Atacama Large Millimeter/ submillimeter Array - ALMA

Science Operations

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High-level concepts for Science Operations

(from the ALMA Project and Operations Plans)

- Observations will be done in service observing mode with flexible (dynamic) scheduling.
- Observations 24h/day interrupted by maintenance periods.
- All observations are executed in the form of scheduling blocks (SBs), each of which contains all information necessary to schedule and execute the observations.
- The default output to the astronomer are reliable images, calibrated according to the calibration plan.
- The Joint ALMA Observatory (JAO) is responsible for the data product quality.
- All science and calibration raw data are captured and archived.

Science Deliverables:

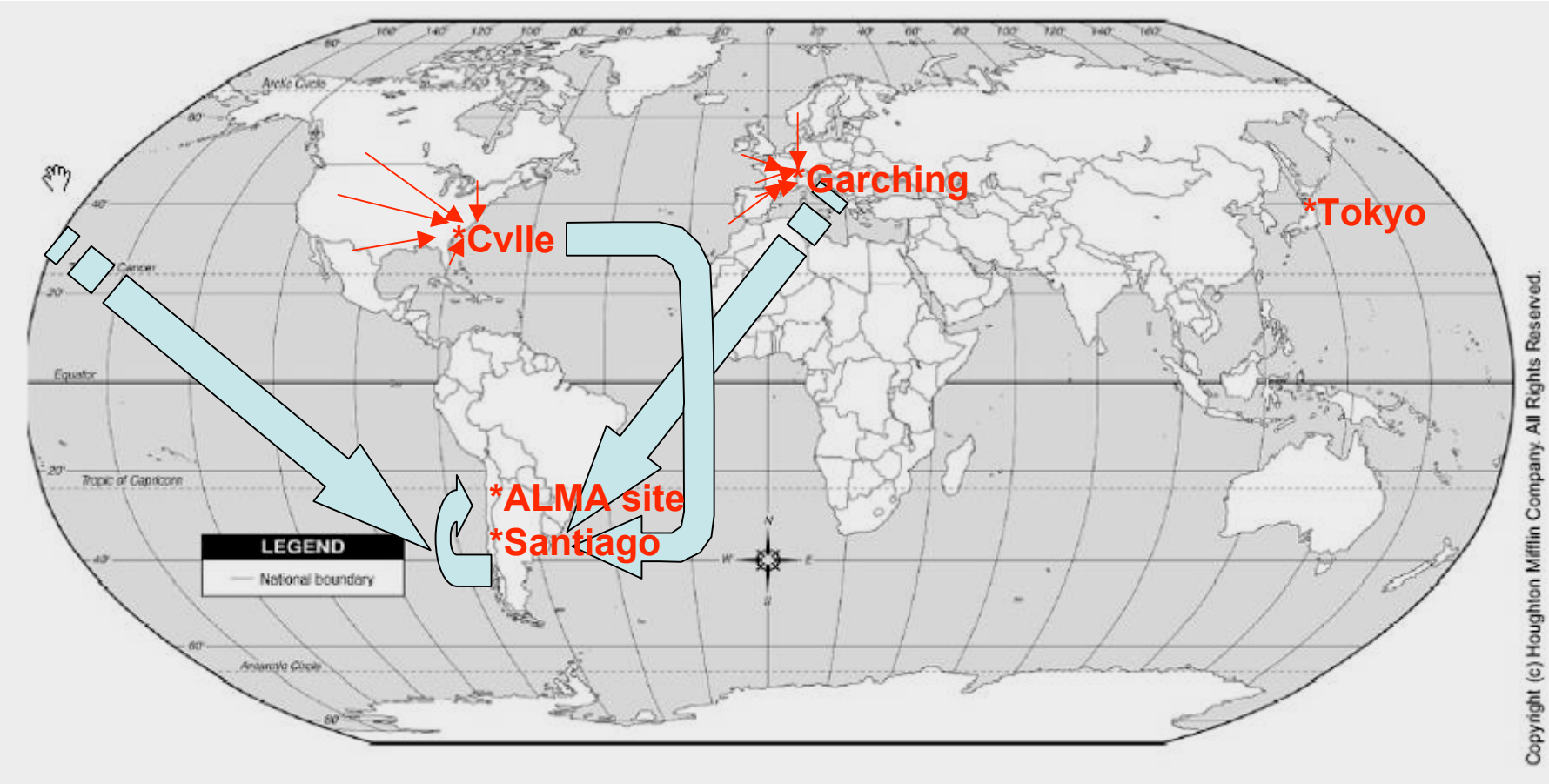
- uv-plane astronomical source and calibration data.
- Processed images, with supporting information on the data processing and quality assurance.
- Off-line data reduction software, including user support for installation and basic usage.
- Software tools for proposal and observation preparation, including user documentation.
- ALMA users manual.

