ALMA and Czech ARC Node

www.asu.cas.cz/alma

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ALMA Regional Centre || Czech

WHAT IS ALMA?
Atacama Large Millimeter/submillimeter Array

ALMA is the largest astronomical project build in international partnership of Europe, North America and East Asia in cooperation with the Republic of Chile. ALMA will be a telescope of revolutionary design, composed of 66 high precision antennas located on the Chajnantor plateau, 5000 meters altitude in northern Chile.

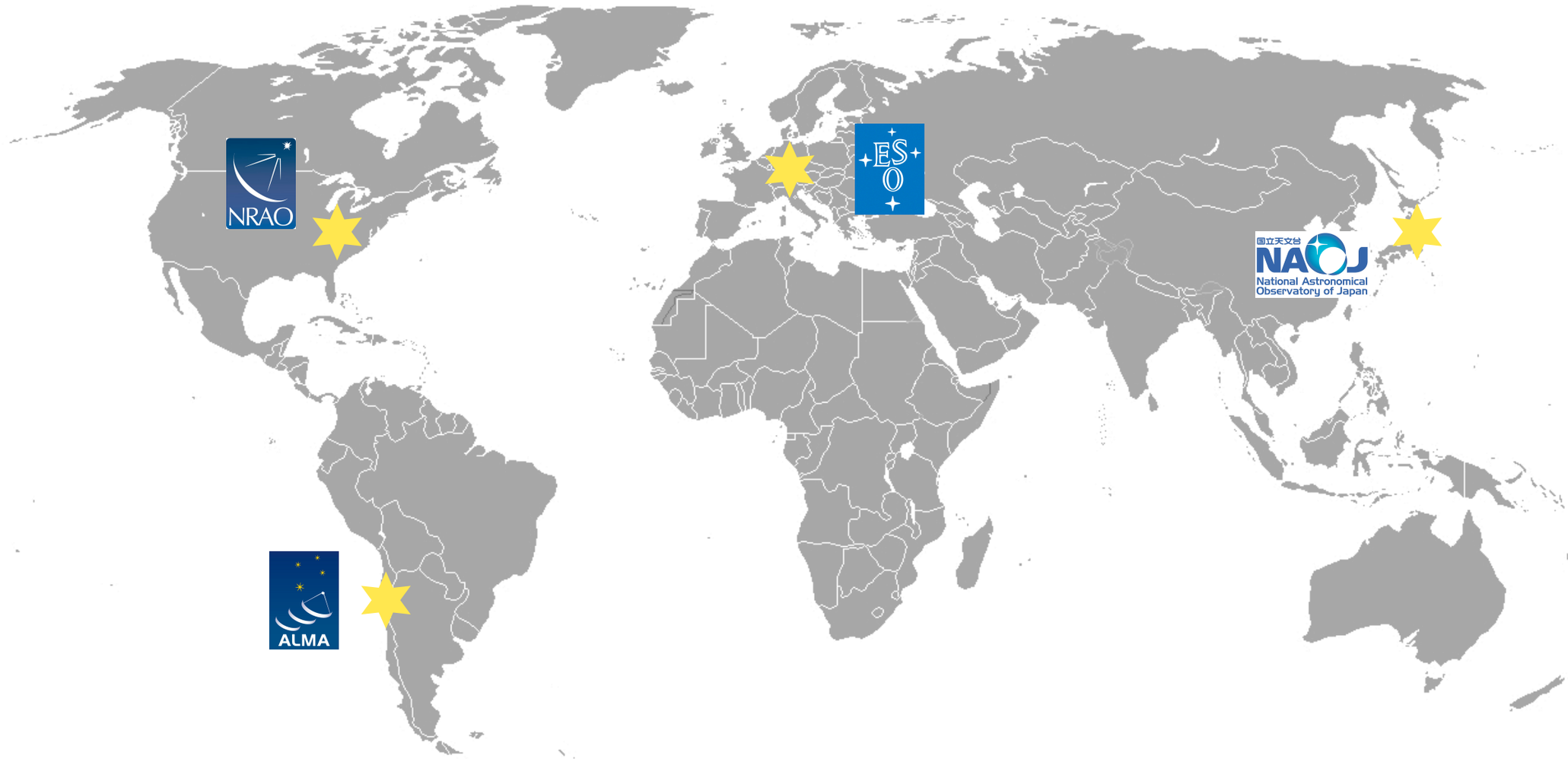
NRAO

ESO

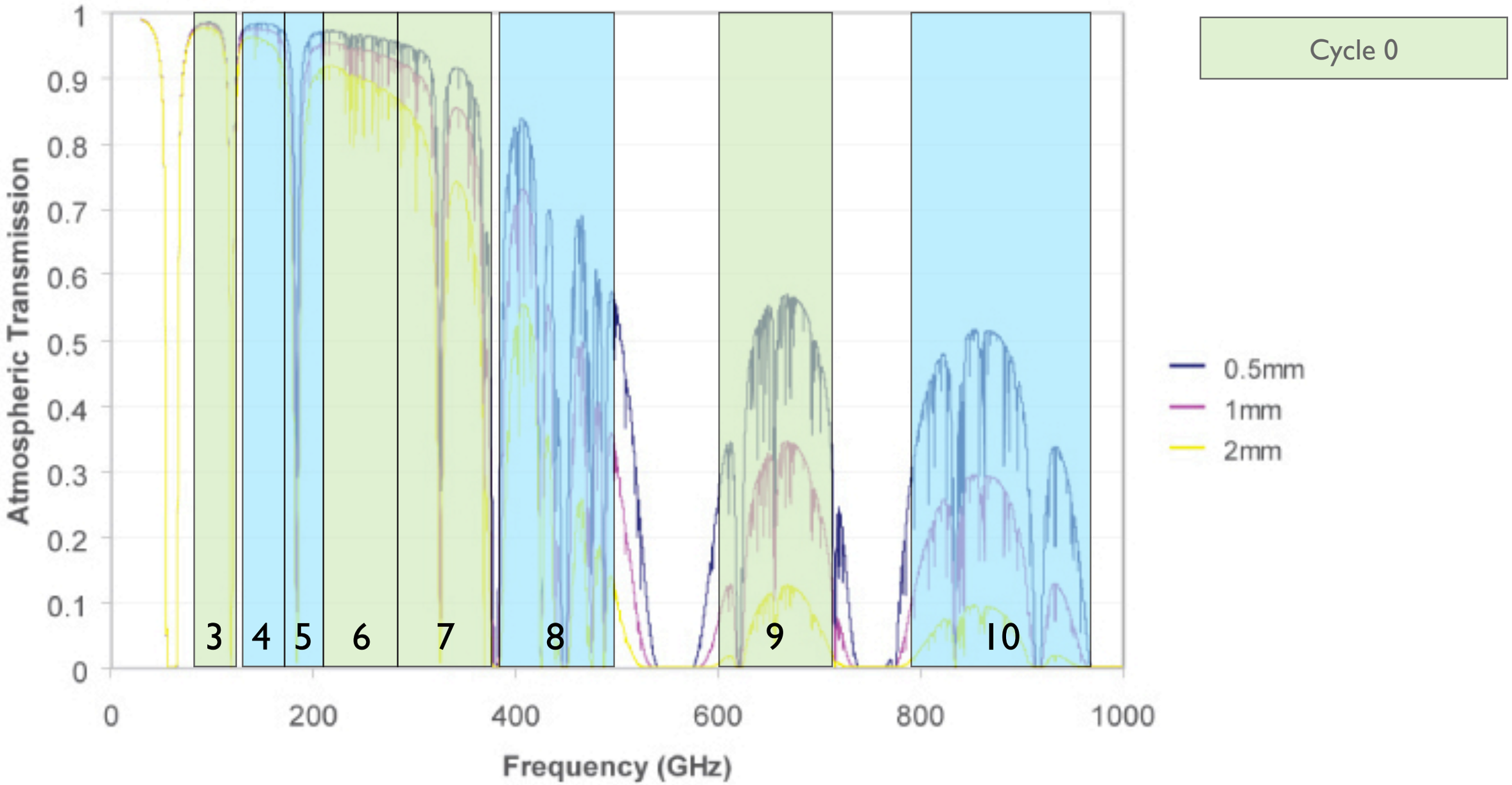
国立天文台 NAOJ
National Astronomical Observatory of Japan

