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EXECUTIVE SUMMARY

As a consequence of the delay in the Senior Review report until November 2006, the task of developing a plan for implementing its recommendations has slipped to this year, FY07. The effort to develop such a plan will be a major focus for FY07; it will follow the upcoming NSF town meetings, and it will have to consider the viability of individual recommendations and their integration into the context of a clear and strong mission for NOAO. Although budget impacts are not anticipated before FY09, the two years previous to that can be used to position NOAO for a smooth transition. The implementation plan will be developed in consultation with NOAO’s advisory committees.

FY07 will see a large number of new capabilities at the NOAO and partner telescopes. These include the instruments QUOTA, NEWFIRM, and WHIRC on Kitt Peak, the Goodman Spectrograph at CTIO, and FLAMINGOS-2 at Gemini South. The arrival of NEWFIRM, a wide-field infrared camera, for the 4-m telescopes will add new momentum to the survey program, and the next call for survey proposals will occur in the middle of the year, to accommodate the expected demand.

The decadal survey initiatives also expect major progress this year. LSST will submit their proposal to NSF’s MREFC program in early 2007, and is working towards a conceptual design review in Spring 2007. The New Initiatives Office is in a transitional state following new instructions from the NSF; a plan is being developed for a GSMT effort that will guarantee community participation in any Extremely Large Telescope that ultimately goes forward. The NVO facility proposal solicitation is expected soon, and NOAO is poised to participate in the operations of the proposed facility. Content for the NVO will be provided, in part, by the launching of the NOAO end-to-end data flow system, which will capture, archive, and distribute data from all NOAO telescopes to the research community.

Progress on the ground-based O/IR system has been a major thrust of the NOAO program and will be an important component of the response to the Senior Review. A third community workshop on the system will help to define areas of need for broadening access or developing new capabilities. This will also provide guidance for the Telescope System Instrumentation Program (TSIP), which is starting its sixth year.

Finally, the NOAO Public Affairs and Educational Outreach (PAEO) program anticipates participation in programs local, national and global in FY07.
1 NOAO DIVISIONS

1.1 NOAO GEMINI SCIENCE CENTER (NGSC)

FY07 Program Overview

The NOAO Gemini Science Center (NGSC) is the gateway to U.S. community access to the two 8.1-m Gemini telescopes. NGSC staff astronomers provide a number of services in support of U.S. Gemini users: provide pre-submission technical assessments of any Gemini proposals being submitted by a U.S. PI, answer Gemini helpdesk questions from the community, write technical reviews for the NOAO TAC on every Gemini proposal submitted to NOAO, help successful PIs prepare Phase II submissions to Gemini in order to execute their observing programs, conduct Gemini site visits in order to maintain their proficiency in Gemini instruments and operations, be part of Gemini instrument teams in conjunction with Gemini astronomers, and help Gemini maintain Web pages. In addition, NGSC engages and educates the entire U.S. astronomy community about current Gemini issues, new observing capabilities and science results via the “NOAO/NSO Newsletter,” the NGSC Web site, and booths at AAS meetings. NGSC is an active participant, as well as a strong advocate of U.S. interests, in the Gemini Science Committee, the Operations Working Group and the International TAC.

FY07 Milestones

- Provide support for five visits per semester to one of the Gemini sites by an NGSC astronomer for the purposes of observing queue operations and instrument familiarization
- Support NOAO’s Phoenix spectrograph at Gemini South in classical mode until Gemini removes it from the telescope in calendar year 2007
- Continue close communications with the U.S. Gemini Science Advisory Committee after a successful in-person meeting in October 2006 by holding telecons to inform the U.S. GSAC of the most recent commissioning plans and the resulting impact on the U.S. community for the large amount of new instruments planned for Gemini South in 2007
- Oversee the testing and final integration phases, through acceptance testing and final delivery, of the FLAMINGOS-2 near-infrared multi-object spectrograph for Gemini South being built at the University of Florida
- Maintain strong ties to the Gemini North base facility by having staff visit on extended stays to interact with the Gemini North staff
- Provide help to organize and some support for the Gemini Science 2007 meeting to be held in Brazil in May 2007

FY07 Work Packages

NGSC Director’s Office
Organize activities within NGSC. Publicize NGSC activities and Gemini opportunities via the “NOAO/NSO Newsletter,” NGSC Web pages, and other means. Organize workshops with the goal of
educating and engaging the U.S. community in Gemini observing opportunities and scientific results. Organize the U.S. Gemini Science Advisory Committee (SAC). Provide U.S. representation on Gemini committees, such as the Gemini Science Committee, Gemini Operations Working Group, and Gemini International TAC. Perform two-way communication with International Gemini Observatory.

**Gemini User Support**
Cost of support of U.S. Gemini telescope users and proposers, primarily from the north. In particular, provide complete support for the U.S. Phase I and Phase II Gemini proposal processes, as well as answer all inquiries by U.S. users.

**Gemini South Operations Support**
Support for Gemini telescope users and proposers from the U.S. community for Gemini South. Also includes the cost of NGSC staff assisting with queue observing and instrument commissioning at Gemini South.

**Instrument Development Oversight**
NGSC lets the contracts for Gemini instruments built in the U.S. This work includes advice and liaison to the instrument teams, management oversight, progress reports to International Gemini, and communication coordination between the instrument team and Gemini.

**AURA U.S. Gemini Fellowship**
The AURA U.S. Gemini Fellowship provides support for South American students and educators from Argentina, Brazil and Chile to study, conduct independent research, work, and teach at United States universities of their choice. This program is administered by NGSC.

**NGSC Post-Doctoral Fellows**
Post-doctoral fellowships to perform scientific research with Gemini and participate in NGSC user support. Salary for one fellowship is supported by AURA; benefits are paid by NGSC.

**FY07 Budget Summary** (Table 1)

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGSC Director's Office</td>
<td>1.80</td>
<td>$16,290</td>
</tr>
<tr>
<td>Gemini User Support</td>
<td>2.10</td>
<td>114,833</td>
</tr>
<tr>
<td>Gemini S. Ops. Support</td>
<td>2.10</td>
<td>334,554</td>
</tr>
<tr>
<td>Instrument Development: Mgmt Oversight/Coordination</td>
<td>0.62</td>
<td>101,112</td>
</tr>
<tr>
<td>AURA U.S. Gemini Fellowship</td>
<td>–</td>
<td>80,000</td>
</tr>
<tr>
<td>NGSC Post-Doc Fellows</td>
<td>1.50</td>
<td>137,211</td>
</tr>
</tbody>
</table>

**Total Net Allocation** 8.12 $784,000

Includes post-doc support from AURA. Application of FY06 carry-forward/(deficit) for the program has been incorporated.
1.2 CERRO TOLOLO INTER-AMERICAN OBSERVATORY (CTIO)

FY07 Program Overview

CTIO operates a suite of two 4-m telescopes (Blanco, SOAR), together with four small telescopes via the SMARTS Consortium in which CTIO retains 25% of the observing time for the community. CTIO also serves as host for the U. Michigan Schmidt telescope, the GONG helioseismology station, the PROMPT gamma-ray burst follow-up telescope array, and several smaller facilities. CTIO additionally provides infrastructure support and, in some cases, staff for all the NOAO programs operating in Chile (NGSC, DPP, NIO, LSST, MIP); while substantial technical expertise is provided, at cost to Gemini Observatory and Las Campanas Observatory. During 2007, CTIO expects that the SOAR telescope will ramp up to over 50% of its time being scheduled for science, and that the Dark Energy Survey project will be approved, allowing commencement of construction of the Dark Energy Camera for the Blanco telescope.

FY07 Milestones

- Achieve DOE and NSF approval for the Dark Energy Survey project, thereby allowing construction of DECam to proceed
- Complete SOAR telescope commissioning activities, and progress the Goodman Spectrograph to operational status
- Reduce budget deficit to zero

FY07 Work Packages

Blanco 4-m Telescope (Telescope A)
Scientific staff include a telescope scientist who also has prime responsibility for the MOSAIC imager and the RC spectrograph, small amounts of time from other scientists who support the ISPI IR imager and the multi-object spectrograph Hydra, and some specialist support from the Engineering and Technical Services (ETS) group in La Serena. Telescope Operations (TelOps) staff is split between operating Blanco and operating SOAR, with no increase in staff.

Non-payroll: major portion is for AURA Observatory Support Services (AOSS) services, including meals, lodging, transport, facility maintenance, and janitorial services. Utilities, fuels and cryogens are also procured via AOSS. Miscellaneous electronic, mechanical and computer supplies. Telescope maintenance covers scheduled replacements and an allowance for mechanical failures, as well as purchasing of major spares.

SOAR 4.1-m Telescope (Telescope B)
Scientific staff equivalent to one person, as required by the SOAR agreement. TelOps and ETS support are included at the level required for normal telescope operations. AOSS meals, rooms and transport for CTIO staff working on SOAR. Salary support for the SOAR Director and administrative assistant, AOSS telescope fees, utilities, supplies, etc., as allocated by the SOAR Director.
SOAR PreOps
A work package for SOAR pre-operations work was established by shortening the operating period of the telescope from 20 to 18 years; in-kind labor from CTIO and cash from Brazil are used to supplement the operations effort over the crucial years of integration and commissioning. Specialist ETS staff are engaged in the commissioning of the telescope and instrumentation provided by NOAO and the other SOAR partners. SOAR PreOps has been steadily ramping down and is expected to exhaust the available funds by, or soon after, the end of FY07.

Small Telescopes (Telescope C)
A small amount of support is provided by the Director’s Office. Technical support, which is provided by CTIO, is fully covered by the SMARTS consortium.

Science Operations
Interface, scheduling, and assistance for visiting observers at all telescopes in Chile to which astronomers have access via NOAO. Includes travel subsidies for graduate students doing thesis research and subsidies for NOAO, Chile, and Las Campanas Observatory (LCO) observers. Recording and calculation of statistical data.

ETS External Work
Extra contract work done by ETS, largely mechanical, undertaken to support local observatories and for load leveling: e.g., work for Gemini (MCAO facility), instrumentation for the SOAR partners (dewars and detector characterization), site testing and monitoring equipment. All work is charged out at the full overhead rate.

Director’s Office
Director, assistant/business manager, administrative assistant, librarian. Oversees CTIO and other NOAO South programs, together with the responsible associate directors. Interface to AURA Observatory in Chile (AURO-O), AOSS, other NOAO management. Includes AOSS utilities and per-use costs, office supplies, director’s travel, training for staff, and the library non-payroll. Also includes support of the Comisión Nacional de Medio Ambiente (CONAMA) light pollution office in La Serena ($15K), to which other observatories in Chile also contribute. Revenues include contribution from Gemini to 50% of library costs, and an estimated $229K from indirect cost credits.

Computer Infrastructure Support (CIS)
Networking/computer support for NOAO South operations; partial or full support for other observatories and programs that use NOAO South facilities, payment for external Internet II bandwidth. Includes maintenance, supplies and provisions of commercial Internet access across all NOAO South. Other costs are AOSS utilities and CIS computers, software and training. Does not include purchases of computer equipment for individual programs. Payroll includes a manager responsible for planning and implementation, in collaboration with Gemini, SOAR, AOSS, DPP, Tucson CIS, etc., plus a small group of programmers and technicians. One full-time FTE supports MS Windows systems. Revenue corresponds to 0.5 FTE provided to Las Campanas Observatory for management of their computer network system both in La Serena and at the telescopes.

Engineering and Technical Services (ETS)
Management and support for the ETS unit: infrastructure for all ETS work, including major
instrumentation work and requests from Gemini and SOAR. Includes the ETS manager, an administrative assistant, and time/effort from two of the three department heads. Also includes effort devoted to union activities by the union head, who is an ETS member. ETS office supplies and computer upgrades, including for New Initiatives Office contract hires (3 FTE), DPP programmers (3 FTE) and directly-reporting Major Instrumentation Program staff (2 FTE). AOSS charges for utilities, rooms, meals and transport for ETS personnel, and facility maintenance. Operations costs for the workshops and laboratories: e.g., computers, new machine tools, optics lab parts, software and software licenses, and test equipment such as oscilloscopes.

Mountain Facilities
Replacement of one vehicle (est. $20K) is necessary in FY07. A small amount for general facility maintenance is budgeted.

Headquarters: La Serena Facilities
A payment to AOSS, calculated on a per-person basis, covering all costs not covered by per-use charges. Consists of two components: (1) cost of security and grounds maintenance for those whose place of work is the AURA La Serena campus, and (2) the larger component comprising AURA-O and AOSS administrative costs for all staff and long-term (over three months) visitors (e.g., the AURA-O director, AOSS management, human resources, and accounting services). A small amount is budgeted for office/building maintenance and modifications.

AOSS Administration
With the re-organization of AOSS costs into per-use and per-person costs, and with CTIO no longer directly purchasing AOSS accounting services, the main part of this work package is for freight charges, mostly originating in Tucson. Also includes a currency-fluctuation reserve, termination payments, retirement payments and years-of-service payments for ex-staff.

Science Research
Salaries for all scientific staff members based in Chile. Includes $5,000 per scientist for personal research expenses, such as conference trips, page charges, computer upgrades, research assistants, and similar items. Additional funds are used to encourage senior astronomers to work at NOAO South as short-term visitors. Supplies include stationary, minor office changes, postage, storage, and miscellaneous new staff expenses. AOSS charges of $70K cover utilities for the science wing, repairs and modifications to offices, utilities, rooms, meals, and transportation for scientific staff when on Tololo or Pachón.

Dark Energy Camera (DECam) and NEWFIRM
Preparation and upgrades specifically for two future instruments for the Blanco telescope. These activities continue from FY06, several were postponed due to lack of funds. Diagnosis and repair of the breaking lateral supports of the Blanco primary. Replacement of Blanco telescope and instrument UPSs. Replacement and upgrade of the Blanco Telescope Control System. Modification of the Blanco Cassegrain cage for NEWFIRM. Attendance at planning and collaboration meetings.

