A three-color composite of the Cat’s Paw Nebulae, NGC6334. This composite combines images in the near infrared J (blue) and K (green) band taken with the NEWFIRM wide-field infrared imager on the Blanco 4-m telescope at CTIO with an IRAC 4.5-micron band (red) image. The imaging was done as part the PhD thesis of Sarah Willis (Iowa State University). The combined NEWFIRM and Spitzer observations found over 2,000 young stellar objects (YSOs) that display excess emission above normal photospheric levels at infrared wavelengths.

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1 OBSERVATORY MANAGEMENT

1.1 SUMMARY OF OBSERVATORY ACTIVITY

FY13 has been another highly productive year for NOAO, with several major achievements (e.g., initial science operations of the Dark Energy Camera at the CTIO Blanco 4-m telescope) and no major operational interruptions.

From FY13 NSF base funding, NOAO plans to deliver and/or enable:

- Operation and maintenance of NOAO facilities in Tucson and on Kitt Peak (Mayall 4-m, WIYN 3.5-m, and 2.1-m telescopes).
  
  **Status:** On-going; a summary is provided in section 2.2 “NOAO North.”

- Operation and maintenance of NOAO facilities in La Serena (including the AURA recinto—compound) and on Cerro Tololo and Cerro Pachón (Blanco 4-m and SOAR 4.1-m telescopes).
  
  **Status:** On-going; a summary is provided in section 2.1 “NOAO South.”

- Scientific user support services and community development activities for the non-NOAO facilities within the US Optical/Infrared (O/IR) System, especially the Gemini Observatory.
  
  **Status:** On-going; a summary is provided in section 2.3 “NOAO System Science Center.”

- Commissioning, science verification, and community and DES operation of the Dark Energy Camera (DECam) at the Blanco 4-m telescope.
  
  **Status:** Completed; see sections 2.1.1 and 2.1.2.

- Commissioning and science verification of the Kitt Peak Ohio State Multi-Object Spectrograph (KOSMOS) at the Mayall 4-m telescope.
  
  **Status:** The external optics vendor failed to deliver a critical assembly. A recovery plan was developed with The Ohio State University, the prime contractor for this project. The recovery plan is progressing well, and it should be completed during this fiscal year. The commissioning and science verification were pushed into the first quarter (Q1) of FY14. For more details, see section 2.4.2.

- Acceptance of the Cerro Tololo Ohio State Multi-Object Spectrograph (COSMOS) at the Blanco 4-m telescope.
  
  **Status:** The status of this project is the same as for its close twin, KOSMOS (see the Status paragraph immediately above).

- Design and development (ReSTAR 1) of a detector package for TripleSpec4, a medium resolution near infrared spectrograph for Blanco 4-m.
  
  **Status:** In progress; see the status report in section 2.4.2.

- NOAO contribution to the WIYN One Degree Imager (ODI) project, including on-sky commissioning of the instrument with a partially filled focal plane.
  
  **Status:** Work on ODI with a partially filled focal plane (pODI) is completed; the instrument is operational and being used regularly by external researchers (see science highlight based on pODI in section 2.2.1). NOAO continues to support the development of improvements in the pODI data system. A project was launched to increase the pODI area from $24 \times 24$ arcmin to...
48 \times 48 \text{ arcmin}. For more details, see sections 2.2.1 “Kitt Peak National Observatory” and 2.3.2 “Science Data Management.”

- Initial science operations for a ground-layer adaptive-optics system with laser guide star for the SOAR 4.1-m telescope (and an associated imager).

  \textbf{Status:} The science verification and release to operations was completed. Use by the first external users will occur before the end of the fiscal year. See sections 2.1.1 “Cerro Tololo Inter-American Observatory” and 2.4.1 “System Instrumentation” for more details.

- New detector system controllers for various instruments on Kitt Peak and Cerro Tololo based on the MONSOON/TORRENT development program.

  \textbf{Status:} In progress; see section 2.4.1 “System Instrumentation.”

- Program and scientific management support of various ReSTAR (Renewing Small Telescopes for Astronomical Research) Phase 1 projects.

  \textbf{Status:} On-going; see section 2.4.1 “System Instrumentation.”

- Design and development activity for the Large Synoptic Survey Telescope (LSST), including telescope systems and on-site support facilities.

  \textbf{Status:} On-going; see section 2.4.4 “LSST Technology.”

- Science data management services that are focused on immediate NOAO needs, including science operations of the Dark Energy Camera and WIYN One Degree Imager.

  \textbf{Status:} On-going; see section 2.3.2 “Science Data Management.”

- Education and Public Outreach program that is focused on critical, local activities and needs while maintaining a national (global) perspective through targeted, innovative programs.

  \textbf{Status:} On-going; see section 3.2 “Education and Public Outreach.”

- Technical and management support/planning for the possible deployment of the BigBOSS spectrograph on the Mayall 4-m telescope.

  \textbf{Status:} On-going; see section 2.2.1 “Kitt Peak National Observatory” and 2.2.2 “NOAO North Engineering and Technical Services.”

- Science support activities for LSST and the LSST community.

  \textbf{Status:} On-going; see section 2.3.4 “System Community Development.”

- Administrative and facility operations services necessary for an organization with more than 250 employees at two geographically distributed sites.

  \textbf{Status:} On-going.
From FY13 (or earlier) NSF supplementary funding, NOAO plans to deliver and/or enable:

- Completion of the deferred maintenance catch-up and infrastructure improvement program (so-called stimulus funding from the American Recovery and Reinvestment Act of 2009).
  
  **Status:** All ARRA-funded projects are on track for completion during FY13; see section 3.4 “ARRA Infrastructure Renewal.”

- Annual Research Experiences for Undergraduates (REU) programs in Tucson and La Serena.
  
  **Status:** The REU program in Chile is completed for this year. The REU program in Arizona is underway; see section 3.2 “Education and Public Outreach.”

- Continued support of current partners (Vanderbilt University/Fisk University and South Carolina State University) in the Partnerships in Astronomy & Astrophysics Research and Education (PAARE) program.
  
  **Status:** No PAARE students were forwarded to NOAO this year.

- Additional design and development activity for LSST.
  
  **Status:** On-going; see section 2.4.4 “LSST Technology.”

- Construction completion of a new, medium-resolution optical spectrograph for the Blanco 4-m telescope (COSMOS) (ReSTAR Phase 1) (commissioning using base funding, see above).
  
  **Status:** See above.

- Continuation of construction of a new, medium-resolution near-infrared spectrograph for the Blanco 4-m telescope (TripleSpec) through a sub-award to Cornell University (ReSTAR Phase 1).
  
  **Status:** See above.

- Participation in the development of scientific user support services for the Virtual Astronomical Observatory (VAO).
  
  **Status:** Mostly completed; see section 2.3.2 “Science Data Management.”

On a cost-recovery basis, NOAO also plans to deliver and/or enable:

- Technical and facility operations support services for tenant and/or partner observatories on Kitt Peak, Cerro Tololo, Cerro Pachón, and Cerro Las Campanas.
  
  **Status:** On-going as described throughout sections 2.1 “NOAO South” and 2.2 “NOAO South.”

### 1.2 ORGANIZATION AND KEY MANAGEMENT CHANGES

There were no changes this period to the organizational structure and key management as presented in the NOAO Annual Program Plan FY 2013. However, recruitment of a long-term associate director for NOAO South was initiated during this period in collaboration with the AURA Observatory Council. By June, four finalists had been interviewed. It is expected that the new associate director for NOAO South will be announced and in place by the end of this calendar year.

The top-level NOAO organization chart for FY13 is shown in the figure below. Circles are top-level programs. Boxes are major sub-activities. Activity managers are shown in parentheses.
At this time, NOAO North does not have a permanent head. Silva and Blum share those duties. NOAO North Engineering & Technical Services (NN ETS) and NOAO South Engineering & Technical Services (NS ETS) provide resources for instrumentation and technology development activity within System Instrumentation (dashed arrows, shaded boxes indicate linked activities). As of 1 October 2012, Central Administrative Services and NOAO South Administrative Services have transitioned to a new business services center under the AURA Corporate Office. NOAO now “purchases” these services from AURA Corporate and no longer manages staff in these areas.
2 NOAO DIVISIONS

2.1 NOAO SOUTH

The NOAO South (NS) division is responsible for operations, maintenance, and development for all NOAO activities in Chile. For program management purposes, these activities are separated into the following subprograms:

- Cerro Tololo Inter-American Observatory
- NOAO South Engineering & Technical Services
- NOAO South Central Facilities Operations
- NOAO South Computer Infrastructure Services

2.1.1 Cerro Tololo Inter-American Observatory

Program Highlights

Science

NGC 6334, or the Cat’s Paw Nebula, is a very active, massive star-forming region located in the Southern Hemisphere sky at a distance of around 1.6 kpc. As part of her PhD thesis, Sarah Willis of Iowa State University used the NEWFIRM wide-field infrared imager on the 4-m Blanco telescope at the Cerro Tololo Inter-American Observatory (CTIO) to obtain a deep, wide-field view of NGC 6334. The new data was combined with Spitzer Infrared Array Camera (IRAC) observations to provide a new look at thousands of young stars that are difficult to find using IRAC observations alone (Willis et al. 2013, submitted).

The combined NEWFIRM and Spitzer observations found over 2,000 young stellar objects (YSOs) that display excess emission above normal photospheric levels at infrared wavelengths. The sensitivity of this study was sufficient to detect young stars down to approximately 0.5 solar masses in areas with low levels of background emission. These YSOs indicate that NGC 6334 is forming at least 4,900 solar masses worth of stars every million years.

Figure 1: A three-color composite of the Cat’s Paw Nebulae, NGC6334, combining NEWFIRM images in the near infrared J (blue) and K (green) band with an IRAC 4.5-micron band (red) image. (Image credit: Willis et al. 2013, submitted.)
By mapping the extinction toward the more than 600,000 stars detected in the near-infrared bands, the team also was able to estimate the total mass of the NGC 6334 molecular cloud, approximately 160,000 solar masses. Over half of the observed mass is condensed into clumps and ridges of dense material capable of forming stars. The rate and efficiency of star formation in this region are significantly higher than those seen in many other giant molecular clouds of the same overall size and mass, such as Orion. Studying the mechanisms of star formation in NGC 6334 may provide a bridge to better understanding of the high star-formation rates and efficiency seen on large scales in starburst galaxies.

**Instrumentation/Management**

During the first six months of FY13, the efforts at CTIO and NOAO South focused on bringing the Dark Energy Camera (DECam) online and on improving performance of the Blanco 4-m telescope and DECam combined. Community science observations, mostly carried out by visiting astronomers, started on 1 December 2012; by mid-FY13, science observations with DECam had become a regular, routine affair, with a structure that provides both technical and scientific support. During this period, the Dark Energy Survey (DES) continued its science verification observations, providing useful feedback to the technical support team at CTIO and allowing the DES consortium to fine tune their strategy and prepare for the DES, which is expected to start in the last quarter of FY13.

With DECam online and in regular use, the focus of the technical group at NOAO South shifted to the Blanco f/8 recovery. Repair of the mirror cell, including a new motor control system, was completed in the third quarter (Q3) of FY13. A new handling cart was designed and fabricated during the first two quarters (Q1 and Q2) of FY13, and fabrication was completed in Q3. The design of the new handling cart includes various features to prevent unsafe handling of the mirror. The new f/8 handler was put into use for the first time at the end of Q3: on June 24, a two-week shutdown started to test the f/8 handler with the repaired mirror cell and the dummy mirror. Installation and commissioning of the actual mirror is planned for the fourth quarter (Q4) of FY13 and will continue into FY14.

At the Southern Astrophysical Research (SOAR) 4.1-m telescope, science verification observations with the SOAR Adaptive Module (SAM) in Laser Guide Star (LGS) mode started in Q3 of FY13. Science verification will continue into Q4. The instrument is available for observing in shared-risk mode during semester 2013B, which begins in August 2013.

CTIO is celebrating its 50th anniversary this year with a variety of activities. The celebrations started with the inauguration of the Dark Energy Camera (DECam) on 9 November 2012. Also during Q1, an exhibition on the history of CTIO was prepared. It includes instruments and other arti-
facts built and/or used at CTIO. This exhibition was first on display in the NOAO South La Serena offices in the month January 2013. In February and March, the exhibition was on display in the entrance of a major La Serena supermarket and in the Palacio Cultural de Coquimbo at Coquimbo, Chile. As part of the celebrations, the visiting hours to CTIO were doubled during the summer months, opening the observatory to the public on Saturdays and Sundays.

The anniversary celebration continued with the scientific conference “Fifty Years of Wide-Field Studies in the Southern Hemisphere: Resolved Stellar Populations in the Galactic Bulge and the Magellanic Clouds,” held by CTIO on 5–9 May 2013. Among the invited speakers were several astronomers who had participated in the observatory during the past 50 years; their presentation highlighted some of the history of CTIO. In addition, most speakers who gave a scientific presentation also made the connection of their research and the history of CTIO. As a courtesy to INACAP, the institute where the conference was held, public talks in Spanish were held at the end of the conference days. The conference was well attended. More than 75 participants, with about one third of the group graduate and undergraduate students, came from all over the world. The majority of participants were from the US and about a third was from South America, making it a true inter-American conference, celebrating the anniversary of an inter-American observatory. Altogether, this was a very festive conference, with a fine mix of history and science.

**Status of FY13 Milestones**

- Complete commissioning and science verification of the Dark Energy Camera (DECam).

  **Status:** Commissioning and science verification were complete by 1 December 2012, when shared-risk community science observations started. The DES consortium, however, opted to continue science verification throughout semester 2012B and including February 2013, the first month of semester 2013A.

- Start regular science operations with DECam on the Blanco, and start the Dark Energy Survey.

  **Status:** Regular science operations started with shared-risk community observations on 1 December 2012. Since then, many improvements to the Blanco-plus-DECam system have been made, and science observations are now routine operation. The first DES season is planned to start 31 August 2013.

- If the Blanco f/8 secondary mirror can be repaired, prepare for installation on the Blanco, and install and commission the secondary using current f/8 instruments ISPI and Hydra.

  **Status:** Work on the repair of the mirror cell, including an upgrade of the motor control system, was completed, as was assemblage of a new handling cart. Starting June 24, the repaired mirror cell with the dummy mirror will be installed on the Blanco 4-m telescope using for the first time the f/8 handler, which was built as part of the DECam project. After this first dry run, the mirror cell will be removed again and prepared for the installation of the actual mirror in the cell.

  The f/8 secondary mirror was repaired at NOAO-North. The figure of the repaired mirror was measured and was found to be similar to the figure as measured in 1993. At the beginning of Q3, the mirror was shipped back to Chile, arriving at Cerro Tololo on 18 April 2013.

  The f/8 mirror will be integrated with the mirror cell during Q4 of FY13. Installation on the Blanco and commissioning of the mirror will follow shortly thereafter.
Complete commissioning of the SOAR Adaptive-optics Module (SAM) only if the DECam operations and Blanco f/8 installation and commissioning allow appropriate resources to be allocated.

**Status:** During Q1, improvements were made in the Laser Launch Telescope set-up as well as in the software, making the LGS adaptive optics system more robust and easier to operate. Commissioning of SAM continued during Q2, and a call for science verification observations was issued. Science verification of SAM started in Q3 and was intermixed with the last details of the commissioning phase. SAM has been offered in shared-risk mode for regular science observations in 2013B.

Start commissioning of the CTIO Ohio State Multi-Object Spectrograph (COSMOS) only if the Blanco f/8 secondary mirror is back in service and DECam operations allow appropriate resources and telescope time to be allocated.

**Status:** There was no progress during this period.

### 2.1.2 NOAO South Engineering & Technical Services

**Program Highlights**

There have been three primary foci of the NOAO South Engineering and Technical Services (NS ETS) group during FY13: (1) bring DECam to routine and optimal use as described in the first milestone below, (2) prepare for the return of the Blanco 4-m f/8 secondary mirror to Chile as noted in section 1.1.1 above, and (3) bring the SOAR Adaptive Module (SAM) to a state in which it can be offered for scientific observations. The NS ETS group also has contributed to developing TripleSpec 4 and twin multi-object spectrographs for CTIO and KPNO (COSMOS/KOSMOS), bringing the SOAR Telescope Echelle Spectrograph (STELES) to SOAR, integration and testing of the SOAR Atmospheric Dispersion Corrector, developing the TORRENT controller, repair and maintenance of Chiron (1.5-m), the Large Synoptic Survey Telescope (LSST) program, and general engineering and technical support of both mountaintops.

**Status of FY13 Milestones**

- Support commissioning of DECam as a facility instrument and its transition into normal operations, integrating it fully with the telescope and its environment to obtain the best images possible on a routine basis.

  **Status:** The commissioning of DECam, followed by science verification, took place during Q1 of FY13. Community science observations started on 1 December 2012, on a shared-risk basis. Meanwhile, the Dark Energy Survey collaboration continued with extended science verification observations through February 2013. Improvements were made to the Blanco-plus-DECam system, and community science observations are now routine operations. NS ETS resources are supporting the effort to improve the Blanco-plus-DECam system in a number of areas, most notably in developing the best possible image quality. To this extent, the group will improve the reliability of the Blanco M1 adaptive optics (AO) system. An upgrade project to increase the resolution of the M1 AO system is ongoing. Fine-tuning of the new Telescope Control System (TCS), which took place during Q1–Q3 of FY13, also improved the image quality. In Q4, the group will be working on thermal control in the dome, within both the instrument and the telescope.

