



# The European ALMA Regional Centre:

interaction with and support to the users

Paola Andreani  
European Southern Observatory

IRAM school Grenoble 10/10/08



# ALMA Operations

IRAM school Grenoble 10/10/08



# Science Operations Astronomer's perspective



## Principles:

- 🍏 Non-experts should be able to use ALMA
- ♣️ Dynamic scheduler to match observing conditions
- ♠️ Reliable and consistent calibration
- ◆ Data public in timely fashion



# ALMA in operations

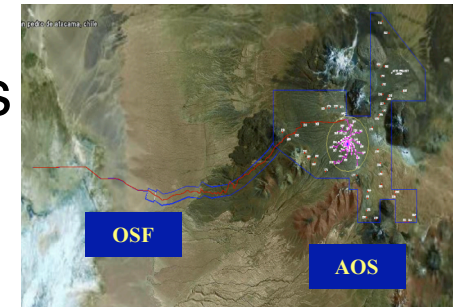


**San Pedro (OSF) Operations Support Facilities**

**array scheduling + operations**

**quick-look reduction**

**maintenance and repair antennas + instruments**



**Santiago (SCO) Santiago Central Office**

**issues of calls**

**TAC (Time Allocating Committee) process**

**SB (Scheduling Block) checks**

**pipeline data reduction**

**quality assessment**

**production of archive**





# The Regional centres

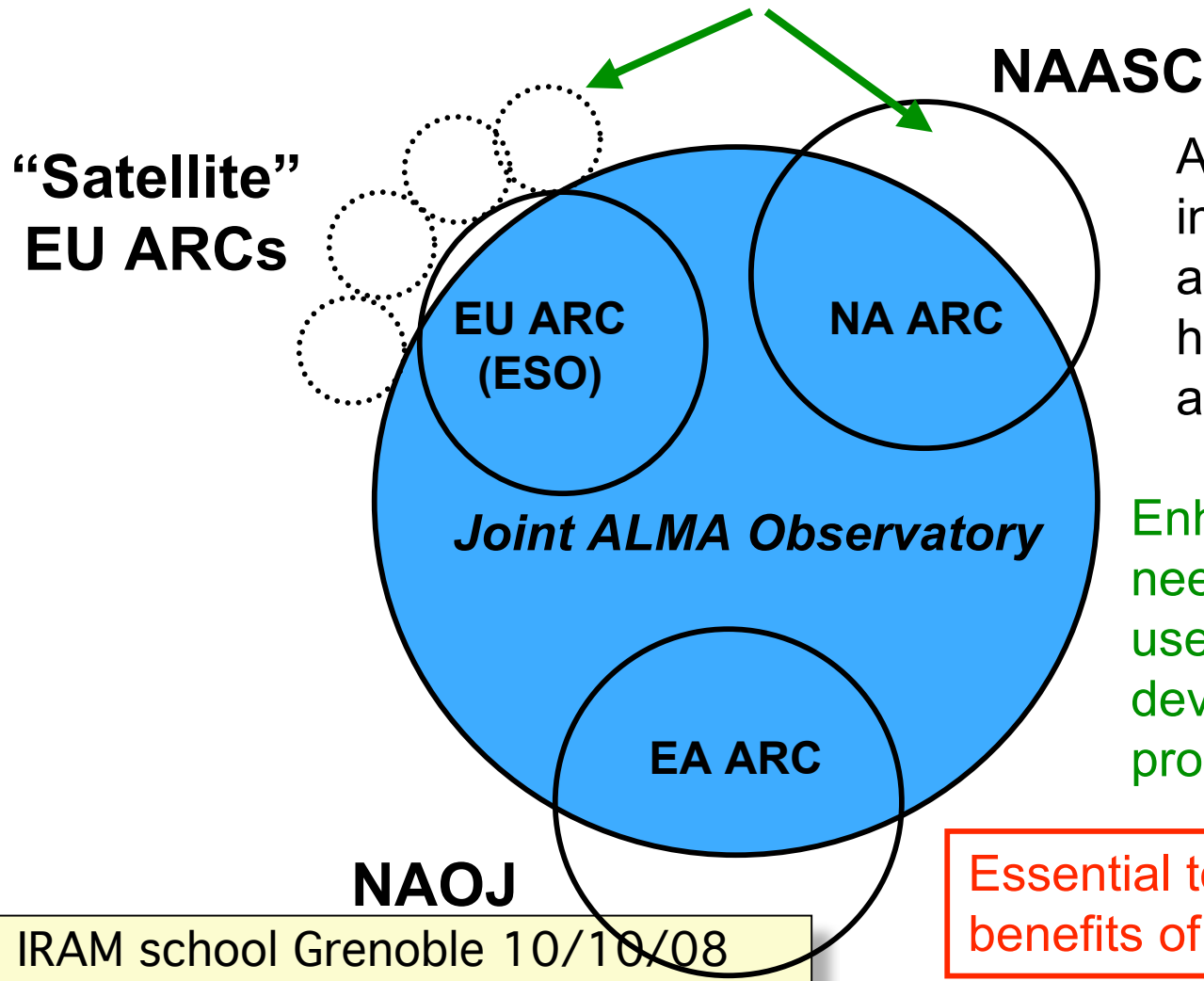
IRAM school Grenoble 10/10/08



# ALMA Operations: Three ALMA Regional Centres - ARCs



Enhanced User Services



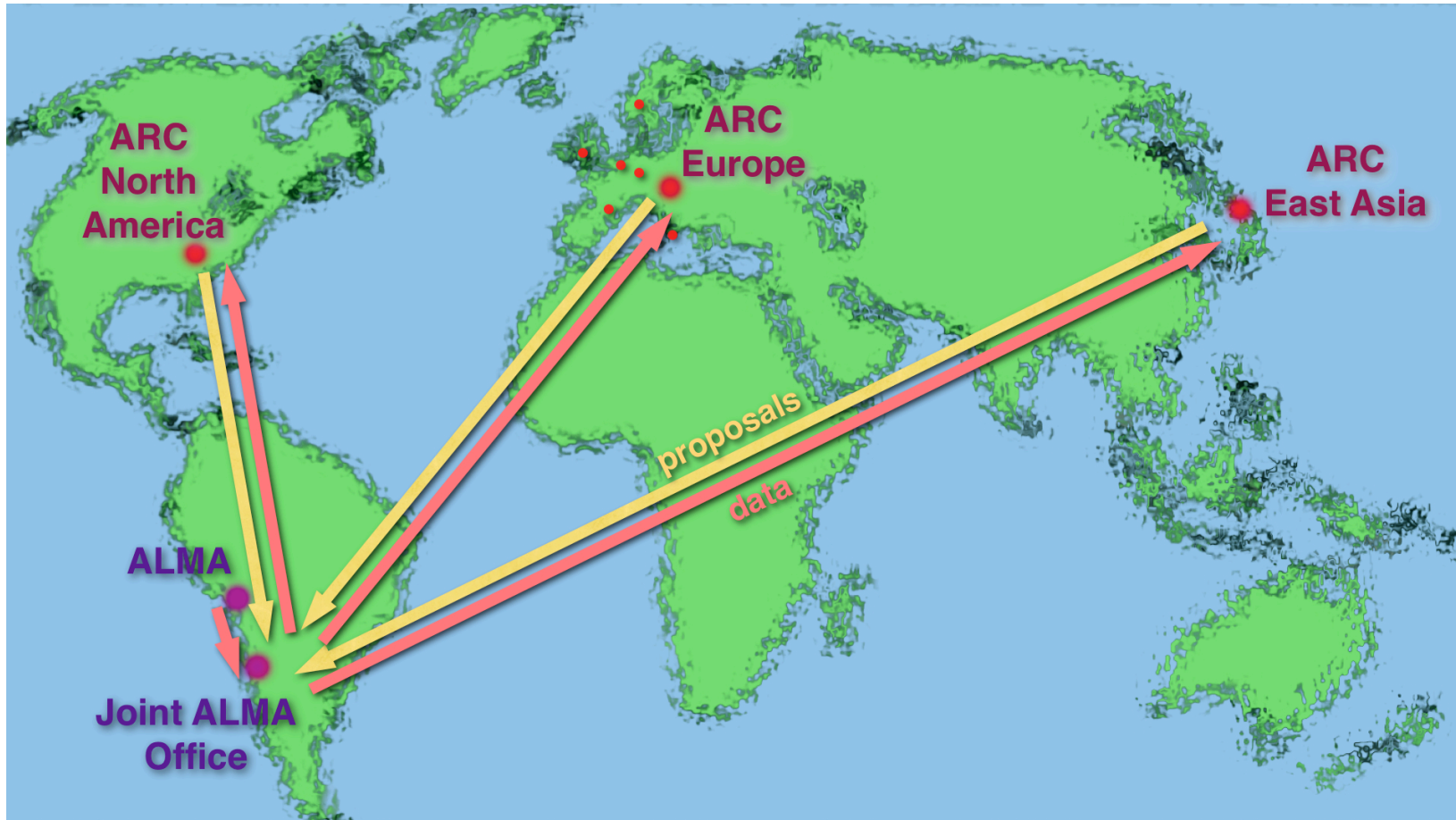
ARCs provide basic user interface, as well as basic archive, software, and hardware maintenance and development

Enhanced services are needed to provide advanced user support, algorithm development, student programs, EPO, grants

Essential to realize the full benefits of ALMA



# The ARCs and their relation to the JAO



IRAM school Grenoble 10/10/08



# The ALMA Regional Centres



- **Core functions**

Scientific support services

- Proposal & observation preparation user support
- Basic data analysis
- ALMA Archive operations: host copy, data package delivery
- OSF AoD shifts (CSV)
- Science community development

version D (approved):  
in the core functions

- **Additional functions**

Extended archive & data reduction support

- f2f help
- Advanced pipeline
- Archival research projects

Support for special projects

Science community development

- basic training, schools, workshops

+ f2f help during first years  
+ archival research help





# Meaning of ALMA Operations

IRAM school Grenoble 10/10/08



# What does science Operations mean?



- **Phase I + II proposals through ARCs**  
(time estimator, end-to-end data simulator)
- **Scheduling blocks to OSF**
- **Data taken in service mode**, dynamic scheduler selects programmes according to science rating weather conditions, array configuration, consistent calibration
- **Pipeline data reduction, quality control, archive**
- **Advanced data reduction at ARCs**



# Getting ALMA time

IRAM school Grenoble 10/10/08



# Getting ALMA time



## Phase I

- ❖ **Joint ALMA Observatory issues calls for proposals**
  - Register on the ALMA web page