* As $5,000 per year is rarely sufficient, CTIO scientists can supplement these funds with competitive grants from the NOAO-wide science research fund and from NASA grants.
### FY07 Budget Summary

(Table 2)

#### Table 2

NOAO Divisions  
CERRO TOLOLO INTER-AMERICAN OBSERVATORY  
FY07 Funding Allocation: $5,445,000

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blanco 4-m (Tel. A)</td>
<td>10.15</td>
<td>1,208,490</td>
</tr>
<tr>
<td>SOAR 4.1-m (Tel. B)</td>
<td>10.38</td>
<td>1,146,032</td>
</tr>
<tr>
<td>SOAR Pre-Ops</td>
<td>3.38</td>
<td>204,733</td>
</tr>
<tr>
<td>Small Telescopes (Tel. C)</td>
<td>0.67</td>
<td>38,889</td>
</tr>
<tr>
<td>Revenue: SMARTS</td>
<td>–</td>
<td>(44,000)</td>
</tr>
<tr>
<td>Science Operations</td>
<td>1.28</td>
<td>97,808</td>
</tr>
<tr>
<td>REU Program</td>
<td>0.33</td>
<td>50,240</td>
</tr>
<tr>
<td>REU Grant (NSF)</td>
<td>–</td>
<td>(42,000)</td>
</tr>
<tr>
<td>ETS External Work</td>
<td>2.00</td>
<td>136,387</td>
</tr>
<tr>
<td>Outside Revenue: Gemini</td>
<td>–</td>
<td>(136,387)</td>
</tr>
<tr>
<td>Director's Office</td>
<td>3.80</td>
<td>385,027</td>
</tr>
<tr>
<td>Gemini Library Contribution</td>
<td>–</td>
<td>(36,500)</td>
</tr>
<tr>
<td>Indirect Cost Recovery</td>
<td>–</td>
<td>(229,112)</td>
</tr>
<tr>
<td>Computer Infra. Support</td>
<td>5.75</td>
<td>570,380</td>
</tr>
<tr>
<td>Revenue: Network Support</td>
<td>–</td>
<td>(60,000)</td>
</tr>
<tr>
<td>ETS Infrastructure</td>
<td>1.80</td>
<td>273,665</td>
</tr>
<tr>
<td>ETS Revenue</td>
<td>–</td>
<td>(8,504)</td>
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<tr>
<td>Mountain Facilities</td>
<td>–</td>
<td>29,000</td>
</tr>
<tr>
<td>HQ: La Serena Facilities</td>
<td>–</td>
<td>416,399</td>
</tr>
<tr>
<td>A OSS Administration</td>
<td>–</td>
<td>297,442</td>
</tr>
<tr>
<td>Science Research</td>
<td>7.41</td>
<td>939,090</td>
</tr>
<tr>
<td>DECam + NEWFIRM</td>
<td>2.22</td>
<td>207,921</td>
</tr>
</tbody>
</table>

| Total Net Allocation             | 49.17| $5,445,000 |

Includes outside revenue for ETS, computer infrastructure and indirect cost recovery.

*No. of FTEs reflects AOSS per use estimates.

†Pesos converted to U.S. dollars at the rate of 450/$ where required.

Application of FY06 carry-forward/(deficit) for the program has been incorporated.
1.3 KITT PEAK NATIONAL OBSERVATORY

FY07 Program Overview

FY07 is a year of new instrumentation for KPNO. QUOTA (a new optical imager for WIYN 3.5-m using innovative orthogonal transfer CCD arrays to provide excellent image quality), NEWFIRM (a new wide-field near-IR imager for the NOAO 4-m telescopes built in collaboration with the University of Maryland), WHIRC (a new high spatial resolution near-IR imager for WIYN 3.5-m), and a significant upgrade to the Bench Spectrograph of WIYN (being undertaken in collaboration with the University of Wisconsin) are all scheduled for commissioning or completion during FY07. These new capabilities demonstrate the continuing commitment of the KPNO staff to maintaining the high quality of our facility and enabling the aspirations of our user community to undertake scientific research of the highest caliber.

FY07 Milestones

- Commission the new wide-field near-IR imager, NEWFIRM, on the Mayall 4-m telescope
- Commission the OTA (orthogonal charge transfer) mode of the optical imager QUOTA on the WIYN 3.5-m telescope
- Commission the WHIRC near-IR imager on the WIYN 3.5-m telescope
- Complete the search for and hiring of a director for Kitt Peak National Observatory
- Complete the upgrade of the Bench spectrograph for the WIYN 3.5-m telescope

FY07 Work Packages

Science Operations
This category refers to support of observers when they are not directly engaged in observing. Observing run preparation, advice on performance for use in proposals, a modest amount of service observing, and the KPNO Observing Support Office activities are included here.

Telescope Partnerships
This is the revenue from partnerships to operate the 4-m and 2.1-m telescopes. We have an agreement in place, approved by the NSF, with Clemson University for 2006–2009.

Telescope A = Mayall 4-m
The items in this category comprise all the costs directly associated with the operations and maintenance of the telescope and its instruments. They include observing assistants, electronic maintenance and facilities group support, as well as all support and minor upgrades of instrumentation. Efforts of scientific staff, KPNO Engineering, 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 pro-rated share of the scientific infrastructure, comprising the computer...
network, mountain scientific administration, maintenance of electronics shops, spares, and test equipment is also assigned by telescope.

**Telescope B = WIYN 3.5-m**
Operations of this telescope are defined by the terms of the consortium agreement. The costs shown represent actual expenditures, offset by revenues from the partner institutions. They include the NOAO contribution to the WIYN Corporate account. Over and above the support defined by the agreement, the total includes all scientific staff activity related to support of WIYN observers, telescope, and existing instruments, technical staff contribution to new instrument development, and expenses for participation in WIYN Consortium activities such as Board and SAC meetings. It does not represent the full WIYN Consortium annual expenses, because substantial partner contributions go directly to WIYN, Inc., primarily for upgrades and administration.

**Telescope C = 2.1-m + NOAO share of WIYN 0.9-m**
This small telescopes category is composed of essentially the same items as enumerated for the 4-m. KPNO staff support only the MOSAIC camera, used for some direct imaging on the WIYN 0.9-m.

**Mountain Facilities**
This expense represents support of the mountain physical plant, exclusive of the telescope domes. It includes the support buildings, dining and lodging facilities operations, power distribution (distinct from the power distribution that is part of KP Mountain Operations), and mountain vehicles and equipment. The actual costs are partially offset by revenues from both visiting observers to KPNO and tenant observatory telescopes.

**Director’s Office**
Included are the KPNO director, part-time management effort of the assistant to the director, and one half-time administrative assistant who also supports the WIYN observatory staff.

**NSO and NRAO Support—Servicing the System**
For efficiency, the costs of facilities and maintenance support of NSO telescopes on Kitt Peak were left within the KPNO skills pool, as represented by this category. Included within are the joint use fee costs for NSO ($46,427) and NRAO ($28,050).

**PAEO Nightly Observing Program**
This expense is for support of the nighttime observing program (NOP) operated by public outreach, which includes food, electricity and vehicle maintenance. Revenues generated from the NOP largely offset these costs.

**Astronomy Community Project Assistance (previously titled Tenant Support)**
This FTE allocation of KPNO engineering will be applied to projects in service or in collaboration with other institutions that benefit astronomy and/or the “Observing System.” The exact level of support in this package will change on a yearly basis depending on the level of collaborative and service work undertaken by the observatory.
KP Mountain Operations
This is a new work-package that provides the mountain support used by all telescope facilities located on the mountain including KPNO. It includes the roads, water and septic systems, support buildings, and power distribution, etc. The actual costs are offset by revenues from the joint use fee (which comes from tenants and KPNO).

Instrumentation Partnerships
This is the revenue from partnerships to develop new instruments. We have an agreement in place, approved by the NSF, with University of Maryland for them to assist with the development of new instrumentation for the WIYN 3.5-m (e.g., ODI) and NOAO 4-m telescopes (e.g., complete NEWFIRM) during 2006–2009.

FY07 Budget Summary (Table 3)

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayall 4-m [Tel. A]</td>
<td>12.00</td>
<td>$ 1,132,423</td>
</tr>
<tr>
<td>Revenue: Telescope Partnerships (projected)</td>
<td>–</td>
<td>(515,000)</td>
</tr>
<tr>
<td>WIYN [Tel. B]</td>
<td>11.75</td>
<td>2,497,187</td>
</tr>
<tr>
<td>WIYN Partner Contributions</td>
<td>–</td>
<td>(1,305,836)</td>
</tr>
<tr>
<td>2.1-m + Other Small Telescopes [Tel. C]</td>
<td>6.27</td>
<td>573,787</td>
</tr>
<tr>
<td>Revenue: Coudé Feed</td>
<td>–</td>
<td>(15,000)</td>
</tr>
<tr>
<td>Science Operations</td>
<td>1.84</td>
<td>142,182</td>
</tr>
<tr>
<td>Mountain Facilities</td>
<td>15.81</td>
<td>1,067,723</td>
</tr>
<tr>
<td>Reimbursements: Utilities, Dorm, Kitchen, Communications</td>
<td>–</td>
<td>(384,000)</td>
</tr>
<tr>
<td>Director's Office</td>
<td>2.40</td>
<td>300,128</td>
</tr>
<tr>
<td>Support to NSO and NRAO</td>
<td>1.15</td>
<td>200,787</td>
</tr>
<tr>
<td>Indirect Cost Recovery</td>
<td>–</td>
<td>(51,000)</td>
</tr>
<tr>
<td>Astronomy Community Support</td>
<td>2.27</td>
<td>166,428</td>
</tr>
<tr>
<td>Support to Nightly Obs. Program</td>
<td>–</td>
<td>38,028</td>
</tr>
<tr>
<td>Revenue: Nightly Obs. Program</td>
<td>–</td>
<td>(38,028)</td>
</tr>
<tr>
<td>Mountain Operations</td>
<td>2.23</td>
<td>197,421</td>
</tr>
<tr>
<td>Joint Use Fees</td>
<td>–</td>
<td>(189,830)</td>
</tr>
<tr>
<td><strong>Total Net Allocation</strong></td>
<td>55.72</td>
<td>$ 3,633,000</td>
</tr>
</tbody>
</table>

Application of FY06 carry-forward/(deficit) for the program has been incorporated.
1.4 TUCSON DIVISION

1.4.1 SCIENCE OPERATIONS – O/IR OBSERVING SYSTEM

FY07 Program Overview

Science Operations includes two major activities, the NOAO time allocation process and management of the ground-based optical/IR system of facilities (TSIP, AODP and strategic planning for the system). These are detailed in the work package descriptions below. Activities in FY07 will emphasize system development in line with the recommendations of the Senior Review and of the Third System Workshop.

FY07 Milestones

- FY07 TAC Administration, including a call for survey projects that would use the new IR imager NEWFIRM
- Management/administration of FY07 Telescope System Instrumentation Program (TSIP): call for proposals, external review, technical/contractual oversight of previously awarded projects
- Development, in collaboration with NSF AST staff, of a new process for the Adaptive Optics Development Program. This process would combine a peer panel review with additional input to guide awards towards studies aligned with a strategic plan for ELT AO systems.
- Hold a third community workshop on the O/IR system, and issue a report from this workshop. As a follow-on activity, bring together the operators of public and private telescopes that are in the 2–5-m aperture class to discuss mechanisms through which these telescopes could behave in a more systemic manner.

FY07 Work Packages

Science Operations/System
All activities involved in the telescope time allocation process for standard proposals and proposals to the NOAO Survey Program. The semester proposal process includes solicitation of proposals, processing of proposals received into the database, Time Allocation Committee meetings, and support for the scheduling of the telescopes. In addition, this work package supports community interaction with the process, particularly for non-NOAO or Gemini telescopes. The Survey Program involves an annual meeting of the survey PIs, as well as an annual survey allocation process which is integrated into the regular TAC process. Support for the NOAO Users Committee is also included.

Telescope System Instrumentation Program
FY07 is the sixth year of the TSIP, which involves an annual proposal solicitation, external review, negotiation of sub-awards/contracts, and technical oversight of funded projects. The administrative, review and oversight expenses are reimbursed from the NSF TSIP allocation.
Adaptive Optics Development Program
FY07 is the fourth year of the AODP, which, like TSIP, was originally conceived as an annual proposal solicitation, external review and award cycle. AODP is aimed at development of adaptive optics capabilities, primarily those needed for very large telescopes of the future. The management and technical oversight activities of AODP are extensive, involving periodic review of performance against plan for both industrial and academic vendors. The AODP work package also includes the strategic updating of the AO road map by a community-based steering committee. Like TSIP, AODP administrative activities are funded from the annual NSF allocation. No awards were given in FY06 because of the limited funds available. Program management, however, including close technical oversight and contractual administration of previously-awarded projects, is ongoing. The NSF has indicated that they want to develop a new model for AODP.

Management of the Ground-Based O/IR System Planning Activities
Periodically, NOAO holds community workshops in which ideas about evolving the system of public and private facilities are discussed. Such a workshop is planned for November 2006 in Scottsdale, Arizona. An organizing committee of representatives of different types of institutions will guide the discussion at the workshop and write a report that will serve directly as an update for TSIP funding priorities as well as provide general guidance for developing new mechanisms to help the evolution of the system.

FY07 Budget Summary (Table 4)

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Operations</td>
<td>2.29</td>
<td>$286,990</td>
</tr>
<tr>
<td>TSIP Admin/Oversight*</td>
<td>0.29</td>
<td>47,259</td>
</tr>
<tr>
<td>Cost Recovery: TSIP Admin/Oversight</td>
<td>–</td>
<td>(47,259)</td>
</tr>
<tr>
<td>AODP Admin/Oversight*</td>
<td>0.40</td>
<td>53,527</td>
</tr>
<tr>
<td>Cost Recovery: AODP Admin/Oversight</td>
<td>–</td>
<td>(53,527)</td>
</tr>
<tr>
<td>Systems Project Office</td>
<td>0.18</td>
<td>91,010</td>
</tr>
<tr>
<td><strong>Total Net Allocation</strong></td>
<td><strong>3.16</strong></td>
<td><strong>$378,000</strong></td>
</tr>
</tbody>
</table>

*NSF funding for FY07 TSIP & AODP sub-awards is shown in Table 16. Application of FY06 carry-forward/(deficit) for the program has been incorporated.
1.4.2 SCIENCE PROGRAM (NOAO NORTH)

FY07 Program Overview

The Science program includes the funds that support NOAO staff scientist and (NOAO-funded) post-doc research, both payroll and ancillary support (page charges, travel, etc.). It also includes the administrative support for this activity.

FY07 Milestones

- Enhance mentoring program to reach the astronomer and scientist staffs, both as “good practice” and as critical to full understanding of the implications of the changes underway in the NOAO mission as a consequence of the Senior Review
- Continue vigilance of over-matrixing of staff, particularly in light of mission changes resulting from Senior Review recommendations
- Continue a strong colloquium schedule

FY07 Work Packages

Science Research
Non-discretionary salary support for all NOAO scientists and astronomers at the research levels appropriate to their responsibilities/rank.

Management/Administration
Payroll for S. Strom, J. Najita and one administrative assistant; non-payroll for supplies, software and hardware, travel, etc. needed to support the Science North administrative staff/managers; funds for small scientific workshops, colloquium speakers, visitors, and consultants.

Scientific Staff Development
Provides for supplies, computer hardware and software, travel, etc. for NOAO North scientific staff.

Research Support
A science research fund that provides all NOAO North and NOAO South staff access to funds to (a) seed new research; (b) complement external funding, e.g., to hire post-docs or students; (c) provide for extraordinary purchases (e.g., filters, specialized computer hardware). The program has been key to enhancing staff productivity and creating an environment in which staff research is perceived to be strongly encouraged and supported. Owing to budget constraints in FY07, no significant new commitments can be made.

Post-Doctoral Fellows and Other Support
Salaries/support for post-doctoral fellows, both NOAO-funded (Goldberg Fellows) and those receiving external grants. Also includes modest funds for supplies, hardware and travel needed to meet occasional requests not covered by grants. There will be no new Goldberg Fellowships awarded in FY07.
FY06 Budget Summary (Table 5)

Table 5
Tucson Division

SCIENCE PROGRAM - NORTH
FY07 Funding Allocation: $1,973,500

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Research</td>
<td>10.15</td>
<td>$1,394,452</td>
</tr>
<tr>
<td>Mgmt/Admin</td>
<td>1.20</td>
<td>118,111</td>
</tr>
<tr>
<td>Sci. Staff Development</td>
<td>0.00</td>
<td>169,850</td>
</tr>
<tr>
<td>Research Support</td>
<td>0.00</td>
<td>78,681</td>
</tr>
<tr>
<td>Post-Doc/Other Support</td>
<td>4.00</td>
<td>721,450</td>
</tr>
<tr>
<td>Post-Doc External Funding</td>
<td>10.80</td>
<td>(509,044)</td>
</tr>
</tbody>
</table>

Total Net Allocation 26.15  $1,973,500

* Funding for Science Program South in CTIO budget (Table 2).

