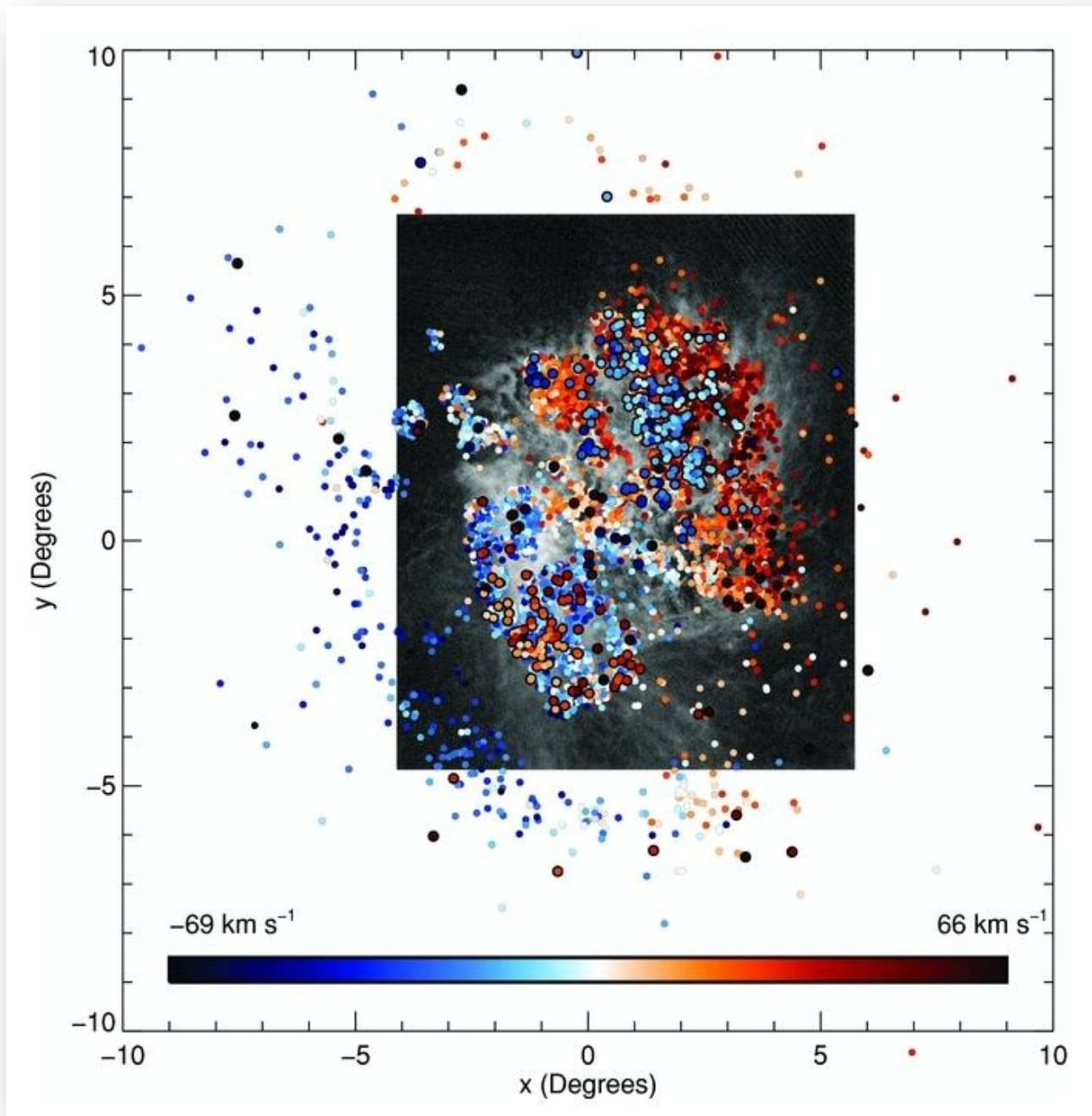


# NOAO

## Annual Program Plan FY 2012







# NATIONAL OPTICAL ASTRONOMY OBSERVATORY

## ANNUAL PROGRAM PLAN FY 2012

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**Cover Image:** Astronomers from the National Optical Astronomy Observatory (NOAO) and their collaborators have found that hundreds of the stars found in the Large Magellanic Cloud (LMC) were stolen from another nearby galaxy—the Small Magellanic Cloud (SMC). In the cover image plot, H<sub>I</sub> gas (gray scale) and stars (points) are shown projected on the sky and the line-of-sight velocities, after correction for the space motion of the LMC, are indicated by the color shading. The rotation of the LMC disk is seen as a gradient running from blue in the lower left corner to red in the upper right corner. Approximately 5% of the stars, however, emphasized by a larger point size, have the opposite gradient. (Image credit: Knut Olsen/NOAO/AURA/NSF.)

## MISSION STATEMENT

The National Optical Astronomy Observatory (NOAO) is the US national research and development center for ground-based nighttime astronomy. Its core mission is to provide access for all qualified professional researchers, via peer review, to state-of-the-art scientific capabilities. Through that access, the US research community is investigating a broad range of modern astrophysical challenges from small bodies within our own Solar System, to the most distant galaxies in the early Universe, to indirect observations of dark energy and dark matter.

To support that mission and help further US leadership in the international arena, NOAO is leading the development of the US Ground-Based Optical/Infrared (O/IR) System—the ensemble of public and private observatories dedicated to international leadership in scientific research, technical innovation, education, and public outreach.

NOAO also is leading programs that help enable a new generation of telescopes, instruments, and software tools to meet the research challenges of the next decade. In particular, NOAO is leveraging in-house scientific and technical expertise gained over 50 years to participate in the development of the Large Synoptic Survey Telescope, a unique, 8-m-class, wide-field imaging telescope, as well as major, wide-field imaging and spectroscopic surveys at the Blanco and Mayall 4-m telescopes. Together, these new facilities will make possible revolutionary advances in the physical understanding of dark energy and dark matter, galactic evolution, time-domain activity of supermassive black holes at the centers of nearby galaxies, and icy bodies in the outer reaches of our Solar System. By pushing back the frontiers of our understanding, these facilities will also surely uncover cosmic phenomena unforeseen today.

To communicate the excitement and opportunities of world-class scientific research and technology development, NOAO operates a nationally recognized Education and Public Outreach (EPO) program. The NOAO EPO program strives to promote scientific literacy and inspire young people to become explorers in science and research-based technology, especially within groups that have been historically underrepresented in the US physics and astronomy science enterprise.

The Association of Universities for Research in Astronomy (AURA) operates NOAO under a cooperative agreement with the National Science Foundation (NSF).

## EXECUTIVE SUMMARY

This is the Fiscal Year 2012 (FY12) Annual Program Plan (APP) for the National Optical Astronomy Observatory (NOAO). NOAO is the national center for ground-based, nighttime astronomy, operated by the Association of Universities for Research in Astronomy (AURA) under a cooperative agreement with the National Science Foundation (NSF).

The NOAO Long-Range Plan (FY 2011–2015) (LRP) is the starting point for the FY12 APP. Respectively, the FY12 APP and LRP provide short- and long-term planning for NOAO and mutually inform each other.

The LRP will be updated during the second quarter of FY12 in the context of the actual FY12 funding received from NSF (if available), projected base funding for FY13 (expected to be released in February 2012), and initial planning for FY13. If available, recommendations from the on-going NSF Astronomy Portfolio Review will also be taken into consideration. In turn, that LRP for FY 2012–2016 will be the starting point for the FY13 APP.

The FY12 APP presents a detailed budget plan for NOAO in the 2012 fiscal year, which begins 1 October 2011. The plan assumes \$29.15M in NSF base funding support per the FY12 President's Request. Of that amount, \$27.95M is allocated to planned activities while \$1.2M is held as an uncommitted reserve, pending clarification of the actual base funding sometime during FY12. The FY12 APP also assumes an additional \$19.2M in other funding for a total spend plan of \$48.35M.

From FY12 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).
- 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).
- 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.
- Commissioning and science verification of the Dark Energy Camera (DECam) at the Blanco 4-m telescope.
- Re-installation of the NEWFIRM wide-field near-IR imager at the Mayall 4-m telescope.
- Commissioning and science verification of the Kitt Peak Ohio State Multi-Object Spectrograph (KOSMOS) at the Mayall 4-m telescope.
- Commissioning and science verification of the Cerro Tololo Ohio State Multi-Object Spectrograph (COSMOS) at the Blanco 4-m telescope.
- NOAO contribution to the WIYN One Degree Imager (ODI) project, including on-sky commissioning of the instrument with a partially filled focal plane.
- 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).
- New detector system controllers for various instruments on Kitt Peak and Cerro Tololo based on the MONSOON/TORRENT development program.
- Program and scientific management support of various ReSTAR (Renewing Small Telescopes for Astronomical Research) Phase 1 projects.

- Design and development activity for the Large Synoptic Survey Telescope (LSST), including telescope systems and on-site support facilities.
- Science data management services that are focused on immediate NOAO needs, including science operations of the Dark Energy Camera and WIYN One Degree Imager.
- Education and Public Outreach program that is focused on critical, local activities and needs while maintaining a national (global) perspective through targeted, innovative programs.
- Technical support and program management required for instrumentation development funded through supplementary budget allocations.
- Administrative and facility operations services necessary for an organization with more than 350 employees at two geographically distributed sites.

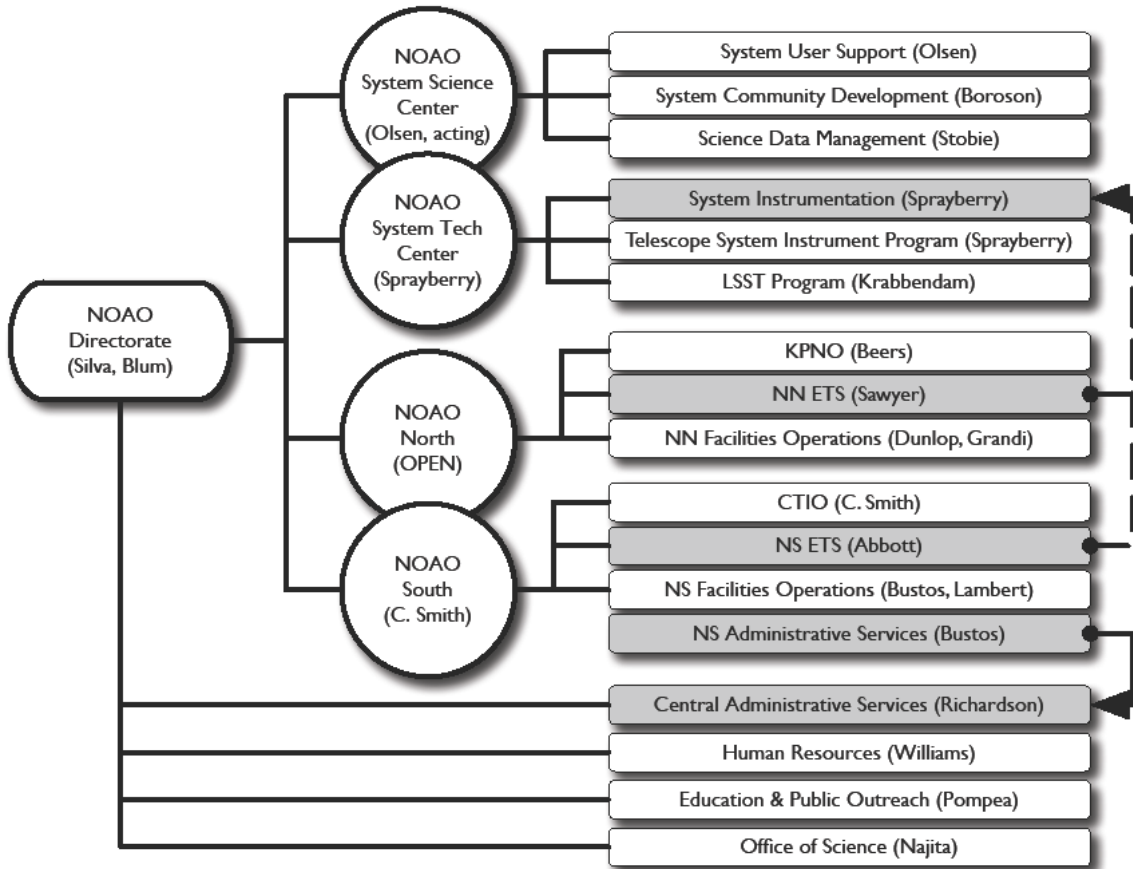
From FY12 (or earlier) NSF supplementary funding, NOAO plans to deliver and/or enable:

- Completion of the deferred maintenance catch-up and infrastructure improvement program (so-called stimulus funding from the American Recovery and Reinvestment Act of 2009).
- Annual Research Experiences for Undergraduates (REU) programs in Tucson and La Serena.
- 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.
- Additional design and development activity for LSST.
- Complete construction of a new, medium-resolution optical spectrograph for the Mayall 4-m telescope (KOSMOS) (ReSTAR Phase 1) (commissioning using base funding, see above).
- Complete construction of a new, medium-resolution optical spectrograph for the Blanco 4-m telescope (COSMOS) (ReSTAR Phase 1) (commissioning using base funding, see above).
- Start construction of a new, medium-resolution near-infrared spectrograph for the Blanco 4-m telescope (TripleSpec) (ReSTAR Phase 1).
- Participation in the development of scientific user support services for the Virtual Astronomical Observatory (VAO).

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.

# 1 ORGANIZATION AND KEY MANAGEMENT FOR FY12



The top-level NOAO organization chart for FY12 is shown in the above figure. Circles are top-level programs. Boxes are major sub-activities. Activity managers are shown in parentheses.

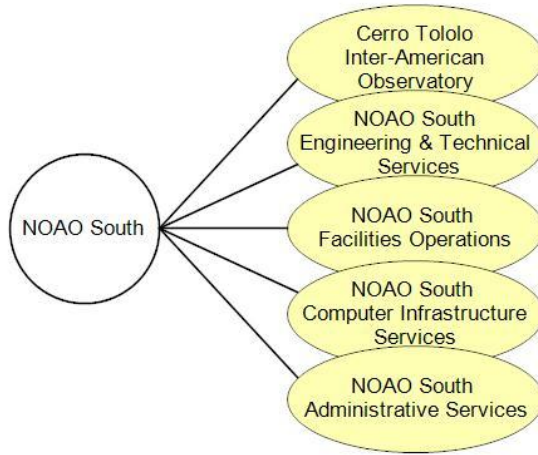
At this time, NOAO North does not have a permanent head. Silva and Blum share those duties. NOAO South Administrative Services reports to Central Administrative Services (solid arrow, shaded boxes indicate linked activities). During FY12, Central Administrative Services and NOAO South Administrative Services will be transitioning to a new business services center under the AURA Corporate Office. 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). Olsen is acting head of the NOAO System Science Center while the permanent head, Verne Smith, is on sabbatical.

## 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 Facilities Operations
- NOAO South Computer Infrastructure Services
- NOAO South Administrative Services



#### 2.1.1 Cerro Tololo Inter-American Observatory

##### Program Overview

The Cerro Tololo Inter-American Observatory (CTIO) operates the Blanco 4-m telescope on Cerro Tololo and the SOAR 4.1-m telescope on Cerro Pachón. NOAO is a 31-percent partner in the SOAR consortium. CTIO is a 25-percent partner in the Small and Moderate Aperture Research Telescope System (SMARTS) Consortium, which operates the 0.9-m, 1.0-m, 1.3-m, and 1.5-m telescopes on Cerro Tololo. CTIO serves as host for more than 10 other telescopes, including the University of Michigan 0.9-m Schmidt telescope, the GONG helioseismology station, the PROMPT gamma-ray burst follow-up telescope array, the Wisconsin H-alpha Mapper, and the Southern Association for Research in Astronomy (SARA) 0.6-m telescope. Technical expertise is provided at cost to Gemini Observatory, and there are a variety of collaborative efforts in a wide range of areas that include scientific, technical, administrative, and outreach activities.

The main focus of activity on Cerro Tololo for FY12 will be the integration, installation, and commissioning of the Dark Energy Camera (DECam) on the Blanco 4-m telescope. In FY11, the CTIO staff carried out extensive modifications to the telescope and building in preparation for the arrival of DECam, including moving and upgrading the control room and computer room of the Blanco, modifying the glycol cooling system, and upgrading the instrument maintenance facility to support work on the camera and detectors. In late FY11, the activity shifted from preparations to actual integration of various pieces of the DECam system, including the first phase of the DECam cooling system. In the second quarter of FY12, the last parts of DECam should arrive on Cerro Tololo and be tested and integrated. Also in the second quarter, the telescope will be taken offline for removal of the current prime focus cage and installation of the DECam cage, the new  $f/8$  system, and, finally, the camera itself. The magnitude of the changes to the telescope requires recommissioning both the  $f/8$  and prime focus systems, which will require most of the remainder of FY12. The installation and commissioning activities will be led by CTIO scientific and technical staff, but will rely heavily on help from the Dark Energy Survey (DES) collaboration support, mostly from Fermilab. While the first priority for CTIO is DECam, the CTIO mountain staff also will support the commissioning of COSMOS and the SOAR Adaptive-optics Module (SAM) if resources allow.

## Milestones

- Complete integration of the parts of DECam (cage, hexapod, and optics) off of the telescope and test the systems before telescope shutdown.
- Complete installation of DECam at the prime focus of the Blanco 4-m telescope.
- Recommission the telescope and instrumentation, including both the *f*/8 instrumentation and DECam at the prime focus.
- Start COSMOS commissioning only if the DECam commissioning and science verification schedule allow appropriate resources and telescope time to be allocated.
- Complete SAM commissioning only if the DECam installation and commissioning allow appropriate resources to be allocated.

## Budget Summary

Table 1 Summary of CTIO program budget

NOAO South (NS)						
Cerro Tololo Inter-American Observatory (CTIO)						
FY2012 Program Budget Summary						
Cerro Tololo Inter-American Observatory (CTIO)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
Directors Office	1.3	\$193,276	\$68,168	\$261,444	\$75,000	\$186,444
Telescope Operations	39.0	\$2,930,338	\$1,879,369	\$4,809,707	\$1,123,927	\$3,685,780
Science Research	2.7	\$359,832	\$130,119	\$489,951	-	\$489,951
User Support	1.1	\$58,956	\$99,000	\$157,956	-	\$157,956
CTIO Staff Retirements	-	-	\$150,000	\$150,000	-	\$150,000
<b>Total</b>	<b>44.1</b>	<b>\$3,542,402</b>	<b>\$2,326,656</b>	<b>\$5,869,058</b>	<b>\$1,198,927</b>	<b>\$4,670,131</b>

## Work Packages

### Director's Office

This work package accounts only for the fraction of time spent in oversight and administration of CTIO-related activities, i.e., the activities directly related to observatory operations as opposed to La Serena and other infrastructure support (see related NOAO South subprograms below). This includes the CTIO director, deputy director, and administrative support for observatory operations. The CTIO Director's Office also covers the costs of efforts to educate the public and governments on the impacts of light pollution, as well as support for the enforcement and improvement of government rules and regulations regarding light pollution.

### Telescope Operations

This package includes all of the NOAO costs associated with the operations and maintenance of the CTIO Blanco 4-m telescope and partner (SOAR, SMARTS) telescopes and instruments. The costs and efforts for all operations and support staff, including both technical and scientific support, are included. Scientific staff time includes telescope scientists who have responsibility for the instrumentation and user support of the instruments. Telescope Operations (TelOps) staff is split between operating Blanco, operating SOAR, and supporting SMARTS operations. For non-payroll expenses, the major portion is for services provided by NOAO South Facilities Operations, including meals, lodging, transport, facility maintenance, and janitorial services. Utilities, fuels, and cryogenics are also pro-

cured from NOAO South Facilities Operations, as well as miscellaneous electronic, mechanical, and computer supplies. Telescope maintenance covers scheduled replacements and an allowance for mechanical failures, as well as purchasing of major spares.

For SOAR, this work package includes scientific staff equivalent to at least one scientist, as required by the SOAR agreement. TelOps and Engineering & Technical Services (ETS) support are included at the level required for normal telescope operations. Meals, rooms, and transport for CTIO staff working on SOAR are included. Also covered is salary support for the SOAR director and administrative assistant, telescope fees, utilities, supplies, etc., as allocated by the SOAR director. These contributions are matched to the SOAR agreement, which specifies the monetary value of in-kind contributions that NOAO must provide to SOAR.

A small amount of support is provided for the SMARTS telescopes. Costs associated with the observing and technical support provided by CTIO are fully recovered from the SMARTS Consortium, while the scientific support for NOAO visiting astronomers is covered by base funds.

#### Science Research

Each NOAO scientific staff member is allocated some fraction of time that includes scientific and/or technical research, professional development activities, and external service (e.g., membership on committees whose activities benefit the astronomical community). That time is collected here proportionally for those staff members who charge functional time to CTIO.

#### User Support

This work package covers interface, scheduling, logistics, and assistance for visiting observers at all telescopes in Chile to which astronomers have access via NOAO. It includes travel costs for graduate students doing thesis research and funding to cover costs for Chilean observers, per the AURA agreement with the Chilean community. Recording and calculation of statistical data is also covered.

#### CTIO Staff Retirements

Chilean law and the AURA labor contract require severance payments to Chilean employees when they end their employment with the organization, whether through resignation, retirement, or by being laid off. Given that many of the NOAO South staff are reaching retirement age, the required payments are now carried on an explicit budget line.

## **2.1.2 NOAO South Engineering & Technical Services**

### **Program Overview**

The NOAO South Engineering & Technical Services (NS ETS) group of NOAO South provides design, fabrication, installation, and operations support for the telescopes and instrumentation on Cerro Tololo and Cerro Pachón. (ETS resources for maintenance activity on Cerro Tololo are included in the CTIO Telescope Operations work package described in section 2.1.1 above.) Its ~25 FTEs are composed of nine engineers and 16 programmers, technicians, and machinists. They are divided between four groups: computer applications, mechanics, electronics, and optics. NS ETS is based in La Serena, and members regularly travel to the telescopes when needed.

The role of NS ETS is to participate in the design, building, and installation of new instruments, functionality, and upgrades for telescopes on both mountains. Major instrument projects are usually developed under the management of the NOAO System Technology Center System Instrumentation (NSTC SI) program with the manpower and expertise of NS ETS staff. NS ETS also complements TelOps in their daily support of operations by providing additional support and expertise as required by circumstances. This support effort is budgeted and charged in the CTIO work packages. Whenever NS ETS personnel work on the mountains, it is always in tight collaboration with the TelOps group. Typical NS ETS projects have a manager, a scientist, and an engineer. The project manager is normally, but not always, drawn from the science department. Scientific oversight is also

provided by the Advisory Committee on Technical Resources. At any given time, NS ETS participates in a variety of projects and collaborations.

During FY11, most of the NS ETS resources were dedicated to moving the SOAR Adaptive-optics Module (SAM) toward completion and preparations for the arrival and installation of DECam. SAM achieved first laser light and successfully closed its adaptive-optics loop, but will require significant work in FY12 to reach full scientific operations. Various upgrades to the Blanco 4-m infrastructure were completed in FY11, including the control room, computer room, and mirror re-aluminization, but the delivery of the camera system slipped, so that installation and commissioning of DECam now fall completely in FY12. Installation of DECam and associated additional modifications to the Blanco infrastructure are the prime focus of the NS ETS group, working together with the CTIO Telescope Operations group, in FY12. Additional effort will go into supporting the completion of SAM, the CTIO Ohio State Multi-Object Spectrograph (COSMOS), and the Hydra upgrade, as well as supporting NOAO's participation in the Large Synoptic Survey Telescope (LSST) Project (work packages described in the NSTC section) and specific projects requested by SOAR.

The milestones below are those that correspond only to NOAO South division activities and, therefore, are focused on DECam. Other NS ETS milestones, in particular those regarding NSTC projects, including SAM, COSMOS, Hydra, and LSST, are included in the NSTC section.

### Milestones

- Support the complete integration and testing of the delivered DECam systems off the telescope, including tests of the camera, cage assembly, hexapod, filter changing system, shutter system, cooling system, and optics.
- Complete (together with CTIO Telescope Operations staff) the installation of DECam on the Blanco 4-m telescope.

### Budget Summary

Table 2 Summary of NS Engineering & Technical Services program budget

NOAO South (NS)						
NOAO South Engineering & Technical Services (ETS)						
FY2012 Program Budget Summary						
NS Engineering & Technical Services (ETS)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
ETS Management	1.9	\$233,474	\$23,000	\$256,474	11,637.00	\$244,837
ETS General Operations	1.1	\$55,855	\$104,890	\$160,745	-	\$160,745
Blanco & Tololo	2.8	\$257,766	\$45,000	\$302,766	-	\$302,766
DECam	7.7	\$686,919	\$146,574	\$833,493	-	\$833,493
SOAR Projects	1.7	\$144,298	-	\$144,298	\$144,298	-
<b>Total</b>	<b>15.2</b>	<b>\$1,378,312</b>	<b>\$319,464</b>	<b>\$1,697,776</b>	<b>\$155,935</b>	<b>\$1,541,841</b>

### Work Packages

#### ETS Management

The cost and effort of managing the engineering and technical groups are covered in this work package. This includes the head of program for ETS and the group leads of the Electronic Engineering, Mechanical Engineering, Optics, and Computer Applications groups. Management of the instrument shop is also covered.

ETS General Operations

This work package includes all costs associated with the maintenance of the NS ETS working environment and operations. The effort for general documentation is covered here, as well as maintenance and cleaning of ETS equipment. General laboratory supplies and materials fall within this work package, as do software licenses and limited computer upgrades. Training for the NS ETS staff is also included.

Blanco & Tololo

This package includes the costs of key upgrades and projects required for the Blanco 4-m telescope and other facilities on Cerro Tololo, including some of the infrastructure facilities that support the telescopes such as the UPS systems, telescope cooling systems, and other necessary upgrades or large-scale repairs. For FY12, this includes work on key areas of the Blanco telescope in preparation for the installation and operation of DECcam.

DECcam

As DECcam is the primary project for FY12, it is a separate work package. This includes all work related to the integration, installation, and commissioning of DECcam, including installation and testing of support systems such as the DECcam cooling system and computer systems. Much of this work will be done in collaboration with, and with a great deal of help from, visiting engineers from DES institutions, particularly Fermilab.

SOAR Projects

The SOAR work package covers the project work requested by and coordinated with the SOAR director. SOAR relies upon the NS ETS group to execute significant upgrade projects and to support the installation, modification, and commissioning of instrumentation and other systems that are delivered by other SOAR partners.