User support:

- Web pages
- Phase I and phase II support
- Helpdesk
- f2f support
- Data delivery
- Archive

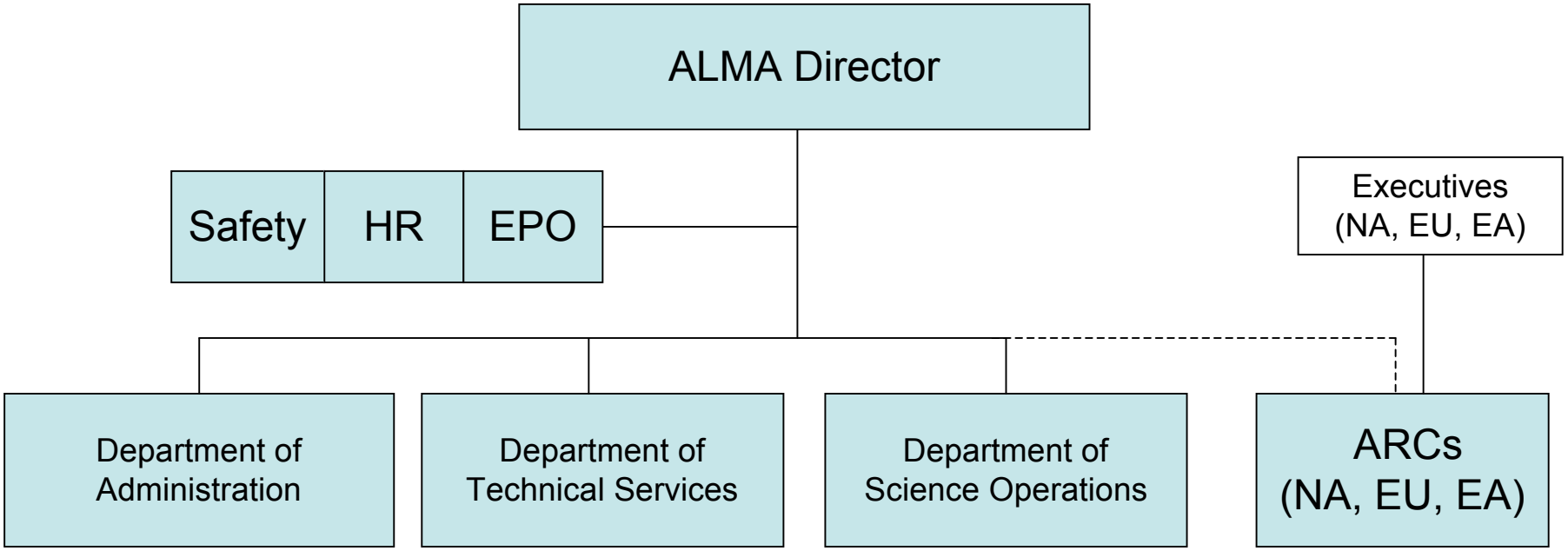
ALMA Science Operations sites

OSF, Santiago and the ARCs

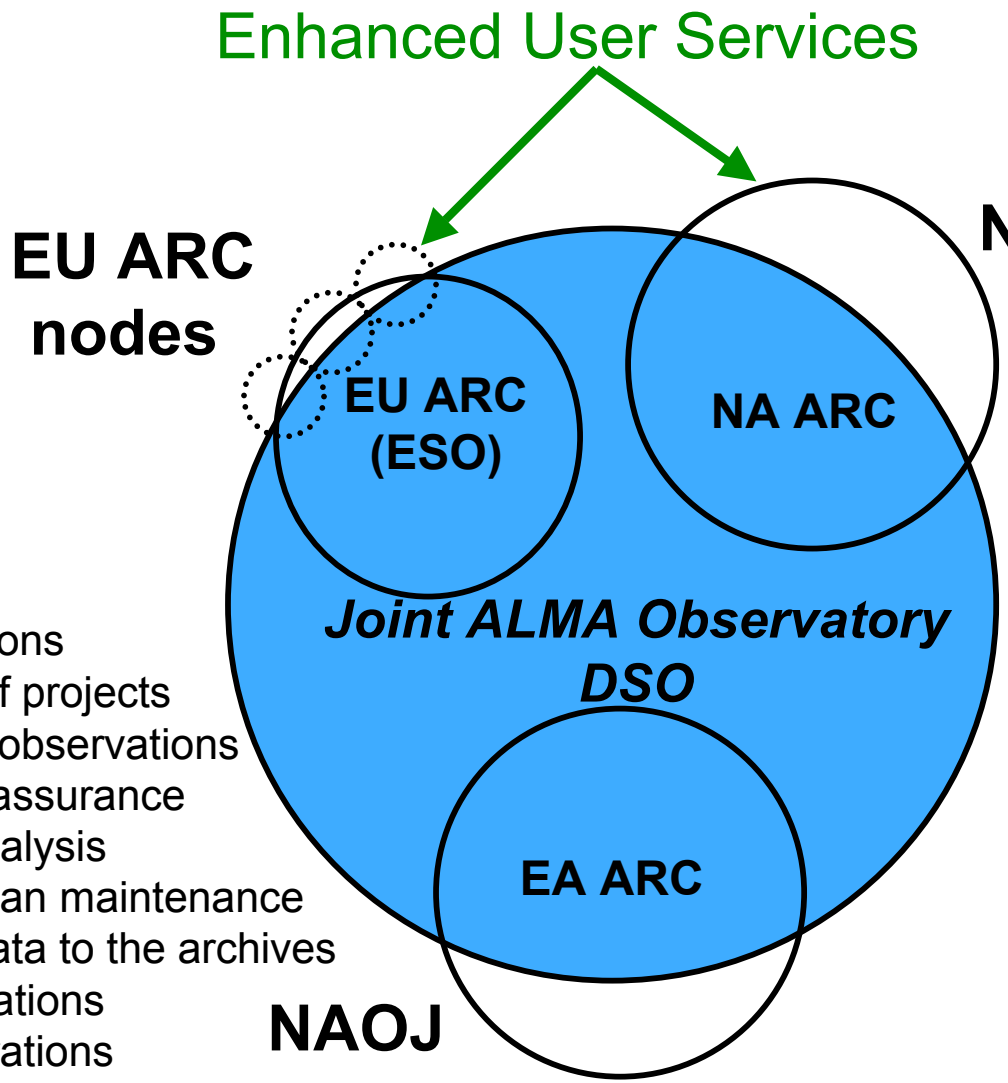


The Joint ALMA Observatory (JAO)

- ALMA is operated by the JAO.
- The ALMA Regional Centers (ARCs) form an integral part of JAO operations.