Includes outside grant funding for post-docs.

Application of FY06 carry-forward/(deficit) for the program has been incorporated.

1.4.3 NOAO DIRECTOR’S OFFICE

FY07 Program Overview

The NOAO Director’s Office program covers the NOAO-wide management activities for the organization. This office communicates directly with AURA and with the NSF. Associated activities under this office include the NOAO library and the safety/risk management office.

FY07 Milestones

- In strategic partnership with AURA and the NSF, develop a viable plan by which NOAO can respond to the recommendations of the Senior Review
- Assist AURA in development of a new 5-year proposal for operations of NOAO
- Complete the recruitment for the director of Kitt Peak
**FY07 Work Packages**

**Management/Administration**
The NOAO Director’s Office coordinates the four divisions of NOAO and ensures that NOAO programs fulfill the mission of the national observatory. Reporting to NSF and AURA are the responsibility of this office. The assistant to the director and a half-time administrative assistant are responsible for institutional documents and periodic reports required under the AURA Cooperative Agreement, as well as administrative coordination of the TSIP and AODP programs. The director’s and deputy director’s shared administrative assistant provides day-to-day secretarial and administrative support, logistics and meeting coordination for visiting AURA, NSF, and external committees, the Users’ Committee, and the monthly meetings of the Committee of Directors and the Management Committee.

**Library**
The Tucson library work package is managed by the Director’s Office.

**Site Safety/Risk Management**
Risk management and safety functions are centralized in the NOAO Director’s Office. A monthly report is prepared by the risk management specialist; site safety reports required under the Cooperative Agreement are published in the NOAO Quarterly and Annual Reports.

**FY07 Budget Summary** (Table 6)

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management/Admin.</td>
<td>2.76</td>
<td>$461,018</td>
</tr>
<tr>
<td>Tucson Library</td>
<td>1.00</td>
<td>172,083</td>
</tr>
<tr>
<td>Indirect Cost Recovery</td>
<td>—</td>
<td>(50,000)</td>
</tr>
<tr>
<td>Site Safety/Risk Mgmt</td>
<td>0.50</td>
<td>76,899</td>
</tr>
<tr>
<td><strong>Total Net Allocation</strong></td>
<td><strong>4.26</strong></td>
<td><strong>$660,000</strong></td>
</tr>
</tbody>
</table>

Includes indirect recovery for library.

Application of FY06 carry-forward/(deficit) for the program has been incorporated.
1.4.4 CENTRAL FACILITIES OPERATIONS (CFO)

FY07 Program Overview

Central Facilities Operations (CFO) provides maintenance, security and grounds support for the Tucson operations at the NOAO and the National Solar Observatory (NSO). With a minimal staff, CFO’s biggest challenges are to maintain several aging structures under flat or reduced funding. Furthermore, CFO supports some of the Kitt Peak (KPNO) services, including the shuttle and vehicle fleet, and, through our work scheduling matrix system, skill support is traded with KPNO when necessary.

In FY07, CFO will focus on completion of the ADA access to the rooftop structures, completion of the flooring upgrade in the main building and basic plant maintenance as funding is available. In FY06, CFO went through a review of storage and parking lot issues and availability. In FY07, as time and funding permits, security and fencing of the NOAO/NSO parking lot will be updated.

FY07 Milestones

- Complete corridor flooring update of floors within the East Wing area
- Continue with program to refurbish 40-year-old mechanical air-handling systems within the main building
- Replace worn out rooftop HVAC package units in the CAS facility
- Develop a plan and implement changes to provide increased access control and security over main parking lot
- Final completion of the ADA access ramp from LSST area to MIP to allow full access to the rooftop offices

FY07 Work Packages

Support Services
Primary management support package includes administration of the PBX, Audix, and call accounting systems; minor engineering, labor and equipment; travel to other sites for engineering support; custodial and other general administrative facilities functions.

Building Maintenance
All facilities and building operations; maintenance/repairs to Tucson facilities and infrastructure systems: painting, equipment replacement, roofing, energy conservation, improvements, and relocations.

Utilities
NOAO-Tucson facility utility costs: electrical, water, sewer, gas, and trash services for headquarters buildings; record keeping and reporting.
Vehicles
Operation/maintenance of the Tucson vehicle fleet, including fuel, repairs and replacement as needed. (FY07 vehicle replacement limited to two vehicles, due to budget constraints.)

Roads and Grounds
Landscaping, grounds control and leasing of parking lot.

Safety and Security
Contracted fire watch and off-hours security contracts, regulatory fees; industrial waste removal fees.

FY07 Budget Summary (Table 7)

<table>
<thead>
<tr>
<th></th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support Services</td>
<td>3.30</td>
<td>$293,704</td>
</tr>
<tr>
<td>Building Maintenance</td>
<td>3.46</td>
<td>246,990</td>
</tr>
<tr>
<td>Utilities</td>
<td>0.27</td>
<td>438,461</td>
</tr>
<tr>
<td>Vehicles</td>
<td>0.76</td>
<td>137,033</td>
</tr>
<tr>
<td>Roads and Grounds</td>
<td>0.19</td>
<td>47,946</td>
</tr>
<tr>
<td>Safety and Security</td>
<td>0.30</td>
<td>108,885</td>
</tr>
<tr>
<td>(Revenue: Indirects)</td>
<td>–</td>
<td>(448,019)</td>
</tr>
<tr>
<td><strong>Total Net Allocation</strong></td>
<td><strong>8.28</strong></td>
<td><strong>$825,000</strong></td>
</tr>
</tbody>
</table>

Includes indirect cost recovery.
Application of FY06 carry-forward/(deficit) for the program has been incorporated.

1.4.5 CENTRAL ADMINISTRATIVE SERVICES (CAS)

FY07 Program Overview

Central Administrative Services (CAS) primarily provides full business services for NOAO and the NSO. Since the Cooperative Agreement began, operational and business support services for the SOAR and WIYN telescopes have also been provided. In FY06, business support was begun under the Cooperative Agreement through Scientific Program Order #9 to provide business services to the LSST Corporation, of which AURA is a founding member. The focus of this service is to assist LSSTC through the design and development phase in becoming a viable corporation to receive and administer NSF funding once the MFREC funds become available.
During the last five years, CAS has improved its efficiencies through better communications, computerization and process improvement. These included a newly developed Sponsored Projects and Grants System, procurement system updates that include a Web-based automated purchasing system and updated CASNET with up-to-the-minute reporting. CAS has been able to provide professional services to their customers with a right-sized staff and in full compliance with government reporting. This was validated during the Total Business Review, which was completed in FY06 by the NSF. Furthermore, in FY07 our system will be updated to include automated travel requests and expense reports with easy access for our global staff. It is important to note that due to the Senior Review recommendations for all the NSF observatories, NOAO business services will again be reviewed in conjunction with recommendations for future funding and the mission of NOAO. CAS staff will be working to assist NSF in their review.

FY07 Milestones

- Human Resources (HR) will implement a change in the medical benefits carrier due to a mandate from the state of Arizona. HR will provide informational meetings and communications and update the website to make a smooth transition. HR will also provide supervisor training to complete the certification process started in FY06.

- Business Administration will successfully implement the new Conflict of Interest policy as required by the Total Business Services Review

- Sponsored Projects will complete the grants management system update including electronic file jackets and furthering their role in reporting, compliance and assistance

- Accounting and Purchasing will implement the on-line check request and travel request portions of the Web-based requisitioning system (Reqless), and add a module for on-line travel expense reporting and update of signature authorization. Additionally, Accounting will prepare for the retirement of the business manager by reviewing the current functions performed, training existing staff to assume responsibility for various new duties, and realigning workloads.

- NOAO Central Administrative Services will work with NSF on accurately reviewing and compiling costs for the Operational Management review as referenced in the Senior Review report

FY07 Work Packages

General Administration
General services provided to NOAO under the AURA umbrella: liability and other business insurance, software licensing, legal consultation, U. S. visa support, and general management. Non-payroll includes associated travel and costs which provide common support to all CAS work packages.

Accounting and Payroll Support
Various related services for NOAO, NSO, WIYN, SOAR, TMT, and LSSTC. Federal reporting for all AURA centers, including AURA Corporate, Gemini and Space Telescope Science Institute.
Human Resources
Employee benefits administration, recruitment, topic briefings, compensation survey, benefit negotiations, policy and development, employee regulations and compliance for NOAO, NSO, and CTIO. Also includes some AURA and Gemini South operations support.

Purchasing and CTIO Support
Routine purchasing, bids and procurements, and export/licensing controls.

Sponsored Projects and Sub-Awards
Primarily contracts, sub-awards and proposal coordination for NOAO North and South, and related functions for NSO. Development, negotiation and pre- and post-award administration of all sub-awards and contracts, including TSIP, AODP, ATST, LSSTC, and other NOAO/NSO divisional programs. Processing of procurements requiring complicated agreements or sub-awards as determined by proposed developed policies in compliance with the NSF cooperative agreement. Proposal coordination includes entry into electronic systems, proposal budget development, funding agency information coordination, proposal submission coordination, and related sponsored-funding duties.

Shipping/Receiving
Shipping, receiving, mail operations, inventory and property control, and hazardous material shipping for NOAO and NSO, and other various items related to NOAO customers such as NSO, LSSTC, AURA, and TMT.

Indirect Support Revenue
CAS provides accounting services for NSO, LSSTC, AURA Corporate, WYIN and SOAR support.

FY07 Budget Summary (Table 8)

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Administration</td>
<td>0.87</td>
<td>$242,228</td>
</tr>
<tr>
<td>Accounting/Payroll</td>
<td>7.00</td>
<td>537,208</td>
</tr>
<tr>
<td>Human Resources</td>
<td>4.10</td>
<td>283,887</td>
</tr>
<tr>
<td>Purchasing/CTIO Support</td>
<td>3.00</td>
<td>235,572</td>
</tr>
<tr>
<td>Sponsored Projects</td>
<td>2.86</td>
<td>212,972</td>
</tr>
<tr>
<td>Shipping/Receiving</td>
<td>2.90</td>
<td>164,994</td>
</tr>
<tr>
<td>(Indirect Cost Recovery)</td>
<td>–</td>
<td>(797,861)</td>
</tr>
</tbody>
</table>

Total Net Allocation 20.73 $879,000

Includes NSO, LSSTC and AURA Corporate indirect support.

Application of FY06 carry-forward/(deficit) for the program has been incorporated.
1.4.6 COMPUTER INFRASTRUCTURE SUPPORT (CIS)

FY07 Program Overview

The Computer Infrastructure Support program, headed by NOAO’s Chief Information Officer, maintains, supports and upgrades the computers and networks within NOAO. The activities related to cyber security are becoming more prominent.

FY07 Milestones

- Continue the effort to maintain the long-term viability of the Tucson-Kitt Peak data connection
- Configure and install a more powerful hardware platform for www.noao.edu
- Improve the NOAO-Tucson network monitoring and early-warning systems

FY07 Work Packages

Operations and Network Protection
Maintenance and improvement of the facility network and of a secure connection of the facility network to the Internet. Maintenance and improvement of a secure software infrastructure providing services to the NOAO-Tucson facility, including e-mail, World Wide Web, FTP, and remote access. Configuration and connection to the network; support and maintenance of computers (including scientific work stations and office PCs) used in the facility.

FY07 Budget Summary (Table 9)

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations</td>
<td>5.55</td>
<td>$597,578</td>
</tr>
<tr>
<td>NSO Cost Recovery</td>
<td>–</td>
<td>(224,578)</td>
</tr>
<tr>
<td><strong>Total Net Allocation</strong></td>
<td>5.55</td>
<td>$373,000</td>
</tr>
</tbody>
</table>

Includes indirect recovery and Gemini support. Application of FY06 carry-forward(deficit) for the program has been incorporated.
2.1 NEW INITIATIVES OFFICE (NIO)

FY07 Program Overview

The AURA New Initiatives Office (NIO) is charged with "ensuring broad astronomical community access to a 30-meter-class telescope that will be contemporaneous with ALMA and JWST, by playing a key role in scientific and technical studies leading to the creation of the Giant Segmented Mirror Telescope (GSMT)." In FY07, NIO efforts will focus on support for GSMT site selection and characterization in Chile and on risk mitigation for GSMT development efforts. The plan for the latter set of activities will be developed during the first part of the fiscal year, in consultation with the NSF and active extremely large telescope (ELT) projects, and is expected to include a combination of technology development and support for common engineering tasks.

In addition to its primary mission of GSMT support, NIO supports smaller initiatives aimed at future national facilities, including Antarctic site testing and interferometry facility planning.

FY07 Milestones

- Develop new program plan for NIO consistent with Senior Review recommendations and NSF directives
- Complete report on GSMT science as a function of aperture
- Complete initial site testing in Chile and provide support for production of site-testing report
- Conditional on funding, select trans-Antarctic mountain test site
- Conditional on funding, deploy astronomical test equipment on Dome A and at the selected trans-Antarctic mountain test site
- Hold workshop on the future development of optical interferometry

FY07 Work Packages

NIO Management
Provides management of the NIO work packages outlined below. Engages in a reassessment of the work packages associated with GSMT science and development in light of the Senior Review. This work package includes a deficit of $133,444 carried over from FY06.

GSMT SWG Support
Provides scientific support to the GSMT Science Working Group (SWG). The GSMT SWG is charged with working with the community to (a) review the progress of the TMT and GMT projects and assess how well each will meet community aspirations; (b) prepare reports and recommendations aimed at guiding federal investment in a GSMT; (c) provide input to appropriate advisory committees, e.g., CAA and AAAC; and (d) develop working relationships with its ESO and Japanese counterparts.
GSMT Site Testing and Site Selection
The goal of this program is to identify top-quality new (undeveloped) sites in northern Chile for the possible location of the GSMT based on the scientific potential for astronomical observations, the constructability of the site and the cost of operating on the site. The program identified multiple candidate sites and placed site testing equipment and instrumentation on three of these; data will be collected using this instrumentation through March 2007. Concurrently, the sites being tested will also be evaluated on geo-technical, constructability, construction, and operation costs, as well as other factors that are important to the selection of the site, but are not directly related to its scientific potential. A report with the site recommendation will be produced by mid 2007. Additional testing may take place on a subset of the sites after March 2007, depending on the conclusions of the initial campaign.

Site Testing Activities (CTIO):
Adds scope to the site testing effort by providing continued support for (a) software pipeline development and upgrade, (b) development of Web-based tools for querying the site evaluation database, (c) enhancing the reliability of extant site evaluation equipment, and (d) providing manpower for ongoing equipment maintenance and repair. Parts (a) and (b) will be the full-time responsibility of a post-doctoral fellow, part (c) involves support by CTIO ETS personnel, and (d) requires two full-time Chilean hires to support testing on three sites in northern Chile.

Site Testing Activities (Tucson):
K. Vogiatzis will perform CFD analysis on a consulting basis and will prepare a detailed technical report and/or presentation summarizing the results of each study.

