
Association of Universities for Research in Astronomy

FACT SHEET ON AURA INITIATIVES IN CHILE March, 2013

Executive Summary

- The Association of Universities for Research in Astronomy, AURA, manages three major NSF-funded optical astronomical facilities, the U.S. National Optical Astronomy Observatory (NOAO), the international Gemini Observatory, and the Large Synoptic Survey Telescope. All of these operate facilities in Chile under the auspices of “AURA Observatory in Chile”, alongside other AURA-managed facilities here.
- AURA began activities in Chile in 1961, and soon thereafter established the first major international observatory in Chile, the Cerro Tololo Inter-American Observatory (CTIO), as part of NOAO. CTIO operates the Blanco 4m telescope, which was the largest telescope in the Southern Hemisphere from its construction in 1974 until 1998.
- In 2000, AURA began operations of the Gemini-South 8m telescope, the twin of Gemini-North in Hawaii, completing the internationally-funded Gemini Observatory, whose current partners include the USA, UK, Canada, Australia, Brazil, Argentina, and Chile.
- AURA currently supports 17 astronomical telescopes on Cerros Tololo & Pachon, with another 10-15 telescopes and astronomical projects under development, with mirror diameters from 0.4m to 8.4m (LSST). In addition, AURA hosts a wide range of other scientific facilities, including two atmospheric studies (SSI & the Andes Lidar Observatory), a geophysical station (UChile/IRIS), a solar observing station (GONG), and a station for the Chilean aeronautical administration (DGAC).
- Since 1961, AURA has managed an integrated U.S. Federal (NSF) investment in Chile of almost \$1 billion USD, and has managed a total investment including international partners of well over \$1B.
- In the period from 1995 to 1999, the CTIO Blanco 4m telescope led the way in the discovery of the accelerating universe (leading to the Nobel Prize in Physics 2011). Both groups utilized the Blanco to discover the supernovae used to measure the acceleration of the universe, and the supernovae were followed up using additional AURA facilities, including other NOAO facilities, Gemini, and the Hubble Space Telescope.



Background

- U.S. and European astronomers have long sought access to the Southern skies, and in particular to observing sites in Chile. Northern Chile is internationally recognized as having some of the best sites in the world for astronomical facilities¹.
- Sites in the southern hemisphere offer access to the Magellanic Clouds, the brightest globular clusters, and provide the best access to the Galactic center.
- AURA has operated in Chile for 50 years. A history of AURA's development of Chilean operations can be found at www.ctio.noao.edu/diroff/ctio_history.htm.
- AURA initiated operations in Chile with the establishment of the Cerro Tololo Inter-American Observatory (CTIO), the first major international observatory to be operated in Chile. The fact that the concept was an "inter-American" initiative symbolized the commitment to be a partner with Chile and other South American countries rather than just an extension of the U.S. national astronomy program.
- Beginning in 1963, the Chilean Congress allowed AURA to operate in Chile and import property and equipment free of duty. In 1969, AURA was granted the juridical character of an International Organization and was given the ability to own property, immunity from legal process, and other rights intended to encourage the establishment of major astronomical facilities.
- Given this long relationship with Chile, it has been essential to maintain strong links with the Government and the Chilean academic community. Two of AURA's member institutions are Chilean: Universidad de Chile and Universidad Catolica.
- NSF/AURA related investments in Chile, including CTIO, Gemini, and SOAR is over \$970M in today's dollars. Future major international investments in Chile include the Large Synoptic Survey Telescope and several major non-AURA facilities such as ALMA, the Giant Magellan Telescope, and the European Extremely Large Telescope. These offer the potential for enormous scientific synergy, especially when combined with the existing facilities at CTIO, Gemini, and SOAR.

¹ The best observing sites in the world, judged on the basis of a combination of atmospheric stability and transmission, are of two types: isolated high mountains in temperate oceans (e.g., Mauna Kea and La Palma), or coastal mountain ranges near a cold ocean with stable subtropical anti-cyclone conditions (e.g., coasts of Chile, Western USA-Mexico, and Namibia).