Science Operations: organization



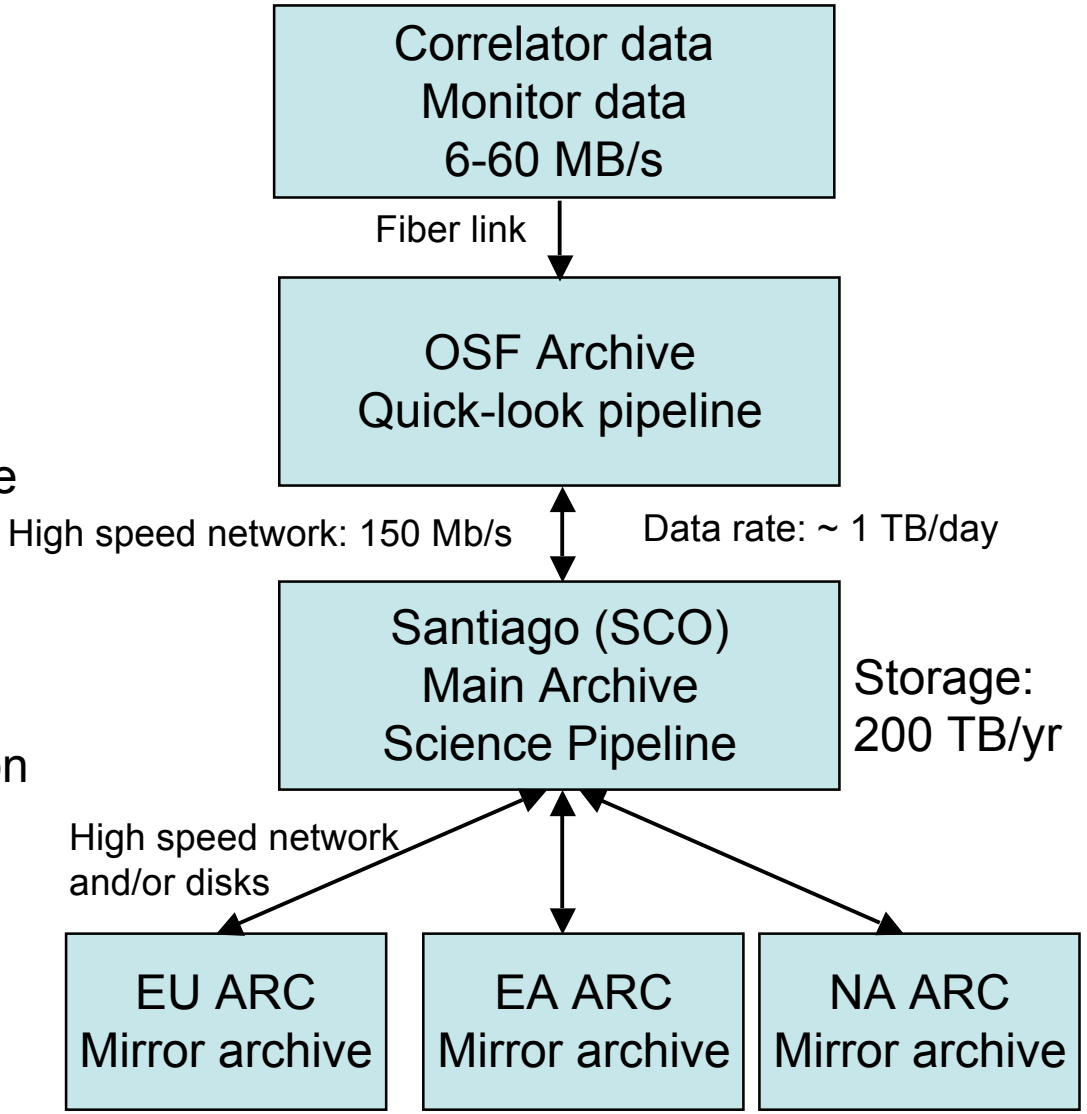
DSO provides:
- Array operations
- Scheduling of projects
- Execution of observations
- Data quality assurance and trend analysis
- Calibration plan maintenance
- Delivery of data to the archives
- Archive operations
- Pipeline operations

The ARCs are the interfaces to the user community.
The ARCs provide (core tasks):
- user support (via helpdesk and f2f)
- delivery of data to the PIs
- software tools for proposal preparation, observation preparation, and data reduction
- Mirror archive operations