GSMT Development Support
NIO is committed to providing technical support to the effort to provide a U.S. community share in GSMT or other extremely large telescope. The effort for the first quarter of FY07, prior to conclusion of the Senior Review, is directed at assisting TMT to define a new baseline design reflecting the results of the TMT CoDR and Cost Review. Subsequently, the technical resources will be directed to GSMT activities in support of the U.S. community, following the recommendations of the Senior Review and direction from the NSF.

Antarctic Site Testing
A proposal has been submitted to the NSF for a collaborative, five-year evaluation of three potential sites for optical/infrared astronomy on the Antarctic plateau. The collaboration involves both U.S. institutions (University of Arizona, University of Wisconsin, University of California – Berkeley, and California Institute of Technology) and international collaborators. Assuming a funding start of Jan. 1, 2007, the FY07 activities will focus on pre-award reconnaissance and deployment of equipment at Dome A and at a trans-Antarctic mountain site to be selected.

Interferometry Studies
NOAO, AURA and NIO joined with the Georgia State University Center for High Angular Resolution Astronomy to sponsor a workshop on The Future Development of Optical Interferometry, to be held in Tucson in November 2006. The workshop attracted 55 participants from the U.S. and Europe. During FY07 NOAO will receive recommendations from the workshop.
for high angular resolution science priorities, concept and technology development. Personnel supporting this effort are based both in Tucson and La Serena.

**FY07 Budget Summary** (Table 10)

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIO Management</td>
<td>1.85</td>
<td>$992,414</td>
</tr>
<tr>
<td>GSMT SWG</td>
<td>0.45</td>
<td>141,981</td>
</tr>
<tr>
<td>Chile Site Testing (North)</td>
<td>0.50</td>
<td>56,765</td>
</tr>
<tr>
<td>Chile Site Testing (South)</td>
<td>5.25</td>
<td>652,571</td>
</tr>
<tr>
<td>GSMT Development Support</td>
<td>8.35</td>
<td>908,406</td>
</tr>
<tr>
<td>Antarctic Site Testing</td>
<td>0.45</td>
<td>89,932</td>
</tr>
<tr>
<td>Interferometry Studies (North)</td>
<td>0.10</td>
<td>25,243</td>
</tr>
<tr>
<td>Interferometry Studies (South)</td>
<td>0.50</td>
<td>39,688</td>
</tr>
</tbody>
</table>

**Total Net Allocation** | 17.45 | $2,907,000

Application of FY06 carry-forward/(deficit) for the program has been incorporated.
2.2 LARGE SYNOPTIC SURVEY TELESCOPE (LSST)

FY07 Program Overview

NOAO is responsible for the design, development and construction of the LSST facilities in Chile, including the telescope, enclosure and support buildings. A proposal for the construction phase of the project will be submitted to the NSF in FY07.

The longest lead component of the project, and hence the one that would normally be the component that defines the critical path, is the M1/M3 monolith. LSSTC has, however, raised sufficient private funds to let a contract for the casting to the University of Arizona, and NOAO staff will be responsible for overseeing the work on this contract. The next items on the critical path are all tasks being undertaken at NOAO: the design and fabrication of the cell for M1/M3, design of the enclosure, design of the support buildings adjacent to the telescope, and geotechnical testing and preparation of the site, including the excavation required to provide a platform for the telescope. NOAO has paced its work on these critical path items so as to be ready for a construction start in FY10, with the letting of major external design contracts paced to the key steps in the proposal review process.

FY07 Milestones

- **Project Management and Systems Engineering**
  - Support the LSST MREFC proposal development
  - Participate and support the LSST concept design review now anticipated in Spring 2007
  - Provide the LSST interim systems engineer
  - Support efforts to secure an AURA agreement with Chile for LSST

- **Facility and Site**
  - Install and operate a 30-meter tower equipped with anemometer sensors on the LSST site
  - Develop an excavation plan for the summit
  - Complete the auto-photometry software package for use on the all sky camera

- **Wavefront Sensing and Alignment**
  - Develop a prototype test plan for a Telescope Alignment System

- **Software and Control**
  - Establish the TCS prototype
  - Complete the first release of the prototype middleware client
• Science Requirements
  – Collaborate with LSST scientist to establish a reference cadence
  – Lead an investigation of sky conditions in the IR all sky camera and visible all sky camera

• Operations Simulator
  – Lead the group of LSST and PanSTARRS collaborators on continued development
  – Provide LSST engineering teams with cadence simulation tool for engineering study

FY07 Work Packages*

Site and Facility

Site Measurements:
Weather and atmospheric assessment of the El Peñón site will continue this year. The DIMM installed on the peak will be maintained and a new 30-meter tower will be installed and populated with anemometers at intermittent heights. The all sky images will continue to be stored and the new auto-photometry assessment software will be completed. A new IR all sky camera will be installed and operated this year.

Site Design and Development:
Testing of the site’s geotechnical condition will begin this year. A study will be contracted for an initial assessment sufficient to feed facility design efforts and development of a plan for excavating the site.

Dome
The LSST dome agility requirements will be very demanding and will require unique solutions. A second contracted dome design concept study will be undertaken, with the objective of developing competing design solutions that provide first-order cost and performance parameters and identify design impact to other systems in the observatory.

Mount
The telescope mount design will continue to be developed. The focus will be on the interface controls with the camera and operational concerns. A complete control model will also be developed and further analysis of the impact of a guide signal in the telescope control loop with be completed.

Reflective Optics

M1/M3 Development Support:
The telescope and site group will continue to work with the University of Arizona to complete the design of the primary/tertiary monolith and monitor preparations for casting the blank.

* The FY07 work packages capture the NOAO effort in the design and development of the LSST. Funding for the total effort in each area derives from both NOAO base funds and additional Design and Development funds provided by NSF; the exact break-out of effort from each of the two funding sources is not explicitly identified in these summary descriptions.
**Mirror Support System:**
Concept designs will be completed for the support systems for both the primary monolithic mirror and the secondary mirror. The focus of these efforts will be on the geometries, requirements, architectures, and control approach to these active mirrors.

**Alignment and Calibration**

**Wavefront Sensing:**
The 2007 effort in this area will focus on three elements of the WFS system: (1) completion of a Beta release of Matlab WF analysis code; (2) integration of optical design, Matlab curvature code and the Matlab reconstruction code for full simulation; and (3) port IRAF routines for source identification, registration and stacking into Matlab for complete evaluation.

**Active Alignment System:**
The objective of this task is to establish a prototype test plan for the telescope alignment system. The test is to put the commercial product representative of the LSST reference instrument into an observatory environment and verify LSST requirements.

**Software and Controls**
The objective is to develop the observatory and telescope control system design and development plans. Novel and new hardware or algorithm approaches will be validated with the emphasis on reliable, predictable and robust operation. Also in this work package, the telescope-related modules of the end-to-end simulator will be developed and utilized to evaluate predicted performance and requirements. The specific tasks this year will focus on the prototypes of the TCS and the middleware clients.

Also in this work package is the design of the Observatory Telemetry System that will log, distribute, present, and evaluate all data points in the observatory. The data is for ongoing evaluation of the system performance, preventive maintenance, and to record observatory conditions during operation to support subsequent evaluation of the scientific data produced. In 2007, the task will focus on the evaluation of tools to database the data and to interface between the database and the transport middleware.

**Utility Systems**
This work package supports the design of the support elements in the LSST and site system. In 2007, the focus is in the critical coating system design and in the electrical system design. Effort for the coating system will focus on refinement of the coating design and demonstrations at small scales in commercial chambers and at large scales in collaboration with Gemini. The design of the electrical system will also be pursued to adjust the reference equipment to support the evolving LSST designs.

**System Engineering and Integration**
The Systems Engineering effort will focus on the development of the flow-down requirements for the individual systems within the telescope by developing the full error budget. NOAO will contribute to the LSST functional requirements document and operational control requirements document that are needed to trace science requirements to engineering specifications.
Project Management

Telescope and Site Group 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 Design and Development funded efforts.

LSST Management:
NOAO will continue to support the LSST Corporation and Project office with Board level representatives, project operations and consultation.

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

Science 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. NOAO will also continue to support the panel commissioned to develop the Design Reference Mission (DRM).

LSST 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.

This work package also involves development and initiation of plans to further develop the simulation code toward a real-time scheduler. The scheduler development should stem from the operations simulator and the simulator should remain current with developed algorithms. Addressing these project needs from a single group will keep these activities integrated and coordinated.

FY07 Budget Summary (Table 11)

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site and Facility</td>
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<tr>
<td>WFS Alignment/Calibration</td>
<td>0.50</td>
<td>84,749</td>
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<tr>
<td>Software and Controls</td>
<td>0.50</td>
<td>35,581</td>
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<tr>
<td>Utility Systems</td>
<td>0.05</td>
<td>12,851</td>
</tr>
<tr>
<td>System Engineering/Integration</td>
<td>0.35</td>
<td>46,555</td>
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<tr>
<td>Project Management</td>
<td>1.55</td>
<td>116,374</td>
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<tr>
<td>Science Requirements</td>
<td>1.13</td>
<td>206,564</td>
</tr>
<tr>
<td>Data Management Support</td>
<td>0.10</td>
<td>22,304</td>
</tr>
<tr>
<td>Operations Simulator</td>
<td>2.05</td>
<td>208,257</td>
</tr>
</tbody>
</table>

Total Net Allocation 6.63 $ 778,000

Supplemental funding is reflected in Table 16. Application of FY06 carry-forward/(deficit) for the program has been incorporated.
2.3 MAJOR INSTRUMENTATION PROGRAM (MIP)

FY07 Program Overview

Over the past decade, there has been unprecedented investment in new telescopes in the 8-m to 10-m class. The challenges for the coming years will be to take full advantage of these facilities by equipping them with advanced, state-of-the-art instrumentation that exploits the unique capabilities of those parts of the U.S. system, and to leverage these experiences into construction of the first instruments for the next generation of telescopes. Experience with the first generation of 8-m telescope instrumentation, as well as modern instruments for smaller telescopes, shows that each of these instruments typically will cost millions to tens of millions of dollars. Their successful deployment will require effective partnerships between astronomers and professional engineers, and a systems approach with strong project management. In addition, coordination among the major astronomical observatories will be necessary to maximize the range of available capabilities and to optimize the infrastructure expenditures required to support the building of complex instruments. Against this backdrop, the Major Instrumentation Program aims to support a robust pipeline for the delivery of instruments to the Gemini telescopes, supply key instrumentation technology to the astronomical community, construct instruments for publicly accessible 4-m telescopes that strengthen the overall U.S. system, and develop the capabilities within the community that will be needed to build the still larger and more complex instruments needed by LSST and GSMT.

FY07 Milestones

- Deliver NEWFIRM to the KPNO Mayall telescope, complete commissioning and begin science verification observing
- Deliver completed MONSOON system for the WIYN Bench Spectrograph (CCD version)
- In collaboration with WIYN staff, implement OTA control on QUOTA MONSOON system
- Make substantial progress toward completion of MONSOON controller for ODI
- Complete fabrication and make substantial progress towards integration and testing of the SAM Main Module
- Hold successful Preliminary Design Review for the SAM Laser Guide Star (LGS) system
- Carry out conceptual design work for one new instrument for a 4-m telescope, to a level sufficient to allow meaningful total cost and schedule estimates

FY07 Work Packages

NEWFIRM

Represents the budget needed to complete NEWFIRM, deliver it to the Mayall telescope and commission it. This assumes delivery to Mayall some time in second quarter FY07 (first quarter of CY07). The work package consists almost entirely of labor and includes no assumed revenue from
the University of Maryland partnership; FY06 was the last year for MIP to receive any funds from that agreement.

**MONSOON**
Represents the labor and capital spending required to supply MONSOON systems of existing designs to the collaborating institutions that have or are expected to place orders. The work package includes revenue anticipated from such orders.

**SAM**
Covers the labor and capital spending needed to move the SAM Main Module through fabrication and into integration and testing. The work package also covers the labor and capital needed to begin design and ordering of components for the Laser Guide Star and its associated beam transfer optics, launch telescope and control system (the LGS module). Work on the LGS module is expected to be completed in FY08.

**MONSOON for DEC and ODI**
Covers the engineering and technician labor needed to continue the development of the MONSOON design to meet the needs of the WIYN+ODI and Blanco+Dark Energy Camera instruments. The developments consist primarily of substantial reductions in physical size and power consumption for a given number of video input channels. The work package also includes some capital spending for associated lab equipment and prototype components.

**Management, Maintenance & Infrastructure**
Includes the labor necessary to manage the Major Instrumentation Program and maintain the shops, labs and facilities. The work package also includes the non-payroll spending needed to purchase supplies; purchase or renew software licenses; purchase, maintain, and replace computers, machine tools and other equipment; and provide for staff training and professional development. It includes assumed revenue of $36,000 from Steward Observatory (University of Arizona) for continued rental of the optical test tower and assumed revenue (with offsetting expenses) of $50,000 for incidental, small instrument shop jobs pursuant to an open agreement with Steward Observatory.

**New 4-M Instrument Start**
Covers the scientist and senior engineer labor associated with the beginning of conceptual design for a new instrument for one of the 4-m class telescopes. The instrument concept has not been chosen yet, but discussions are actively proceeding within NOAO, using the forum of NOAO’s Instrument Priorities Advisory Committee, to set future scientific goals for the 4-m telescopes and to identify technically viable ways to achieve those goals.
**FY07 Budget Summary** (Table 12)

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
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<tr>
<td>NEWFIRM</td>
<td>2.90</td>
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<tr>
<td>MONSOON</td>
<td>1.50</td>
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<td>Revenue from MONSOON</td>
<td>–</td>
<td>(65,000)</td>
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<tr>
<td>SOAR Adaptive Module</td>
<td>7.76</td>
<td>879,889</td>
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<tr>
<td>MONSOON for DECam &amp; ODI</td>
<td>3.40</td>
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<tr>
<td>Management, Maintenance, and</td>
<td>2.85</td>
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<tr>
<td>Infrastructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New 4-m Instrument Start</td>
<td>–</td>
<td>263,203</td>
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<tr>
<td><strong>Total Net Allocation</strong></td>
<td>18.41</td>
<td>$2,528,000</td>
</tr>
</tbody>
</table>

Includes outside revenue for MONSOON.
Application of FY06 carry-forward/(deficit) for the program has been incorporated.
2.4 DATA PRODUCTS PROGRAM (DPP)

FY07 Program Overview

FY07 will mark a significant milestone in the evolution of the Data Products Program. Although the program has delivered pieces of the data management system in the past four years, including the NOAO Survey Archive in 2002 and the Data Transport System in 2004, the complete “End-to-End” system will be deployed in 2007. With this deployment, DPP will enter a full-scale operational phase, in which the system must be monitored and maintained continuously. The staffing and priorities must be reorganized in support of the extensive operational responsibilities this implies. The delivery of NEWFIRM will demand extensive attention, as the software DPP has developed in support of NEWFIRM operations (including the Data Handling System, the quick-look environment, and the NEWFIRM pipeline) will be tested and put into regular use. The NVO facility will transition into an operational phase, and DPP will support the user community through deployment and support of Web-based as well as desktop-based tools and services (such as VO-capable IRAF).

FY07 Milestones

- Deployment & operation of v1 of NOAO End-to-End (E2E) data management system. Operation of this system marks a major new focus of effort within the DPP program, given that up to now the focus has been largely on the development of the system. Significant changes in staff responsibilities will be required. This will include delivery of more than two years of cached NOAO data to PIs and community. Ingest of this data into the NOAO Science Archive will make it available to both PIs and the wider astronomical community, providing a quite significant increase in the overall total data volume available through the NVO (an additional 20 TB!)