ALMA Regional Centre

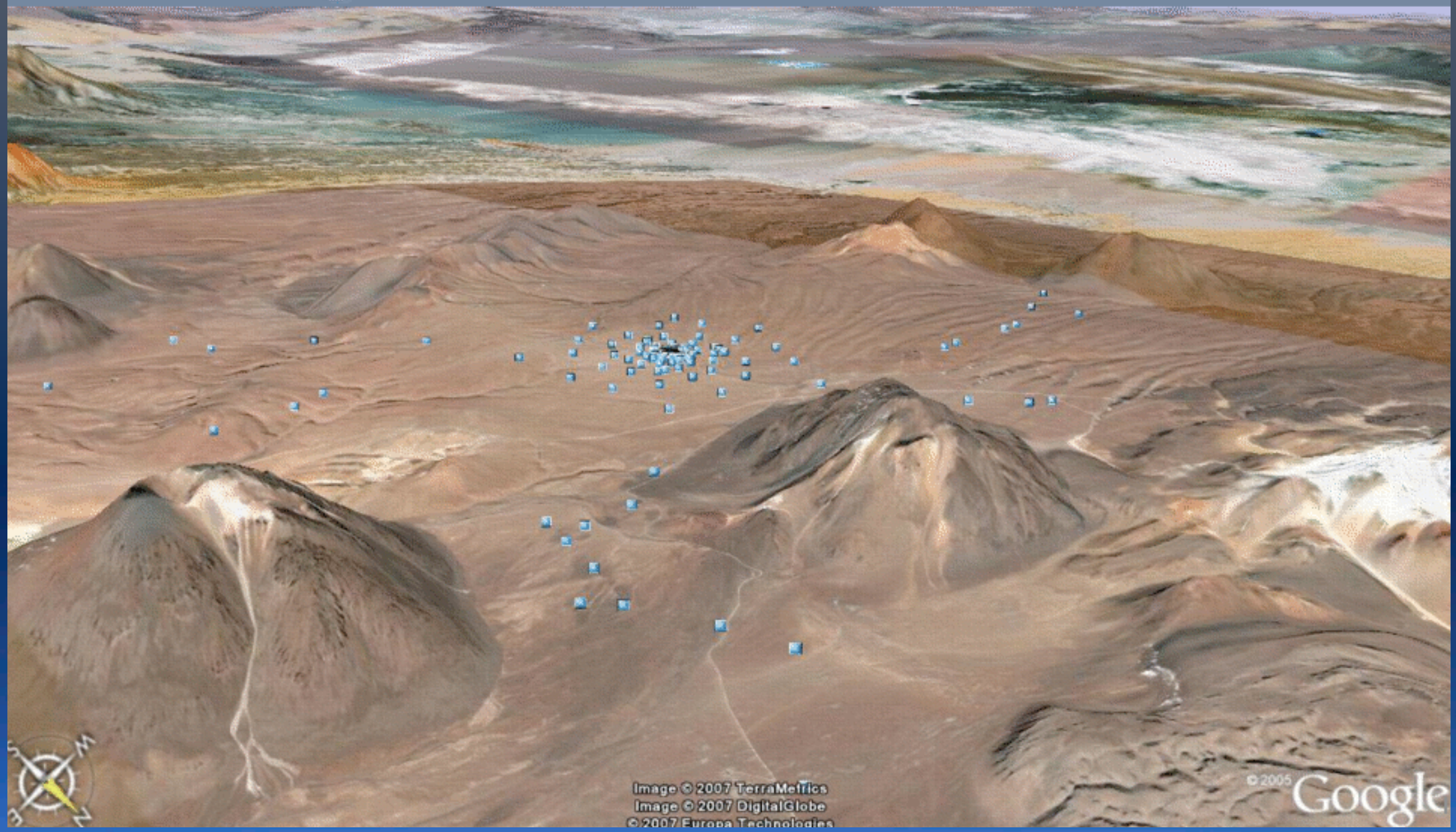
The science interface between the ALMA project and the user communities will be provided by the three ALMA Regional Centres (ARCs), in Europe, North America and East Asia.



