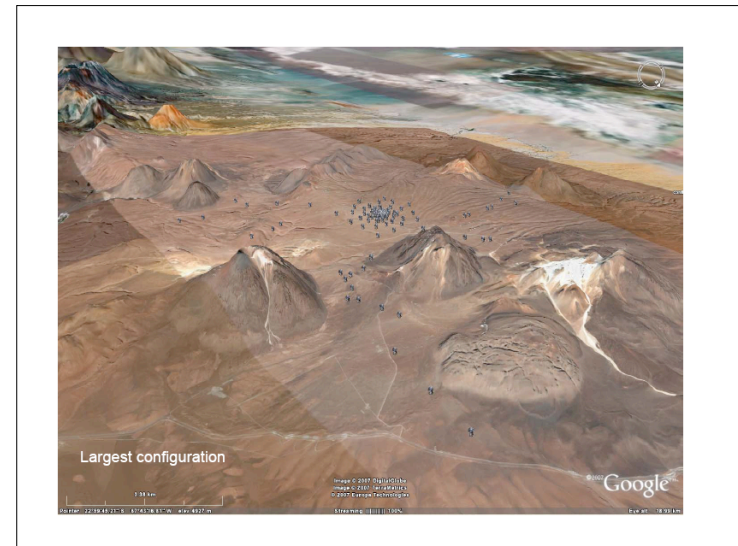
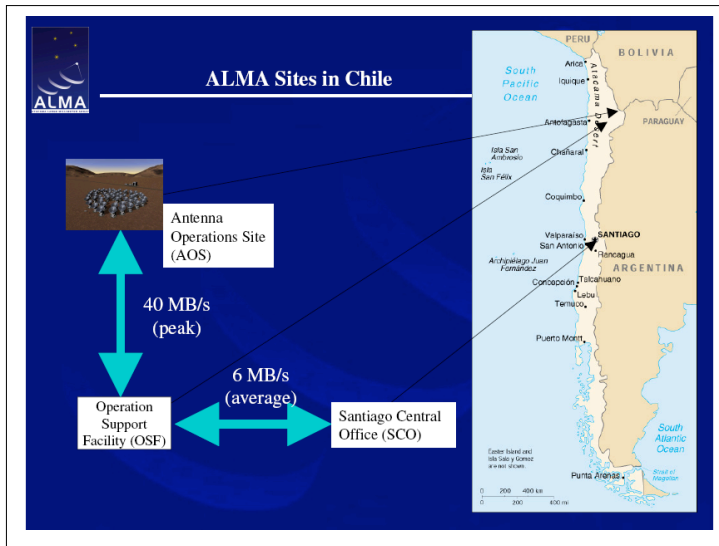
→ Joint ALMA Office: Construction project
→ Joint ALMA Observatory





ALMA Sites

- **Array Operations Site – AOS** – Antennas, correlator, reconfiguration. 5 km
- **Operations Support Facility – OSF** – Array operation, equipment maintenance 2.9 km
- **Santiago Central Offices – SCO** – Administration, scientific support. sea level
- **ALMA Regional Centers – ARCs + ARClets** – interfaces to astronomy community





ALMA Science Requirements

Three "level I" science goals:

- Spectral line CO/C+ in z=3 MWG < 24hrs
- resolve PPD at 150 pc – gas/dust/fields
- Precise 0.1" imaging above 0.1% peak
- High Fidelity Imaging.
- Routine sub-mJy Continuum / mK Spectral Sensitivity.
- Wideband Frequency Coverage.
- Wide Field Imaging Mosaicing.
- Submillimeter Receiver System (..& site..).
- Full Polarization Capability.
- System Flexibility (hardware/software).



⇒ ALMA Technical Specifications

- 54 12-m antennas, 12 7-m antennas, at 5000 m altitude site, desert environment.
- Antennas: Surface accuracy ±25 μm, 0.6" reference pointing in 9m/s wind, 2" absolute pointing all-sky.
- Array configurations between 150m to ~15 -18km.
- 10 bands in 31-950 GHz + 183 GHz WVR. Initially:

✦86-119 GHz	"3"	3 mm
✦125-169 GH	"4"	2 mm
✦211-275 GHz	"6"	1.3 mm
✦275-370 GHz	"7"	0.85 mm
✦385-500 GHz	"8"	0.65 mm
✦602-720 GHz	"9"	0.45 mm
✦787-950 GHz	"10"	0.35 mm

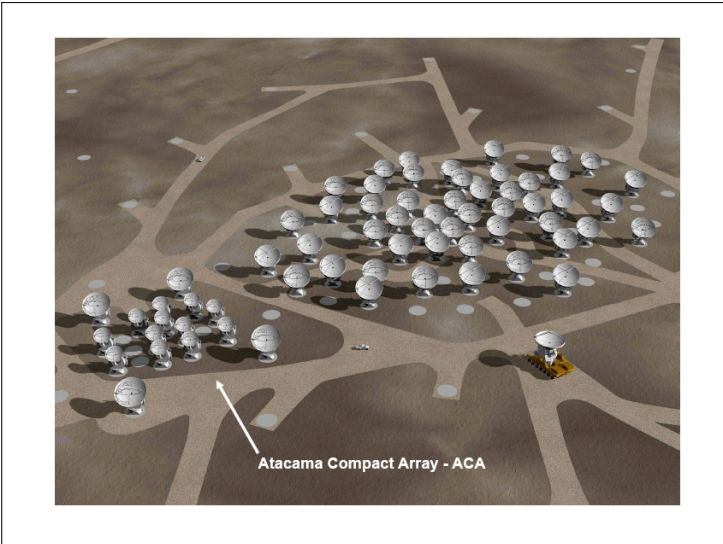
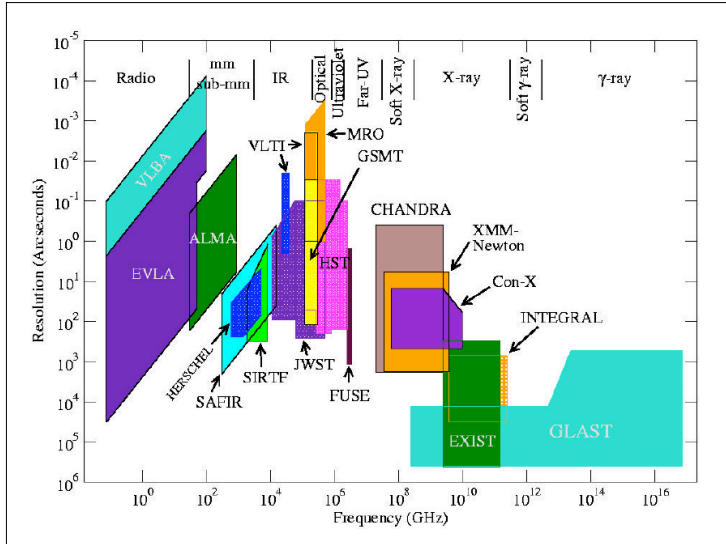