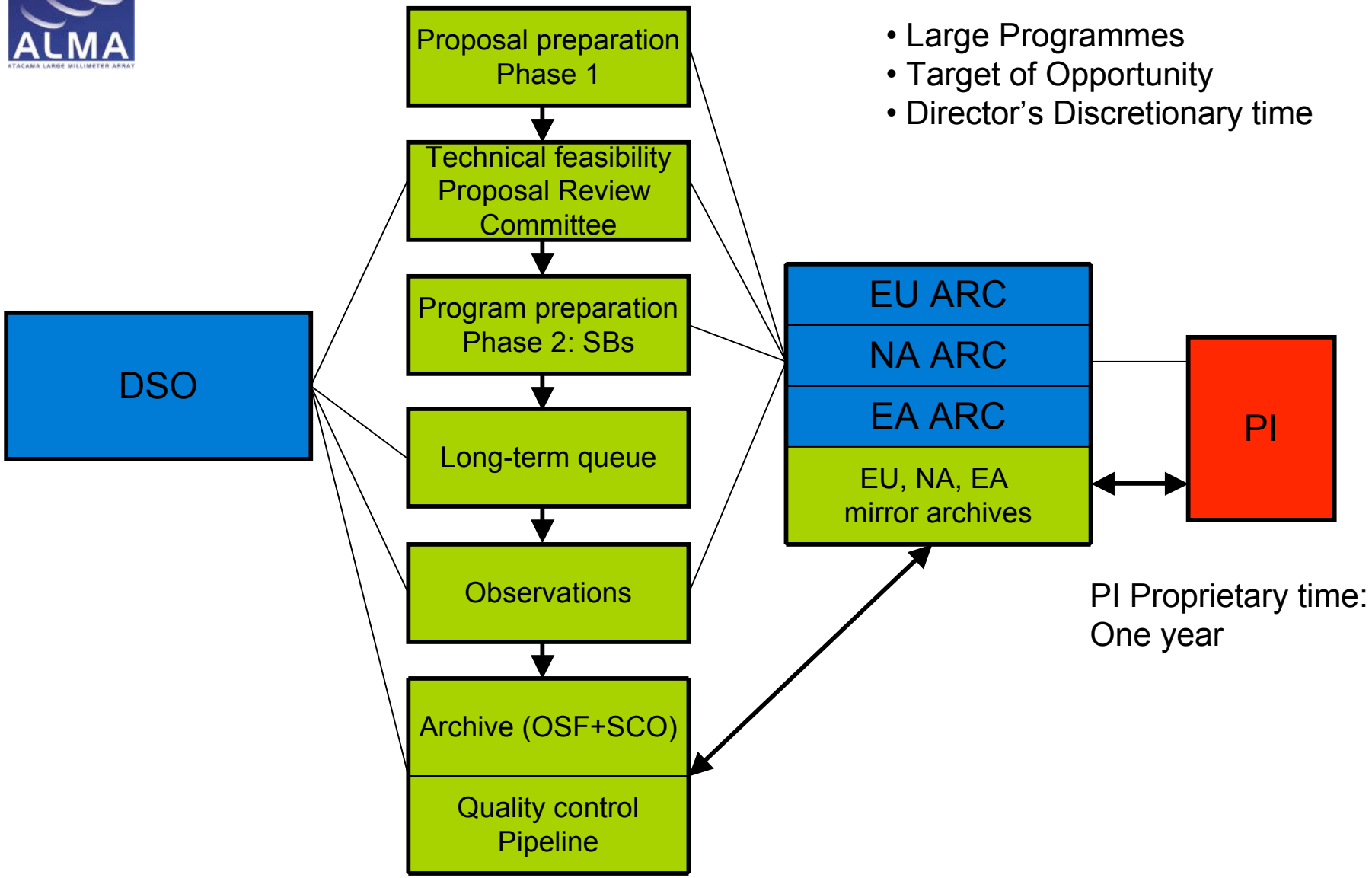
Archiving

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



Program flow



Early Science Operations

- Start Science Operations before the ALMA construction finishes
- Conditions for Early Science Operations:
  - 16 antennas with at least 4 receiver bands
  - Single field interferometry and pointed mosaics
  - Baselines out to 1 km
  - Basic set of spectral line modes
  - Single dish mapping (zero baseline observations) of extended objects in continuum and spectral line mode
  - Calibration better or comparable with existing mm-arrays
- Early Science Operations
  - One year scheduling period
  - Time shared with commissioning. At least 33% of available time will be used for observations

