NOAO PROGRAM PLAN FY 2003

Submitted to the National Science Foundation
under Cooperative Agreement No. 9613615
July 1, 2002

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PREFACE

As the reader can see at a glance (p.52 below), the current budget request significantly understates the funds needed to sustain NOAO's efforts to (1) provide observing capabilities critical to the U.S. system, and (2) advance the goals of the decadal survey. If the FY 2003 budget is augmented above the level presented here, priorities for restoration are as follows:

1. Purchase of a full set of 2K×2K infrared arrays for the NEWFIRM 4K×4K infrared imager. This investment will provide an internationally competitive IR survey capability crucial to planning major programs on 8-m to 10-m class telescopes .

2. Aggressive pursuit of the site testing program for the Giant Segmented Mirror Telescope. This investment will accelerate evaluation of sites, a factor believed to be on the critical path for completion of the GSMT early in the NGST era.

3. Funding for recruitment of scientific staff equal to the new mission for NOAO described in the forthcoming Cooperative Agreement for fiscal years 2003-2007. This investment will enable NOAO staff to play an effective leadership role in advancing community interests in LSST and GSMT, while ensuring continued first-class operation of wide-field capabilities at CTIO and KPNO and support for the Gemini telescopes.

Michael A'Hearn, Chairman, AURA Observatories Council
Jeremy Mould, Director, NOAO

EXECUTIVE SUMMARY

NOAO's strong commitment to merit-based research, links to Gemini, proven experience in forging international collaborations and domestic partnerships, and continuing presence as the representative of broad-based community interests, are vital factors in the successful implementation of the McKee-Taylor decadal survey, *Astronomy & Astrophysics in the New Millennium.*

A new Cooperative Agreement with the National Science Foundation starting in FY 2003 brings a fresh perspective in which NOAO is the NSF's optical/infrared observatory, equipped to meet the research community's needs specific to astronomy. Primary among these are (1) access to telescopes of the independent observatories, with research infrastructure improved with public funds, and (2) expert science working groups to act as interfaces between the NSF's astronomy division and the large telescope entrepreneurs. NOAO is building on its base of expertise in operating Time Allocation Committees to distribute research resources with maximum effect.

The key elements of NOAO's Program Plan for FY 2003 are to:

- Perform engineering studies and site testing for a 30-meter Giant Segmented Mirror Telescope (GSMT)
- Design the gigapixel camera and other aspects of the Large Synoptic Survey Telescope (LSST)
- Populate the new NOAO Science Archive with diverse survey data
- Deliver the facility infrared spectrometer to Gemini South
- Build a 16-megapixel infrared camera initially for the Mayall 4-meter telescope
- Extend the benefits of the Telescope System Instrumentation Program (TSIP) to the community
- Broaden our public outreach, expanding links to Chile, new NASA missions, and the Kitt Peak Visitor Center
- Enhance the research focus and opportunities of NOAO's own scientific staff.

INTRODUCTION

Last year's Program Plan launched NOAO's transformation into the effective national observatory described by the Astronomy and Astrophysics Survey Committee. Looking to the end of the decade 2001–2010, NOAO has three top-level science goals:

- Explore the Universe with unprecedented resolution and depth with a 30-meter class giant diffraction-limited optical/infrared telescope
- Survey the sky weekly with a large telescope with dramatically wider field and sensitivity for time-varying objects
- Utilize technological advances to provide access to real-time and archival databases on a scale never before possible

With the AURA New Initiatives Office publication of the comprehensive report "Enabling a Giant Segmented Mirror Telescope for the Astronomical Community" in March 2002 (http://www.aura-nio.noao. edu/book/index.html), NOAO takes up a new role in the quest for a Giant Segmented Mirror Telescope (GSMT). The Division of Astronomical Sciences of the NSF has authorized NOAO to establish and maintain a Science Working Group (SWG) for the GSMT. This group is intended to be the community-based body that will develop the science case and justification for any federal investment in the GSMT by the NSF or other agencies. The SWG will represent the U.S. community in assembling relevant partnerships for describing and advocating the appropriate federal role in this project. This guidance is intended to be a product of all public, private, and international groups that expect to play a role in the GSMT. SWG members are to participate actively in technical, observational, and theoretical astrophysical studies that will be useful in defining and focusing the scientific objectives for the GSMT.