- Complete the final round of development of the SOAR Adaptive-optics Module (SAM) and support its transition into normal operations.
NOAO DIVISIONS

Status: Modifications to SAM in Q1—hardware and software upgrades—improved the performance and stability of the AO loop. In Q2, the focus shifted to using SAM for science observations, exercising the system, and, while doing so, improving the interfaces. Science verification started in Q3 and will continue into Q4. SAM is offered on a shared-risk basis for semester 2013B, which runs from August 2013 through January 2014.

2.1.3 NOAO South Facilities Operations

Program Highlights

NOAO South Facilities Operation (NS FO) concentrated on completing the projects funded by the American Recovery and Reinvestment Act of 2009 (ARRA). Completed during Q1–Q3 of FY13 were the Tololo dormitory renovation and Mountain waterline replacement. The remaining ARRA projects to complete are meeting room improvements and water system work in La Serena, both of which will be done by the end of Q4 of FY13.

NS FO’s support of new, small telescope projects on Cerro Tololo continued with the completion of enclosures for the Korea Microlensing Telescope Network (KMTNet) telescope and the eighth Panchromatic Robotic Optical Monitoring and Polarimetry Telescope (PROMPT 8). That support will continue through the end of FY13 with the anticipated start of construction for the T-80 (Brazilian) Telescope and the MEarth Project of the Harvard/Smithsonian consortium.

Several other projects will involve additional work during Q4 of FY13. Logistical site support of the LSST Project has begun to ramp up as that project prepares for its Final Design Review with the expectation of a construction start in FY14. NS FO will complete the office moves at the La Serena NOAO headquarters to consolidate the new AURA divisions and the other common service groups: Operations and NOAO South Computer Infrastructure Services. A major roof repair project for the La Serena office complex is in the planning and bidding stage and is expected to be executed by the end of Q4 of FY13.

Status of FY13 Milestones

- Define and implement new Service Level Agreements. This includes a redefinition of the fee structure, as CAS and Facilities are now separate entities with CAS no longer part of NOAO.

  Status: Draft documentation of Service Level Agreements—general for all services and specific to road maintenance—was reviewed by the heads of the user programs. Their comments were incorporated, and a full draft incorporating all covered services is in progress.

- Execute maintenance contracts for primary electrical transformers and for fire alarm systems.

  Status: Fire alarm maintenance was completed in Q3. Emergency repair work was necessary to respond to a recurrent failure of the Cerro Pachón transformer. Specifications to replace that transformer are being developed along with a recommendation to management and a proposal for long-term maintenance of all the transformers.

- Define a long-term solution for the upper (north) entry to the La Serena recinto. Currently, there are two options for the north entry, neither being a long-term solution. The first option, which has been available for many years, uses an entrance from the Universidad de La Serena that the university is planning to close. The other option is an entry located at a curve in the main road. Take steps to formalize the long-term plan with the neighboring university and the Municipality.
Status: Long-term plans continue to be developed. Periodic contact is maintained with the University of La Serena to update their timeframe for continued use of the entrance across their property. Extended closures of the University gate during FY13 highlight the need for this solution.

- Complete the Cerro Tololo dormitory renovation project, and put all renovated rooms into use.
  
  Status: Completed in Q2 of FY13.

- Support the completion by NS Computer Infrastructure Services of the new common communications facility on Cerro Pachón.
  
  Status: The facility was completed in Q2. Plans were made in Q3 to coordinate with Gemini the transfer of equipment located in their facility and the timing of the required, short outage of communications on Cerro Pachón. That outage is expected to be executed in Q4. A tentative time frame of August 19–24 is scheduled that corresponds to a non-observing engineering window for Gemini.

- Complete the water system improvements on both mountains and in the La Serena recinto.
  
  Status: The mountain water system improvements were completed in Q2. During Q3, the La Serena water system improvements progressed: the well pump was replaced and the tank replacement and upgrade of the chlorination system was begun as was evaluation of valves and other infrastructure. Those items begun in Q3 will continue into Q4.

- Complete the library/meeting room/cafeteria project in La Serena.
  
  Status: All work was completed in Q2 except for construction of the exterior patio. Quotations for that work were gathered during Q3. The patio work will be completed in Q4.

2.1.4 NOAO South Computer Infrastructure Services

Program Highlights

The NOAO South Computer Infrastructures Services (NS CIS) group has had an active FY13. During Q1, three Cerro Tololo tenants were moved to autonomous subnets to prevent their traffic from impinging on the NOAO network: the Schmidt telescope, the Las Cumbres Observatory Global Telescopes, and the Panchromatic Robotic Optical Monitoring and Polarimetry Telescopes.

NS CIS staff responded to a significant outage that occurred during Q2 between the mountain summits and La Serena. While it was primarily due to a commercial power outage, failures in the Cerro Tololo generator and microwave uninterruptible power supply circuits that were caused by different sized batteries being installed uncovered a weakness in personnel training. That weakness will be corrected with a class for both NOAO and Gemini CIS staff.

Other projects took place in Q2. Tools to better control the traffic types flowing over the CTIO networks were evaluated. Installation of a new Cisco ASA firewall in La Serena will provide throughput up to 4 Gbs, removing the 100 Mbs limit that had been in place. Q2 saw the start of a project to replace old (some >10 years) and failing Polycom units. As they are expensive, they will be added selectively to budgets over a period of years.

During Q3, NS CIS purchased and installed a Barracuda Web filter to provide consistency with the filter used at NOAO North. By the end of Q3, negotiations were nearing an end for Entel to install an autonomous backup link of 20 Mb from Cerro Pachón and Cerro Tololo to La Serena. There
will also be an Internet connection for the houses on the compound that is apart from the office infrastructure.

A valued NS CIS employee who has maintained the NOAO South network infrastructure will leave NOAO at the end of June to pursue a position at Gemini. A replacement is being sought and should be hired in early Q4 of FY13.

**Status of FY13 Milestones**

- Complete a common network support facility on Cerro Pachón and transfer all backbone network systems into this facility to provide more robust and independent operations.
  
  *Status: Some work such as running fibers and making terminations at the relevant locations was completed in Q1. Moving antennas and microwave could not be completed then due to funding shortages. Currently, this project is stalled until a convenient window of time can be found when SOAR and Gemini are both in engineering time. However, the new Entel backup link, once it is obtained, may alleviate the restraints.*

- Complete the upgrade of the current 622 Mbps network backbone to the planned 1 Gbps international segment of the AURA network backbone.
  
  *Status: Essentially, this project has been completed. However, there still exists a sharing of the 1 Gbps link within Santiago. This should be fixed when REUNA completes a ring in Santiago of 10 Gbps*

- Move essential information technology (IT) services in La Serena to virtual server machines for improved reliability.
  
  *Status: Ongoing. The DNS master server was moved to a virtual machine in Q3. The one major service will be the email service.*

**2.2 NOAO NORTH**

The NOAO North (NN) division is responsible for the administration, facilities, and information technology (IT) support for NOAO activities based in southern Arizona. For program management purposes, these activities are separated into the following subprograms:

- Kitt Peak National Observatory
- NOAO North Engineering & Technical Services
- NOAO North Central Facilities Operations
- NOAO North Computer Infrastructure Services
2.2.1 Kitt Peak National Observatory

Program Highlights

Science

- In a new study using the NOAO Kitt Peak National Observatory (KPNO) Mayall 4-m telescope, observations of a large sample of stars with candidate planets identified by the NASA Kepler Mission have revealed that many of the stars, and hence their planets, are actually somewhat larger than originally thought. In addition, the researchers confirmed that planets larger than Neptune are more likely to be found orbiting stars that contain more heavy elements (such as iron) than the Sun. Small planets, however, have been discovered around stars that are both rich and poor in metals. These new results will be published by Mark Everett (NOAO), Steve Howell (Kepler Project Scientist, NASA Ames Research Center), David Silva (NOAO), and Paula Szkody (University of Washington) in the Astrophysical Journal (in press, 2013arXiv1305.0578E).

- Using the new wide-field camera, the partially populated One Degree Imager (pODI), at the WIYN 3.5-m telescope, WIYN Scientist Jayadev Rajagopal (NOAO) has found that the peculiar asteroid P/2010 A2’s tail is much longer than previously supposed. The tail is about a million...
km long, roughly three times the distance from the earth to the moon. Images taken with pODI (see Figure 4) reveal a tail that stretches over a quarter of a degree from the body of asteroid P/2010 A2. The pODI camera can currently image an area of the sky about the size of the full moon; a future upgrade will increase the size of the field to about four times as large.

- Evan Skillman (University of Minnesota) and colleagues used the KPNO Mayall 4-m telescope to obtain spectroscopic observations of an H II region in the nearby dwarf irregular galaxy Leo P. They were able to accurately measure the temperature-sensitive [O III] λ4363 line, and determine a “direct” oxygen abundance of 12 + log(O/H) = 7.17 ± 0.04. Thus, Leo P is an extremely metal deficient (XMD) galaxy, and, indeed, one of the most metal deficient star-forming galaxies ever observed. For its estimated luminosity, Leo P is consistent with the relationship between luminosity and oxygen abundance seen in nearby dwarf galaxies. Leo P exhibits normal α-element abundance ratios (Ne/O, S/O, and Ar/O) when compared to other XMD galaxies, but elevated N/O, consistent with the “delayed release” hypothesis for N/O abundances. In a recent paper in The Astronomical Journal (Skillman et al. 2013AJ....146....3S), they suggest that XMD galaxies may be divided into two classes: the relatively rare XMD emission line galaxies that are associated with starbursts triggered by infall of low-metallicity gas and the more common, relatively quiescent XMD galaxies like Leo P, with very low chemical abundances due to their intrinsically small masses.

Figure 5: The spectrum of the H II region in Leo P taken with the KPNO 4-m telescope. Note the clear detection of the temperature sensitive [O III] λ4363 emission line and the very weak strength of the [N II] λλ6548, 6584 lines, indicative of a very low abundance. Hα, Hβ, and O III λ5007 are all off scale to allow better visibility of the weaker emission lines.

Management

KPNO management remains intact from FY12, with no changes in personnel.

The Director of WIYN resigned her position in March 2013, in order to assume a position as Deputy Division Director for the Division of Astronomical Sciences at the National Science Foundation. In her absence, day-to-day operations of the WIYN facility have been managed from the KPNO Director’s Office. In June 2013, the WIYN board recommended the appointment of Dr. Eric Hooper, a staff member at the University of Wisconsin, to take over as the interim WIYN Director. This appointment is still being finalized by the University of Wisconsin.

NOAO hosted a meeting of Kitt Peak tenants at the end of March 2013, at which NSF management presented an outline of their plans and constraints for financial support of mountain infrastructure in the future. NSF has directed KPNO management to assemble a cost estimate for operations of “outside-the-enclosure” activities that are required for current tenants to carry out their science activities on Kitt Peak. Information was gathered during Q3, and that activity is nearing completion.

NOAO astronomers and KPNO management and technical personnel continued to contribute considerable effort to planning for the Big Baryon Oscillation Spectroscopic Survey (BigBOSS)
project, which has been renamed the Mid-Scale Dark Energy Spectroscopic Investigation (MS-DESI, or DESI). At the end of Q1, the Gordon and Betty Moore foundation announced the awarding of a $2.1 million grant to the Berkeley Center for Cosmological Physics to support the development of technologies required for the DESI project. These include the development of the prototype for ten advanced spectrographs that will be used by DESI and purchase of the large glass blanks for two of the four lenses in the corrector optics that will be used on the Mayall 4-m telescope to achieve the 3-degree-wide field of view planned for this project.

The KPNO director and two other NOAO managers attended a DESI collaboration meeting at the Lawrence Berkeley National Laboratory in early March 2013, to discuss use of the Mayall telescope for the experiment and to participate in discussions of alternative survey strategies for DESI.

In May 2013, the Department of Energy (DOE) announced the selection of the Mayall 4-m telescope as the preferred site for execution of DESI. The KPNO director and NOAO deputy director (ex-officio) were appointed to the DESI Interim Steering Committee by DESI Project Director Michael Levi at Lawrence Berkeley National Lab (LBNL). The responsibility of this committee is to advise the DESI project director on matters related to the DESI collaboration in advance of the formation of more formal structures and by-laws.

The NSTC head of program, who is the project manager for the NOAO DESI project, along with ~8 other NOAO staff, will attend a DESI collaboration meeting at LBNL in July 2013, to kick off activities related to preparation for the first DESI Critical Design (CD-1) review, which is anticipated to take place by the end of calendar year 2013. The Co-chairs of the DESI Community Science Advisory Committee, Constance Rockosi (UCSC) and Joan Najita (NOAO, ex-officio), along with the other members of the committee, have completed development of a White Paper that outlines plans for a number of potential community science projects that might be carried out with the DESI instrument, either during the DESI survey or after its completion.

The Delivered Image Quality assessment and improvement team for the Mayall 4-m telescope has developed a set of tests and possible improvements to the Mayall to ensure that it can deliver the best possible images at prime focus (and other foci), in anticipation of future (survey and principal investigator) demanding programs, including DESI. The first of these tests have already been carried out, and more will be executed during the upcoming summer shutdown. Information is being exchanged with scientific staff at CTIO regarding improvements that may have much in common between the Mayall and Blanco 4-m telescopes.

NOAO is proceeding with an upgrade of pODI (currently with a field of view of 24′ × 24′) to achieve a 48′ × 48′ field of view. The first foundry run to produce the required orthogonal transfer arrays (OTAs) was completed in Q3, and tests are underway and will continue during Q4 to assess the suitability of the chips prior to proceeding with a second foundry run. If the foundry runs prove successful, pODI will be decommissioned in February 2014. It is expected that the upgrade, commissioning, and science verification of the upgraded ODI will be completed during Q1 of FY15.

The repair of the WIYN dome and alterations to the HYDRA bench spectrograph room were completed in Q3 of FY13. Work on the Instrument Handling Facility (IHF), which is being installed in the refurbished Fourier Transform Spectrometer (FTS) room at the McMath-Pierce Solar Telescope, continued in Q3 and is now nearing completion with the expectation that the IHF will be ready for occupancy during Q4 of FY13.

During Q3, KP staff revised the sewer flow for the Visitor Center restroom to improve the flow and eliminate the periodic flow blockage problems and associated contamination issues. Staff replaced several deteriorated evaporative coolers and are working to complete the replacement of the Dormitory 1 heating boiler by the end of the Q4 of FY13. Other ongoing efforts to repair and/or re-
place water heaters, flooring materials, and blackout shades also should be completed by the end of the Q4 of FY13.

Tests during Q2 of the water quality on KPNO indicated that the quality is well within requirements of the Environmental Protection Agency (EPA), but the staff will continue to monitor this issue and ensure that all regulations are followed. In Q3, KPNO received a letter of acceptance from the EPA, concerning NOAO-submitted documents that responded to the EPA Administrative order received at the end of FY12, indicating that NOAO is now in full compliance.

**Kitt Peak Visitor Center**

The table below summarizes the number of visitors who participated in paid groups/programs at Kitt Peak during the first nine months of FY13.

<table>
<thead>
<tr>
<th>Group/Program</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>General public tours</td>
<td>2,197</td>
<td>2,995</td>
<td>1,638</td>
<td>6,830</td>
</tr>
<tr>
<td>School groups K-college</td>
<td>230</td>
<td>85</td>
<td>133</td>
<td>448</td>
</tr>
<tr>
<td>Special tours</td>
<td>40</td>
<td>68</td>
<td>172</td>
<td>280</td>
</tr>
<tr>
<td>VIP tours</td>
<td>51</td>
<td>74</td>
<td>34</td>
<td>159</td>
</tr>
<tr>
<td>Nightly Obs. Program</td>
<td>1,548</td>
<td>2,364</td>
<td>2,161</td>
<td>6,073</td>
</tr>
<tr>
<td>Advanced Obs. Program</td>
<td>39</td>
<td>38</td>
<td>26</td>
<td>103</td>
</tr>
<tr>
<td>Other classes &amp; workshops</td>
<td>40</td>
<td>23</td>
<td>61</td>
<td>124</td>
</tr>
<tr>
<td>Youth Group Overnights</td>
<td>NA</td>
<td>59</td>
<td>15</td>
<td>74</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td>4,145</td>
<td>5,706</td>
<td>4,240</td>
<td>14,091</td>
</tr>
</tbody>
</table>

**Status of FY13 Milestones**

- Install and commission the new Kitt Peak Ohio State Multi-Object Spectrograph (KOSMOS) on the Mayall 4-m telescope.

  **Status:** Commissioning of KOSMOS was delayed due to continued difficulties with the final assembly of the optics. Alternative lens mounting procedures were designed and approved during Q2, and work was able to continue during Q3. KOSMOS is expected to be completed in time for the commissioning, which is now scheduled for early October 2013 (observing semester 2013B). Additional commissioning time is planned for later in the observing semester.

- Complete a prioritized, cost-estimated list of Mayall 4-m improvements targeted at Delivered Image Quality, and begin work on a subset of these areas as resources permit. Efforts to investigate and improve the pointing and tracking performance of the Mayall 4-m will continue.

  **Status:** In progress. A prioritized, estimated improvements list was submitted to the KPNO director Timothy Beers. Several nights of Test and Engineering runs were executed during Q2 and Q3; additional tests are anticipated to be carried out during the coming summer shutdown in Q4. The tests done to date were aimed at evaluating and updating corrections to telescope aber-
rations applied by the 4mAPS active optics system. In Q2, thermal sensors were installed in the dome, and thermal load tests were carried out to investigate how efficiently heat can be removed from the former FTS room (proposed as a site for the DESI spectrographs). Accelerometers provided by the DESI project were installed at prime focus in Q3, and used to measure vibrations induced by standard telescope operations (slewing, dome rotation). Comprehensive tests of the pointing and tracking indicate that the current level of performance, approximately 16 arcsec rms in Right Ascension (RA) and 10 arcsec rms in Declination (Dec) is limited by the design of the incremental encoder interfacing to the telescope.