**2.1.3 NOAO South Facilities Operations****Program Overview**

The NOAO South Facilities Operations (NS FO) group is responsible for operations, maintenance, and long-term stewardship of the physical infrastructure shared by the facilities hosted by AURA Observatory (AURA-O) in Chile. This includes support buildings, housing, and miscellaneous other facilities in La Serena and on Cerro Tololo and Cerro Pachón. NS FO has direct performance and financial impact on the execution of mission-critical activities of all of the observatories at the site, including CTIO, SOAR, Gemini, and more recently LSST. The group's mission is to continue to provide cost-effective services to ensure safe and uninterrupted science operation for the diverse programs and tenants at the AURA-O sites in Chile. On the mountaintops, the NS FO group is charged with the environmental oversight and protection of 33,000 hectares of land and 38 miles of unpaved roads; five large dormitory buildings; several other buildings serving as shops, offices, and warehouses; utilities (electric, gas, telephone); kitchen/cafeteria services; and a water system including pump, storage, potable water treatment, and sewage. In La Serena, NS FO oversees 13.52 hectares of land (the *recinto*), which includes 27 houses, one 10-room dormitory building, three office buildings and laboratories of 27,200 square feet, plus 8,220 square feet of maintenance shop buildings; sewage, water system with a deep well pump, water storage, treatment, and distribution through water mains and pipes; and custodial services.

The winter (June–August) of FY11 brought the worst weather impact experienced since operations on Cerro Pachón began around 2000. Heavy snows and extreme cold took their toll on the facilities infrastructure of both Cerro Tololo and Cerro Pachón, causing problems in the water systems, electrical outages, and significant damage to the roads. Beyond the normal operations, the focus of the NS FO group for FY12 will be to complete the repairs to the water systems and electrical lines

and repair and rebuild several sections of the mountain roads, especially on Cerro Pachón, while also trying to address weaknesses in operations and recovery procedures that were exposed by the storms.

The NS FO group also is responsible for carrying out or overseeing most of the remaining projects funded by the American Recovery and Reinvestment Act of 2009 (ARRA), including dorm improvements on both Cerro Tololo and Cerro Pachón. See section 3.5 for milestones related to those projects.

### Milestones

- Reconstruct and repair sections of road damaged by the 2011 winter storms, with a focus on improving the stability and durability of roads on Cerro Pachón.
- Carry out a thorough maintenance of the water systems on both Cerro Tololo and Cerro Pachón, repairing storm damage and improving the systems to monitor water levels.
- Complete phase 3b of the Pachón dining hall/dormitory expansion, including the internal terminations and bringing the structure to full operations.
- Complete the meeting room/cafeteria project in La Serena.

### Budget Summary

Table 3 Summary of NS Facilities Operations program budget

NOAO South (NS)						
NOAO South Facilities Operations (FO)						
FY2012 Program Budget Summary						
NS Facilities Operations (FO)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
NS Central Facilities Operations	17.8	\$760,575	\$580,224	\$1,340,799	\$1,010,986	\$329,813
NS Mountain Operations	23.0	\$748,488	\$868,045	\$1,616,533	\$1,616,533	-
NS Director's Office	1.5	\$130,959	\$128,500	\$259,459	\$6,500	\$252,959
<b>Total</b>	<b>42.2</b>	<b>\$1,640,022</b>	<b>\$1,576,769</b>	<b>\$3,216,791</b>	<b>\$2,634,019</b>	<b>\$582,772</b>

### Work Packages

#### NS Central Facilities Operations

Included in this work package are the shared costs of operations of all of the AURA La Serena facilities, including warehouse, shipping/receiving, inventory control, security, water and sewer facilities, garage and transport, and the La Serena motel, as well as general maintenance and janitorial services. These activities are now integrated into NOAO South responsibilities, and all costs are recovered through charges to the programs. Also included in this work package are the costs of NOAO's share of metered facilities in La Serena, including utilities such as electricity, telephone, fuel, natural gas, and water, as well as liquid nitrogen for the laboratories. Payments for building maintenance, auto maintenance, and janitorial services are included. General safety supplies and services for the La Serena activities also are included here.

#### NS Mountain Operations

This work package covers the shared costs of operations of all AURA mountaintop facilities, including road maintenance, power line maintenance, water system maintenance, emergency medical services, communication and telephone system maintenance, kitchen operations, and dormitory operations.

### NS Director's Office

The NOAO South Director's Office coordinates all activities of NOAO in Chile, including the activities on both Cerro Tololo and Cerro Pachón, together with the facilities and administration of the La Serena campus. This package includes the NOAO South director as well as administrative support and director's office supplies for the La Serena offices. The costs of the La Serena library operations are included here as well as the funding for the NOAO South safety officer.

The costs of the wide range of student programs at NOAO South are covered in this work package. The NSF-funded Research Experiences for Undergraduates (REU) program at CTIO is incorporated here, including funding for the postdoctoral fellow who is in charge of the program. The costs of the Práctica de Investigación en Astronomía (PIA) program also are included here, together with more general "práctica" (internship) programs in engineering, technical, and administrative activities.

## **2.1.4 NOAO South Computer Infrastructure Services**

### **Program Overview**

The NOAO South Computer Infrastructure Services (NS CIS) group provides information technology (IT) support for NOAO personnel and facilities in Chile and supports the backbone communications and network infrastructure for all AURA-O facilities in Chile. Support is included for desktop computers and servers for all NOAO South staff (scientific, technical, and administrative). In support of all facilities, including Gemini, SOAR, and the tenants, NS CIS provides the network infrastructure support necessary to maintain reliable connectivity between the mountaintops (Cerro Tololo and Cerro Pachón) and La Serena as well as between La Serena and the rest of the world. The NS CIS group also provides IT support for Las Campanas Observatory at cost and will include network support for NRAO/ALMA connectivity from Santiago to the US mainland. This work package also includes payments (and cost recovery) for Internet connectivity for NOAO South and all tenants.

In FY12, NS CIS staff will integrate the DECcam computers into the network and computing infrastructure on Cerro Tololo, taking over support of the hardware systems and basic operating system maintenance. This work also includes support for the remote use of the systems for final development and debugging, as well as remote monitoring of the systems. All of these systems and remote access must be integrated within the appropriate site cyber-security policies and procedures, and incompatibilities with remote systems and policies must be ironed out. NS CIS will also bring into operation the final segment (Santiago-US) of the new 1-gigabit per second (Gbps) AURA international network backbone.

### **Milestones**

- Complete the integration of DECcam computer systems into the NOAO South network environment and take over operations and maintenance support of those systems.
- 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.
- Finalize the 1-gigabit per second (Gbps) international segment of the AURA network backbone and connect NRAO/ALMA and Las Campanas/Magellan to the upgraded backbone.

### **Budget Summary**

Table 4 Summary of NS Computer Infrastructure Services program budget

NOAO South (NS)						
NOAO South Computer Infrastructure Services (CIS)						
FY2012 Program Budget Summary						
NS Computer Infrastructure Services (CIS)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
NOAO South CIS	4.3	\$328,475	\$151,000	\$479,475	\$10,000	\$469,475
Las Campanas Support	0.7	\$66,051	-	\$66,051	\$60,000	\$6,051
AURA Santiago	0.2	\$15,455	-	\$15,455	\$12,003	\$3,452
AURA Network Backbone	0.5	\$49,255	\$363,746	\$413,001	\$413,001	-
<b>Total</b>	<b>5.6</b>	<b>\$459,236</b>	<b>\$514,746</b>	<b>\$973,982</b>	<b>\$495,004</b>	<b>\$478,978</b>

## Work Packages

### NOAO South CIS

This work package covers all support for network and computer systems at NOAO South, both in La Serena and on Cerro Tololo, including systems from major projects such as DES/DECam. It also includes management of the group, supplies and materials, travel and training, maintenance contracts, and the new equipment needed to support the ever-expanding network and computing needs of all NOAO and affiliate (SOAR, LSST) activities in Chile.

### Las Campanas Support

Under a memorandum of understanding with Carnegie Observatories, the NS CIS group provides most of the networking and computer system support for the Las Campanas Observatory. This includes significant remote support of the systems on their mountaintop as well as occasional site visits when a physical presence is needed for repairs, maintenance, or upgrades of hardware.

### AURA Santiago

The NS CIS group also provides limited support for the Santiago office of AURA-O in Chile, including maintenance and problem solving for their small internal network, support for their Internet connectivity (particularly their secure link via a virtual private network, VPN, to systems in La Serena), and support for their computers running Microsoft Windows operating systems.

### AURA Network Backbone

This major work package covers all activities related to the operations and maintenance of the core network backbone for all of the AURA operations in Chile, and the work package includes network support for the Las Campanas/Magellan Observatories and NRAO/ALMA connectivity to the US mainland. This backbone includes the network links from Cerro Pachón to Cerro Tololo, from Cerro Tololo to La Serena (both via wholly-owned and operated microwave links), from La Serena to Santiago (via REUNA, the Chilean equivalent of the US Internet2 educational and research network), and from Santiago to Miami (via collaboration with Florida International University and AmPath, including significant support from NSF networking initiatives). The costs of this work package include both the fees related to network services and the manpower required to maintain and operate this complex network while supporting all of its users.

## 2.1.5 NOAO South Administrative Services

### Program Overview

Within a legal and contractual framework established by AURA through its Chilean juridical entity the AURA Observatory (AURA-O), NOAO South Administrative Services provides a range of administrative (business) services for NOAO and the AURA-O programs in Chile, including Gemini

South, SOAR, LSST, SMARTS, and smaller tenant observatories. The administrative services are fully integrated into NOAO with strong ties in the systems of and working relationships with the Central Administrative Services staff at NOAO North (NN CAS). The administrative functions include general management (compliance, reporting, and oversight), personnel and payroll (procurement, shipping, receiving, and distribution), general accounting, budgeting, and audits. The group must comply with rules and regulations from both the US federal government and the government of the Republic of Chile.

In FY11, the NOAO South Administrative Services staff continued moving toward completion of the transition to the accounting (USL) and procurement (Reqless) systems used in Tucson by NN CAS. The USL and Reqless systems will be in use at the start of FY12, and work will continue on the development of a local version of CASNET to support the generation of reports in Chilean pesos. The Administrative Services staff, supported by the NOAO contracts staff in Tucson, will continue a review and renewal of the AURA-O tenant agreements, to eliminate references to now-defunct divisions (e.g., AURA Observatory Support Services) and to provide a firmer and clearer definition of the infrastructure and operations activities provided by the NOAO South Facilities Operations and Administrative Services programs.

Along with NN CAS, NS Administrative Services has two primary objectives for FY12: first, prepare for the upcoming NSF Business Service Review (BSR) scheduled for May; and second, work closely with AURA, NSO, and Gemini to consolidate administrative services for AURA's NSF-funded centers into a centralized business unit reporting to the AURA Corporate Office.

### **Milestones**

- Continue the review of all AURA program and tenant agreements, replacing references to AURA Observatory Support Services with references to the NOAO South Administrative Services and Facilities Operations programs and more clearly defining the roles and responsibilities of AURA-O, NOAO South, and the programs and/or tenants themselves.
- Working groups within NOAO South Administrative Services will continue to review and update administrative policies and procedures in advance of the upcoming Business Service Review being conducted by NSF. As completed, policies and procedures will be posted to a Web site and made readily available to all NOAO South Administrative Services staff.
- Members from NOAO South accounting, procurement, and contracts departments will join working groups with representatives from other AURA Centers to plan and prepare for the upcoming administrative consolidation.

## Budget Summary

Table 5 Summary of NS Administrative Services program budget

NOAO South (NS)						
NOAO South Administrative Services						
FY2012 Program Budget Summary						
NS Administrative Services	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
General Administration	2.2	\$251,142	\$67,818	\$318,960	\$318,960	-
Purchasing	2.7	\$141,729	\$25,064	\$166,793	\$166,793	-
Network	1.0	\$59,140	\$1,928	\$61,068	\$61,068	-
Budgeting & Accounting	4.0	\$226,806	\$55,661	\$282,467	\$282,467	-
Reception	2.0	\$50,240	\$31,356	\$81,596	\$81,596	-
Personnel & Payroll	2.0	\$132,570	\$42,204	\$174,774	\$174,774	-
CTIO Fees	-	-	\$686,773	\$686,773	-	\$686,773
<b>Total</b>	<b>13.9</b>	<b>\$861,627</b>	<b>\$910,804</b>	<b>\$1,772,431</b>	<b>\$1,085,658</b>	<b>\$686,773</b>

## Work Packages

### General Administration

The General Administration work package includes the management of the Administrative Services program, financial planning, and contract management. Management of this program includes administrative coordination with other on-site AURA programs, including Gemini, SOAR, and LSST. This work package also covers the contracts for all NOAO South and related functions in Chile for Gemini, SOAR, and LSST. The work package also includes development, negotiation, and pre- and post-award administration of contracts in Chile. Processing of procurements requiring complicated agreements as determined by proposal policies in compliance with the NSF cooperative agreements and Chilean law is in this work package.

### Purchasing

This work package includes the Procurement group, which is responsible for purchasing, asset control, and warehouse operations including shipping/receiving. Purchasing within Chile for all AURA programs is managed through this group, which operates under Chilean contract and purchasing regulations. Although the individual AURA programs maintain their own asset registers, the NOAO group maintains the global AURA asset control in order to comply with Chilean regulations and support import/export needs. The warehouse provides a single point of contact for shipping and receiving within Chile and works closely with the AURA Santiago office to manage the international import/export needs of all AURA programs, including shipments of expensive astronomical instrumentation.

### Network

This work package covers the business IT needs of the administration group, including support for network connectivity, desktop computer support, and limited programming effort to support Web pages and local forms for collecting and managing information.

### Budgeting & Accounting

The Accounting group, which is responsible for budgets, accounting, and billing for services provided by NOAO South Facilities Operations and Administrative Services programs, is included in this work package. Budget preparation and management for the administrative and facilities services must be performed in such a way as to allow transparent review of site and per-use fees, which must

be approved by the NSF together with overhead rates. In order to manage the risk of exchange rate variations, the fees are maintained in Chilean pesos, requiring the accounting group to carefully manage transfers between pesos and US dollars for not only NOAO, but all of the AURA programs.

### Reception

This work package includes the reception area at NOAO South. This is a shared resource of all the AURA programs, including Gemini, SOAR, and LSST. Receptionists receive visitors, phone calls, and correspondence and direct them to all of the groups on site.

### Personnel & Payroll

Through its local juridical entity, AURA-O, AURA maintains a framework of personnel policies and procedures that are compliant with Chilean labor law. The overall compensation package for all AURA employees hired within Chile is established through a collective bargaining process repeated every two years. Based on that framework and the active collective bargaining agreement, the NOAO South Personnel group, included in this work package, manages the personnel contracts and payroll for all Chilean-national AURA staff working in Chile, including all Chilean employees of NOAO, Gemini, and SOAR. One-on-one personnel management (i.e., performance evaluations, work assignments) remains the responsibility of each individual program.

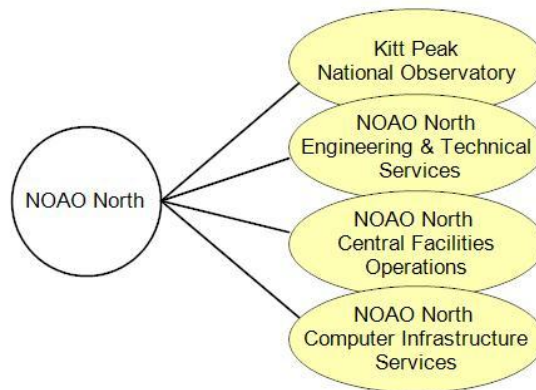
### CTIO Fees

The work packages above for NOAO South Administrative Services represent services for all of the AURA-O programs in Chile, including NOAO, Gemini South, SOAR, LSST, SMARTS, and smaller tenant observatories. This work package contains the NOAO portion of the costs of those shared services.

## 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 Facilities Operations
- NOAO North Computer Infrastructure Services



### 2.2.1 Kitt Peak National Observatory

#### **Program Overview**

Kitt Peak National Observatory (KPNO) operates the Mayall 4-m telescope and the 2.1-m telescope. KPNO is a partner in the operation of the facilities of the National Solar Observatory (McMath-Pierce Solar Telescope and SOLIS), the WIYN Observatory (3.5-m and 0.9-m telescopes), and the National Radio Astronomy Observatory (Very Long Baseline Array) that are on Kitt Peak. KPNO provides infrastructure for more than 20 tenant telescopes operated by institutions from around the world.

FY12 will be the final year of a five-year program of repairs and improvements to the KPNO facility infrastructure to improve astronomical research efficiency. KPNO will continue the process

of bringing new capabilities to its users. These priorities are well matched to the Senior Review recommendations. Building on the successes of prior years, FY11 saw continued efforts to renew the capabilities of the observatory. In FY11, KPNO finished an upgrade and commissioning of Mosaic-1 (an optical imager), which included new, more sensitive detectors and a modern controller system that greatly improved the operational efficiency of this heavily used instrument. In collaboration with NSTC and The Ohio State University (OSU), KPNO began in FY10 the process of bringing a new optical spectrograph, KOSMOS, to the Mayall 4-m telescope. KOSMOS is scheduled to see first light in the beginning of FY12 and to be commissioned as a facility instrument by the spring of 2012. The NEWFIRM wide-field infrared imager, which moved from the Mayall 4-m in FY10 to be deployed at the Blanco 4-m at CTIO, will return to KPNO in early FY12 to be recommissioned at the Mayall. In FY10, KPNO issued a call for proposals to provide a major new observing capability with the Mayall 4-m telescope in exchange for telescope time to execute a large science project. Following a formal, non-advocate proposal review held in FY11, NOAO has conditionally selected the Big Baryon Oscillation Spectroscopic Survey (BigBOSS) project to put a wide-field, multi-object spectrograph at the Mayall prime focus and is partnering with the BigBOSS collaboration on the next steps necessary to get this project funded by the Department of Energy. These efforts illustrate the continuing commitment of the KPNO staff to maintain the high quality of the facility and to enable the aspirations of the national user community to undertake scientific research of the highest caliber.

### Milestones

- Receive NEWFIRM when it returns to KPNO from CTIO and recommission it on the Mayall 4-m telescope
- Install and commission the new spectrograph, KOSMOS, on the Mayall 4-m telescope.
- Deploy expanded data bandwidth to and from Kitt Peak according to plans finalized in FY11.
- Complete inspection of the Mayall 4-m building exterior according to plans made in FY11 in consultation with the structural engineering firm M3.

### Budget Summary

Table 6 Summary of KPNO program budget

NOAO North (NN)						
Kitt Peak National Observatory (KPNO)						
FY2012 Program Budget Summary						
Kitt Peak National Observatory (KPNO)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
Director's Office	3.2	\$405,934	\$35,550	\$441,484	\$2,000	\$439,484
Telescope Operations	26.3	\$2,346,634	\$951,220	\$3,297,854	\$738,478	\$2,559,376
Science Research	1.5	\$234,517	-	\$234,517	-	\$234,517
User Support	2.4	\$127,557	\$47,500	\$175,057	-	\$175,057
Mountain Facilities	20.9	\$1,056,414	\$589,195	\$1,645,609	\$537,711	\$1,107,898
KPNO Public Outreach & Education	13.7	\$637,123	\$328,388	\$965,511	\$809,500	\$156,011
KP Site Protection	0.5	48,983.00	\$6,000	\$54,983	-	\$54,983
<b>Total</b>	<b>68.5</b>	<b>\$4,857,162</b>	<b>\$1,957,853</b>	<b>\$6,815,015</b>	<b>\$2,087,689</b>	<b>\$4,727,326</b>

## **Work Packages**

### Director's Office

This work package includes the KPNO director, assistant/deputy to the director, assistance from a program/budget manager, an administrative assistant, and a part-time office assistant. Collectively, they support observatory planning and operations; outreach to government agencies (city, county, state, and federal); relations with the Tohono O'odham Nation, tenant observatories, and instrumentation and operations partners; and coordination with other divisions of NOAO.

### Telescope Operations

This package includes all of the NOAO costs directly associated with the operations and maintenance of the KPNO (Mayall 4-m and 2.1-m) and partner (WIYN, NSO, NRAO) telescopes and instruments. The costs and effort of all operations, facilities, engineering, scientific, and related staffs are included. A prorated share of the scientific infrastructure, comprising the computer network, mountain scientific administration, maintenance of electronics shops, spares, and test equipment, also is tracked on a per telescope basis.

For the WIYN 3.5-m, operations are defined by the terms of the consortium agreement. The costs shown represent actual expenditures made by KPNO, offset by revenues from the partner institutions, including KPNO on behalf of NOAO. Costs paid directly by the other partners or by WIYN Observatory are not included. The itemized costs include the NOAO contribution to the WIYN capital funds. Over and above the support defined by the agreement, the total includes all scientific staff activity related to support of the WIYN observers, telescope, and existing instruments. Also included are expenses for NOAO participation in WIYN Consortium activities such as Board and Science Advisory Committee meetings. It does not represent the full WIYN Consortium annual expenses, because substantial partner contributions go directly to WIYN, Inc. and are managed and spent by the WIYN Observatory.

The responsibility for supporting the costs of facilities and maintenance of NSO telescopes remained with KPNO, as did the pool of skilled staff necessary to undertake the work, when NSO was functionally separated from NOAO. A base level of support of NSO facilities on Kitt Peak is included in this work package. Also included in this work package are the joint use fees for NSO and NRAO paid by KPNO.

When needed, KPNO provides some support to other NOAO divisions (LSST operation of the Calypso telescope on Kitt Peak is a recent example) and receives some reimbursement for costs from these internal divisions and external groups. This work package tracks these expenditures and revenues.

### Science Research

Each NOAO scientific staff member is allocated some fraction of time that includes scientific and/or technical research, professional development activities, and external service (e.g., membership on committees whose activities benefit the astronomical community). That time is collected here proportionally for those staff members who charge functional time to KPNO.

### User Support

This category refers to support of observers when they are not directly engaged in observing. Observing run preparation, advice on observatory performance for use in proposals, occasional service observing, and the KPNO Observing Support Office activities are included here. The KPNO Observing Support Office also assists WIYN and NSO observers with their travel and lodging needs on the mountain. Post-observing-run assistance for KPNO visitors, including advice on data reduction provided by KPNO staff, also is included in this work package. Support of PhD thesis student travel and lodging is included in this work package.

### Mountain Facilities

This work package consists of two sub-packages: Mountain Operations and Support to Tenants. The Mountain Operations sub-package includes support of the mountain physical plant, external to the

telescope domes, used by KPNO and its partner observatories (but not tenant observatories). It includes the support buildings, dining and lodging facilities operations, power distribution (distinct from the power distribution that is part of the Support to Tenants sub-package), and mountain vehicles and equipment. The actual costs are partially offset by revenues from visiting observers to KPNO and from tenant observatory telescopes.

The Support to Tenants sub-package includes those aspects of mountain operations/facilities used by all telescope facilities located on the mountain, including KPNO. It includes the roads, water systems, septic systems, support buildings, and power distribution. The actual costs are offset by revenue from the joint use fee (which comes from tenants and KPNO).

#### KPNO Public Outreach & Education

KPNO works to share the knowledge and excitement of astronomy with the public through a range of well-recognized and successful activities that are focused on those who visit Kitt Peak and on the people of the Tohono O'odham Nation in Arizona. The activities are often in collaboration with the NOAO EPO office and other organizations. This work package tracks the costs and revenues associated with these efforts. Significant levels of volunteer labor contribute to this effort, however, the FTE entry in Table 6 only includes non-volunteer (paid) labor.

There are three sub-packages: the Kitt Peak Visitor Center (KPVC), Tohono O'odham Outreach, and other Public Outreach/Press/Education activities. The KPVC runs the museum and gift shop on the mountain, an online store, tours for the public, the Nightly Observing Program (NOP), and the Advanced Observing Program (AOP). The program is intended to take in fees and revenue that cover most of its costs. The Tohono O'odham Outreach and other public outreach and education programs change slightly from year to year, but include support of outreach to the Tohono O'odham Nation (programs with elementary, middle-school, and high-school students of the Nation; the Boys & Girls Club of Sells; programs at the Nation's recreational centers; and evening programs with the NOP on the mountain) and a partnership with the University of Arizona Alumni Association's Astronomy Summer Camp program, parts of which are held on Kitt Peak and make use of KPNO facilities. Numerous press and media requests to visit and film on the mountain for science education purposes are supported. Funding of special events or activities is included in this work package in the years when these are planned.

#### KP Site Protection

KPNO works to educate the people and governments of Arizona on the protection of surrounding area night skies for the cultural legacy of the local community and for scientific research. These local site protection efforts are included in this work package.

## **2.2.2 NOAO North Engineering & Technical Services**

### **Program Overview**

NOAO North Engineering & Technical Services (NN ETS) provides technical support for maintaining and improving KPNO and WIYN telescopes and instruments. In addition, NN ETS provides support to the NOAO System Technology Center's (NSTC) System Instrumentation group for new instrument development and construction. NN ETS provides a pool of technical resources with expertise in software and control systems, detector systems, mechanical systems, electronics, and optics. NN ETS maintains a machine shop, an optics fabrication and testing shop, a coatings lab for small optical components, an electronics stock room, and various clean rooms and labs for electronic, detector, and cryogenic system assembly and test.

During FY12, NN ETS will focus on addressing critical, deferred maintenance on the KPNO telescopes, while supporting the effort to deploy a partial focal-plane version of the One Degree Imager (ODI) on WIYN. Other significant activities will include supporting design efforts of the Big Baryon Oscillation Spectroscopic Survey (BigBOSS), deployment and operations of the Kitt Peak

Ohio State Multi-Object Spectrograph (KOSMOS) and the NEWFIRM wide-field infrared imager, and upgrading detector systems on existing instruments. In Tucson, efforts will be initiated to improve document configuration management and to reorganize and modernize the electronics labs.

### Milestones

- Focus KPNO improvement efforts on high-priority deferred-maintenance projects, primarily on the Mayall telescope. These projects will be those identified as high priority due to the risk potential for personnel and equipment safety, or extended downtime if failure occurs.
- Support the ODI project by preparing the WIYN telescope and facility to accommodate the instrument, assembling a reduced-focal-plane version of the instrument, and deploying it on the telescope by the end of FY12.
- Enhance the KPNO facility instrument suite by supporting BigBOSS design efforts, supporting NEWFIRM and KOSMOS operations after they are commissioned on the Mayall telescope, and upgrading aging CCD systems with MONSOON/TORRENT controllers.
- Launch an effort to reorganize and modernize the Tucson electronics labs to better utilize the lab space, improve the working conditions for technical staff, and improve overall efficiency for lab operations.
- Implement a comprehensive configuration management plan for KPNO documentation and begin migration of existing documentation to meet the requirements of the plan. This plan will include document reconciliation, data mining, format conversion, database development, and Web-based access.