While the California Extremely Large Telescope (CELT) enters a two-year phase A study, and AURA's New Initiatives Office (NIO) pursues selected complementary GSMT studies for its broader community, NOAO turns its attention to the Large Synoptic Survey Telescope (LSST) as its major design challenge. The goal is to submit a fully costed proposal to build and operate the LSST in December 2004. During the FY 2003 Program Plan year, we aim to complete the necessary engineering studies, develop a design reference mission, and initiate two pilot programs: an operations pilot at Kitt Peak and a data management pilot using the Blanco telescope on Cerro Tololo.

The Data Products Program (DPP) will complete its data management study for LSST during FY 2003. The DPP will broaden and deepen the NOAO Science Archive (NSA) launched in April 2002, in accordance with NOAO's Long Range Plan. FY 2003 will see the completion of a number of NOAO survey projects and the combined returns of the SIRTF (Space Infrared Telescope Facility) Legacy program and its NOAO support program.

The goals set for NOAO's Major Instrumentation Program (MIP) make FY 2003 a critical year for this program, including such major milestones as:

- Delivery and commissioning of GNIRS (Gemini Near-Infrared Spectrograph)
- Decision on the Gemini South Adaptive Optics Imager (GSAOI) contract
- Critical Design Review for NEWFIRM (NOAO Extremely Wide-Field Infrared Imager) and a foundry run for its infrared arrays

The FY 2003 Program Plan has been prepared in the full expectation of success in each of these projects.

Within the structure of the International Gemini Observatory (IGO), each partner agency created a national project office to represent its participation in Gemini. The project offices form the nodes of communication between the IGO and each partner country, providing input and advice to IGO on partner perspectives and communicating to the national communities the capabilities and science opportunities that IGO presents. NOAO is the home of the U.S. national project office. To mark the transition from project to operations, AURA re-launched the U.S. national Gemini project office as a science center in 2002. The goals of the NOAO Gemini Science Center (NGSC) are to meet U.S. community needs for 8-m aperture telescopes; to provide user support, including data reduction and analysis procedures; and to develop the input from the U.S. partner perspective to the IGO in science planning, instrument development, and operations support. NOAO and the NGSC bring to the Gemini partnership a long history of broad community involvement in the scientific planning and operations of national observatory facilities, including full community participation in the NOAO telescope time allocation process. NGSC taps into a wide range of in-house scientific expertise that encompasses the Gemini science goals and instrumentation diversity. The NOAO Major Instrumentation group provides valuable engineering resources. The joint presence of NOAO and Gemini on the Cerro Pachón site offers extensive opportunities for collaboration on telescope support and instrument sharing.

The 20-year history of NOAO has been one of increasing cooperation between its northern and southern hemisphere observatories. Important milestones were the cloning of the two-hemisphere structure in the international Gemini project and the merger of time allocation and oversight bodies. The Long Range Plan for NOAO continues this trend with new programs bridging the divisions—the Major Instrumentation Program and Data Products Program are prime examples. In this Program Plan, we introduce the term *NOAO South* to encompass these new cross-cutting programs as well as the operations of Cerro Tololo Inter-American Observatory (CTIO) itself; the term also includes NGSC activities in the South in support of Gemini, and GSMT studies and efforts undertaken by the New Initiatives Office in the South.

Cerro Tololo Inter-American Observatory (CTIO) and Kitt Peak National Observatory (KPNO) enter the first year of "Cheap Ops" with somewhat different approaches. At CTIO, the small telescope consortium will make its debut. The consortium approach to operations should work to the advantage of time domain science, including studies of Gamma Ray Bursters, X-ray novae, Cataclysmic Variables, and RR Lyrae stars. NOAO will retain a share of the time on these telescopes for the general community. The Southern Observatory for Astrophysical Research (SOAR) telescope will see first light. At KPNO, an instrumentation partner institution has been invited to assist in the development of NEWFIRM in return for guaranteed time on the Mayall telescope.

FY 2003 will mark the second year of the NSF's $4 million-per-year Telescope System Instrumentation Program (TSIP). The program yields telescope time on the facilities of the independent observatories for the community and complements these facilities with instruments that are most strategic within the U.S. observing system as a whole. This is the first of the decadal survey initiatives to be successfully implemented by NOAO for the NSF.

Finally, NOAO will enter FY 2003 with a new Cooperative Agreement with the NSF. In addition to the Observatory Council's review of the current program plan, the NSF will seek direct advice from a new committee.