- Establish a Community Science Advisory Committee for BigBOSS.

  **Status:** Completed. A White Paper summarizing the committee’s suggestions for community science projects was delivered to the KPNO director in Q3.

- Establish routine, remote observing procedures with high-demand Mayall 4-m instruments from other NOAO sites and from third-party locations.

  **Status:** Completed during Q3 for all routinely used instruments except NEWFIRM.

- Complete refurbishment of the McMath-Pierce Fourier Transform Spectrometer (FTS) room in order to establish the new Instrument Handling Facility (IHF).

  **Status:** In progress. The contractor is executing the refurbishment and is on track to complete their activities during Q4 of FY13.

- Continue targeted building modification and/or renovation efforts of telescope and KPNO support facilities to address building deficiencies, telescope and instrumentation support system needs, and program requirements.

  **Status:** In progress.

- Complete repair of the bench spectrograph room at WIYN.

  **Status:** Completed in Q3.

### 2.2.2 NOAO North Engineering & Technical Services

**Program Highlights**

During the year, NN ETS completed design work for the Mayall mirror lift upgrade, provided support for DESI (formerly known as BigBOSS) development, completed work on the Mayall f/8 secondary mirror repair, and provided support for KPNO operations and ReSTAR instruments. KPNO operational support included diagnosis and repair of the failure in the Mayall f/8 secondary support system.

**Status of FY13 Milestones**

- Start conversion of hard-copy drawings to electronic form and begin adding them to the new documentation system.

  **Status:** The new document system was installed in Q1, and training of key personnel was completed. By the end of Q3, policies and procedures were largely in place, both for conversion and inclusion of older documents and new documents. The migration of current electronic documentations is expected to take place around the end of FY13.
• Complete conceptual design work on the Mayall mirror lift upgrade. Develop an implementation plan, including a budget and schedule.

Status: The design was completed and reviewed in March.

• Complete conceptual design work on the Mayall shutter brake replacement. Develop an implementation plan, including a budget and schedule.

Status: This work was put on hold in order to ensure the mirror lift design work could be completed in a timely fashion.

• Complete the Mayall mirror lift upgrade, including the acceptance testing.

Status: The installation work was initially planned for the summer (August/September), and the telescope schedule was planned accordingly (continued science operation, but no Cassegrain instrument changes). However, vendor quotes for key components pushed delivery very late in this period, so the installation has been rescheduled for October/November/December 2013, when a lengthy block of time with no Cassegrain instrument changes was already scheduled. Thus, the installation is delayed, but scientific use of the telescope is not impacted.

• Finalize an implementation plan for replacement of CCD systems. This requires final definition of the long-term instrument suite for the Mayall and 2.1-m telescopes.

Status: The near-term future of the small telescopes and final instrument suite at both the Mayall and WIYN are not fully defined, but it appears that at most one additional CCD system will be required beyond those modern systems already implemented or planned for KOSMOS.

• Implement and commission the replacement CCD systems. The specifics of these systems are contingent on the final long-term instrument suite for the Mayall and 2.1-m telescopes, and on the availability of resources.

Status: Priority has been given to the KOSMOS and COSMOS CCD systems (see section 2.4.2) and replacement of the failed CCD on the 2.1-m telescope. If an additional CCD system is required, the work will take place in FY14.

• Complete the Mayall structural modification concept for BigBOSS.

Status: Note that “BigBOSS” has been renamed “DESI” (Dark Energy Spectroscopic Instrument); the latter term will be used hereafter. This is an on-going effort where outside parties at Lawrence Berkeley National Laboratory (LBNL) are responsible for much of the effort. NOAO efforts have focused on the disassembly/assembly work and in providing technical support as requested to the overall effort. This work should continue through FY14, at least.

• Complete the facility modification concept for BigBOSS.

Status: This is an on-going effort where outside parties (LBNL) are responsible for much of the effort. As a result of work within the last year, it has been concluded that the spectrographs cannot be placed in the old Fourier Transform Spectrometer (FTS) room and that the Coudé lab should be used for this purpose instead. Thermal and vibration characterization has been performed. Work to define cooling loads, service access, and many other characteristics of the DESI instrument continues and should continue through FY14, at least.

• Complete the Mayall performance documentation for BigBOSS. Performance measurements should include pointing, tracking, and delivered image quality.
**Status:** This work is largely complete. One important result of the pointing/tracking effort is reinforcing the conclusion that the existing telescope control system (TCS) cannot be maintained for another decade without modification, as lower-level hardware and software are both obsolete. A plan has been developed to replace these sub-systems, while retaining as much as possible of the overall TCS.

- Complete the NOAO/BigBOSS interface plan.
  
  **Status:** This is an on-going effort; a draft set of interfaces definitions should be in place for the first DESI Critical Design Review (CD-R), which should occur around the end of calendar year 2013.

- Complete repairs to the Blanco f/8 secondary mirror.
  
  **Status:** This work was completed in March 2013, including final optical testing. No refiguring was required after the repair.

- Verify the final optical performance of the Blanco f/8 secondary mirror and ship it to CTIO.
  
  **Status:** The mirror was successfully shipped to CTIO in April 2013.

### 2.2.3 NOAO North Central Facilities Operations

**Program Highlights**

This has been a challenging year for the NOAO North Central Facilities Operations (CFO) group, with staff focused on a wide range of activities. Efforts were also limited due to unanticipated medical leaves for staff and the unexpected departure of a key craftsperson. During the year, CFO has supported the renovation work for the Kitt Peak instrument handling facility and the replacement of thirty-three single-pane window units with double-pane units. Actions are ongoing to review bids for replacement of the primary Tucson phone system with initial efforts anticipated to begin during the last quarter of the fiscal year immediately following NSF approval to award the contract. Staff members are continuing to work on bid documentation for several other planned projects for Kitt Peak and Tucson. In addition to routine building support, the maintenance staff has worked on numerous plumbing and tile repairs in addition to the restroom renovations. The summer heat continues to take its toll on the older HVAC units with repairs and replacements ongoing during the final quarter of FY13.

**Status of FY13 Milestones**

- Continue targeted building modification and renovation efforts at NOAO North Tucson to address building deficiencies and space needs.
  
  **Status:** During the second quarter, repairs were completed on various corridor floor tiles and exterior building siding. Also during that time frame, staff worked with appropriate sub-contract providers to plan and schedule the removal of deteriorated trees and the proper disposal of hazardous materials. The actual removal of the trees occurred during the third quarter. Projects are to complete a planned exterior painting project and to replace the deteriorated walkway at the rooftop modular structure will continue into the fourth quarter of FY13.

- Continue the ongoing program to upgrade the various restrooms by replacing fixtures to improve water conservation efforts and by improving the deteriorated interior finishes and accessibility.
Status: Staff completed renovation to the drafting area men’s restroom during the second quarter and worked to finish up renovations to the women’s restroom during the third quarter. Staff also spent time in the third quarter to correct plumbing drainage problems in several restrooms with plans to continue addressing additional restroom renovations and the installation of new water saving fixtures through the end of the fiscal year.

- Pursue upgrading the original, exterior, single-pane window units of the Tucson main building to improve energy efficiency and reduce sound intrusion from the new Tucson streetcar system.

Status: During the third quarter, the contractor completed the removal of approximately 36 single-pane windows in 13 offices on the Second Street side of the Tucson main building and replaced them with dual-pane, energy-efficient windows. Two additional offices that receive a significant heat gain from facing direct sunlight are scheduled to have their windows replaced during the fourth quarter of FY13. It is anticipated that additional single-pane windows will be targeted and budgeted for replacement in future fiscal years.

- Upgrade and/or replace deteriorated or obsolete portions of the mechanical air distribution system.

Status: Planned efforts to renovate portions of the building piping and air handler systems have been limited due to the unexpected absence and then third quarter departure of key staff. Other efforts in this area to occur during the fourth quarter are being directed toward replacement of older HVAC units that are experiencing compressor failures.

- Begin integration of the new building management control system installed in FY12 to help enhance control over the heating and control systems and pursue energy reductions.

Status: The new system now has full control over the operation of the central plant equipment and the majority of the building air handler systems. Where appropriate, staff are making adjustments and operational changes to reduce costs.

2.2.4 NOAO North Computer Infrastructure Services

Program Highlights

The NOAO North Computer Infrastructure Services (NN CIS) group has worked on a variety of projects during this reporting period. During Q1, a new system for VPN remote access to the NOAO-Tucson network was implemented. The new anyconnect.noao.edu system uses the RADIUS password system that also is used for the internal NOAO-WiFi wireless system. The system has been used by over 135 staff (NOAO and associated groups) since its installation. The FreeBSD Operating System (OS) was rebuilt onto new disks that replaced failed disks during Q2. This was to allow NN CIS to implement newer OS versions and to make systems more maintainable. The systems upgraded include ftp, email, ssh, logs, radius, www, Taurus, and arpwatch. While the www server was “mostly” moved to new hardware, a complete conversion was stymied by the presence of very old (decade plus) programs that do not work with new security-aware system software. Thus, the old www is being run in parallel with the new one until all the software issues can be fixed. The remaining systems (adass, scope, and dhcp-kp) were upgraded later. Also in Q2, a new backup system was installed on Kitt Peak using BackupPC software to back up the downtown servers and personal computers (PCs). During Q2 and Q3, a large amount of work was devoted to helping the AURA-CAS organization implement a private network and Internet gateway in parallel with the NOAO-Arizona network.
Due to several unfortunate incidents in FY13, the NOAO director required the CIS groups to implement Web monitors and filters. So, during the Q2–Q3 time frame, a Barracuda Web Filter 610 was installed in the NOAO-Arizona network. The Web filter interacts with the Cisco 7206 router/firewall (using the Web Cache Communication Protocol) in such a way that bulk data flows are not impeded, but outgoing Web requests are inspected for inappropriate Web addresses. Because of the technique used to implement NOAO’s public wireless network in Tucson, a separate, temporary, Cisco switch was put in place to allow the traffic on this network to be filtered by the Barracuda Web Filter. The lessons learned in this exercise will be applied to the NOAO-Tucson security network domain planning to be undertaken in Q4 of FY13.

To follow the new AURA password policies and respond to security deficiencies in NOAO systems, several internal password systems and policies were implemented in Q3. The email server (CommuniGatePro) at NOAO North was modified to use the RADIUS password infrastructure. To prepare for this, the email server was cleared of a decade’s worth of unnecessary information. The system, ssh.noao.edu, was modified to no longer accept passwords from sources outside the NOAO North local network in favor of public-private key pairs. Several of the public servers used by NOAO North staff, including ftp, Taurus, and crux, were modified to accept RADIUS passwords in place of stand-alone passwords.

In Q3, NN CIS kicked off a major effort to change the way the group supports Windows workstations (desktops/laptops/severs) at NOAO North. The effort will continue into Q4. Windows XP will no longer be supported on the NOAO network after April 2014 when Microsoft drops security patch support. Windows 2000 and earlier versions (98, 95, etc.) are already obsolete and should not be present on the network. NOAO’s current McAfee/Symantec Anti-Virus software will be replaced by tools from Shavlik that combine Anti-Virus protection with patch management (including Adobe, Java, Firefox, Chrome, Thunderbird, Microsoft, and Apple patches). All Windows workstations that are not already part of an Active Directory will be incorporated into ad.tuc.noao.edu and AURA-specified password policies will be applied. NN CIS will make every effort to insure that all operators of Windows workstations use a non-administrator account for day-to-day activities.

In Q4 of FY13, the NN CIS group will plan for and begin implementation of “secure network domains” both on Kitt Peak and in Tucson. For Kitt Peak, a system will be planned that isolates tenant networks (including Dormitory 3) from each other and from the NOAO network. If time permits, the group will begin implementation, which will include a discovery process to specify what pieces of the NOAO network must be accessible by the tenants and an engineering assessment of the existing Central Ethernet switch for Kitt Peak to determine if it is cable of implementing the necessary security rules. If necessary, new hardware will be procured. In Tucson, the NN CIS will plan a minimal security domain configuration for CIS workstations and servers to isolate them from the general network and to implement a DMZ (demilitarized zone). Using this plan, and extrapolations to other Tucson network communities, the group will determine the necessary hardware that will need to be installed in place of the Cisco 7206 firewall/gateway that is more than 10 years old (and its temporary companion discussed above). If time and budget allows, NN CIS will order and configure the new equipment.

Status of FY13 Milestones

- Implement a Windows Active Directory Domain in Tucson to include approximately 225 currently unmanaged Windows workstations, laptops, and servers in Tucson (owned by NOAO, NSO, and other organizations), and implement the AURA policies on passwords and account lockout.
**Status:** In Progress. In Q1, a member of the NN CIS staff attended a six-day training session on Windows Server 2008 R2 to help the CIS group prepare for the rollout of the Windows Active Directory system. The production Windows Active Directory (AD) system was in place by the end of Q1. During Q3, a memo was sent to the staff outlining the procedure for assimilation, which is being done gradually. Good progress was made during Q3 and will continue in Q4 on the goal of incorporating the Shavlik patch installation and virus protection into the AD system to replace the existing McAfee and Symantec anti-virus systems and ad-hoc patch control.

- Investigate and prepare a strategy for an FY14 implementation to bring approximately 100 Apple Mac workstations and laptops and approximately 225 Linux workstations, laptops, and servers under password and account lockout control.

  **Status:** In Progress. Sample systems are being obtained from vendors and tested. The ADmitMac software from Thursby software was tested during Q1. There are plans to evaluate during Q4 the DirectControl software from Centrify as a method to bring Apple Mac systems under “control” of the Windows Active Directory Domain in order to use Group Policies to enforce password and account-lockout policies.

- Begin detailed planning for Security Domains at the Mayall 4-m telescope and such domains on the rest of Kitt Peak and in Tucson that are necessary to support the Mayall Security Domains. NN CIS staff will install the Mayall Security Domains during the 2013 summer shutdown. Preliminary planning for Security Domains at the other NOAO telescopes on Kitt Peak will begin in FY13.

  **Status:** Rescheduled for FY14 due to other priorities. However, a partial revamping of the mountain networks is scheduled to begin in Q4 of FY13 in the context of isolating the tenant networks from each other and from the NOAO network.

- Begin planning for Security Domains in Tucson in preparation for an FY14–15 implementation. NN CIS staff will consult with the owners and users of the Tucson computers to define the domains and the access rules for interconnecting the domains.

  **Status:** A somewhat de-scoped project is scheduled for Q4 of FY13. NN CIS is focusing on a project that will isolate some of the CIS-administered servers and systems into a security domain that will look a lot like a DMZ. While not all-encompassing, this project is large enough to illuminate the issues.

- Incorporate the DMZ for Internet-facing servers into the Tucson Security Domain scheme.

  **Status:** Planning and hardware prototyping for the somewhat de-scoped project (per previous milestone status) is scheduled for Q4 of FY13.

- Plan and prototype the hardware needed to do the necessary routing among the Tucson Security Domains.

  **Status:** Scheduled for Q4 in the context of the two previous milestones.
2.3 NOAO SYSTEM SCIENCE CENTER

NSSC consists of four major programs that cover the main areas of user interface with the world-class telescopes and instruments within the extended network of US and international ground-based optical/infrared (O/IR) system facilities (the System): System User Support (SUS), Science Data Management (SDM), Telescope Allocation Committee (TAC) management team, and System Community Development (SCD). SUS provides end-to-end support for users of System facilities: providing technical expertise to the observing proposal process (including for NOAO’s directly managed facilities), helping users with the preparation and execution of their observations (in particular, for Gemini programs), and answering post-observing data questions. SDM supports the community’s data management needs by archiving all raw data from NOAO facilities, providing pipeline processing for selected instruments, and developing tools and pipelines for new and future projects and instruments, such as DECam, pODI, and KOSMOS. The TAC team manages the entire NOAO observing proposal process, which covers the NOAO Call for Proposals, proposal submission, ingestion of proposals into the NOAO proposal database, and hosting the TAC panel meetings that provide scientific rankings of all observing proposals submitted to NOAO. SCD leads the development of the System by engaging the community through the LSST science collaborations, working on tools that will help the community make effective use of LSST’s planned data products, planning a roadmap for the development of the System, and maintaining involvement with facilities providing ground-based optical interferometry.

2.3.1 System User Support

Program Highlights

Science

Science highlights for Q1 and Q2 included projects with time allocated through the NOAO TAC to observe with the Gemini and Keck telescopes (see the corresponding NOAO Quarterly Scientific Reports at www.noao.edu/dir/reports_archive.php for extended summaries). Among the Q1 highlights reported was the result by De Mello et al. (2012) showing intra-group pre-enrichment in interacting galaxies though GMOS-N observations; and by Mohanty et al. (2012), who constrained the role of the magnetic field in sub-stellar eclipsing binaries using spectroscopy with the Keck/High Resolution Echelle Spectrometer. The Q2 report highlighted a paper by Cooke et al. (2013) showing that damped Ly-alpha systems have been enriched by core-collapse supernova events, based partially on Keck observations; also Luhman et al. (2013) were able to obtain GMOS spectroscopy of the closest binary brown dwarf, confirming its nature.

The Q3 highlight is a new science result from the Gemini Near-Infrared Coronagraphic Imager (NICI) Planet-Finding Campaign, which includes several programs approved through the NOAO TAC, that was recently accepted for publication (Nielsen et al., arXiv:1306.1233). This important study examines the frequency of giant planets around early-type stars through high-contrast imaging of nearby B and A stars with NICI. The search for giant planets did not yield any new candidate within 400 AU projected separation from 70 stars. Statistical analysis based on the constraints from
these observations shows that very few gas-giant planets are to be found at large separation from the parent B or A stars. Uranus and Neptune analogs at distances as in our Solar System are not at all common in these type stars, and confirm that the discovery of giant planets around the star HR 8799 is not a common occurrence. These results have a profound implication on how gas-giant planets form and evolve.