ALMA Technical Specifications

- 8 GHz BW, dual polarization.
- Flux sensitivity ~0.2 mJy in 1 min at 345 GHz
- Interferometry, mosaicing & total-power observing.
- Correlator: 4096 channels/IF (multi-IF), full Stokes.
- Data rate: 6MB/s average; peak 60-150 MB/s.
- All data archived (raw + images), pipeline processing.

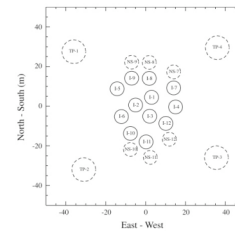
ALMA in a nutshell

Band	frequency range (GHz)	wavelength range (mm)	angular resolution b _{max} =200m ... 18km (arcsec)	line sensitivity (mJy)	continuum sensitivity (mJy)	primary beam (arcsec)	largest scale (arcsec)
3	84-116	2.6-3.6	3.0 .. 0.034	8.9	0.060	56	37
4	125-169	1.8-2.4	2.1 .. 0.023	9.1	0.070	48	32
5	163-211	1.4-1.8	1.6 .. 0.018	150	1.3	35	23
6	211-275	1.1-1.4	1.3 .. 0.014	13	0.14	27	18
7	275-373	0.8-1.1	1.0 .. 0.011	21	0.25	18	12
8	385-500	0.6-0.8	0.7 .. 0.008	63	0.86	12	9
9	602-720	0.4-0.5	0.5 .. 0.005	80	1.3	9	6

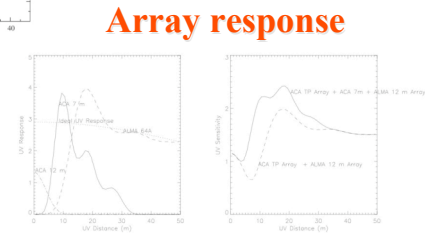


Role of ACA

- Supplement the 50-element array data with
 - Short baseline data (7-m antennas)
 - Total power data (12-m antennas)
 ⇒ Enhance fidelity of ALMA images (overcome “missing-flux” problem)
- Stand-alone mode of operation
 - ⇒ Available for *target-of-opportunity* observations, wide-field surveys, etc.



ACA layout



Array response

Iguchi et al., 2009 PASJ 61, 1

Fig. 2. Left: UV response profile of the ACA and the most compact configuration of the ALMA 64-element array with $\beta = 4$. Right: UV sensitivity profile. Observing parameters are same as those of Figure 1. The configuration of the ACA is a strawperson design described in Section 7.

ACA stand-alone mode

Table 6.*

Band	Frequency (GHz)	7 m Array			ACA full Array		
		ΔI_m (mJy beam ⁻¹)	θ_{fov} (")	θ_{res} (")	ΔI_m (mJy beam ⁻¹)	θ_{fov} (")	θ_{res} (")
Band 3	94	3.1	113	16	1.6	66	9.6
Band 4	145	4.3	73	10	2.1	43	6.2
Band 6	224	6.7	47	6.7	3.3	28	4.0
Band 7	345	16	31	4.3	8.1	18	2.6
Band 8	410	27	26	3.7	14	15	2.2
Band 9	670	190	16	2.2	102	9	1.3
Band 10	860	365	12	1.7	206	7	1.0

* Field of view (θ_{fov}), angular resolution (θ_{res}), and single point-source sensitivity (ΔI_m) for continuum observations with ACA. The 1 second on-source integration, 8 GHz bandwidth at a single polarization, and 25-percentile atmosphere at main atmospheric windows (see figure 10) are assumed.

Iguchi et al., 2009 PASJ 61, 1

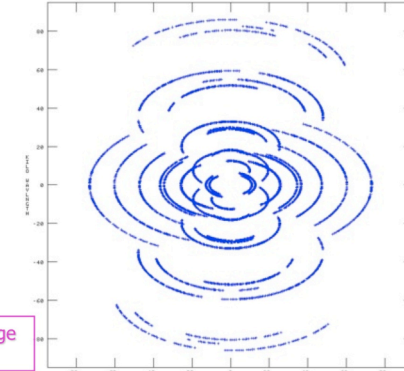
mm Interferometers (u,v) coverage

OVRO mm Array,
6 Antennas

L-configuration
single integration

L-Configuration few
hrs of observations

Final coverage: a
few hrs in both the L
and H configurations



N.B. (u,v) coverage
is not uniform

Leonardo Testi: ALMA & Protoplanetary Disks, Bologna, 10 Nov 2009

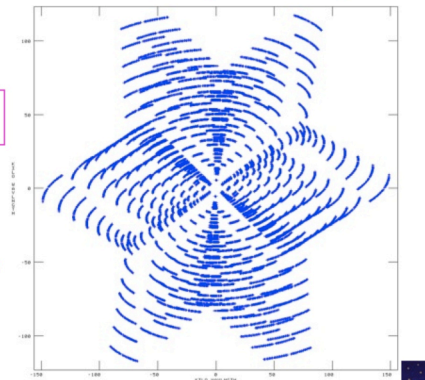
mm Interferometers (u,v) coverage

Very Large Array,
27 Antennas,
1.5h of observing time!

N.B. (u,v) coverage is still
not uniform.