THE NOAO GEMINI SCIENCE CENTER (NGSC)

Milestones FY 2003

- Issue and publicize the calls for proposals for U.S. observers for semesters 2003A and 2003B for Gemini North and Gemini South; assist the U.S. community in preparing proposals and scientifically evaluate such proposals
- Provide support for observing with Phoenix on Gemini South
- Increase the visibility of Gemini in the U.S. astronomical community through NGSC outreach activities
- Stimulate and organize U.S. input into the Gemini next-generation instrumentation planning process by means of workshops for the U.S. community and through the selection and briefing of U.S. delegates to the international planning workshop
- Work with Gemini and the University of Florida to commission the Thermal-Region Camera and Spectrograph (T-ReCS) and perform system verification
- Deliver GNIRS to Gemini South, perform final acceptance testing at the telescope, and participate in GNIRS commissioning, with the assistance of the NOAO Major Instrumentation Program (MIP) staff
- For the Near-Infrared Coronagraphic Imager (NICI), Mauna Kea Infrared will complete mechanical and electronic fabrication
- Continue the Gemini South Adaptive Optics Imager (GSAOI) design and complete a Preliminary Design Review (PDR), if NOAO is awarded the fabrication contract, with the assistance of the NOAO MIP staff
- Support a program of post-doctoral scholars who will capitalize on Gemini science opportunities

Calls for Proposals for Gemini North and South

The opportunity to propose for Gemini observations is communicated to the U.S. community by NGSC via the *NOAO Newsletter,* electronic announcements, and Web pages. User support at NGSC is performed by a group of more than a dozen instrument scientists, ranging from quarter-time to full-time, whose areas of scientific and technical expertise are matched to the diversity of Gemini instrumentation. These instrument scientists assist the U.S. principal investigators in preparing observing proposals and

provide the first level of technical proposal evaluation for the telescope allocation process. U.S. investigators submit proposals for Gemini observations through the standard NOAO proposal process; they are evaluated scientifically by the NOAO telescope Time Allocation Committee (TAC) system. The NGSC also assists successful U.S. proposers with the Gemini Phase II submission process.

Observing Support for U.S. Visitor Instrumentation on Gemini South
NGSC staff provide support for the operation of U.S. visitor instrumentation on Gemini. NOAO's high-resolution infrared spectrograph Phoenix is a visitor instrument on Gemini South, and will be shared between SOAR and Gemini South. NGSC staff will work with Gemini on the operation, maintenance, and calibration of Phoenix, and will provide documentation on Phoenix performance, operation modes, and calibration procedures for the Gemini community. Phoenix was the most heavily requested instrument on Gemini South by U.S. proposers for semesters 2002A and 2002B.

NGSC Outreach to the U.S. Astronomical Community
NGSC will communicate with the user community by means of articles in the *NOAO Newsletter*, special brochures, "town meetings" and special sessions at AAS meetings, electronic announcements, and Web-based information. During FY 2003, NGSC staff will present its PowerPoint presentation at several U.S. universities. The presentation gives an overview of the Gemini telescopes and instruments, and explains how to apply for Gemini observing time and how the NGSC provides support to the U.S. astronomical community. Currently under exploration is the use of web casts to inform the users on specifics of Gemini instrumentation and to instruct them on the use of the Gemini Observing Tool for preparing queue programs. The NGSC intends to organize and conduct science workshops, in collaboration with the IGO and partner countries, to highlight particular areas of Gemini science that are both timely and productive. The NGSC will also sponsor technical workshops, such as the Tucson workshop on adaptive optics (AO) data reduction, to assist the community in obtaining the highest scientific return from Gemini observations. Future workshops may focus on multiple object spectroscopy in the optical and near-IR (with GMOS and FLAMINGOS), on integral field spectroscopy, or on mid-infrared observing and reduction procedures.

NGSC will work closely with both the NOAO and IGO Outreach groups to identify important Gemini science discoveries and to highlight these science stories for the public via press releases, media outlets, and the NOAO and Gemini Web sites.

Representation and Advocacy of U.S. Community Interests and Needs
Within the structure of the International Gemini Observatory (IGO), each partner agency created a national project office to represent its participation in Gemini. NOAO is the

home of the U.S. national project office, and the director of the NGSC is the U.S. project scientist for Gemini. In order to access and represent U.S. interests, the NGSC director is assisted by a science advisory committee (U.S. SAC) that consists of eight to ten prominent members of the U.S. community. This committee meets once or twice annually to advise on science direction, operations models, instrumentation concerns, and the full variety of Gemini matters. The most recent meeting occurred in March 2002 in Pasadena, California. NGSC also selects representatives for the U.S. on Gemini committees. Specifically, NGSC is responsible for sending six delegates to the Gemini Science Committee. (Five community members selected from the U.S. Gemini SAC, plus the interim NGSC Director, participated in the April 2002 meeting.) Additionally, NGSC sends one delegate to the Gemini Operations Working Group, and representatives to other Gemini committees as needed (e.g., the organizing committee for the Gemini next-generation instrument workshop, and the organizing committee for the Gemini Instrumentation Lessons Learned II Workshop).