Management and User Support

SUS continued to provide user support for NOAO facilities not directly operated by NOAO. During this reporting period, SUS supported Gemini proposers in several ways: by completing help-desk tickets, by supporting the NOAO TAC process, by participating in the Gemini International TAC (ITAC) process, and through the completion of the Phase II process, including mask-checking for Gemini Multi Object Spectrograph (GMOS) programs. SUS continually interacted with Gemini to improve the observing experience for US users. Most of the interaction occurred through the joint Gemini-National Gemini Offices (NGOs) bi-weekly meetings, emails, and the bi-annual Operations Working Group (OpsWG) meetings. The SUS head of program participated at the OpsWG in February where the Gemini director and the NGO heads discussed possible responsibility shifts between Gemini and the NGOs. Such discussion is active at NOAO within SUS, NSSC, and beyond, and it will be a top agenda item at the next OpsWG meeting in August 2013. The Gemini Board asked the NGOs to provide details on how to incorporate sole responsibility for Phase II verification with the current or planned staffing, and the NGOs are exploring alternative activities to support the Gemini US community.

Status of FY13 Milestones

- Provide all manner of user support for open-access time to a broad and continually evolving array of non-NOAO/non-Gemini facilities, such as Keck and MMT and continued access to CHARA or any new facilities that might be offered under NOAO-managed time.

  **Status:** In the Call for Proposals of 2013A and 2013B, NOAO offered observing time with Subaru (through Gemini exchange), MMT, Keck, CHARA, and the Anglo-Australian Telescope and pre-TAC support for CHARA, and TAC-related support for all other facilities.

- Continue effective support of US Gemini access and programs, such as Phase I and Phase II observing processes, the HelpDesk, and site visits, with the view towards productive user access to the increased number of US nights on the Gemini telescopes resulting from the UK withdrawal as well as any new observational capabilities that come online.

  **Status:** SUS continued to support all activities related to Gemini programs submitted to NOAO. Support to the US Gemini users was in the form of completion of HelpDesk tickets, technical reviews for mature and new capabilities, and acting as the first point of contact for the Gemini users.

- Provide SUS staff knowledge and expertise of the facilities that constitute the NOAO-managed suite of telescopes and instruments in support of the NOAO time allocation process (such as technical reviews).

  **Status:** SUS staff supported new capabilities in 2013A when they began support for the Gemini Multi-Conjugate Adaptive Optics System/Gemini South Adaptive Optics Imager (GeMS/GSAOI), with some members of the NGO visiting the facility and acquiring Phase II expertise through training. SUS began providing support for FLAMINGOS 2 with the 2013B observing semester; selected SUS members underwent training for the upcoming Phase II for this new instrument.
• Foster close ties and lines of communication with the new (as of 1 August 2012) Gemini directorate and staff, with the goal of promoting the effective use of the Gemini telescopes by the US user community.

\textit{Status:} The NGO heads met with the Gemini director in February 2013 during the OpsWG meeting. A conversation was begun regarding the future role of the NGOs, which might vary between partners. Following discussions within SUS and NSSC, NOAO provided input on possible developments of its role with Gemini. The interaction is continuing.

• Embark on shared missions within NSSC with SCD and SDM, such as using SUS staff System experience and scientific expertise to advise on continuing evolution of the System, or helping SDM to improve the user experience with the NOAO data archives.

\textit{Status:} SDM was involved in the conversation regarding the new NGO responsibilities and whether these could involve some SDM activities in the future.

• Work with the community, relevant committees, and NOAO staff in supporting the processes necessary to plan and procure new instruments or capabilities for NOAO and Gemini telescopes.

\textit{Status:} SUS has representation in the Gemini Science and Technology Advisory Committee (STAC), where the discussion on new instrumentation is very active at this time. The Gemini STAC met in April in Tucson; STAC recommendations included pursuing commissioning of the multi-object spectrometer mode of the FLAMINGOS-2, and upgrading the GMOS, Near-Infrared Imager, and Altair detectors and controllers.

2.3.2 Science Data Management

\textbf{Program Highlights}

The start of Dark Energy Camera (DECam) operations at CTIO at the end of Q1 has caused an enormous increase in the data flow through the End-to-End (E2E) data management system. On one night in Q3, an NOAO observing program took 786 DECam exposures with a tile-compressed data volume of 370 GB (889 GB uncompressed), all captured without incident. Total daily data volumes ingested into the archive have exceeded 1 TB on several occasions during Q3.

SDM has been operating the DECam Community Pipeline (CP) through the first three quarters of FY13. The CP has continued to evolve, and staff have provided extensive feedback to the Dark Energy Survey Data Management (DES-DM) team who developed and delivered the CP. The feedback included detailed recommendations to guide continued processing and calibration improvements. SDM anticipates that DES-DM will deliver future updates that provide proper removal of the pupil pattern, address nonlinearities at low and high count levels, provide better cross-talk corrections and bad pixel masking, and other improvements during Q4 of FY13. The SDM pipeline scientist re-orchestrated the CP operations within the framework of the NOAO High Performance Pipeline System (NHPPS), added an operator review interface and a calibration library similar to those used for the Mosaic and NEWFIRM pipelines, wrote modules to repackage the data products into the format required for the NOAO Archive, and implemented multi-image cosmic ray rejection following the same procedures used in other NOAO pipelines in Q3. CP processing is slow, and can require 24 hours per night of observations, making it difficult to keep up with the data flow and harder still to reprocess earlier observations through more recent pipeline improvements. However, CP-reduced data were regularly archived and retrieved in Q3 by users, some of whom provided useful feedback. SDM has a dedicated pipeline operator, who routinely runs all three standard pipelines (Mosaic, NEWFIRM, and DECam).
Another major focus of effort for SDM in FY13 has been the WIYN pODI Portal, Pipeline and Archive (PPA) system. The pipeline, being developed by NOAO, continued to improve with the incorporation of additional calibration steps in Q3. Basic removal of instrument signatures, world coordinate solution calibration, and stacking are all working well. Fringe removal and sky flats will be implemented in Q4 of FY13. The pODI pipeline operation transitioned from NOAO to the PPA environment there at Indiana University during Q3. At present, the pipeline only operates for data taken in static guiding mode, but future development for coherent OTA guiding is planned.

The NOAO Archive was upgraded to version 1.9 and subsequently 1.9.1 during Q3, which included a major overhaul of the underlying software infrastructure. Most notably, the Portal was converted to the JRuby platform. For users, this provides much faster response times for queries. For SDM operations, it has significantly improved the robustness of the Archive and Portal, and has led to easier and faster testing and deployment. Version 1.9 also includes the first deployment of a Simple Image Access (SIA) service, which is being tested intensively by interested expert community users. After another upcoming interim release (1.9.2), SDM plans to deploy a major new Archive upgrade, v2.0, in August 2013. Its most notable feature will be a new, easier to use, security and authentication system, to replace the National Virtual Observatory (NVO) Single Sign-On system that has been used to date. Other improvements will be the ability to ingest and store non-FITS data files, using special header files to store necessary metadata. This is a prerequisite for future plans to extend the range of data types that the Archive can serve, including non-image products delivered by NOAO Survey Programs or other contributed data products.

Members of SDM continue to provide support for the Virtual Astronomical Observatory (VAO) project, testing new services and tools before release, supporting the VAO Help Desk, and participating in VAO outreach events. Testing began in Q3 of an initial version of the VAO command-line interface (CLI) tools; a release is planned for the fall of 2013. An Image Reduction and Analysis Facility (IRAF) update (v2.16.1) is expected in August 2013. SDM is developing the data handling system (DHS) for the KOSMOS spectrograph, whose first light at the Mayall 4-m telescope is expected in October 2013.

Status of FY13 Milestones

- Continue operation of a functionally complete version of the SDM End-to-End (E2E) data management system including data capture, transport, archiving, pipeline processing (of Mosaic, NEWFIRM, and DECam data), and user access.

  **Status:** Operations have continued as normal. The total size of the NOAO data holdings is currently over 120 terabytes (not counting the redundancy copies.) DECam continues to be the most demanding instrument due to its data rate and processing requirements. There have not been any outages of user-facing services except those required by planned service upgrades.

- Operate the Dark Energy Camera (DECam) Community Pipeline received from the Dark Energy Survey (DES) project. Continue to work with the DES astronomers and developers to validate the pipeline during commissioning, science verification, and science observing.

  **Status:** The NOAO DECam Community Pipeline (CP) has been in stable operation since March 2013 with occasional target updates. Community data are being pipeline processed and associated reduced data products are archived and distributed to PIs. The DES-CP team has made great progress in understanding the remaining major instrumental artifacts and implementing improvements to the pipeline. By the end of FY13, these improvements will be delivered, tested, and put into production at NOAO.
• Continue to provide data handling and transport support for the NOAO instrumentation: Mosaic, NEWFIRM, KOSMOS, COSMOS, DECam, and pODI.

**Status:** The Data Transport System continued to work quite well in transporting DECam data to NCSA and Tucson and pODI data to Tucson and Pervasive Technologies, Inc (PTI) at Indiana University. Improvements to the system, including a new transport protocol and a Web-based monitoring tool, were completed by the SDM intern in April 2013. Deployment of the new system is expected in August 2013. Work continued through Q3 on the deployment of the KOSMOS Data Handling System with plans for a functioning system when the instrument hardware becomes available.

• Continue development of a science pipeline for the WIYN One Degree Imager (ODI) to operate within the Open Grid Computing Environment (OGCE) on the Extreme Science and Engineering Discovery Environment (XSEDE).

**Status:** The pODI pipeline developer continued development and testing of the automatic science pipeline on the SDM DECam pipeline cluster during Q3. The PPA team at PTI secured several computer nodes on a local cluster, Quarry, for deployment and remote operation of the automatic pipeline by the WIYN data analyst/operator. There are no immediate plans to deploy to XSEDE at this time. Work continues on enhanced calibration steps and evaluation of the calibrated data produced by the pipeline.

• Support the Virtual Astronomical Observatory by building extensions to the VOClient package to provide a suite of command-line tools and a Python interface to support shell scripting and user-built tools, by organizing VO Community Days and an exhibit for the winter 2013 American Astronomical Society (AAS) meeting, and by supporting the help desk and software continuous integration systems.

**Status:** By the end of Q3, the VOClient CLI tools were in final testing and awaiting approval for public release. Development of the native and VOClient versions of the PyVO interfaces are also underway with release expected this fall. SDM staff supported the April Open House for the AURA Member Representatives Meeting in Tucson, giving presentations and building exhibits. No additional VO Days are planned for this fiscal year.

• Begin a long-term project to enhance the IRAF CL scripting language for support of pipeline task development and multi-core/multi-CPU systems. These changes will include the addition of in-memory image operators and automated parallel execution that will greatly improve the desktop performance of all tasks operating on large imagers such as the DECam and ODI.

**Status:** Initial work on the extensions to the IRAF CL designed to permit user-defined functions and subroutines was begun in Q2 and continued in Q3. Long-standing bugs in the CL are being addressed as part of a general upgrade release (IRAF v2.16.1) scheduled for August 2013.

• Reduce operational overhead by migrating several services to a virtualization platform, by using a distributed version control system for operational code and configuration information, and by extending use of configuration management systems.

**Status:** Progress continued in this area in Q3. All new services and machines are now virtualized and under puppet management as they are deployed. Older machines and services are migrated as effort allows. The current focus is on reducing the time required to support normal operational workflows, and most of this work has been spent in supporting a transition to a new authentication system for the NOAO archive portal.
• Deploy a La Serena portal to give local access to the southern Mass Storage System (raw data only).

    **Status:** There was no specific progress on this item during Q3, partly because the southern Mass Storage System failed, which required significant effort to build and deploy a replacement. At the same time, to increase redundancy that was lost following NCSA’s termination of their tape service, a third mass store on spinning disk was constructed at Kitt Peak. These two stores required significant effort and expense.

• Update the archive and portal components of the End-to-End (E2E) system to incorporate the NOAO Survey Archive data holdings into the NOAO Science Archive (NSA) and merge the data sets.

    **Status:** Progress in this area is ongoing. The main area of progress has been the move to external header files as the interface for file metadata required by the Archive. The purpose is to allow the Archive to natively support a wider variety of the file types (besides FITS image data), which is a requirement for the full transition into a single Archive.

• Continue to upgrade and develop the End-to-End (E2E) system by creating a faster download client, developing an initial capability to store and retrieve FITS binary tables and non-FITS files, and creating tools to support the ingest of file associations for Mosaic reduced data and continue to maintain the NOAO Science Archive (NSA) infrastructure by investigating an upgrade of the authentication and authorization software and upgrading selected, critical third party software.

    **Status:** E2E v1.9.1 was deployed in June and added the capability of ingesting any format file into the Archive. Previously the Archive was restricted to ingesting only FITS format files. Work to replace the NVO authentication and authorization service for Archive users with a local service was completed. The new service will be deployed in E2E v2.0 on early August in alignment with the new observing semester. Work on the faster download client is expected to be completed by the end of FY13.

• Devise and deploy a plan for maintaining and upgrading the many hardware components of the End-to-End (E2E) system in the north and south.

    **Status:** A strategic plan for maintaining and upgrading the E2E hardware components in the north and south was completed in Q3. Some aspects of the plan and associated practices were tested during the builds of the new mass stores in the south and on Kitt Peak.

### 2.3.3 Time Allocation Committee

#### Program Highlights

For the 2013B semester NOAO offered public, peer-reviewed access to 14 telescopes: the Mayall 4-m, WIYN 3.5-m, and 2.1-m at Kitt Peak; the Blanco 4-m, SOAR 3.5-m, 1.5-m, 1.3-m, and 0.9-m at Cerro Tololo; Gemini North and South; Keck I and II; Subaru (through a Gemini time exchange); and the Anglo-Australian Telescope. In addition, time on the CHARA array was available for this semester, but was allocated in the previous proposal cycle. A total of 375 new proposals requesting nearly 1200 nights of telescope time were received by the proposal deadline of 28 March 2013. This was also the deadline for the submission of proposals for Survey Programs using NOAO facilities; 17 survey proposals were received. Oversubscription rates (for new programs and surveys) by telescope are available at [www.noao.edu/gateway/tac/obsreqs13b_s.html](http://www.noao.edu/gateway/tac/obsreqs13b_s.html).
The Time Allocation Committee (TAC) for 2013A met in Tucson on 5–9 November 2012. The TAC comprised eight panels (three extragalactic, three Galactic, one solar systems, and one Survey Programs), each made up of five voting members and a non-voting Chair. The panel membership is available at www.noao.edu/gateway/tac.html. The overall process was managed (and chaired) by the head of program for the TAC group. The process was successfully completed, and notices announcing the results were emailed in June 2013.

NOAO also ran a Special Call for Proposals for DECam for the 2013A semester. This call was the result of the Blanco/DECam being undersubscribed by the 2013A regular call. NOAO received 44 proposals requesting 168.1 nights (only ~40 nights were available for scheduling) in response to the special call. NOAO ran a rapid review process where the TAC met via telecon to rank-order the proposals (the panels met on 18 February 2013 and sent the rank-ordered proposals to CTIO on February 20).

NOAO is in the process of preparing the 2014A Call for Proposals.

Status of FY13 Milestones

- Work with SUS to issue calls for proposals for regular programs (twice a year) and survey programs (once a year).
  
  **Status:** Semester 2013A and B proposal cycles are complete. NOAO also ran a Special Call for CTIO/DECam proposals during the 2013A semester. NOAO is preparing the 2014A Call for Proposals.

- Convene Time Allocation Committee (TAC) panels twice a year to review the proposals and provide recommendations to the NOAO director.
  
  **Status:** The TAC process is complete for semesters 2013A and B. The TACs met on 5–9 November 2012 (2013A call) and 30 Apr–9 May 2013 (2013B call). In addition, a Special Call for CTIO/DECam proposals was held during February 2013.

- Work with the public and private observatories to prioritize and schedule the approved programs.
  
  **Status:** This was accomplished for the 2013A and 2013B semesters.

- Keep the membership of the Time Allocation Committee (TAC) panels current and ensure that they include the expertise required to review the scientific and technical aspects of the proposals.
  
  **Status:** This is complete for the 2013A and B semesters. Planning for 2014A is in progress.

- Coordinate with SUS and the private observatories to provide timely technical reviews of the proposals.
  
  **Status:** This was successfully completed for the 2013A and B semesters. Planning for 2014A is in progress.

- Ensure timely announcements of the results of the time allocation process.
  
  **Status:** This was successfully completed for the 2013A and B semesters. Planning for 2014A is in progress.
• Incorporate appropriate feedback about the time allocation process into improvements for the next proposal cycle.
  
  **Status:** The feedback from the TAC is overwhelmingly positive. The TAC team continues to work toward improving (and simplifying) the process.

• Investigate the evolution of the proposal process for KPNO as the federal investment in this observatory is divested.
  
