

Groundbreaking for the ALMA Project

On November 6, 2003 at the site of the future Operations Support Facility (OSF) for ALMA at an altitude of 9600 feet, ground was broken by ALMA Director Massimo Tarengi, NSF Division of Astronomical Sciences Director Wayne van Citters and ESO Council President Piet van der Kruit at a ceremony attended by dozens of distinguished guests. Only a little more than 30 years after the first detection of interstellar CO by the NRAO 12m telescope, construction of ALMA, a telescope capable of detecting the first CO molecules in the Universe, had begun.



Figure 1 Flags of the ALMA participant countries fly beside the new road to the array site, which lies Cerro Negro (background).

Some 50 special guests in a convoy of 17 vehicles participated in a Site visit on the previous day, the largest crowd of visitors so far. All remained well during the trip indicating that the site is quite accessible to the uninitiated when adequate precautions, such as the use of the provided bottled oxygen, are taken.

From around the world and from across Chile, guests began to arrive just before noon on the newly constructed ALMA road from Chilean highway 23 between San Pedro de Atacama and Toconao through the OSF site to the 16,500 foot Llano de Chajnantor, the site of the ALMA telescopes. Guests mingled in the stunning weather, meeting newcomers near a display of the flags of the ALMA participant nations. As one approached the splendid white tent, the center of

festivities, members of the press interviewed the various ALMA principals. Far below, the vista extended for dozens of miles, dominated by the great Salar de Atacama stretched along the horizon to the village of San Pedro. In the foreground, the temporary camps for construction workers and ALMA personnel were already in place. Peering over the northern horizon, the upper reaches of Licancabur dominated the skyline. Up the mountain, the new ALMA road wound through the rocky landscape beside Cerro Negro toward the high site. Slowly guests made their



Figure 2 Local Atacamenan music provided a festive atmosphere.

way toward the tent, sampling refreshments along the way. Cries of 'Hola!' rang out as arriving old friends greeted one another to the sounds of Atacameñan music.

By a quarter past twelve, most had arrived at the tent to seek their assigned tables. Each table had been given the name of a Chilean wildflower; a photo marked each. Thus familiarized with the local flora, guests met their tablemates and took their seats. At each place lay a mysterious dark felt bag. Projected high above the speakers was the new ALMA logo--a Southern Cross above an array of radio telescopes. Event organizers and Masters of Ceremonies Daniel Hofstadt and Eduardo Hardy (ESO and AUI/NRAO representatives in Chile respectively) introduced an array of speakers.

Leading off, ESO Council President Piet Van der Kruit outlined the scientific promise of ALMA. "We are children of the Universe. Actually, we are children of the Universe in a very strict sense. Look at our bodies. By weight we are made

up of about a quarter or so of hydrogen. The rest is in other chemical elements, of which carbon, nitrogen and oxygen are the major contributors. In contrast, the Universe, when it was about three minutes old and sufficiently cool that atomic nuclei could exist, consisted of three-quarters of hydrogen and one quarter of helium. There was no carbon, no nitrogen, no oxygen or any other chemical element except a trace of lithium and boron. We now know that the chemical elements that make up most of our bodies were formed by nuclear reactions in heavy stars that live for a very short while and blow themselves up as supernovae and release the heavy elements into the interstellar gas so that new planets and possibly life can be formed. We are stardust. In spite of progress in the twentieth century, such as understanding nucleosynthesis, there are still fundamental questions left. Some important ones among these are the following. When and how did galaxies form and in what way did early star formation and chemical enrichment take place? How do planets form around young stars? To completely solve all aspects of these and other problems we absolutely need to be able to observe at millimeter and sub-millimeter wavelengths.”



Figure 3 Dr. Lo addresses the participants in the Groundbreaking ceremony.