Transparency and ALMA bands



Google-Earth view of site with antennas in the most extended configuration – baselines to 16km



Array Operation Site (AOS)

Operations Support Facility (OSF)

ALMA workers camps

Main OSF building

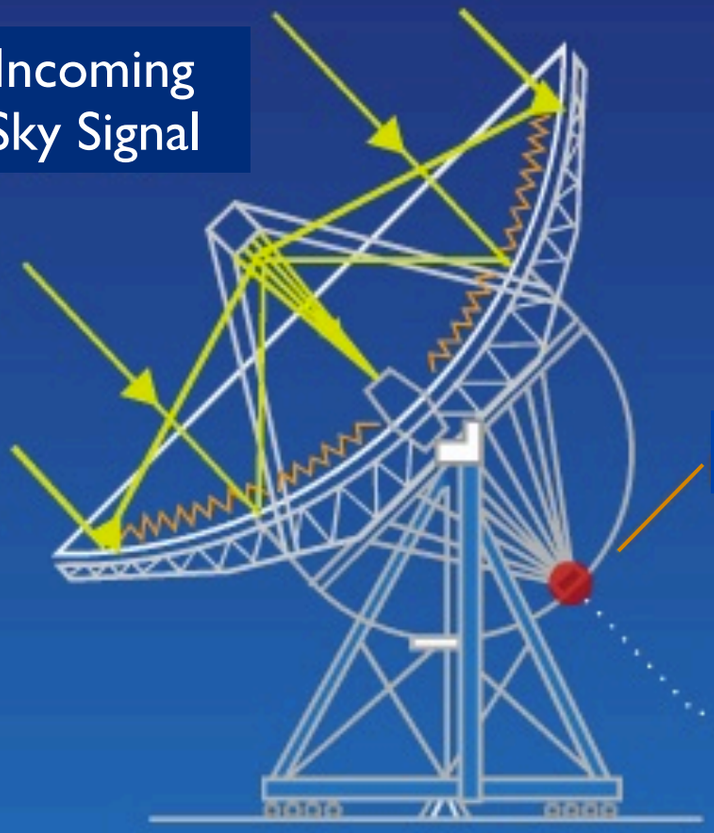
Antenna integration sites

NA

EA

EU

Incoming
Sky Signal

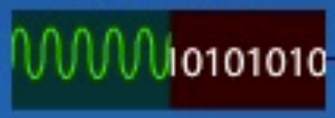


Front End

Back End

ALMA
(66 antennas)

Up to
15 km
of fibre



Analog | Digital

Array Operation Site (AOS)
Correlator

6.4 - 64
mb/s Link

Operation Support Facility (OSF)
Archive – Operations – Science

ALMA Specificatios

Number of antennas:	66
Antenna diameter:	12 m & 7 m
Antenna surface precision:	< 25 μm
Antenna pointing accuracy:	< 0.6”
Total collecting area:	> 7000 m^2
Angular resolution:	0.2” λ (mm) / baseline (km)
Configuration extent:	0.15 – 14 km
Baselines:	up to 2145
Frequency range:	31.3 – 950 GHz (10 bands)

Antennas

Vertex
(North America)
12 m

AEM
(Europe)
12 m

MELCO
(East Asia)
12 m

MELCO
(East Asia)
7 m

Science Objectives

ALMA will provide an unprecedented combination of sensitivity, angular resolution, spectral resolution, and imaging fidelity at the shortest radio wavelengths for which the Earth's atmosphere is transparent. It will provide scientists with an instrument capable of producing detailed images of the formation of galaxies, stars, planets, in both continuum and the emission lines of interstellar molecules. It will image stars and planets being formed in gas clouds near the Sun, and it will observe galaxies in their formative stages at the edge of the Universe, which we see as they were roughly ten billion years ago. ALMA will provide a window on celestial origins that encompasses both space and time, providing astronomers with a wealth of new scientific opportunities. In particular, with ALMA astronomers will:

* Image the redshifted dust continuum emission from evolving galaxies at epochs of formation as early as z=10;
* Trace through molecular and atomic spectroscopic observations the chemical composition of star-forming gas in galaxies like the Milky Way, but at a redshift z~3 in less than 24 hours of observation;
* Reveal the kinematics of obscured galactic nuclei and quasars on spatial scales smaller than 100 pc;
* Assess the influence that chemical and isotopic gradients in galactic disks have on the formation of spiral structure;

Science Objectives

* Determine the dynamics of dust-obscured protostellar accretion disks, the rate of accretion and infall from the nascent molecular clouds, the mass distribution over the disk, and the structure of molecular outflows;
* Detect the photospheres of stars in every part of the Hertzsprung-Russell diagram, and resolve the photospheres and chromospheres of giant and supergiant stars within a few hundred parsecs;
* Image the gas kinematics in protoplanetary disks around young Sun-like stars with a resolution of a few astronomical units out to a distance of 150 pc (roughly the distance to the star forming clouds in Ophiuchus or Corona Australis), enabling the study of their physical, chemical and magnetic field structures and detection of the tidal gaps created by planets undergoing formation in the disks;
* Reveal the crucial isotopic and chemical gradients within circumstellar shells that reflect the chronology of invisible stellar nuclear processing;
* Obtain unobscured, sub-arcsecond images of cometary nuclei, hundreds of asteroids, Centaurs, and Kuiper-belt objects in the solar system along with images of the planets and their satellites;
* Image solar active regions and investigate the physics of particle acceleration on the surface of the Sun.

European ARC nodes

The European ARC has the responsibility of providing scientific user support to the European astronomical community. It supports its users mainly in the areas of proposal preparation, observation preparation, data reduction, and data analysis.

The Czech ARC node

The Czech ARC node should provide regional support to applicants from countries of the Central and Eastern European region.

It will provide especially the following services:

* Scientific and technical support to ALMA users, especially:
    * Solar, galactic, extra-galactic and relativistic astrophysics.
    * Laboratory measurements of molecular spectral lines.
* Observation planning, data quality check.
* Data storage and processing, data reduction using CASA.

Czech ARC Team

Our Node is new – starting in January 2010

* **Marian Karlicky:** head, solar research
* **Miroslav Barta:** CASA, AOT, integrated tests, Imaging Group – EACIG, solar research
* **Bartosz Dabrowski:** CASA, AOT, integrated tests, Imaging Group – EACIG, solar research
* **Pavel Jachym:** AOT, integrated tests, galactic research
* **Devaky Kunneriath:** galactic centre science, radio astronomy
* **Stanislav Stefl:** stay at ESO-Paranal, Chile, stellar research
* **Michaela Kraus:** stellar radio astronomy
* **Stepan Urban:** molecular spectroscopy
* **Jiri Polach:** computers, Internet

Czech ALMA Node

List of our recent activities

* Building of new room for ALMA visitors at Astronomical Institute, Ondrejov.
* The paper titled "Solar research with ALMA" (M. Karlický, M. Bárta, B. Dabrowski, P. Heinzel) published in Solar Physics, 2011.
* Participation in several official tests of CASA, Imaging Group – EACIG and OT.
* Participation in ALMA Community Days 2011 at ESO/Garching and CASA Tutorial for ALMA, 2011 at ESO/Garching.