NGSC plans to survey the principal investigators of U.S.-approved Gemini programs to gauge their satisfaction with the data they received and related interactions with Gemini and NGSC. The results of this survey, which will be conducted at the close of each semester, will be distributed to the U.S. Gemini Board and SAC members, the NOAO director, and the Gemini director and associate directors.

Next-Generation Instrumentation Planning

The current set of Gemini instrument specifications and science goals was assembled during an international meeting ("the Abingdon Meeting") in 1997. In May or June 2003, a second international meeting will be held to explore the next generation of instrumentation and to develop the strategic plan for the IGO in the coming decade, including the role of Gemini in the Next Generation Space Telescope (NGST) era. As was also done prior to the Abingdon meeting, the NGSC will conduct community workshop(s) in the U.S. to prepare the science cases and instrumentation opportunities that best satisfy the needs and preferences of our community, and to coordinate the Gemini Observatory within the U.S. system of observing capabilities. The NGSC will also recruit and brief the U.S. delegates to the international next-generation Gemini instrumentation meeting and will collaborate with Gemini on the organization of this meeting.

Thermal-Region Camera and Spectrograph (T-ReCs)

T-ReCS, the mid-IR imager and spectrograph for Gemini South, is in its final test and debug phase at the University of Florida. During FY 2003, NGSC will work with U. Florida and Gemini to commission T-ReCS on the Gemini South telescope. System verification at Gemini is the final step of testing; it is intended to demonstrate that the entire observing system is in place, that scientific observations with the commissioned

instrument can be planned and performed, and that resulting data are of the quality expected.

The Gemini Near-Infrared Spectrograph (GNIRS)
GNIRS is a long-slit spectrograph for the Gemini South telescope that will operate from 1 to 5 microns and will offer two plate scales and a range of dispersions. As of May 2002, assembly of the GNIRS subsystems into a complete instrument is about to begin. During FY 2003, in cooperation with the MIP group, GNIRS will delivered to Gemini South and undergo acceptance testing at the telescope, and the GNIRS team will train Gemini staff in its operation and maintenance. This will complete the GNIRS contract. Commissioning of GNIRS will also be completed during FY 2003, and system verification will be underway.

The Near-Infrared Coronagraphic Imager (NICI)
NICI is an optimized coronagraph with dual-beam imaging for Gemini South. It is being built by Mauna Kea Infrared (MKIR) with funding from NASA. NGSC provides management oversight for NICI, including quarterly reviews. NICI passed its Preliminary Design Review in April 2002 and is expected to pass its Critical Design Review before the end of FY 2002. During FY 2003, MKIR will complete the fabrication of mechanical and electrical subsystems for NICI.

Gemini South Adaptive Optics Imager (GSAOI)
NOAO was selected through an international competition as one of two teams to develop a conceptual design for the Gemini South Adaptive Optics Imager. The instrument is being designed for use with the multi-conjugate adaptive optics (MCAO) system, which is being built for Gemini South. The imager will cover wavelengths between 0.9 and 2.4 microns, and will be based on a 4k x 4k HgCdTe mosaic. This is sufficient to cover the well-corrected field of view of the MCAO system (about 80×80 arcsec) with a pixel scale matched to diffraction-limited images. In August 2002, NOAO will complete the design study and submit a fixed-price proposal for completing the instrument. In order to complete the instrument in the two years Gemini has allowed, NOAO must move quickly from the concept design in the proposal to a mature design, which meets the requirements of a Preliminary Design Review.

Data Reduction, Calibration, and Analysis Software
In order to attain Gemini science goals, data reduction, calibration, and analysis software needs to be developed for the Gemini data products. The NOAO Data Products Program (DPP) will strengthen these efforts, providing system enhancements, data quality, and error mapping specifically for Gemini data. The reduction and analysis of multiple-object and integral field spectroscopy, and infrared images and spectra all require software

support, which is linked to ongoing Image Reduction and Analysis Facility (IRAF) development. In FY 2003, this effort will be funded through FY 02 carryover.

NGSC Postdoctoral Fellowship
To mark the launch of the NGSC, AURA will create and support a new postdoctoral program to encourage young U.S. astronomers to utilize the Gemini telescopes for innovative science. Salary for this post is paid by AURA; NOAO will cover benefits for the post.