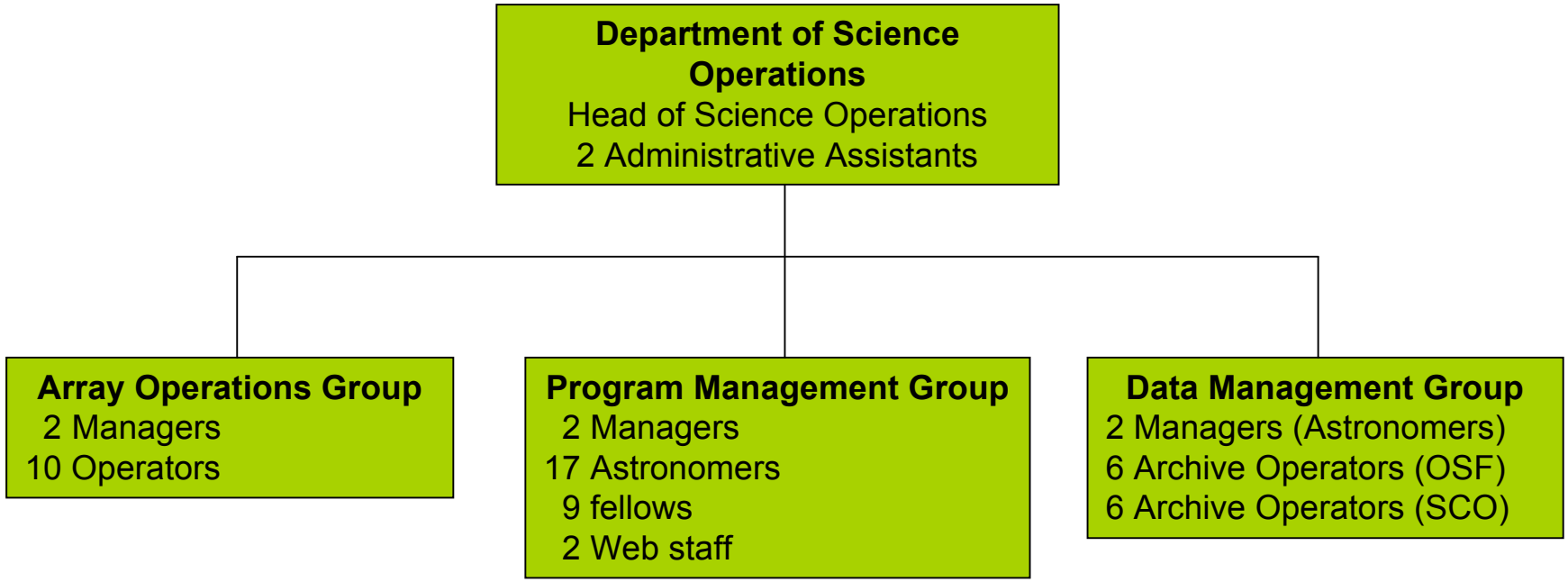
Full Science Operations

- Inauguration: > 50 antennas, at least 75% of the time dedicated to observations.
- Full Science Operations: Most equipment delivered and all observing capabilities have been reached
- Two scheduling periods per year
- The antenna configurations will be changed from the most compact to the most extended configurations over a timescale of a year

- The ALMA development plan: which capabilities will ALMA have beyond 2020?

Department of Science Operations

(Full Operations)