### Budget Summary

Table 7 Summary of NN Engineering & Technical Services program budget

NOAO North (NN)						
NOAO North Engineering & Technical Services (ETS)						
FY2012 Program Budget Summary						
NOAO North Engineering & Technical Services (ETS)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
ETS Management	1.0	\$127,523	\$19,500	\$147,023	-	\$147,023
KPNO Improvements	5.4	\$525,926	\$78,800	\$604,726	-	\$604,726
WIYN Improvements	2.1	\$186,884	-	\$186,884	-	\$186,884
BigBOSS	0.3	\$39,043	\$28,600	\$67,643	-	\$67,643
Instrument Upgrades	2.1	\$216,319	\$27,000	\$243,319	-	\$243,319
ETS Computers and Infrastructure	0.3	\$36,084	\$14,500	\$50,584	-	\$50,584
ETS Lab Cleanup & Reorganization	0.3	\$26,769	\$11,000	\$37,769	-	\$37,769
Drawing Conversion and Document Organization	0.8	\$57,482	\$20,000	\$77,482	-	\$77,482
Drafting Room Operations	0.1	\$8,248	\$14,875	\$23,123	-	\$23,123
Electronics Lab Operations	0.9	\$67,048	\$73,000	\$140,048	-	\$140,048
Optics Shop Operations	0.4	\$35,613	\$17,300	\$52,913	-	\$52,913
Instrument Machine Shop Operations	1.2	\$90,626	\$89,200	\$179,826	\$50,000	\$129,826
ETS Staff Training & Development	0.5	\$45,533	\$38,500	\$84,033	-	\$84,033
NSO Funded Projects	1.0	\$70,678	-	\$70,678	\$70,678	-
<b>Total</b>	<b>16.3</b>	<b>\$1,533,776</b>	<b>\$432,275</b>	<b>\$1,966,051</b>	<b>\$120,678</b>	<b>\$1,845,373</b>

## **Work Packages**

### ETS Management

This work package includes the labor necessary to manage the NOAO North Engineering and Technical Services group, as well as the non-payroll spending to cover supplies, computers and software, and office equipment/furnishings. Also included are travel expenses for management-related business such as workshops, collaboration meetings, and visits to CTIO.

### KPNO Improvements

This package includes the costs directly associated with the improvement of the KPNO (Mayall 4-m and 2.1-m) telescopes and facilities. The costs include the labor for NN ETS staff; purchases of supplies, materials, and equipment required for the improvements; and equipment rentals. The major improvement efforts will include a structural inspection of the Mayall building exterior trusses, refurbishment of the Mayall dome shutter brakes and lift elevator, and upgrades to the Telescope Control Systems and guide cameras of the Mayall 4-m and 2.1-m telescopes.

### WIYN Improvements

This package includes the costs directly associated with the improvement of the WIYN telescope and facility. The costs include labor only for NN ETS staff that is provided in part to fulfill obligations of the WIYN Agreement. All non-labor expenses are paid for by WIYN funds. The WIYN improvements will focus on the facility upgrades needed to accommodate the ODI instrument.

### BigBOSS

This package includes the costs directly associated with supporting the technical development of the BigBOSS instrument. The costs include labor to support engineering design of the instrument, development of interface control documents, and evaluation of telescope performance and capabilities. This package also includes spending for miscellaneous expenses to support the engineering activities and domestic travel expenses.

### Instrument Upgrades

This package includes the costs directly associated with the support and improvement of the KPNO facility instruments on the Mayall, WIYN, and 2.1-m telescopes. The costs include labor and supplies for the instrument upgrades and foreign travel to CTIO to support the integration and operations of the Cerro Tololo Ohio State Multi-Object Spectrograph (COSMOS). Major instrument support efforts will include upgrading CCD systems with TORRENT controllers; supporting NEWFIRM, KOSMOS, and COSMOS after commissioning; and planning Mayall telescope upgrades to improve KOSMOS observing efficiency.

### ETS Computers and Infrastructure

This work package includes the labor and non-payroll needed to maintain the file servers, general-use computers, printers, and other equipment used by NN ETS staff throughout the NOAO Tucson headquarters.

### ETS Lab Cleanup & Reorganization

This work package encompasses a cleanup and reorganization effort for some of the Tucson labs to better utilize the lab space, improve the working conditions for technical staff, and improve overall efficiency for lab operations. The costs include labor to relocate, organize, discard, or surplus unused equipment and materials and non-payroll spending for new supplies and equipment. The goals of the reorganization are to centralize the MONSOON/TORRENT production; improve the surface mount technology facilities for better compliance with the guidelines for Restriction of Hazardous Substances (RoHS), electrostatic discharge (ESD) protection, and safety; create more effective instrument assembly and testing work areas; and provide technicians with expanded, desk work areas.

Drawing Conversion and Document Organization

This work package includes the labor needed to implement a comprehensive configuration management plan for KPNO documentation and to support migration of existing documentation to meet the requirements of the plan. The work will include document reconciliation, data mining, format conversion, database development, and Web-based access. Since the ETS staff is heavily committed to other work obligations, this work package includes spending for miscellaneous expenses to allow work to be sent to out-of-house sources, or to hire temporary help.

Drafting Room Operations

This work package includes the labor and non-payroll expenses needed to support and maintain the drafting room operations. The labor covers the support of drafting equipment such as printers and plotters, maintaining document files, and providing document copies. It also covers the non-payroll spending needed to purchase supplies, purchase and maintain computers and database servers, purchase and maintain plotters and copiers, and purchase or renew software licenses.

Electronics Lab Operations

This work package covers the labor needed to maintain the electronics labs and stock room. It also covers the non-payroll spending needed to purchase supplies; purchase and maintain computers for the electronics lab staff; purchase or renew software licenses; purchase, maintain, or replace lab tools and other equipment; and purchase cryogenics and gases needed to operate instruments and equipment.

Optics Shop Operations

This work package covers the labor needed to maintain the optics and coatings labs. It also covers the non-payroll spending needed to purchase supplies; purchase and maintain computers for the lab staff; purchase or renew software licenses; purchase, maintain, or replace tools and other equipment; and purchase cryogenics and gases needed for coating operations.

Instrument Machine Shop Operations

This work package covers the labor needed to maintain the instrument shop. It also covers the non-payroll spending needed to purchase supplies; purchase and maintain computers for the instrument shop staff; purchase or renew software licenses; purchase, maintain, or replace machine tools and other equipment; and hire outside services to align and calibrate CNC machines.

It also includes assumed revenue (with offsetting expenses) of \$50,000 for incidental instrument shop jobs pursuant to an open agreement with the University of Arizona's Steward Observatory (Steward). Under prior NSF approval, NOAO has an open work order with Steward that allows engagement of the NOAO instrument shop for small "walk-in" jobs if the NOAO shop has time available to do the work, provided that no one job exceeds \$5,000 and that the total of all such jobs during the fiscal year does not exceed \$50,000. Because these jobs are irregular, subject to both the demand from Steward and the ability of the NOAO shop to do the work, it is not known at the start of the fiscal year how much revenue will be realized under this open agreement. The program plan assumes the annual maximum of \$50,000, as shown under "Funding, Other" for this work package. This work package also assumes offsetting capital expenses for replacement tooling, etc., in the amount of \$50,000 to ensure that none of this assumed revenue is deemed to meet salaries. In the event that the actual revenue during the year is less than the maximum, the shop will make a corresponding reduction in replacement tooling and other discretionary purchases.

ETS Staff Training & Development

This work package covers the time (labor) for staff training and professional development. It also includes the non-payroll spending for an advanced Altium electronic computer-aided design training course; certifications for Altium, vacuum, ESD, and safety training; and supplies and materials associated with training and development.

### NSO Funded Projects

This work package covers regular maintenance activities carried out by NN ETS personnel for the National Solar Observatory (NSO) facilities and instruments in Tucson and on Kitt Peak. All of this work will be paid for by NSO funds, shown as the amount under “Funding, Other” for this work package.

## **2.2.3 NOAO North Central Facilities Operations**

### **Program Overview**

NOAO North Central Facilities Operations (NN CFO) provides facilities support services for the NOAO North division and limited support to the Kitt Peak facilities group. These support services include: building operation and maintenance, utilities, vehicle fleet operations, telecommunications, and property management. This support is provided to all occupants of the Tucson facilities, including NSO, ATST, WIYN, and LSST Corporation (LSSTC), with funding provided through a recharge indirect rate revenue process (see [www.cas.noao.edu/cas/Finance/FaqIndirect](http://www.cas.noao.edu/cas/Finance/FaqIndirect)) for non-NOAO institutions and consortia. NN CFO also receives limited revenue from Gemini for maintenance, operation, and support of their Hilo building access control system.

During FY12, NN CFO will continue to address the increasing maintenance and renovation issues imposed by the 50-year-old structures and some building deficiencies through targeted renovation. Efforts continue to focus on renovating space as necessary to accommodate evolving space demands while working to reduce utility usage and operational costs. During FY12, staff will continue to provide significant support to the major infrastructure renovation efforts through the American Reinvestment and Recovery Act of 2009 (ARRA) funds made available to NOAO by the NSF.

### **Milestones**

- Upgrade various restrooms to replace fixtures to improve water conservation efforts and to improve the deteriorated interior finishes and accessibility.
- Resurface the main asphalt parking lot to prevent deterioration and extend its life.
- Continue the air-handler chilled-water system modifications and the building electrical project efforts to improve system operations and reduce energy usage.
- Continue the program to update meeting rooms and public spaces.
- Continue to make targeted renovation and building modifications at NOAO North Tucson facilities to address building deficiencies and space needs.

## Budget Summary

Table 8 Summary of NN Central Facilities Operations program budget

NOAO North (NN)						
NOAO North Central Facilities Operations (CFO)						
FY2012 Program Budget Summary						
NOAO North Central Facilities Operations (CFO)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
Tucson Program Management and Support	4.2	\$237,290	\$152,000	\$389,290	\$214,000	\$175,290
Tucson Utilities	0.3	\$23,548	\$508,500	\$532,048	\$299,000	\$233,048
Tucson Safety and Security	0.5	\$36,365	\$114,500	\$150,865	\$76,000	\$74,865
Property Management	0.9	\$40,600	-	\$40,600	\$7,000	\$33,600
Tucson Vehicle Fleet	0.7	\$39,167	\$93,000	\$132,167	\$69,000	\$63,167
Tucson Roads and Grounds	0.2	\$11,717	\$21,000	\$32,717	\$19,000	\$13,717
Tucson Building Maintenance	3.0	\$213,054	\$114,750	\$327,804	\$196,000	\$131,804
Building Modification	0.2	\$14,546	\$19,000	\$33,546	\$8,000	\$25,546
Proposed Major Facility Projects	-	-	\$38,000	\$38,000	-	\$38,000
<b>Total</b>	<b>10.0</b>	<b>\$616,287</b>	<b>\$1,060,750</b>	<b>\$1,677,037</b>	<b>\$888,000</b>	<b>\$789,037</b>

## Work Packages

Each NN CFO work package, except Proposed Major Facility Projects, includes revenue through indirect payments for facility support from NSO, AURA Corporate, WIYN, SOAR, and LSSTC. Also included is a portion of the indirect revenue (General and Administrative fees) received for the grant management that is provided to grantees such as individual astronomers, Gemini, and other consortia.

### Tucson Program Management and Support

This primary management support package includes administration of the PBX, Audix, and call accounting systems; minor facility engineering services; labor and equipment; travel to other sites for support issues; subcontracted custodial services; and other general administrative facilities functions.

### Tucson Utilities

This includes the Tucson facility utility costs for electrical, water, sewer, and gas; trash and recycling services for headquarters buildings; record keeping; and reporting requirements.

### Tucson Safety and Security

Contracted fire watch and off-hours security contracts as well as regulatory and industrial waste removal fees are covered here.

### Property Management

This work package includes tagging, recording, and inventory control of NOAO North property and coordination with NOAO South on NSF property reporting.

### Tucson Vehicle Fleet

Operation and maintenance of the Tucson vehicle fleet including fuel, maintenance, repairs, and replacements are in this work package. High-mileage vehicles generally are replaced with hybrids to conserve and reduce fuel costs.

Tucson Roads and Grounds

This work package covers landscaping, grounds maintenance, and building access control.

Tucson Building Maintenance

This work package covers all operations of, maintenance for, and repairs to the NOAO North Tucson buildings and their infrastructure systems. This generally includes painting, equipment repairs and replacement, roofing, energy conservation, internal improvements, and relocation of offices.

Building Modification

This work package includes minor building modifications, construction, demolition, and remodels.

Proposed Major Facility Projects

This work package provides for major infrastructure renovation, replacement, and improvement projects. In FY12, these projects include upgrading the restrooms, replacement of outdated roof HVAC units, and targeted building renovations. Planning efforts will continue on replacement of the outdated PBX system and the fire/security alarm system.

**2.2.4 NOAO North Computer Infrastructure Services**

**Program Overview**

While the primary core function of NOAO North Computer Infrastructure Services (NN CIS) is to provide computer infrastructure support to NOAO North, support also is given to NSO, ATST, SOAR, and WIYN. Revenue is generated through indirect support to areas other than NOAO North. Funding for support is provided through a recharge indirect rate revenue process.

**Milestones**

- Implement several initiatives inspired by the AURA Cybersecurity Audit which took place in FY10: Network DMZ (*de militarized zone*) to isolate Internet-facing network servers from the rest of the internal network; radius server to provide a secure “single sign-on” system for our users to access network systems such as VPN, ssh, and the secure wireless system; and “split” wireless system to isolate “inside” and “outside” users of our wireless system.
- Continue the improvement program for the NOAO North computer lab concentrating on power and backup power systems.

**Budget Summary**

Table 9 Summary of NN Computer Infrastructure Services program budget

NOAO North (NN)						
NOAO North Computer Infrastructure Services (CIS)						
FY2012 Program Budget Summary						
NOAO North Computer Infrastructure Services (CIS)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
CIS Operations	5.4	\$548,962	\$96,038	\$645,000	\$170,000	\$475,000
CIS-Gemini Support	0.1	\$4,946	-	\$4,946	\$4,946	-
<b>Total</b>	<b>5.4</b>	<b>\$553,908</b>	<b>\$96,038</b>	<b>\$649,946</b>	<b>\$174,946</b>	<b>\$475,000</b>

## Work Packages

### CIS Operations

This work package includes maintenance and improvement of the Tucson facility network and of a secure connection for the facility network to the Internet. It covers maintenance and improvement of a secure software infrastructure providing services to the NOAO-Tucson facility, including email, World Wide Web, FTP, and remote access. The work package also includes configuration of and connection to the network, and support and maintenance of computers (including scientific work stations and office computers) used in the facility. Revenue includes indirect payments from NSO for computer infrastructure support.

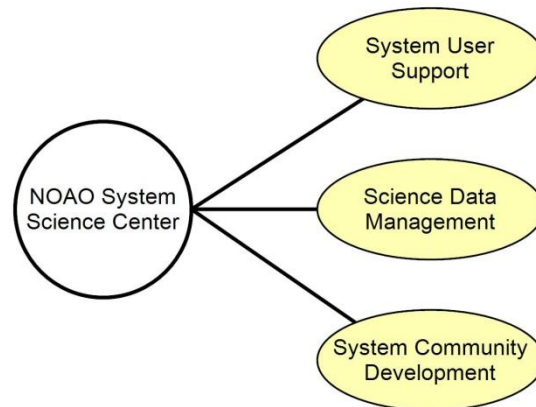
### CIS-Gemini Support

NN CIS provides a small amount of IT support for the Gemini Observatory's interests in Tucson. These interests include supporting one Gemini staff member (resident in Tucson) and maintaining Gemini's procurement server, which is located at the NOAO office in Tucson. The NN CIS labor is charged directly to a Gemini labor account and reflected under "Funding, Other."

## 2.3 NOAO SYSTEM SCIENCE CENTER

The existing and planned facilities of the US Ground-Based Optical/Infrared System (System) constitute an extended and powerful system of observational capabilities. A key mission for NOAO is to deliver community access within the System to a broad range of world-class instruments on telescopes of all apertures. The NOAO System Science Center (NSSC) forms NOAO's interface with the System with the primary aims to strengthen the contributions of NOAO's directly managed facilities to the System, to provide user support for System facilities not directly managed by NOAO, and to anticipate and advocate for the future development of the System. The NSSC mission thus incorporates a wide range of responsibilities, many of which focus on present-day facilities, while others deal with the evolution toward a future system, such as organizing community input for the LSST and GSMT projects.

NSSC consists of three major programs: System User Support (SUS), Science Data Management (SDM), and System Community Development (SCD). SUS provides help to users of the currently available open-access time to facilities that are not managed by NOAO, which covers the entire process of proposal preparation, submission, observing, and post-observing data questions. SDM support revolves around the archiving of all raw data from NOAO facilities and pipeline processing for selected instruments, as well as the data needs and support for future projects that involve NOAO. SCD maintains a broad view of the current state of the System and how community desires and needs are best mapped into the future evolution of this system.



### 2.3.1 System User Support

#### Program Overview

System User Support (SUS) is the main point of contact between the user community and their access to non-NOAO System capabilities. The services provided by SUS include help with proposal preparation and submission for all System facilities and help with post-observing data processing.

The non-NOAO facilities to which the community-at-large will have access in FY12 include the US share of the Gemini Observatory telescopes (funded by the NSF, and which consists of ~100 to 110 nights per year per telescope), NSF-funded community access through the Telescope System Instrumentation Program (TSIP) to Keck, the Multiple Mirror Telescope (MMT), and the Large Binocular Telescope (LBT), along with nights on the Palomar 200-inch (5-m) Hale Telescope funded through the NSF via the ReSTAR program. In addition, time has been made available to the user community in semesters 2012A and 2012B on the Center for High Angular Resolution Astronomy (CHARA) interferometer.

During FY12, SUS, through non-NOAO observatory site visits and staff collaborative efforts, will provide a steadily increasing base of expertise for the broad variety of non-NOAO facilities that will be available to the user community. The SUS staff astronomers have, as a group, a broad range of observing experience and scientific expertise that represent to the user community a valuable asset, which can be used to enhance the effectiveness of the ground-based facilities that are available through NOAO-managed open-access time.

Support of US time on the Gemini telescopes will continue to dominate overall SUS support levels, due to the large number of nights on Gemini and its operations model, which requires rather intensive support through the Phase II process. In order to account for the departure of the UK from the Gemini partnership at the end of calendar year 2012—which will probably result in a reduction of up to 20–25% of the funding, which represents the UK share—Gemini will be implementing the beginnings of a new operations model. This transition will impact NSSC/SUS Gemini support during FY12, so the NSSC/SUS management remains in close contact with Gemini management in order to be prepared for any necessary support changes.

### **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, the Multiple Mirror Telescope (MMT), and the Large Binocular Telescope (LBT), and continued access to the Center for High Angular Resolution Astronomy (CHARA) interferometer or any new facilities that might result from a successful ReSTAR Phase 2 proposal.
- Continue to support US Gemini access and programs such as the Phase I and Phase II observing processes, the Gemini Helpdesk, and site visits with the view towards an increasing number of US nights on the Gemini telescopes after calendar year 2012 and the UK withdrawal.
- Provide the NOAO user community with SUS staff knowledge and expertise of the facilities that constitute the NOAO-managed suite of telescopes and instruments in support of the NOAO TAC process (such as technical reviews).
- Foster closer ties and lines of communication with the Gemini staff through specific and well-defined joint efforts, if such efforts can be identified and sufficient resources are available. An example would be the recent discussions about NSSC help in upgrading certain Gemini instrument Integration Time Calculators (ITCs).
- Embark on shared missions within NSSC with SCD and SDM, such as using SUS staff System experience and scientific expertise to advise on the continuing evolution of the System, or helping SDM to improve the user experience with the NOAO data archives.
- Work with the community and relevant committees in supporting the process to procure the next sets of instruments for NOAO and Gemini telescopes.

## Budget Summary

Table 10 Summary of NSSC System User Support program budget

NOAO System Science Center (NSSC) System User Support (SUS) FY2012 Program Budget Summary						
System User Support (SUS)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
Director's Office	1.8	\$212,117	\$58,000	\$270,117	-	\$270,117
System Operations Support	3.1	\$391,260	\$68,000	\$459,260	-	\$459,260
Science Research	2.5	\$334,981	-	\$334,981	-	\$334,981
Classical Observer Support	-	-	\$70,000	\$70,000	-	\$70,000
SUS Committee Support	-	-	\$30,000	\$30,000	-	\$30,000
Palomar 5-m Support	0.1	\$15,971	\$3,000	\$18,971	-	\$18,971
TAC Phase I	1.9	\$169,095	\$94,000	\$263,095	-	\$263,095
<b>Total</b>	<b>9.5</b>	<b>\$1,123,424</b>	<b>\$323,000</b>	<b>\$1,446,424</b>	<b>-</b>	<b>\$1,446,424</b>

## Work Packages

### Director's Office

The costs for managing NSSC are in this work package. These are the resources necessary to organize activities within NSSC as a whole, such as Web page efforts, managing a significant NSSC presence at AAS meetings, organizing and supporting various committees or workshops, along with travel to necessary committee meetings.

### System Operations Support

SUS staff support of US System telescope users and proposers on non-NOAO facilities is covered in this work package. Since observing programs on Gemini represent the largest part of US access time on non-NOAO facilities, a sizable fraction of this work package goes to support US Gemini Phase I and Phase II proposal processes. This effort includes help desk inquiries, site visits to provide staff with training on the Gemini telescopes (in order to improve knowledge of queue operations), as well as visits to other non-NOAO facilities for familiarization and training.

### Science Research

Each NOAO scientific staff member is allotted some fraction of time that includes scientific and/or technical research, professional development activities, and external service (e.g., membership on external committees whose activities benefit the astronomical community). That time is collected in this work package proportionally for those staff members who charge functional time to SUS.

### Classical Observer Support

NOAO encourages classical observing at the Gemini telescopes (which are operated mostly in queue observing mode) in an effort to both foster and increase the interactions of US observers with Gemini staff, as well as observer familiarity with the Gemini sites, telescopes, and instruments. Part of this encouragement includes travel funding for one observer for each classically scheduled US Gemini program (typically about 15–20% of US programs, accounting for about 25% of US time). This work package manages this travel for Gemini classical observers.

### SUS Committee Support

This work package supports a number of committee meetings for NOAO internal committees and for some external committees. The various committees consist of the newly formatted NOAO Users

Committee, along with US representation on the Gemini Science and Technology Advisory Committee (STAC), Gemini Operations and Working Group, and Gemini International TAC. This package also covers any needed meetings between the US members of the various NOAO and international committees with representatives of the NSF or users concerning System-related issues.

#### Palomar 5-m Support

This work package contains funds to be paid to Caltech for access to the Palomar Hale 200-inch (5-m) Telescope, as well as small amounts of NOAO staff time for community user support. The funding for FY12 is part of the ReSTAR programs and covers a planned total of ~20 nights in semesters 2012A and 2012B.

#### TAC Phase I

The telescope time allocation process reports to NSSC and the work package is put into SUS. The personnel associated with the Time Allocation Committee (TAC) activities as well as the travel, food, and lodging for TAC panel members are included in this work package.

### **2.3.2 Science Data Management**

#### **Program Overview**

The work of the Science Data Management (SDM) program is directed toward meeting the immediate data management needs of NOAO and its user community. It operates an End-to-End (E2E) system to archive all raw data from NOAO facilities, to pipeline process and archive data from the Mosaic and NEWFIRM instruments, and to serve those data to the astronomical community via the Portal, the interface to the NOAO Science Archive (NSA).

Within SDM base resources, the program will continue to maintain, operate, grow, and technologically support this E2E system. In FY12, SDM will start to handle data from DECam, archiving the raw data and processing data from NOAO proposals through the DECam Community Pipeline. This will greatly augment the volume of data that passes through the E2E system. SDM will validate the data archiving, operate the Community Pipeline, and support community users' access to the raw and reduced data. SDM will continue its ongoing effort to improve and streamline the Portal, with the aim of simplifying access to NOAO data and increasing community usage of the NSA and SDM data products, particularly with the large volumes of DECam data in mind. In collaboration with the Indiana University Pervasive Technology Institute (PTI), SDM is developing a science pipeline, portal, and archive system for the WIYN One Degree Imager (ODI), activity that will continue in FY12. SDM will also be involved in the developing collaboration between NOAO and the BigBOSS team and, ultimately, will be responsible for ensuring that BigBOSS data management (including archiving and pipeline processing) meets the needs of the user community. In FY12, SDM expects to work with the BigBOSS team and NOAO management to help define the parameters of this collaboration and to develop requirements for the pipeline and archive systems. Finally, SDM is charged with maintaining the IRAF facility through software development.

#### **Milestones**

- Continued operation of a functionally complete version of the SDM End-to-End (E2E) data management system, which includes data capture, transport, archiving, pipeline processing (Mosaic, NEWFIRM, and DECam data), and user access.
- Install and operate the DECam Community Pipeline received from the Dark Energy Survey (DES) project. Work with DES astronomers and developers to validate the pipeline during commissioning and shared-risk observing.

- Continue to provide support for the NOAO instrumentation: Data Handling System (DHS) support for Mosaic, NEWFIRM, KOSMOS, and COSMOS; and Data Transport System (DTS) support for DECam. Explore the use of DTS for data transport for LSST Data Challenges. Update the Archive for the ingestion of KOSMOS data.
- Develop a science pipeline for the WIYN One Degree Imager (ODI) to operate within the Open Grid Computing Environment (OGCE) on the TeraGrid. Assist in deployment of the pipeline for commissioning of the partial-focal-plane version of ODI.
- Deploy upgrades of the archive and portal components of the E2E system with important, new features for the user: association between all data and calibration files from a given observation; ability of a principal investigator (PI) of an NOAO observing program to grant permission for the co-investigators to access and retrieve the PI's' proprietary data; easier ways for users to find the data they seek with tools for sorting, filtering, and parsing query results; and compatibility of the portal with Safari and Chrome browsers.
- Develop and deploy improved data delivery mechanisms that will scale to the high data rates of DECam and ODI.
- Provide more, publically accessible data to the community through the NOAO Science Archive: update the archive and portal components to merge the NOAO Survey Archive data holdings into the NOAO Science Archive and begin that merge; read and recover Mosaic data from the Save-the-Bits holdings to ingest the data into the NOAO Science Archive, pipeline-process the data, and archive the reduced data products.
- Investigate data warehousing solutions for the NOAO Science Archive in order to more efficiently support the tremendous increase in data and metadata from the new instrumentation in FY12 and beyond. Implement a starting solution.
- Formulate a plan for BigBOSS data management in collaboration with the BigBOSS team.
- Continue support for IRAF and its users. Update the IRAF.noao.edu Web site. Add enhancements to the IRAF scripting environment. Continue the natural integration of IRAF with the Virtual Observatory (VO) data and services, an in-kind effort for the Virtual Astronomical Observatory (VAO).
- Support the release of the client-side VO tools and interfaces to the user community. Continue participation in the Data Access Layer (DAL) and VOEvent working groups for the International Virtual Observatory Alliance (IVOA). (Supported by VAO grant.)
- Continue to lead the VAO User Support effort in the areas of training, advocacy, quality assurance, and testing. Create a VAO User's Group. Support a special workshop and exhibit at the January 2012 AAS meeting in Austin. Develop user documentation. (Supported by VAO grant).