NGSC FY 2003 Budget and Major Work Packages

- **Gemini User Support:** Cost of two-FTE support of Gemini telescope users and proposers.
- **Gemini South Operations:** Support for instruments of particular import to the U.S. community on Gemini South, e.g., Phoenix and Hokupa'a 85 South.
- **NGSC Data Reduction Software:** Cost of Data Products Program staff efforts to develop data reduction software for Gemini facility instruments to assist the U.S. community in reducing and analyzing their Gemini data. (To be funded from FY 2002 carryover.)
- **NGSC Director's Office:** Costs associated with management/administration of NGSC, especially travel and external relations designed to advocate the interests of the U.S. Gemini community; dissemination and communication of NGSC activities, workshops, and opportunities for the U.S.

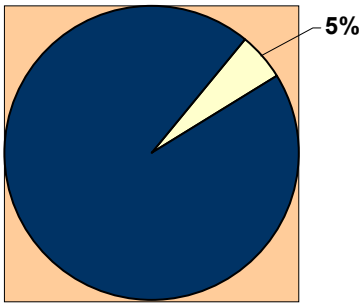
NOAO GEMINI SCIENCE CENTER (NGSC)
FY 03 Spending = $1,171
(Dollars in Thousands)

Work Package	FTE	Total $
Gemini User Support	2.0	197
Gemini S. Operations Support	3.1	277
Data Reduction Software*		-
Director's Office	1.9	260
NGSC Postdoc**	1.0	30
AURA Gemini Fellowship	1.0	100
Instrument Development	2.8	307
Total Program	**11.7**	**$1,171**

** To be funded from FY 02 carryover.*

***Payroll costs of NGSC postdoctoral fellowship will be funded by AURA; NOAO to pay benefits.*

NGSC FY 03 Spending = $1,171K



community; coordination of U.S. Gemini Science Advisory Committee activities and community-based definition of next generation instruments; representation on Gemini Science Committee, Gemini Operations Working Group, and similar bodies.

- **AURA Gemini Fellowship:** Administered by NGSC, this program provides support for South American students and educators from Argentina, Brazil, and Chile to study, conduct independent research work, and teach in the United States at universities and research institutions of their choice.
- **NGSC Instrument Development:** For Gemini instruments built in the U.S., NGSC lets the contracts, provides advice and liaison to the instrument teams, carries out management oversight, reports progress to IGPO, and coordinates communications between the instrument team and IGPO.

NOAO SOUTH

Milestones FY 2003

Southern Astrophysical Research (SOAR) Telescope

- Complete final acceptance tests of the active optics system, including all three mirrors; ship to Chile and install in the telescope
- Complete integration of the telescope, ready for first light on April 1, 2003
- Accelerate telescope and instrument commissioning such that the facility is fully science-ready by the end of FY 2003, including, as specific responsibilities for CTIO staff, (1) completion, testing, installation and commissioning of the Instrument Support Boxes (ISBs), and (2) completion, testing, installation, and commissioning of the SOAR optical imager

Cerro Tololo Inter-American Observatory (CTIO)

Blanco 4-m Telescope

- Commission the Infrared Side Port Imager (ISPI) for first science use in late 2002.
- Develop a long-range instrumentation plan for the Blanco telescope
- Transition from operating the Blanco + smaller telescopes to the Blanco + SOAR

CTIO Small Telescopes

- Transfer operation of the CTIO small telescopes to a consortium

CTIO Instrumentation

- Hold the Conceptual Design Review for the SOAR adaptive optics project

SOAR Telescope

SOAR experienced substantial delays with the dome and active optics contracts. The primary mirror is critical path; delays in its completion are responsible for the first-light target date slipping by six months. Integration of the facility is proceeding with the aid of CTIO Engineering and Technical Services and TELOPS manpower, which is part of an agreement to augment SOAR project manpower in exchange for a reduction in the length of the period for which NOAO will operate the telescope. The SOAR project has asked its partners to infuse extra funding to allow the project team to continue until at least first light. In part to compensate for the current delay, a program to accelerate the post first

light activities is being planned. By the time of first light, the facility thermal environment should be well controlled, the initial instruments will be ready, and all software systems should be well tested. This should allow for a rapid transition to science operations with the optical imager and the IR imager/spectrometer OSIRIS.