Critical parameters:

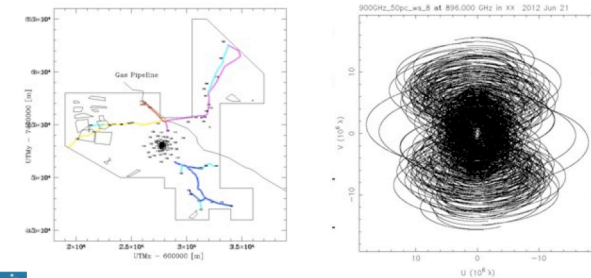
- Long baselines
- Short baselines
- Number of (u,v) points
- (u,v) coverage distribution



Leonardo Testi: ALMA & Protoplanetary Disks, Bologna, 10 Nov 2009

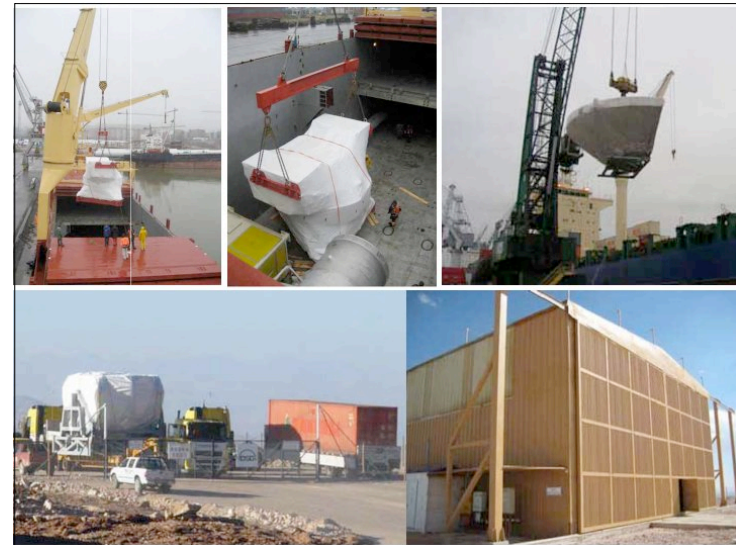
mm Interferometers (u,v) coverage

- ♦ Current mm interferometers offer typically $\sim 10^4$ visibility measurements in several hours, the VLA delivers $\sim 10^6$ visibilities per hour
- ♦ ALMA will improve by almost two orders of magnitude