**Budget Summary**

Table 11 Summary of NSSC Science Data Management program budget

NOAO System Science Center (NSSC) Science Data Management (SDM) FY2012 Program Budget Summary						
System Data Management (SDM)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
Program Management (North)	1.3	\$167,409	\$30,760	\$198,169	-	\$198,169
Program Management (South)	-	-	\$2,500	\$2,500	-	\$2,500
Archive (North)	1.8	\$203,991	\$7,500	\$211,491	-	\$211,491
Archive (South)	0.2	\$12,633	-	\$12,633	-	\$12,633
Data Management (North)	3.5	\$385,779	\$110,025	\$495,804	-	\$495,804
Data Management (South)	1.0	\$91,179	\$81,550	\$172,729	-	\$172,729
Pipeline Development	0.7	\$89,801	\$64,500	\$154,301	-	\$154,301
Portal Development (South)	0.8	\$50,531	\$5,000	\$55,531	-	\$55,531
Science Support Software	0.5	\$66,580	\$6,500	\$73,080	-	\$73,080
Service (North)	0.5	\$54,190	-	\$54,190	-	\$54,190
Science Research (North)	1.2	\$170,949	\$2,500	\$173,449	-	\$173,449
VAO Grant (North)	2.4	\$315,972	\$187,184	\$503,156	\$503,156	-
ODI-DM	1.9	\$272,694	\$6,000	\$278,694	-	\$278,694
VO Support	0.1	\$14,166	-	\$14,166	-	\$14,166
<b>Total</b>	<b>15.7</b>	<b>\$1,895,874</b>	<b>\$504,019</b>	<b>\$2,399,893</b>	<b>\$503,156</b>	<b>\$1,896,737</b>

**Work Packages**

Program Management (North/South)

This work package covers program management activities, which include staffing, day-to-day management, as well as staff training and development. Payroll reflects all of the management time (for head of program/program manager) and fractions of staff time spent in overall management activities (e.g., program planning meetings). Non-payroll budget items cover all non-operations costs, including staff travel to support coordination between SDM staff at NOAO North and NOAO South, National Center for Supercomputing Applications (NCSA) partnerships, staff development, staff computing support (including all desktop development computers), and supplies.

Archive (North/South)

This covers software design and implementation for the NOAO Science Archive (NSA) and related parts of the NOAO E2E data management system. In addition to data capture, transport, and archival systems, this includes the enhancements necessary to archive DECcam raw and pipeline-reduced data and KOSMOS raw data, as well as work to maintain compatibility with new and changing Virtual Observatory (VO) standards.

Data Management (North/South)

This covers all aspects of operating all SDM systems, including the E2E data management system, from telescope to end-users. Operation of the E2E system comprises the management and operation of the distributed data transport system, the data processing pipelines, the configuration and operation of the NSA data centers in Tucson and La Serena, and the remote operation and coordination of the data storage at the NCSA. This work package also includes operation and support of the NOAO Portal, including management of the help desk and all end-user interaction for use of the E2E system. Costs related to the hardware necessary to support mountain data storage, data storage in Tuc-

son and La Serena, pipeline processing, and user interfaces and tools (Web-based portals) are included here to support the software testing framework.

#### Pipeline Development

The Mosaic and NEWFIRM pipelines are now in regular operation. This work package includes the costs for the occasional changes, improvements, or bug fixes that are needed for the pipelines, particularly when astronomers use these instruments in ways for which the pipeline had not been tested. The bulk of this work package is allocated to the support of DECam, including additional hardware for the DECam Community Pipeline Computer System and the pipeline's deployment with operational and scientific testing. Also included are the costs for the pipeline developers to update and document IRAF procedures for reduction of KOSMOS data and to assist in the preparation of a User's cookbook.

#### Portal Development (South)

The Portal is the users' window to the data holdings of the NSA and the basic interface through which users retrieve raw and reduced data from the archive. It also provides access to a broad range of widely distributed VO resources, including data, tools, and services. This work package reflects the FY12 costs for the SDM to continue improvements to the basic search and retrieval process for NOAO data in order to make it simpler and more efficient for the users.

#### Science Support Software

This package provides for ongoing IRAF system maintenance and support, as well as integration of the new FITS image kernel.

#### Service (North)

This work package covers the variety of administrative and technical service roles and activities in which SDM staff at NOAO North and South are involved, including development of *NOAO Newsletter* content and other internal NOAO activities, participation in standards committees for data formats, e.g., ADASS, FITS, and VO committees, as well as providing software support for the Office of Compliance and the System User Support group of NSSC.

#### Science Research (North)

Each NOAO scientific staff member is allocated some fraction of time that includes scientific and/or technical research, professional development activities, and external service (e.g., membership on committees whose activities benefit the astronomical community). That time is collected here proportionally for those staff members who charge functional time to SDM.

#### VAO Grant

This package covers work in support of the new Virtual Astronomical Observatory (VAO), including standards, tools, and services, as well as a newer component of user support. This work package relies upon the funding that NOAO-SDM receives from the NSF grant to the VAO LLC for product development, standards and protocols, operations, and user support. Given the large value and distributed participation in this grant, it is separated from the more general (and smaller scale) grant-supported work.

#### ODI-DM

Costs for SDM to develop an ODI Tier 1 Science Pipeline to run on the TeraGrid are included here. An initial delivery is targeted for mid 2012.

#### VO Support

This package covers in-kind work NOAO provides to the VAO including IRAF development, standards and protocols support, and user support.

### 2.3.3 System Community Development

#### **Program Overview**

System Community Development (SCD) has the goal of understanding community desires for the evolution of capabilities within the US Ground-Based Optical/Infrared (O/IR) System and guiding the System's development to provide those capabilities. General activities include development of plans for parts of the System, such as the small and mid-size telescopes (ReSTAR), as well as a roadmap for the entire O/IR System. The three subsidiary programs described below focus efforts on community interaction with specific projects or capabilities: Large Synoptic Survey Telescope (LSST), optical interferometry, and the System roadmap. Each of these has the goal of fostering community understanding of the corresponding set of science capabilities, promoting community engagement, and facilitating community input.

#### ***LSST Science***

NOAO will continue to serve as the hub for interaction between the LSST Project and the astronomy community. This will enable valuable and wide-ranging scientific input to the Project in order to maximize the scientific return during the observational phase of the Project. One aspect of this ongoing support is the solicitation and review of proposals for US community involvement in the LSST Science Collaborations. This includes individual membership in pre-existing collaborations as well as the creation of new collaborations. NOAO will also continue to support efforts to develop planning documents and tools for modeling operations. In addition, NOAO will coordinate and facilitate broader participation by the LSST Science Collaborations, in some cases by acting as the host for Collaboration meetings.

Scientists at NOAO will continue to work on the LSST operations simulator project. This will include attending weekly operations simulator meetings where simulation results are analyzed and progress is reviewed, working with LSST Science Collaborations to develop merit function requirements, and assisting with the development and testing of merit function code.

NOAO scientists will continue to develop the NOAO variable sky project to enable realistic predictions of transient events that may be discovered by time-domain surveys. This will allow for planning the scale of event handling necessary for the LSST Project, as well as provide estimates of the follow-up capacity required to study the time-variable sources. In addition, NOAO scientists will continue development of software infrastructure necessary to characterize and distribute events discovered by time-domain surveys. The goal for the software tool is to act as an aggregator of information from time-domain surveys and existing databases. The software will characterize the distinctive elements of the events and provide an interface for humans and machines to identify interesting events.

#### ***Optical Interferometry Science***

NOAO will continue to work with optical interferometry facilities and with the astronomy community to define community interest in and requirements for optical interferometry and to enable peer-reviewed access whenever and wherever possible. NOAO will support planning, execution, and follow-up of visitor programs for the NOAO/CHARA 2012 observing program. NOAO will also work with CHARA and other array operators in an effort to arrange future open invitations, both as special (one time) arrangements, and as longer-term relationships possibly involving a quid pro quo for federal funding.

#### ***The System Roadmap Committee***

US astronomers who carry out research using ground-based O/IR telescopes find themselves in a unique situation when compared to other astronomical user communities throughout the world. This uniqueness is due to the mix of federally funded plus state/private university and other institutionally funded ground-based O/IR telescopes. In other large astronomical research communities, most large

ground-based telescopes are centrally funded. The entirety of US ground-based O/IR telescopes is referred to as the “System.”

Viewed from the perspective of competitiveness on an increasingly expanding international stage, the US situation has both pluses and minuses. On the plus side, the diversity of System resources provides astronomers with multiple avenues and platforms from which to mount observational experiments across a wide scale. On the minus side, the inherent diversity within the System results in some inefficiency and, sometimes, a lack of consensus, which can hinder large-scale planning and projects.

Accentuating the positive aspects provided by such a diverse US System, while minimizing negative aspects, necessitates that the System not be simply a convenient term referring to the combined suite of facilities, but an evolving structure that contains within itself the means to become a more integrated and coherent entity. During FY12, NOAO will form and convene a standing System Roadmap Committee (SRC), which will guide the development of biennial reports on the status of the US ground-based O/IR System. The process will consist of the following steps:

1. Solicit input from the broad US astronomical community on needed or desired capabilities that are either missing from the System or are insufficient to meet user needs, as well as comments on planned future facilities.
2. Solicit input from those individuals, committees, or boards who speak for the non-federal facilities in order to understand their constraints and needs relative to broad community needs.
3. Develop both short-term (two-year) and long-term (ten-year) plans that seek to address both the community and facility needs within a reasonable resource envelope. Priorities will be science-based.
4. Synthesize the plans into a report to include the following:
  - An assessment of the current status of the System.
  - The desired state of the System in the short term and in the long term.
  - A scientifically justified list of desired capabilities with developmental paths, as needed.
  - Any recommended structural changes to the System.
  - Proposed mechanisms, including resource estimates, for providing new capabilities or structural changes.
  - The developmental paths that lead to new capabilities or structural changes should include assessment points and decision points at which choices should be made.
5. Assist in presenting the report results to the community, the facility operators, and the NSF.

### **Milestones**

- Solicit and conduct the review of proposals for membership in the LSST Science Collaboration groups and for the forming of new LSST Science Collaboration groups.
- Host working meetings of each of the LSST Science Collaboration groups. Help the chairs organize these meetings and ensure that results are effectively communicated to the LSST Project.
- Complete work on currently specified merit functions and metrics, design and implement a report format, and package these for convenient application in simulation studies.
- Develop both numerical and graphical methods for comparing and visualizing the relative performance of simulations with respect to the merit functions.
- Utilize the metric tools to compare a cross-section of simulations, evaluate the sensitivity of performance to simulation parameters and the principal performance tradeoffs.

- Review the findings of the LSST Scheduling Working Group and prepare a draft LSST Scheduling Science Requirements document.
- Continue developing the NOAO variable sky project to characterize the transient sky.
- Prepare a “lessons learned” report for the first full year of CHARA Array community access.
- Negotiate for community access to the Navy Prototype Optical Array in 2013.
- Enable community access to the CHARA Array in 2012 by working with Georgia State University in the development and implementation of a policy for access, the NOAO and CHARA Time Allocation Committees for processing of community proposals, and acquisition and delivery of data.
- Consult with CHARA on planning and implementation of facility improvements that will support increased productivity of community science operations.
- The System Roadmap Committee will meet and issue a first System Roadmap Report.

### Budget Summary

Table 12 Summary of NSSC System Community Development program budget

NOAO System Science Center (NSSC) System Community Development (SCD) FY2012 Program Budget Summary						
System Community Development (SCD)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
LSST Science Development	1.9	\$322,507	\$29,500	\$352,007	-	\$352,007
Optical Interferometry	0.1	\$20,489	\$8,500	\$28,989	-	\$28,989
Science Research	2.0	\$342,996	-	\$342,996	-	\$342,996
Roadmap Committee	-	-	\$28,000	\$28,000	-	\$28,000
<b>Total</b>	<b>3.9</b>	<b>\$685,992</b>	<b>\$66,000</b>	<b>\$751,992</b>	<b>-</b>	<b>\$751,992</b>

### Work Packages

#### LSST Science Development

This work package contains funds for community science development for the LSST Project.

#### Optical Interferometry

This work package includes the general activities aimed at strengthening the engagement of the community with the host organizations of US optical interferometry facilities.

#### Science Research

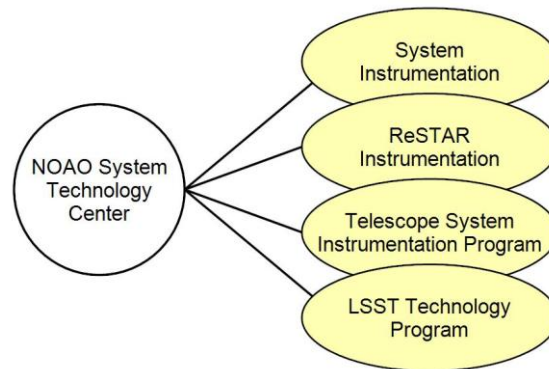
Each NOAO scientific staff member is allocated some fraction of time that includes scientific and/or technical research, professional development activities, and external service (e.g., membership on committees whose activities benefit the astronomical community). That time is collected here proportionally for those staff members who charge functional time to SCD.

#### Roadmap Committee

Support of the activities of the System Roadmap Committee, including their meeting in Tucson and support to produce a report is included in this work package.

## 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. The former GSMT/ELT Technology program, which in past years was a separate program within NSTC, has been dramatically reduced in scope, and the few remaining activities have been absorbed into the SI program. This change reflects NOAO's reduced role in liaison with US-based GSMT/ELT development following the release of *New Worlds, New Horizons in Astronomy and Astrophysics*, the Astro2010 decadal survey report.

### 2.4.1 System Instrumentation

#### Program Overview

During FY12, System Instrumentation (SI) will be focused on bringing new capabilities to the 4-m class of telescopes that NOAO operates and on enhancing the performance and reliability of existing instruments at those telescopes. Some of this effort will be funded in part by an award from the NSF for implementation of the ReSTAR program; those work packages are described in section 2.4.2. The SI activities are funded predominantly from the NOAO base budget with some from other sources as noted below.

#### Milestones

- Begin the on-telescope integration of the ODI instrument with a partially-filled focal plane of Orthogonal Transfer Array (OTA) detectors to assess optical, mechanical, and OTA performance (subject to approval of a proposed plan by the WIYN Board).
- Resolve final issues with image quality of returned laser spots to complete the on-telescope integration and testing of the entire SOAR Adaptive-optics Module (SAM) system, including the Main Module, the Laser Guide Star system, and the integrated CCD imager.

- Begin the on-sky commissioning and science verification of the entire SOAR Adaptive-optics Module (SAM) system, including development of all science user software and training for SOAR observatory support staff.
- Assemble and deliver the production TORRENT controllers to the remaining ReSTAR projects that need them, as well as to KPNO and CTIO for replacement of obsolete controllers on instruments already in service.
- Begin implementation of software and management systems to plan and track all NOAO engineering projects in both hemispheres in a fully integrated fashion.
- Oversee the return of the NEWFIRM wide-field infrared imager from CTIO to the KPNO Mayall 4-m telescope, including support of CTIO and KPNO staffs in disassembling and packing the instrument at Cerro Tololo, reassembling it at Kitt Peak, and reintegrating it on the Mayall telescope.

**Budget Summary**

Table 13 Summary of NSTC System Instrumentation program budget

NOAO System Technology Center (NSTC)						
System Instrumentation (SI)						
FY2012 Program Budget Summary						
System Instrumentation (SI)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
ODI Instrument Construction	3.8	\$512,580	\$60,000	\$572,580	\$60,000	\$512,580
SAM Construction	1.8	\$168,762	\$7,000	\$175,762	-	\$175,762
SAM Commissioning	0.2	\$23,813	\$10,000	\$33,813	-	\$33,813
TORRENT Production	2.6	\$233,667	\$23,000	\$256,667	-	\$256,667
DECam Integration Support	0.8	\$142,780	-	\$142,780	-	\$142,780
Project Portfolio Management	1.5	\$170,632	\$131,000	\$301,632	-	\$301,632
NEWFIRM Move from CTIO to KPNO	0.7	\$80,611	\$3,000	\$83,611	-	\$83,611
Dewar - Tokovinin	0.5	\$49,244	-	\$49,244	-	\$49,244
Design & Analysis Group Contracts	0.7	\$122,812	\$8,000	\$130,812	\$123,443	\$7,369
GSMT Program	1.6	\$307,319	\$62,000	\$369,319	\$341,584	\$27,735
Design & Analysis Group Overhead	0.4	\$60,573	\$37,000	\$97,573	-	\$97,573
Science Research	1.3	\$251,973	-	\$251,973	-	\$251,973
NSTC-SI Management	1.0	\$140,260	\$45,500	\$185,760	-	\$185,760
<b>Total</b>	<b>17.0</b>	<b>\$2,265,026</b>	<b>\$386,500</b>	<b>\$2,651,526</b>	<b>\$525,027</b>	<b>\$2,126,499</b>

**Work Packages Supported Entirely from the NOAO Base Budget**

ODI Instrument Construction

This work package contains the NOAO labor and incidental materials needed to complete the assembly of the One Degree Imager (ODI) for WIYN with a partially filled focal plane (approximately 10 out of 64) of OTA devices. These devices will be functional—but not science-grade—products from the “Lot 6” foundry run. If the work proceeds on schedule, the instrument should be ready for integration on the WIYN telescope around the end of FY12. The start of work under this package is contingent upon approval of the project plan by the WIYN Board at its October 2011 meeting. NOAO’s proposal is to contribute the labor for this package as its share of the ODI plan costs, but to require reimbursement from the WIYN consortium for all associated non-payroll costs.

### SAM Construction

This work package covers the labor and capital needed to complete the installation and on-telescope testing of the entire SAM system: the adaptive-optics bench known as the Main Module, the Laser Guide Star system, and the integrated CCD imager. Installation of the components was completed in the first half of FY11. On-sky testing began immediately thereafter, but a combination of technical problems and weather losses prevented the team from completing the test and verification program before the end of FY11. With the start of FY12, the SAM integration effort will be suspended for at least six months while the CTIO technical staff is fully committed to the integration of the Dark Energy Camera (DECam) on the Blanco 4-m telescope. SAM testing and verification will resume during the second half of FY12, with a goal of completing this effort by the end of FY12. Efforts under this work package will be complete when the adaptive optics system can reliably close its control loop on the laser guide star for correction of ground-layer turbulence while determining tip-tilt corrections from nearby natural stars, enabling enhanced-seeing imaging with the integrated CCD imager.

### SAM Commissioning

This work package covers the labor and capital needed to fully characterize the scientific performance of the complete SAM system. It includes the effort needed to ensure that the SAM system is ready for use by visiting observers, including completion of observer user interface software, user manuals, and other information needed for community members to propose for and observe with the system. Work under this package will begin only after the SAM Construction work package is completed; due to the hiatus in SAM verification caused by DECam work, the effort under this package will not begin until quite late in FY12.

### TORRENT Production

This work package covers the labor and non-payroll costs needed to construct, assemble, and test all copies of the TORRENT controllers as required by the various ReSTAR instrumentation programs, as well as internal testing uses and deployment on other instruments at KPNO and CTIO as requested by their respective directors.

### DECam Integration Support

This work package covers the labor costs associated with the planning, design, and analysis work by NSTC staff in support of efforts at CTIO to install and integrate DECam on the Blanco 4-m telescope. This work includes development or review of designs for new or modified components for the telescope and its interfaces, engineering analysis of the performance of these components and of the telescope as a whole with DECam installed, and coordinating the joint efforts on these tasks underway in both Tucson and La Serena.

### Project Portfolio Management

This work package includes the labor and non-payroll costs to establish and begin implementing an NOAO-wide system for planning and tracking all engineering projects across both hemispheres. NOAO is becoming involved in more projects, most of which involve commitments to external partners, at a time when budgets are tight and pressures are increasing to reduce (or at least not increase) engineering staffs. Recent experiences with conflicting demands on the limited, available resources have highlighted the need for a comprehensive, professionally managed system for planning and tracking all of NOAO's engineering projects. Labor costs here include two new project management positions, one each at NOAO North and NOAO South, to implement the planning and tracking system and provide continuing liaison between the management system and the individual project teams. The non-payroll costs include the purchase of a large-scale software package for managing a portfolio of projects and the consulting services required to tailor the package to NOAO's needs and to integrate it with NOAO's existing accounting and timekeeping software. The package budget assumes that the first half of FY12 will be used for selecting a management system and ordering asso-

ciated software, with implementation beginning in the second half of the fiscal year. The new positions are expected to be filled about halfway through the fiscal year.

#### NEWFIRM Move from CTIO to KPNO

This work package covers the labor needed to assist the CTIO technical staff with disassembling and packing NEWFIRM for shipment back to Kitt Peak, the non-payroll funding to cover the costs of transportation and insurance for the shipment, and the labor to assist the KPNO technical staff in reassembling NEWFIRM and reintegrating it with the Mayall 4-m telescope. It is intended that NEWFIRM will remain at CTIO until the integration of the Dark Energy Camera begins. DECam integration was expected to begin late in FY11, but minor delays in the DECam assembly pushed the start of integration into the first quarter of FY12, in turn delaying the move of NEWFIRM back to KPNO. NEWFIRM is now scheduled for removal from the Blanco 4-m telescope in late October 2011, with packing and shipping following immediately thereafter.

#### Dewar - Tokovinin

The CTIO high-resolution spectrometer (CHIRON) is a new, fiber-fed, echelle spectrograph for the CTIO 1.5-m telescope. It is designed for radial velocity searches for exoplanets, but it is also useful as a general user spectrograph. It was funded by an award from the NSF Major Research Instrumentation (MRI) program to Dr. Debra Fischer (formerly of San Francisco State University, now at Yale) as principal investigator (PI). Dr. Andrei Tokovinin is the NOAO staff project scientist. Integration and commissioning of the opto-mechanical system is complete, but performance of the Dewar/detector/controller system has proven unacceptable. This system was a deliverable from NOAO in the original instrument construction plan. This work package covers the cost of labor for repairing wiring and other faults inside the Dewar, replacing the older MONSOON controller with a new TORRENT controller, and optimizing the performance of the detector and controller to meet the PI's requirements. The effort under this work package is expected to begin in December 2011 and to continue for approximately three months.

### **Work Packages Supported in Whole or in Part by Other Funds**

#### Design & Analysis Group Contracts

This work package covers efforts of NSTC personnel on various small, instrument-related design or consulting projects being carried out with other observatories throughout the US ground-based O/IR system. These projects include consulting with the University of Hawaii Institute for Astronomy on aspects of the mechanical design of their near-infrared, immersion grating, echelle spectrograph (iSHELL), and providing design or consulting services for spectrograph projects underway at Indiana University (FHiRE) and planned by Lowell Observatory (LSES). In all cases, the work represents a small fraction of the time of the NSTC individuals involved; in all cases, the projects were initiated by requests from PIs at the external institutions who wished to take advantage of some specialized expertise at NSTC in collaboration with their own staffs. And finally, in all cases, the work is fully paid for by the external institution at NOAO's approved, fully burdened labor rates.

#### GSMT Program

This work package covers the efforts of NSTC personnel with respect to the US GSMT/ELT development efforts. There are two types of work included here. The first, and considerably larger, type consists of providing engineering assistance to the Giant Magellan Telescope (GMT) and the Thirty Meter Telescope (TMT) projects upon request and on a cost-recovery basis. The second, and smaller, type consists of the minor remaining efforts to oversee use of the design development funding provided to GMT under NSF SPO-10 (AST-0443999). TMT completed its use of this funding early in FY11, so there is no remaining effort associated with oversight of TMT. GMT is expected to complete and close out its funding sub-award during the first half of FY12.

## Overhead Work Packages

### Design & Analysis Group Overhead

This work package covers the labor and non-payroll costs needed to keep the design and analysis engineers within NSTC working productively. It includes staff time and costs advanced for training and professional development including conference attendance, purchase and maintenance of computers, and purchase or renewal of software licenses.

### Science Research

Each NOAO scientific staff member is allocated some fraction of time that includes scientific and/or technical research, professional development activities, and external service (e.g., membership on committees whose activities benefit the astronomical community). That time is collected here proportionally for those staff members who charge functional time to SI.

### NSTC-SI Management

This includes the labor necessary to manage the System Instrumentation program, as well as the non-payroll budget to cover supplies, computer purchases, support for the non-payroll costs of scientific and professional development activities of the instrument scientists, and travel and conference expenses for scientists.

## 2.4.2 ReSTAR Instrumentation

### Program Overview

In November 2008, NOAO submitted an unsolicited proposal to the NSF for supplemental funding to cover the costs of implementing the recommendations of the ReSTAR Committee. Late in FY09, NSF awarded NOAO supplemental funding under SPO-1 AST-0244680 for some of the items requested in the proposal. Three instrument-related projects were initiated in FY10 using this first year of ReSTAR funding: KOSMOS, an optical spectrograph for the KPNO Mayall 4-m telescope; a detector and controller upgrade for the Mosaic-1 prime-focus camera on the KPNO Mayall 4-m telescope; and a detector and controller upgrade for the Hydra spectrograph on the CTIO Blanco 4-m telescope.

Late in FY10, NOAO was formally advised that NSF would provide additional funding, under CSA (4) AST-0936648, for a second year of ReSTAR implementation work, and that this funding would be targeted towards building two instruments for the CTIO Blanco 4-m telescope: COSMOS, an optical spectrograph (a duplicate of KOSMOS), and TripleSpec, a near-infrared moderate-resolution spectrograph.

This section describes the work packages associated with these instrument construction and upgrade projects. Each project is funded partly from the supplemental funds awarded in response to the ReSTAR proposals and partly from NOAO's base budget, as noted below. For each work package, the amount shown under "Funding, Other" is the amount of supplemental funds awarded in response to the ReSTAR proposals.