Blanco 4-m Telescope

In order to give a first-rate wide-field imaging capability, the Blanco will be operated with the Mosaic CCD imager (8K × 8K) at prime focus and the ISPI IR imager (2K × 2K) at side-port Cassegrain focus. Hydra, mounted at direct Cassegrain, complements this with wide-field multi-object spectroscopy. These three instruments can be mounted simultaneously. Until new SOAR and Gemini instrumentation is ready, we will continue to alternate Hydra with the RC and Echelle spectrographs, both of which are still popular. Their capabilities soon will be superseded by the Goodman spectrograph on SOAR, GMOS and bHROS on Gemini, and IMACS on Magellan. Although the wide-field capabilities of Mosaic, ISPI, and Hydra complement the new instrumentation on the 6-m to 8-m telescopes, CTIO is developing a forward-looking plan to ensure that the Blanco telescope remains in the forefront of facilities available to U.S. astronomers.

Near-fixed instrumentation will ease the transition from operating the Blanco and smaller telescopes on Cerro Tololo to operating Blanco on Cerro Tololo and SOAR on Cerro Pachón. This transition has already begun as part of the SOAR integration activities, and will be completed in 2003.

CTIO Small Telescopes

CTIO continues to operate the 1.5-m and 0.9-m telescopes. The only instruments currently offered on the 1.5-m are the CCD imager and optical spectrograph; the 0.9-m continues to offer CCD imaging only. CTIO is also part of the YALO consortium, which operates the 1.0-m Yale telescope with dual optical-IR imager ANDICAM in Q-scheduled mode. (The YALO agreement expires at the end of 2002.) The 1.3-m ex-2MASS survey telescope has been transferred to NOAO, while the University of Michigan's Schmidt telescope closed in March 2002. In order to revitalize science with the small telescopes, the CTIO-owned 1.5-m, 1.3-m, and 0.9-m telescopes have been offered for consortium operation for a three-year period beginning in 2003. Responses to this announcement will be evaluated in mid-2002, and following NSF approval, operations should begin in semester 2003A. NOAO would be a consortium member at approximately the 25 percent level to retain access for the general user community.

The Major Instrumentation Program at NOAO South

The MIP will develop and test concepts for SOAR adaptive optics, with Conceptual Design Review planned for early 2003. The aim of this project is to develop a relatively simple system that will complement those on larger telescopes such as Gemini. The system envisaged would have two modes: partial correction over a wide field, and a high-resolution small field at optical wavelengths. It would be first built to use natural guide stars, and then upgraded with a Rayleigh laser.

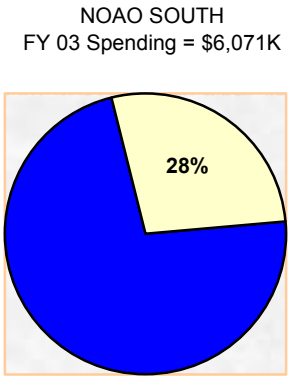
NOAO South FY 2003 Budget and Major Work Packages

- **Science Operations:** Pre- and post-observing support; travel and full costs for graduate students engaged in thesis research. Telescope Allocation Committee (TAC) activities.
- **Instrument Upgrades:** Improvements to instruments and detector systems.
- **Computer Infrastructure Services:** Maintenance and upgrades of the computer and network systems.
- **Blanco 4-m:** All operating and maintenance costs, including minor upgrades by scientific staff members, the TELOPS group, and La Serena-based Engineering and Technical Services.

NOAO-South
FY03 Spending = $6,071
(Dollars in Thousands)

Work Package	FTE	Total $
Science Operations	2.4	220
Pre/Post Observer Support	1.4	82
Queue/Service Observing		78
Library	1.0	60
Instrument Upgrades	5.1	231
(Revenue: External Work)		(210)
Computer Infra. Services (CIS)	6.5	456
Blanco [Tel. A]	15.8	1,065
Telescope Operations	12.2	915
Software Support	0.1	6
Telescope Upgrades	3.6	144
SOAR [Tel. B]	17.5	1,251
Telescope Operations	9.5	882
Software Support	0.1	6
Telescope Upgrades	8.0	363
Small Telescopes [Tel. C]	4.5	289
Telescope Operations		287
Software Support		0
Telescope Upgrades		2
Mountain Facilities (AOSS)	8.8	577
Science Research	1.7	258
Director's Office	5.7	446
(Indirect Cost Recovery)		(125)
Central Facilities Ops [AOSS]	11.0	189
Central Admin. Services [AOSS]	8.8	344
Public Affairs/Ed. Outreach	0.4	117
(REU Grant)		(60)
Data Products Program	1.4	70
LSST	0.5	53
NIO/GSMT	1.9	325
Major Instrumentation Program	8.3	575
Total NOAO-South	**100**	**$6,071**