  - Prepare a proposal with the ALMA Observing Tool
  - user can contact their ARC node for assistance
    - European ARC provides documentation
- ❖ **ALMA Observatory (with ARCs help)**  
coordinates refereeing process
  - Program Review Committee ranks proposals
- ❖ **Executives approval**



# Getting ALMA time

## MAKE A PROPOSAL!

- ❖ **Scientific case**
- **Instrument setup: frequency**
- **rms**
- **S/N**
- **source extension**
- **spatial resolution**

## Phase I



- ❖ ALMA referee (s help) coordinates
- Pr proposals
- ❖ Execu

SEND



# The ALMA observing tool



The screenshot displays the ALMA Observing Tool interface for a project named "NGC 253 CO (1a)". The interface is divided into several panels:

- Project Structure:** A tree view on the left showing the project hierarchy. Key items include "Science Plan", "Science Goal - generated", "Field Setup", "Spectral Setup", "Control Parameters", "Calibration Setup Parameters", "NGC 253-SFI", "NGC 253 hi res", "4 Targets" (including J0050-094, J0120-270, J0051-068, and NGC 253), "Resources", "5 Field Sources" (including Primary: NGC 253), "4 Instrument Setup", and "7 Observing Parameters".
- Editors:** The central panel shows a large image of the NGC 253 galaxy with a field of pointing positions overlaid. A smaller inset image shows a zoomed-in view of the field with a yellow box highlighting a specific area.
- Field Source Editor:** A panel on the right provides details for the selected field source, "Primary: NGC 253". It includes fields for Name, Source Name, Source Coordinates (System, RA, Dec), Reference Position (Offset), Field Pattern, and PointingPattern (Offset).
- Frequency and Antenna Parameters:** A panel at the top right shows "Frequency used" set to 230.00000 (source), "Antenna Diameter" set to 12m, and "Show Fov(circle)" checked.
- Image Query:** A panel below the frequency parameters shows "Image Server" set to "Digitized Sky (V)" and "Image Size(arcmin)" set to 12.
- Field Source Editor:** A panel below the image query shows "This FieldSource is used by 1 target." and "Field Source" set to "Primary: NGC 253".
- Reference Position (Offset):** A panel below the field source editor shows "Reference Position (Offset)" set to "00:47:20.973, -25:18:03.17 J2000" and "image filename" set to "/home/martin/.jsky/cache/jsky63873.fits".
- Field Pattern:** A panel below the reference position shows "Field Pattern" set to "Type point".
- PointingPattern:** A panel below the field pattern shows "PointingPattern" set to "Offset" and "Offset Unit" set to "arcmin".

The interface also includes a menu bar (File, Edit, Tool, Search, Options, Help), a toolbar, and a status bar at the bottom with tabs for "Spectral", "Spatial", "Forms", and "Catalog".