### Milestones

- KOSMOS: Integrate and commission the completed instrument on the KPNO Mayall 4-m telescope.
- CTIO-Hydra CCD and Controller Upgrade: Modify the Dewar to provide better thermal performance, integrate the new CCD and controller with the modified Dewar, and recommission the upgraded Hydra instrument on the CTIO Blanco 4-m telescope.
- COSMOS: Complete laboratory integration in The Ohio State University (OSU) instrument lab.

- COSMOS: Deliver the assembled instrument to CTIO and begin integration and commissioning on the Blanco 4-m telescope.
- TripleSpec: Execute a formal partnership agreement with Cornell University for the construction of TripleSpec.
- TripleSpec: Complete the evaluation of minor design revisions and order long-lead-time components to launch the fabrication phase.

## Budget Summary

Table 14 Summary of NSTC ReSTAR Instrumentation program budget

NOAO System Technology Center (NSTC)						
ReSTAR Instrumentation						
FY2012 Program Budget Summary						
ReSTAR Instrumentation	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
KOSMOS for Mayall - Supplement	0.4	\$48,651	\$5,000	\$53,651	\$53,651	-
KOSMOS for Mayall - Base Budget	0.3	\$32,365	-	\$32,365	-	\$32,365
COSMOS for Blanco - Supplement	1.6	\$175,854	\$24,000	\$199,854	\$199,854	-
COSMOS for Blanco - Base Budget	0.1	\$9,882	-	\$9,882	-	\$9,882
Hydra-South Upgrade - Base Budget	1.9	\$141,064	\$10,000	\$151,064	23,164.00	\$127,900
TripleSpec - Supplement	1.3	\$161,523	\$1,801,000	\$1,962,523	\$1,962,523	-
Science Research	0.3	\$43,835	-	\$43,835	-	\$43,835
<b>Total</b>	<b>5.8</b>	<b>\$613,174</b>	<b>\$1,840,000</b>	<b>\$2,453,174</b>	<b>\$2,239,192</b>	<b>\$213,982</b>

## Work Packages

### KOSMOS for Mayall – Supplement

KOSMOS, the Kitt Peak Ohio State Multi-Object Spectrograph, will be a modern, high-throughput, moderate-resolution spectrograph for the KPNO Mayall 4-m telescope. It is being built in close partnership with the instrumentation group in the Astronomy Department at The Ohio State University (OSU), which has just finished a very similar instrument called OSMOS for the Hiltner 2.4-m telescope at MDM Observatory. During FY11, OSU and NOAO completed purchase and fabrication of all components for KOSMOS and were nearly done with integrating it in the OSU instrument lab by the end of FY11. Delivery of the powered optics was delayed by problems with the performance of the anti-reflection coatings supplied by the original subcontractor; a different coatings contractor was chosen and the problem was resolved, but the resolution prevented delivery to KPNO before the end of FY11. This FY12 work package covers the final payments to OSU and as much of the remaining NOAO engineering and technical labor costs as can fit within the ReSTAR supplemental funding for this project. This work package is funded entirely from Year 1 of the ReSTAR funding, received at the end of FY09 as a supplement to SPO-1 AST-0244680. Most of that supplemental funding for this project was expended or encumbered in FY11 on the contract with OSU and the purchase of major instrument components; the remainder is funding this work package.

### KOSMOS for Mayall – Base Budget

This work package, funded entirely from NOAO's base budget, covers all of the costs of NOAO's project scientist's participation in the specification of science goals and functional requirements, as well as that scientist's participation in planning and carrying out the on-sky commissioning. It also

covers the remaining part of the NOAO engineering, technical, and managerial effort that is not covered in the KOSMOS for Mayall – Supplement work package above.

#### COSMOS for Blanco – Supplement

COSMOS, the Cerro Tololo Ohio State Multi-Object Spectrograph, will be a modern, high-throughput, moderate-resolution spectrograph for the CTIO Blanco 4-m telescope. It will be a virtual copy of the KOSMOS instrument for Kitt Peak, differing only in the mechanical details necessary to adapt the front and back of the instrument to the slightly different telescope mounting and CCD Dewar attachments, respectively, at CTIO. Like KOSMOS, COSMOS is being built through a close partnership with OSU. Major capital items for both instruments were ordered at the same time, and fabrication of mechanical parts was scheduled so as to minimize the incremental labor for making the second set of parts. It is expected that laboratory integration of COSMOS will begin at OSU as soon as the KOSMOS commissioning is underway, nominally, early in FY12. This work package covers the remaining capital items to be purchased by NOAO and the balance of the cost of the sub-award to OSU for their portion of the construction activities. It also covers the bulk of the NOAO managerial, engineering, and technical effort on COSMOS. This work package is funded entirely from NSF funds awarded under CSA (4) AST-0936648 for Year 2 of the ReSTAR implementation.

#### COSMOS for Blanco – Base Budget

This work package, funded entirely from NOAO's base budget, covers all of the costs of NOAO's project scientist's participation in the specification of science goals and functional requirements, as well as that scientist's participation in planning and carrying out the on-sky commissioning. It also covers the remaining part of the NOAO engineering, technical, and managerial effort that is scheduled in FY12 and not covered in the COSMOS for Blanco – Supplement work package above.

#### Hydra-South Upgrade – Base Budget

The popular Hydra multi-object, fiber-fed spectrograph on the CTIO Blanco 4-m telescope will be upgraded with a new CCD and new controller. The new CCD will provide enhanced sensitivity throughout the visible spectrum, with dramatic improvement in far-red wavelengths. It will also enable on-chip Nod-&-Shuffle mode with reduced multiplex (i.e., using every other fiber for a science target), which will provide an additional improvement in far-red performance through more accurate sky subtraction. The new TORRENT controller will give faster readout, improved noise performance, and enhanced reliability and serviceability compared to the existing Arcon unit. ReSTAR SPO-1 supplement funding (from the Year 1 award) covered the non-payroll cost of purchasing the new CCD and parts for the TORRENT controller in FY11. This FY12 work package covers labor costs of modifying the Dewar, integrating the new CCD and controller with the Dewar, and recommissioning the instrument. The project was split over two years due to the total commitment of CTIO engineering and technical resources in FY11 to high-priority major projects, which included the SAM commissioning and DECam integration. This work package is covered entirely from the NOAO base budget.

#### TripleSpec – Supplement

TripleSpec will be an efficient, moderate-resolution, near-infrared spectrograph for the Blanco 4-m telescope. It will be built in close partnership with the Department of Astronomy at Cornell University, which has already built a version of this instrument that is deployed at the 200-inch Hale Telescope on Mount Palomar. TripleSpec was originally designed to be readily adaptable to different telescopes; one major goal of this version for the Blanco will be to retain as much of the original design as possible to realize the maximum savings in cost and schedule. Because of limitations on the availability of the required personnel at both NOAO and Cornell, the design work for the Blanco version could not begin until June 2011. The partners intend that the designs for the necessary minor modifications will be complete early in FY12 with an internal cost and planning review to be held as soon as possible thereafter. Instrument construction is anticipated to require another two years beyond that point. For FY12, this work package covers the first year of payments to Cornell under

the anticipated construction contract, as well as the major capital items to be purchased directly by NOAO, primarily the infrared detectors and their controllers. It also covers the labor of NOAO's managerial, engineering, and technical staff in carrying out their portions of the partnership work on integrating the detectors and controllers and writing the instrument software. This work package is covered entirely from NSF funds awarded under CSA (4) AST-0936648 to support Year 2 of the ReSTAR implementation.

#### Science Research

Each NOAO scientific staff member is allocated some fraction of their time to be spent on scientific and/or technical research, professional development activities, and external service (e.g., membership on committees whose activities benefit the astronomical community). That time is collected here proportionally for those staff members who charge functional time to ReSTAR instrumentation projects.

### **2.4.3 Telescope System Instrumentation Program**

#### **Program Overview**

The Telescope System Instrumentation Program (TSIP) funds development of new instruments for, or operational costs of, non-federal observatories in return for US community access to observing time on those telescopes as administered by the NOAO TAC. NOAO organizes an external review each year to select proposals for funding. The panel recommendations are presented to NSF for approval, and then NOAO works with successful teams to negotiate a sub-award and memorandum of understanding, including allocation of telescope time.

Due to delayed appropriations from Congress, NOAO operated under a continuing resolution for most of FY11. The FY11 TSIP funding came even later in the fiscal year, so those funds will be expended in FY12. As a result of these delays, proposals are due just after the end of FY11. Early in calendar year 2012, NOAO will convene the panel of outside reviewers to evaluate the proposals and make funding recommendations.

After negotiations are complete, NOAO will establish regular oversight activities with each new program including monthly reports and teleconferences. Current programs that will be overseen in FY12 include MODS2, an optical spectrograph for the LBT (Ohio State); Binospec, a multi-object, dual-beam spectrograph for MMT being built by the Center for Astrophysics at Harvard-Smithsonian; an Adaptive Secondary for Magellan (Steward); MOSFIRE, a near-infrared, multi-object spectrograph for Keck; an optical integral field spectrograph for Keck (KCWI); a CCD upgrade to the Magellan optical multi-object spectrograph IMACS; and ODI, a wide-field imager for WIYN.

Also included in this program is oversight of the remaining sub-award under the Adaptive Optics Development Program (AODP), originally funded by NSF SPO-6 (AST-0336888).

#### **Milestones**

- Complete an external review of FY11 TSIP proposals and negotiate sub-awards with successful proposers.
- Establish an oversight process for FY11 TSIP sub-awards.
- Conclude the remaining sub-award under the Adaptive Optics Development Program (AODP) and close out the program.

## Budget Summary

Table 15 Summary of NSTC Telescope System Instrumentation Program budget

NOAO System Technology Center (NSTC)						
Telescope System Instrumentation Program (TSIP)						
FY2012 Program Budget Summary						
Telescope System Instrumentation Program (TSIP)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
TSIP Program FY12	0.2	\$27,451	\$2,906,000	\$2,933,451	\$2,933,451	-
<b>Total</b>	<b>0.2</b>	<b>\$27,451</b>	<b>\$2,906,000</b>	<b>\$2,933,451</b>	<b>\$2,933,451</b>	<b>-</b>

## Work Packages

### TSIP Program FY12

New awards this year will be based on the solicitation for proposals received late in FY11. Activities in FY12 will consist of external review of the proposals, negotiation of sub-awards, and technical oversight of the funded projects and operational programs. The NOAO administrative, review, and oversight expenses are reimbursed from the NSF TSIP allocation awarded under SPO-5 AST-0335461 and not from the NOAO base budget. NSF has told NOAO that there will be no new TSIP funding in FY12.

## 2.4.4 LSST Technology Program

### Program Overview

NOAO continues to support the LSST Project in three important areas: (1) as a founding institutional partner, NOAO participates in the governance of the Project with staff at two key Project positions, Board Member and Deputy Project Manager; (2) responsibility for the design, development, and construction of the facilities in Chile, including the telescope, enclosure, and support facilities both on the summit and in La Serena; and (3) community engagement intended to support science collaborations in developing the science missions and input into the LSST Project to maximize the scientific return of the LSST Project and survey. The latter is discussed further in the NOAO System Science Center section 2.3.3. The following information focuses on the direct support to the Project design and development and the Telescope and Site subsystem specifically.

The successful completion of the Preliminary Design Review late in FY11 will allow the focus in FY12 to be on the recommendations from that review and the transition of the project to the final design and construction readiness phase. The Project will submit a new proposal to the NSF to support the extended Design and Development after 2012, and NOAO will again prepare its plans to be consistent with that effort. The NOAO group will continue to receive funding from the LSST award (AST-1036980) to augment base funding and the two funding streams will continue to be accounted for separately but managed as a single coherent and efficient effort.

The technical effort in FY12 will focus on the completion of the summit facility design work and the detailed interfaces to this facility. The Phase 1 effort at ARCADIS is to be completed in early 2012, and the final design specification effort will follow a several month project review to conclude this multiyear effort. The telescope mount procurement plans will be drafted, and all interested bidders will be invited to an early bidders' conference to review the plans for the development of this important system. The design details for other systems that pose cost, schedule, and technical risk will continue to be the focus of additional development in 2012.

## Milestones

- Facility and Site:
  - conduct a thorough review of the 90% summit facility design package delivered by ARCADIS Chile under the current Phase 1 contract, and
  - plan and execute the final phase of the ARCADIS effort to bring the summit facility design package to a natural conclusion before its use in the construction phase.
- Dome Design:
  - develop the final procurement plan for this element of the work breakdown structure (WBS) and develop an interested bidders list through communication of the design and plans, and
  - finalize the interface designs to the facility consistent with the 90% and 100% summit facility design packages.
- Telescope Mount:
  - complete the next level of design details in the solid model and finite element model,
  - complete the procurement plan and package for the design and build contract, and
  - conduct a design conference for interested contractors to review the details of the telescope mount design and acquisition plans.
- Reflective Optics:
  - collaborate with LSST's primary mirror vendor to evaluate the final polishing progress of the separately funded primary-tertiary mirror,
  - monitor and evaluate the technical interfaces and final fabrication of the primary mirror shipping container under construction with non-federal funds by LSST Corporation,
  - develop the circuit diagram and bill of materials for the mirror inner-loop controller, and
  - build and test a secondary mirror actuator prototype.
- Wavefront. Alignment and Calibration:
  - complete the full design model of the atmospheric monitoring telescope (Calypso),
  - complete the evaluation of prototype hardware developed for the instrument calibration screen, and
  - complete the updated Wide-Field Survey Wavefront Sensor (WFS) pipeline and report the performance results against simulated data and on-sky data.
- Software and Controls:
  - develop the systems for control software development by expanding the LSST software development plans into this detailed area of code,
  - prepare the SysML software model for a software critical review, and
  - combine the scheduler and operations simulation final development plans into a single coordinated effort.

- Utility System:
  - update the design for the electrical distribution, grounding, and utility services for the summit facility to be consistent with the final summit facility design package; and
  - complete the final requirements package for the utility systems for the base facility in La Serena.
- Systems Engineering:
  - coordinate and complete the development of all level 2 telescope and site interface documents;
  - organize a system safety review and subsystem design reviews for the utility systems, software, and inner-loop controller; and
  - complete a yearly report of risks and hazards as informed by the ongoing processes in these areas.
- Project Management:
  - support the project with participation as the Deputy Project Manager and as an LSST Board Member,
  - support the project with oversight of the image simulation efforts,
  - complete the 2012 inputs for the Project Management Control System, and
  - support and participate in Project-wide reviews.
- Science Mission and Requirements: provide inputs for the commissioning plan.
- Operations Simulator:
  - lead the operation simulation group, and
  - complete a design review of the operation simulator tool set.
- Education and Public Outreach: support LSST graphic design tasks and Web site development.

## Budget Summary

Table 16 Summary of NSTC Large Synoptic Survey Telescope Program budget

NOAO System Technology Center (NSTC)						
NOAO Large Synoptic Survey Telescope Program (LSST)						
FY2012 Program Budget Summary						
NOAO Large Synoptic Survey Telescope Program (LSST)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
Site and Facility	1.5	\$162,434	\$29,943	\$192,377	\$35,599	\$156,778
Dome	1.0	\$100,375	50,000.00	\$150,375	\$108,313	\$42,062
Telescope Mount	0.5	\$81,296	-	\$81,296	-	\$81,296
Reflective Optics	2.0	\$291,408	-	\$291,408	\$204,637	\$86,771
Software and Controls	2.6	\$301,456	\$33,500	\$334,956	-	\$334,956
WFS Alignment/Calibration	1.9	\$284,884	\$15,000	\$299,884	\$299,884	-
Utility Systems	1.8	\$239,068	-	\$239,068	\$219,818	\$19,250
System Engineering/Integration	3.1	\$425,232	\$15,000	\$440,232	\$328,943	\$111,289
Project Management	2.9	\$410,473	\$153,721	\$564,194	\$189,361	\$374,833
Data Management	0.2	\$31,384	-	\$31,384	\$31,384	-
Science Mission and Requirements	0.1	\$14,343	-	\$14,343	-	\$14,343
Operations Simulator	1.5	\$161,916	-	\$161,916	-	\$161,916
Education and Public Outreach	0.6	\$31,471	-	\$31,471	\$31,471	-
Science Research	0.3	\$58,048	-	\$58,048	\$21,924	\$36,124
<b>Total</b>	<b>19.9</b>	<b>\$2,593,788</b>	<b>\$297,164</b>	<b>\$2,890,952</b>	<b>\$1,471,334</b>	<b>\$1,419,618</b>

## Work Packages

AURA was awarded a separate NSF grant (AST-1036980) for the completion of the Design and Development (D&D) phases for construction readiness of the LSST. NOAO manages the award for AURA and passes through the majority of the funds to LSSTC as a sub-awardee and retains a portion of the funds to pursue elements of the D&D work captured in work packages as noted below. This supplemental (“Other”) funding and the NOAO base funds are accounted for separately but managed as a single coordinated project.

### Site and Facility

The summit facility architectural and engineering contractor, ARCADIS Chile, will conclude the first phase of their effort this year with the delivery of the 90% document package. The team will focus on the review of this deliverable and provide feedback to the contractor for their final phase of effort to complete the full design package. This work package includes revenue from the D&D award under cooperative support agreement AST-1036980.

### Dome

The LSST dome preliminary design has been developed with particular focus on the details of the light/wind screen. This work package will focus on the next steps in the design of the structure and bearing systems. The effort will also address the design with industrial suppliers to understand fabrication concerns and to generate interest in the vendor pool for this critical system. This work package includes revenue from the D&D award under cooperative support agreement AST-1036980.

### Telescope Mount

The telescope mount design will continue to be developed and the vendor for the supply of the system will be chosen through a rigorous, open-selection process. The team effort will focus on the final

development of interface details and the completion of the design, requirements, and procurement documents to support the procurement process. The system design will be presented to the interested vendor community at a design conference that will start the proposal solicitation process. By the end of this fiscal year, a vendor will be chosen, and a contract will be in place for final design work. The contract will include an option to continue with the system fabrication following the proper MREFC authorization to the Project. Working with the contractor that will supply the mount in this final design phase offers significant reduction in technical and programmatic risk.

#### Reflective Optics

The Telescope and Site group will continue to work with the University of Arizona as they complete the primary/tertiary monolithic mirror. During this year, the front surface processing will continue and the optical metrology will commence. The mirror is currently scheduled for completion late in this fiscal year. The NOAO group will continue to monitor the processing and incorporate relevant results into the mirror support system and telescope system designs. This work package includes revenue from the D&D award under cooperative support agreement AST-1036980.

The secondary mirror optical fabrication procurement package will be developed this year and also put out for bid later in the year. The contract will be for the final design of the optical fabrication process and metrology system and will include an option to buy the effort for fabrication. The secondary mirror fabrication is a long-lead item in the construction phase, and having the contractor identified and ready to proceed greatly reduces budget and schedule risks and offers significant technical advantage. Designs will be completed for the secondary mirror support systems. The focus of the effort will be on a detailed specification and axial actuator prototype testing.

The design of the inner loop controller will commence this fiscal year. LSST will create a common control module that will serve as the foundation for all local controllers necessary in both the primary and secondary mirror systems. The electrical schematic and controller parts will be developed in this first year of development.

#### Software and Controls

The Software and Controls work package addresses the LSST observatory control system, the telescope control system, the communication middleware layer, and the facility database for capturing system telemetry during operation. The objective this year is to continue the detailed development of the observatory and telescope control system with further prototypes to test the system more thoroughly and to support a software system design review. Final interface requirements will also be established to support the telescope mount final design package.

#### WFS Alignment/Calibration

The effort in this work package will address the wavefront sensing pipeline development, the planning for Calypso upgrades, and the testing of instrument calibration hardware currently in development. The updated WFS pipeline will be exercised and tested against simulated and sky data. The plans for the upgrade of the Calypso telescope will be developed, complete with a new, solid model of the telescope and associated critical drawings to support the plans. The new prototype diffusers being delivered early in the fiscal year will be tested for performance to support the final design plans of the calibration screen. This work package includes revenue from the D&D award under cooperative support agreement AST-1036980.

#### Utility Systems

This work package supports the design of the support elements in the LSST and site system. In FY12, the focus continues on the central safety system, power distribution, and utility designs to support summit facility architectural and engineering services and to develop the final requirements for the base facility utility system as well. This work package includes revenue from the D&D award under cooperative support agreement AST-1036980.

### System Engineering/Integration

The Systems Engineering effort will focus on the flow-down requirements for the individual systems within the telescope and the interface control definitions. Standardization of components and design philosophies will be an important theme this year as will the continuation of Hazard and Risk analysis. The telescope systems engineer will organize several subsystem reviews and will coordinate the completion of all critical level 2 telescope interface control documents. This work package includes revenue from the D&D award under cooperative support agreement AST-1036980.

### Project Management

The Telescope and Site group is based at NOAO. The core team is located and managed there with additional participation from the LSST collaboration and contracted efforts. This work package will see to the coordinated management of the efforts directed at the telescope and site elements as well as the reporting of progress for both in-kind efforts and D&D-funded efforts. The team will also manage the LSST image simulation effort. This work package includes revenue from the D&D award under cooperative support agreement AST-1036980.

NOAO will continue to support the LSSTC and Project office with Board-level representatives, project operations planning, and general project consultation.

NOAO will provide systems administration support of LSST servers, clusters, and communication lines for LSSTC, data management, and telescope and site assets as required. This will include appropriate personnel for the tasks of both equipment and software administration.

### Data Management

Data management system development will be supported with continued efforts to interact with private companies and scientific collaborations to represent LSST interests in fiber communication networks in Chile and from Chile to the US. This effort will also include collaboration with the project to further develop the data management infrastructure plans, especially as they impact the summit and base in Chile. This work package includes revenue from the D&D award under cooperative support agreement AST-1036980.

### Science Mission and Requirements

NOAO scientists will continue to support the science program development, mission priority evaluation, and justifications for the LSST. They will continue to support the interpretation of the science requirements and the evaluation of technical approaches and site parameters on predicted scientific performance. The scientific effort in this work package in FY12 will be focused on direct support to operations scheduling development.

### Operations Simulator

NOAO will continue to be the lead organization in the development and maintenance of the LSST Operations Simulator. This includes efforts to keep the developed tool maintained and responsive to the needs of the Project as well as providing specific and potentially custom versions of the simulator to elements of the Project for various investigations. The group will support parametric sensitivity testing for scientists and engineers, maintain the Web site standard reporting tools for result distribution, and support specific tests to enable development of the operational scheduler design.

### Education and Public Outreach

This work package will support the LSST education and public outreach effort. NOAO staff will provide Web site content management, newsletter article layouts, public information release production, and visual art support with digital photography and layout design effort. This work package includes revenue from the D&D award under cooperative support agreement AST-1036980.

### Science Research

Each NOAO scientific staff member is allocated some fraction of time that includes scientific and/or technical research, professional development activities, and external service (e.g., membership on

committees whose activities benefit the astronomical community). That time is collected here proportionally for those staff members who charge functional time to LSST Technology. This work package includes revenue from the D&D award under cooperative support agreement AST-1036980.

## 3 NOAO-WIDE PROGRAMS

### 3.1 CENTRAL ADMINISTRATIVE SERVICES

#### Program Overview

The Central Administrative Services (CAS) program provides business services and operational support to NOAO, NSO, AURA, WIYN, SOAR, LSST Corporation (LSSTC), and, on a limited basis, Gemini and other consortia and universities. These services include program administration, accounting and payroll, budgeting, reporting, procurement, contracts, shipping and receiving, and import/export.

For FY12, there are two primary objectives for CAS: first, prepare for the upcoming NSF Business Service Review (BSR) scheduled for May 2012; second, work closely with AURA, NSO, and Gemini to consolidate administrative services for AURA's NSF-funded centers into a centralized business unit reporting to the AURA Corporate Office.

#### Milestones

- Working groups within CAS will continue to review and update administrative policies and procedures in advance of the upcoming Business Service Review being conducted by NSF. As completed, the policies and procedures will be posted to a Web site and made readily available to all CAS staff.
- Members from the CAS accounting, procurement, and contracts departments will join working groups with representatives from other AURA Centers to plan and prepare for the upcoming administrative consolidation.
- In preparation for the consolidation of administrative functions within the AURA's NSF-funded centers, Business IT will begin revising Web-based programs into a single, unified code base with a common interface for all users.
- The NOAO Human Resources (HR) department will work cooperatively with AURA to plan and prepare for the upcoming human resources consolidation across AURA's NSF-funded centers. Efforts have already begun to develop a model for consolidation of HR services in La Serena across NOAO and Gemini.
- The Human Resources department will focus on increasing its presence and availability to staff at all remote locations, including Chile, as well as working cooperatively with the Tribal Employment Rights Office in Sells, Arizona, to enhance recruitment efforts of Native American candidates at Kitt Peak.
- The Human Resources department will continue to undertake and review the Human Resources systems, processes, procedures, and policies. A new recruitment system will be introduced in FY12 that will streamline and automate recruitment activities.

## Budget Summary

Table 17 Summary of Central Administrative Services program budget

Central Administrative Services (CAS) FY2012 Program Budget Summary						
Central Administrative Services (CAS)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
Program Management (PM)	2.6	\$306,437	\$125,665	\$432,102	\$234,388	\$197,714
Accounting and Payroll (A&P)	7.2	\$426,500	\$43,000	\$469,500	\$309,000	\$160,500
Human Resources (HR)	4.4	\$324,395	\$36,300	\$360,695	\$188,600	\$172,095
NOAO Purchasing Office (NPO)	2.5	\$166,834	\$10,250	\$177,084	\$93,200	\$83,884
Materials Transfer and Receiving (MT&R)	3.0	\$123,297	\$49,200	\$172,497	\$90,000	\$82,497
Export/Import Control (EIC)	0.5	\$30,928	\$3,650	\$34,578	\$20,700	\$13,878
Business IT (BIT)	1.3	\$131,599	\$15,000	\$146,599	\$146,599	-
Contracts Office (CO)	1.8	\$156,804	\$17,000	\$173,804	\$89,500	\$84,304
<b>Total</b>	<b>23.2</b>	<b>\$1,666,794</b>	<b>\$300,065</b>	<b>\$1,966,859</b>	<b>\$1,171,987</b>	<b>\$794,872</b>

## Work Packages

Each CAS work package below includes a portion of the revenue for accounting and other administrative support provided to NSO, AURA Corporate, Gemini, WIYN, SOAR, and LSSTC. Each work package also includes a portion of the general and administrative revenue (G&A) collected on grants and other outside projects.

### Program Management (PM)

This work package focuses on administrative program management, budgeting, financial reporting, award monitoring, and proposal coordination for NOAO and its customers. Proposal coordination includes entry into electronic systems, proposal budget development, funding agency information coordination, proposal submission coordination, and related sponsored-funding duties.

### Accounting and Payroll (A&P)

This includes various related services for NOAO, NSO, WIYN, SOAR, and LSSTC. Also included is the federal reporting and audit for all AURA Centers, including AURA Corporate, Gemini, and Space Telescope Science Institute. Some AURA and Gemini accounting and payroll support is included here as well.

### Human Resources (HR)

This work package includes employee benefits administration, recruitment, topic briefings, compensation surveys, benefit negotiations, policy and development, employee regulations (including visa support), and compliance for NOAO, NSO, CTIO expatriates, WIYN, SOAR, and LSSTC. This work package also covers assistance on pension administration provided to AURA.

### NOAO Purchasing Office (NPO)

Routine purchasing, bids, and procurements for NOAO, NSO, WIYN, SOAR, and LSSTC with the exception of local Chilean purchases are in this work package.

Materials Transfer and Receiving (MT&R)

Shipping, receiving, mail operations, inventory, and hazardous material shipping for NOAO, NSO, WIYN, SOAR, and LSSTC are in this work package.

Export/Import Control (EIC)

Export/import and licensing controls are in this work package, including support to Gemini and other institutions for transfer of instruments and other items to and from Chile.

Business IT (BIT)

This work package includes business IT programming, network maintenance, and support for administrative software and hardware.

Contracts Office (CO)

This work package contains primarily contracts and sub-awards for NOAO North and South and related functions for NSO, WIYN, and SOAR. The work package also includes development, negotiation, and pre- and post-award administration of all sub-awards and contracts, including TSIP, AODP, ReSTAR, ATST, LSSTC, ARRA, and other NOAO/NSO divisional programs. Processing of procurements requiring complicated agreements or sub-awards as determined by proposal policies in compliance with the NSF cooperative agreements is in this work package.

## **3.2 OFFICE OF SCIENCE**

### **Program Overview**

Each NOAO scientific staff member is allocated some fraction of time for scientific and/or technical research. That specific time is budgeted under the Science Research work package within their home departments.

More global science research support funds are collected here under the Office of Science (OS) program. This program includes funding for staff development and mentoring, colloquia visits, publication page charges, Goldberg and other postdoctoral fellowships, and promotion and tenure reviews.

### **Milestones**

- Develop an implementation plan for the Responsible Conduct in Research policy.
- Develop a retraining program for Responsible Conduct in Research for NOAO scientific staff.
- Provide mentoring and career development resources to staff as needed, particularly to postdoctoral researchers.
- Develop hiring guidelines for NOAO scientific staff.

## Budget Summary

Table 18 Summary of Office of Science program budget

Office of Science (OS) FY2012 Program Budget Summary						
Office of Science (OS)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
Office of Science (North)	0.3	\$15,160	\$9,500	\$24,660	-	\$24,660
Scientific Staff Support (North)	0.6	\$36,996	\$50,500	\$87,496	-	\$87,496
Office of Science Program Head	0.7	\$97,684	\$7,500	\$105,184	-	\$105,184
Goldberg Fellow 2	1.0	\$75,643	\$10,000	\$85,643	-	\$85,643
Colloquium Support (North)	0.1	\$6,064	\$13,500	\$19,564	-	\$19,564
Science Research (North)	0.5	\$88,588	-	\$88,588	-	\$88,588
Colloquium Support (South)	0.1	\$3,291	\$10,500	\$13,791	-	\$13,791
Office of Science (South)	0.3	\$19,353	-	\$19,353	-	\$19,353
Scientific Staff Support (South)	0.5	\$16,457	\$41,000	\$57,457	-	\$57,457
Science Research (South)	0.0	\$3,193	-	\$3,193	-	\$3,193
Visitor Program	-	-	\$7,000	\$7,000	-	\$7,000
Science Program Research Funds - South	-	-	\$85,400	\$85,400	-	\$85,400
Science Program Research Funds - North	-	-	\$192,500	\$192,500	-	\$192,500
Grant-Supported Research Staff	9.8	\$873,574	\$21,000	\$894,574	\$894,574	-
<b>Total</b>	<b>13.8</b>	<b>\$1,236,003</b>	<b>\$448,400</b>	<b>\$1,684,403</b>	<b>\$894,574</b>	<b>\$789,829</b>

## Work Packages

### Office of Science (North/South)

Programs designed to improve the scientific environment (such as in-house career development activities) are included in this work package. Modest support is provided for NOAO South personnel to maintain various Office of Science activities there.

### Scientific Staff Support (North/South)

These work packages cover the cost of administering the scientific staff support activities and support for the libraries. They contain the non-payroll funds needed to pay page charges for NOAO scientific staff and to provide the office supplies they need, including computer upgrades.

### Office of Science Program Head

This work package supports the scientific staff member serving as the head of the program to oversee the activities of the OS, the travel and supplies needed to fulfill that role, and modest administrative support.

### Goldberg Fellow 2

This work package includes salary and research support for Goldberg Fellows.

### Colloquium Support (North/South)

This package includes expenses for NOAO North and South to support colloquia at each site.

### Science Research (North/South)

Each NOAO scientific staff member is allocated some fraction of time that includes scientific and/or technical research, professional development activities, and external service (e.g., membership on

committees whose activities benefit the astronomical community). That time is collected here proportionally for those staff members who charge functional time to OS.

#### Visitor Program

This package supports visits by members of the astronomical community to NOAO to engage in research-related activities.

#### Science Program Research Funds (North/South)

This work package includes the individual research support funds allocated to each NOAO scientific staff member. Each year, the astronomer-track and scientist-track staff at NOAO North are allocated \$5,000 per person; those at NOAO South are allocated \$7,000 per person to cover the additional cost of travel from Chile. Goldberg Fellows are allocated \$10,000 each year.

#### Grant-Supported Research Staff

This work package includes the salary support for postdocs who are funded through various external grants. This also includes grant-funded data aides.

### **3.3 EDUCATION AND PUBLIC OUTREACH**

#### **Program Overview**

The FY12 Education and Public Outreach (EPO) program is designed to reach, excite, inform, and educate a wide variety of audiences, including the next generation of scientists, engineers, and professional astronomers as well as science outreach practitioners, teachers and museum educators, K-16 students, and the general public. The program also supports and provides leadership to the national astronomy education “system” by identifying key needs and by forming strategic partnerships that utilize NOAO’s unique expertise in astronomy education and outreach as well as its experience in reaching underserved and/or underrepresented groups. The program focuses on NOAO’s strengths in observational astronomy, technology, and astronomical data. NOAO EPO staff have expertise in key astronomy education areas such as instructional materials development, teacher professional development, optics and technology education, data-enabled science education, and science education in informal environments. NOAO shares that expertise with science education professionals in order to contribute to the critical national efforts to improve science literacy. The NOAO programs use astronomy and related disciplines such as optics in order to encourage children to pursue science, math, computing, engineering, and other technological careers.

The EPO program serves as a national model for best practices by federally funded research and development centers in the following areas specifically required under America Competes: development of a globally competitive science, technology, engineering, and math (STEM) workforce; increased participation of women and underrepresented minorities in STEM; improved pre-K-12 STEM education and teacher development; improved undergraduate STEM education; and increased public scientific literacy. EPO staff members have played national and international leadership roles in many NSF-funded education and outreach projects, and the dissemination of the intellectual products from those programs continues to shape and form core parts of the NOAO EPO program for FY12, e.g., the Teaching with Telescopes and the Dark Skies Awareness programs at NOAO North and South.

The EPO program covers the spectrum of formal and informal science education in the US and in Chile with an emphasis on dark skies education, scientist-teacher partnerships, telescopes and optics education for elementary and middle-school students, access to telescopes and observing, teacher and museum educator professional development, public information activities, and strong support for local and regional outreach. The Kitt Peak Visitor Center (KPVC) and other NOAO public outreach efforts directly address programs for the Tohono O’odham Nation on whose property Kitt Peak National Observatory is located. The Centro de Apoyo a la Didáctica de la Astronomía

(CADIAS) astronomy teaching center in Chile plays a similar outreach role in Chile. Many programs emphasize best practices in the use of the cyber-infrastructure for distance education. In Chile, there is a strong dark skies education program for the IV Región de Coquimbo and a program to train educators who work as guides in the municipal and tourist observatories in towns that surround US facilities in Chile. All programs emphasize broadening participation. Regional programs focus on the large Hispanic and Native American populations in Arizona while programs in Chile focus on young women and other underrepresented groups in science in northern Chile. In both locations, there is an additional emphasis on rural populations.

EPO will continue to build on the long-time success of its Research Experiences for Undergraduates (REU) program in both hemispheres by adding underrepresented minority students and university faculty from the NSF Partnerships in Astronomy & Astrophysics Research and Education (PAARE) program to the mix of its mentorship activities. NOAO is currently a participating institution in PAARE grants to South Carolina State University and Fisk University.

EPO also has a strong role in the public information area and is in charge of Web, print, and exhibit materials to better educate the astronomical community on NOAO's role as the institution that guides the evolution of the ground-based O/IR system of telescopes.

### **Milestones**

- Lead national efforts related to the Teaching with Telescopes professional development and support program designed to amplify the educational value of the Galileoscope telescope kit.
- Conduct professional development workshops and programs for formal and informal science educators in coordination with 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).
- Support a wide-ranging, dark skies awareness program for Chile and southern Arizona, with strong support for the national/international GLOBE at Night program started and run by NOAO.
- Continue to seek every opportunity to work with the Tohono O'odham Nation schools and community centers and the Tohono O'odham Nation Department of Education to bring science, and especially astronomy, to their students.
- Support the small nature and science centers in the successful NSF-funded Astronomy From the Ground Up program in which NOAO played a key role. The program trains educators at hundreds of small science and nature centers nationwide.
- 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.
- Support the training of guides and provide support for astronomy programs for the public at the major municipal/tourist observatories in Northern Chile.

## Budget Summary

Table 19 Summary of Education and Public Outreach program budget

Education and Public Outreach (EPO) FY2012 Program Budget Summary						
Education and Public Outreach (EPO)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
Photo Imaging	1.1	\$73,231	\$13,000	\$86,231	-	\$86,231
Newsletter	0.3	\$23,477	\$23,500	\$46,977	-	\$46,977
Public Information/Web Site	1.4	\$99,854	-	\$99,854	-	\$99,854
Educational Outreach	3.2	\$219,904	\$41,314	\$261,218	\$62,000	\$199,218
Teacher Research Experiences	0.5	\$41,596	\$16,500	\$58,096	\$50,000	\$8,096
Teaching with Telescopes	0.5	\$47,246	\$17,000	\$64,246	-	\$64,246
REU North Director's Support	0.4	\$49,326	\$3,000	\$52,326	-	\$52,326
CTIO Outreach	4.0	\$189,380	\$37,600	\$226,980	-	\$226,980
Dark Skies Education	1.1	\$65,444	\$43,000	\$108,444	-	\$108,444
Science Research	0.6	\$67,694	-	\$67,694	-	\$67,694
Project ASTRO	0.6	\$25,607	\$8,250	\$33,857	-	\$33,857
Tohono O'odham Outreach	0.4	\$36,771	\$18,000	\$54,771	-	\$54,771
Conferences & Meetings	-	-	\$13,500	\$13,500	-	\$13,500
<b>Total</b>	<b>13.9</b>	<b>\$939,530</b>	<b>\$234,664</b>	<b>\$1,174,194</b>	<b>\$112,000</b>	<b>\$1,062,194</b>

## Work Packages

### Photo Imaging

This work package provides salary and equipment support for one FTE and one 0.25 FTE in the NOAO Photo Imaging Lab. This operation furnishes high-quality graphics and image production services to all NOAO North and NSO Tucson staff on a daily basis, with great flexibility and ease of access, while working at significantly less than the commercial rate. The Photo Imaging Lab also produces a variety of multimedia products, electronic newsletters, and other tools to aid NOAO's efforts to better engage the astronomical community.

### Newsletter

This work package supports the production and distribution of the *NOAO Newsletter*, including full in-house editorial production and graphic design.

### Public Information/Web Site

This work package covers partial payroll costs of the EPO Public Affairs Program Coordinator, Webmaster, and part-time office assistant who work on media activities, the NOAO Web site, requests for use of NOAO imagery (including revenue from commercial use), maintenance and growth of the popular NOAO Image Gallery, and responses to public inquiries. This work package also serves as the coordination point with similar offices at the Gemini Observatory and Space Telescope Science Institute. This work package reflects time spent by EPO staff on high-priority NOAO organizational items such as the e-newsletter *Currents* and public Web pages.

### Educational Outreach

This work package provides staff and supporting funds to prepare and conduct NOAO's non-grant-funded educational programs for teachers, museum and planetarium educators, and students. It is the central source of non-salary support funds for the general activities of NOAO EPO, such as travel and supplies. This includes local and regional outreach in formal and informal science education

venues and new brochures, posters, and handout materials. This work package includes revenue provided by NSO to support NSO EPO efforts on Kitt Peak, some public information functions, and general EPO outreach locally and regionally on behalf of NSO.

#### Teacher Research Experiences

This work package provides professional development support for teachers to bring astronomical research to their classrooms; this includes support for a proposed teacher research project in Chile and for teachers who have graduated from the Teacher Leaders in Research Based Science Education program. Possible revenue in this work package would come from the proposed program submitted to the NSF Office of International Science and Engineering for teacher research experiences in Chile. The one-year program would start in FY12.

#### Teaching with Telescopes

This work package provides support for teaching optics using the Hands-On Optics (HOO) and Teaching with Telescopes curricular materials. This area has emerged as a flagship effort of EPO, after a long-term, NSF-sponsored partnership with the Optical Society of America, SPIE-The International Society for Optical Engineering, ASP, and AAS. It is targeted primarily at reaching underserved students nationwide in school and after-school science programs and at informal science centers. NOAO is the primary developer of the HOO modules and Teaching with Telescopes teaching kit.

#### REU North Director's Support

This work package provides support for the NSF Research Experiences for Undergraduates (REU) site leader for KPNO. EPO covers 0.35 FTE of the salary cost of the KPNO site director. Other costs for supporting the six KPNO REU students, such as their 10-week residence and subsequent trip to the January AAS meeting, are grant-funded.

#### CTIO Outreach

This work package includes the cost of CTIO EPO staff to conduct outreach and includes the management of the Centro de Apoyo a la Didáctica de la Astronomía (CADIAS), a community astronomy teaching center outside of La Serena, which also includes an Internet-connected public library. CADIAS has proven to be a highly productive small astronomy education center. The work package also includes support for the traveling planetarium program, annual rental and gasoline costs for an AURA vehicle for official local use, liaison activities to conduct training of the staff at the small tourist observatories built by municipalities near La Serena to attract local tourists, and miscellaneous non-payroll support for outreach by CTIO staff. It also includes some support for undergraduate student work on the Hugo Schwartz robotic telescope with students of Universidad de La Serena.

#### Dark Skies Education

Dark Skies Education now incorporates the GLOBE at Night program and includes increased efforts to protect observatory sites at both NOAO North and South. It includes support for regional distribution of the very successful Dark Skies Teaching Kit developed during IYA2009 and for training of teacher and museum dark sky teaching ambassadors. The program works with the Cooper Environmental Center in Tucson and a number of nature centers in Chile as well as schools in both countries.

#### Science Research

Each NOAO scientific staff member is allocated a fraction of time that includes scientific and/or technical research, professional development activities, and external service (e.g., membership on committees whose activities benefit the astronomical community). That time is collected here for those staff members whose home department is EPO.

#### Project ASTRO

This is the very successful and nationally recognized Arizona implementation of a program started by the ASP that emphasizes teacher-scientist partnerships. The program pairs Arizona grades 3–9 teachers with volunteer amateur or professional astronomers and engineers with an interest in astronomy. The goal is to build long-lasting partnerships that enrich science education in schools. The program has expanded into a regional program.

#### Tohono O’odham Outreach

This work package builds on NOAO’s expanding relationship with the Tohono O’odham through support of a variety of formal and informal education programs on the Nation. Examples include programs at community and recreation centers and schools, the Tohono O’odham community college, star parties, and professional development workshops for teachers. This work package also supports all NOAO-Tohono O’odham education efforts conducted on Kitt Peak.

#### Conferences & Meetings

Primary support of the twice yearly AAS meetings to pay for booth space, relevant print jobs related to handouts, and exhibit production and shipping costs.

### **3.4 NOAO DIRECTOR’S OFFICE**

#### **Program Overview**

The NOAO Director’s Office (NDO) provides high-level leadership, management, and budgetary control for the ensemble NOAO program. It is the main programmatic interface between NSF, AURA, and the rest of the NOAO management team. NDO is responsible for the production and delivery of NSF-required reports such as the Annual Program Plan and the Long-Range Plan. NDO is also responsible for NOAO-wide programs such as broadening participation, the Users Committee, the EPO Advisory Committee, and the NOAO Risk Management Office.

The NDO is led by the NOAO director and deputy director and supported by one dedicated, full-time administrative assistant. Part-time support from several Tucson-based administrative assistants is provided as needed for specific tasks (e.g., report generation and submission). When appropriate, various NOAO scientists are assigned part-time to the NDO to execute specific functions (e.g., diversity advocates).

#### **Milestones**

- Deliver a revised Long-Range Plan by the end of the second quarter in FY12.
- Develop an annual program plan for FY13, to be delivered during the first quarter of FY13.
- 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.
- As necessary, prepare an action plan in response to recommendations from the NSF Astronomy Portfolio Review that affect NOAO.
- Facilitate on-going management training for the NOAO senior management team.
- 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).

- Review the process of hiring with the head of science and HR to insure that minority candidates are identified at the time they apply and that all short lists 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.
- Continue to work on ways to improve communication between NOAO staff at all levels.
- Diversity advocates 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.
- Develop and implement a compliance risk assessment program to review current policies and procedures to outline areas of concern and make recommendations for policy and/or procedural changes.
- Convene a compliance committee to include a broad class of employees who will be charged with developing a “Code of Conduct” for NOAO, reviewing new and revised policies and procedures for implementation, and assisting the NOAO chief compliance officer (CCO) in identifying potential risk areas for further reviews.
- Prepare and conduct compliance training in the top two risk areas from the outcome of the compliance risk assessment program.
- As necessary, support AURA and/or CAS with NSF-mandated reviews (e.g., Business Service Review and Mid-Term Management Review).
- With coordination of the LSST Project office, establish the members of the LSST Safety Council and hold the first external safety review meeting.
- In collaboration with NOAO South, establish and coordinate an independent safety review of the progress and planned activities for the Dark Energy Camera (DECam) installation.
- With coordination of the NOAO North Engineering & Technical Services Manager, continue to enhance safety control measures for Kitt Peak annual maintenance efforts during operational shutdown periods.
- Begin to revise the NOAO/NSO Business Contingency Plan and the Kitt Peak Emergency Manual due to recent management changes.

## Budget Summary

Table 20 Summary of NOAO Director's Office program budget

NOAO Director's Office (NDO) FY2012 Program Budget Summary						
NOAO Director's Office (NDO)	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
NOAO Director's Office	3.4	\$536,437	\$71,950	\$608,387	\$60,000	\$548,387
Broadening Participation Program	0.4	\$33,669	\$10,000	\$43,669	-	\$43,669
Safety & Risk Management	0.9	\$92,605	\$10,200	\$102,805	-	\$102,805
AURA Discretionary Fund	-	-	\$24,500	\$24,500	\$24,500	\$0
Tucson Library	0.9	\$60,093	\$126,000	\$186,093	-	\$186,093
Science Research	0.6	\$88,451	-	\$88,451	-	\$88,451
NOAO Users Committee	-	-	\$6,000	\$6,000	-	\$6,000
NOAO EPO Advisory Committee	-	-	\$6,000	\$6,000	-	\$6,000
Office of Compliance	1.0	\$180,615	\$15,000	\$195,615	-	\$195,615
Recruitment	-	\$0	\$22,500	\$22,500	-	\$22,500
<b>Total</b>	<b>7.2</b>	<b>\$991,870</b>	<b>\$292,150</b>	<b>\$1,284,020</b>	<b>\$84,500</b>	<b>\$1,199,520</b>

Table 21 Summary of NOAO Director's Reserve program budget

NOAO Director's Reserve FY2012 Program Budget Summary						
NOAO Director's Reserve	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
Director's Reserve	-	-	\$798,182	\$798,182	-	\$798,182
<b>Total</b>	<b>-</b>	<b>\$0</b>	<b>\$798,182</b>	<b>\$798,182</b>	<b>\$0</b>	<b>\$798,182</b>

## Work Packages

### NOAO Director's Office

The NOAO Director's Office coordinates all high-level program planning and execution. Reporting to NSF and AURA is the responsibility of this office. This office consists of the director, deputy director, and NDO administrative assistant. Several other people provide part-time support for specific functions, e.g., production of reports required by NSF. This work package includes the indirect revenue contribution from NSO for operation of the library.

### Broadening Participation Program

This program has three key focal points: (1) workplace climate issues for women and minority scientists and engineers at NOAO, (2) recruitment and retention of underrepresented individuals for the NOAO workforce, and (3) recruitment and retention of underrepresented individuals throughout the educational pipeline from undergraduate to postdoctoral fellowships. Although NOAO cannot solve the entire "pipeline problem," it can support efforts to improve it. Activities occur at the NOAO and AURA level. Two NOAO scientists staff this program part-time, supported by other NOAO staff as required. Funding is provided for attending AURA meetings, conferences, and professional meetings of underrepresented groups.

### Safety & Risk Management

Risk management and safety functions are centralized within the NOAO Director's Office under the NOAO risk manager, who is responsible for the development, direction, and administration of safety,

health, security, and environmental programs and activities. The risk manager has supported other organizations when requested, including Gemini, CTIO, NSO, and SOAR. Participation continues with LSST, ATST, and instrument groups by developing and completing risk management documents and other tasks in preparation for design and program reviews. In addition, he is responsible for managing AURA's industrial insurance as the AURA insurance program administrator and supports the Central Facilities Office as the assistant facilities manager. A monthly report is generated as well as the required site safety (risk management) reports that are published in the NOAO quarterly and fiscal year annual reports.

#### AURA Discretionary Fund

Included here is a small fund provided to the NOAO director by AURA Corporate.

#### Tucson Library

This work package covers funding for the Tucson library (librarian, acquisitions, periodicals, and one conference trip).

#### Science Research

Each NOAO scientific staff member is allocated some fraction of time that includes scientific and/or technical research, professional development activities, and external service (e.g., membership on committees whose activities benefit the astronomical community). That time is collected here proportionally for those staff members who charge functional time to NDO.

#### NOAO Users Committee

Funding for an annual committee meeting (mainly committee member travel support) is included in this work package.

#### NOAO EPO Advisory Committee

Funding for an annual committee meeting (mainly committee member travel support) is included in this work package.

#### Office of Compliance

NOAO operates within a regulatory regime established by NSF in combination with applicable directives from other federal agencies. NOAO also must comply with regulations imposed by state and local authorities as well as the Tohono O'odham Nation, where applicable. Regulatory extent and complexity continue to expand with time. The NOAO chief compliance officer (CCO) is responsible for regulatory compliance oversight on behalf of the NOAO director. AURA remains responsible for regulatory compliance with Chilean agencies. As necessary and appropriate, the NOAO CCO assists AURA in such matters.

#### Recruitment

Activities and costs for recruitment and relocation of a new NOAO associate director for KPNO during FY12.

#### Director's Reserve

The Director's Reserve contains all unallocated FY12 base funds combined with all unexpended or uncommitted FY11 base funds. This reserve will be used for unpredictable spending needs, such as major changes in the US dollar to Chilean peso exchange rate or unexpected maintenance needs that require immediate response. If possible, it might also be used as seed money for science capability development at NOAO facilities. The budgeted amount was calculated assuming a total FY12 base funding of \$29.15M. Actual base funding and, hence, the Director's Reserve is likely to be smaller.

### 3.5 ARRA INFRASTRUCTURE RENEWAL

#### Program Overview

NOAO was awarded \$5.6M by NSF in FY09 (August 2009) for a proposal to renew critical infrastructure at its four main sites: La Serena Base Facility, Tucson Headquarters, Cerro Tololo (including Cerro Pachón), and Kitt Peak. This one-time infusion of funds is aimed at renovating key systems and infrastructure, the maintenance of which has been deferred as a result of years of tight budgets. The funding is part of the American Recovery and Reinvestment Act of 2009 (ARRA). The NOAO ARRA proposal has a nominal three-year spend plan. The work packages below include work that will be accomplished in FY12 for multi-year projects (this is year 3 of a 3-year program).

#### Milestones

- Complete the Kitt Peak water system renovation.
- Begin construction on the Kitt Peak instrument handling facility.
- Complete the Tucson environmental controls project.
- Complete the Tucson electrical distribution system renovation.
- Complete the Cerro Pachón kitchen and dining facility.
- Complete dormitory renovations at CTIO.
- Complete the La Serena meeting room upgrades.
- Complete the La Serena mechanical shop renovation.
- Complete the La Serena security fencing project.
- Complete the La Serena meeting room renovations.

#### Budget Summary

Table 22 Summary of ARRA Infrastructure Renewal program budget

ARRA Infrastructure Renewal FY2012 Program Budget Summary						
ARRA Infrastructure Renewal	FTE	Budget, Labor	Budget, Non-Labor	Budget, Total	Funding, Other	Funding, NSF Base
CTIO ARRA Year 3	0.5	\$80,099	\$801,491	\$881,590	\$881,590	-
KPNO ARRA Year 3	0.5	\$42,374	\$1,756,441	\$1,798,815	\$1,798,815	-
La Serena ARRA Year 3	0.2	\$26,700	\$182,697	\$209,397	\$209,397	-
Tucson ARRA Year 3	0.5	\$40,037	\$343,897	\$383,934	\$383,934	-
<b>Total</b>	<b>1.6</b>	<b>\$189,210</b>	<b>\$3,084,526</b>	<b>\$3,273,736</b>	<b>\$3,273,736</b>	<b>-</b>

#### Work Packages

##### CTIO ARRA Year 3

This work package covers a host of renovation projects for dormitories and living space on Cerro Tololo and Cerro Pachón including a kitchen and dining facility at the AURA dormitory on Cerro

Pachón. Items for the latter site will benefit users of SOAR, Gemini, and LSST. These projects will be completed largely through external contracts. Other major projects include renovation of the water system that serves both Cerro Tololo and Cerro Pachón. Project oversight and some labor will be carried out by CTIO staff paid through ARRA funding.

#### KPNO ARRA Year 3

Two major projects will be undertaken at Kitt Peak. The over 40-year-old infrastructure that enables potable water for all of the facilities on Kitt Peak will be renovated. Design and construction of a new instrument handling facility will be done for servicing and improving instruments on the mountain, which will remove the need to transport them to Tucson for servicing. For the next generation of multimillion dollar instruments coming to NOAO facilities (e.g., ODI on WIYN), such a facility is an essential component of ensuring a long and scientifically productive lifetime for the instruments. Both projects should begin the construction phase in FY12. The water system project was delayed in FY11 when the original contractor backed out of the project due to health issues. NOAO is waiting for NSF approval to bid the instrument handling facility project.

#### La Serena ARRA Year 3

This work package contains projects for the La Serena shop refurbishment, security fencing upgrades, and water system renovation. All three projects are primarily subcontracted. Other projects include meeting room renovation. CTIO staff paid through ARRA funding will carry out project oversight and some labor.

#### Tucson ARRA Year 3

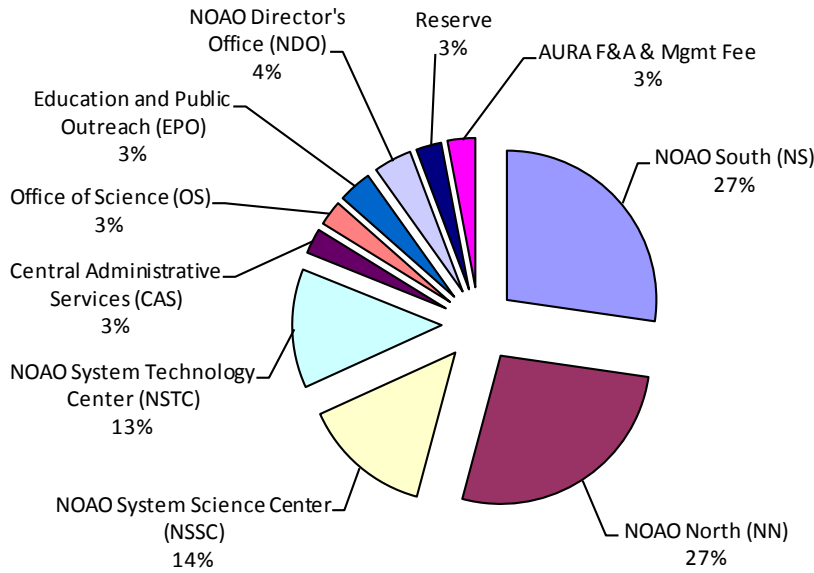
This work package includes a major renovation/upgrade to the computer room in Tucson, which supports activity across NOAO, a complete renovation of the electrical distribution system in the west wing of the main building including replacement of the NOAO transformer, and upgrades to the environmental controls for the main building. The first two projects were largely complete by the end of FY11. The bulk of this work package will be accomplished through subcontracts. A civil engineer supported by ARRA funds was hired in FY10 and will continue to support this activity and that on Kitt Peak in 2012. CAS staff will carry out contract processing and reporting (for both NOAO North and South).

## 4 FY12 BUDGET SUMMARY

### 4.1 FY12 SPEND BUDGET SUMMARY

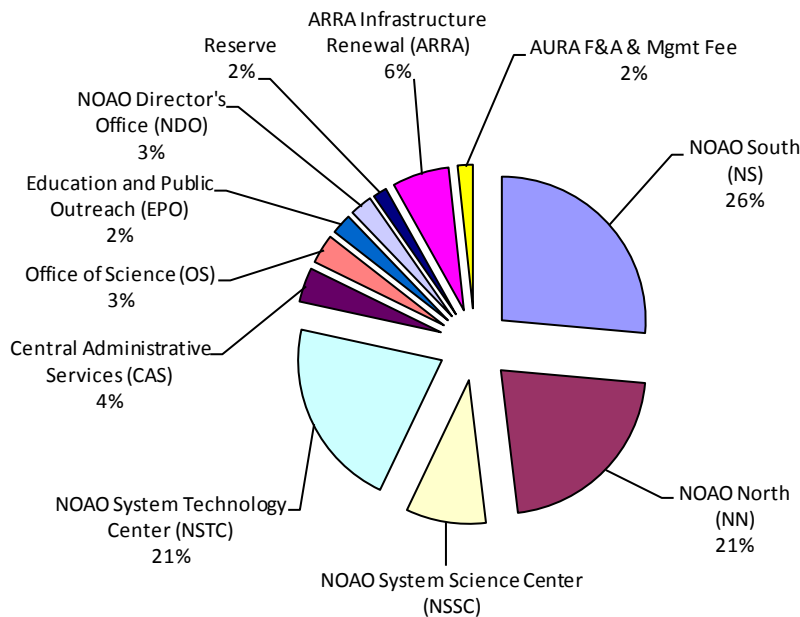
The FY12 NOAO spend budget is summarized in Table 23. The first pie chart below shows the breakdown of the NSF *base* funding in terms of percentages, while the second pie chart shows the percentage breakdown of the *total* funding.

**FY2012 NSF Base Funding**



Spend plan as a percentage of NSF base funding by program.

**FY2012 Total Funding**



Spend plan as a percentage of total funding by program.

Table 23 and its key summarize the NOAO FY12 budget allocation. The table rolls up the individual budget tables provided in the previous sections for each program.

Table 23 NOAO FY12 Budget Allocation Summary Rollup

Rollup Table				
FY2012 NOAO Budget Allocation Summary				
NOAO DIVISION	FTE	Budget, Total	Funding, Other	Funding, NSF Base
<b>NOAO South (NS)</b>				
Cerro Tololo Inter-American Observatory (CTIO)	44.1	\$5,869,058	\$1,198,927	\$4,670,131
NS Engineering & Technical Services	15.2	\$1,697,776	\$155,935	\$1,541,841
NS Facilities Operations	42.2	\$3,216,791	\$2,634,019	\$582,772
NS Computer Infrastructure Services	5.6	\$973,982	\$495,004	\$478,978
NS Administrative Services	13.9	\$1,772,431	\$1,085,658	\$686,773
<b>NS Subtotal</b>	<b>120.9</b>	<b>\$13,530,038</b>	<b>\$5,569,543</b>	<b>\$7,960,495</b>
<b>NOAO North (NN)</b>				
Kitt Peak National Observatory (KPNO)	68.5	\$6,815,015	\$2,087,689	\$4,727,326
NN Engineering & Technical Services	16.3	\$1,966,051	\$120,678	\$1,845,373
NN Central Facilities Operations	10.0	\$1,677,037	\$888,000	\$789,037
NN Computer Infrastructure Services	5.4	\$649,946	\$174,946	\$475,000
<b>NN Subtotal</b>	<b>100.2</b>	<b>\$11,108,049</b>	<b>\$3,271,313</b>	<b>\$7,836,736</b>
<b>NOAO System Science Center (NSSC)</b>				
System User Support	9.5	\$1,446,424	-	\$1,446,424
Science Data Management	15.7	\$2,399,893	\$503,156	\$1,896,737
System Community Development	3.9	\$751,992	-	\$751,992
<b>NSSC Subtotal</b>	<b>29.0</b>	<b>\$4,598,309</b>	<b>\$503,156</b>	<b>\$4,095,153</b>
<b>NOAO System Technology Center (NSTC)</b>				
System Instrumentation	17.0	\$2,651,526	\$525,027	\$2,126,499
ReSTAR Instrumentation	5.8	\$2,453,174	\$2,239,192	\$213,982
Telescope System Instrumentation Program	0.2	\$2,933,451	\$2,933,451	-
Large Synoptic Survey Telescope	19.9	\$2,890,952	1,471,334.00	\$1,419,618
<b>NSTC Subtotal</b>	<b>42.8</b>	<b>\$10,929,103</b>	<b>\$7,169,004</b>	<b>\$3,760,099</b>
<b>Central Administrative Services (CAS)</b>	<b>23.2</b>	<b>\$1,966,859</b>	<b>\$1,171,987</b>	<b>\$794,872</b>
<b>Office of Science (OS)</b>	<b>13.8</b>	<b>\$1,684,403</b>	<b>\$894,574</b>	<b>\$789,829</b>
<b>Education and Public Outreach (EPO)</b>	<b>13.9</b>	<b>\$1,174,194</b>	<b>\$112,000</b>	<b>\$1,062,194</b>
<b>NOAO Director's Office (NDO)</b>	<b>7.2</b>	<b>\$1,284,020</b>	<b>\$84,500</b>	<b>\$1,199,520</b>
<b>NOAO Director's Reserve</b>	<b>-</b>	<b>\$798,182</b>	<b>-</b>	<b>\$798,182</b>
<b>ARRA Infrastructure Renewal (ARRA)</b>	<b>1.6</b>	<b>\$3,273,736</b>	<b>\$3,273,736</b>	<b>-</b>
<b>AURA F&amp;A and Management Fee</b>	<b>-</b>	<b>\$872,920</b>	<b>-</b>	<b>\$872,920</b>
<b>FY2012 TOTAL</b>	<b>352.7</b>	<b>\$51,219,813</b>	<b>\$22,049,813</b>	<b>\$29,170,000</b>

Key to Table 23 Budget Allocation Summary Rollup

<b>NOAO South (NS)</b>	This NOAO division focuses on the administration, facilities, and IT support services for NOAO activities based in La Serena, Chile.
Cerro Tololo Inter-American Observatory (CTIO)	This work package includes the operational and mountain facilities support costs for CTIO. It does not include NOAO-wide administrative costs.
NS Engineering & Technical Services	This work package includes design, fabrication, installation, and operations support for the telescopes and instrumentation on Cerro Tololo and Cerro Pachón.
NS Facilities Operations	This work package includes the shared costs of operations of all of the AURA La Serena facilities, including warehouse, shipping/receiving, inventory control, security, water and sewer facilities, garage and transport, and the La Serena motel, as well as general maintenance and janitorial services. It also includes the shared costs of operations of all AURA mountaintop facilities on Cerro Tololo and Cerro Pachón, including road maintenance, power line maintenance, water system maintenance, emergency medical services, communication and telephone system maintenance, kitchen operations, and dormitory operations. All activities related to the management of general NOAO activities in La Serena are contained in this work package.
NS Computer Infrastructure Services	This work package includes computer system support for NOAO South including network maintenance and software support. It includes system security and access.
NS Administrative Services	This work package includes the costs of administrative support to all programs on the AURA site in Chile, which include personnel and payroll, procurement, budget and accounting, reception, and general management of the site.
<b>NOAO North (NN)</b>	This NOAO division focuses on the administration, facilities, and IT support services for NOAO activities based in southern Arizona.
Kitt Peak National Observatory (KPNO)	This work package contains the operational and mountain support costs for KPNO including personnel, travel, miscellaneous equipment, tenant support, Site Director's office, user support, NSO support, instrumentation and modernization upgrades, and other mountain facilities costs. Also included are costs of telescope operation and maintenance and partnerships. It does not include NOAO-wide administrative costs.
NN Engineering & Technical Services	This work package includes design, fabrication, installation, and operations support for the telescopes and instrumentation on Kitt Peak.
NN Central Facilities Operations	This work package includes the NOAO North facilities operation costs of non-mountaintop building maintenance, roads and grounds, utilities, vehicles, and the computer network in Tucson.
NN Computer Infrastructure Services	Included in this work package is computer system support for NOAO North, NSO, SOAR, and WIYN including network maintenance and software support. It also includes system security and access.
<b>NOAO System Science Center (NSSC)</b>	This NOAO division is a combination of the Science Data Management, Science User Support, and System Community Development programs. It includes personnel, travel, support, and equipment for NSSC to provide US community access and user support to the two Gemini telescopes. Support is provided for in NOAO North and South. Science research time for scientific staff that have NSSC functional responsibilities and NSSC postdoc support is also included.
System User Support	This work package includes management of US community access to Gemini and other System telescopes, including periodic meetings of NOAO user constituencies, other informational workshops and committees, and the annual meeting of the survey teams. It also includes user support for observing proposal preparation and submission for all System facilities, as well as post-observing data processing.
Science Data Management	This work package contains the planning and management of SDM North and South, development and operation of the End-to-End Data Management System, user support, and data management for other initiatives. It includes community involvement and data in the VAO.

Key to Table 23 Budget Allocation Summary Rollup

System Community Development	This work package focuses on connecting the US community-at-large with the new science capabilities under development such as LSST, GMT, TMT, LCOGTN and various emerging facilities for optical interferometry.
<b>NOAO System Technology Center (NSTC)</b>	This NOAO division is responsible for coordinating technological enhancements to the US Ground-Based O/IR Observing System. It incorporates System Instrumentation, Telescope System Instrumentation Program, the NOAO LSST Project Office, and the NOAO portion of the ReSTAR supplement program.
System Instrumentation	This work package contains the operations and management of the instrumentation program supporting NOAO, the System, and the community. It also includes MONSOON and other instrumentation support.
ReSTAR Instrumentation	This work package includes projects funded through the NSF ReSTAR proposal including a new instrument for the KPNO Mayall 4-m telescope, detector upgrades to one existing instrument each at KPNO and CTIO, and access to the Palomar telescope.
Telescope System Instrumentation Program	The Telescope System Instrumentation Program (TSIP) funds development of new instruments for, or operational costs of, non-federal observatories in return for US community access to observing time on those telescopes as administered by the NOAO TAC.
Large Synoptic Survey Telescope	This work package includes support for the LSST Project in two important areas: (1) responsibility for the design, development, and construction of the facilities in Chile, including the telescope, enclosure, and support facilities both on the summit and in La Serena; and (2) community engagement intended to support science collaborations in developing the science missions and input into the LSST.
<b>Central Administrative Services (CAS)</b>	This work package includes the Tucson-based human resources, accounting/financial management, procurement, payroll, shipping/receiving, and export control and includes support to NSO, AURA Corporate, WIYN, SOAR, other AURA centers, and LSSTC.
<b>Office of Science (OS)</b>	This work-package contains support to science staff, including administrative support, colloquia, travel, page charges, and conferences/workshops. It also includes salary support for fellowships and those science staff on sabbatical or directly supporting the OS activity.
<b>Education and Public Outreach (EPO)</b>	This work package contains the NOAO North and South education and public outreach programs, REU programs, public affairs, and graphic arts.
<b>NOAO Director's Office (NDO)</b>	This work package focuses on the activities of the NOAO director, deputy director, administrative support staff, risk management, library, and safety coordination. It also includes these functions as provided by the CTIO director for NOAO South.
<b>NOAO Director's Reserve</b>	This work package includes unallocated FY12 base funds combined with all unexpended or uncommitted FY11 base funds. This reserve will be used for unpredictable spending needs, such as major changes in the US dollar to Chilean peso exchange rate or unexpected maintenance needs that require immediate response.
<b>ARRA Infrastructure Renewal (ARRA)</b>	NOAO was awarded \$5.6M by NSF in FY09 (August 2009) for a proposal to renew critical infrastructure at its four main sites: La Serena Base Facility, Tucson Headquarters, Cerro Tololo (including Cerro Pachón), and Kitt Peak. This one-time infusion of funds is aimed at renovating key systems and infrastructure.
<b>AURA F&amp;A Management Fee</b>	This work package includes the AURA support to NOAO and the AURA F&A for new funds and carry forward from nonexpended FY11 funds. The AURA management fee for FY12 is 2.48 percent.
<b>FY2012 Total</b>	This total includes the full cost of NOAO programs.

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## 4.2 SOURCES OF FY12 REVENUE FUNDS

The following Table 24 and its key summarize the other revenue—non-NSF base funding—received for each program.

Table 24 NOAO FY12 Other Revenue Summary Rollup

FY2012 NOAO Other Revenue Summary			
NOAO DIVISION	FY2011 NSF Funds Carried Forward or Supplemental New Funds	FY2012 Other Revenue	FY2012 Revenue
<b>NOAO South (NS)</b>			
<i>CTIO Indirects and Miscellaneous Revenue</i>		\$75,000	
<i>CTIO SOAR Labor Recharge and Indirects</i>		\$257,325	
<i>CTIO SMARTS Payroll and Direct Support</i>		\$715,301	
<i>CTIO SMARTS Labor Recharge and Indirects</i>		\$151,301	
<i>NS ETS SOAR Projects Labor Recharges and Indirects</i>		\$167,572	
<i>NS FO La Serena Facilities Support to Gemini, SOAR, and AURA-O</i>		\$850,855	
<i>NS FO Mountain Facilities Support to Gemini, SOAR, and AURA-O</i>		\$1,085,658	
<i>NS FO Gemini Library Support</i>		\$5,000	
<i>NS FO REU and PIA Support</i>		\$1,500	
<i>NS CIS Computer Network Support to AURA Centers, Las Campanas, ALMA, and Tenants</i>		\$495,005	
<i>NS Administrative Services Support to Gemini, SOAR, and AURA-O</i>		\$1,085,658	
	<b>NS Subtotal</b>	-	<b>\$4,890,175</b>
			<b>\$4,890,175</b>
<b>NOAO North (NN)</b>			
<i>KPNO DS3 Link</i>		\$40,000	
<i>KPNO Meal &amp; Dormitory Revenue</i>		\$395,000	
<i>KPNO KPVC Sales Revenue and Memberships</i>		\$809,500	
<i>KPNO Joint Use Fee</i>		\$101,711	
<i>KPNO Misc Facilities Use Fees</i>		\$9,000	
<i>KPNO WIYN Operational Support</i>		\$732,478	
<i>NN ETS Instrument Shop Support for NSO and Grants</i>		\$120,678	
<i>NN CFO Support to NSO, WIYN, LSSTC, and Other</i>			
<i>Indirect Cost Revenue</i>		\$868,000	
<i>NN CFO Space Lease</i>		\$20,000	
<i>NN CIS Support for NSO and Gemini</i>		\$174,946	
	<b>NN Subtotal</b>	-	<b>\$3,271,313</b>
			<b>\$3,271,313</b>
<b>NOAO System Science Center (NSSC)</b>			
<i>Science Data Management VAO Grant</i>		-	<b>\$503,156</b>
			<b>\$503,156</b>

(Table 24 is continued on the next page.)

Table 24 (Continued)

Revenue Rollup Table (Continued)			
FY2012 NOAO Other Revenue Summary			
NOAO DIVISION	FY2011 NSF Funds Carried Forward or Supplemental New Funds	FY2012 Other Revenue	FY2012 Revenue
<b>NOAO System Technology Center (NSTC)</b>			
<i>System Instrumentation TMT and GMT Support</i>		\$341,584	
<i>System Instrumentation WIYN ODI Support</i>		\$60,000	
<i>System Instrumentation ATST Support</i>		\$123,443	
<i>ReSTAR Instrumentation</i>	\$2,239,192		
<i>Telescope System Instrumentation Program Award</i>	\$2,933,451		
<i>Large Synoptic Survey Telescope NSF Supplement</i>	\$1,471,334		
<b>NSTC Subtotal</b>	<b>\$6,643,977</b>	<b>\$525,027</b>	<b>\$7,169,004</b>
<b>Central Administrative Services (CAS)</b>			
<i>Indirect Cost Revenue from Support to NSO, WIYN, SOAR, LSSTC, and Grants</i>		\$919,198	
<i>AURA Corporate Support</i>		\$186,789	
<i>Gemini Payroll and IT Support</i>		\$66,000	
<b>CAS Subtotal</b>	<b>-</b>	<b>\$1,171,987</b>	<b>\$1,171,987</b>
<b>Office of Science (OS)</b>			
<i>Grant Supported Staff Costs</i>	-	\$822,355	\$822,355
<b>Education and Public Outreach (EPO)</b>			
<i>Support to NSO</i>		\$62,000	
<i>Teacher Student Research</i>		\$50,000	
<b>EPO Subtotal</b>	<b>-</b>	<b>\$112,000</b>	<b>\$112,000</b>
<b>NOAO Director's Office (NDO)</b>			
<i>Grant Indirect Revenue</i>		\$60,000	
<i>AURA DDF</i>		\$24,500	
<b>NDO Subtotal</b>	<b>-</b>	<b>\$84,500</b>	<b>\$84,500</b>
<b>ARRA Infrastructure Renewal (ARRA)</b>			
<i>NSF ARRA Award</i>	\$3,273,736	-	\$3,273,736
<b>FY2012 TOTAL</b>	<b>\$9,917,713</b>	<b>\$11,380,513</b>	<b>\$21,298,226</b>

Key to Table 24 NOAO FY12 Other Revenue Summary Rollup

<b>NOAO South (NS)</b>	NOAO Division
CTIO Indirects and Miscellaneous Revenue	Revenue from small projects for Gemini and other external entities and general indirect cost recovery.
CTIO SOAR Labor Recharge and Indirects	General indirect cost recovery from SOAR operational support.
CTIO SMARTS Payroll and Direct Support	Revenue from the SMARTS Consortium for operational labor and miscellaneous support.
CTIO SMARTS Labor Recharge and Indirects	General indirect cost recovery from SMARTS operational support.
NS ETS SOAR Projects Labor Recharges and Indirects	Revenue for labor provided by NS Engineering & Technology staff for SOAR project support.

Key to Table 24 NOAO FY12 Other Revenue Summary Rollup

NS FO La Serena Facilities Support to Gemini, SOAR, and AURA-O	Revenue from providing facilities services to the tenants.
NS FO Mountain Facilities Support to Gemini, SOAR, and AURA-O	Revenue for support of mountain operations from Gemini, SOAR, AURA-O, and other tenants on Cerro Tololo and Cerro Pachón.
NS FO Gemini Library Support	Contributions for support of the La Serena Library from Gemini.
NS FO REU and PIA Support	Grant revenue.
NS CIS Computer Network Support to AURA Centers, Las Campanas, ALMA, and Tenants	NOAO support revenue from the users.
NS Administrative Services Support to Gemini, SOAR, and AURA-O	Revenue from providing administrative services to the tenants.
<b>NOAO North (NN)</b>	NOAO Division
KPNO DS3 Link	Revenue from tenants for maintenance and support.
KPNO Meal & Dormitory Revenue	Revenue from nighttime programs, meals sold, and dormitory rental on Kitt Peak.
KPNO KPVC Sales Revenue and Memberships	Revenue from Visitor Center, sales, night observing programs, etc. and the Friends of Kitt Peak program.
KPNO Joint Use Fee	Annual fee charged to all tenants on KP for joint support services provided.
KPNO Misc Facilities Use Fees	Miscellaneous revenue from use of the facilities.
KPNO WIYN Operational Support	Support funds from the WIYN partners towards support of operations.
NN ETS Instrument Shop Support for NSO and Grants	Revenue from NSO or grant accounts to cover payroll costs of instrument shop work requested by NSO or grant awardees, respectively.
NN CFO Support to NSO, WIYN, LSSTC, and Other Indirect Cost Revenue	Indirect revenue from grants and support and business administrative services and facilities support provided by NOAO North Central Facilities Operations to NSO, WIYN, LSSTC, etc.
NN CFO Space Lease	Revenue from leasing Tucson space to LSSTC, University of Arizona, etc.
NN CIS Support for NSO and Gemini	Revenue from labor support by NOAO North Computer Infrastructure Services to NSO and Gemini.
<b>NOAO System Science Center (NSSC)</b>	NOAO Division
Science Data Management VAO Grant	NSF grant support for NOAO work on the Virtual Astronomical Observatory (VAO).
<b>NOAO System Technology Center (NSTC)</b>	NOAO Division
System Instrumentation TMT and GMT Support	Revenue received in return for supporting AURA employees employed by TMT, leasing of office space to TMT, and some site support work packages; GMT KASI contract revenue is included also.
System Instrumentation WIYN ODI Support	Revenue received from WIYN Observatory to cover non-payroll costs associated with the final assembly of the instrument with partial focal plane.
System Instrumentation ATST Support	Labor support to ATST.
ReSTAR Instrumentation	The NOAO portion of the ReSTAR proposal support.

*Key to Table 24 NOAO FY12 Other Revenue Summary Rollup*

Telescope System Instrumentation Program Award	Program funded by NSF (AST-0335461) outside of the normal base budget. The work package includes the administrative costs of oversight of the program including sub-awards, technical project management, and proposal selection.
Large Synoptic Survey Telescope NSF Supplement	NOAO supplemental portion of the Design and Development program award (AST-1036980).
<b>Central Administrative Services (CAS)</b>	NOAO Division
Indirect Cost Revenue from Support to NSO, WIYN, SOAR, LSSTC, and Grants	Revenue for accounting and other administrative support provided to NSO, WIYN, SOAR, and LSSTC, as well as general and administrative revenue (G&A) collected on grants and other outside projects.
AURA Corporate Support	Support funds for business administrative support for AURA Corporate including payroll, audits, and reporting.
Gemini Payroll and IT Support	Revenue from support for Gemini payroll and computer support
<b>Office of Science (OS)</b>	NOAO Division
Grant Supported Staff Costs	Grant and outside support for postdocs including Hubble fellowships, etc.
<b>Education and Public Outreach (EPO)</b>	NOAO Division
Support to NSO	Revenue provided by NSO to support NSO EPO efforts on Kitt Peak, some public information functions, and general EPO outreach locally and regionally on behalf of NSO.
Teacher Student Research	This revenue would be from a proposed program submitted to the NSF Office of International Science and Engineering for teacher research experiences in Chile. The one-year program would start in FY12.
<b>NOAO Director's Office (NDO)</b>	NOAO Division
Grant Indirect Revenue	A portion of grant revenue goes to the Director's Office for miscellaneous science support and NSO library support.
AURA DDF	Funding from AURA Corporate for discretionary expenditures.
<b>ARRA Infrastructure Renewal (ARRA)</b>	New program funds.
NSF ARRA Award	American Recovery and Reinvestment Act of 2009 (ARRA) infrastructure stimulus funds for the award (AST-0947035).
<b>FY2012 Total</b>	Outside Revenue not provided by the NSF core program. Includes supplemental funds used for NOAO base programs. (Refer to revenue table for full detailed revenues per program.)



### 4.3 DIVISION OF EFFORT—NOAO SCIENTIFIC/MANAGEMENT STAFF

In accordance with the reporting requirements for the NOAO Annual Program Plan defined by the NSF/AURA Cooperative Agreement effective 1 October 2009, the fractional division of effort for each NOAO scientific staff member across FY12 budgeted programs is shown in Table 25 on the following pages.

Scientific staff members and programs shown in Table 25 are those funded under NSF funds allocated to the FY12 NOAO base budget. Programs and scientists (e.g., postdoctoral research associates) funded under external grants or non-AST/NSF sources are included as well. All columns show the FTEs by program. Also included in Table 25 are the technical, engineering, and other staff who are either partially or totally funded by other funding as defined by the Cooperative Agreement. Table 26 provides a breakdown of the sources of other funding by FTE.