- Delivery of components in support of NEWFIRM. DPP must deliver the NEWFIRM Data Handling System to support the management of the data coming directly off the camera and the creation of FITS files. DPP also must deliver a NEWFIRM quick-look observing environment for use on the mountain, as well as a NEWFIRM pipeline processing system for creation of archive-quality processed data products. These image processing tools will be based on IRAF tasks, so a NEWFIRM IRAF package will also be delivered.

- Delivery of VO-capable IRAF package. VO capabilities were developed in FY06 with the support of NVO funding. The release of these new capabilities to the community requires additional work to build a new IRAF release.

- Development of v2 of the NOAO E2E system for delivery in early FY08, supporting more advanced NOAO data products (e.g., stacked MOSAIC images) and supporting more advanced VO tools (many developed by the broad VO community)

FY07 Work Packages

DP Program Management
Covers program management activities, including staffing, day-to-day management, staff training and development, and all-staff meetings. Payroll reflects all of the management time (T. Boroson and
R. C. Smith) and fractions of staff time spent in all-staff meetings. Non-payroll budget items cover the non-“operations” costs, including staff travel to support North/South coordination, U. Maryland and NCSA partnerships, staff development, staff computing support (including all desktop development computers), and supplies. AOSS fees are also included here ($36,540), based in pesos on the standard peso conversion factor.

**Archive Facility**
Covers software design and implementation for the NOAO Science Archive (NSA). The first major milestone for early FY07 is the release of an incremental version of the NSA (after the first major release in late FY06). The first release and incremental release will support ingest of all NOAO data streams, ingest of calibrated data from the MOSAIC cameras, plus raw data from partner institutions (SOAR, SMARTS, WIYN), and observer access to proprietary and non-proprietary data. The early FY07 incremental release will fully support NEWFIRM and improve robustness and usability of the system. The other major FY07 milestone will be development of the next major release of the NSA as part of the next major E2E release in late FY07. The features of this release are TBD, but will probably include support for catalogs and more emphasis on providing services to the NOAO NVO portal and associated scientific tools to improve the scientific capabilities of the system. The total level of effort in this work package is slightly down from previous years as we move effort from this work on the foundations of our program to development of the higher (user) levels in our system (the portal) and to operations. However, continued work on this level is required to support new features in Portal and in the VO in general.

Operational aspects of the NSA operations, including the activities required to ingest data, support users, and the non-payroll budget for computer hardware necessary to store and serve data, are included in the Data Management work package.

**Data Management**
Covers all aspects of operating all DPP systems, including the E2E data management system, from telescope to users. Operation of the E2E system comprises the management and operation of the distributed data transport system, the data processing pipelines, and the configuration and operation of the NSA data centers in Tucson and La Serena, as well as the remote operation and coordination of the data center at the NCSA. The level of effort in this package has doubled due to the anticipated demands of continuously operating the E2E system.

Hardware necessary to support mountain data storage, semi-permanent data storage in Tucson and La Serena, pipeline processing, and user interfaces and tools (Web-based portals) is included here, as is the separate hardware needed to support software development and testing. In future submissions we will separate out the development hardware costs into the relevant work packages.

Funds for internet bandwidth between NOAO/South and the U.S. are also included in this WP. This represents the full NOAO cost of the link shared by NOAO and Gemini. All network use at NOAO South (CTIO, NGSC, LSST, NIO, MIP, Science, and DPP) are covered by this funding, as are SOAR, SMARTS, and other tenant activities on Tololo. Cost recovery at least from SOAR and SMARTS is under discussion, but no agreements have even been drafted at this time to allow for possible inclusion in this budget.

Storage costs include only semi-permanent storage costs, where the total storage volume is capped at ~20 to 30 TB in Tucson and La Serena and permanent storage is provided at no cost by the NCSA under a joint MOU (signed in FY05). Partial investment in the semi-permanent storage costs from affiliate institutions (SOAR, SMARTS and WIYN) is assumed. However, no continued
operational costs for affiliate institutions are assumed. This policy is being developed to provide data management services to affiliate institutions as long as they comply with the requirements of well-defined proprietary periods for their data, thus making their data useful for the broader astronomical community.

**IRAF System Development/Support**
Provides for ongoing, minimal, IRAF system development and support. While this does not include community user support for IRAF, it does include support for upgrades and changes to the core system to support new high-priority platforms and support for new releases needed to include support for certain key new packages such as NEWFIRM and VO. The development portion of such new packages is mostly or fully provided for in other work packages.

**Pipeline Development**
This work package provides for limited continued development of data reduction pipelines and supporting infrastructure for processing various NOAO instrument data streams. The major FY07 milestone for this work package will be the delivery of the necessary generalization of the MOSAIC pipeline and general pipeline infrastructure in response to the delivery of the NEWFIRM pipeline. The NEWFIRM pipeline is a separate work package, but the impact of that development and associated improvements to the general pipeline infrastructure will be felt throughout the pipeline system. This work package also provides for the evolution of the MOSAIC pipeline to provide more advanced data products, such as catalogs and possibly time-domain data products from NOAO imagers, as well as exploration of deployment of the MOSAIC and/or NEWFIRM pipelines on the NCSA supercomputing platforms. Finally, this work package provides for limited participation in the DEC and ODI pipelines. The DEC pipeline is being developed at the University of Illinois, and the ODI development plan is still in formative stages as of this writing, but will almost certainly include contributions from the University of Maryland. The possible integration of the UMD pipeline effort with the efforts covered by this work package is contemplated in the level of effort described here.

**National Virtual Observatory Development**
In the FY06/FY07 timeframe, the NVO will “officially” move from a development phase to “operations.” Although the operation of the NVO is not yet a well-defined activity, it will almost certainly incorporate elements of continued development and true operations, with distributed and centralized aspects. In this work package, we have documented only the administrative portion of our involvement in the NVO, including the possible continued involvement of the NVO project scientist (D. DeYoung), and NOAO’s scientific and technical representatives to the NVO (C. Miller and M. Fitzpatrick, respectively). It also includes their travel to key NVO meetings. We have assumed that this necessary level of administrative activity will be funded by the “NVO Operations” grant, for which the announcement of opportunity is expected any time now.

Additional VO efforts, including developmental and operational aspects, are included in other work packages as they pertain to elements of the global DP system. The most visible VO work will be done in the Portal Development work package, where the effort to develop advanced scientific tools and a highly usable interface is undertaken. Aspects of VO operations will be undertaken in the Data Management work package, as we will provide user support for at least the VO tools and interfaces we host, and, possibly, some support for additional services (hopefully recovering that support cost from NVO Operations). Funding for VO Event development, providing VO support for time-
domain astronomy, came separately in FY06 and we will explore avenues of acquiring additional support in FY07 for the development of this important standard.

Portal Development
From the user’s perspective, the Portal is a window to NOAO tools and data and a linkage mechanism for all the widely distributed resources of the VO. From our point of view, the Portal is a platform upon which we can develop new analysis and visualization capabilities that have broad utility. The current version of the Portal is a prototype, suitable primarily for demonstrating this approach. In FY07, the Portal will be re-engineered into a stable, robust system with a comprehensive set of tools along the lines of the current prototype. It will be one of the first, if not the first, integrated VO user interface, and therefore, will be a test-bed for much VO-related infrastructure, such as security, management of computational resources, and the transport of large amounts of data. Development of the Portal will approach the level of effort on the NSA in FY07, and, in future years, it will be the focus of DPP’s developmental activities. This focus will provide the basis for our role in LSST, supporting the astronomical community and its use of the petabytes of images and catalogs through development and deployment of advanced VO tools and services.

Grants Support
Documents grants to individuals (as opposed to the NVO grant, which is to the DP program). These grants may include work related to the DPP core and extended program (such as the mini-VO grants received in FY06) or other external work. Specifically, this work package documents the (scientific) grants which support Sean Points.

FY07 Budget Summary (Table 13)

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
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<th>Amount</th>
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<td>Program Management</td>
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<td>Data Management</td>
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<td>IRAF Development/Support</td>
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<td>Pipeline Development</td>
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<tr>
<td>NVO Development</td>
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<td>ITR Grant Support: NVO</td>
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<td>Portal Development</td>
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<td>Grants Supported</td>
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<td><strong>19.25</strong></td>
<td><strong>$1,593,000</strong></td>
</tr>
</tbody>
</table>

Table 13
NOAO-Wide Programs
DATA PRODUCTS PROGRAM (DPP)
FY07 Funding Allocation: $1,593,000

Grant revenue for NVO and Workshops reflected.
Application of FY06 carry-forward/(deficit) for the program has been incorporated.
2.5 PUBLIC AFFAIRS AND EDUCATIONAL OUTREACH (PAEO)

FY07 Program Overview

The FY07 PAEO budget request is the second comprehensive plan for education and outreach programs at both NOAO North and South. It marks the first year of total NOAO core funding responsibility for the Astronomy Research Based Science Education (A-RBSE) program, our acclaimed teacher research and professional development program, and the final year of NSF grant support for Hands-On Optics. Public outreach will be expanded through the automation of the Kitt Peak Visitor Center telescope dome, a full year of the third site for the Nightly Observing Program, ongoing growth of the Kitt Peak membership group, and by creative programs such as GLOBE at Night.

FY07 Milestones

- Identify new funding source(s) for Hands-On Optics to continue this valuable program in FY08
- Develop an online data access/research component to the Astronomy Research Based Science Education (A-RBSE) program
- Support dark skies education through activities at the “Night Sky” meeting in Washington, DC, in February 2007 and an expanded GLOBE at Night 2007 program
- Automate the “El Enano” telescope for outreach at Cerro Mayu in Chile
- Develop a strategic plan for the Kitt Peak Visitor Center (KPVC), including a fundraising component and long-term exhibit plan
- Completely automate the KPVC 20-inch telescope dome for remote Web-based public program use
- Finish the design and install the new “Sunnel” exhibit in the public hallway of the McMath-Pierce Solar Telescope, and install a new telescope mirror display in the KPVC
- Continue to recruit Kitt Peak members by adding at least 100 new members this year
- Prepare a plan to celebrate the 50th anniversary of Kitt Peak National Observatory in 2008

FY07 Work Packages

Public Information:
Covers the payroll costs of the PAEO manager and the office staff 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, responses to public inquiries, and half-time assistance with NOAO lobby visitors. This work package also serves as the coordination point with similar offices at the Gemini Observatory, Space Telescope Science Institute, NASA, the
Spitzer Science Center, Chandra Science Center, etc., and the Southwestern Consortium of Observatories for Public Education (SCOPE).

NOTE: This staff is supported by the non-salary accounts of NE4000, which are listed for the sake of simplicity in the Educational Outreach work package.

NOAO/NSO Newsletter
Production and bulk mailing postage costs of the quarterly hardcopy NOAO/NSO Newsletter (circ. 2,200 copies), including full in-house editorial production and graphic design.

Photo Imaging
Provides salary and equipment support for the single-person NOAO Photo Imaging Lab. This operation, led by Pete Marenfeld, 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 less than one-fifth of the commercial rate. Thus far, Pete has been able to carry on with the full recovery of digital recharge revenue ($9,000) that had been accomplished in recent years with two people.

Educational Outreach
Provides staff and supporting funds to prepare and conduct NOAO’s non-grant funded educational programs for teachers and students, and it is the central source of non-salary support funds for the general activities of NOAO PAEO, such as travel and supplies.

Major projects include the flagship Project ASTRO and Family ASTRO programs, support for meetings and conferences such as the biannual AAS meetings, local outreach with NOAO GK-12 science education fellows, teacher workshops with the Southern Arizona GEMS Center, educator activities with MESA of Arizona, outreach to the Tohono O’odham Nation, and new brochures, posters and handout materials.

Astronomy Research Based Science Education
Includes the costs of the acclaimed Astronomy Research Based Science Education (A-RBSE) program, formerly known as TLRBSE. After 11 years, this is the first year of its complete reliance on the core NOAO budget.

We have constantly sought to reduce the demand on the core budget in the years of transition, through program process improvement. This lower-cost program was also achieved by reducing the number of new teachers to be trained in the program from 21 to 18, and by trimming support for consultants, travel to NSTA meetings, and support for the three novice science teachers that are supposed to be mentored by the A-RBSE teacher participant. Approximately $15,000 was retained to offer continuing observing experiences for previously trained teachers and their students, known as the Teacher Observing Program, which addresses NSF concerns that undergraduate students, small college faculty, secondary science teachers, and even high school students can benefit from training in basic astronomical observing and data handling. The Teacher Observing Program is a competitive proposal-based program, and provides long-term support to A-RBSE teacher graduates and their students. It has created high visibility for NOAO through the excellent science fair projects done by students connected with the program. It also provides additional research opportunities for the students who publish in the NOAO Research Based Science Education journal for students.

Major annual costs include a Distance Learning course offered by NOAO (with an effort underway to export this course to other astronomy teacher research programs), an intensive two-
week summer workshop, and travel costs for the previous cadre of A-RBSE teachers to attend the spring National Science Teacher’s Association meeting to meet as a group to discuss progress in implementing astronomy research into the classroom.

This nationally-known NOAO program has a demonstrated track record of success that has attracted strong interest from the Spitzer Science Center and the Las Vegas school district, among others, in augmenting it for their own professional teacher development needs. The requested FY07 budget meets the project’s minimum needs to continue its current impact.

TERC: “Investigating Astronomy”
This fully grant-funded work package supports the work of manager of science education, S. Pompea, and S. Croft as subcontractors to the non-profit educational development organization TERC in Cambridge, MA (see www.terc.edu) in a project to develop the first new high-school-level curriculum in astronomy in nearly two decades. NOAO has primary responsibility in FY07 to develop software and image resources for the curriculum. This includes imagery for students to pursue authentic investigations, as well as guides for students and teachers. Pilot testing of the new curriculum began in FY06 and continues with further revisions and expanded testing nationwide in FY07. NOAO and its partners will also provide translation into Spanish of many of the curricular materials including materials for community astronomy events. This effort builds upon the Spanish Language Astronomy Education Materials Center created by NOAO in past years. Investigating Astronomy is funded under an NSF Instructional Materials grant, with TERC as the lead and the Astronomical Society of the Pacific as the third partner.

“Hands-On Optics” (HOO)
This grant-funded work package supports PAEO’s role in an optics education program conducted in partnership with the Optical Society of America and SPIE-The International Society for Optical Engineering. It is targeted primarily at reaching underserved students nationwide in after-school science programs and at informal science centers, such as the Orlando Science Center. NOAO is the primary developer of the six, plastic tub-sized HOO modules, which include manuals and supplies of equipment such as lasers, mirrors, lenses, and kaleidoscopes. In FY07, NOAO will continue distributing the six HOO modules and kits, and will conduct related trainings in Arizona, Colorado, California, Washington state, Hawaii, Maryland, New York, New Mexico, and Florida.

NOAO has primary project responsibility for the training of all of the educators in after-school programs and at science centers nationwide, as well as the training of the optics volunteers (resource agents) who will work with these teachers. The program is designed to reach over 30,000 seventh-grade-level students nationwide, but, more importantly, will establish long-term optics education programs at the HOO sites nationwide. NOAO’s S. Pompea will continue his role as director of the project during FY07.

