RevMexAA (Serie de Conferencias), **35**, 265–266 (2009)

THE ALMA PROJECT

L.-Å. Nyman, on behalf of the ALMA Project[1,2]

RESUMEN

El Gran Arreglo milimétrico y submilimétrico Atacama (ALMA) es un telescopio internacional que se encuentra en construcción en el desierto de Atacama al norte de Chile y que operará en las longitudes de onda milimétricas de radio. ALMA estará situado a una altitud de 5000 m. lo cual brinda una excelente transmisión atmosférica en el intervalo de longitudes de onda intrumentales entre 0.3 y 9 mm. ALMA estará formado por 2 componentes observacionales: un arreglo principal de hasta 50 antenas de 12 metros de diámetro colocadas en múltiples configuraciones, abarcando un intervalo entre 0.15 y 18 km, así como un conjunto de 4 antenas de 12 m de diámetro y 12 antenas, cada una de 7 m, operando en un arreglo compacto. Dos correladores digitales flexibles proveerán mediciones del contínuo así como de líneas espectrales con alta sensibilidad y doble polarización en el ancho de banda de 8GHz. Para la longitud de onda más corta y la configuración más extendida, la resolución angular de ALMA será de $0.005''$. El intrumento utilizará mezcladores superconductores (SIS) para brindar la menor contribución posible de ruido en la recepción, así como un radiómetro de vapor de agua de propósito especial para permitir la calibración de la distorsión de fase atmosférica. Las primeras observaciones científicas se esperan en el año 2010 y el arreglo estará completamente operacional en 2012.

ABSTRACT

The Atacama Large Millimeter/Submillimeter Array (ALMA) is an international millimeter-wavelength radio telescope under construction in the Atacama Desert of northern Chile. ALMA will be situated on a high-altitude site at 5000 m elevation which provides excellent atmospheric transmission over the instrument wavelength range of 0.3 to 9 mm. ALMA will be comprised of two key observing components a main array of fifty 12 m diameter antennas arranged in a multiple configurations ranging in size from 0.15 to 18 km, and a set of four 12 m and twelve 7 m antennas operating in a compact array 50 m in diameter (known as the Atacama Compact Array, or ACA), providing both interferometric and total-power astronomical information. High-sensitivity dual-polarization 8 GHz-bandwidth spectral-line and continuum measurements between all antennas will be available from two flexible digital correlators. At the shortest planned wavelength and largest configuration, the angular resolution of ALMA will be $0.005''$. The instrument will use superconducting (SIS) mixers to provide the lowest possible receiver noise contribution, and special-purpose water vapor radiometers to assist in calibration of atmospheric phase distortions. Early science observations are expected in 2010, with full operations in 2012.

Key Words: telescopes

1. ALMA SCIENCE

The ALMA Project will provide scientists with an instrument uniquely capable of producing detailed images of the continuum and in spectral lines of the formation of galaxies, stars, planets and of the chemical precursors necessary for life itself. ALMA will be an appropriate successor to the present generation of millimeter-wave interferometric arrays. It will complement telescopes such as the Very Large Telescope, Gemini, Subaru and the future James Webb Space Telescope with its ability to image dust enshrouded objects or cold molecular material.

2. THE SITE

ALMA is located on Chajnantor at an altitude of about 5000m in the Atacama Desert of northern Chile. The site is high and dry with a typical amount of precipitable water vapor of less than one millimeter, which produces excellent atmospheric transmission in the mm and submm wavelength ranges covered by ALMA instrumentation (see Figure 1).

3. CONSTRUCTION

The construction of ALMA began in 2002 with site development and hardware/software development in the partner institutes. Japan formally joined ALMA in 2004, bringing additional resources to develop the Atacama Compact Array (ACA). ALMA

[1]ALMA, El Golf 40, Piso 18, Las Condes, Santiago, Chile (lnyman@alma.cl).

[2]More ALMA information can be found at: `www.alma.info`

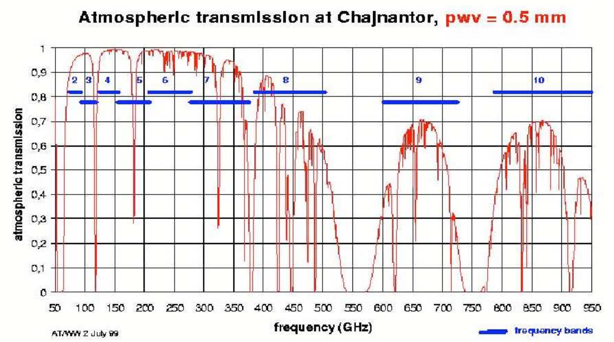

Fig. 1. Atmospheric transmission at Chajnantor at a precipitable water vapor level of 0.25 mm. The ALMA receiver bands are indicated.

Fig. 2. An artist's conception of the most compact configuration of ALMA, including ACA (photo courtesy ESO).

Fig. 3. The ALMA Technical Building on Chajnantor.

Fig. 4. A Mitsubishi antenna undergoing holographic surface measurements.

has two key observing components: an array of up to sixty-four 12 m diameter antennas arranged in multiple configurations ranging in size from 0.15 to $\sim$16 km, and the ACA four 12 m and twelve 7 m antennas operating in closely-packed configurations $\sim$50 m in diameter (see Figure 2). Up to ten receiver bands will be installed in each antenna, covering all mm and sub-mm atmospheric windows between 9 and 0.3mm. High-sensitivity, dual-polarization 8 GHz-bandwidth spectral-line and continuum measurements between all antennas will be available from two flexible digital correlators.

The antennas are connected to the correlators through a complex optical fiber network, transmitting digitized astronomical signals. The two correlators are located in the Technical Building on Chajnantor (Figure 3). Array operations and archiving of the data from the correlators will take place in the Operations Support Facility (OSF) situated approximately 30 km away at an altitude of 2800 m. Instrument and major antenna maintenance will also take place in the OSF. The ALMA central archive will eventually be located in the ALMA offices in Santiago and data will be transferred through a high-speed network.

The first six antennas have arrived to the OSF where they are being assembled and tested (Figure 4). The two antenna transporters will arrive to Chile in early 2008, the Japanese correlator is being installed in the Technical Building, the OSF buildings will be ready for acceptance during early 2008, and tests of the first production receivers are underway.

4. SCIENCE OPERATIONS

The astronomical community will interface with ALMA through the ALMA Regional Centers (ARCs) located in the US, Europe and Japan. The ARCs will provide the scientific portals for the use of ALMA. They will operate mirror archives, deliver data to the end-user, and provide tools and assistance for proposal preparation and submission, observing preparation, image processing and analysis of the astronomical data. A primary goal for ALMA is to produce an easy-to-use system, allowing the involvement of a diverse research community.