The Atacama Large Millimeter Array, ALMA, is an astronomical telescope designed to provide clear and detailed images of the formation of galaxies, stars and planets. ALMA will efficiently detect the light at millimeter and submillimeter wavelengths (wavelengths 1000 times greater than visible light) that is emitted by gas and dust in the process of forming a new object in the heavens. In addition to revealing the physics of star, planet and galaxy formation, ALMA will reveal the chemical composition of the forming objects; it will show us whether the organic chemical precursors to life are present. Owing to the enormous distance across the universe, ALMA allows us to step back in time and explore galaxies in formation as they were billions of years ago.

ALMA is a *synthetic aperture* telescope, a single telescope made up of 64 individual radio antennas or *dishes* each 12 meters (39 feet) in diameter. Each antenna is transportable so that the antenna configuration can be expanded to as large as 15 kilometers (10 miles) or contracted to as small as 150 meters (500 feet). This gives ALMA a *zoom lens* capability.

What are the Key Technologies?

- ALMA antennas are the most precise, open air, radio antennas ever built
- Receivers are based on superconducting heterodyne detectors operating at 4 degrees above absolute zero; ALMA is the biggest superconducting electronics system in the world
- ALMA images are formed by digital processing of the received data at a rate of 16,000 million-million (1.6×10^{16}) operations per second

Where is ALMA to be Located?

In the Altiplano of northern Chile at 5000 meters (16,500 ft) elevation. The site accommodates the large, 10 mile diameter, array configuration and is above most of the water in the atmosphere that degrades ALMA's imaging capability. It is the highest, driest, observatory site in the world.

What will ALMA cost?

The United States share of ALMA is $276M; Europe, as an equal partner, will provide an equal share of the cost.

How does ALMA Compare with the new Space and Ground-based Telescopes?

ALMA is the scientific complement to new optical/IR telescopes on the ground and in space. The gas and dust that envelops young stars and galaxies is opaque to visible light. But that gas and dust envelope is translucent to the light at millimeter wavelengths studied by ALMA. Scientists using ALMA may image either the gas/dust shroud to explore the matter building the new star or galaxy, or they may peer through that veil to image the young object itself. ALMA and the new optical/IR telescopes provide scientists with a complete picture.

How will ALMA be Built and Operated?

In the U.S. ALMA is a key project of the National Science Foundation (NSF). Responsibility for ALMA construction and operations will be assigned to the National

Radio Astronomy Observatory (NRAO), a NSF facility that is operated under Cooperative Agreement by Associated Universities, Inc. (AUI). AUI/NRAO also operates the Very Large Array, the Very Long Baseline Array, and the Robert C. Byrd Green Bank Telescope on behalf of the NSF in support of the research endeavors of U.S. scientists and students.

ALMA:
An International Partnership

Two Partners:

1. The North American Coalition of the following:

- U.S. National Science Foundation
- National Research Council of Canada

2. European coalition of the following:

- European Southern Observatory
- *France:* Centre National de la Recherche Scientifique
- *Germany*: Max-Planck-Gesellshaft
- *Netherlands*: Foundation for Research In Astronomy/Nederlandse Onderzoekschool voor Astronomie
- *Spain:* Officina de Ciencia y Tecnologia and the Instituto Geografico
- *Sweden:* Natural Science Research Council
- *United Kingdom:* Particle Physics And Astronomy Research Council