

Mercury

Autumn 2017

Volume 46 · Number 4



astrosociety.org

A Nation of the Stars

Observatories in Chile give back to the people who give them dark skies.

By Steve Murray



Gemini South Observatory Starlab Operator Dalma Valenzuela leads a stargazing session during the 2017 AstroDay in Chile. Courtesy Gemini Observatory/AURA/Manuel Paredes.



Finding the oldest galaxies. Identifying the source of gamma ray bursts. Measuring the expansion rate of the universe. These and other major discoveries have come from telescopes high in the deserts of Chile. International astronomy has flourished here for almost 60 years, thanks to the country's dry air and dark skies, and Chile promises to dominate the future of astronomy, as well. At current rates of construction, the nation will host 75 percent of the world's astronomical observing capacity by 2025.

While amazing scientific work is taking place at the observatories, quieter work is occurring around them. Education and outreach specialists with the organizations that manage these sites are engaged with Chilean universities, schools, and local communities to make sure that everyone in the country benefits from their presence. Chileans think of themselves as a nation of the stars. It's the job of these specialists to foster that tradition.

Cooperative Efforts

Three organizations manage almost all international observatories in Chile: The Association of Universities for Research in Astronomy (AURA), the European Southern Observatory (ESO), and Associated Universities, Inc. (AUI).

International cooperation between Chile and these organizations began with an important guarantee: In return for the use of observatory lands, 10 percent of available telescope time was reserved for Chilean astronomers.

"It's hard to get observing time," notes Laura Ventura, Team Leader in Chile for the ESO education and Public Outreach Department (ePOD). "No other country, not even the [ESO] member states, has guaranteed time except Chile." The arrangement has made Chilean astronomers one of the most rapidly developing science communities in the world.



Gemini South Observatory Head of Engineering Operations Michiel Van Der Hoeven describes the 8.2-meter primary mirror to local students as part of "Journey to the Universe" activities. [Gemini Observatory/AURA/Manuel Paredes]

Astronomy Partners in Chile

The Association of Universities for Research in Astronomy (AURA), headquartered in Washington, D.C., operates the Cerro Tololo Inter-American Observatory (CTIO), the Gemini South Observatory, and the Large Synoptic Survey Telescope (LSST), which is scheduled for first light in 2019. The European Southern Observatory (ESO), headquartered in Garching, Germany, manages instruments including the Very Large Telescope (VLT) at Paranal Observatory, the Atacama Large Millimeter/submillimeter Array (ALMA), the APEX Telescope, and the European Extremely Large Telescope (E-ELT), which is currently under construction. Associated Universities, Inc. (AUI), also headquartered in Washington, D.C., collaborates in the management of ALMA and manages radio telescopes for several partner countries.

TABLE OF CONTENTS

Chris Smith, Head of Mission for AURA in Chile, points out that cooperative efforts go beyond formal agreements to include sponsored internship programs for Chilean astronomers, engineers, and administrators. Smith adds that Chilean astronomers have been brought in to help plan a new AURA-LSST Data Access Center in Chile, and a School for Data Science in La Serena to teach the tools and techniques needed to explore the massive quantities of data that the LSST will generate.

For the Schools

Even as day-to-day astronomy research goes on, activities to connect future generations to astronomy take place in Chile's schools. The AURA education and public outreach (EPO) teams of CTIO and



The Galileo Mobile Project brings the excitement of astronomy to young children in Chile, Bolivia, and Peru. [GalileoMobile/ESO]

Gemini observatories, for example, use a mobile planetarium to teach astronomy in local classrooms and distribute teacher training materials for a range of sciences (in addition to astronomy). The ESO outreach team helps organize school visits to observatories in La Silla and Paranal, especially during the mid-July winter vacation and at the end of the school year in late November.

Tim Spuck is the STEM Development Officer for AUI. His focus is on visiting education programs and teacher exchanges, where he interacts with AURA, ESO, the US Embassy, and CONICYT (the National Commission for Scientific and Technological Research — Chile's counterpart to the US National Science Foundation). Spunk's biggest passion, however, is cultivating student talent. "We underestimate the abilities of our students," he says. "If we can just get them motivated, they have tremendous potential. When it comes to STEM, there's a role for everyone. It's not about getting kids interested in astronomy. It's about getting them interested in their universe."

He's currently involved with "modeling," a mentoring approach to help Chilean students learn by pairing each age group with a younger one. "If they don't have anyone around them where they can say, 'I can become like you,' that's a real negative," says Spunk. But "If we have graduate students working with undergraduates, undergrads working with high school students, and high schoolers working with younger kids, this near-peer role modeling is incredibly powerful."

CONICYT liked Spunk's approach and embraced it in their own programs. Now, astronomers who receive CONICYT academic fellowships are required to devote a minimum number of hours to outreach education as a condition of that financial support. As it evolved, Spunk also found an indirect payoff from the approach — astronomers became better science communicators as a result of their outreach experiences. "That scientist is giving something incredible," he says. "But that scientist is getting something just as

[TABLE OF CONTENTS](#)



At the 2013 inauguration of ALMA, the Atacama Large Millimeter/sub-millimeter Array. [ESO]

important. If they're better communicators, they'll do a better job. We tend to overlook that."

For the Country

"Chile sees itself as an astronomical country," explains Ventura. "This is more and more in our social consciousness." The ESO team nurtures this spirit with a series of recurring public exhibitions and events throughout Chile. "Every year we have an open house right here at our offices as part of the national celebrations of the 'Day of Astronomy,' typically every third week in March.

"Chile also has an official 'Month of Astronomy' now, which we participate in during the third week in May," she adds. "We have the universities and higher institutions participating and we, together with ALMA Observatory, organize an open house. We also participate

in the 'National Week of Science,' normally the first or second week of October." It's a busy outreach calendar for the small team.

Public engagement includes support for the country's astronomy infrastructure. ESO staff helped the Chilean government restore an historic observatory in central Santiago to use for public education, and helped establish an Astronomy Park at the University of Santiago Planetarium. ESO outreach also impacts community life around its observatories through undergraduate scholarships for students in the Antofagasta region, where Paranal Observatory is located, and with support for cultural, sporting, and educational projects in the remote Sequitor community, the operations center for the APEX Telescope.

AURA public activities include "AstroDay" in La Serena, where outreach teams explain the work of the nearby Gemini Observatory and describe the career opportunities available there to students and the community. AURA's nascent LSST outreach program even offers citizen science projects that involve local citizens in real astronomical data analysis, and their outreach staff develops online resources in both Spanish and English for easier access to astronomy and STEM information.

Observatories in Chile are almost all located on remote, fragile desert lands. Equipment and supplies come and go all the time in support of astronomers, support personnel, and visitors. How, then, do these installations treat the land around them? Its resources? Its environment?

"This is their home," says Spuck. "When you walk into someone's home there's a certain reverence and respect that needs to take place. We don't want to be seen by Chile as just leasing ground. We want to be partners in this astronomy endeavor. A lot of work was done before construction [of ALMA], to involve the indigenous community as to what would take place and where construction would be done."

TABLE OF CONTENTS

Smith is careful to point out that AURA, like ESO, works with Chile's Ministry of Environment to protect observatory lands. In fact, because some of these sites host protected species, a lot of AURA land remains undeveloped. LSST staff are even relocating flora and fauna around their site to reduce the impact of observatory construction.

Of course, for astronomers, the most important environment is Chile's dark skies. While the high deserts are remote, Chile's towns grow and spread over time just like they do elsewhere in the world. Smith and Fernando Comerón, ESO's Representative in Chile, supervise efforts by their respective agencies in a joint office with the Chilean Minister of Environment, to protect sky quality. AURA's work with the government led to Chile's first light pollution regulations in 1998 and, in 2015, the Gabriela Mistral International Dark Sky Sanctuary, the first of its kind, was established and named after the famous Chilean poet.

For the World

Astronomical tourism is an important and fast-growing economic resource for Chile. According to Comerón, ESO observatories alone attract around 8,000 visitors per year; a remarkable figure considering how remote these sites are. Chile hosts more than 10 community observatories to accommodate both international tourists and domestic visitors. AURA helped local communities build several of them and equipped them with science and docent training materials.

CTIO staff donated a telescope to help launch the first community observatory — Cerro Mamalluca in Vicuña. The ESO assisted the government in the construction of another — the Observatorio Cruz del Sur in the Combarbalá region. And the ESO is currently helping Chile to realize the huge potential of this resource by collaborating with AURA representatives, observatories, hotel operators, and guides to develop a comprehensive business strategy for astrotourism.

Coming Together

Although clear, dark skies have enabled important astronomical discoveries in Chile, they aren't the only factor in scientific success. "An informed and interested citizenry, youth interest in STEM careers, a skilled workforce, and support for the observatories and their unique needs is essential if we are to all work together to unlock the secrets of the universe" says Spuck. "We cannot achieve this without a robust and vibrant public outreach effort."

Outreach professionals in Chile recently came together to coordinate and amplify their impact throughout country. "Reaching for the Stars," an integrated roadmap for future outreach efforts, was formally presented to CONICYT at the end of 2016 — the product of an earlier summit involving the US Embassy, the US National Science Foundation, CONICYT, and Explora (the outreach arm of CONICYT). The roadmap will launch new approaches for spreading the excitement of science and new ways of collaborating across the outreach teams of different observatories.

"It's good to become open to new ideas and maybe do things together, because we don't have the resources to do things by ourselves," notes Ventura.

Within 10 years the Large Synoptic Survey Telescope, the Giant Magellan Telescope, and the European Extremely Large Telescope will be operating in the high deserts of Chile. While their findings will awe the world, the researchers who work with them will understand that they're operating in a unique cultural setting, and that reaching up for science also means reaching out to the people whose country makes their work possible. ★

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TABLE OF CONTENTS