- **SOAR:** Scientific staff, operational, and engineering costs associated with pre-operations and transitional integration and commissioning activities, as required under the consortium agreement.
- **1.5-m, 1.3-m, and 0.9-m Telescopes (Telescope C):** Operations and maintenance of the 1.5-m and 0.9-m telescopes until consortium operation begins. Nominally, CTIO's direct contribution consists of telescopes and instruments, and the consortium will pay for services as needed.
- **Mountain Facilities:** Payments to AURA Observatory Support Services (AOSS) for support of the physical plant on the mountains. Includes maintenance of the roads, dormitories, kitchen services, utilities, and provision of security, safety, and medical emergency services.
- **Science Research:** Personal research time of scientific staff and two CTIO post-docs; scientific staff support and library.
- **Director's Office:** CTIO director and deputy director, including administrative support.
- **Public Affairs and Educational Outreach:** Programs not included under the REU grant, e.g., CTIO's Práctica in Astronomía (PIA) program for Chilean students, Light Pollution Control Office, and local outreach and public education programs.
- **Central Facilities:** AOSS maintenance and security services at La Serena and Santiago.
- **Central Administrative Services:** AOSS accounting, payroll, travel, and human resources services; import/export; warehousing; official interface to local and central governments.



KITT PEAK NATIONAL OBSERVATORY

Milestones FY 2003

Science Operations

- First light and commissioning of Goddard IRMOS
- Design of telescope interfaces for NEWFIRM
- Acquisition and implementation of new acquisition/guiding TVs
- Commissioning of 4-m image quality improvements as a system
- Precision control and stability of WIYN telescope focus
- Establishment of instrumentation partnership for Mayall 4-m
- Implementation of system of reimbursable tenant support

The budgetary context of KPNO project work for FY 2003 is an approximately 15 percent reduction in purchasing power. That adjustment has been induced by a combination of NOAO internal re-direction to achieve the goals of new telescope development in the Long Range Plan and of reduced NSF allocation to NOAO in the FY 2003 budget. Major goals for the year will be consolidation at the new level of support, and maintenance of high reliability and productivity through scheduling that favors longer instrument blocks and observing runs. There will be modest resources available for telescope and instrument upgrades.

Goddard IRMOS
This instrument employs a digital micro-mirror array as a cold, programmable slit mask for multi-object spectroscopy in the near-IR, as a prototype for future NASA applications. It complements the capabilities of FLAMINGOS in offering higher spectral dispersion, and will receive the f/15 beams of the 4-m and 2.1-m. KPNO staff are designing and fabricating the telescope interface and handling hardware. Its first run on the 2.1-m is planned for early calendar year 2003.

NEWFIRM Interface
The next major instrument for NOAO telescopes will be NEWFIRM, the wide-field near-infrared camera. Significant design effort from KPNO engineering will be required for modifications to the 4-m Cassegrain cage and for the details of guiding, mechanical, and electrical interfaces.

Acquisition and Guiding Cameras
The current generation of acquisition TVs date from the early 1990s. They are intensified CCDs that are nearing the end of their useful lifetimes and are showing limitations in

sensitivity and focus. The telescope and instrument scientists will specify the performance of the next generation of devices, which must be integrated mechanically and through software to replace the existing TVs for general mountain use. This project will have a substantial capital component.

4-m Image Quality

The components of active primary support, precision secondary control, wave front camera, and air handling and conditioning for the primary will all be in place and separately functioning by the end of FY 2002. Image quality control must then be fully commissioned at a systems level. This process includes deployment of additional thermal probes and precision micrometers, computer control of air flow volume and mirror surface temperature set points, and development of a detailed operating procedure that is straightforward for mountain staff to follow as a function of ambient conditions.

WIYN Focus Control

The extremely tight images produced by the WIYN tip/tilt module, as well as the routine imaging with Mini-Mosaic, have shown that image quality now is limited largely by the performance of the secondary actuation. Subject to consortium approval, an upgrade project will significantly improve the stability and precision control of this system. The goal is to push the top 10 percent image quality to better than the current 0.4” from Mini-Mosaic and 0.25” from the WTTM, and saving the valuable sky time now spent in frequent focusing.

Instrumentation Partnerships

With NSF and AURA approval, KPNO has solicited partners for the development of major new instrumentation for the Mayall 4-m telescope. The proposals will be reviewed and partners recommended in FY 2002. Finalizing the terms of the actual partnership arrangements and the provision of telescope time is expected in FY 2003.