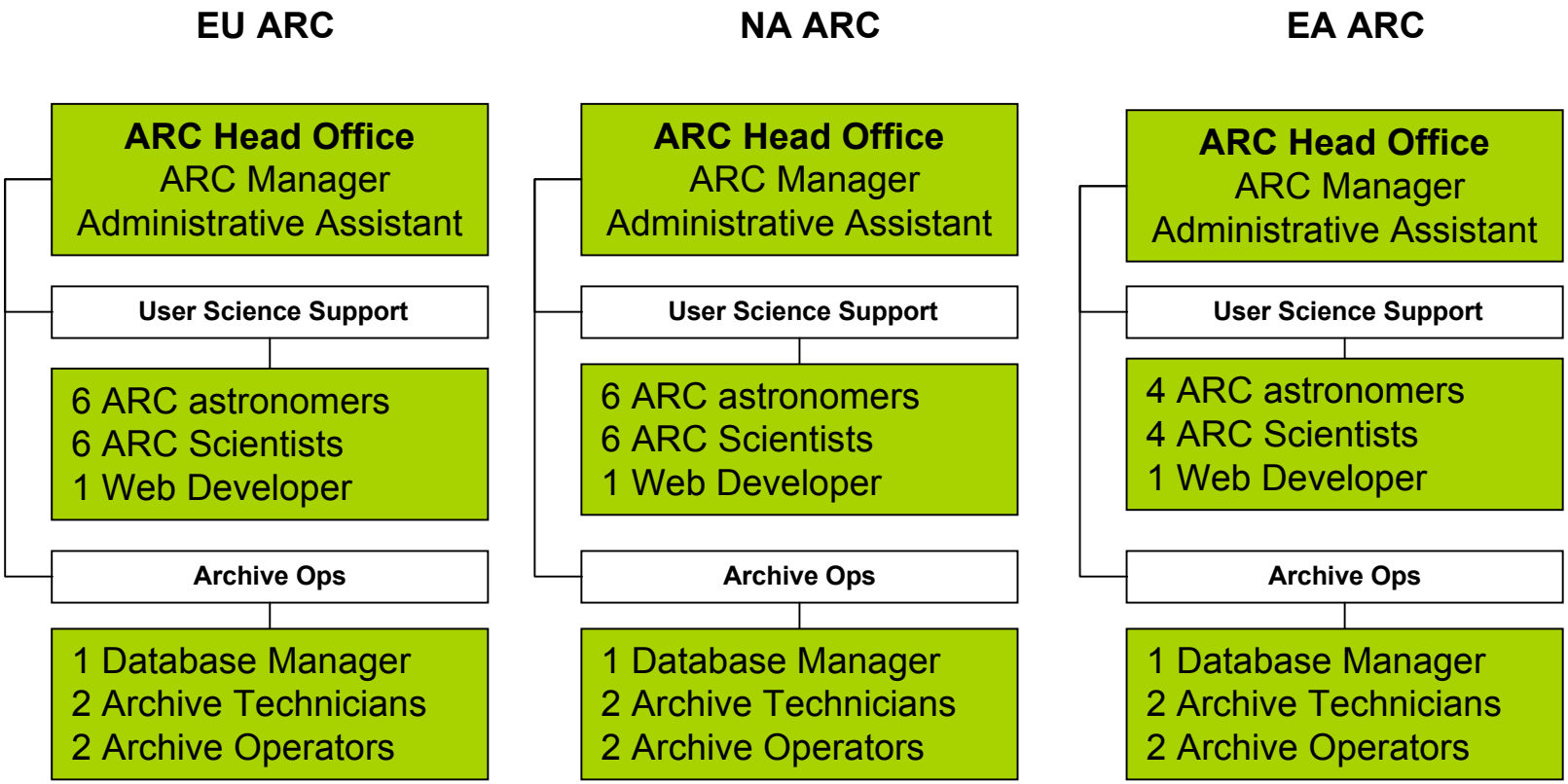


- Array operations

- Observations
- Quality assurance
- PRC support
- Web pages

- Archive and pipeline operations
- Quality assurance

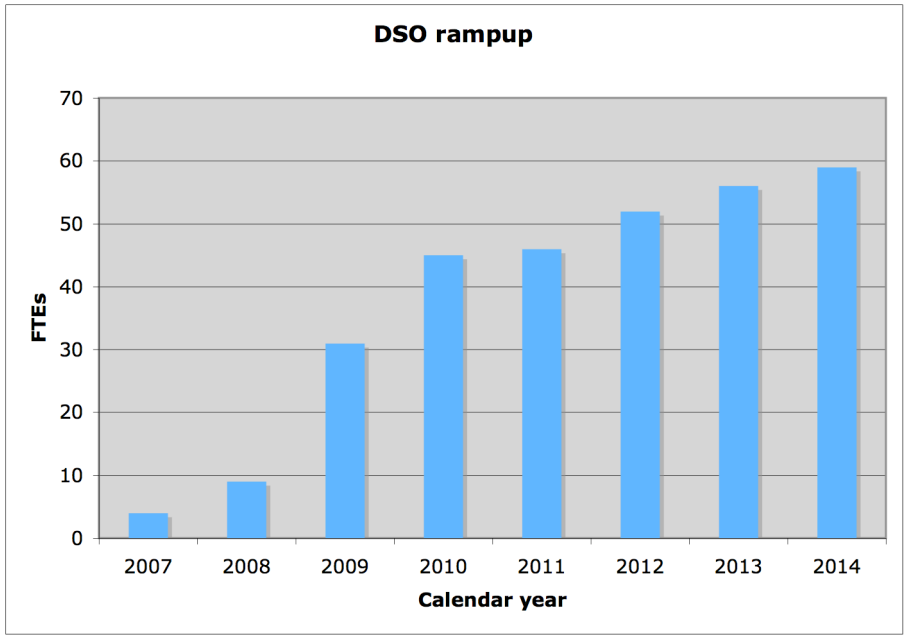
ARC staffing

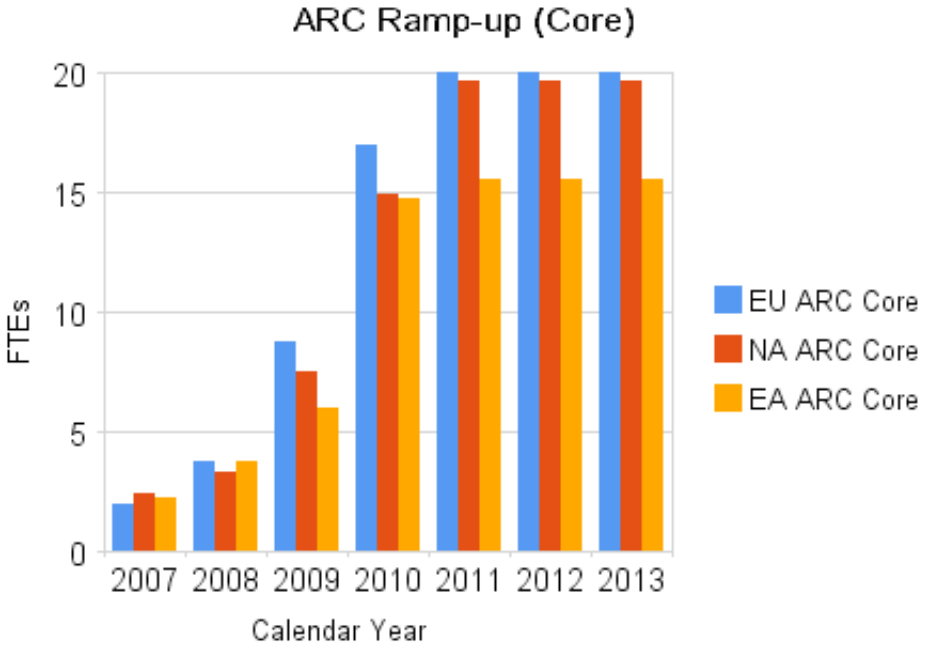


Preparations for Early Science

- Early Science will start in the second half of 2011
- 8 months before the start of Early Science the decision to go ahead with Early Science will have to be taken, and the Call for Proposals will be submitted. The following should be ready at this time:
  - Web pages and call for proposal
  - User documentation available
  - OSF and SCO archives operating
  - Help desk set up and operating
  - F2f support organized.
  - Software tools tested and operational:
    - Proposal submission tool
    - Scheduling Block preparation tool
    - Program Review Committee support tools.
    - Tools to support and keep track of observations
    - CASA data reduction tool (support for all observing modes used during early science)
  - User tutorials started (Proposal submission tool, CASA tutorials already started)