NSF Research Experiences for Undergraduates (REU) – KPNO Site Program
Provides salary support at 0.25 FTE for the KPNO REU site leader (K. Mighell). Other costs for supporting the six summer REU students, such as their 10-week residence in Tucson and subsequent trip to the January AAS meeting, are grant-funded.
NOAO South Outreach
This second full year of PAEO responsibility for all educational outreach at NOAO South (beyond the NSF grant-funded CTIO REU program) includes the first realistic support costs of an active outreach program in and around the La Serena region.

This work package also includes the cost of a CTIO draftsman, Hugo Ochoa, at 0.5 FTE to serve as the primary staff organizer of local activities, in close coordination with David Orellana, the director of CADIAs (“Centro de Apoyo a la Didáctica de la Astronomía”), the newly established Astronomy Teaching Support Center. Ochoa and Orellana have been extremely active in astronomy education at CTIO and are well-known and respected in the local and regional education community.

The program continues to foster and conduct videoconference-based bilingual educational workshops conducted under the name ASTRO-Chile. It also includes support for the ongoing Gemini/NOAO/RedLaSer planetarium program, $5,000 in annual rental costs for an AURA vehicle for official local use (plus gasoline costs), liaison and education activities to assist the many small observatories built by municipalities near La Serena to attract local tourists, and miscellaneous non-payroll support for outreach by CTIO staff.

Kitt Peak Visitor Center (KPVC)
Supports the daily operations of the Kitt Peak Visitor Center and its staff, including nighttime guides. New elements include: (1) an increase of $1.00 per person to $3.50 (adult) and $2.00 (children) in the fees charged for Docent Guided Tours, (2) an increase in the amount of revenue generated from special classes and events other than the evening star gazing programs, (3) a $9,500 charge for tenant costs associated for the Roll-Off Roof building (third NOP site), (4) additional seasonal part-time Gift Shop staff personal to help during busy months of January through May, (5) $40,000 in KPNO mountain staff charges for janitorial services and maintenance help.

NOTE: 30% of expected NSO indirects have been applied to this work package.

Public Outreach
Covers the core costs of the management of the Kitt Peak Visitor Center, volunteer docents and the general community outreach and informal science programs performed by R. Fedele and R. Wilson. Key elements in FY07 include: (1) equipment upgrades to CCD camera, solar filters, LCD Monitor, and Digital Cameras; (2) the last payment for the 16-inch RC telescope for the Roll-Off Roof building; and (3) increasing the core amount of volunteer docents by offering 2 training classes.

NOTE: 30% of expected NSO indirects have been applied to this work package.

“Astronomy From the Ground Up”
This NSF grant-funded program, done in partnership with the Astronomical Society of the Pacific and the internationally-based Association of Science Technology Centers, is designed to train small science museums and nature centers in the basics of presenting programs in astronomy (such as light and color, optics and telescopes, size of the universe, changes in the universe, star parties, Moon hikes, etc.) and in helping them interpret the latest astronomy and space science news for their visitors. NOAO EO and PO staff are spending significant time on this potentially revolutionary project, which is a mixture of face-to-face and distance learning professional development workshops.

The project will continue to expand nationwide with regional workshops planned in St. Louis and at least one other location. An even larger number of educators will participate in an expanded
program of on-line workshops. All of the workshop participants will be part of an on-line community of practice to reinforce what was learned in the workshops and to share best practices.

**KPVC Membership Program**
FY07 will mark the second full year of this new membership program, which is targeted to grow to about 220 members by the end of the fiscal year. Members receive a newsletter, members-only events, free admission to telescope tours, and discounts for nighttime programs and purchases in the Visitor Center store.

**Astronomy Education Review (AER)**
The Astronomy Education Review is a journal/Web site that provides a meeting place for those engaged in astronomy and space science education, in either formal or informal settings. The journal gets between 150,000 and 200,000 hits and 1,000 downloaded articles per month, impressive given the size of the astronomy education community. It has become the premier site for astronomy education research and discussion.

**TMT Support**
Supported by NIO FY06 carry-forward funds, this provides salary support for the editor (D. Isbell), Web designer (M. Newhouse) and graphics designer (P. Marenfeld) for the TMT public Web site (www.tmt.org) and the monthly TMT electronic “Newscast.”

**LSST Support**
PAEO continues its work under LSST D&D funding, including work by S. Croft on a A-RBSE-like teacher-student research project on the characterization of Near-Earth Objects, biweekly coordination via LSST EPO team telecons, conference and media support, informal Web page consulting, and planetarium outreach planning with the American Museum of Natural History in New York. The intellectual merit of the NOAO effort addresses the question of how large astronomical data sets can be used in education, how they can be integrated into middle school earth science/astronomy curriculum, and how we can increase the effectiveness of techniques for visualization of astronomical data at smaller science centers such as Kitt Peak Visitor Center and at large museums and planetaria.
**FY07 Budget Summary** (Table 14)

<table>
<thead>
<tr>
<th>FY07 Work Package</th>
<th>FTE</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Information</td>
<td>1.60</td>
<td>127,873$</td>
</tr>
<tr>
<td><em>NOAO/NSO Newsletter</em></td>
<td>0.20</td>
<td>58,817$</td>
</tr>
<tr>
<td>Photo Imaging</td>
<td>0.85</td>
<td>61,344$</td>
</tr>
<tr>
<td>Digital Re-charge</td>
<td>–</td>
<td>(9,000)</td>
</tr>
<tr>
<td>Educational Outreach</td>
<td>3.33</td>
<td>187,701$</td>
</tr>
<tr>
<td>Grant Funds: Ed. Outreach</td>
<td>–</td>
<td>(124,543)</td>
</tr>
<tr>
<td>A-RBSE Program</td>
<td>1.45</td>
<td>355,524$</td>
</tr>
<tr>
<td>Grant Funds: A-RBSE</td>
<td>–</td>
<td>(11,026)</td>
</tr>
<tr>
<td>Public Outreach: TERC</td>
<td>0.35</td>
<td>56,121$</td>
</tr>
<tr>
<td>Grant Funds: TERC</td>
<td>–</td>
<td>(56,121)</td>
</tr>
<tr>
<td>Public Outreach: HOO</td>
<td>3.05</td>
<td>132,187$</td>
</tr>
<tr>
<td>Grant Funds: HOO</td>
<td>–</td>
<td>(132,187)</td>
</tr>
<tr>
<td>REU - Tucson</td>
<td>0.32</td>
<td>97,111$</td>
</tr>
<tr>
<td>Grant Funds: REU</td>
<td>–</td>
<td>(64,772)</td>
</tr>
<tr>
<td>NOAO S. Outreach</td>
<td>0.60</td>
<td>90,315$</td>
</tr>
<tr>
<td>KP Visitor Ctr</td>
<td>13.37</td>
<td>928,674$</td>
</tr>
<tr>
<td>Revenue: KP Visitor Ctr</td>
<td>–</td>
<td>(857,336)</td>
</tr>
<tr>
<td>Public Outreach</td>
<td>0.85</td>
<td>166,040$</td>
</tr>
<tr>
<td>Indirect Cost Recovery</td>
<td>–</td>
<td>(43,300)</td>
</tr>
<tr>
<td>Astronomy from Ground Up</td>
<td>0.50</td>
<td>56,511$</td>
</tr>
<tr>
<td>Grant Funds: AGU</td>
<td>–</td>
<td>(56,511)</td>
</tr>
<tr>
<td>KP Membership Services</td>
<td>0.15</td>
<td>13,157$</td>
</tr>
<tr>
<td>Revenue: KP Membership</td>
<td>–</td>
<td>(10,250)</td>
</tr>
<tr>
<td><em>Astronomy Educ. Review</em></td>
<td>0.65</td>
<td>51,825$</td>
</tr>
<tr>
<td>Grant Funds: AER</td>
<td>–</td>
<td>(23,255)</td>
</tr>
<tr>
<td>Support to LSST</td>
<td>0.35</td>
<td>31,605$</td>
</tr>
<tr>
<td>Revenue from LSST</td>
<td>–</td>
<td>(31,605)</td>
</tr>
<tr>
<td>KPNO Mountain Support</td>
<td>0.86</td>
<td>38,101$</td>
</tr>
</tbody>
</table>

**Total Net Allocation**  28.48 $  1,033,000$  

Application of FY06 carry-forward/(deficit) for the program has been incorporated.
3.1 FY07 DIVISIONAL ORGANIZATION AND KEY MANAGEMENT

The NOAO Director is responsible for coordination of the four divisions and more than 20 programs of the national observatory. The NOAO Deputy Director is responsible for standing in for the Director. He also heads the Data Products Program, Science Operations/The System, the Telescope System Instrumentation Program, and Computer Infrastructure Services in Tucson.

The CTIO Director is responsible for management of Cerro Tololo Inter-American Observatory. Pending a search for a new director, the Acting Director of KPNO is responsible for management of Kitt Peak National Observatory. The NGSC Director is responsible for management of the NOAO Gemini Science Center.

The Associate Director for Science is responsible for the NOAO-wide scientific research program. The Associate Director for Instrumentation is responsible for the Major Instrumentation Program, which is an NOAO-wide program. The Associate Director for GSMT Development is the head of the AURA New Initiatives Office and, with S. T. Ridgway, manages the Adaptive Optics Development Program. The Project Director of the NOAO LSST Program is responsible for NOAO’s role in the design and development phase of the Large Synoptic Survey Telescope. The Assistant Director for Public Affairs and Educational Outreach has NOAO-wide responsibility for these functions. The Associate Director for Administration and Facilities is responsible for management of Central Administrative Services, Central Facilities and Operations and overall financial management of NOAO.
3.2 FY07 BUDGET SUMMARY

Table 15
FY07 BUDGET SUMMARY
NSF Funding Allocations to NOAO FY07 Base Budget
Total Allocation = $24,579
(Dollars in Thousands)

<table>
<thead>
<tr>
<th>NOAO Division/Program*</th>
<th>KPNO</th>
<th>CTIO</th>
<th>NGSC</th>
<th>TUCSON</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Ops/System</td>
<td>142</td>
<td>98</td>
<td>–</td>
<td>378</td>
<td>618</td>
</tr>
<tr>
<td>Instrument Development &amp; Upgrades</td>
<td>(515)</td>
<td>208</td>
<td>101</td>
<td>–</td>
<td>(206)</td>
</tr>
<tr>
<td>Telescope A</td>
<td>1,132</td>
<td>1,208</td>
<td>115</td>
<td>–</td>
<td>2,456</td>
</tr>
<tr>
<td>Telescope B</td>
<td>1,191</td>
<td>1,351</td>
<td>335</td>
<td>–</td>
<td>2,877</td>
</tr>
<tr>
<td>Telescope C</td>
<td>574</td>
<td>(5)</td>
<td>–</td>
<td>–</td>
<td>569</td>
</tr>
<tr>
<td>Mountain Facilities</td>
<td>684</td>
<td>29</td>
<td>–</td>
<td>–</td>
<td>713</td>
</tr>
<tr>
<td>Sci. Research/Post-Docs</td>
<td>–</td>
<td>939</td>
<td>137</td>
<td>1,974</td>
<td>3,050</td>
</tr>
<tr>
<td>Director's Office</td>
<td>285</td>
<td>119</td>
<td>16</td>
<td>660</td>
<td>1,081</td>
</tr>
<tr>
<td>Headquarters</td>
<td>–</td>
<td>416</td>
<td>–</td>
<td>825</td>
<td>1,241</td>
</tr>
<tr>
<td>Central Admin. Svcs.</td>
<td>–</td>
<td>297</td>
<td>–</td>
<td>879</td>
<td>1,176</td>
</tr>
<tr>
<td>Education/Public Outreach</td>
<td>(18)</td>
<td>8</td>
<td>–</td>
<td>1,033</td>
<td>1,023</td>
</tr>
<tr>
<td>LSST</td>
<td>–</td>
<td>45</td>
<td>–</td>
<td>733</td>
<td>778</td>
</tr>
<tr>
<td>ETS Infrastructure</td>
<td>–</td>
<td>265</td>
<td>–</td>
<td>–</td>
<td>265</td>
</tr>
<tr>
<td>Data Products Program</td>
<td>–</td>
<td>456</td>
<td>–</td>
<td>1,137</td>
<td>1,593</td>
</tr>
<tr>
<td>NIO/TMT</td>
<td>–</td>
<td>692</td>
<td>–</td>
<td>2,215</td>
<td>2,907</td>
</tr>
<tr>
<td>Major Instrumentation</td>
<td>–</td>
<td>880</td>
<td>–</td>
<td>1,648</td>
<td>2,528</td>
</tr>
<tr>
<td>Servicing NSO &amp; NRAO</td>
<td>157</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>157</td>
</tr>
<tr>
<td>AURA Support/Mgmt. Fee</td>
<td>–</td>
<td>–</td>
<td>80</td>
<td>789</td>
<td>869</td>
</tr>
</tbody>
</table>

Total Net Allocation* $3,633 $7,518 $784 $12,644 $24,579

*FY07 NSF funding for LSST Supplement, TSIP and AODP is shown in Table 16.

†Key to FY07 Work Packages in Table 15

Science Operations/ System: Cost of telescope time allocation activities, including periodic meetings of NOAO user constituencies: e.g., the NOAO Users' Committee, the annual meeting of the survey teams. Administration/oversight costs of the TSIP and AODP.