Leonardo Testi: ALMA & Protoplanetary Disks, Bologna, 10 Nov 2009

Three prototype antennas at ATF



Transport to OSF

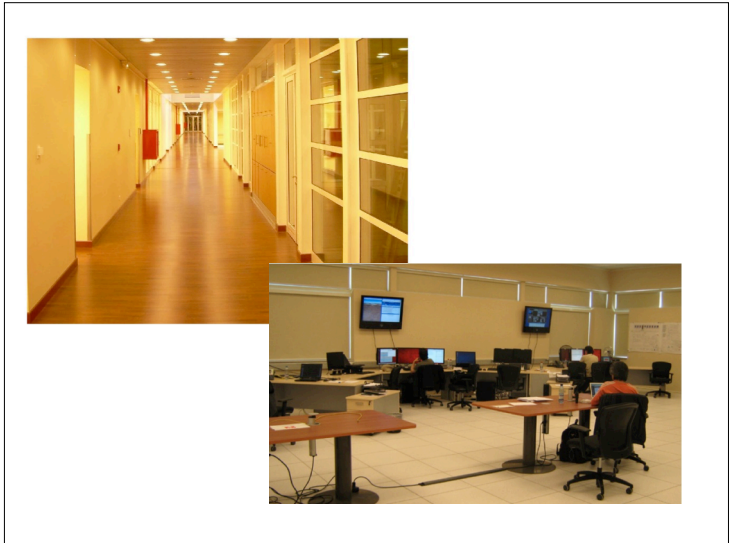


OSF - Site Erection Facilities; Technical Facility



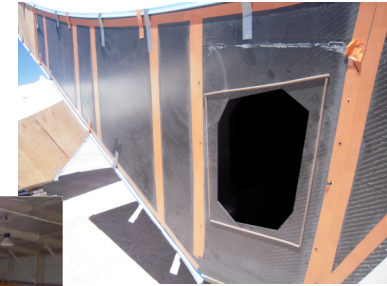
Operations Support Facility - 2900m







CFRP BUS: Carbon Fibre Reinforced Backup Structure



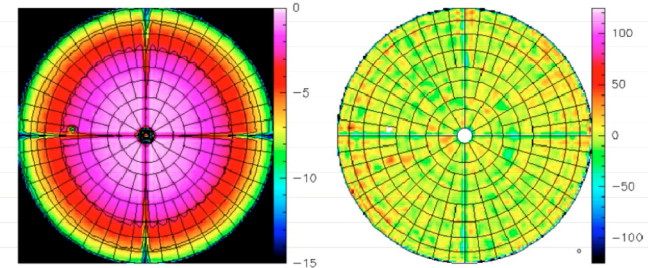
Bruno Marano



Antenna Performance

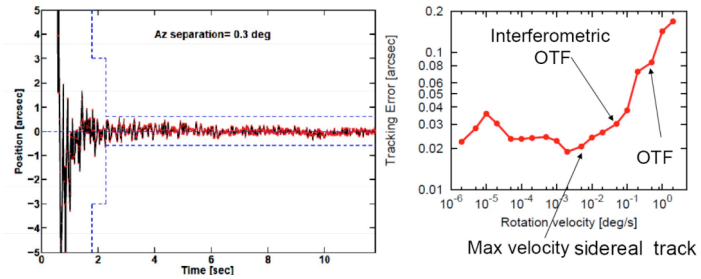
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RF: Uprgt: - Q1-AUG-2008 00:13:49 - almaproc@oper02 - ALMA01 - ALMA/Vertex 12-m Pro @
Am: Rst(B) ATFTower test scans 2 to 270 (Q1-AUG-2008) Elev: 3.73
Pfr: Rst(B)
rms Pha: 12 0.00
Edge taper = 18.23x 16.61 dB - offset X= -0.02 Y= -0.02 m
Focus offsets (X,Y,Z) = -0.30 0.12 8.90 mm; Astigmatism = 0.00 mm
Phase rms (unweighted)= 0.056 (weighted)= 0.047 radians
Surface rms (unweighted)= 12.80 - (weighted)= 10.85 µm
ηh(104.020 GHz) = 0.870; ηh(230.0 GHz) = 0.863; ηh(345.0 GHz) = 0.851
S/T(104.020 GHz) = 28.050 Jy/K; S/T(230GHz) = 28.290 Jy/K; S/T(345 GHz) = 28.861 Jy/K
ηv = 0.672 -ηv = 0.865 -ηv(104.020 GHz) = 0.998 -ηv(230 GHz) = 0.989 -ηv(345 GHz) = 0.976
Rms/ring: 11.8 8.88 9.63 7.42 8.46 8.37 10.4 20.9
Amplitude (front view) Normal errors (front view)
-15.000 to 0.000 by 3.000 -125.000 to 125.000 by 50.000
  
```



Antenna Performance

Antenna tests ➤ Excellent pointing and tracking



Front End Specifications

• Preliminary results within parentheses are referred to the vacuum window and do not include noise from optics losses

ALMA Band	Frequency Range	Receiver noise temperature		Mixing scheme	Receiver technology	Supplier
		T_{R} over 80% of the RF band	T_{R} at any RF frequency			
1	31.3 – 45 GHz	17 K	28 K	USB	HEMT	Not assigned***
2	67 – 90 GHz	30 K	50 K	LSB	HEMT	Not assigned
3	84 – 116 GHz	37 K (40K)	62 K (50K)	2SB	SIS	HIA
4	125 – 169 GHz	51 K (45K)	85 K (-59K)	2SB	SIS	NAOJ
5	163 – 211 GHz**	65 K	108 K	2SB	SIS	OSO
6	211 – 275 GHz	83 K (40K)	138 K (60K)	2SB	SIS	NRAO
7	275 – 373 GHz*	147 K (75K)	221 K (100K)	2SB	SIS	IRAM
8	385 – 500 GHz	196 K (160K)	294 K (-270K)	2SB	SIS	NAOJ
9	602 – 720 GHz	175 K (120K)	263 K (150K)	DSB	SIS	NOVA
10	787 – 950 GHz	230 K	345 K	DSB	SIS	NAOJ ?

* - between 370 – 373 GHz T_{R} is less than 300 K

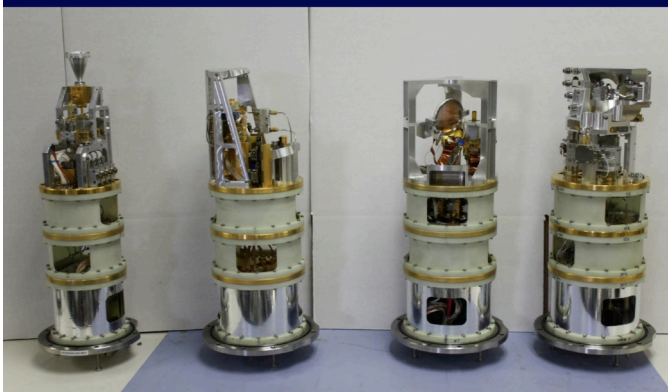
** - Limited to 6 units, funded by the EC under FP6

*** - Under consideration by U. Chile

• Dual, linear polarization channels:
 • Increased sensitivity
 • Measurement of 4 Stokes parameters

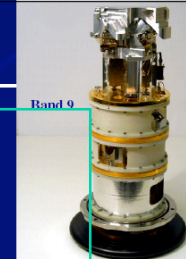
• 183 GHz water vapour radiometer:
 • Used for atmospheric path length correction

Bands 3 (84-116 GHz), 6 (211-275 GHz), 7 (275-373 GHz), and 9 (602-720 GHz) SIS “cartridges”

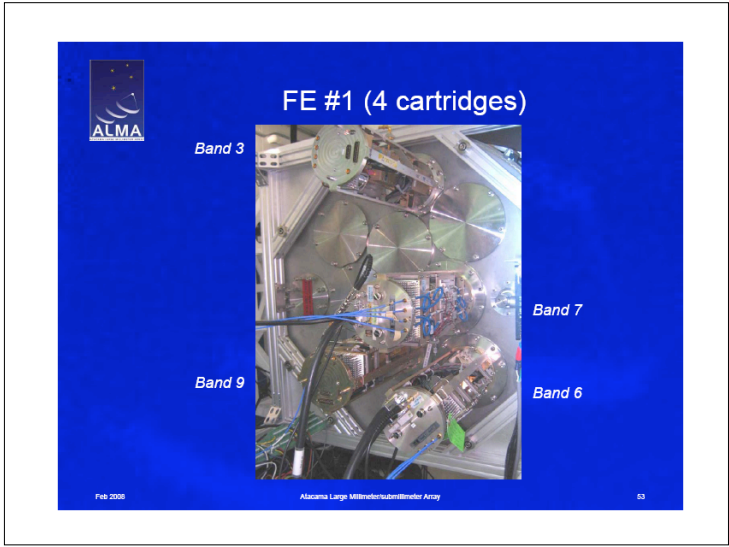
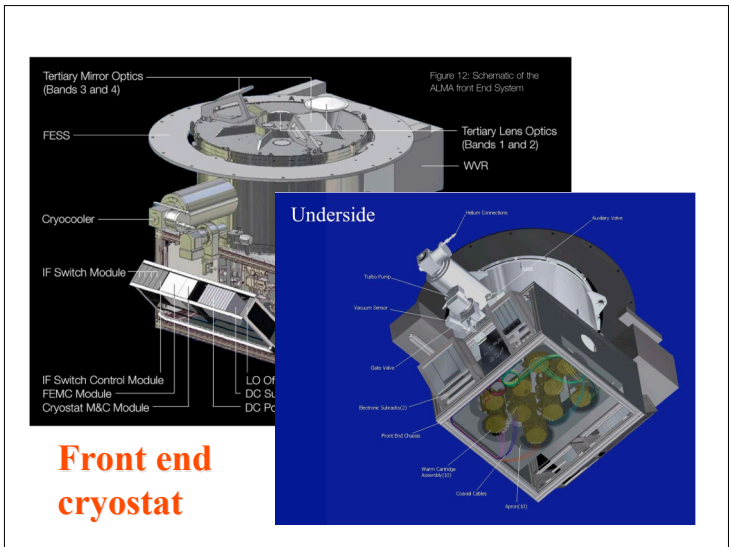


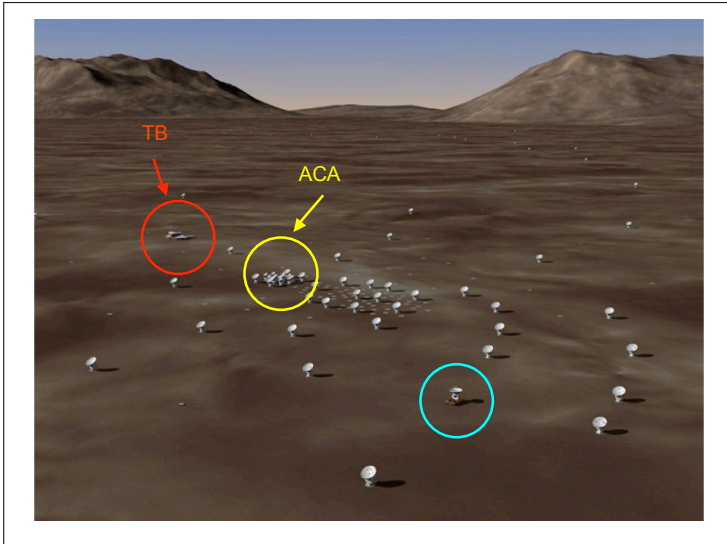
Cartridge Production

- Band 3 (HIA, Canada) 3 mm 86-119 GHz
- Band 6 (NRAO, USA) 1.3 mm 211-275 GHz
- Band 7 (IRAM, France) 0.85 mm 275-370 GHz
- Band 9 (NOVA, The Netherlands) 0.45 mm 602-720 GHz
- Band 4 (NAOJ, Japan) 2 mm 125-169 GHz
- Band 8 (NAOJ, Japan) 0.65 mm 385-500 GHz
- Band 10 (NAOJ, Japan) 0.35 mm 787-950 GHz



Available from start





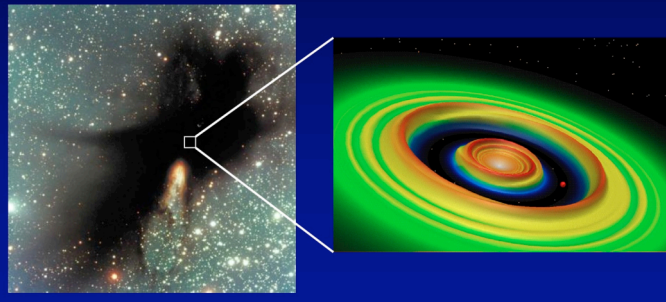
AOS - technical building, correlator Q1



ACA Correlator – Oct '07

ALMA Science

Make images of new stars being formed, with planets emerging from the disks around them.



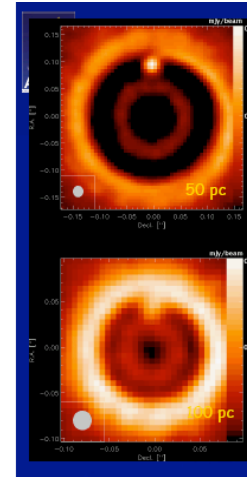
ALMA Key science 1: Planetary regions, nearby disks

$$M_{\text{planet}} / M_{\text{star}} = 0.5 M_{\text{Jup}} / 1 M_{\text{sun}}$$

Orbital radius: 5 AU