Preparations for Early Science:
Staff rampup





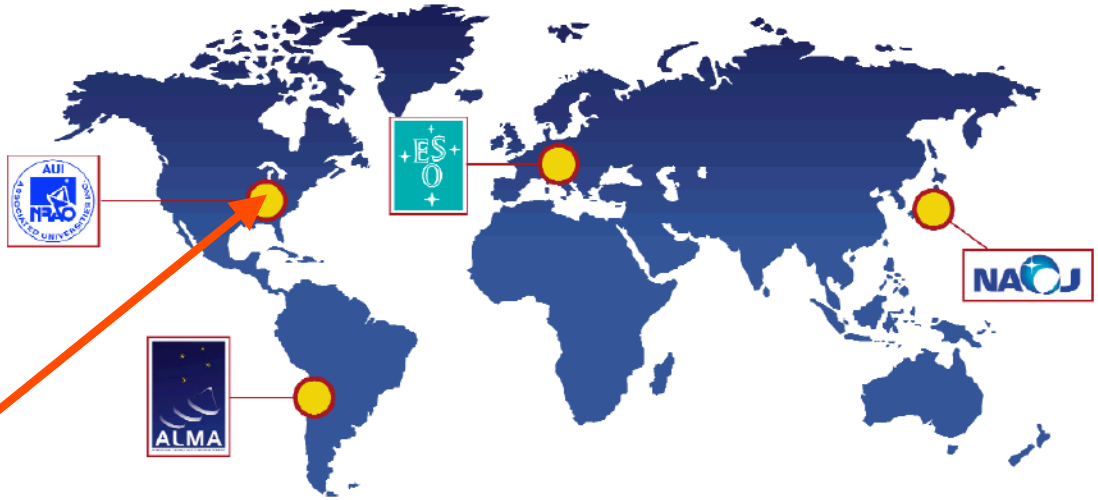
Interaction between DSO and the ARCs:
SciOpsIPT

- Members: Head of DSO, ARC Managers and Director
- First f2f meeting in September 2007
- Biweekly telecons, f2f meetings 4 times/year, wiki
- Issues:
  - Staff and recruiting
  - Production of detailed implementation plans
  - ARC commissioning activities
  - Setup of helpdesk
  - Setup of f2f user support
  - Setup of archives
  - Setup of User Portal
  - Web pages
  - Organize staff for tests of software tools

NAASC: North America ALMA Science Center in NRAO headquarters, Charlottesville, VA

The North American ARC is a partnership between the US, Canada (7.25%), and Taiwan

The NAASC is a combination of the NA ARC and US funded Full Science Support



One-stop shopping for NA-related astronomers

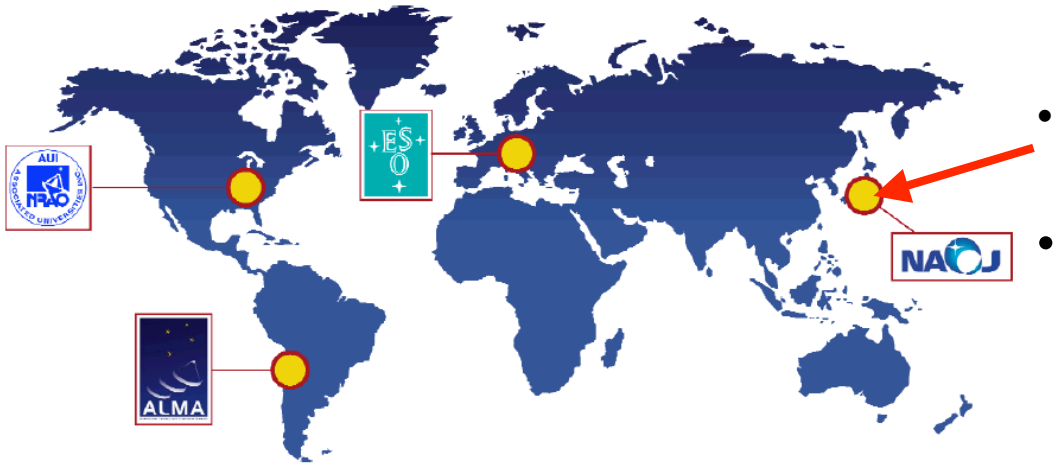
- Proposals
- Observing scripts
- Data archive and reduction

NA Non-Core Development

- Support of UVa Microfabrication Laboratory for high-frequency SIS mixer design & fabrication
- Development of “Splatalogue” spectral line catalogue
- Development of ALMA Simulator task within CASA
- Through NRAO end-to-end (E2E) division: IVO activities; NRAO data vault; user portal
- Through NRAO Office of Science & Academic Affairs (OSAA): postdoc, student & visitors programs; page-charge support, support for data reduction visits, organize and run schools/tutorials