Instrument Development & Upgrades: Responsibilities of the CTIO and KPNO directors, this effort refers to projects such as detector and controller upgrades or the commissioning of new capabilities.
Key to FY07 Work Packages in Table 15

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Infrastructure Support (CIS):</td>
<td>Computer system support to each division, including network maintenance and software support. CIS is a management responsibility of the NOAO deputy director.</td>
</tr>
<tr>
<td>Telescopes A, B, C:</td>
<td>Operations, upgrades and software support work packages by telescope. Telescope A = the Mayall 4-m at KPNO, the Blanco 4-m at CTIO and Gemini user support in the NGSC division, respectively. Telescope B = WIYN at KPNO, SOAR at Cerro Pachón and Gemini South operations support. Telescope C = smaller telescopes at KPNO and CTIO. CTIO work packages contain projected operational costs as per the annual AOSS tenant agreements. The modest level of support under CTIO “Telescope C” reflects the predominant role of the SMARTS consortium in operating the four small legacy telescopes on Cerro Tololo.</td>
</tr>
<tr>
<td>Mountain Facilities:</td>
<td>Building maintenance, kitchen and accommodations, roads, grounds, and utilities at CTIO and KPNO. At CTIO, some costs are allocated through the AOSS structure and annual agreement of the tenants.</td>
</tr>
<tr>
<td>Scientific Research/Post-Docs:</td>
<td>Costs of scientific staff research, including post-docs, administration of scientific staff, travel, and publications.</td>
</tr>
<tr>
<td>Director’s Office:</td>
<td>Activities of the NOAO or division director, deputy director, administrative support staff, risk management, library, and safety coordination.</td>
</tr>
<tr>
<td>Headquarters:</td>
<td>Facilities operation costs of non-mountaintop building maintenance, roads and grounds, utilities, vehicles, and the computer network. Headquarters management is the responsibility of the associate director for administration and facilities in Tucson and the CTIO director in La Serena.</td>
</tr>
<tr>
<td>Central Administrative Services (CAS):</td>
<td>Human resources, accounting/financial management, procurement, payroll; AURA corporate and other AURA center support. CAS management is the responsibility of the associate director for administration and facilities in Tucson and the CTIO director in La Serena.</td>
</tr>
<tr>
<td>Education/Public Outreach</td>
<td>Education and public outreach programs, REU programs, public affairs, and graphic arts.</td>
</tr>
<tr>
<td>LSST</td>
<td>Includes support to begin preparation of a technically sound and well-budgeted project proposal for the Large-aperture Synoptic Survey Telescope (LSST) program.</td>
</tr>
<tr>
<td>ETS Infrastructure</td>
<td>At CTIO, this includes the infrastructure component of ETS. Costs consist of management, administrative, training, travel, and contract hire expenditures, as well as AOSS charges. The operation and maintenance components and upgrades of the ETS infrastructure are also included. In the NGSC column, this work package refers to instrument development and project oversight of instruments for Gemini in the U.S. community. ETS infrastructure is the management responsibility of the associate director for instrumentation in Tucson and the CTIO director in La Serena.</td>
</tr>
</tbody>
</table>
**†Key to FY07 Work Packages in Table 15**

<table>
<thead>
<tr>
<th>Work Package</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Products Program</td>
<td>This work package includes all planning, administrative and day-to-day management of the Data Products Program for both DPP North (in the Tucson column) and DPP South (in the CTIO column). Efforts required to expand the interim archive involve all data sets in the NOAO Survey program and initial storage of raw data from both CTIO and KPNO; design and implementation of a fully engineered archive facility for NOAO; increasing management of the day-to-day archive system, media, and user support; and cross-divisional support for development of major IRAF system utilities, NGSC instrument data reduction software, data management planning for the LSST, and other initiatives.</td>
</tr>
<tr>
<td>NIO/TMT</td>
<td>Includes the support for the AURA New Initiatives Office in the development of a Thirty Meter Telescope (TMT), science merit functions, integrated modeling of TMT design concepts, site testing in NOAO South, cost estimates, developing a road map for technologies for ELTs and their instruments, and exploring partnerships that will advance the design and support of a TMT concept to ensure national community involvement.</td>
</tr>
<tr>
<td>Major Instrumentation</td>
<td>Includes NOAO North and NOAO South completion of design and fabrication of instruments; responses to calls for proposals for instruments; continuation of support as requested to other NOAO/NSO programs, including LSST, KPNO, CIS, NSO, and GONG, as well as some outside programs such as Gemini and Steward Observatory; and support and maintenance for the infrastructure (shops, labs, and so on) used by MIP and other programs at the current level of functionality.</td>
</tr>
<tr>
<td>Servicing NSO &amp; NRAO</td>
<td>Under KPNO, this line refers to the costs of technical support of NSO and NRAO.</td>
</tr>
<tr>
<td>AURA Support/Mgmt. Fee</td>
<td>Listed under the Tucson column only. The number listed under NGSC for this line item refers to the cost of AURA’s U.S. Gemini Fellowship Program and is, therefore, a budget item separate and distinct from the AURA management fee. Under the new cooperative agreement, the AURA management fee is calculated based on a G&amp;A indirect rate of 1.93 percent instead of a flat negotiated fee.</td>
</tr>
</tbody>
</table>
3.3 SOURCES OF FY07 INCREMENTAL FUNDS

Table 16
FY07 BUDGET SUMMARY
Incremental Funds to FY07 NSF Base Budget Allocation*
(From Partner Contributions, Tenant Fees, External Grants, etc.)
Total Incremental Funds = $13,601
(Dollars in Thousands)

<table>
<thead>
<tr>
<th>Source of Funds</th>
<th>KPNO</th>
<th>CTIO</th>
<th>NGSC</th>
<th>TUCSON</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIYN Partners</td>
<td>1,306</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,306</td>
</tr>
<tr>
<td>Partner Contributions:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMARTS, 2.1-m, KP 4-m</td>
<td>515</td>
<td>44</td>
<td>-</td>
<td>-</td>
<td>559</td>
</tr>
<tr>
<td>Tenants/Observer Fees;</td>
<td>574</td>
<td>145</td>
<td>-</td>
<td>220</td>
<td>939</td>
</tr>
<tr>
<td>External Work Revenue</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grant Funds: REU</td>
<td>222</td>
<td>42</td>
<td>-</td>
<td>65</td>
<td>329</td>
</tr>
<tr>
<td>Grant Funds: A-RBSE</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Grant Funds: TERC</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>Grant Funds: HOO</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>132</td>
<td>132</td>
</tr>
<tr>
<td>Revenue: KPVC &amp; Fees from Public Programs</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>868</td>
<td>868</td>
</tr>
<tr>
<td>Grant Funds: ITR</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>TSIP Funding (NSF)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4,000</td>
<td>4,000</td>
</tr>
<tr>
<td>AODP Funding (NSF)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,500</td>
<td>1,500</td>
</tr>
<tr>
<td>LSST Supplement (NSF)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>936</td>
<td>936</td>
</tr>
<tr>
<td>NVO and Workshop Support</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>122</td>
<td>122</td>
</tr>
<tr>
<td>HST Grants</td>
<td>-</td>
<td>86</td>
<td>-</td>
<td>1,160</td>
<td>1,246</td>
</tr>
<tr>
<td>NASA Grants</td>
<td>-</td>
<td>188</td>
<td>48</td>
<td>1,338</td>
<td>1,574</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$2,617</td>
<td>$505</td>
<td>$48</td>
<td>$10,431</td>
<td>$13,601</td>
</tr>
</tbody>
</table>

*Indirect revenue from NSO/GONG and grant funding/business operations support to LSSTC, TMT and GMT not shown.

†Includes 977K of NASA Destiny funding of which 899K will be sub-awarded.

3.4 FY07 DIVISION OF EFFORT – NOAO SCIENTIFIC STAFF†

In accordance with the reporting requirements for the NOAO Annual Program Plan defined in Scientific Program Order No. 1 of the NSF/AURA Cooperative Agreement, the fractional division of effort for each NOAO scientific staff member across FY07 budgeted programs is shown in Table 17.

†Scientific staff members and programs shown in Table 17 are those funded under NSF funds allocated to the FY07 NOAO base budget. Programs and scientists (e.g., post-doctoral research associates) funded under external grants or non-AST/NSF sources are not included.
TABLE 17  FY07 Fractional Division of Effort of NOAO Scientific Staff  
by Budgeted Programs  
(FY07 NSF-Allocated Funds Only)  

<table>
<thead>
<tr>
<th>Name</th>
<th>Research</th>
<th>CTIO</th>
<th>KPNO</th>
<th>NGSC</th>
<th>SCI OPS</th>
<th>DPP</th>
<th>MIP</th>
<th>PAEO</th>
<th>NIO</th>
<th>LSST</th>
<th>Non-NSF</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbott, T.</td>
<td>0.20</td>
<td>0.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>Blum, R.</td>
<td>0.50</td>
<td>0.00</td>
<td>0.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
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* On Sabbatical for \( \frac{1}{2} \) year.
### TABLE 17  
**FY07 Fractional Division of Effort of NOAO Scientific Staff by Budgeted Programs**  
*(FY07 NSF-Allocated Funds Only)*

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* Post-doctoral research associate (Goldberg Fellow) in FY07. Externally-funded post-docs are not shown in this table.
4 STATUS OF FY06 MILESTONES

NOAO GEMINI SCIENCE CENTER

FY06 Milestones

- Provide a support astronomer for six Gemini queue runs per semester in order to keep NGSC astronomers expert and current in Gemini instrumentation and observing procedures
  
  *This goal was met or exceeded in the 2005B (9 runs), 2006A (8 runs) and 2006B (7 runs) semesters.*

- Provide user and operational support for NOAO’s Phoenix high-resolution infrared spectrograph on Gemini South
  
  *This goal was met in each semester. NGSC supported 17 nights in 2005B, 28 nights in 2006A and 14 nights in 2006B.*

- Beginning March, 2006, maintain a strong and informed NGSC staff presence at the Gemini North base facility in Hilo
  
  *Due to the switchover of director from Taft Armandroff to Verne Smith, the implementation of this milestone was delayed to September 2006. But it began then, with NGSC spending 14 people-days in Hilo in September 2006. This program is continuing into FY07.*

- Provide training in Gemini operations and user support activities for three new scientists joining the NGSC staff in FY06
  
  *Three new assistant astronomers were successfully integrated into NGSC in FY06: Adwin Boogert (December 2005), Katia Cunha (February 2006), and Susan E, Ridgway (July 2006).*

- Maintain and enhance communication with the U.S. Gemini Science Advisory Committee by organizing at least one in-person meeting to discuss science direction, operations models, instrumentation issues, and other Gemini matters, as well as by sending electronic updates to inform committee of program progress, etc.
  
  *The U.S. Gemini SAC met in Tucson in October 2005, as well as maintained contact throughout all of FY06.*

- For the Near-Infrared Coronagraphic Imager (NICI), oversee Mauna Kea Infrared testing of the instrument; successfully complete acceptance testing and delivery to Gemini
  
  *NGSC staff members Mark Trueblood, Ron Probst and Verne Smith oversaw the NICI project through its final acceptance testing and delivery to Gemini in September 2006.*

- For the FLAMINGOS-2 near-infrared multi-object spectrograph for Gemini South, assist U. Florida to integrate and test the instrument, then complete acceptance testing
  
  *The Flamingos-2 project was overseen by Mark Trueblood, Taft Armandroff and Verne Smith in FY06; it continues on towards acceptance testing.*
CERRO TOLOLO INTER-AMERICAN OBSERVATORY

FY06 Milestones

- Progress the Dark Energy Camera Project through Preliminary Design Review

  *The Dark Energy Camera project had a successful “Fermilab Director’s” review in FY06, while the optical corrector, for which the fabrication defines the critical path, passed Preliminary Design Review and was subsequently progressed to being ready for glass purchase.*

- Complete commissioning and science verification of the SOAR telescope; initiate normal science operations

  *Replacement of the primary mirror lateral links by an actively controlled system proved successful, and enabled the telescope to ramp up to scheduling 40% of time for science by the end of FY06. Commissioning and science verification activities were not completed and will continue in FY07.*

- Successfully negotiate new Small and Moderate Aperture Research Telescope System (SMARTS) II agreement, to begin January 2006

  *SMARTS II began operations in January 2006.*

- Reduce deficit to $0.4 million via cost-savings

  *The deficit was reduced to approximately $0.4 million via a combination of cost-savings and partnership revenue.*

KITT PEAK NATIONAL OBSERVATORY

FY06 Milestones

- Prepare Mayall 4-m telescope and facility for integration and commissioning of NEWFIRM in FY07

  *The preparatory work on the Mayall 4-m telescope and building is on schedule for completion in December 2006, approximately one month before NEWFIRM is scheduled for first light in January 2007.*

- Prepare WIYN telescope and facility for integration and commissioning of WIYN High-Resolution IR Camera (WHIRC) in FY07

  *The preparatory work for WHIRC is on schedule to enable first light of WHIRC in June 2007.*

- Prepare WIYN telescope and facility for integration and commissioning of QUOTA, the 8K × 8K CCD imager with Orthogonal Transfer Arrays, in late FY06

  *This work was completed and QUOTA had a successful “first light” observing run in October 2006.*

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†This milestone may be threatened by any rescission of the reduced FY06 budget.
• Participate in development, commissioning, and deployment of 1 or 2 Monsoon controllers for CCD use on existing instruments

This project continues and should be completed in FY07 with the deployment of WHIRC and the Bench spectrograph upgrade for the WIYN 3.5-m.

• Complete integration of IRMOS and offer to observers on shared risk basis

This was completed and we supported visitor observing programs in observing semesters 2006A and 2006B.

• Add operations partners to maintain current staffing levels for safe, reliable, and productive use of existing telescopes

This goal was accomplished with the signing of an agreement with Clemson University to assist with the operation of the Mayall 4-m telescope. The agreement gives Clemson 10% of the available science observing time for three years in return for approximately 10% of the operating costs of the telescope.

TUCSON DIVISION PROGRAMS

SCIENCE OPERATIONS/OIR SYSTEM

FY06 Milestones

• FY06 TAC administration, including public time on Keck, Magellan, MMT, and HET

Oversubscription levels during 2006 were systematically higher for the larger telescopes, with the TSIP telescopes and Gemini running in the range 3–6, the 4-m class telescopes in the range 2–3, and the smaller telescopes in the range 1.5–2. Two new surveys were selected to start in the 2006B semester: “The Outer Limits Survey: Stellar Populations at the Extremities of the Magellanic Clouds” (PI: A. Saha, NOAO) and “ChaMPPlane II: Optical Spectra and IR Imaging Identification of ChaMPPlane X-Ray Sources” (PI: J. Grindlay, CfA).

• Management/administration of FY06 Telescope System Instrumentation Program (TSIP): call for proposals; external review, technical/contractual oversight of previously awarded projects

The fifth annual call for TSIP proposals was made in October 2005, and a record 5 proposals were received, oversubscribing the $2M available by a factor of 4. Two instrumentation projects—MOSFIRE, a multi-object IR spectrograph for Keck, and a new camera for IMACS, an optical spectrograph on Magellan—were approved for funding. Two previously funded instruments, MODS-2 for LBT and MMIRS for Magellan and the MMT, are nearing completion.

† This milestone is dictated by the reduced FY06 budget. Failure to find operations partners may lead to closure of the 2.1-m.
Adaptive Optics Development Program (AODP): Ongoing technical/contractual oversight of previously awarded projects

Funding was only available in FY06 to continue payments on previously funded awards.

SCIENCE PROGRAM (NORTH)

FY06 Milestones

- Continue the staff mentor program and carry out initial evaluation of its efficacy

  The program has worked effectively for our post-doctoral fellows and was expanded to include detailed advising regarding proposal preparation, job application, interviewing, and career planning in general. The program has not been implemented as effectively with staff astronomers and scientists. During FY07, it will be necessary to address this deficiency, particularly in view of the need to provide information and some level of comfort regarding NOAO’s rapidly evolving roles.

- Provide support for staff scientific research

  Support of publications, travel and basic computer needs continued unabated. Budget restrictions precluded new commitments to partial support for post-doctoral fellows, graduate students or research assistants.

- Proactively monitor matrixing of staff with the goal of minimizing extreme multi-tasking

  Associate directors are now keenly aware of these issues and the level of multi-tasking has been reduced as compared with 2–3 years ago.

- Continue to organize joint colloquia and lunch talks with Steward Observatory staff

  The program provided the following topics and speakers as a source of intellectual stimulation for NOAO, Steward and LPL staff:

  "Probing the ISM of High z Galaxies with DLA and GRB's"  Jason X. Prochaska  University of California Lick Observatory
  "The Solar Neon Puzzle, or which is wrong: Helioseismology, Stellar Atmospheres, and Stellar Evolution?"  Dr. Dave Arnett  Steward Observatory
  "The SkyMapper Telescope and Southern Sky Survey"  Dr. Brian Schmidt  Australian National University
  "Dwarf Disk Galaxies: Exploring Dynamics and Baryon Content at the Faint-end of the Luminosity Function"  Dr. Marla Geha  Carnegie Observatories
  "Black Hole Demographics from AGN Statistics"  Dr. Luis Ho  Carnegie Observatories, Pasadena
  "New Prospects for Imaging Giant and Terrestrial Exoplanets"  Dr. Oliver Guyon  Subaru Telescope, NAOJ
Enhance interaction among the Tucson astronomical community via active participation in the LAPLACE Astrobiology Center, the Formation and Evolution of Planetary Systems (FEPS) and other major joint research activities

Key members of the scientific staff and post-doctoral fellows are active participants in both LAPLACE and FEPS, to the mutual benefit of scientists at Steward, LPL and NOAO. The LAPLACE modules at NOAO have continued to be productive.
NOAO DIRECTOR’S OFFICE

FY06 Milestones

- Recruit a new Director for KPNO to replace R. Green; a reduced FY06 budget may restrict the field to internal candidates

  An acting director, Dr. Buell Januzzi, was appointed. A search began, but was suspended due to the delay in the release of the report of the Senior Review. The search was reopened in the fall of 2006 with applications due by December 15th.