  **Status:** No progress has been made as yet.

### 2.3.4 System Community Development

#### Program Highlights

**LSST Science**

The NOAO LSST Science group developed a proposal to prepare the community for the Large Synoptic Survey Telescope (LSST) during its construction phase. The proposed plan, which was developed in partnership with the LSST Corporation during Q1, was summarized in a white paper titled, “The NOAO LSST Community Science Center: Illuminating the Path to LSST.” The goals of the proposed LSST Community Science Center will be to: (1) provide an interface between the LSST research community and LSST Project during the construction phase, (2) stimulate LSST pathfinder scientific research in advance of the survey, and (3) help the LSST science community organize itself to meet the challenges of LSST-based research. A poster describing these plans was presented at the January 2013 AAS meeting in Long Beach, California. The white paper is available to the public at the NOAO website, [ast.noao.edu/facilities/future/lsst/lcsc](http://ast.noao.edu/facilities/future/lsst/lcsc). Throughout the remainder of FY13, NOAO staff began the initial steps for creating this Community Science Center.

NOAO LSST Science staff worked with LSST Data Management staff on developing ideas and software for science data quality analysis (SDQA). The ultimate goal of this work is to provide an interface to the scientific community, bringing their expertise to bear on the problem of LSST data quality. NOAO staff are becoming familiar with the LSST Data Management software stack, in particular, the quality analysis module.

The Operations Simulator (OPSim) project began the year with work on reducing the running time of OPSim version 2.6 by approximately a factor of five, enabling production-speed turn-around on substantial parameter studies. The OPSim group formulated the requirements, goals, and schedule for OPSim version 3.0, which will support look-ahead and alternate algorithm investigations. This version was in beta testing by the end of Q3. The group conducted several simulation studies in Q1 for LSST systems engineering, including the impact of increased detector read noise on U-band depth. The simulation post-processing suite was upgraded, including SSTAR version 3.9. Work was initiated on plans to improve the accessibility of OPSim data products to members of the community at large.

The annual organization by NOAO of the selection of new LSST science collaborations and new members for existing LSST science collaborations was delayed while membership criteria were revised by the LSST Board. The new selection took place in May 2013. There were ten proposals for membership in existing collaborations of which seven were approved.

NOAO scientists helped to organize and run a meeting on “LSST in Tucson” in February 2013 to promote Tucson-wide interaction for scientific use of LSST. A major goal was collaboration across departments and organizations. There were representatives from NOAO, the Planetary Sci-
ences Institute, and many departments at the University of Arizona (Astronomy, Physics, Computer Science, and Statistics).

Following the “LSST in Tucson” meeting, staff from NOAO initiated discussions with the University of Arizona computer science department on approaches to the problem of developing an LSST-scale transient broker. A design for the software infrastructure necessary to filter alerts was created as a result. With a computer science faculty member as PI, NOAO staff submitted an Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE) proposal to support the computer science aspects of development for a broker. Weekly meetings are being held to continue work on a prototype.

In order to facilitate science collaboration involvement in the construction phase of the LSST Project, NOAO organized a meeting for the collaboration chairs that was held in Tucson in March 2013. Each of the science collaborations was represented by at least one chair. In addition, staff from the LSST Project and the new LSST director, Steve Kahn, attended. They began the process of developing a road map for future interaction between the collaborations and the Project.

NOAO scientists ran a workshop titled “Spectroscopy in the Era of LSST,” which was held in Tucson in April 2013. Over fifty attendees discussed capabilities they would like to see for follow-up of LSST discoveries. There was representation from across the US, including public and private universities, federal facilities, and international observatories. Breakout sessions on science topics produced lists of desired capabilities. A white paper summarizing the workshop is in preparation. Presentations from the meeting can be found through the “Program” link on the NOAO website at www.noao.edu/meetings/lsst-spec.

The LSST Science group created a draft website in Q1 to provide access to the projects of the group. This documents the group’s activities and products.

Work began in Q2 to provide user support and data quality analysis for the Sloan Digital Sky Survey (SDSS) Stripe 82 data set, which was reprocessed by the LSST software development pipeline as part of their Winter 2013 Data Challenge. Results from that analysis are being used to design the Summer 2013 Data Challenge, which will re-reduce Stripe 82 in all filters and turn on additional analysis algorithms.

**Optical Interferometry Science**

NOAO worked with Georgia State University to offer community access to the Center for High Angular Resolution Astronomy (CHARA) optical interferometry array on Mt. Wilson. In the semester 2013A proposal competition, the NOAO TAC recommended five proposals for scheduling, and all have been scheduled by CHARA staff. During its four years of operation, the CHARA-NOAO optical interferometry access program has received 42 proposals, of which 16 have been scheduled.

SCD staff continued to consult with the CHARA staff on facility improvement oriented toward improving array sensitivity and science productivity. In this fiscal year, SCD contributed to technical planning and design reviews in the CHARA Phase I implementation of adaptive optics (funded) and in design studies for Phase II (in planning).

NOAO NSSC, in collaboration with Lowell Observatory, the CHARA Array, the Navy Precision Interferometer, the Observatory of Paris, and the European Interferometry Initiative, convened a two-day International Optical Interferometry Forum in Flagstaff, Arizona, 15–16 March 2013. This group met “to provide a venue for exchanges on planning, opportunities, collaborations, possible coordination, issues related to the optimization and science operation of current array facilities, and opportunities for the future.” By the conclusion of the session, the group had developed plans for a continuing annual forum meeting, as well as a number of initiatives for immediate implementa-
tion. The forum will function as an element of the International Astronomical Union Commission 54, and the officers of the commission will have the responsibility to advance the forum activities and objectives. Several recommendations, including web pages and social networking, became operational in the third quarter of FY13.

**The System Roadmap Committee**

In Q1, the System Roadmap Committee (SRC) analyzed the potential impact of the NSF Portfolio Review Committee report in the context of the US Ground-Based Optical/Infrared System. The Roadmap Committee found that the report would have a significant (adverse) impact on the health of the System and the astronomical community, with the magnitude of the impact depending on how the report is implemented. The Roadmap Committee released a statement describing the potential impact of the report and made suggestions regarding its implementation. Published in issues 24 and 25 of *Currents*, the NOAO electronic newsletter, the statement attracted over 900 endorsements from the astronomical community. The endorsing community is broadly based and includes individuals from more than 200 US institutions located in 43 states and the District of Columbia.

**Status of FY13 Milestones**

- Solicit and conduct the review of proposals for membership in the LSST Science Collaboration groups and for forming new LSST Science Collaboration groups.
  
  **Status:** Completed in May 2013.

- Host working meetings of each of the LSST Science Collaboration groups. Help the group chairs organize these meetings and ensure that results are effectively communicated to the LSST Project.
  
  **Status:** Completed. Chairs of the LSST Science Collaboration groups met in March 2013.

- Complete development of the LSST Operations Simulator (OPSim) version 3, with the enhanced capability of replaceable modules for alternate scheduling algorithms, system constraints, and environmental input, and greater flexibilities for specifying science use case requirements.
  
  **Status:** Version 3 is currently in beta testing.

- Implement and evaluate at least one alternate LSST scheduling algorithm and compare the performance with the current algorithm.
  
  **Status:** Progress on this is pending the beta testing results of OPSim version 3.

- Provide simulations and necessary, customized post-processing analysis to support LSST System Engineering performance margin investigations for the Final Design Review.
  
  **Status:** Progress on this is pending the beta testing results of OPSim version 3.

- Design and implement a software framework for systematic evaluation of LSST Merit Functions (developed in FY12) as an automated element of standard post-processing of all LSST Operations Simulator (OPSim) simulations.
  
  **Status:** An analysis of the use cases was carried out in December, and a design of the framework was completed in January. A prototype implementation was planned by the end of the third
The quarter of FY13. The draft requirements will be reviewed in July, and availability of resources will be determined at that time, with an expected completion in the August–October time range.

- Implement the Assimilator (prototyped in FY12) for the use of metrics to measure the comparative technical and science performance of LSST schedule simulations.

  **Status:** The requirements for the assimilator were defined in April, the algorithms coded and delivered in June, and beta testing was begun. It is expected that the assimilator code will be accepted in July.

- Write a statement of work describing the LSST Science Data Quality Analysis (SDQA) effort that will be reviewed and agreed to by NOAO and the LSST Project Office.

  **Status:** Ongoing, as discussions continue on how best to approach the effort.

- Install and perform basic tests of the LSST Data Management (DM) software stack and the Pipeline Quality Assessment (PipeQA) software.

  **Status:** Completed in Q1.

- Begin designing metrics to test the output of LSST Data Management (DM) software, specifically, Pipeline Quality Assessment (PipeQA), starting with the output photometry from single frames.

  **Status:** New metrics will be written as the Stripe 82 support work is completed.

- Identify potential fixes for any LSST Data Management (DM) software bugs that may be discovered through the Science Data Quality Analysis (SDQA) effort.

  **Status:** A few small bugs were discovered through the PipeQA installation and testing work, and these were fixed. Some data quality issues were discovered during analysis of the LSST reprocessed Stripe 82 data set.

- Involve LSST Science Collaboration members in the Science Data Quality Analysis (SDQA) effort as possible and necessary.

  **Status:** LSST Science Collaboration members are being involved in the LSST reprocessed Stripe 82 data analysis effort. SCD established and maintained a mailing list and wiki page in support of this outreach to the Science Collaborations.

- Use Science Data Quality Analysis (SDQA) algorithms in analysis of DECam science verification and shared-risk images.

  **Status:** No progress yet.

- Begin work on the description of a flow-down from top-level Science Data Quality Analysis (SDQA) written requirements to low-level requirements.

  **Status:** No progress yet.

- Attend weekly LSST Data Management (DM) telecons and Applications telecons as needed.

  **Status:** Ongoing.

- Develop a description and requirements specification for an LSST-scale event broker.
Status: A description and requirements specification of a prototype event broker was completed in collaboration with the University of Arizona Computer Science Department, and included as part of the NSF INSPIRE proposal submitted in May.

- Host the “Spectroscopy in the Era of LSST” workshop.

Status: The workshop was held in April 2013. A summary white paper is in preparation. Presentations from the meeting can be found through the “Program” link on the NOAO website at www.noao.edu/meetings/lsst-spec/.

- Negotiate for community access to the Center for High Angular Resolution Astronomy (CHARA) Array in 2013 and provide required support to community users and the NOAO time allocation process.

Status: The CHARA Array was announced in the NOAO 2013A Call for Proposals; proposals were received, time was allocated, and science runs were scheduled.

- Consult with CHARA on wavefront sensing improvements that will increase the productivity of the array.

Status: The final design review for Phase I of the CHARA adaptive optics implementation project was held in October 2012; fabrication is in progress. Discussions are under way with potential vendors for the unusual configuration deformable mirrors needed for Phase II of the project.

- Plan for and hold a meeting of the System Roadmap Committee in FY13 and issue a System Roadmap Report.

Status: In Q1, the SRC, led by the NOAO Office of Science head of program) and Tom Soifer (Caltech), discussed the NSF Portfolio Review report and needs of the System community and wrote a statement in response to the report that was published in the NOAO electronic newsletter Currents. The committee also created a petition website through which it received nearly 1000 endorsements from concerned members of the astronomy community. The report was forwarded to the NSF in Q2.

2.4 NOAO SYSTEM TECHNOLOGY CENTER

The NOAO System Technology Center (NSTC) is responsible for coordinating technological enhancements to the US Ground-Based Optical/Infrared System (System) by NOAO directly, in collaboration with various partner institutions, or through the Telescope System Instrumentation Program (TSIP). As such, it takes the leadership role on technical activities within NOAO that are needed to realize new telescope projects or to enhance the instrument complements on existing System telescopes operated by NOAO or other entities.

The NSTC incorporates four programs serving these goals: (1) System Instrumentation (SI), which oversees the direct efforts of NOAO to build
new instruments or enhance the performance of existing instruments for its own telescopes, for the Gemini telescopes, and for other telescopes participating in the System; (2) ReSTAR Instrumentation, which manages the implementation of NSF-funded projects for the 4-m System; (3) Telescope System Instrumentation Program (TSIP), which provides funding to other observatories for new instrumentation in return for time on their telescopes being made available to the US community through the NOAO Time Allocation Committee (TAC); and (4) LSST Technology, which provides scientific, engineering, and management support to the LSST Project and is responsible for telescope mount, enclosure design, and site work within the LSST partnership.

2.4.1 System Instrumentation

Program Highlights

Significant progress was made during the first six months of FY13 on the SOAR Adaptive optics Module (SAM). Science verification proposals were run during Q2 and Q3 and will continue into Q4. SAM is being offered on a share-risk basis to the general community for the 2013B observing semester (August 2013–January 2014).

Discussions were held with Gemini during Q1 and again in Q3 on the subject of replacements for the obsolete infrared detector controllers on the Gemini Near Infrared Spectrograph (GNIRS) and Near-Infrared Imager (NIRI). Options included the TORRENT system developed within NSTC and a commercial product (the “Leach” controller) from Astronomical Research Cameras, Inc. NSTC also discussed supporting Gemini’s efforts to incorporate either new controller into the Gemini software environment. No firm plans have been made yet due to other workloads on the necessary personnel, but planning is ongoing. Discussions were also initiated in Q2 with the Universidad de Chile about the potential use of the TORRENT controller technology developed at NOAO as part of a larger facility modernization program; again, no firm plans have yet been made.

Status of FY13 Milestones

- Implement the corrections needed to remove heat from the light path for the SOAR Adaptive Optics Module (SAM) Laser Guide Star (LGS) system, and determine whether any further technical improvements are needed to reduce the projected size of the laser spots to match the scientific requirements for good seeing correction.

  Status: Completed in Q1. Electronics boxes were relocated to remove the heat source, and the laser return spots are now consistently small enough to be captured within the wavefront sensor sub-apertures in all seeing conditions where adaptive correction is beneficial.

- By the third quarter of FY13, begin the on-sky commissioning and science verification of the entire SAM system, including development of all science user software and training for SOAR observatory support staff.

  Status: Completed in Q3. The call for science verification proposals was published in January 2013, and science verification programs were carried out during Semester 2013A (February–July 2013).

- By the end of FY13, begin community scientific use of SAM on a shared-risk basis.

  Status: Completed. The Call for Proposals for the 2013B observing semester offered SAM to the general community on a shared-risk basis. This observing will begin August 2013.
Jointly with the NOAO North Engineering & Technical Services group, begin implementation of a new documentation tracking system for Kitt Peak instruments and instrumentation projects.

Status: Completed as to NSTC engagement in Q3. The NOAO North ETS group selected a system and began importing recent engineering documents during Q2 of FY14. Documents and drawings from NSTC projects were among the first ingested into the new system.

2.4.2 ReSTAR Instrumentation

Program Highlights
During Q1 of FY13, the partnership of The Ohio State University (OSU) and NOAO determined that the glue bonding of the camera lenses for KOSMOS and COSMOS could not survive the required temperature range. The partnership then shifted its approach toward implementing liquid-coupled triplets and doublets in the cameras. During Q2, OSU completed mechanical design and prototyping of the liquid-filled cells, and the design was approved with comments by external reviewers. Late in Q2, OSU began releasing fabrication drawings to the NOAO shop, and NOAO immediately began fabrication of the camera lens cell and barrel components. In order to protect the schedule, a number of the simpler parts with more relaxed tolerances were sent to outside fabricators to enable the NOAO shop to concentrate on the more critical and complex items. Fabrication was carried out during Q3 and completed in early July 2013, and all parts were fit-tested and accepted. Assembly of the camera barrels will be carried out jointly by NOAO and OSU personnel in August, with laboratory acceptance testing of the completed instruments following immediately thereafter. Based on the progress to date, KOSMOS is scheduled to go to the Mayall 4-m telescope in October 2013.

Status of FY13 Milestones

- KOSMOS: Integrate and commission the completed instrument on the KPNO Mayall 4-m telescope.

  Status: Progress on resolving the problems with the assembly of the camera systems continues as described above. Integration on the Mayall 4-m telescope will take place after the 2013 summer shutdown, and first light is scheduled for 7 October 2013.

- COSMOS: Complete laboratory integration in The Ohio State University (OSU) instrument lab.

  Status: Progress as described above continues on resolving the problems with assembly of the camera lens system. Lab integration should be carried out during Q4 of FY13, and it will occur at NOAO in Tucson to reflect the fact that final assembly of the camera optics will take place there.

- COSMOS: Deliver the assembled instrument to CTIO and begin integration and commissioning on the Blanco 4-m telescope.

  Status: No progress was made beyond what is described above. Delivery is expected in the first months of calendar year 2014.

- TripleSpec: Receive the detectors at NOAO, modify the existing lab Dewar for testing the TripleSpec detectors, integrate the first detector (of the two needed by TripleSpec) with the test Dewar and controller electronics in the lab, and complete the optimization of the first detector.
Status: Not completed, but enough progress was made to preserve the overall instrument schedule. By the end of Q2, NOAO had received the bare multiplexer (MUX), the Engineering Grade A array (for the slit viewing camera) and the Science Grade array (for the spectrograph) from the vendor, completing the purchase contract. NOAO also received during Q2 was the International Traffic in Arms Regulations (ITAR) license from the US State Department, allowing the Chilean engineers on the project to work with the detectors in Chile; NOAO provided the security enhancements for the La Serena laboratory required by the terms of the ITAR license. After examining two existing laboratory Dewars, NOAO staff concluded that the extensive modifications needed by the existing Dewars made construction of a new test Dewar a quicker and more reliable option. The design of the test Dewar was worked on during Q3 and completed in early July 2013, and fabrication of the Dewar will be done by the end of FY13. Warm testing of the bare MUX will begin in August 2013, and cold testing of the MUX and optimization of the detectors will begin in the first quarter of FY14 after completion of the test Dewar. This schedule will still allow delivery of the optimized detector-controller systems to Cornell in time for integration into the overall instrument without delaying final delivery of the instrument to CTIO.

- TripleSpec: Support NOAO’s Cornell partner in completing the acquisition of the optics, Dewar, and other long-lead-time components, and be ready to support Cornell’s Dewar and optics integration early in FY14.