Current AURA Operations in Chile

- Major telescopes operated by AURA include the 4-meter CTIO Blanco, and the 4-meter the Southern Astrophysical Research (SOAR) telescope, the 8-meter Gemini telescope, along with the active development of the future 8.4-meter Large Synoptic Survey Telescope (LSST).
- The AURA Head of Mission is the overall Director of AURA-O and the primary legal representative and interface with Chilean institutions. The designation as Head of Mission must be approved by the U.S. Secretary of State. The current Head of Mission, Chris Smith, maintains all diplomatic and legal interfaces and is the overall site director. Other local directors for NOAO/CTIO, Gemini and SOAR are responsible for operations inside the respective domes, while NOAO is also responsible for the operational support of the site as a U.S. national facility. All collaborate for the common good and optimizing cost effectiveness and scientific advancement.
- AURA owns over 90,000 acres in the IV region of Chile, including an office and residential compound in La Serena and the extensive property including Cerro Tololo, Cerro Pachon, and Cerro Morado. The current value of AURA owned property is \$5-8 M depending on the method of valuation². Most recently, in 1999, AURA purchased an additional tract of land on Cerro Pachon to better protect the observing conditions for Gemini, SOAR, and the future LSST.
- AURA maintains a corporate office in Santiago to facilitate interactions with governmental agencies. AURA supports and assists other U.S. entities wishing to commence operations in Chile, and provides ongoing support to others (e.g. performing administrative activities in Santiago for Las Campanas Observatory)
- AURA policy, established through agreement with the Universidad de Chile on behalf of the Chilean astronomical community, is to provide 10% of all observing time to Chilean astronomers.
- AURA employs almost 200 Chileans, several of whom occupy senior management positions in CTIO and Gemini.
- From its beginnings in Chile, AURA has allowed Chilean employees to unionize, and has maintained excellent relations with the union's representatives and its employees. AURA sponsors educational and recreational activities for all Chilean employees. The most recent collective bargaining agreement was accepted in June 2012.

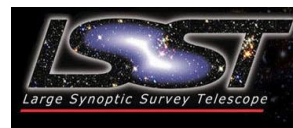
² In 2000, AURA proposed and the NSF accepted a provision allowing AURA-owned land to be utilized by any successor to AURA holding a cooperative agreement for management and operations. This was to ensure that AURA's ownership did not present an impediment to future re-competition of the cooperative agreement.



- In 1977, at the request of AURA, the Government of Chile declared the AURA site including Cerro Tololo and Cerro Pachon a privileged scientific sanctuary where mining is prohibited without permission of the President of Chile. AURA continues to monitor mining activity around the site to ensure compliance.
- AURA also administers and contributes directly to the program of the Oficina de Protección de la Calidad del Cielo (OPCC), a division of the Chilean Environmental Protection Agency (CONAMA) responsible for ensuring the continuing high quality of the night skies in the II, III, and IV regions of Chile by monitoring the application of laws related to outdoor lighting and advocating for improvements to those laws. The OPCC is financially supported by all the international optical observatories in Chile (specifically AURA, ESO, and Carnegie Observatories).
- AURA is participating in a DOE/NSF collaboration to bring a new \$35M instrument, the Dark Energy Camera (DECam) to the CTIO Blanco 4-meter to undertake the Dark Energy Survey (DES). The DES will be a 5-year joint DOE/NSF funded project, which effectively started with DES science verification in November 2012. The DECam also represents a major new CTIO facility instrument for the general astronomical community.
- AURA, through NOAO, manages a high-speed network communications backbone, both within Chile and internationally, for all AURA and tenant facilities on Cerro Tololo and Cerro Pachon, as well as several off-site partners.
 - ⇒ AURA is an active member of REUNA, the Chilean equivalent of Internet2, and maintains a strong presence in the development of research and educational networking within Chile.
 - ⇒ AURA has partnered with Florida International University on AMPATH (the Americas Pathway) and several follow-on NSF-funded OCI initiatives to maintain high-speed international research and educational network connectivity from the U.S. to South America (and specifically to Chile). This connectivity not only benefits the AURA facilities in Chile, but also supports both NRAO/ALMA data transfer to the U.S. and the operations of Carnegie Observatories on Las Campanas. The network link is also providing connectivity for a U.S.-funded project on ESO's La Silla site.