Under AURA policy, astronomer-track scientists at NOAO are accorded 50% personal research time; scientist-track staff are granted 20% research time. Scientists and/or astronomers who perform administrative and management duties are granted research time appropriate to their track (to a max of 50%). This personal science research time is allocated to staff within each program as a maximum possible, based on position, following fulfillment of the individual's functional duties within the program. Beside each name in Table 25 are the letter abbreviations defined below to show staff positions. Exceptions to the percentage allocated for personal science research time and grant-funding are noted in the table footnotes. The percentage of time accorded by position follows:

- Director, Deputy Director, and Associate Director (D): max of 20%
- Head of Program (H): max of 20%
- Full, Associate, and Assistant Astronomer (A): max of 50%
- Full, Associate, and Assistant Scientist (S): max of 20%
- EPO Scientist and Associate Scientist (PS): max of 10%
- Postdocs and Goldberg Fellows (P): max of 100%

Table 25 FY12 Fractional Division of Effort of NOAO Scientific Staff/Key Management by Budgeted Program with Technical, Engineering, and Other Staff with Other Funding (FY12 NSF-Allocated Funds Only)

Scientific Staff & Key Mgmt (excluding postdoctoral research associates)															
Name	Research	CTIO	NS	KPNO	NSSC			NSTC			OS	EPO	NOAO DIR	GRANTS/ OTHER	Total
					SUS	SDM	SCD	SI	TSIP/ ReSTAR	LSST					
Abbott, Timothy (S)	0.20	0.80	-	-	-	-	-	-	-	-	-	-	-	-	1.00
Allen, Lori E. (S)	0.20	-	-	0.80	-	-	-	-	-	-	-	-	-	-	1.00
Beers, Tim (D)	0.20	-	-	0.80	-	-	-	-	-	-	-	-	-	-	1.00
Blum, Robert D. (D)	0.10	-	-	-	-	-	-	-	0.02	-	-	-	0.88	-	1.00
Boroson, Todd (H)	0.50	-	-	-	-	-	-	-	-	-	-	-	-	0.50	1.00
Cunha, Katia (A) <sup>†</sup>	0.25	-	-	-	0.25	-	-	-	-	-	-	-	-	-	0.50
Dey, Arjun (A)	0.50	-	-	0.20	0.30	-	-	-	-	-	-	-	-	-	1.00
Dickinson, Mark E. (A)	0.50	-	-	-	-	0.50	-	-	-	-	-	-	-	-	1.00
Elias, Jonathan H. (A)	0.20	-	-	-	-	-	-	0.33	0.32	-	-	-	-	0.15	1.00
Garmany, Catharine D. (PS)	0.20	-	-	-	-	-	-	-	-	-	-	0.67	0.13	-	1.00
Gregory, Brooke (S) <sup>‡</sup>	0.10	0.40	-	-	-	-	-	-	-	-	-	-	-	-	0.50
Heathcote, Stephen (D)	-	0.95	-	-	-	-	-	-	-	-	-	-	-	0.05	1.00
Hinkle, Kenneth H. (S)	0.20	-	-	-	0.80	-	-	-	-	-	-	-	-	-	1.00
James, David (A)	0.10	0.50	-	-	-	-	-	-	0.40	-	-	-	-	-	1.00
Jannuzi, Buell T. (A)	0.50	-	-	-	-	-	0.50	-	-	-	-	-	-	-	1.00
Joyce, Richard R. (S)	0.20	-	-	0.72	0.08	-	-	-	-	-	-	-	-	-	1.00
Lauer, Tod R. (A)	0.50	-	-	0.05	-	0.10	0.30	-	-	-	-	-	0.05	-	1.00
Mamajek, Eric (A)	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	1.00
Matheson, Thomas D. (A)	0.50	-	-	-	0.25	-	0.25	-	-	-	-	-	-	-	1.00

\* For the grant and other funding sources see Table 26.

† Katia Cunha is a half-time employee; she is on sabbatical until 31 July 2012.

‡ Brooke Gregory is a half-time employee.

Scientific Staff & Key Mgmt (excluding postdoctoral research associates)															
Name	Research	CTIO	NS	KPNO	NSSC			NSTC			OS	EPO	NOAO DIR	GRANTS/ OTHER <sup>1</sup>	Total
					SUS	SDM	SCD	SI	TSIP/ ReSTAR	LSST					
Merrill, K. Michael (S)	0.20	-	-	0.80	-	-	-	-	-	-	-	-	-	-	1.00
Mighell, Kenneth J. (S) <sup>§</sup>	-	-	-	-	-	-	-	-	-	-	-	0.35	-	0.65	1.00
Najita, Joan R. (H)	0.50	-	-	-	-	-	-	-	-	-	0.50	-	-	-	1.00
New Astronomer #2 (A)	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	1.00
Norman, Dara (S)	0.20	-	-	-	0.40	-	-	-	-	-	-	-	0.40	-	1.00
Olsen, Knut (H)	0.50	-	-	-	0.40	-	0.10	-	-	-	-	-	-	-	1.00
Points, Sean D. (S)	0.20	0.40	-	-	-	-	-	-	0.40	-	-	-	-	-	1.00
Pompea, Stephen M. (H)	0.20	-	-	-	-	-	-	-	-	-	-	0.80	-	-	1.00
Probst, Ronald G. (S)	0.20	-	-	0.25	0.04	-	-	0.20	0.31	-	-	-	-	-	1.00
Rajagopal, Jayadev (S)	0.20	-	-	0.64	0.16	-	-	-	-	-	-	-	-	-	1.00
Ridgway, Stephen T. (A)	0.50	-	-	-	-	-	0.50	-	-	-	-	-	-	-	1.00
Ridgway, Susan E. (A)	0.50	-	-	-	0.50	-	-	-	-	-	-	-	-	-	1.00
Saha, Abhijit (A)	0.50	-	-	0.15	-	-	0.35	-	-	-	-	-	-	-	1.00
Shaw, Richard A. (S)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00
Silva, David (D)	0.10	-	-	-	-	-	-	-	-	-	-	-	0.90	-	1.00
Smith, Malcolm G. (A) <sup>**</sup>	0.25	0.25	-	-	-	-	-	-	-	-	-	-	-	-	0.50
Smith, Robert C. (D)	0.20	0.30	0.30	-	-	-	-	-	-	-	-	-	-	0.20	1.00
Smith, Verne V. (D) <sup>††</sup>	0.50	-	-	-	0.50	-	-	-	-	-	-	-	-	-	1.00
Sprayberry, David (H)	0.20	-	-	-	-	-	-	0.75	0.02	-	-	-	-	0.03	1.00
Stanghellini, Letizia (A)	0.50	-	-	-	0.50	-	-	-	-	-	-	-	-	-	1.00

<sup>§</sup> Kenneth Mighell is 100% grant-funded with 35% coming from EPO for the REU grant and the remaining 65% from outside sources.

<sup>\*\*</sup> Malcolm Smith is a half-time employee.

<sup>††</sup> Verne Smith is on sabbatical until 31 July 2012.

Scientific Staff & Key Mgmt (excluding postdoctoral research associates)															
Name	Research	CTIO	NS	KPNO	NSSC			NSTC			OS	EPO	NOAO DIR	GRANTS/ OTHER <sup>**</sup>	Total
					SUS	SDM	SCD	SI	TSIP/ ReSTAR	LSST					
Stobie, Elizabeth B. (H)	-	-	-	-	-	0.80	-	-	-	-	-	-	-	0.20	1.00
Tokovinin, Andrei (A)	0.50	0.05	-	-	-	-	-	0.45	-	-	-	-	-	-	1.00
Valdes, Francisco (S)	0.20	-	-	-	-	0.80	-	-	-	-	-	-	-	-	1.00
van der Bliek, Nicole S. (D)	0.20	0.57	0.05	-	-	-	-	0.10	-	-	0.08	-	-	-	1.00
Walker, Alistair R. (A)	0.50	0.43	-	-	-	-	-	-	-	0.07	-	-	-	-	1.00
Walker, Constance (PS)	0.20	-	-	-	-	-	-	-	-	-	-	0.80	-	-	1.00
<b>Sci Staff FTE Totals:</b>	<b>13.00</b>	<b>5.65</b>	<b>0.35</b>	<b>4.41</b>	<b>4.18</b>	<b>2.20</b>	<b>2.00</b>	<b>1.83</b>	<b>1.47</b>	<b>0.07</b>	<b>0.58</b>	<b>2.62</b>	<b>2.36</b>	<b>2.78</b>	<b>43.50</b>

Postdoctoral Research Associates															
Name	Research	CTIO	NS	KPNO	NSSC			NSTC			OS	EPO	NOAO DIR	GRANTS/ OTHER <sup>**</sup>	Total
					SUS	SDM	SCD	SI	TSIP/ ReSTAR	LSST					
Atlee, David (P)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00
Dong, Hui (P)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00
Everett, Mark (P)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00
Hong, Sungryong (P)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00
Kaleida, Catherine (P)	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	1.00
Kartaltepe, Jeyhan S. (P)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00
Kunder, Andrea M. (P)	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	1.00
Pfarr, Janine (P)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00
Salyk, Colette (P)	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00
Schuler, Simon C. (P)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00

<sup>\*\*</sup> For the grant and other funding sources see Table 26.

Postdoctoral Research Associates															
Name	Research	CTIO	NS	KPNO	NSSC			NSTC			OS	EPO	NOAO DIR	GRANTS/ OTHER**	Total
					SUS	SDM	SCD	SI	TSIP/ ReSTAR	LSST					
Subasavage, Jr., John (P) <sup>§§</sup>	-	0.20	-	-	-	-	-	-	-	-	-	-	-	-	0.20
<b>Postdoc FTE Totals:</b>	<b>2.00</b>	<b>1.20</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>7.00</b>	<b>10.20</b>

Technical, Engineering, and Other Staff with Outside (Other) Funding, as Known															
Name	NOAO N	CTIO	NS	KPNO	NSSC			NSTC			OS	EPO	NOAO DIR	GRANTS/ OTHER***	Total
					SUS	SDM	SCD	SI	TSIP/ ReSTAR	LSST					
Alvarez, Rodrigo	-	0.53	-	-	-	-	-	0.05	0.27	-	-	-	-	0.15	1.00
Angeli, George Z.	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00
Ball, William J.	-	-	-	0.79	-	-	-	-	-	-	-	-	-	0.21	1.00
Barg, Mary I.	-	-	-	-	-	0.65	-	-	-	-	-	-	-	0.35	1.00
Bull, Franklin T.	0.95	-	-	-	-	-	-	-	-	-	-	-	-	0.05	1.00
Cardemil, Rodolfo	-	0.15	0.80	-	-	-	-	-	-	-	-	-	-	0.05	1.00
Cho, Myung K.	-	-	-	-	-	-	-	0.20	-	-	-	-	-	0.80	1.00
Corson, Charles	-	-	-	0.90	-	-	-	-	-	-	-	-	-	0.10	1.00
Delgado, Francisco	-	0.20	-	-	-	-	-	-	-	0.55	-	-	-	0.25	1.00
Estay, Omar	-	0.48	-	-	-	-	-	-	-	0.40	-	-	-	0.12	1.00
Fitzpatrick, Michael J.	-	-	-	-	-	0.72	-	-	0.03	-	-	-	-	0.25	1.00
Flores, Samuel	-	0.01	0.89	-	-	-	-	-	-	-	-	-	-	0.10	1.00
Garagorri, Petri	-	0.03	0.92	-	-	-	-	-	-	-	-	-	-	0.05	1.00
George, James R.	-	-	-	0.32	-	-	-	0.30	0.15	-	-	-	-	0.23	1.00
Gott, Shelby	-	-	-	0.70	-	-	-	-	-	-	-	-	-	0.30	1.00

§§ The postdoc appointment for John Subasavage, Jr. ends 31 December 2011.

\*\*\* For the grant and other funding sources see Table 26.

Technical, Engineering, and Other Staff with Outside (Other) Funding, as Known															
Name	NOAO N	CTIO	NS	KPNO	NSSC			NSTC			OS	EPO	NOAO DIR	GRANTS/ OTHER***	Total
					SUS	SDM	SCD	SI	TSIP/ ReSTAR	LSST					
Harris, Ronald C.	-	-	-	0.45	-	-	-	0.30	0.10	-	-	-	-	0.15	1.00
Herrera, David A.	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00
Holck, Daniel	-	0.98	-	-	-	-	-	-	-	-	-	-	-	0.02	1.00
Hughes, James B.	-	-	0.60	-	-	-	-	-	-	-	-	-	-	0.40	1.00
Leiva, Rodrigo	-	0.64	-	-	-	-	-	0.13	0.17	-	-	-	-	0.06	1.00
Martinez, Manuel	-	0.57	-	-	-	-	-	0.17	-	-	-	-	-	0.26	1.00
Moore, Peter C.	-	0.10	-	-	-	-	-	0.45	0.25	-	-	-	-	0.20	1.00
Muller, Gary P.	-	-	-	-	-	-	-	0.65	-	-	-	-	-	0.35	1.00
New Elec. Tech.	-	0.80	-	-	-	-	-	-	-	-	-	-	-	0.20	1.00
New Obsr. Support.	-	0.80	-	-	-	-	-	-	-	-	-	-	-	0.20	1.00
New Sw. Sys. Eng.	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00
Pakzad, Sabrina L.	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00
Pinto, Victor	-	0.83	-	-	-	-	-	-	-	-	-	-	-	0.17	1.00
Poczulp, Gary A.	-	-	-	0.47	-	-	-	-	-	0.20	-	-	-	0.33	1.00
Rath, Steve P.	-	-	-	-	-	-	-	0.73	0.07	-	-	-	-	0.20	1.00
Repp, Roger A.	-	-	-	0.85	-	-	-	0.05	0.05	-	-	-	-	0.05	1.00
Rivera, Rossano	-	0.55	-	-	-	-	-	0.14	0.23	-	-	-	-	0.08	1.00
Rojas, David	-	0.90	-	-	-	-	-	-	-	-	-	-	-	0.10	1.00
Rojas, Javier	-	0.90	-	-	-	-	-	-	-	-	-	-	-	0.10	1.00
Schmidt, Ricardo	-	0.51	-	-	-	-	-	0.05	0.34	-	-	-	-	0.10	1.00
Schumacher, German	-	0.51	-	-	-	-	-	-	-	0.43	-	-	-	0.06	1.00
Schurter, Patricio	-	0.38	-	-	-	-	-	0.25	0.27	-	-	-	-	0.10	1.00
Seaman, Robert L.	-	-	-	-	-	0.90	-	-	-	-	-	-	-	0.10	1.00
Thomas, Brian A.	-	-	-	-	-	0.75	-	-	-	-	-	-	-	0.25	1.00

Technical, Engineering, and Other Staff with Outside (Other) Funding, as Known															
Name	NOAO N	CTIO	NS	KPNO	NSSC			NSTC			OS	EPO	NOAO DIR	GRANTS/ OTHER***	Total
					SUS	SDM	SCD	SI	TSIP/ ReSTAR	LSST					
Toro, Eduardo	-	0.03	0.92	-	-	-	-	-	-	-	-	-	0.05	1.00	
Walker, David	-	-	0.75	-	-	-	-	-	-	-	-	-	0.25	1.00	
<b>Tech/Engr FTE Totals</b>	<b>0.95</b>	<b>9.90</b>	<b>4.88</b>	<b>4.48</b>	<b>-</b>	<b>3.02</b>	<b>-</b>	<b>3.47</b>	<b>1.93</b>	<b>1.58</b>	<b>-</b>	<b>-</b>	<b>10.79</b>	<b>41.00</b>	

Table 26 Sources for Grant and Other Funding FTEs Noted in Table 25

Name	Position	Sources of Grants and Other Funding (Non-NSF Base)												Total
		AURA	Gemini	NSO/ ATST	SOAR	WIYN	Las Campanas	SMARTS	NASA	VAO	TMT/ GSMT	University Projects		
Alvarez, Rodrigo	Electronic Technician 2				0.15									0.15
Angeli, George Z.	Principal Engineer											1.00		1.00
Atlee, David	Research Associate								1.00					1.00
Ball, William J.	Engineering Associate					0.21								0.21
Barg, Mary I.	SDM Operations Manager										0.35			0.35
Borosan, Todd A.	Head of Program-SCD					0.50								0.50
Bull, Franklin T.	Computer Coordinator		0.05											0.05
Cardemil, Rodolfo	Computer Programmer 3							0.05						0.05
Cho, Myung K.	Principal Engineer			0.25								0.55		0.80
Corson, Charles	Senior Engineer					0.10								0.10
Delgado, Francisco	Computer Programmer 1				0.25									0.25
Dong, Hui	Research Associate								1.00					1.00
Elias, Jonathan H.	Head of Program-GSMT			0.10								0.05		0.15
Estay, Omar	Computer Programmer 3				0.12									0.12
Everett, Mark	Research Associate								1.00					1.00
Fitzpatrick, Michael J.	Sr Software Systems Engr.										0.25			0.25

		Sources of Grants and Other Funding (Non-NSF Base)											
Name	Position	AURA	Gemini	NSO/ ATST	SOAR	WIYN	Las Campanas	SMARTS	NASA	VAO	TMT/ GSMT	University Projects	Total
Flores, Samuel	Electronic Technician 3						0.10						0.10
Garagorri, Petri	Computer Programmer 3						0.05						0.05
George, James R.	Electronic Tech. Supervisor					0.23							0.23
Gott, Shelby	Senior Software Engineer					0.30							0.30
Harris, Ronald C.	Senior Instrument Maker					0.15							0.15
Heathcote, Stephen R.	Director, SOAR	0.05											0.05
Herrera, David A.	Data Reduction Specialist								1.00				1.00
Holck, Daniel	Instrument Specialist 1				0.02								0.02
Hong, Sungryong	Research Associate								1.00				1.00
Hughes, James B.	Sr. Scientific Programmer						0.40						0.40
Kartalpe, Jeyhan S.	Research Associate								1.00				1.00
Leiva, Rodrigo	Designer Draftsman 2				0.06								0.06
Martinez, Manuel	Senior Engineer				0.26								0.26
Mighell, Kenneth J.	Scientist								0.65				0.65
Moore, Peter C.	Senior Engineer					0.20							0.20
Muller, Gary P.	Senior Engineer					0.25						0.10	0.35
New Elec. Tech.	Electrical Technician							0.20					0.20
New Obsr. Support.	Observer Support							0.20					0.20
New Sw. Sys. Eng.	Software Systems Engineer									1.00			1.00
Pakzad, Sabrina L.	Data Reduction Specialist								1.00				1.00
Pforr, Janine	Research Associate								1.00				1.00
Pinto, Victor	Instrument Maker 4				0.17								0.17
Poczulp, Gary A.	Optics & Coatings Lab Sprvr					0.33							0.33
Rath, Steve P.	Technical Assoc II											0.20	0.20
Repp, Roger A.	Instrmnt Shop Facility Sprvr					0.05							0.05

		Sources of Grants and Other Funding (Non-NSF Base)											
<i>Name</i>	<i>Position</i>	AURA	Gemini	NSO/ ATST	SOAR	WIYN	Las Campanas	SMARTS	NASA	VAO	TMT/ GSMT	University Projects	Total
Rivera, Rossano	Designer Draftsman 2				0.08								0.08
Rojas, David	Senior Engineer							0.10					0.10
Rojas, Javier	Senior Engineer							0.10					0.10
Schmidt, Ricardo	Senior Engineer Manager				0.10								0.10
Schuler, Simon	Research Associate								1.00				1.00
Schumacher, German	Manager Computer Services				0.06								0.06
Schurter, Patricio	Associate Engineer				0.10								0.10
Seaman, Robert L.	Software Systems Engineer									0.10			0.10
Shaw, Richard A.	Scientist								0.80	0.20			1.00
Smith, Robert C.	Director, CTIO	0.20											0.20
Sprayberry, David	Head of Program-NSTC										0.03		0.03
Stobie, Elizabeth	Head of Program-SDM									0.20			0.20
Thomas, Brian A.	Sr Software Systems Engineer									0.25			0.25
Toro, Eduardo	Computer Programmer 2						0.05						0.05
Walker, David	Computer Programmer 3				0.25								0.25
<b>Totals:</b>		<b>0.25</b>	<b>0.05</b>	<b>0.35</b>	<b>1.62</b>	<b>2.32</b>	<b>0.65</b>	<b>0.60</b>	<b>10.45</b>	<b>2.35</b>	<b>1.63</b>	<b>0.30</b>	<b>20.57</b>

## ACRONYMS AND ABBREVIATIONS

A&F	— Administration and Facilities (NOAO)
AAS	— American Astronomical Society
ACTR	— Advisory Committee on Technical Resources
ADASS	— Astronomical Data Analysis Software and Systems
ALMA	— Atacama Large Millimeter Array
AODP	— Adaptive Optics Development Program
AOP	— Advanced Observing Program
APP	— Annual Program Plan
ARRA	— American Recovery and Reinvestment Act of 2009
ASP	— Astronomical Society of the Pacific
AST	— Astronomy Division (NSF)
ASTC	— Association of Science-Technology Centers
ATST	— Advanced Technology Solar Telescope
AURA	— Association of Universities for Research in Astronomy
AURA-O	— AURA Observatory in Chile
BOSS	— Baryon Oscillation Spectroscopic Survey
BSR	— Business Service Review
CADIAS	— Centro de Apoyo a la Didáctica de la Astronomía
CAS	— Central Administrative Services (NOAO)
CASNET	— Central Administrative Services Network (application interface)
CCD	— Charge-coupled device
CCO	— Chief Compliance Officer
CFO	— Central Facilities Operations (NOAO)
CHARA	— Center for High Angular Resolution Astronomy
CIS	— Computer Infrastructure Services (NOAO)
CNC	— Computer numerical controlled (machine tool)
COSMOS	— Cerro Tololo Ohio State Multi-Object Spectrograph
CTIO	— Cerro Tololo Inter-American Observatory
D&D	— Design and Development
DAL	— Data Access Layer
DDF	— Director's Discretionary Fund (NOAO)
DECam	— Dark Energy Camera
DES	— Dark Energy Survey
DHS	— Data Handling System
DM	— Data Management
DMZ	— De-militarized zone
DTS	— Data Transport System
E2E	— End-to-End

ELT	— Extremely Large Telescope
EPO	— Educational and Public Outreach
ETS	— Engineering & Technical Services (NOAO)
F&A	— Facilities & Administration
FHiRE	— Fiber High Resolution Echelle
FITS	— Flexible Image Transport System
FO	— Facilities Operations (NOAO)
FTE	— Full-Time Equivalent
FTP	— File Transfer Protocol
FY	— Fiscal year
G&A	— General & Administrative
Gbps	— Gigabits per second
GHOS	— Gemini High-Resolution Optical Spectrograph
GMT	— Giant Magellan Telescope
GONG	— Global Oscillation Network Group
GSMT	— Giant Segmented-Mirror Telescope
HOO	— Hands-On Optics (NOAO)
HR	— Human Resources
HVAC	— Heating, ventilating, and air conditioning
IMACS	— Inamori-Magellan Areal Camera and Spectrograph
IR	— Infrared
IRAF	— Image Reduction and Analysis Facility
IT	— Information technology
ITC	— Integration Time Calculator
IVOA	— International Virtual Observatory Alliance
IYA	— International Year of Astronomy
KASI	— Korea Astronomy and Space Science Institute
KCWI	— Keck Cosmic Web Imager
KOSMOS	— Kitt Peak Ohio State Multi-Object Spectrograph
KPNO	— Kitt Peak National Observatory
KPVC	— Kitt Peak Visitor Center
LBT	— Large Binocular Telescope
LCOGTN	— Las Cumbres Observatory Global Telescope Network
LNA	— Laboratório Nacional de Astrofísica
LRP	— Long-Range Plan
LSES	— Long Slit Echelle Spectrograph
LSST	— Large Synoptic Survey Telescope
LSSTC	— Large Synoptic Survey Telescope Corporation
MDM	— Michigan-Dartmouth-MIT Observatory
MMT	— Multiple Mirror Telescope
MODS2	— Multi-Object Double Spectrograph (copy 2 by Ohio State)
MOSFIRE	— Multi-Object Spectrograph for InfraRed Exploration

MREFC	— Major Research Equipment and Facility Construction
MRI	— Major Research Instrumentation (NSF)
NCSA	— National Center for Supercomputing Applications
NDO	— NOAO Director’s Office
NEWFIRM	— NOAO Extremely Wide Field Infrared Imager
NN	— NOAO North
NOAO	— National Optical Astronomy Observatory
NOP	— Nightly Observing Program
NRAO	— National Radio Astronomy Observatory
NS	— NOAO South
NSA	— NOAO Science Archive
NSF	— National Science Foundation
NSO	— National Solar Observatory
NSSC	— NOAO System Science Center
NSTA	— National Science Teachers Association
NSTC	— NOAO System Technology Center
O/IR	— Optical/Infrared
ODI	— One Degree Imager (WIYN)
OGCE	— Open Grid Computing Environment (Indiana University)
OS	— Office of Science (NOAO)
OSMOS	— Ohio State Multi-Object Spectrograph
OSU	— The Ohio State University
OTA	— Orthogonal Transfer Array
PAARE	— Partnerships in Astronomy & Astrophysics Research and Education
PBX	— Private Branch Exchange
PI	— Principal investigator
PIA	— Práctica de Investigación en Astronomía
PROMPT	— Panchromatic Robotic Optical Monitoring and Polarimetry Telescopes
PTI	— Pervasive Technology Institute
ReSTAR	— Renewing Small Telescopes for Astronomical Research
REU	— Research Experiences for Undergraduates (NSF)
RoHS	— Restriction of Hazardous Substances
SAM	— SOAR Adaptive-optics Module
SARA	— Southern Association for Research in Astronomy
SCD	— System Community Development (NOAO)
SDM	— Science Data Management (NOAO)
SI	— System Instrumentation (NOAO)
SMARTS	— Small and Moderate Aperture Research Telescope System
SOAR	— Southern Astrophysical Research Telescope
SOLIS	— Synoptic Optical Long-term Investigations of the Sun
SPIE	— Society of Photo-optical Instrumentation Engineers
SPO	— Scientific Program Order (NSF)

SRC	— System Roadmap Committee
ssh	— Secure shell
STAC	— Science and Technology Advisory Committee
STEM	— Science, technology, engineering, and math
SUS	— System User Support (NOAO)
SysML	— Systems Modeling Language
TAC	— Time Allocation Committee
TelOps	— Telescope operations
TMT	— Thirty Meter Telescope
TSIP	— Telescope System Instrumentation Program
UK	— United Kingdom
UPS	— Uninterruptible power supply
US	— United States of America
VAO	— Virtual Astronomical Observatory
VO	— Virtual Observatory
VPN	— Virtual private network
WBS	— Work breakdown structure
WFS	— Wide-Field Survey Wavefront Sensor
WIYN	— Wisconsin-Indiana-Yale-NOAO (3.5-m telescope)