Status: Progress is continuing. The spectrograph grating was received at Cornell during Q2, and the cross-dispersing prisms were received in Q3. The Calcium Fluorite lenses for the slit-viewing imager were also received in Q3. Work on other deliverables continued on schedule. Cornell produced during Q2 and released during Q3 detailed designs for components that interface to NOAO activities such as the detector mounts.

- CTIO-Hydra CCD and Controller Upgrade: Begin integration of the new CCD and controller, and design modifications to the Dewar to accommodate the new CCD.

Status: No progress was made on this during FY13 due to the higher priority of other work at CTIO.

2.4.3 Telescope System Instrumentation Program

Program Highlights

The older of the two sub-awards for the Keck Cosmic Web Imager (KCWI)—the one supporting the Design Development Phase—was completed during Q2 by the California Association for Research in Astronomy (CARA) with the delivery of the final requirements document and design report. That sub-award was formally closed by NOAO. Oversight continued into Q3 on the remaining KCWI sub-award—the one covering the Full-Scale Development phase for construction and commissioning of the instrument. During Q2 of FY13, the KCWI team produced a revised plan for the Full-Scale Development phase, incorporating the extensive comments from a project review held in November 2012 concerning primarily the plan for integration and testing in the Caltech laboratory. In Q3, NOAO and CARA negotiated minor changes to the payment milestones under the sub-award to reflect the new project schedule.

The sub-award for the Adaptive Secondary Mirror (ASM) for the Magellan Observatory was completed in Q3 as the Mirror unit finished highly successful commissioning runs at the telescope in December 2012 and April 2013. Due to a shift in the scientific priorities of the Magellan community, the ASM will be used as commissioned with a visible/near-infrared camera called CLIO instead of the mid-infrared camera called MIRAC described in the original TSIP proposal. The ASM project
team and NOAO negotiated an amendment to the sub-award in Q2 to recognize commissioning with CLIO as satisfying the scientific requirements of the sub-award. This amendment was presented to, and approved by, the review committee chair and the lead reviewer from the review panel that recommended funding of the ASM project. It was executed in Q3 of FY13 following approval by the NSF. This sub-award was then closed.

The sub-award to The Ohio State University for the Multi-Object Double Spectrograph (MODS2) for the Large Binocular Telescope (LBT) also approached completion, with acceptance testing of MODS-2 expected in Q4 of FY13. This sub-award is expected to close by the end of FY13.

The sub-award to the Smithsonian Astrophysical Observatory (Smithsonian) for the Binospec spectrograph project continued as planned throughout FY13. Normal oversight was provided via routine monthly reports and follow-up teleconferences between NOAO and the Smithsonian project team. Overall, the team made good progress during FY13, looking toward delivery of the instrument to the MMT Observatory in early calendar year 2015.

These are the only TSIP sub-awards still outstanding.

**Status of FY13 Milestones**

- Provide regular oversight for TSIP instrumentation projects still underway.

  **Status:** Ongoing. Regular monthly reports were received from, and follow-up teleconferences held with, all projects underway. NOAO worked especially closely with the Magellan ASM and LBT MODS2 projects to assist them in advancing toward completion and close-out of the sub-awards.

2.4.4 LSST Technology

**Program Highlights**

Significant progress was made in the LSST Technology program in this reporting period to support a number of early procurement efforts and advance the design and development effort toward construction.

The summit facility design effort entered its final development phase in Q1 to move toward 100% completion. In Q2, an engineering review meeting was held in Santiago, on March 13, to confirm air compressor and water chiller specifications, finalize architectural design details, and approve of design updates to incorporate action items and errors discovered in the 90% package delivery. The 100% summit facility design package was received from ARCADIS in early July. This significant milestone was achieved through a coordinated design review and development between the ARCADIS group and the LSST engineering team. The LSST team will review the final plans to insure the nearly 200 remarks and comments compiled from the previous 90% package delivery are sufficiently addressed. Once review is complete and the facility plans are accepted (planned for mid-July), the LSST team will move forward with seeking a Chilean general contractor via an early procurement effort. The schedule is to award this activity late in calendar year 2013 (CY13).

The procurement effort for the secondary mirror (M2) fabrication was completed in Q1, with a single vendor award recommendation submitted to the LSST project manager for approval. By the end of Q3, the secondary (M2) mirror optical fabrication and cell assembly contract had been awarded to ITT Exelis and the Phase A kickoff meeting to address risk reduction was completed.

The procurement effort for the M2 Hexapod and Camera Hexapod/Rotator systems was initiated in Q1 and major progress was achieved in Q2. The Hexapod/Rotator final design review was suc-
cessfully completed on January 18, in Tucson, with external reviewers from ATST and the Hobby-Eberly Telescope (HET). As a result of the panel’s final report, the statement of work documentation was improved to maximize vendor capabilities during the initial prototype period. The Request for Proposal (RFP) bid package was released on February 7, and five compliant bids from qualified vendors were received on March 22. An internal seven-person proposal evaluation committee was established to review the bids. In late April of Q3, that committee reviewed and recommended to the LSST Project Office a vendor to be awarded the contract for the Camera Hexapod/Rotator and the Secondary Mirror (M2) Hexapod systems. The fixed price contract will fund the early design efforts to meet the stringent LSST hexapod and rotator requirements for precision pointing of large, cantilevered payloads. The contract award should be negotiated by the end of FY13.

The LSST Technology team began preparations in Q2 for the Telescope Mount Assembly (TMA) Final Design Review that was held in Tucson, on May 9–10. This meeting, led by a three-member external committee, was to assess the design maturity, review the system performance requirement, and gauge the completeness of the procurement package. The meeting also served as a vendor pre-bid conference with substantial participation of 18 members from 10 companies interested in the TMA effort. The TMA procurement effort will begin in July, with bids due in early September 2013.

The LSST software team organized and began preparations in Q1 for the Telescope Software Control Design Review that was held on 7–8 February 2013, in Tucson. The external review committee (consisting of software developers from the Advanced Technology Solar Telescope (ATST), Gemini, and DCT) examined the software code and architecture for the Telescope and Observatory Control Systems. The review panel report was received later in Q2 and approved of the chosen software plan. The report included a number of useful recommendations to improve the supporting documentation.

The LSST Project team has begun preparations for the NSF Final Design Review to be held in Tucson, the week of October 21. Substantial efforts will be focused on updating the overall basis of estimates to support the construction plan, conclusion of a number of subsystem technical reviews to support the technical approach, and refinement of the overall project schedules for consistency between subsystems.

**Status of FY13 Milestones**

- **Facility and Site:**
  - Support the completion of the summit support design effort, which is contracted with ARCADIS in Santiago; and
  - conduct a closeout review of the 100% completion summit facility design package.

  **Status:** The 100% summit facility design package was received from ARCADIS in early July. Solid modeling efforts of the design and technical review from the LSST team have enabled the cooperative completion of the design package. The final effort from the ARCADIS team will be to supply support to the procurement effort as the LSST team seeks a Chilean general contractor.

- **Dome Development:**
  - Complete the dome requirements document in preparation for external procurement, and
  - complete the dome wind/light screen prototype test design.
**Status:** The dome wind/light screen system has undergone significant redesign after the telescope elevation pointing requirements were reduced to 20 degrees (from 15 degrees). This change has enabled the design to be based upon the current Gemini telescope wind screen concept, utilizing an existing three interleaved solid panel design instead of the more complex fabric-based system previously baselined. The procurement effort for the dome enclosure, drive system, and wind/light screen system will be supported in early FY14.

- **Telescope Mount:**
  - Complete the preliminary design package for the telescope mount, including a requirements document and interface details;
  - complete the procurement package for the design and build contract; and
  - award the telescope design and fabrication contract.

**Status:** The Telescope Mount Assembly (TMA) final design review was completed successfully in early May. The procurement package documentation was authored to include a statement of work, specifications, and baseline design document. These documents were subsequently modified and updated to include the various comments supplied by the external review committee and vendor comments. The RFP bid package is scheduled for release in early July, with vendor bids due in early September to award a fixed-price design/build contract.

- **Reflective Optics:**
  - Collaborate with the LSST primary mirror vendor to evaluate the ongoing optical fabrication performance,
  - develop the initial prototype of the inner loop controller, and
  - award the secondary mirror optical fabrication contract, and work with the vendor on Phase A design and risk reduction activities.

**Status:** The M1M3 effort at the University of Arizona Steward Optical Mirror Laboratory (SOML) is scheduled for completion in late CY13. Both mirror surfaces have been polished to enable optical interferometric measurements to guide the final surface polishing effort. The LSST team had reengaged the SOML engineer team to validate the surface quality analysis to enable an efficient final acceptance testing effort.

The design of the inner loop controller (ILC) has been developed, with component selection and schematic layout completed. The contract for fabrication of the initial seven prototype boards has been awarded and delivery is scheduled for late July. Initial LabVIEW control programming of the ILC boards will be performed in-house, with micro-controller chip programming provided via local subcontract support.

**ITT Exelis** completed the kick-off meeting for the Phase A work for the M2 polishing and Cell Assembly effort. The initial tasks will focus on bread board design of optical metrology components to provide risk reduction of the planned optical fabrication metrology effort. Hologram test hardware is scheduled for delivery and prototype testing in December 2013.

- **Wavefront, Alignment and Calibration:**
  - Remove the Calypso telescope from its site, evaluate the hardware condition, and formulate a detailed refurbishment plan;
support the LSST calibration design review with input on instrument and atmospheric calibration equipment performance; and deploy the prototype active optics system curvature algorithm pipeline for hardware testing.

**Status:** The Calibration system design review is scheduled for early July to include the instrument calibration dome screen and the atmospheric calibration telescope. The current dome screen design has evolved to a more traditional reflective screen, illuminated by a tunable light source to provide incremental wavelength illumination. Due to workload constraints, the Calypso telescope will be relocated to NOAO in late CY13 to support the refurbishment plan.

- **Software and Controls:**
  - Complete the design review of the telescope control system, including external review; and
  - develop the scheduler preliminary design.

**Status:** The software development effort has continued with the preliminary design of the telescope survey scheduler through the release of the OPsim ver 3 code, which includes a look-ahead algorithm. Additional LabVIEW programming efforts will be provided to support the LSST middleware software architecture in late CY13 to improve the virtual interfaces to various subsystem components.

- **Data Management:** Develop the data management infrastructure plans, especially as they impact the summit and base facilities in Chile.

**Status:** The LSST software team continued interaction with Project Data Management to coordinate infrastructure needs to be consistent with the summit and base facilities in Chile.

- **Utility Systems:** Update the design for the electrical distribution, grounding, and utility services for the summit facility to be consistent with the 100% summit facility drawing package and any vendor-specific information from the secondary mirror and mount contracts.

**Status:** The LSST team provided input to the ARCADIS summit facility design to insure the electrical distribution and utility services for the summit facility are consistent with the needs of the major subsystem vendor designs, including the secondary mirror, the mount, and the camera team.

- **Systems Engineering:**
  - Coordinate and complete the development of level 2 telescope and site interface documents;
  - complete the requirements modeling for the telescope and site, as well as the observation control systems; and
  - update the hazard analysis and risk register of the telescope and site system.

**Status:** Systems engineering worked to update the interface documents among the telescope and site, data management, and the camera teams. Hazard analysis was performed on the major subsystems prior to the commencement of the early procurement efforts. The risk register has been reviewed and updated to support the documentation efforts.

- **Project Management:**
  - Support the project with participation as an LSST Board member and an AURA Management Council for LSST (AMCL) member,
– complete the 2012 inputs for the updated Project Management Control System, and
– support and participate in project-wide reviews.

Status: The FY13 Project Management Control System (PMCS) has been updated to include the recent, early procurement efforts for the M2 system, the Camera Hexapod/Rotator, and M2 Hexapod systems. More recent cost estimates have been accumulated to support the construction plan and the upcoming NSF Final Design Review scheduled for late October 2013.

• Operations Simulator:
  – Support the Operations Simulator (OPSim) group lead and the OPSim group’s principle interface to the LSST Project,
  – develop scientific metrics for the analysis of the OPSim output, and
  – complete the final design version of the OPSim tool set to support the LSST final design review and the preparation for construction.

Status: Release of the OPSim version 3 code was completed in late May and provided to the LSST software development team for bug checking and further code development. The new code release includes the addition of a look-ahead algorithm to be used in the eventual operational telescope survey scheduler.

• Education and Public Outreach: Support LSST graphic design tasks and website development to support design reviews and planned procurements.

Status: The LSST engineering team adopted the use of custom website pages and links to provide information transfer to support the numerous technical design reviews and procurement efforts. The websites have been extremely useful and efficient in offering equal, non-discriminatory access to multiple end users, and they have provided a superior forum for sharing data files, computer models, and documentation.
3 NOAO-WIDE PROGRAMS

3.1 OFFICE OF SCIENCE

Program Highlights
The head of the Office of Science (OS) reviewed the publication statistics for NOAO staff as part of the December 2012 visit of the Observatory Visiting Committee. The results showed that NOAO staff continue to make significant contributions to the astronomical literature, although there is dispersion in the rate at which staff members publish. The results were discussed within the AURA Observatory Visiting Committee and with the NOAO director. In Q2, the OS head of program helped organize a community-based effort to demonstrate the likely impact of community science with the Big Baryon Oscillation Spectroscopic Survey (BigBOSS). She also co-chaired the BigBOSS Community Science Committee, which completed and submitted their report to the NOAO director in May 2013. The report demonstrates the broad impact that BigBOSS—renamed Mid-Scale Dark Energy Spectroscopic Instrument (MS-DESI) in May 2013—community science would have in addressing major astronomical questions highlighted in the 2010 Decadal Survey, New Worlds, New Horizons. The results will be presented at the MS-DESI collaboration meeting in July 2013.

Status of FY13 Milestones

- Develop an implementation plan for the Responsible Conduct in Research policy.
  
  Status: No progress as yet. The implementation plan will be developed in FY14.

- Continue to develop materials for and implement a retraining program on Responsible Conduct in Research for NOAO scientific staff.

  Status: In Q1, the OS program held a successful Tuesday science coffee in Tucson on the topic of “Responsible Conduct in Research: Working in a Collaboration.” The discussion included the questions of what is a fair publication policy for a research collaboration and what should happen when collaborators do not follow the publication policy. Also discussed was the extent of individual responsibility in publications reporting collaborative research. Is one ethically responsible for everything in a publication or just the part on which one worked? If the first author is not a native English speaker, how much effort should one contribute to correcting the grammar and wording of the paper? These materials were shared with scientific staff at NOAO South.

- Provide mentoring and career development resources to staff as needed, particularly to postdoctoral researchers.

  Status: The OS head of program and others met in Q1 with Neil Barker (AURA Human Resources) to help develop a pilot mentoring program at NOAO for members of the scientific and technical staff. The program is modeled on a successful mentoring program at Gemini Observatory. Also in Q1, OS staff helped to recruit scientific staff members who are interested in participating in the design of the mentoring workshop that will introduce the program. OS staff participated in the brainstorming sessions that were part of the development process. The experience at the Gemini mentoring workshop held in Hilo was useful in helping to improve the format of the NOAO workshop. The NOAO workshop, scheduled for July 2013, will augment existing mentoring activities at NOAO.
In Q2, the OS program sponsored the “Marketing for Scientists” seminar given by astronomer Marc Kuchner (NASA Goddard Space Flight Center). It was widely attended by graduate students, post-docs, and some scientific staff.

- Develop hiring guidelines for NOAO scientific staff.

**Status:** Draft hiring guidelines were created in Q1 following discussion with the NOAO diversity advocate and other scientific staff members. The guidelines were approved by the NOAO Director and posted at www.noao.edu/os/files/SciStaffHiringGuidelines.pdf in Q2. The guidelines were provided in Q3 to the committees in charge of ongoing staff searches.

- Develop materials that promote the awareness of NOAO’s “Greatest Scientific Hits,” both lifetime, and in recent years.

**Status:** No progress as yet, due to focusing on higher priority activities.

### 3.2 EDUCATION AND PUBLIC OUTREACH

**Program Highlights**

The Education and Public Outreach (EPO) staff were involved during this reporting period in the key educational and outreach areas listed below.

**Education Outreach:** From October 2012 through June 2013, the EPO students and staff supported many local events each week. Events included the Sells Elementary School weekly after-school program, dark skies sessions for classes visiting the Cooper Center for Environmental Learning, and school star parties (some with light pollution themes). About a third of the local events were dark skies education events.

The cadre of EPO undergraduate students continued to support the building of education kits for Teaching with Telescopes, the Arizona Dark Skies and Energy Education program, and the Dark Skies Africa program as well as kits for education programs in Chile.

The EPO outreach students, who are part of NOAO’s undergraduate mentoring program, support many of our educational events. For example, they assisted with the hands-on optics and Galileoscope builds with hundreds of students at events such as the Raytheon MathMovesU in February 2013, an optics festival at St. Michael’s School in March, and a Galileoscope star party in Yuma in May. For the Tohono O’odham Nation, EPO staff and students supported NOAO booth at the Sells Rodeo and Fair in February, as well as a special educational summer camp in June on the Tohono O’odham Nation in Pisinemo. NOAO EPO had a booth and solar telescope at the two-day Tucson Festival of Books, which attracted over 100,000 participants to the University of Arizona. The NOAO EPO also hosted hands-on, astronomy-themed activities for three Family Science Nights at the Arizona-Sonora Desert Museum this summer (one each in June, July, and August), as well as dark skies education activities for 20 middle-school girls at the Arizona-Sonora Desert Museum’s Earth Camp at the Biosphere 2 in June. Dark skies education is also provided twice a year for the Tucson Amateur Astronomy Association’s Fundamental’s Class and the Girl Scouts of America lo-
Journey’s program. Overall, EPO averages about 20 educational events per month in Tucson and southern Arizona.