- Scientific Workshops – venues to explore future directions for ALMA

East Asian ARC



- Located in Mitaka (at NAOJ)
- Partnership with Taiwan

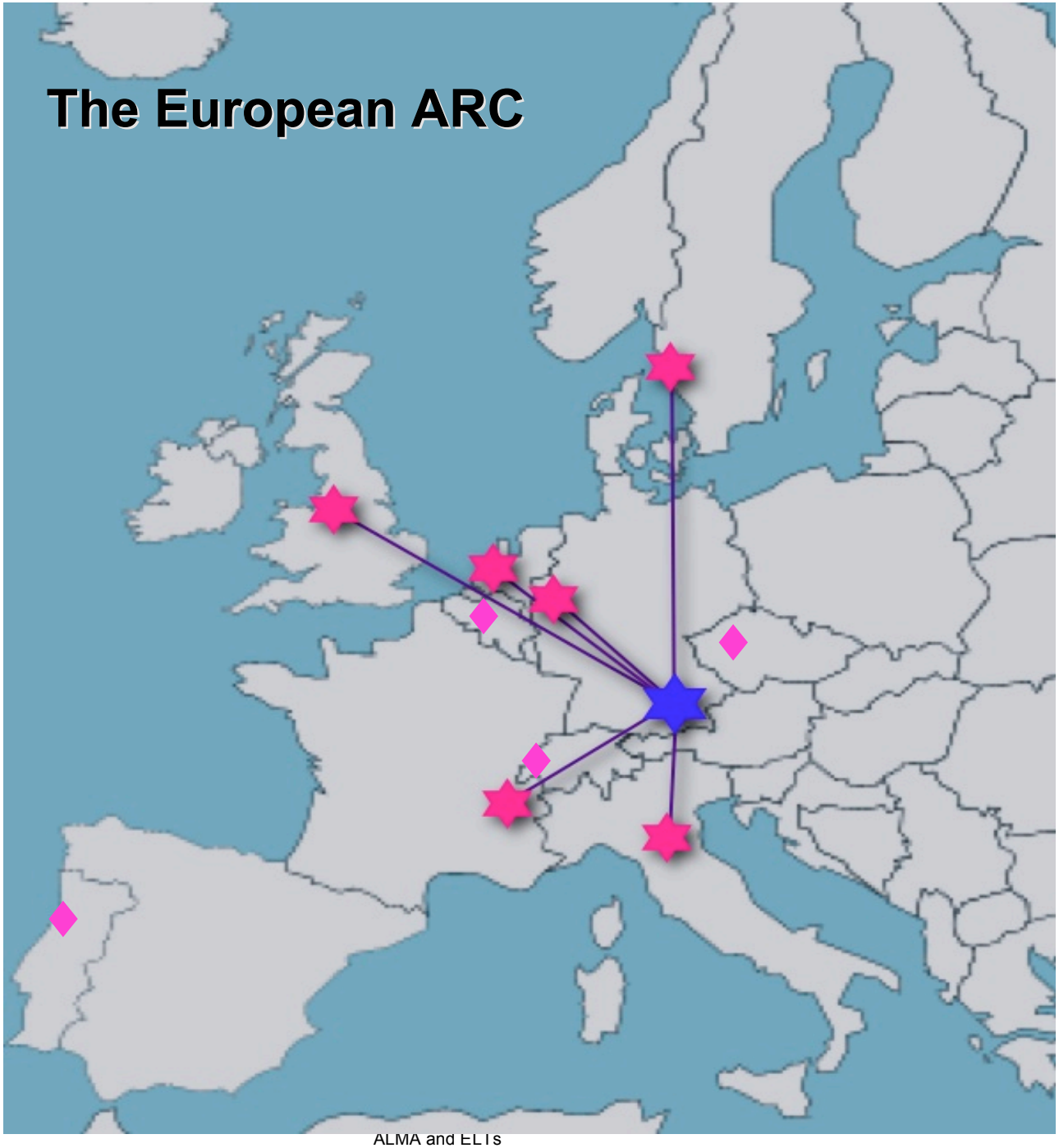
EA-ARC non-core development:

- Joint archive of ALMA, Nobeyama 45m, (SMA?)
- Data base with quality parameters for existing telescope (45m, SMA) data
- Data filler to CASA (45m, SMA, NMA)
- Laboratory molecular line database (Toyama),
  - cross-identification with other-wavelength data
  - http://www.sci.u-toyama.ac.jp/phys/4ken/atlas/
- VO—collaboration with JVO group (NAOJ)

The European ARC

★ **ARC nodes location**

♦ : express interest



The European ARC

- Core functions
  - Scientific support:
  Proposal & observation preparation
  user support
  - Archive Operations:
  host a copy, data delivery
  - Astronomer on duty at OSF
  - Science community activity
  - User support:
  f2f help

- Non-core functions
  Data reduction
  - Advanced pipeline
  - Extended archive support
  - Support for special projects
  - Science community activity:
  training, schools, workshops

ESO: ARC Department

ARC nodes

ARC nodes

ESO ARC + nodes

ALMA simulators

www.almaobservatory.org

The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership among Europe, Japan and North America, in cooperation with the Republic of Chile. ALMA is funded in Europe by the European Organization for Astronomical Research in the Southern Hemisphere, in Japan by the National Institutes of Natural Sciences (NINS) in cooperation with the Academia Sinica in Taiwan and in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC). ALMA construction and operations are led on behalf of Europe by ESO, on behalf of Japan by the National Astronomical Observatory of Japan (NAOJ) and on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI).