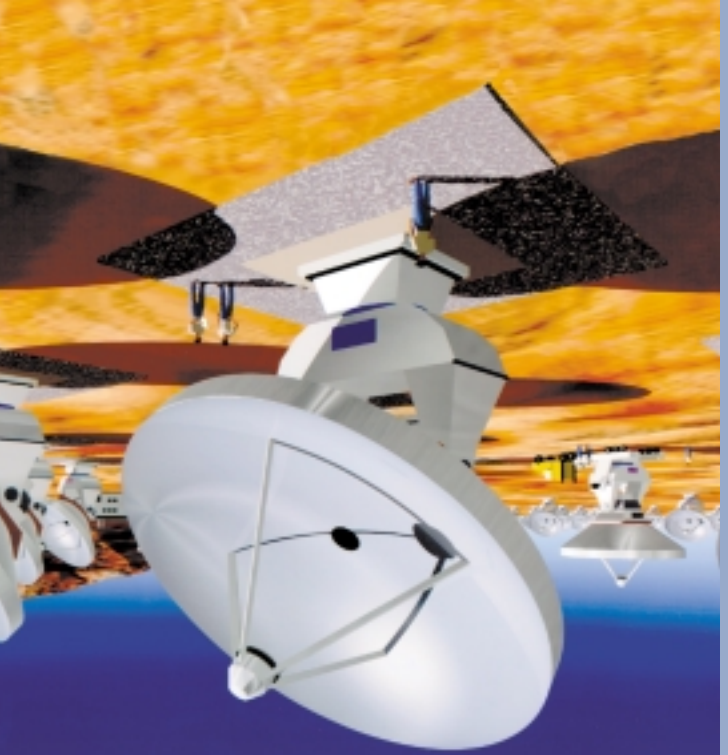


ALMA

Millimeter
Array

Atacama
Large
Millimeter
Array

The Extraordinary ALMA site

In order to make the clearest possible images from the Earth, millimeter wavelength telescopes need a dry site. That's because water vapor in the air absorbs millimeter waves. So, the drier the telescope site, the better the view.

When trying to decide "where on Earth" to build ALMA, scientists considered sites in New Mexico, Arizona, Hawaii, and Chile. Extensive tests showed that the sky above the Atacama Desert of Chile has the unsurpassed clarity and stability essential for ALMA. That is why ALMA will be built there at 16,500 feet elevation (more than 3 miles high) in the "foothills" of the Andes.

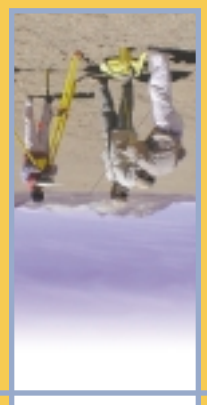
Visit us!

You don't have to go to South America to visit ALMA.
Find us on the web at
http://www.alma.nrao.edu
http://www.eso.org/projects/alma
http://www.nro.nao.ac.jp/~lmsa/index.html

If you have questions about ALMA, write to us at
almainfo@nrao.edu

Fast facts

- ALMA is an array of 64 telescopes that will work together as a single instrument; each antenna's dish is 12 meters (39 feet) wide.
- The telescopes that make up ALMA will help us learn about stars, galaxies, and other objects in the universe by collecting the millimeter wavelength "light" they emit.
- Astronomers won't look through the telescopes. Instead, electronic detectors and computers will take the millimeter wavelength signals the telescopes collect and turn them into pictures of the objects in space from which scientific information is extracted.
- The superconducting receivers inside the ALMA antennas will operate at just four degrees above absolute zero (about –270° Celsius); this technology means ALMA will be the biggest superconducting electronics system in the world.
- The 64 ALMA antennas will be arranged in the shape of a spiral. Each individual antenna can be moved, so the shape of the array can be changed. This will give ALMA a "zoom-lens" capability. At its largest, the array will be 14 kilometers (10 miles) wide; at its smallest, only 150 meters (500 feet).
- ALMA will be built in Chile's Atacama Desert, some parts of which have had no recorded rainfall in over 400 years. This makes it a superb site for millimeter astronomy, which requires a dry sky.
- ALMA is a partnership among the United States, Europe, and Japan – making ALMA a truly global astronomical project.
- When ALMA is completed (by 2011), it will be the largest and most capable imaging array of telescopes in the world.
- The ALMA correlator (the specialized computer that will combine the information received by all 64 ALMA antennas) will perform 16,000 million-million (1.6 x 10^{16}) operations per second. That is equivalent to millions of today's fastest personal computers, all working together.



(NRAO/AUI photo by Bryan Butler)

Using the Global Positioning System to mark a location at the ALMA site.

ALMA:
Imaging
Cosmic
Dawn

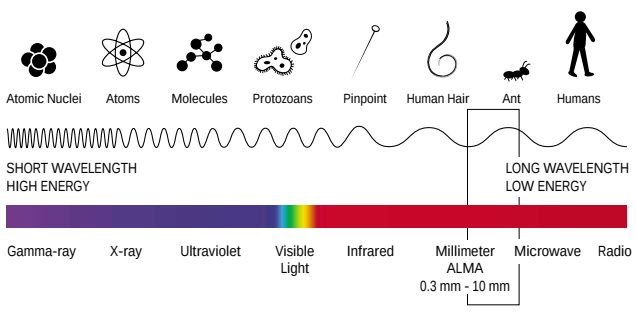
What is ALMA?

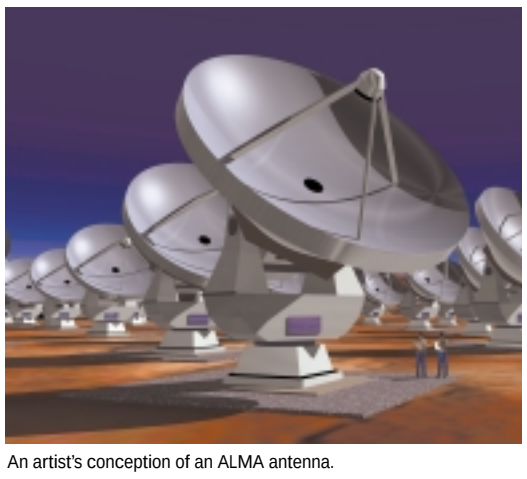
The Atacama Large Millimeter Array (ALMA) is a group of 64 radio-telescope antennas that will work together to study the universe from a high mountain site in the Atacama Desert of Chile. The ALMA antennas will collect the millimeter wavelength "light" given off by cool objects like the gas and dust near stars and galaxies.

ALMA is funded by an international partnership among the United States, Europe, and Japan. It may include more countries in the future.

What is millimeter wavelength astronomy?

Objects that astronomers study, like stars and galaxies, give off many different kinds of light in addition to visible light. Some examples of these are radio waves, infrared waves, X-rays and gamma rays. But most of the energy in the universe is present in the millimeter portion of the spectrum. The millimeter waves that carry this energy are more energetic than radio waves, and less energetic than infrared waves (see diagram below). Until now, this abundant millimeter wavelength "light" has not been studied with the crisp resolution that ALMA will provide.



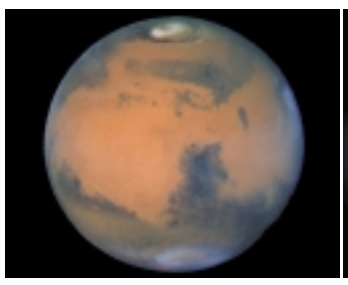


(ESO)

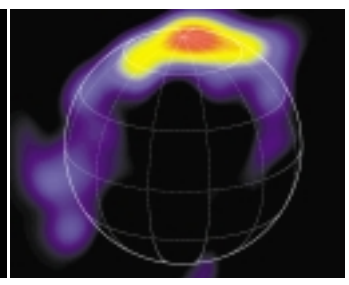
An artist's conception of an ALMA antenna.

What will ALMA study?

- Cosmology – the age of the universe, its size and structure
- The formation of galaxies (like the Milky Way) at the earliest times in cosmic history
- New planets forming around young stars in our Galaxy
- The birth of new stars in spinning clouds of gas and dust
- The Sun, planets, comets and asteroids of our solar system



Mars in visible light, as seen by the Hubble Space Telescope.
(STScI/NASA)



Viewing Mars at millimeter wavelengths reveals heavy water in the planet's atmosphere.
(OVRO image by Mark Gurwell)

How will ALMA work?