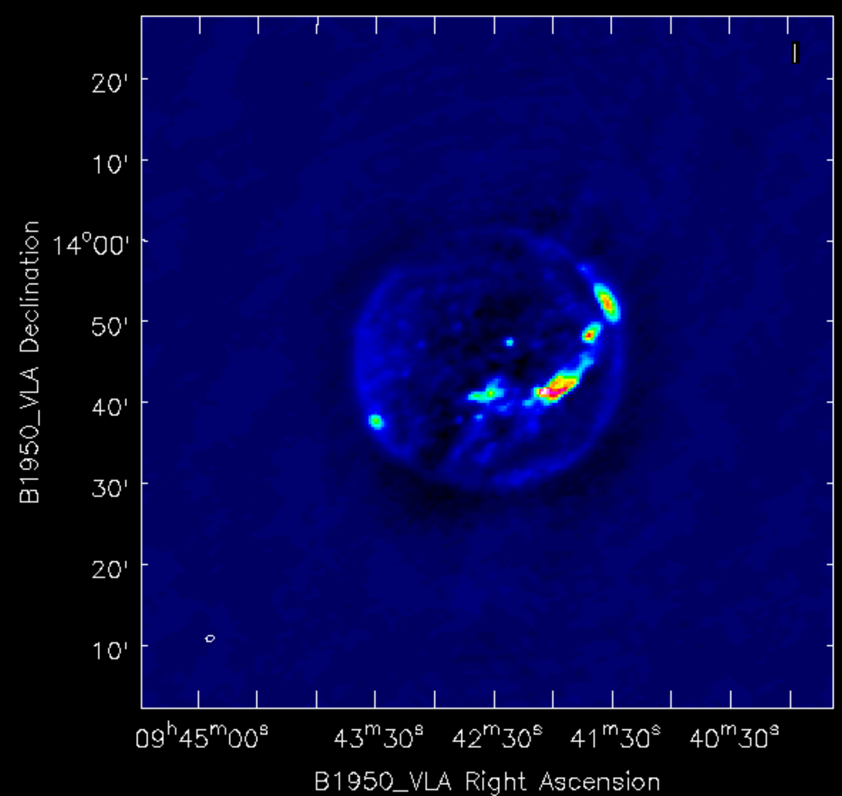
List of our recent activities

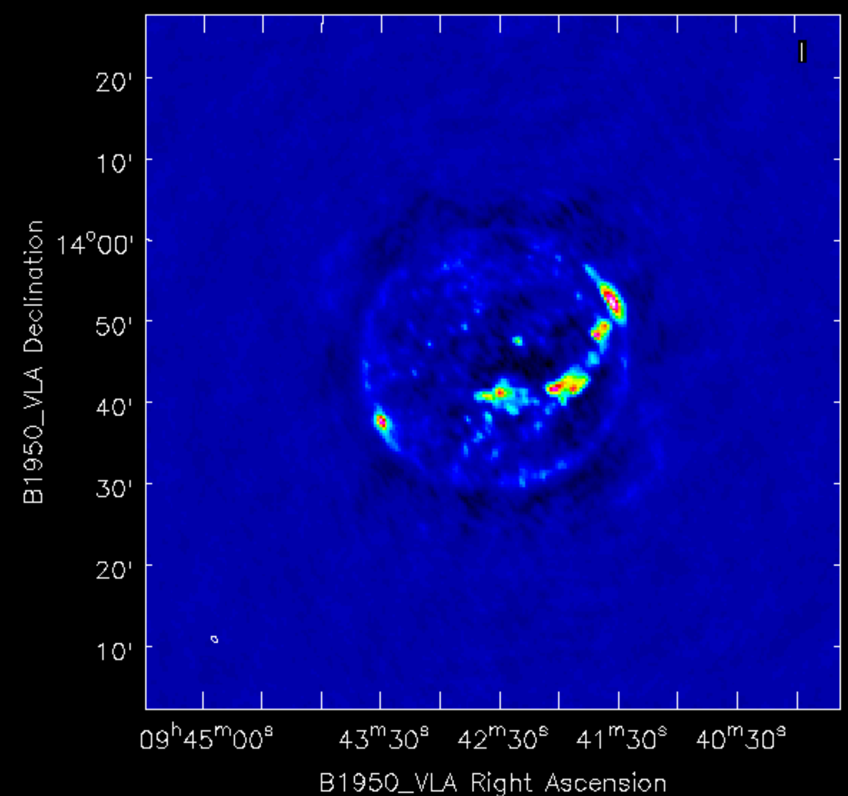
* First CASA tests using solar radio data.
* Presentation about Czech ARC node and solar research with ALMA at international conferences.
* Contact support scientist for one project of Cycle 0.
* Test of internet connection between Ondrejov – Garching.
* Local Czech ESO-ALMA node meetings.
* Local school about preparation of ALMA proposals.
* Wikipedia ALMA webpages to Czech and Polish languages.
* Papers about ALMA in Czech and Polish journal.
* Lectures about ALMA (Czech Republic, Slovakia, Poland).

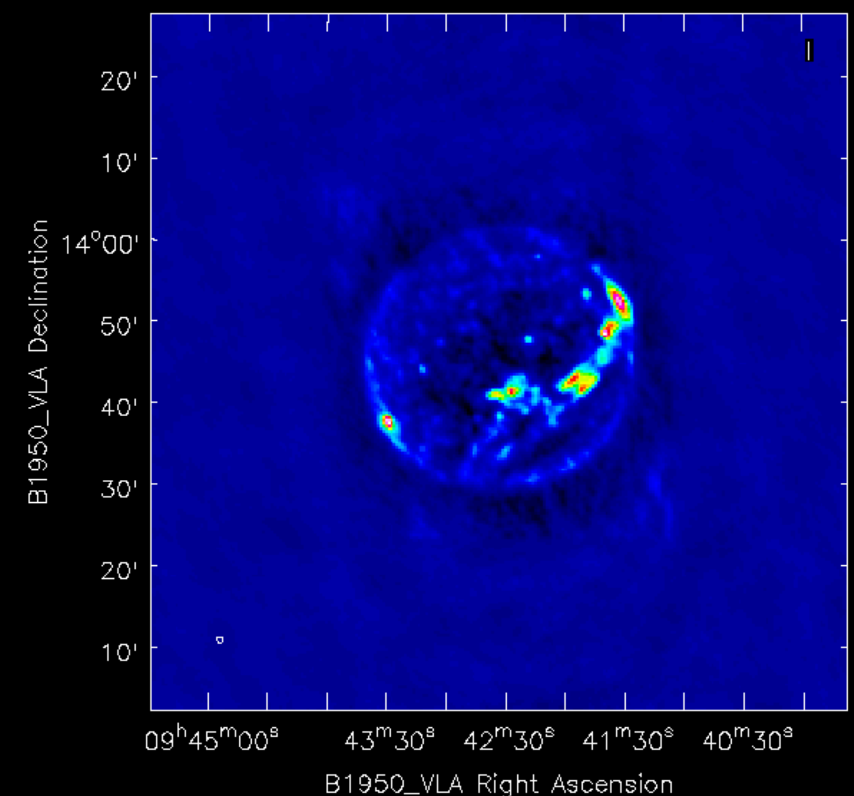
Solar continuum data at 20 cm from VLA

CASA sit-together session

October 29, 2010







Our node (present status)

* We have new office for up to 3 ALMA visitors.
* We arranged cheap accommodation for visitors in guest rooms of Astronomical Institute at Ondrejov.

Hardware

* Three PC, Linux, Intel, memory 8GB, disks 1 TB, 24" screen.

Early Science

Cycle 0

* **March 2011** – start of Cycle 0
* **June 2011**– proposal deadline
* **September 2011**– start Cycle observations

Cycle 1

* **April 2012** – start of Cycle 1
* **July 2012** – proposal deadline
* **Beginning 2013** – start Cycle observations

ALMA Early Science – Cycle 0 Capabilities

* At least sixteen 12 m antennas in the ALMA array, yielding sensitivities ~10% of the full ALMA.
* Wavelength coverage in Bands 3, 6, 7 & 9 (100 – 675 GHz).
* Two configurations, the Compact Configuration (baselines from 18 m to 125 m) and the Extended Configuration (baselines from 36 m to 400 m).

* Single field imaging, and small mosaics:

  Single pointing: field of view will be defined by the angular resolution of the single antenna.
  Pointed mosaic: max 50 points, field of view depend from frequency of observations.

ALMA Early Science Capabilities

Receiver Band	Frequency [GHz]	Angular Resolution ["]	Field of View ["]
Properties of Compact Configuration (baselines ~18 m to ~125 m)			
3	100	5.3	62
6	230	2.3	27
7	345	1.55	18
9	675	0.8	9
Properties of Extended Configuration (baselines ~36 m to ~400 m)			
3	100	1.56	62
6	230	0.68	27
7	345	0.45	18
9	675	0.23	9

ALMA Science Portal at ESO

http://almascience.eso.org/

CASA

http://casa.nrao.edu/

Observing Tool (OT)

http://almascience.eso.org/call-for-proposals/observing-tool

Phases of Proposal Submission

(1) Phase I: Proposal submission
(2) Phase II: Submission of observing program

Proposals in preparation

Project: **Triggered star formation in the Carina flare II**
PI: Jachym, P.
Co-I's: Barta, M., Palous, J., & Wunsch, R.

Project: **CO observation of ram pressure stripped Virgo dwarf IC3418**
PI: Jachym, P.
Co-I's: Barta, M., Kenney, J. D. P., & van Gorkom, J.

Project: **Structure and dynamics of the "quiet" solar chromosphere**
PI: Barta, M.
Co-I's: Karlicky, M., & Dabrowski, B.