Disk mass as in the circumstellar disk around the Butterfly Star in Taurus

(ALMA: 10km, $t_{\text{int}}=8\text{h}$, 30° phase noise)
Wolf & D'Angelo (2005)
astro-ph / 0410064



ALMA Key Science 2: Astrochemistry



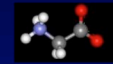
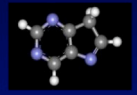








Spectrum courtesy B. Turner (MPIA)

- Millimeter/submillimeter spectral components dominate the spectrum of planets, young stars, many distant galaxies.
- Most of the observed transitions of the 125 known interstellar molecules lie in the mm/submm spectral region—here some 17,000 lines are seen in a small portion of the spectrum at 2mm.

Orion Nebula CSO/CI, F. & N. (1978)

11

Some complex organic molecules

Detected		Not (yet) detected	
 Acetic acid	 Di-methyl ether	 Glycine	 Purine
 Ethanol	 Sugar	 Pyrimidine	 Caffeine
 Methyl cyanide	 Methyl formate	<i>We do not know how far this chemical complexity extends.</i>	
 Benzene	 Ethyl cyanide		

Based on Ehrenfreund 2003

ALMA Key science 3: Interstellar Medium

Carbon Monoxide (CO) Image of Taurus Molecular Clouds

¹³CO Image showing densest regions

Size of Moon in Sky = ~1000 resolution elements
note incredible detail observed in this star forming region! Credit: M. Heyer

ALMA Key science 4: high redshift deep fields

M82 from ISO, Beaton and Cox

As galaxies get redshifted into the ALMA bands, dimming due to distance is offset by the brighter part of the spectrum being redshifted in. Hence, galaxies remain at relatively similar brightness out to high distances.

Flux density (Jy)

Frequency (GHz)

$z=0.3$

$z=1$

$z=2$

$z=0$

ALMA Deep field: 'normal' galaxies at high z

HST

$z < 1.5$

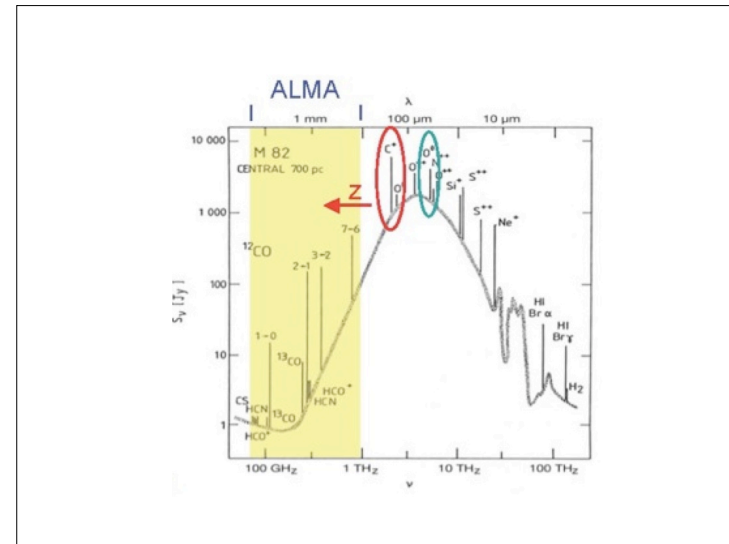
ALMA

$z > 1.5$

- Detect current submm gal in **seconds!**
- ALMA deep survey: 3days, 0.1 mJy (5 σ), 4'
- HST: a few thousand Gals, most at $z < 1.5$
- ALMA: a few hundred Gals, most at $z > 1.5$
- Parallel spectroscopic surveys, 100 and 200 GHz: CO/other lines in majority of sources
- Redshifts, dust, gas masses, plus high res. images of gas dynamics, star formation

Galaxies $z < 1.5$ Galaxies $z > 1.5$

15



Map the most distant parts of the Universe – this means looking back in time about 12 Gyrs

Left: Hubble image of distant galaxies Right: Mm-wave images of nearby galaxies

M61 828 5055

2903 3627 4503

4414 7381 9663

The engine of nearby AGNs

Gas clouds Jet type 1

NLR

BLR

Dense torus Thin accretion disk Black hole type 2

$\text{CO}(2-1)$ ALMA beam 4 pc

Several (competing) models:

Geometry	Dynamics	Structure
large ~100 pc (observed)	rotation	cont./diff medium
small ~1 pc (ALMA)	rotation and outflow (ALMA)	clumpy medium (ALMA)

ALMA OPERATIONS

- Two calls for proposals per year
- A single TAC for NA+EU+EA
- Service observing (PI not involved in observations)
- Dynamic scheduling:
 - Best project in queue determined every SB (hr-scale)
 - Depends on weather + configuration + priority

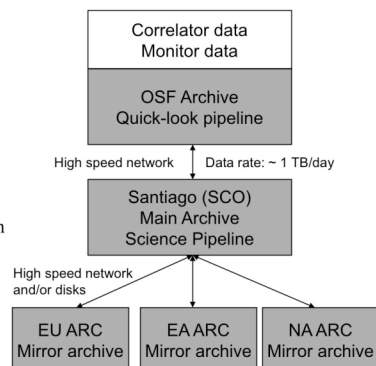
ALMA OPERATIONS

- Calibration and imaging pipeline
 - Final product: data cube
- Archive
 - Raw data + pipeline products
 - 200 TB/yr
 - public after 18 months
- User face-to-face support provided

Archive has a central role

- Archive content:
- All raw and calibration data
 - All monitor data
 - All data products produced by the standard pipeline (images etc.)
 - Observing logs
 - Proposals
 - SBs
 - Publications and other information

Virtual Observatory compliant



Observing Time

- No guaranteed time
- Single TAC for NA+EU+EA
 - EU ~ 35%, NA ~ 35%, EA ~ 20%, Chile = 10%
 - in ESO: D~21%, F~16%, E~9%
 - in ALMA: D~7.5%, F~5.5%, E~3%
- Huge competition to be expected
- Early Science Call for Proposals: end of 2010; ES starts 8 months later (2011)

Early Science Requirements

- At least 16 12-m antennas fully commissioned
- Receiver bands 3, 6, 7, and 9 available on all antennas, plus bands 4 and 8 on as many antennas as possible
- Sufficient antenna stations (platforms) to provide range of configurations covering the shortest spacings out to at least 1 km
- Synthesis mapping of single fields, plus pointed mosaic mode
- Basic set of spectral modes
- Linear and circular polarisation of compact sources
- Single-dish mapping of extended objects in both continuum and spectral line modes, including on-the-fly observing
- Calibration of all the above to a level comparable with existing mm-wave arrays - requires hot/ambient loads and WVRs
- Software to support users' applications, the preparation and execution of observations and off-line data reduction

**Expected in 2012: observe >75% of time with >40% of antennas;
2013: formal end of construction**

Phase 1 Observing proposal

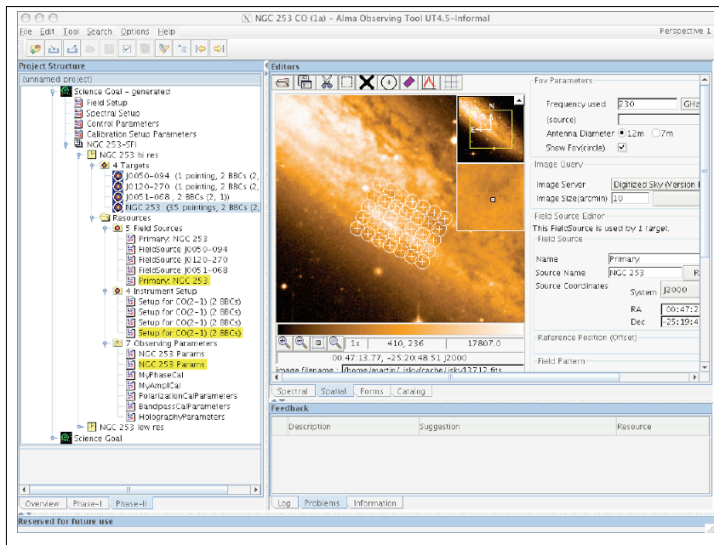
- mostly concentrated on science
- some administrative information
- minimal amount of technical information
- target list

Phase 2 Observing program

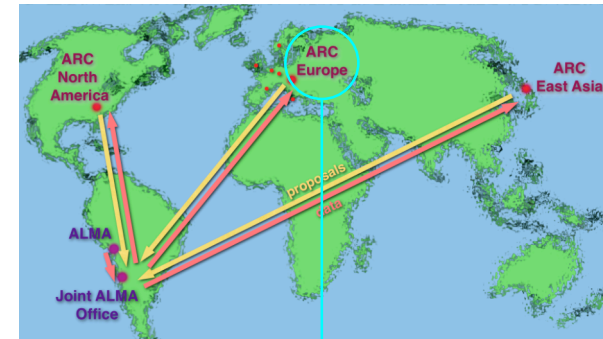
- complete set of technical details
- full specifications of how observations are to be carried out
- consistency with Phase 1

Observing program - AOT

- scheduling blocks (SchedBlocks) [cf. VLT]
 - key executable self-consistent units:
 - targets, correlator set-up, receiver set-up, pointing, phase calibrators, etc.
- Observing Units Sets (ObsUnitSets)
 - structure to support recursive hierarchy of SchedBlocks

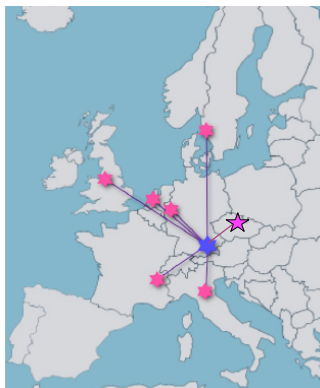


ALMA World-wide organisational structure



Central node (ESO) + Network of regional nodes

The EU ARC-network



ESO Central node
+

Independent regional nodes

Bonn-Bochum-Cologne (D)

IRA, Bologna (I)

IRAM (Grenoble; F, E)

Leiden (+; NL)

Manchester (+; UK)

Nordic (Onsala; DK, S, SU, NOR, IS)

Ondrejov (CZ)

Also interested in joining: Lisbon (P); Zürich (CH); Belgium

Responsibilities & interactions detailed in "Memo of Understanding"

European ARC

Core tasks ⇒ ESO

- Basic user support (Helpdesk)
- Emit Call for Proposals, Phase I, Phase II
- ALMA archive operations
- Data product support: delivering data and software

Additional tasks ⇒ ARC nodes

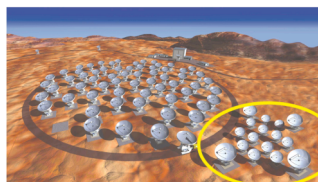
(see next slide)

ROLE of the ARC-nodes

- ✓ **Build a community** (e.g. ALMA/ARC-days 2007, 2008; tutorials; seminars; schools; meetings; PRINs)
- ✓ **Provide face-to-face user support** (post-obs.) and archival data-mining
- ✓ **Offer help in specific areas of expertise** (see next slide)
- ✓ **Provide user feedback**
- ✓ **Be involved with software development & testing manuals, cookbooks; share with the other ARCs/ARC-nodes** e.g. CASA-testing; ALMA Observation Preparation software-test
- ✓ **Be involved in commissioning/science verification phase**
- ✓ **Maintain website** (<http://www.alma.inaf.it/>)

Areas of expertise in EU ARC-nodes

1. Wide-field, high-dynamic range imaging (UK/NL/F)
2. Mosaicing (I)
3. High-frequency observing (NL)
4. Infrastructure for advanced data analysis tools (D/NL/Nordic)
5. Data handling/GRID-technology (I/P)
6. Coordinating surveys/key projects (I)
7. Polarimetry (I/F/D)
8. Astrometry (Nordic/D/UK)
9. Pipeline heuristics (D)
10. Automatic data calibration (D)
11. Data pipelining (UK)
12. Multi-frequency synthesis (Nordic/UK)
13. Array combination imaging (UK)
14. Robust self-cal methods and use of WVR data (Nordic)
15. Data handling and server (P)
16. Instrumental calibration (F)