IRAM school Grenoble 10/10/08



# Getting ALMA time



## Phase II

- ❖ Phase I: Proposals are submitted using ALMA Observing Tool
  - Phase II: Successful PIs submit observing programme using the Observing Tool
  - Preparation of the scheduling blocks
  - European ARC helps with observation planning and validates observing schedule



# The ALMA observing tool



The screenshot displays the ALMA Observing Tool interface for a project named "NGC 253 CO (1a)". The interface is divided into several panels:

- Project Structure:** A tree view showing the project hierarchy, including Science Plan, Science Goal, Field Setup, Spectral Setup, Control Parameters, Calibration Setup Parameters, and NGC 253-SFI. Under NGC 253-SFI, there are 4 Targets and 5 Field Sources. The "Primary, NGC 253" field source is highlighted.
- Editors:** A central panel showing a visualization of the field source. It includes a main image of the NGC 253 galaxy, a zoomed-in view of the field source, and a pointing pattern overlay. The pointing pattern consists of a grid of points, with a central point highlighted. The image filename is shown as `/home/martin/.jsky/cache/jsky63873.fits`.
- Field Source Editor:** A panel on the right showing the configuration for the selected field source. It includes fields for Name, Source Name, Source Coordinates (System, RA, Dec), Reference Position (Offset), Field Pattern, and Pointing Pattern. The "Primary, NGC 253" field source is used by 1 target.
- Fov Parameters:** A panel showing the Field of View (Fov) parameters, including Frequency used (230.00000), Antenna Diameter (12m), and Show Fov(circle) (checked).

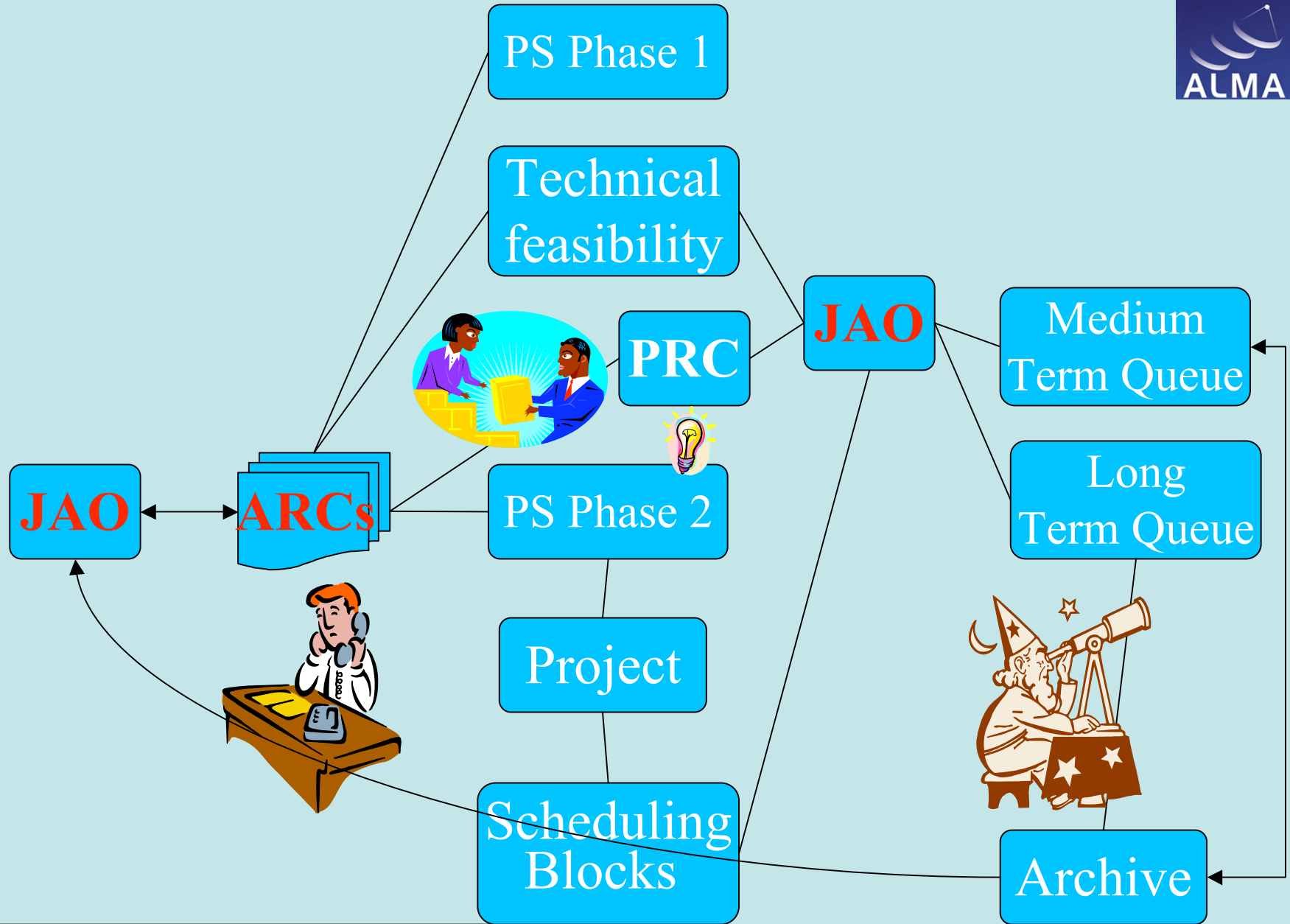
At the bottom of the interface, there are tabs for "Spectral", "Spatial", "Forms", and "Catalog". The status bar at the bottom indicates "Reserved for future use".

IRAM school Grenoble 10/10/08





# ALMA DATA FLOW





# Getting ALMA data

IRAM school Grenoble 10/10/08



# Getting ALMA data



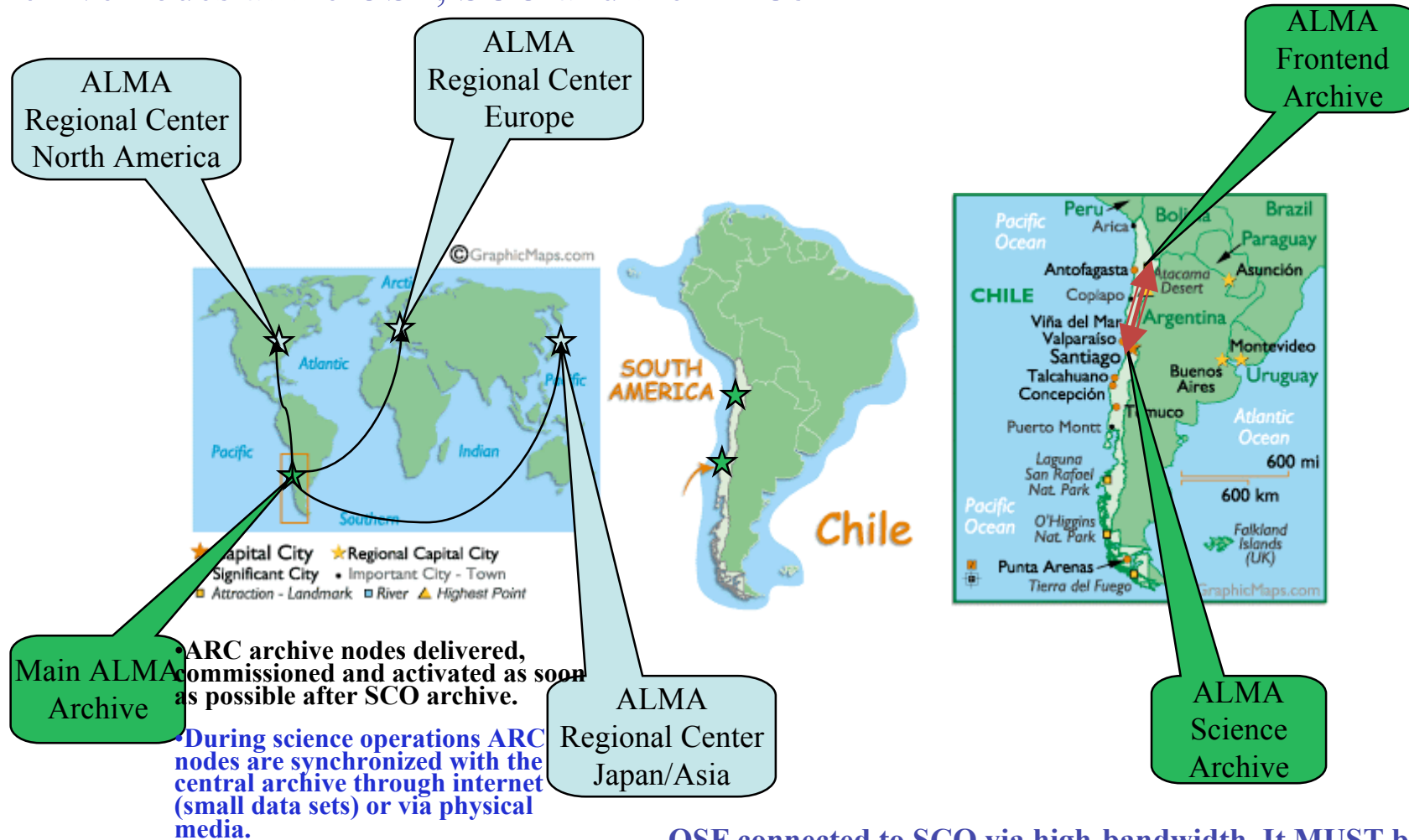
- ❖ Queue based dynamic scheduling
  - Programs are composed of 30-60 min scheduling blocks
- ❖ Raw data pass through multi-tiered quality assurance
  - Combination of on-site duty astronomer, ARC staff, and automated checks
- ❖ Data proceeds to pipeline and archiving
  - Data available from ARC (ESO) within ~2 weeks (TBD, quick if internet available)
  - Pipeline products (images and calibrated u-v data), raw data off-line data processing software made available to PIs
  - Expert hands-on data reduction help from ARC nodes staff provided on request, helpdesk also available at ESO



# The ALMA archives and data distribution



Archive nodes at the OSF, SCO and the ARCs



Main ALMA Archive

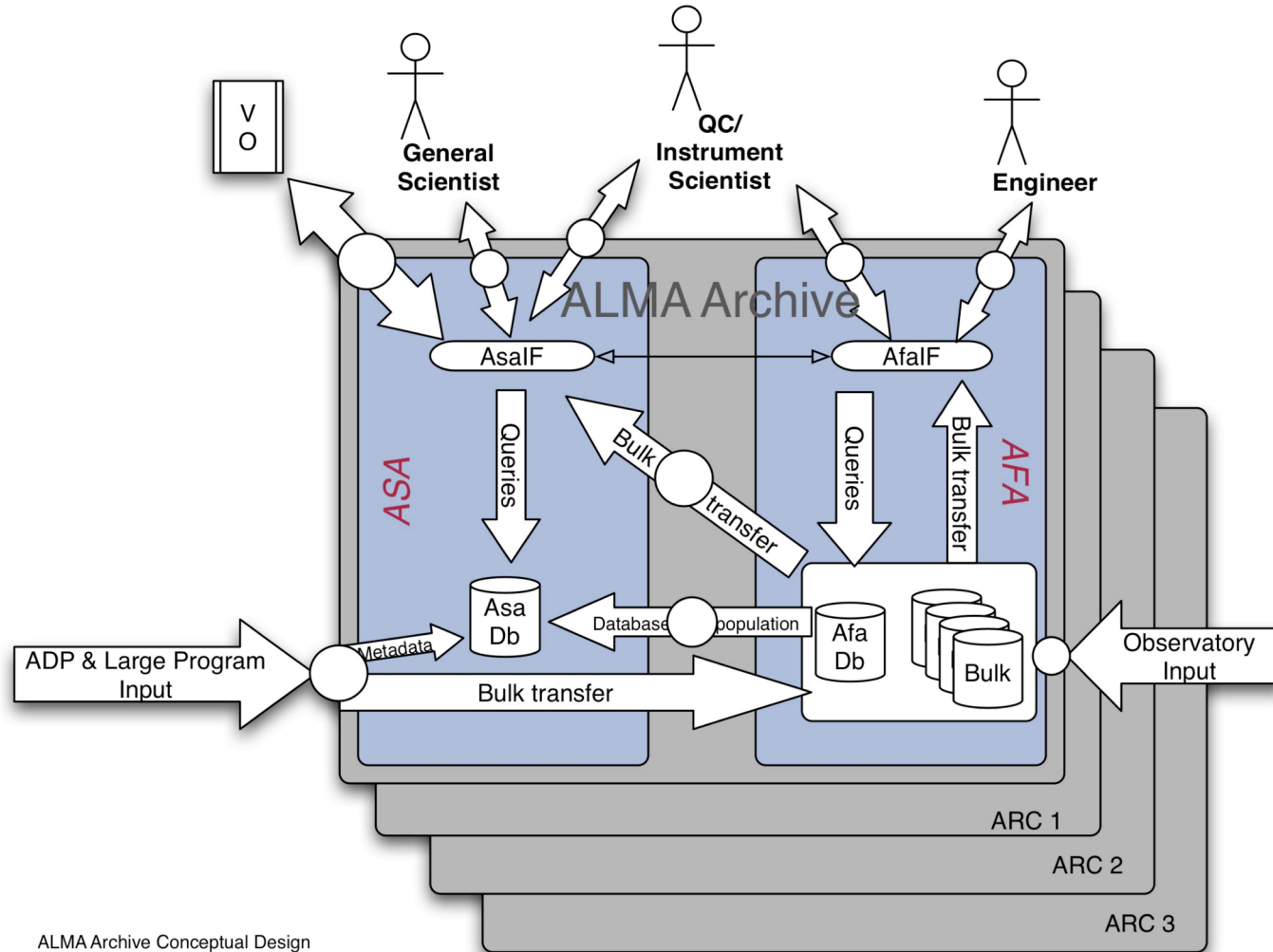
- ARC archive nodes delivered, commissioned and activated as soon as possible after SCO archive.
- During science operations ARC nodes are synchronized with the central archive through internet (small data sets) or via physical media.

IRAM school Grenoble 10/10/08

OSF connected to SCO via high-bandwidth. It MUST be always possible to operate ALMA even if the internet link does not work



# The ALMA Archive



ALMA Archive Conceptual Design  
Andreas Wicencec, 2006-01-15

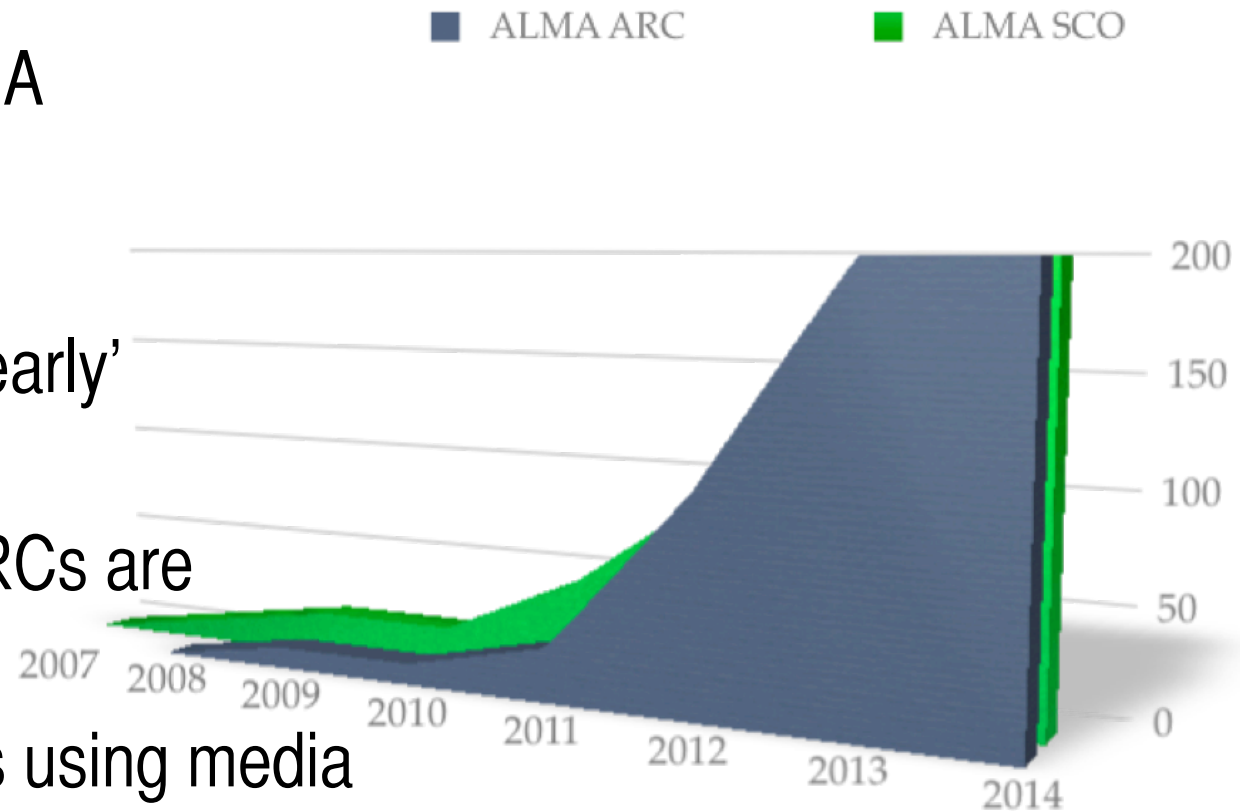
IRAM school Grenoble 10/10/08



# Data volume



- 1 year nominal ALMA is 200 TB.
- we've planned for 200 TB during the 'early' years in total.
- no backups! The ARCs are the backups.
- Replication to ARCs using media if necessary and over network once possible.

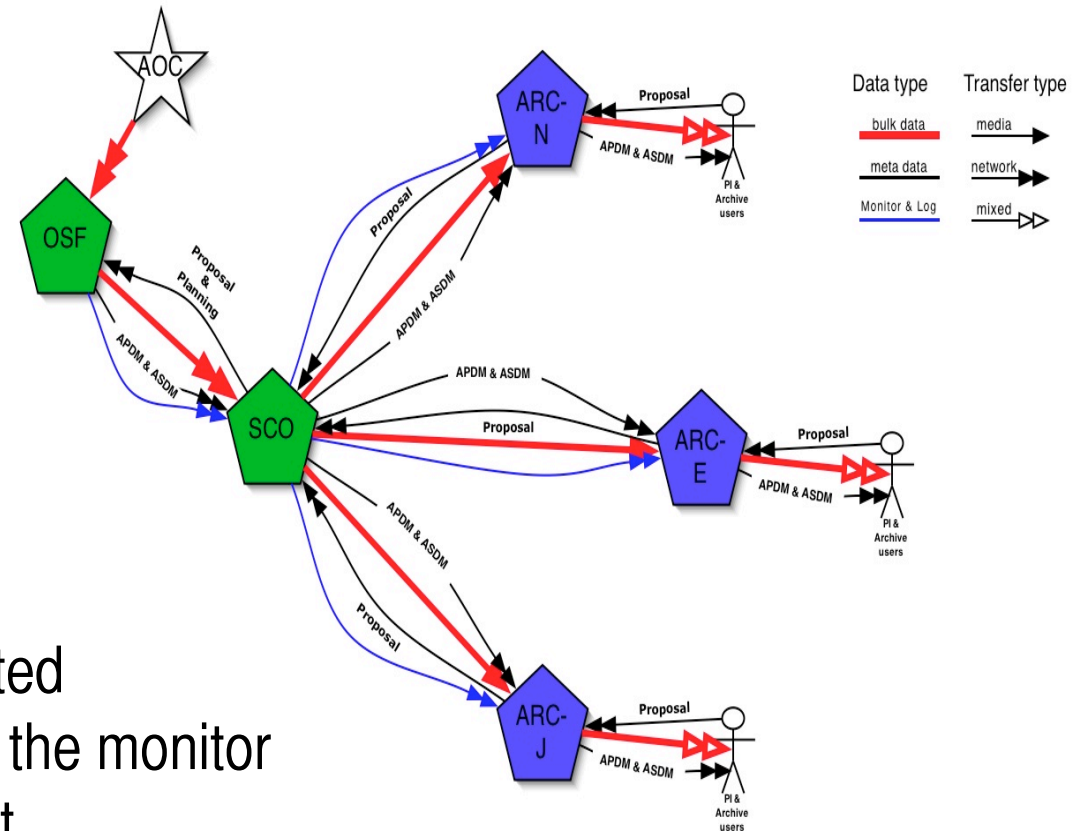




# High level concepts



- SCO is hub for bulk and meta-data.
- OSF archive is hidden. Data are first replicated to SCO and from there to the ARCs.
- In general everything is replicated to the ARCs; in practice part of the monitor and log data might be irrelevant.
- Proposals are submitted to the SCO and replicated to the ARCs. OT submission interface talks to SCO.





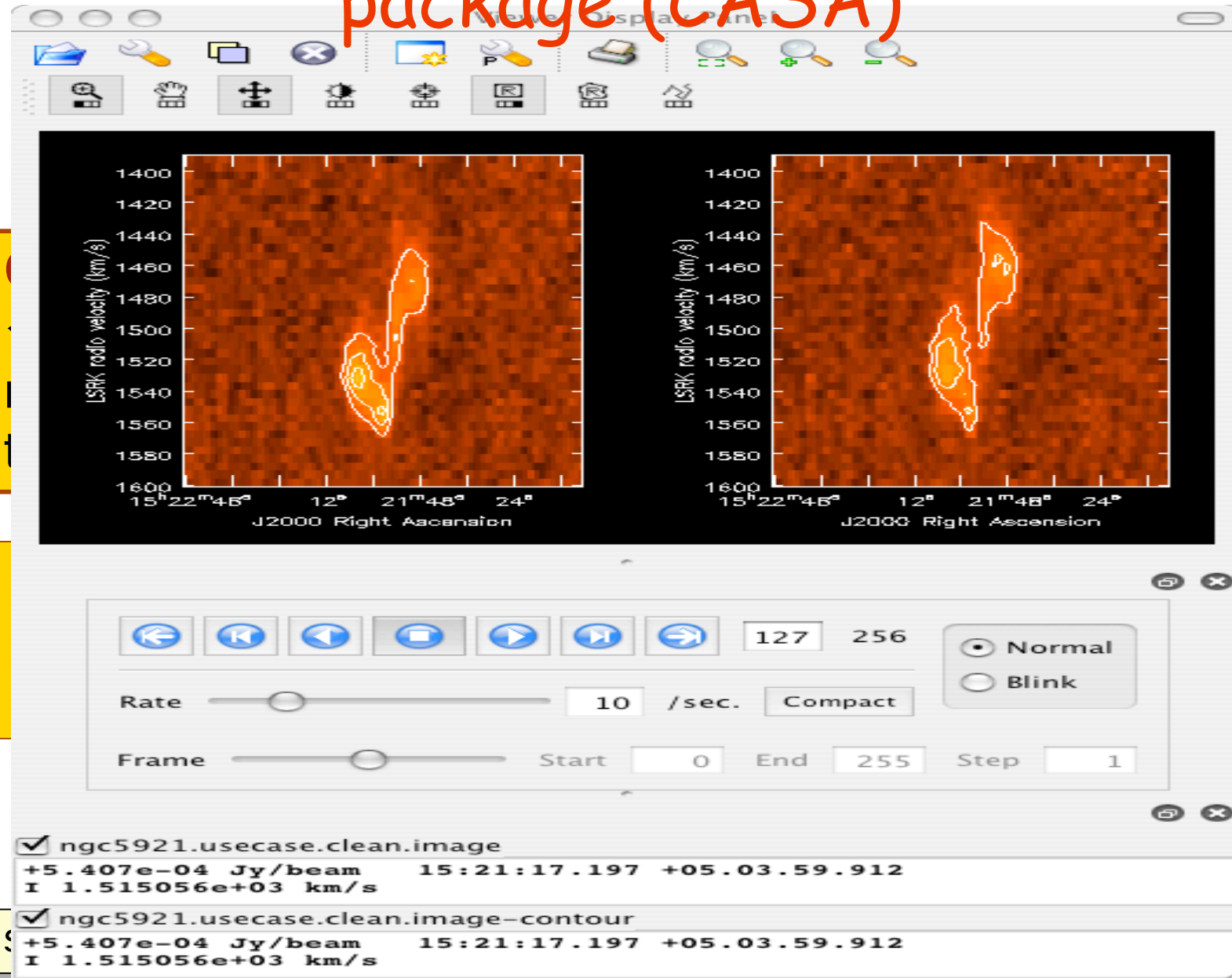
# Data reduction

IRAM school Grenoble 10/10/08





# The ALMA offline reduction package (CASA)



IRAM S



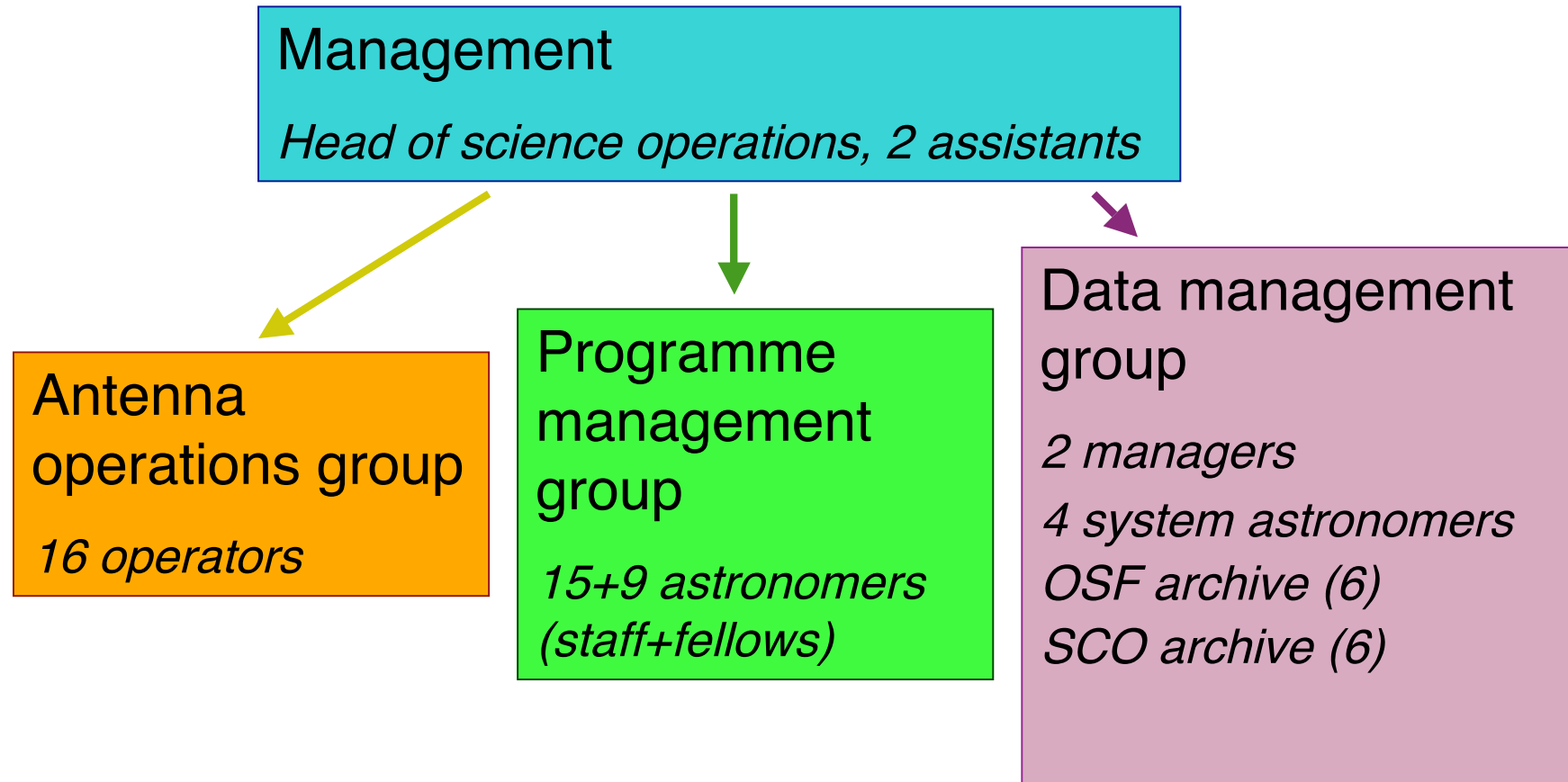
How many people  
do we need?



# Chilean ALMA Operations



- The department of science operations (DSO)





# ALMA Operations: ALMA Regional Centres: Full Operations



European ARC Manager Assistant	North America ARC Manager Assistant	East Asia ARC Manager Assistant
User support (7+5 astronomers+scientists)	User support (7+5 astronomers+scientists)	User support (4+4 astronomers+scientists)
Archive facility 5 operators	Archive facility 5 operators	Archive facility 5 operators



# The ALMA Regional Centres



## The European ARC

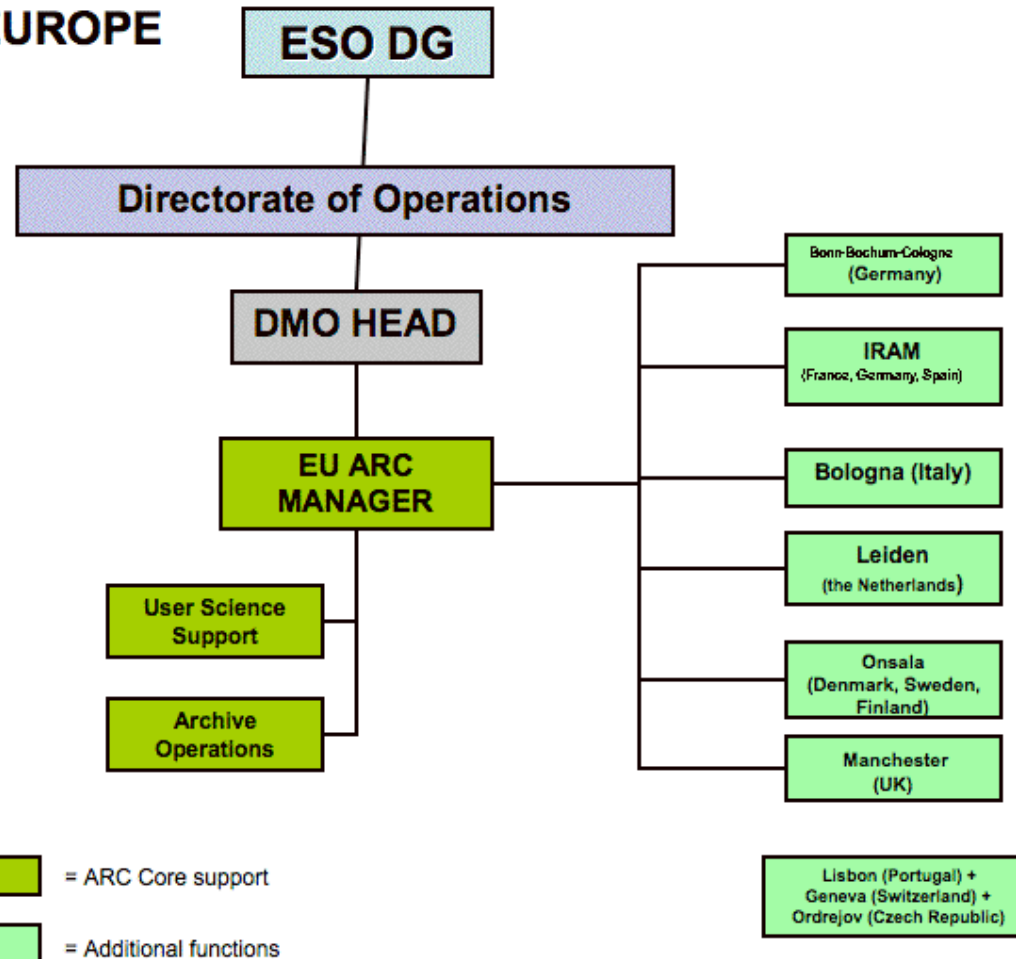
IRAM school Grenoble 10/10/08



# the European ARC



ARC EUROPE



IRAM school Grenoble 10/10/08



# The ALMA Regional Centres

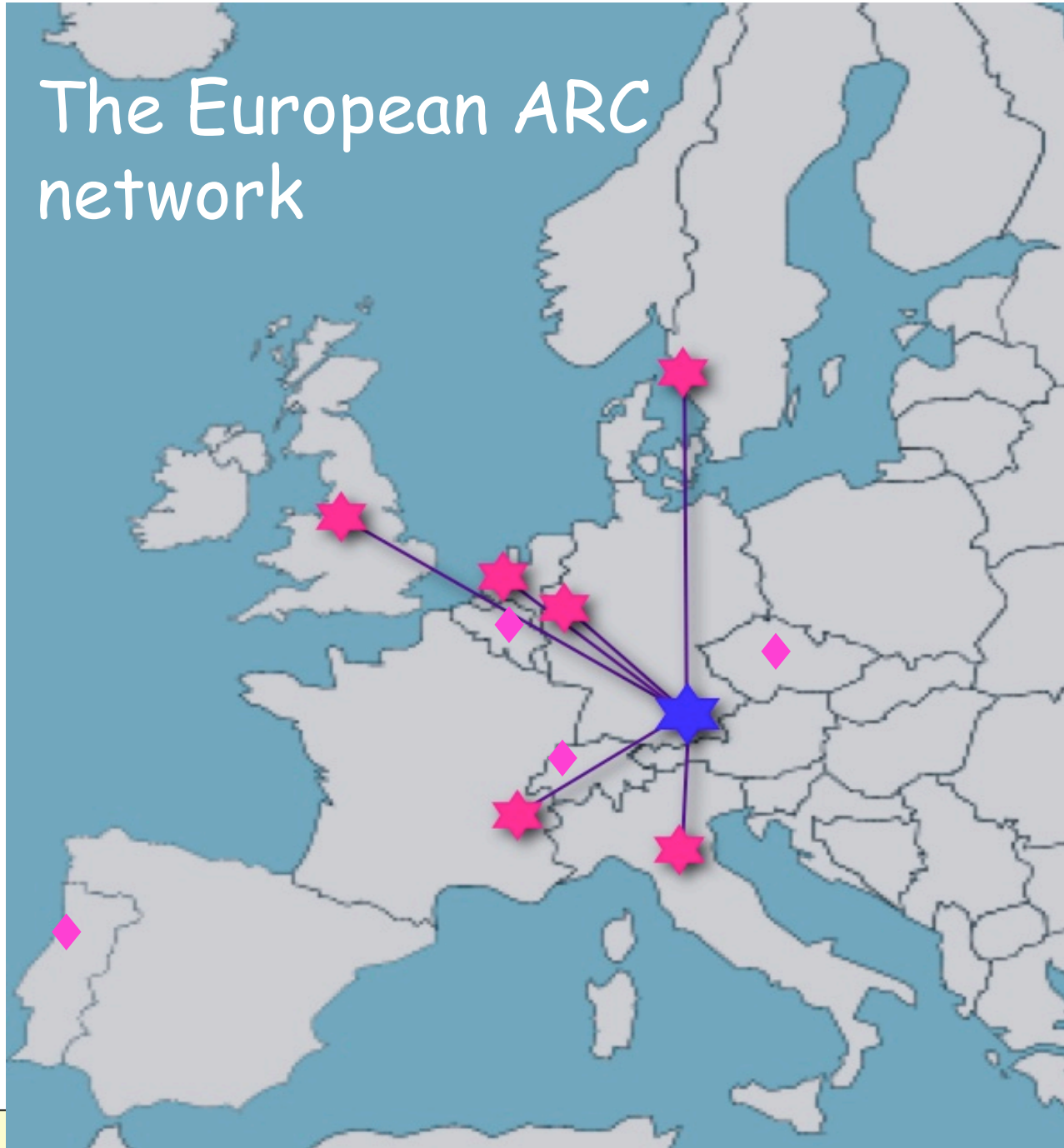


## The European ARC network



# The European ARC network

◆ : under discussion



IRAM school [arc@eso.org](mailto:arc@eso.org)





# ARC nodes tasks

(additional functions)



- **Extended archive and data reduction support:**
  - f2f data processing support in a dedicated physical location
  - modified pipeline versions
  - re-processing of large and/or complex datasets
  - advanced simulation development
  - advanced algorithm development and use
  - help with archival research projects
  - Support for special projects: public surveys and large programs
- **Science community development:**
  - support for ALMA research (e.g., basic training for new users), post-doctoral fellowships, training schools and workshops
  - ALMA-related specific science workshops, leading science community development activities with ad-hoc assistance from the ESO ARC and advanced public outreach



# ARC nodes: location and expertise



Bonn-Cologne-Bochum (D) ([F. Bertoldi](#))

*expertise:* Infrastructure for advanced data analysis and modeling (incl. Cologne Database for Molecular Spectroscopy), Polarimetry, Astrometry, Pipeline heuristics, Automatic data calibration

IRAM (F,D,E) ([F. Gueth](#))

*expertise:* calibration, phase correction, polarimetry, imaging simulator, SMA configurations, schools

Bologna (I) ([J. Brand](#))

*expertise:* data handling (GRID techniques), mosaicing, coordinating surveys/key-projects, polarimetry

Manchester (UK) ([T. Muxlow](#))

*expertise:* data analysis, archive, data reduction heuristics, proposal preparation

Onsala - Nordic node (S,DK,SF) ([J. Conway](#))

*expertise:* multi-frequency synthesis, GRID computing, phase modeling, self-calibration, astrometry, deconvolution, astrochemical modeling and radiation transfer

Leiden (NL) ([M. Hogerheijde](#))

*expertise:* high-frequency imaging, wide field imaging, data analysis tools

Portugal + Switzerland + Czech Republic + Belgium ([Lisbon](#), [Geneva Obs.](#), [Ordenjov Obs](#)) express interest

IRAM school Grenoble 10/10/08



# What ARCs are going to do



- **Participating in software pre-release tests**
- **Commissioning** (as a means of pre-AoD training)
  
- **PST submission support (Phase I support)**
- **Phase II support**
  - helpdesk
  - SB verification
- **Offline & data reduction help-desk support**
- **Documentation** (End-user doc + web content)
- **Astronomer on Duty**
- **Coordination meetings between ARCs, JAO**
- **Science Verification**
- **TAC Support** (technical feasibility assessment)

} **Pre-Ops**

} **Full Ops**



# What ARC nodes are going to do

- Participating in offline software tests
- Commissioning?

} **Pre-Ops**

- Face to face help for Phase I and II
- Offline & data reduction face-to-face support
- Advanced data reduction
- Training of students, schools
- Science Verification?
- Special Projects

} **Full Ops**



# Current Timeline



**2008 Continue Prototype System Testing (Socorro)**

**2008-2009 ARCs testing of observing tool, offline reduction software,  
pipeline heuristics**

**Early 2008 First antenna arrival and testing at ALMA site**

**Late 2009 Commissioning Begins with 3-element array**

**2010 Science Verification begins**

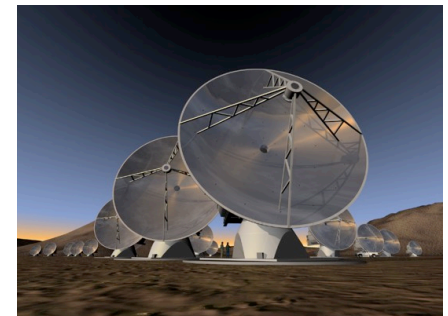
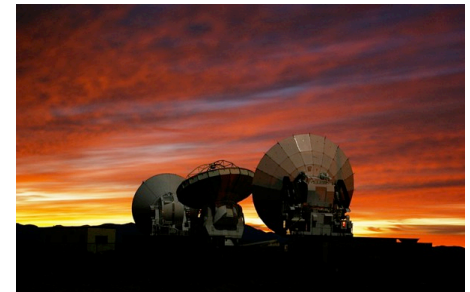
- 6+ antennas, 2+ bands, continuum & spectral line, 1km baselines

- Off line data reduction

**2011 Early Science begins (16 antennas, ... baselines)**

**2012 Pipeline images for standard modes**

**2013 Baseline ALMA Construction Complete**



IRAM school Grenoble 10/10/08



# Community Input

into the operations of the Global ALMA project and the EU ARC

- ❖ International community input into the ALMA project (via the ALMA Board) is through the ALMA Science Advisory Committee (ASAC)

<http://www.alma.nrao.edu/committees/ASAC/>

- ❖ European community input into the ALMA project and operation of the EU ARC is through the European ALMA Science Advisory Committee (ESAC)

<http://www.eso.org/projects/alma/administration/committees/esac>



# ALMA Operations mean



- Every astronomer will be able to observe with ALMA
- Every astronomer will get help from proposal submission to data delivery (ESO role)
- Advanced and special projects will get help as well (ARC nodes role)
- Astronomers will be trained, if they wish



# Questions?

IRAM school Grenoble 10/10/08