**Public Information Office:** The NOAO Web-based Image Gallery and the EPO program Web pages underwent considerable changes during Q2. The number of images and videos maintained in the Image Gallery was expanded and some formats were changed, new categories were added, and links to similar images were given greater visibility to make the gallery more usable. The EPO program pages were redesigned to include newer programs and highlight the programs in common between NOAO North and South. For details about the FY13 media releases produced by the Public Information Office, see the “Media Releases” section on page 47.

**Project ASTRO:** The seventeenth year of Project ASTRO at NOAO concluded with the Spring Awards Ceremony and project workshop in April 2013. This year, EPO awarded two telescopes to local schools in recognition of their important astronomy education work. A 6-inch Celestron telescope was awarded to Mesquite Elementary in Vail, Arizona, and the “Hugo Ochoa Memorial Telescope,” another 6-inch Celestron telescope decorated in honor of Hugo Ochoa, formerly of the NOAO South EPO group, was awarded to Liberty Elementary in the Sunnyside School District of South Tucson, Arizona.

EPO staff emphasized support for small, rural, and disadvantaged schools in the Project ASTRO program. Twenty new partnerships from Arizona communities that included the Tohono O’odham Tribal Nation, Marana, Safford, Sierra Vista, and Safford took part in the program. The next workshop is scheduled for 6–7 September, 2013.

**Research Experiences for Undergraduates (REU):** The NSF AST-0754223 grant—REU Site: Research Experiences for Undergraduates (REU) Site Program at Kitt Peak National Observatory—(PI: Boroson) will finish on 31 July 2013. The required Final Report and Project Outcomes Report have been written and will be submitted to the NSF when they become due 1 August 2013.

The NSF AST-1262829 grant—REU Site: Research Experiences for Undergraduates (REU) Site Program at Kitt Peak National Observatory—(PI: Mighell) was awarded in the amounts of $324,758 for FY13 through FY15 and $114,905 for FY16. The 2013 KPNO REU program is well underway. The REU students arrived in Q3 and will be busy during Q4 working on their projects and attending lectures. The following table lists the names of the 2013 KPNO REU students, the university/college that they attend, and their NOAO-North mentor:

<table>
<thead>
<tr>
<th>KPNO REU Students</th>
<th>Institution</th>
<th>Mentor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aida Behmard</td>
<td>Yale University</td>
<td>Dara Norman</td>
</tr>
<tr>
<td>Kirsten Blancato</td>
<td>Wellesley College</td>
<td>Jeyhan Kartaltepe</td>
</tr>
<tr>
<td>Jeanine Chmielewski</td>
<td>Michigan Technology University</td>
<td>Stephen Pompea</td>
</tr>
<tr>
<td>Nicholas Kutsop</td>
<td>Northern Arizona University</td>
<td>Ken Mighell</td>
</tr>
<tr>
<td>Rachel Nydegger</td>
<td>Utah State University</td>
<td>Connie Walker</td>
</tr>
<tr>
<td>Rachel Smullen</td>
<td>University of Wyoming</td>
<td>Janine Pforr</td>
</tr>
</tbody>
</table>

**Dark Skies Education Programs:** Highlights of Q1 activities included the submission of two papers presented at the International Astronomical Union (IAU) General Assembly’s special session on light pollution, a paper on illumination engineering, and three papers at the Astronomical Society of the Pacific meeting on survey results from NOAO’s dark skies programs, the Earth and Sky Photo Contest, a workshop on the science of Native American storytelling, and the annual meeting for
the International Dark Sky Association and the regional National Science Teachers Association. Presentations were given on NOAO’s Dark Skies Education programs and a preview of the 6-minute, full-dome planetarium show on light pollution. NOAO’s NASA Space Grant student presented her research results on characterizing the night sky brightness in the Tucson area over time. During December, the EPO staff convened (and presented at) four sessions of the American Geophysical Union, which included “Teacher Professional Development Programs Promoting Authentic Science Research in the Classroom” and oral and poster sessions on citizen-science. Also in December was the product of the last audio podcast on dark skies for the 365DaysOfAstronomy.org series of podcasts.

Activities at the January AAS meeting included a special session on light pollution that was organized and executed by an EPO staff member, R. Green (IAU Committee 50 president), and P. Seitzer (chair, AAS Committee on Light Pollution, RFI, and Space Debris); NOAO REU student Linsey Jensen’s research poster presentation, “Characterizing Sky Brightness throughout the Night in and around Tucson, AZ;” and a talk by NOAO staff, “A Comprehensive Approach to Dark Skies Research and Education at NOAO.”

Five GLOBE at Night worldwide campaigns were successfully held from the first third of January through May. The Adopt-a-Street project for GLOBE at Night was expanded to several other cities. About 15,000 measurements were submitted worldwide.

The Arizona Dark Skies and Energy Education program (funded by the APS Foundation) held two day-long teacher workshops during Q2 for nearly all Yuma sixth-grade teachers. Final student projects were presented on May 3 during the Yuma District One’s Family Science Night in conjunction with the Yuma Galileoscope star party for fifth grade students. Between events, iPads supplied to the teachers in the program were used to communicate with NOAO staff using FaceTime. External evaluation of the program showed very positive outcomes. Also in Q2, NOAO EPO was involved with the International Dark Skies Association and Loch Ness Productions in the creation of a free, six-minute planetarium show on light pollution called “Losing the Dark.” The video is downloadable for free in flat-screen mode for classroom use and comes in eight languages.

In Q3, NOAO EPO again chaired the Global Astronomy Month. GLOBE at Night was a centerpiece activity as well as the international Earth and Sky photo contest. The contest’s winning photos were acclaimed by MSNBC, National Geographic, Sky and Telescope, Astronomy Picture of the Day website, and The Huffington Post. A new dark skies educational outreach project was started this spring with funds awarded by the IAU Office of Astronomy for Development. Kits similar to the Arizona Dark Skies and Energy Education program were built and sent to twelve coordinators in African countries. Google+ hangout sessions have been used to instruct the coordinators and their teachers on the activities.

During Q4, two 2013 REU students, Rachel Nydegger and Jeanine Chmielewski, will be working with the EPO group to work on light pollution studies. Ms. Nydegger is working on characterizing over time the night sky brightness in and around Tucson and on nearby mountaintops, while Ms. Chmielewski is working on the evolution of the spectral energy distribution of light pollution in the Tucson area.

**Teaching with Telescopes:** The Arizona Galileoscope program continued with a combination of teacher professional development programs that worked directly with students in schools and culminated with star parties in a number of Arizona cities. The final star party with hundreds of teachers and students occurred in Flagstaff, Arizona, in October 2012. A Galileoscope star party was held at the Discovery Park science center in Safford, Arizona, in November. The Math MovesU Galileoscope build (in partnership with Raytheon) took place at the University Marriott in February 2013. The final Galileoscope star party for FY13 took place in Yuma in May.
Tohono O’odham Outreach: The number of education projects and events on the Tohono O’odham nation has continued to climb. In addition to a regular, weekly after-school program, NOAO EPO staff, helped at several science fairs, set up the NOAO booth at the three-day Tohono O’odham Rodeo and Fair in February, and initiated a Galileoscope observing program at the Bureau of Indian Affairs Tohono O’odham High School west of Sells. Plans for NOAO staff to teach elementary astronomy at Tohono O’odham Community College in the fall semester are underway.

CTIO Outreach: The EPO-South team worked with its community collaborators during FY13 in different joint projects aimed at bringing science to the Region’s students and general public. On October 2012, the team celebrated “The National Week of Science” with their Explora-CONICYT partners. All worked together to organize and participate in a series of events such as outstanding student visits to CTIO labs and telescope sites and public fairs in La Serena and Coquimbo, among other activities. Also in October, the team collaborated on workshops and talks with the XV International Amateur Astronomy Congress (CIAA2012) that took place in Iquique, in the very north of Chile. It was attended by more than 155 enthusiastic amateur astronomers.

For CTIO’S 50th Anniversary celebrations during this fiscal year, the EPO-South team collaborated closely with the CTIO Director’s Office to put together and execute activities for the community such as the CTIO 50 Years Exhibition and the additional telescope tours on Sundays that, altogether, received more than 3,000 visitors for this reporting period. The CTIO 50 Years exhibition was presented in the Jumbo Supermarket of La Serena Mall, in the Cultural Center “Palace” of Coquimbo, and at the Educational Center INACAP last May 2013. The exhibition is mounted in CADIAS and will stay there until it is presented in the Foreign Affairs Ministry in Santiago on September 2013.

The EPO-South team continued its collaboration with CEAZA (Center for Advanced Studies in Arid Zones) in the joint project “Science, education, and sustainability for the touristic development of the Region of Coquimbo.” The project, which will be implemented during a two-year period, will develop scientific-related competencies (including astronomy) in the habitants of the Punta Choros and Caleta Hornos areas, for a sustainable tourism in the Region of Coquimbo. At the beginning of Q3, the team participated in another joint project with CEAZA, called “Science Boulevard,” that was held on April 18, and included collaboration with eight other educational/scientific partner institutions. That event, held in the public park Pedro de Valdivia, was attended by over 1,600 students attending 37 schools of La Serena. There were more than 30 displays by the partner institutions showing only hands-on activities for the students. Both CEAZA-CTIO joint projects are financed by grants of CONICYT through CEAZA.

On April 22, the live performance of the Seuil Lab (www.seuil-lab.com) project “Enlace de Sueños (Connection of Dreams),” was realized on Cerro Tololo and simultaneously in three different countries through webcasting (see utv.u-strasbg.fr/index.php?id_video=299) with the support of REUNA. This project aims to connect art, astronomy, and technology through art performance.

Also in Q3, the team started an astronomy training cycle, for preschool teachers and students being trained as preschool teachers, that is related with Universidad Santo Tomás of La Serena. The training includes workshops on basic astronomy, spectroscopy, and light pollution control. This cy-
cricle was carried out throughout all of Q3 and will continue with additional activities until the end of the first semester. Seventy-five preschool teachers and 15 students will receive more than 48 hours of training.

In summary, a total of 98 different educational events were performed by the EPO-South staff during this reporting period.

**Media Releases**

There have been 12 national press releases since 1 October 2012, covering a variety of topics including the DECam dedication, the new ODI camera at WIYN, as well as various science research results from telescopes at Kitt Peak and Cerro Tololo. Three of these press releases were featured at the June meeting of the American Astronomical Society (AAS) as requested by the AAS press secretary. All of the NOAO press releases are available through the home page of the NOAO website (www.noao.edu), and the AAS press conferences and papers received considerable Internet attention.

1. NOAO: Dark Energy Camera Dedication begins Celebration of 50th Anniversary of Cerro Tololo Inter-American Observatory (November 1)
   www.noao.edu/news/2012/pr1205.php
2. NOAO: Galaxy Clusters May Offer Critical Clues to Dark Energy (November 19)
   www.noao.edu/news/2012/pr1206.php
3. WIYN/NOAO: The Bubble Nebula, Observed with the New One Degree Imager Camera (December 4)
   www.noao.edu/news/2012/pr1207.php
4. WIYN/NOAO: A Panoramic Loop in Cygnus (December 18)
   www.noao.edu/news/2012/pr1209.php
5. NOAO: A Valentine Rose (February 12)
   www.noao.edu/news/2013/pr1301.php
6. NOAO: Asteroid 2012 DA14 Speeds Away from Earth (February 18)
   www.noao.edu/news/2013/pr1302.php
7. NOAO: Star Birth in Cepheus (April 1)
   www.noao.edu/news/2013/pr1303.php
8. NOAO: A Better View with Adaptive Optics into the Heart of a Globular Cluster (April 30)
   www.noao.edu/news/2013/pr1304.php
   www.noao.edu/news/2013/pr1305.php
10. NOAO/WIYN: New Camera at WIYN Images an Asteroid with a Long Tail (June 3)
    www.wiyn.org/About/asteroidP2010A2.html
11. NOAO: Kepler Stars and Planets are Bigger than Previously Thought (June 4)
    www.noao.edu/news/2013/pr1306.php
12. NOAO: NGC 6334 - A Mini Starburst Region?
    www.noao.edu/news/2013/pr1308.php
Status of FY13 Milestones

- Lead national efforts related to the Teaching with Telescopes professional development and support program designed to amplify the educational value of the NSF Hands-On Optics program and the Galileoscope telescope kit.

  Status: NOAO led a vigorous effort with Galileoscope programs across the state. For example, in Tucson, the MathMovesU event built Galileoscopes with over 250 students. NOAO is incorporating aspects of Hands-On Optics into its new, NSF-funded project on “Colors of Nature.”

- Conduct professional development workshops and programs for formal and informal science educators in coordination with organizations such as the National Science Teachers Association (NSTA), the American Astronomical Society (AAS), Astronomical Society of the Pacific (ASP), and the Association of Science-Technology Centers (ASTC).

  Status: NOAO staff gave three workshops at the NSTA Meeting in Louisville and participated in the National Earth Science Teachers Association (NESTA) Share-a-Thon in October 2012. Four workshops were given at the NSTA meeting in Phoenix in December 2012 and participated in the NESTA Share-a-Thon at this meeting.

- Support a wide-ranging, dark skies awareness program for Chile and southern Arizona, with strong support for the national/international program Global Learning and Observations to Benefit the Environment (GLOBE) at Night started and run by NOAO.

  Status: The NOAO GLOBE at Night program was very active in Chile and the U.S. with multiple campaigns this year. NOAO’s dark skies program at the Cooper Environmental Center in Tucson has regular training sessions with classes.

- Continue to seek every opportunity to work with the Tohono O’odham Nation’s schools, community centers, and Nation Department of Education to bring science, and especially astronomy, to their students.

  Status: The program with the Nation consisted of a number of star parties at the Tohono O’odham Community College and Cultural Center as well as an afterschool science program offered each week at the Sells elementary school. The program with the Nation continues to grow and students from the Nation will participate in the “Colors of Nature” summer academy in July 2013 in Tucson.

- Support the strategic plan for NOAO South outreach and the Centro de Apoyo a la Didáctica de la Astronomía (CADIAS) astronomy teaching center in Chile. This includes dark skies education and teaching with Galileoscopes.

  Status: The EPO-South program has a large number of activities with dark skies education and the Galileoscope. These programs are being integrated into programs for the touristic observatories and into the CEAZA project.

- Support the training of guides and provide support for astronomy programs for the public at the major municipal/tourist observatories in northern Chile.

  Status: Further work was done in November in the establishment of a binocular observing program including further training of the guides at most of the touristic observatories. In particular, a more involved program on binocular astronomy with the Observatorio Cruz del Sur was progressing well through Q3 and into Q4.
3.3 NOAO DIRECTOR’S OFFICE

Program Highlights
During much of this fiscal year, the NOAO Director’s Office has been dealing with the outcome of the NSF Astronomical Sciences Portfolio Review, with three major themes: (a) supplying NSF with requested information and various “fact finding” reports, (b) developing concepts and preliminary plans for an organization with significantly reduced funding and a restructured scope of work, and (c) communicating as much as allowed by NSF with the US research community about those concepts and plans.

Significant parallel secondary activities included orchestrating: (a) the recruitment of a new associate director for NOAO South; (b) NOAO involvement in the development of the Dark Energy Spectroscopic Instrument (DESI, formerly known as BigBOSS); (c) development of a new cost model for tenant support on Kitt Peak; (d) development of a concept for an LSST Community Science Center; and (e) deeper NOAO involvement in a University of Arizona College of Science initiative for cross-campus LSST research collaboration.

Normal, steady-state programmatic activity included completion and delivery of the FY 2013 Annual Program Plan as well as the FY 2012 Fiscal Year Annual Report, initiation of the FY 2014 Annual Program Plan development process, and the delivery of numerous standard reports to NSF.

The director and his deputy attended and/or made presentations to the following committees: NSF Program Review Panel (October), AURA Observatory Visiting Committee (December, January), AURA Board of Directors (September, February, April), AURA Member Representatives (April), AURA Observatory Council (March), and NOAO Users’ Committee (May).

The director and his deputy also attended AAS meetings in January and May to interact with members of the community-at-large as well as to conduct NOAO Town Halls. On both occasions, these town halls consisted of a 30-minute presentation followed by a 30-minute question-and-answer session.

In January, at the request of NSF, the director became a member of the Gemini and TMT Boards of Directors and attended his first board meetings during May and January, respectively. The director is already a member of the LSST Board of Directors and the AURA Management Community for LSST (AMCL). Those groups met during both October and April.

The deputy director was appointed to the Giant Magellan Telescope Science Advisory Committee (GMT SAC). This committee meets monthly by phone and twice a year in person.

The director attended the “Science from the Next Generation Imaging and Spectroscopic Surveys” workshop at European Southern Observatory headquarters in Garching bei München, Germany. His presentation was titled “Wide-field Surveys at NOAO.”

The deputy director attended the Fermi Lab Physics Advisory Committee (PAC) meeting in October on behalf of the NOAO director. The PAC discussed the planning for a large spectroscopic dark energy experiment to be carried out on NOAO telescopes.

The NOAO director traveled to Chile for: (a) the DECam dedication event and NOAO South science staff retreat (deputy director attended these events as well) (November); (b) the OVC visit (January); and (c) candidate interviews for the associate director for NOAO South position (June) as well as to present the annual State of NOAO address to NOAO South employees. The deputy director traveled to Chile to attend the CTIO 50th anniversary science symposium on wide field imaging surveys where he presented a poster and also gave the conference summary.