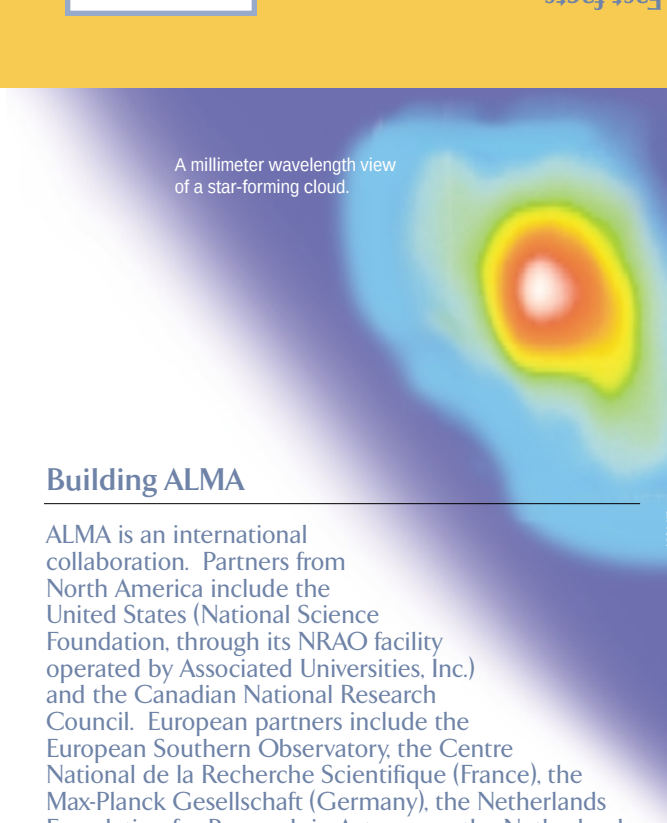
Cosmic millimeter waves are reflected from the surface of each dish up to the subreflector above the dish's center. From there they are guided down into a receiver inside the telescope. There the signals are digitized and sent along underground fiber-optic cables to a large signal processor in the control building. This specialized computer, called a correlator, will combine all of the data from the 64 antennas to make a super-sharp image.

Who will use the telescope?

Scientists from all over the world will use ALMA. They will compete for observing time by submitting proposals, which will be judged by a group of their peers on the basis of scientific merit.

A High Priority

Both in 1991 and 2000, committees of the U.S. National Research Council (the operating arm of the National Academies of Sciences and Engineering) endorsed ALMA as one of the highest priority new observatories to be built. Similar committees in such ALMA partner countries as Canada, the United Kingdom, France, and the Netherlands have stated that they too view the construction of ALMA with priority.

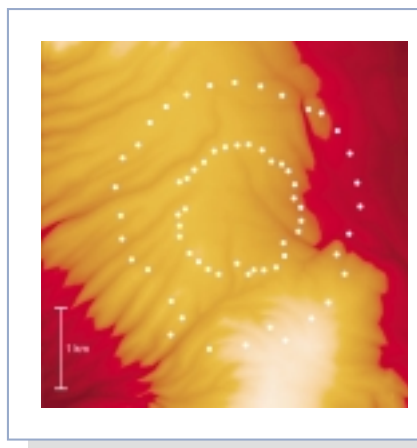


A millimeter wavelength view of a star-forming cloud.

(JCMT)

Building ALMA

ALMA is an international collaboration. Partners from North America include the United States (National Science Foundation, through its NRAO facility operated by Associated Universities, Inc.) and the Canadian National Research Council. European partners include the European Southern Observatory, the Centre National de la Recherche Scientifique (France), the Max-Planck Gesellschaft (Germany), the Netherlands Foundation for Research in Astronomy, the Netherlands Onderzoekschool Voor Astronomie, the United Kingdom Particle Physics and Astronomy Research Council, Instituto Geográfico Nacional and Ministerio de Ciencia y Technología (Spain) and the Swedish Natural Science Research Council. Japan is a partner in ALMA through the National Astronomical Observatory of Japan. Chile, as host nation for ALMA, participates in the project through its presence on the ALMA Coordinating Committee and by making available the superb astronomical site in the Atacama Altiplano.



A possible arrangement of the 64 ALMA antennas, shown on a topological map of the site. Darker areas (red) are at lower elevation; lighter areas (yellow, white) are at higher elevation. Most of the antennas are located on a high ridge.
(NRAO/AUI)

The Atacama Large Millimeter Array (ALMA)

(NRAO/AUI photo by Simon Radford)

The Atacama Large Millimeter Array (ALMA) Site.
Atacama Desert, Chilean Andes.

(ESO)