Building on the theme of international cooperation, Director of the Division of Astronomical Sciences of the National Science Foundation of the U. S. Wayne van Citters delivered a message from Rita Colwell, the Director of NSF. In her message, Dr. Colwell said: “The plateau where ALMA's antennae will rise is one of the most starkly beautiful places on Earth. It's not enough for the scientific community to identify an outstanding site for astronomy; we rely also on the generosity and cooperation of a willing host. Chile has a long history of opening regions of exceptional scientific merit to the world community. The Atacama

Large Millimeter Array will expand our vision of the universe with "eyes" that pierce the shrouded mantles of space through which light cannot penetrate. ALMA's 64 radio telescopes will serve as windows through which scientists and the curious public will "see" back in time and far away, to where the earliest and most distant galaxies were forming." Van Citters noted "How far we have come in our understanding, our ambition, our sheer scientific audacity in less than one professional lifetime." From debating whether sufficiently bright detail would support baselines as long as 100m on fledgling arrays, or whether extragalactic molecules could possibly be bright enough, to the present, he continued, where we "await ALMA's ability to map molecular gas in the first generation of galaxies; this gas already contains elements heavier than hydrogen that were forged in the first generations of stars to form, less than a billion years after the origin of time itself."

Arthur Carty, President of the National Research Council of Canada, noted that as a chemist by training, he had "come to appreciate the value of astronomy not only as a fundamental and important scientific discipline, but also as a unique vehicle for encouraging national and international cooperation and for turning our young people on to science and technology."

Noting that the date was exactly the fortieth anniversary of the signing of ESO's first agreement with Chile, ESO Director-General Catherine Cesarsky noted "Here, on Chilean soil, in the great emptiness of the Atacama desert and closer to the sky than ground-based astronomers have ever been, we are now embarking upon an ambitious exploration of new and unknown celestial territories. We do so in the service of science and society, ultimately for the benefit of humanity.

NRAO Director Fred K. Y. Lo recalled the long road leading to the ALMA groundbreaking in his remarks.

Intendente Jorge Molina welcomed ALMA to the Second Region of Chile and made reference to the interest of the Region in becoming the "astronomy world capital" now that both the VLT and ALMA are located there. He also referred to the impact ALMA will have on the local community, in particular after the signature on 28 October of the agreement between ALMA and the Intendencia that benefits the San Pedro Commune.

Mayor of San Pedro de Atacama Sandra Berna echoed Intendente Molina's remarks, noting that San Pedro was the capital of Chilean archaeology and that now it may become a capital of science as well. Finally, the Bishop of Antofagasta, blessing the beginning of the ALMA construction work, used biblical imagery in referring to the astronomical aims of the project.

A reflection on ALMA science was given by the President of AUI, Riccardo Giacconi, winner of the 2002 Nobel Prize in Physics during a break in the lunch.

Dr. Giacconi shared his vision of the scientific significance of ALMA, elaborating on themes of particular interest. "ALMA will have unsurpassed sensitivity and imaging capabilities for molecular spectroscopic study of external galaxies and will be able to detect the first galaxies formed through their dust emission at $z > 20$. It will be able to study star formation cores in nearby galaxies and assess the role of morphology and environment in their dynamic and chemical evolution. The siting of ALMA in the southern hemisphere will permit detailed studies of the large and small Magellanic clouds. The study of organic molecules in interstellar space will provide indispensable clues to the origin of life in the universe. "



Figure 4 Dr. Riccardo Giacconi, President of AUI, noted the great scientific promise of ALMA.

Project Director Massimo Tarenghi expressed the ALMA team's feelings about reaching this milestone. *"We may have a lot of hard work in front of us", he said, "but all of us in the team are excited about this unique project. We are ready to work for the international astronomical community and to provide them in due time with an outstanding instrument allowing trailblazing research projects in many different fields of modern astrophysics".*



Figure 5 NSF's Robert Dickman christens a block with Chilean wine as Eduardo Hardy, Fred Lo, Massimo Tarenghi, Catherine Cesarsky and Daniel Hofstadt (l-r) watch.