The deputy director chaired and participated in the SOAR Science Advisory Committee (SAC) teleconference (February) and attended the GMT SAC meeting and the GMTIFS Instrument Work-
shop (Pasadena in March) as well as the NSF-initiated KPNO Tenants meeting (Tucson in March). The deputy director executed a community survey for the SOAR telescope with the help of the SOAR Science Advisory Committee and then organized the results and delivered a report to the SOAR Board.

The deputy director participated in the director’s review of the DES pre-operations review by phone (March) and then in the actual pre-operations review, held jointly for NSF and DOE at Fermilab in April. He also organized and executed the annual NOAO Users’ Committee meeting (May) and participated in the HST Cycle 21 panel review (also in May).

The NOAO Director’s Office hosted and led tours for visiting astronomers and NSF officials in this reporting period. At NOAO in February, the NOAO director, deputy director, and senior staff hosted representatives of the Korea Astronomy and Space Science Institute staff for two days. During his March visit to NOAO South, the NOAO deputy director guided tours, along with some NOAO South staff, of the NOAO South facilities for the NSF associate director for MPS and the NSF director of the Division of Astronomical Sciences. Later in March, the NOAO director took the NSF program officer for NOAO on a tour of KPNO facilities.

In mid-March, the director represented NOAO at the W.M. Keck Observatory 20th Anniversary Celebration in Kona, Hawaii.

The NOAO deputy director sat on two search committees during this period: CTIO director search and the CTIO postdoctoral search. Both committees have produced candidate short lists and presented these to NOAO management.

**Status of FY13 Milestones**

*Observatory Management*

- Develop an annual program plan for FY13, to be delivered during the first quarter of FY13.

  **Status:** Completed and delivered.

- Deliver scientific quarterly and annual progress reports as required by NSF under the terms of their cooperative agreement with AURA for the management of NOAO.

  **Status:** Quarterly reports were delivered for Q1 and 2. This document is a cumulative report that includes Q1, Q2, and Q3, and therefore satisfies the Q3 delivery. The FY 2012 Annual Fiscal Year Report was completed and delivered during Q1 of FY13.

- Prepare an action plan in response to recommendations from the NSF Astronomy Portfolio Review that affect NOAO.

  **Status:** On-going, based on frequent dialogues with NSF. With their concurrence, an NOAO Transformation Plan will be developed by the end of this fiscal year and delivered to NSF by 15 October 2013.

- Facilitate on-going management training for the NOAO senior management team.

  **Status:** There has been limited formal training this year, but the NOAO director is working with the new AURA Human Resources leadership to make this a priority for FY14.

- Continue to work on ways to improve communication between NOAO staff at all levels.
**Status:** Relative to FY12, this fiscal year has seen (a) more question-and-answer opportunities between the NOAO director and employees, (b) a new, discussion oriented format for NOAO scientific staff meetings, and (c) increased frequency of articles on the director’s internal blog.

- As necessary, support AURA with NSF-mandated reviews (e.g., Business Service Review and Mid-Term Management Review).

**Status:** The NOAO Director’s Office supported the NSF-mandated Business Service Review of the NOAO Cooperative Agreement. No Mid-Term Management Review was scheduled this fiscal year.

**Diversity Program**

- The diversity advocate will continue to maintain a national presence at meetings such as the National Society of Black & Hispanic Physicists, Society for Advancement of Chicanos and Native Americans in Science (SACNAS), in addition to the regular meeting of the AURA Workplace & Diversity Committee.

**Status:** The NOAO diversity advocate continued to participate in activities of the National Society of Black Physicists (NSBP) and the National Society of Hispanic Physicists (NSHP) as co-chair of the NSBP’s ASTRO section and as AAS councillor liaison to the AAS Committee on the Status of Minorities in Astronomy (CSMA). The diversity advocate participated as a panel member in a review of the National Radio Astronomy Observatory diversity program in June 2013.

- Insure that all short lists for staff recruitment reflect the proportion of minority candidates who have applied. Insure that procedures for hiring are outlined clearly. Work with the NOAO associate directors to help minority staff feel more included in the NOAO mission.

**Status:** The diversity advocate contributed text and comments to the NOAO Science Office program head for the NOAO Scientific Staff Hiring Guidelines. Updates on staff searches have been provided to the diversity advocate who has given information and suggestions when requested. AURA Human Resources and the diversity advocate continued to work together on a center-wide mentoring workshop that will take place in July 2013.

- Continue, in coordination with AURA, to work on broadening participation in the NSF science enterprise by engaging individuals, institutions, and geographical areas “…that do not participate in NSF research programs at rates comparable to others.” (Quote from the Executive Summary of Broadening Participation at the National Science Foundation: A Framework for Action, August 2008).

**Status:** AURA’s partnership with the Iowa, Illinois, Nebraska, STEM Partnership for Innovation in Research (IINSPIRE) will continue to be supported by the NOAO diversity advocate through her solicitation of student projects and mentors from the NOAO Engineering and Technical Services staff as well as greater participation in coordinating AURA’s support for the program.

**Safety Program**

- Review the NOAO Safety program and expand the reach and effectiveness of the program as resources allow.

**Status:** By the end of Q2, the NOAO Safety program review was completed, and a new NOAO South safety engineer had been on the job for almost three months. There was no further progress in Q3.
With the coordination of the LSST Project office, establish the members of the LSST Safety Council and participate in external safety review meetings.

**Status:** There was no progress on this during Q1 and Q2. However, in Q3, two reviewers were confirmed, with the goal of having three by the first LSST Safety Council meeting on 15 August 2013.

With coordination of the NOAO North Engineering & Technical Services manager, continue to enhance safety control measures for the Kitt Peak annual maintenance efforts during operational shutdown periods.

**Status:** Completed in Q2. The shutdown work to prepare for the removal and repair of the Mayall f/8 secondary mirror began at the end of Q3.

Begin to revise the NOAO/NSO Business Contingency Plan and the Kitt Peak Emergency Manual due to recent management changes.

**Status:** By the end of Q3, revisions to both documents were completed and both are up-to-date.

### 3.4 ARRA INFRASTRUCTURE RENEWAL

**Program Highlights**

Most of the projects funded through the American Reinvestment and Recovery Act of 2009 were completed with the end of the second quarter of FY13. During the third quarter, a short extension of the funding through to the end of the fiscal year was requested and granted to ensure that the few activities that remain on-going can be completed. Efforts are focused on completing the Kitt Peak Instrument Handling Facility, dormitory renovations at Cerro Tololo, and improvements in the La Serena facilities. Progress is noted below in the Status of FY13 Milestones section.

**Status of FY13 Milestones**

- Complete the Kitt Peak Instrument Handling Facility (IHF).

  **Status:** The planning and bid process for this project occurred during the first two quarters of FY13. The chosen contractor was busy during the third quarter of FY13 with actual facility renovation, which will be substantially complete before the end of the fourth quarter. Also during the third quarter, NOAO staff identified the instrument testing and equipment needs; procurement of the items is ongoing. It is anticipated that once the contractor’s work is done staff will complete the testing equipment installation and have the facility ready for operation before the end of the fiscal year.

- Complete dormitory renovations at CTIO.

  **Status:** Dormitory renovations were completed in December 2012.

- Complete the La Serena meeting room upgrades.

  **Status:** The project to convert an underused area of the CTIO La Serena library into a staff interaction space and a multipurpose meeting/dining area was 90% complete at the end of Q3 of FY13. The remaining work to install an outdoor patio should be completed by the end of July 2013.
• Complete the La Serena water system improvements.

  **Status:** Materials were purchased for the tank, pump, and chlorination system upgrades. Quotes for the installation were received, and the contract work is pending. This work will be completed by the end of August 2013.
## 4 FY13 BUDGET SUMMARY

**NATIONAL OPTICAL ASTRONOMY OBSERVATORY**

**BUDGET SUMMARY REPORT FOR AST-0809409**

**FY 2013 as of 6/30/2013**

<table>
<thead>
<tr>
<th>Program Area</th>
<th>Total Funds Available</th>
<th>Y-T-D Expenditures &amp; Encumbrances</th>
<th>Unencumbered Balance</th>
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<tbody>
<tr>
<td>Carryover from Prior Year</td>
<td>New Funds</td>
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</tr>
<tr>
<td><strong>NOAO South (NS)</strong></td>
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<tr>
<td>Cerro Tololo Inter-American Observatory</td>
<td>110,000</td>
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<tr>
<td>NS Computer Infrastructure Services</td>
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<td>NS Subtotal</td>
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<td><strong>NOAO North (NN)</strong></td>
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<td>Kitt Peak National Observatory</td>
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<tr>
<td>System User Support</td>
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<td>929,762</td>
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<td>Science Data Management</td>
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<td>System Community Development</td>
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<td>794,389</td>
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<td>Time Allocation Committee</td>
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<td>308,537</td>
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<td>System Instrumentation</td>
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<td>ReSTAR Instrumentation</td>
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<td>LSST Technology</td>
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<td>NSTC Subtotal</td>
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<td>1,749,771</td>
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<td><strong>Office of Science (OS)</strong></td>
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<td>Education and Public Outreach (EPO)</td>
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<td>AURA Services &amp; Fees</td>
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<td>NSTC Subtotal</td>
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<td>1,749,771</td>
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<td><strong>Total NOAO Base Programs</strong></td>
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<td>2,911,164</td>
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<td><strong>ARRA Infrastructure Renewal</strong></td>
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<td>1,023,399</td>
<td>643,468</td>
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<tr>
<td><strong>Total NOAO Programs</strong></td>
<td>5,929,786</td>
<td>25,500,000</td>
<td>31,429,786</td>
</tr>
</tbody>
</table>

**TOTAL**                                          | 5,929,786             | 25,500,000                         | 31,429,786           |
Observing proposal (request) statistics for telescope time awarded through the NOAO telescope time allocation process (TAC) are published on the NOAO web site. The proposal statistics for 2013B can be found as follows:

- **Request Statistics by Telescope**: [http://www.noao.edu/gateway/tac/obsreqs13b_s.html](http://www.noao.edu/gateway/tac/obsreqs13b_s.html)
  The statistics provided are broken down first by observatory and then by telescope and include the number of requests (proposals), nights requested, nights allocated, nights scheduled for new programs (standard and survey), and subscription rates for new programs (standard and survey).

- **Request Statistics by Instrument**: [http://www.noao.edu/gateway/tac/inst13b_s.html](http://www.noao.edu/gateway/tac/inst13b_s.html)
  The statistics provided are for the 375 new proposals (standard and survey) submitted to the 2013B NOAO TAC. They are broken down first by observatory, then by telescope and instrument with totals by telescope and include the number of proposals, “runs,” total nights and dark nights; the percentage of dark nights; and the average nights/run.
6 USAGE OF ARCHIVED DATA

The first two tables below illustrate access to and usage of reduced data in the NOAO Science Archive (R2) from NOAO Survey programs. The table on the left shows the data download volume in gigabytes, the number of files retrieved and the number of unique visitors (for that month) who downloaded archive data through the ftp site. The table on the right shows the Web activity logged from the NOAO Science Archive web site. It includes users (visitors) collecting additional information before or after downloading data, as well as visualization of the data online.

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<thead>
<tr>
<th>Date</th>
<th>Bandwidth (GB)</th>
<th>Pages Viewed</th>
<th>Unique Visitors</th>
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<tr>
<td>Oct 2012</td>
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<td>Nov 2012</td>
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<td>Dec 2012</td>
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<td>Jan 2013</td>
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<tr>
<td>May 2013</td>
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<td>4,669</td>
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</tr>
<tr>
<td>Jun 2013</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total:</td>
<td>16,633.77</td>
<td>261,779</td>
<td>312</td>
</tr>
</tbody>
</table>

The NOAO Portal provides principal investigators (PIs) access to their raw data from all instruments and to pipeline-reduced products from the Mosaic instruments at the CTIO and KPNO 4-m telescopes and the NEWFIRM instrument. The metadata are stored in a searchable Archive, which allows discovery and retrieval from the NOAO Portal (portal-nvo.noao.edu). After the requisite proprietary period (usually 18 months), the data become accessible to the general public.

<table>
<thead>
<tr>
<th>Date</th>
<th>Bandwidth (GB)</th>
<th>Pages Viewed</th>
<th>Unique Visitors</th>
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</thead>
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<tr>
<td>Oct 2012</td>
<td>60.79</td>
<td>9,064</td>
<td>1,261</td>
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<tr>
<td>Nov 2012</td>
<td>49.82</td>
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<tr>
<td>Dec 2012</td>
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<td>Jan 2013</td>
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<td>Feb 2013</td>
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<td>Mar 2013</td>
<td>72.19</td>
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<td>Apr 2013</td>
<td>53.16</td>
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<td>1,578</td>
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<tr>
<td>May 2013</td>
<td>48.95</td>
<td>10,847</td>
<td>1,381</td>
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<tr>
<td>Jun 2013</td>
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</tr>
<tr>
<td>Total:</td>
<td>494.18</td>
<td>96,672</td>
<td>12,186</td>
</tr>
</tbody>
</table>
The following table lists the grants received by NOAO staff from non-NSF agencies during the first nine months of FY 2013. (No new grants were received in either Q2 or Q3 of FY13.)

<table>
<thead>
<tr>
<th>Principle Investigator</th>
<th>Awarding Agency</th>
<th>Title</th>
<th>Budget Amount</th>
<th>Period of Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saha, Abhijit</td>
<td>STScI</td>
<td>Establishing a Network of DA White Dwarf SED Standards</td>
<td>$118,757</td>
<td>11/01/2012–10/31/2015</td>
</tr>
<tr>
<td>Dey, Arjun</td>
<td>STScI</td>
<td>Small-scale Morphology and Continuum Colors of Giant Lyα Nebulae</td>
<td>$22,266</td>
<td>10/11/2012–09/30/2015</td>
</tr>
</tbody>
</table>

Acronyms used in table:

STScI – Space Telescope Science Institute
SED – spectral energy distribution
8 NOAO SAFETY REPORT FOR Q3

Risk management support continued during the critical movements and operations of the Blanco f/8 secondary mirror both at NOAO North and South. On April 12, the mirror was loaded into a freight truck in Tucson and arrived safely in La Serena the following week. The NOAO South safety and environmental engineer provided safety oversight during critical moves in La Serena and assisted engineering with procedures development for the first-time interface between the f/8 secondary assembly and the DECam prime focus cage on the Blanco telescope. Both the NOAO South safety and environmental engineer and the NOAO risk manager participated in the f/8 Installation Review on June 20. The NOAO South safety and environmental engineer continued her work with the engineering team to verify the safe installation of the f/8 during a trial run using a dummy mirror that began on June 24. Actual installation is planned for August 2013.

The NOAO risk manager presented and participated in the LSST Telescope Mount Assembly (TMA) Design and Safety Review on May 9–10 as preparation for finalizing the TMA bid and contract documents. The hazard analysis process (a variation of Mil Standard 882) continued with the LSST telescope engineers with a focus this quarter on the camera and telescope interface. Two reviewers have been confirmed to date for the LSST Safety Council membership, with the goal of having three reviewers selected before the first LSST Safety Council meeting, which is scheduled for 15 August 2013 during the week-long LSST Joint Technical Meeting.

“Emergency Planning – The AURA/NOAO/NSO Contingency Plan” (a disaster recovery plan) was updated and improved this quarter. The plan was distributed to key management and a Plan Brief was presented to the NOAO Executive Committee on June 10. The “Open This First” document was upgraded, and the new version is located on the NOAO Safety Intranet page and is included on the Contingency Plan flash drives provided to key management. Initial actions of the contingency plan were implemented during the observation of the Sycamore Fire south of Kitt Peak on June 24–25. The Sycamore Fire died out and posed no threat to Kitt Peak.

An item in the NOAO Director’s Office News (E-News) of 26 April 2013 invited Tucson staff to sign up for the University of Arizona UAlert. This is a free service that delivers emergency alerts to University of Arizona students, faculty, staff, and their families and friends. Emergency messages are delivered via members’ cell phones, mobile devices, and/or email during a campus emergency. UAlert allows members to receive notifications about critical incidents affecting any of the University of Arizona campuses. During a critical incident, a series of messages will be sent to notify the community about the situations and provide important information and instructions. When the situation has been resolved, a final “all clear” message will be sent. UA students, employees, and their friends and families are encouraged to check the UA website and local media reports for other critical updates.

Kitt Peak observer safety information and requirements acknowledgement forms and procedures were completed this quarter. This project was a collaborative effort that included Kitt Peak scientific support, engineering, risk management, and EPO staff. Each NOAO Kitt Peak telescope control room and the administrative office sports a new, informational poster (see Figure 6) and the “Observing At Kitt Peak” web page (www.noao.edu/kpno/observer_info.shtml) includes new observer orientation instructions for the Operating Assistants and new safety acknowledgement forms for observers.
The third Advanced Technology Solar Telescope (ATST) project safety review occurred at NOAO, in Tucson, on 18 June 2013. NSF requires a project safety review every 12 months until construction is complete. The ATST safety review was conducted by a risk management (environmental, health, and safety) review committee established and chartered by the ATST Project safety manager. ATST engineers presented the current project status, current identified risks, and a 12-month projection. The review committee consists of Richard Hislop, chair (Hislop & Associates, Inc.); Joseph J. Kane (Thunder Road Consulting, LLC); Mark Grushka (MJGrushka Consulting); and the NOAO risk Manager. A report of the review committee’s findings will be submitted to the Project team on 9 July 2013.

Figure 6: New “Kitt Peak Observer Safety Information and Requirements” poster Kitt Peak telescope control rooms and administrative offices. (Image credit/design: Pete Marenfeld/NOAO/AURA/NSF.)