Tenant Services

Reduced operations funding from the base budget inevitably leads to reduced staffing directly in support of KPNO operations. To maintain availability of a range of critical staff skills on the mountain, a portion of labor from a more full staff pool is being offered to tenants on a reimbursable basis. They may make a minimum commitment to access to a full range of KPNO support personnel, including custodial, crafts, mechanical, electronic maintenance, and engineering services.

Kitt Peak Mountain Facilities

- Upgrade PBX telephone switching system
- Replace primary septic tank
- Continuing repair and replacement of aging infrastructure

PBX Upgrade
The existing system has not been upgraded since 1997. The tenant consortium has approved expenditures to upgrade from version 4.0 to the current version 9.x.

Septic Tank Replacement
The primary tank serves the kitchen, administration maintenance, and two dorms. This tank requires replacement to meet current standards and increased flow rates.

Infrastructure Repair and Upgrade
We plan to continue corrective action on infrastructure repairs (utility lines, environmental issues, etc.). Large portions of the underground utilities were installed in the early 1960s and are well past their expected lifetimes. Some telephone lines have evidence of water intrusion and the associated static. Water lines are being patched and main valves are in need of replacement or corrective action. Problems are also occasionally encountered with primary underground electrical lines. Efforts will continue to correct and/or replace as appropriate, sharing costs with tenants through the Joint Use fee.

KPNO FY 2003 Budget and Major Work Packages

- **Science Operations:** Pre- and post-observing support; observing run preparation, advice on performance for use in proposals, a modest amount of service observing, and the cost of the KPNO Observing Support Services (KPSS) in Tucson.

KITT PEAK NATIONAL OBSERVATORY (KPNO)
FY 03 Spending = $3,839
(Dollars in Thousands)

Work Package	FTE	Total $
Science Operations	1.5	107
Pre/Post Observer Support		93
Queue/Service Observing		14
Instrument Upgrades		131
Mayall 4-M [Tel. A]	16.9	1,252
Telescope Operations		1,156
Software Support		48
Telescope Upgrades		109
(Cost Recovery: Aluminizing)		(61)
WIYN [Tel. B]	9.2	821
Telescope Operations		945
Software Support		129
Telescope Upgrades		61
(WIY Partner Contributions)		(314)
2.1-M & Other [Tel. C]	4.6	343
Telescope Operations		302
Software Support		12
Telescope Upgrades		29
Mountain Facilities	19.5	1,260
(Cost Recovery: Tenant Obs.)		(591)
Science Research	1.7	163
Director's Office	1.7	248
Support for NSO Facilities	2.0	105
Total KPNO	**57.2**	**$3,839**

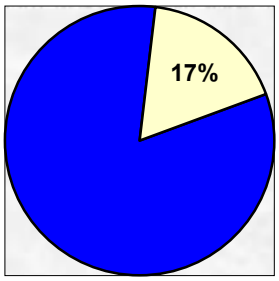
- **Mayall 4-m (Telescope A):**
  All costs directly associated with the operations and maintenance of the telescope, e.g., observing assistants, electronic maintenance and facilities group support, and all support and minor upgrades of instrumentation. Efforts of scientific staff, KPNO engineering staff, and the mountain programming group in support of the telescope and its instruments are included, along with start-up assistance for observers at the telescope. A prorated share of the scientific infrastructure comprising the computer network, mountain scientific administration, maintenance of electronics shops, spares, and test equipment is assigned by telescope.

- **WIYN Telescope (Telescope B):** KPNO operations of this telescope are clearly defined by the terms of the consortium agreement. The costs shown represent actual expenditures, offset (under "WIY Partner Contributions") by revenues from the non-NOAO partner institutions. In addition to the support defined by the agreement, the total includes all scientific staff activity related to support of the WIYN observers, telescope and existing instruments, and expenses for participation in WIYN consortium activities such as Board and SAC meetings.

- **2.1-m + NOAO share of WIYN 0.9-m (Telescope C):** All costs of operations and maintenance of the 2.1-m; on the WIYN 0.9-m, KPNO staff support the instruments for direct imaging only.

- **Mountain Facilities:** Support of the mountain physical plant (exclusive of the telescope domes), including roads, water and septic systems, support buildings, dining and lodging facilities operations, power distribution, and mountain vehicles and equipment.

KPNO FY 03 Spending
$3,839K



- **Instrument Upgrades:** More major projects (such as detector or controller upgrades) that call primarily on the talents of the major instruments group.
- **Science Research:** AURA-mandated research time that accompanies direct scientific staff effort in support of KPNO.
- **Director's Office:** The KPNO director and assistant to the director (.5 FTE); one administrative assistant who supports the entire NOAO-Tucson scientific staff.