17. Atmospheric phase calibration (F)
18. ALMA imaging simulations (F)



ALMA

- Key science
- 1: Planetary regions, nearby disks
 - 2: Astrochemistry
 - 3: Interstellar medium
 - 4: High-redshift deep fields

50x12m + (4x12m + 12x7m)
0.3-3mm; resol: 0".015λ(mm)

Italy & ALMA

Strong interest in: planetary sciences, star formation, stellar evolution, galaxy formation, high-redshift universe, cosmology

Italian representatives in ALMA:

Testi – European Project Scientist
Tofani – ALMA Management Advisory Committee (AMAC)
Maiolino – European Science Advisory Committee (ESAC)
Andreani – EU ARC Manager
Tarengi – former Director ALMA; now ESO rep. in Chile

Origin of the It. ALMA Regional Centre

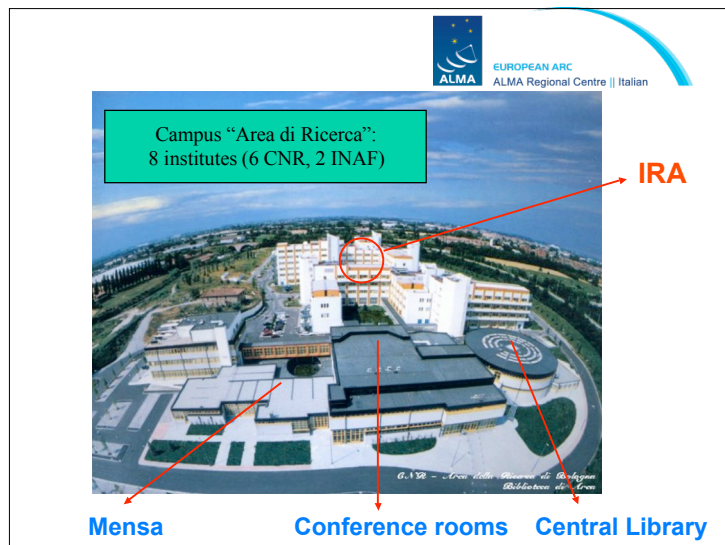
In response to ESO-call, national INAF-ALMA Commission* was established in June 2004. This recommended:

IRA to host ALMA Regional Centre

Primarily based on IRA's extensive experience with (radio) interferometrical instruments, observing techniques, software packages and development, and managing large data sets.

Expression of interest from INAF to ESO.
Italian ARC: hosted by IRA-Bologna, funded by INAF

* Testi, de Zotti, Mack, Natta, Pucillo



Present situation



ARC-working group consisting of:

6 staff-members Brand, Gregorini, Mack, Nanni, Prandoni, Zanichelli

3 post-docs + 1 technician:

Rossetti (VLBI, radio, polarisation, extra-galactic)	60%
Mignano (software development, opt/IR, extra-galactic)	50%
Casasola (mm-interferometry, single-dish, extra-gal.)	50%
Bedosti (computer systems, software)	100%

<7/2008: Fontani ((sub-) mm, galactic; preparation for ALMA)

Rossetti: One of 4 original EU CASA-user support specialists who train EU community in its use, and act as interface between the EU-users and developers at NRAO.

Future situation



Immediate Future:

1 new post-doc to be hired 2010
 1 ESO-ALMA COFUND Fellow may arrive 2010
 INAF: ARC astronomer (tenure) 2010
 INAF: ALMA science (tenure) 2010 (Arcetri or IRA)
 Hardware acquisition: ≥ 2008 (www.alma.inaf.it)

Long-term: ≥ 2011:

1 FTE provided by (4-6) IRA-staff; 1 system manager;
 4 post-doc positions
 + Involve experts from other institutes

Activities: recent & future

Regular (ca. 1/month) internal ARC-meetings; ALMA days

Received first visitor!

CASA-tutorial - 27-29 April 2010

ALMA-course (Rome/Teramo) - Nov. 2009

International School on "ALMA and Astrochemistry"
 (COST Action: The Chemical Cosmos: understanding chemistry in astronomical environments) - 2011

Preparation of visitors' open-plan offices (1 Gb/s link)

Web page development (Joomla!) (<http://www.alma.inaf.it>)

Italian ARC

http://www.alma.inaf.it/

ALMA-related activities of the Italian astronomical community

INAF
ISTITUTO NAZIONALE DI ASTRONOMIA
NATIONAL INSTITUTE FOR ASTROPHYSICS

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Management

- Administrator
- Systems Monitor

The Italian ARC is one of the six nodes that constitute the European network that will provide technical and scientific support to ALMA users.

The nodes will be operating in close collaboration with each other and with the central node at ESO, Garching. Each node contributes its own specific expertise, in order to ensure that maximum advantage is taken of the European competences in the field of mm-astronomy and interferometry.

Once ALMA is fully operational, the Italian ARC intends to fulfill its duties regarding face-to-face help and computing support.

International Post-Doctoral Fellowship (05/2009/IRA/BS)

A postdoctoral position will be available at the Italian node of the European network of ALMA Regional Centres (ARCs). When ALMA is operational, the ARC-nodes will provide general user support and infrastructure for data analysis.

Last Updated on Sunday, 20 September 2009 11:49

Read <http://www.alma.inaf.it/>

For detail see : ESO Fellowship

There is the possibility for applicants to

Search

Search

Who's Online

We have 1 guest online

Jobs @ INAF-Arc

- test
- test

Jobs @ ESO

- 2009/9999 Speculative Application
- 2009/0051 Operation Staff Astronomer
- 2009/0050 Telescope Instruments Operator
- 2009/0048 System Engineer
- 2009/0047 ARC Astronomer

Local resources

http://www.alma.inaf.it/index.php?option=com_content&view=section&id=5&Itemid=55

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Local resources

All the host institute we are presently equipping an open-plan office to simultaneously accommodate at least four visitors requesting face-to-face help.

The ARC will furthermore provide visitors with a dedicated computer server and adequate disk space. Each visitor's workspace will be equipped with a desktop computer, with which he can connect to the server (running CASA) and access the data.

The host institute, and therefore the ARC, will be connected with a high-speed optical fiber network to the outside world, allowing fast data transfer (1 Gbit/sec in 2009; 10 Gbit/sec by 2012).

The ARC has already acquired part of the hardware we think necessary for an efficient service, and will extend computing power and storage capacity over the next two – three years to its full potential. Presently we have 16 Tb of disk space and one 12-unit blade cluster (96 cores) dedicated to the ARC.

- The ARC Open Space (0 Articles)
- The ARC cluster of computers (4 Articles)
- Software (4 Articles)

INAF - Istituto di Radioastronomia
Via P. Gobetti 101 - 40129 Bologna - Italy

An overview of the computer cluster

www.alma.inaf.it/index.php?option=com_content&view=article&id=64-the-arc-cluster&catid=1

The cluster is built up on two high-speed networks, one at 1 Gbit/sec for standard TCP/IP communication and the second one at 10 Gbit/sec for the network file system. The computing core of the cluster is the blade rack DELL PowerEdge M1000E that holds 12 "blade computers" arcb01 ... arcb12.

The computing elements (arcb01 ... arcb12) and the storage servers (arcserv1 and arcserv2) use a local private network and cannot be used starting from outside the Bologna Campus. The server arcserv is the gateway to access the ARCcluster from the public internet at the address arcserv.alma.inaf.it. Arcserv host can be accessed via ssh and transfer hosts at the remote services (accounting, web, ftp, etc) of the Italian ARC.

Many Terabyte of disk space will be required for data reduction during the operational stage. The server arcserv1 and arcserv2 manage, in a redundant way, the Red 5 system that hosts the disks packs and supports all disk error for the GINIS network file system. All the cluster nodes will mount the data space via GINIS filesystem on the 10 Gbit/sec network. Also the systems outside the cluster will mount the network file system, but only via NFS at 1Gbit/s.

At the Alma operation stage the link with the GAN network, that is the Italian National Research & Educational Network, will have a speed from 1 to 10 Gbit/s.

Photorealization of the cluster in the ARC cluster

USEFUL WEB PAGES

Latest News:
<http://www.almaobservatory.org/>

General ALMA pages at ESO:
<http://www.eso.org/sci/facilities/alma/>

Possible Science Projects (DRSP):
<http://www.eso.org/sci/facilities/alma/science/drsp/>

ESO-ARC pages:
<http://www.eso.org/sci/facilities/alma/arc/>

Italian ARC-pages:
<http://www.alma.inaf.it/>

Check for job offers.