CURRENT ISSUES OF IMPORTANCE

- Maintenance of a southern hemisphere observing capability is essential to the US community. Ongoing threats that AURA has had to address include:
 - The incursion of mining operations—AURA monitors mining claims on a daily basis. Although mining on AURA property requires the approval of the Chilean President,



- experience with other observatories demonstrates that the Chilean government may be reluctant to shut down such operations if they are well underway. Thus continued vigilance is necessary. Mining adjacent to AURA property is also a concern and we have worked with new operators to minimize their impact.
- Light Pollution--Increase in light pollution levels can have a deleterious effect. AURA has worked with local municipalities, the ministry, and nearby commercial operators to implement lighting standards that preserve the night sky.
 - Currency Fluctuations--Inflation and currency exchange rates have posed a major problem for all observatories operating in Chile. Driven by external factors such as the price of copper, it remains volatile and a source of significant uncertainty in strategic planning for AURA and its facilities in Chile. AURA has sought relief both from the Congress and administratively within the NSF. Presently, AURA adjusts salaries for personnel, but the programs remain at risk.
 - LSST: AURA manages the LSST construction program, and NOAO is a partner and host on Cerro Pachon.
 - LSST was the top ranked astronomy program by the Astro2010 Decadal Survey and a new start as early as 2014 is possible.
 - Cerro Pachon was chosen as the best site scientifically after an exhaustive site survey that included potential sites on US soil as well as other international locations.
 - This is a survey telescope that will have substantial benefits to the Chilean community. AURA has negotiated an operating agreement with the University of Chile that will benefit the entire Chilean astronomical community in terms of data access and data management.
 - AURA has supported the LSST site preparation, including the recent submission of environmental protection report that led to the governmental approval for construction on the site.
 - AURA/NOAO is leading the telescope design and construction team for LSST, and is also leading the negotiations for high-bandwidth Chilean and international network connectivity necessary for the transfer of petabytes of information to the U.S.-based LSST archive center.
 - Gemini: In 2009, the UK announced its intended withdrawal from the Gemini Program. Australia has also signaled that they will withdraw from partner status after 2015.
 - Although the US community has strongly signaled a desire for more observing time, the current astronomy division budget may not support this, and it may be necessary to identify additional Gemini partners.
 - Many in the US community have expressed a view that AURA's operations in Chile that include CTIO and Gemini South be combined in some way. This may be



considered as a part of the overall governance changes associated with the new Gemini International Agreement.

- Connectivity for US observatories in Chile: AURA is taking a lead in establishing greater connectivity from Chile to the mainland, particularly in preparation for LSST operations. This will benefit not only AURA managed facilities, but ALMA and other future telescopes.
- AURA is pursuing development of cyber-infrastructure in Chile in collaboration with REUNA, the Chilean Ministry of Foreign Relations, CONICYT (the Chilean equivalent of the NSF), and the Chilean academic community.



AURA Outreach and Education Programs in Chile

- AURA was instrumental in helping establish The International School of La Serena (TISLS), which is now an independent entity open to Chilean students and one of the top schools in Chile (consistently ranked in the top 50 schools nationally over the past 10 years and ranked one of the top three in the region)
- AURA assisted the Universidad de Chile and Universidad Catolica in establishing joint PhD programs with Yale and Princeton for Chilean students.
- Other student programs include CTIO's Prácticas de Investigación en Astronomía (PIA) program for Chilean astronomy undergraduates and the AURA-wide internship program for Chilean students in engineering, technical, and administrative programs. In 2010, these programs supported more than 25 Chilean students working at AURA facilities in Chile.
- AURA has an active outreach program for the local community including:
 - ⇒ CADIAS (Centro de Apoyo a la Didáctica de la Astronomía) is a facility administered by CTIO devoted principally to the support of teaching astronomy as well as astronomical outreach in local schools. It represents an ongoing partnership between AURA, the Municipality of La Serena, and the Chilean national library. It includes a small auditorium, several telescopes donated by CTIO, a branch of the national library, and a number of other exhibits. CADIAS programs annually reach more than 20,000 students, teachers, and other members of the public.
 - ⇒ Gemini Virtual Tour Kiosks fully translated into Spanish. These are currently running and maintained for the public at the Cerro Pachón summit, Gemini South Base facility lobby, Collowara observatory, Cruz del Sur Observatory, and CADIAS.
 - ⇒ CTIO's regular weekly (Saturday) public tours to Cerro Tololo, and ad-hoc tours for special-interest groups of both Cerro Tololo and Gemini facilities.
 - ⇒ ASTRO-Chile: an annual program of bi-lingual workshops and interaction between students and teachers in Tucson, Arizona and La Serena, Chile, merging the teaching strategies and techniques from both countries into a cross-cultural exchange via video-conference.
 - ⇒ CTIO supported the establishment of the first Chilean municipal observatory in Vicuña, Mamalluca, and together CTIO and Gemini have supported the development of several more (now more than seven) public visitor observatories in the communities of the IV region of Chile.
 - ⇒ Gemini's StarTeachers exchange program provided professional development and exchange of science teachers between Hawai'i and the region of Coquimbo, Chile.



- ⇒ FamilyAstro: This adaptation of the ASP's program has been in Chile since 2005 and Gemini has trained multiple schools and institutions that implement family events in schools in the region.
- ⇒ AstroDay-Chile: an annual event led by Gemini bringing astronomy to the public in La Serena during the summer. The event brings together most of the professional, amateur, and municipal observatories showing their programs, and has recently included booths of several Chilean universities distributing information about their astronomy programs. This one-day event typically reaches more than 2500 members of the public each year.
- Gemini sponsors various additional outreach programs, including an active amateur astronomy club, a StarLab (portable planetarium) program for rural schools, and regularly provides talks at local schools. Staff also attend the National Conference in Astronomy in Chile every year, and has an ongoing Spanish translation of the observatory's press releases.
- CTIO sponsors additional outreach activities including programs targeted at handicapped and disabled students, a portable planetarium program that is integrated into teaching plans at local schools, and is the Chilean node of the international Globe at Night program, involving schools throughout Chile in dark sky education. CTIO also sponsors and helps organize the International Conference of Amateur Astronomy and the National Conference for Student Astronomy in Chile.
- CTIO is also a member of the Regional Agency for Productive Development, a government-sponsored group promoting sustainable regional development, including "astro-tourism".
- The combined AURA outreach programs (CTIO and Gemini) represent an annual investment of over \$250,000 in support of Chilean education and public awareness.
- A common theme of the combined AURA outreach programs is education about the contamination of the night sky by outdoor lighting, and the need to protect the night sky in future lighting initiatives. These efforts are strengthened through collaboration with the OPCC and the international efforts of the Globe at Night program and the International Dark-sky Association.



Key AURA Staff in Chile

AURA-O

Dr. Chris Smith: AURA Observatory Head of Mission

Mr. Hernan Bustos: Administrative/Legal representative in Chile

Mrs. Edilia Cerda: Deputy Legal representative

Ms. Camila Ibarlucea: Administrative Assistant

Cerro Tololo Inter-American Observatory (CTIO)

(a division of the National Optical Astronomy Observatory)

Dr. Nicole van der Blik: Interim Director CTIO

Mr. Jeff Barr: Facilities and Administration Manager

Mrs. Leonor Opazo: Administrative Manager

Gemini South

(the southern half of the international Gemini Observatory)

Dr. Nancy Levenson: Associate Director of Gemini/Head of Science

Dr. Andy Adamson: Associate Director Science Operations

Mrs. Lucia Medina: Executive Assistant

SOAR

Dr. Steve Heathcote: Director

Mrs. Marcela Urquieta: Administrative Assistant