- Develop a Web page to inform the community of the availability of observing opportunities on U.S. small telescopes

  The Community Access Telescope Clearing House (CATCH) Web site is now available to the community and can be found at http://www.noao.edu/system/catch. The Web site offers information about and links to all available community observing opportunities, including those resulting from TSIP or PREST awards, as well as those at NOAO facilities. It is maintained by NOAO’s Science Operations program.

COMPUTER INFRASTRUCTURE SUPPORT (CIS)

FY06 Milestones

- Complete the upgrade of the scientist workstation network to 1 Gb/sec

  With the completion of the project to expand the Aspen 8810 Ethernet switch as the “backbone” of the NOAO Tucson network and the installation of an HP ProCurve 4208vl switch in the Engineering building, every scientist and engineer in the NOAO Tucson complex has or can have a 1 Gb/sec Ethernet connection to his or her desktop.

- Implement transition plan for maintaining the DS3 data line from Tucson to Kitt Peak after the NSF subsidy ends in March, 2007.

  The TOUA portion of the DS3 circuit tripled in price in September 2006 (we misunderstood the agreement and thought the change would occur 6 months later). So far, we are eating the increased cost. Negotiations with TOUA for a new long term agreement have as of yet not been fruitful. Meanwhile, efforts are underway to reduce the equipment costs involved with the DS3 circuit.
CENTRAL FACILITIES OPERATIONS (CFO)

FY06 Milestones

- Complete ADA ramp access between LSST and MIP areas

  Due to staffing commitments, the project was not started until late in the year and should be completed in the first quarter of FY07.

- Review AURA duplex building and develop a process to remove it and expand parking area

  A review was completed and a plan to remove it was developed. This plan involved a land swap between AURA and the University of Arizona (UA) and the northwest parking lot which NOAO rents from the UA. The swap was put on hold for review in the spring of 2007, due to availability of AURA funds.

- Review other storage areas; develop a plan to free up space and to decommission or sell old, unused buildings

  Consolidation and re-utilization of space in another location was done to stop usage of a deteriorated building area. Plans have also been put together to revise the parking areas. Contact was made with the UA to investigate the possibility of property trades, demolishing deteriorated structures and enhancing the parking areas. An asbestos survey was completed to enable demolition to proceed once approval is obtained. An agreement was prepared with the UA for a portion of the property, but it has not been finalized and NSF approval to complete the remaining plan has not been pursued.

- Continue to maintain the aging Tucson facility, and as budget permits, improve those areas most critical to the changing nature of operations

  Facilities staff continued maintenance in several critical areas of the building, HVAC&R and electrical systems. Contracts were implemented to repaint the exterior of the main building to seal the walls and prevent additional deterioration. A primary boiler was replaced after it failed, the primary cooling tower required emergency repair and a 480-volt short in a primary backup chiller system was repaired. Additional efforts were required to replace two roof-top HVAC units when they failed. Staff continued efforts to clean the heating and cooling coils in several original-equipment air handling systems to remove debris and improve operations and efficiency. A new, energy-efficient air compressor was installed to replace a deteriorated unit at the Tucson coatings facility.

- Continue security upgrades, as budget permits

  Access control was extended to external access to a meeting room and to an electronics supply storage area.
CENTRAL ADMINISTRATION SERVICES (CAS)

FY06 Milestones

- Successfully implement the LSSTC Services agreement

  *The LSSTC services agreement was successfully implemented and an audit of the LSSTC corporation from inception through FY05 was completed.*

- Take the lead in assisting AURA to deliver a working document on consolidation of Center Administration Services to be submitted to the AURA Board in Spring 2006

  *The AURA business study was extended to spring 2007 due to the complexities of the logistical needs. However, NOAO took the lead by hosting all the first meetings of the AURA Business Services Studies. Furthermore, three of the five committees are chaired by NOAO staff. The reports to the AURA Center Business Managers will be delivered in December 2006 for review in January 2007.*

- Fully implement new Sponsored Research processes in the areas of pre- and post-award submissions, reporting, and subcontracting

  *Implementation of the NOAO Sponsored Projects Offices was fully completed in June 2006 with the debut of the new pre- and post-awards reporting system. Staffing for the office consists of a sponsored projects manager, sub-award and contracts officer and a sponsored projects specialist. Together, this new team has implemented a new Web site, grants and contracts reporting system, and sponsored projects assistance system. The newly designed, informational and integrated Web site can be found at [http://www.noao.edu/cas/spo](http://www.noao.edu/cas/spo).*

- Continue to improve NOAO North/South relationships and processes including providing an in person annual benefit update to expatriates by HR staff

  *Human Resources made two trips to NOAO South this year to present benefit updates and work with the expatriates on supporting their needs. Furthermore, the administrative manager for CTIO received training on expatriate support and will now be a liaison with the Tucson office. Both NOAO and Gemini HR staff worked together with AOSS to develop an expatriate informational program. Further progress was made through the AURA HR business study team to implement better policies for those located in La Serena.*
NOAO-WIDE PROGRAMS

NEW INITIATIVES OFFICE (NIO)

FY06 Milestones

- Initiate M1 support; M2 and M3 conceptual designs

  Conceptual design reviews were held for M3 on March 1, 2006, and for M2 on April 6, 2006. Additional material was provided for the TMT CoDR in May and for the Cost Review in September. Support activities were also carried out for M1 in connection with the two latter reviews.

- Develop an Observatory Requirements Document

  A draft ORD was developed during FY06 and placed under change control.

- Initiate a feasibility study of a Mid-IR Echelle Spectrograph (MIRES)

  The feasibility study was completed and a review was held March 17, 2006. Additional material was produced in response to the review committee report and for the TMT CoDR and Cost Review.

- Assist completion and submission of GSMT Science Working Group’s science-as-a-function-of-aperture study for the NSF

  A draft of the report has been prepared and the final version is scheduled for release in mid-2007.

- Hold a workshop on future major IR interferometry facilities

  Preparations for the workshop were carried out; the workshop was scheduled for November 2006.

- Begin site testing at Cerro Tolancha [sic]; permit Cerro Quimal

  Site testing was started on Cerro Tolonchar. The site testing permit for Quimal was denied, as it is a culturally sensitive site; it was agreed that no further attempt would be made to carry out testing on Quimal. Site testing is, therefore, currently underway at three sites in northern Chile.

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*Cerro Quimal milestone is threatened by any rescission of the FY06 budget.*
LARGE SYNOPTIC SURVEY TELESCOPE (LSST)

FY06 Milestones

Project Management and Systems Engineering

- Complete a telescope and site Conceptual Design Review

  The telescope and site reference design was completed in August 2006. A formal concept design review is now expected to be held in the spring of 2007.

- Complete NOAO’s contribution to the NSF Major Research Equipment and Facilities Construction (MREFC) proposal

  NOAO has provided sections on the telescope and site, the systems engineering, and the operations. The proposal effort is on-going and NOAO continues to contribute with material and with editing of the document.

- Complete the system error budget

  NOAO has completed the structure for a radially symmetric image blur error budget and an image ellipticity error budget. These tools are in place and used for LSST systems engineering.

- Complete NOAO’s contribution to the Operational and Functional Requirements Documents

  The operational and functional requirements documents were put on hold. NOAO has continued development of the telescope and site requirements document and the LSST requirement traceability matrix. NOAO also provides the LSST interim systems engineer, who was appointed late in the year.

- Complete optical design optimization

  A fine tuning of the LSST optical design was made in January 2006. This design, version 3.1, is the LSST baseline design.

Facility and Site

- Complete support effort to final site selection process

  The telescope and site group completed its support of the LSST site selection process with a third compiled data set, a proposal request and review process, several committee meetings, and the organization of a final meeting for the site committee to develop its final recommendation. The committee made its recommendation and, following an additional question period, the LSST Board accepted the committee recommendation to site the LSST on Cerro Pachón.
■ Maintain the DIMM on Cerro Pachón for site evaluation

The new DIMM installed on Cerro Pachón for the site evaluation process was maintained to support site selection data package. Since this is the selected LSST site, maintenance of the DIMM has continued.

LSST continues to log all sky image and weather data to build on its database of comparable data from three major astronomical observatories.

Telescope Mount

■ Complete the telescope system reference design

The vendor studies for the telescope and the vibration damping system were completed this year and the reference design for the telescope system was determined from the study results.

■ Complete the camera support system reference design

Finite element analysis of the camera support system was completed and contact with industrial vendors was made to establish the reference design for the camera hexapod support system.

Telescope Optics

■ Complete the reference design for the secondary mirror

Secondary mirror concept studies with two industrial vendors were completed this year and the results were folded into internal design and analysis results to complete the reference design of the thin meniscus actively-supported secondary mirror.

■ Work with LSSTC contractor (Steward Obs.) to complete design of M1/M3 monolithic mirror

The telescope and site group worked with the SOML to complete the design of the M1/M3 mirror design. The thickness of the casting was the critical parameter established through analysis of the casting process limits and the resulting mirror performance.

Wave Front Sensor and Active Alignment System

■ Complete the wavefront reconstructor analysis code

Three separate analyses were completed this year to establish the basic reconstructor algorithm and the important sensor geometry in the focal plane. The effort supported the development of the baseline design to have four wavefront sensors located in the corners of the focal plane, and that the resulting information adequately samples the field to determine active optics corrections to the system.

■ Complete concept analysis of active alignment system

An industrial study and internal analysis was completed to establish the laser tracker technology as the reference design component to support system alignment on telescope. The performance was established to show it quickly and easily brings the optics within WFS capture range and will provide a significant support to efficient initial integration alignments.
Science and Operations

- Complete NOAO's contribution to the Science Requirements Document (SRD)

  *The LSST Science Requirements Document has been released and is under version control. NOAO provides a representative on the Science Council for the LSST charged with oversight of the SRD.*

- Continue development of the Operations Simulator, leading PanSTARRS and LSST development

  *The Operations Simulator has developed steadily throughout the year. NOAO has led the technical development of the effort with significant support from LSST partners and the PanSTARRS project. Several releases were published this year and the tool is the primary resource to analyze LSST survey performance.*

- Complete NOAO's contribution to an LSST operations plan

  *NOAO supported an LSST collaboration meeting to discuss LSST operations and took the lead in developing the first draft document.*

Data Management

- Host one meeting to develop community access models and data models for the LSST

  *NOAO supported the LSST/NVO meeting held for collaboration discussions on this topic.*

MAJOR INSTRUMENTATION PROGRAM

FY06 Milestones

- Deliver NEWFIRM to KPNO Mayall 4-m telescope and begin on-sky commissioning

  *NEWFIRM completed two cold test cycles with substantial rework following each one. All optics and detectors were received, although a replacement for Lens 8 is on order due to the marginal quality of the first version. NEWFIRM passed its optical alignment checks with all lenses installed. At the end of FY06, NEWFIRM was being reassembled for a complete system checkout on the flex rig. Initial delivery to the Mayall telescope is scheduled for January 2007.*

- Complete development of “production” CCD Monsoon system

  *The first-generation CCD version of MONSOON is in active production and has been delivered to a number of collaborator institutions.*

- Delivery of production Monsoon controllers (both CCD and IR) to KPNO and collaborator institutions working on WIYN and CTIO-Blanco instrumentation development

  *MONSOON controllers were delivered to collaborators working on projects including the Dark Energy Camera, WHIRC, FHiRE (Indiana University), QUOTA (WIYN), and the WIYN Bench Spectrograph Upgrade (KPNO).*
Launch second generation of engineering development for advanced Monsoon CCD controller design, in collaboration with WIYN and CTIO-Blanco instrumentation development groups

*Development programs were launched for adapting the MONSOON CCD controller for the WIYN One-Degree Imager and the Dark Energy Camera.*

Successfully complete Preliminary Design Review for the SOAR Adaptive Module (SAM) and launch detailed design and fabrication phase

*The Preliminary Design Review for SAM was held in December 2005. The review panel approved the design with some suggestions and comments. The panel also approved the plans to proceed directly to fabrication for the subsystems with more mature designs (opto-mechanical, mechanical superstructure, electronics and software). The SAM team incorporated most of the suggestions and proceeded with detailed design development and began fabrication of mechanical components in mid-FY06. Optics were also ordered, and most had been received by the end of the fiscal year.*

Successfully complete a joint Japanese/American conference on GWFMOS science opportunities led by Project Scientist A. Dey (NOAO) as Science Organizing Committee Chair and supported by financial assistance from the NOAO Gemini Science Center

*The conference was held in November 2005 under the leadership of Dr. Dey.*

Budget for explicit under-spending in FY06 to offset at least 60% of accumulated FY03–FY05 overspending on Gemini design studies

*MIP began FY06 with an accumulated deficit of over $530,000. By the end of FY06, that deficit was completely eliminated, and MIP finished FY06 with a surplus of about $73,000.*

**DATA PRODUCTS PROGRAM (DPP)**

**FY06 Milestones**

By July, 2006, release the initial version of an end-to-end data flow system that provides proprietary and non-proprietary access to raw and reduced data from the NOAO telescopes. The release includes NOAO Science Archive Release 3.0 as well as a prototype of the NOAO data portal that will integrate access to local and external archived data with local and external tools, including some IRAF tasks packaged as Web services.

*An operational prototype of the NOAO data portal was delivered in January 2006. In July 2006, working prototype versions of the three major components of the end-to-end data management system (archive, pipeline, and advanced portal) were completed. However, these versions were deemed not robust enough for operational deployment. Intensive refactoring began in August, with a renewed focus on the interfaces between the components as well as the operational efficiency (given the minimal operational staff available to run the system). This refactored system is due to be released as an operational system in early 2007 for the 2007A observing semester.*
By the end of FY06, implement routine operation of data reduction pipelines for CCD Mosaic and NEWFIRM, delivering reduced data from each night’s observing to the archive within one day. By this time, the entire backlog of cached CCD Mosaic data will have been reduced and ingested.

The working version of the MOSAIC pipeline was delivered by the end of FY06, and was undergoing intensive scientific verification. Integration with the above end-to-end data management system was delayed. Therefore, while the pipeline was used to reduce significant portions of the two years of cached MOSAIC data for science verification, those reductions were not “routine operation” nor were the data ingested into the NOAO Science Archive. This activity will begin in the first quarter of CY07. Design work for the NEWFIRM pipeline began in late FY06, for delivery in mid-FY07.

Collaborate on the development of a proposal for operation of the National Virtual Observatory (NVO), with the goal of significant NOAO participation in the operations phase.

Our active participation in NVO activities continued in FY06, with highlights including deployment of a new NVO portal, NVO@NOAO, which supports the new data discovery tool NOAO Sky, a Google-map-like interface to the VO. The actual proposal for operations of the NVO was delayed by more than a year due to issues at NSF/NASA level, but towards the end of FY06 we became involved in the development of the NVO operations proposal.

PUBLIC AFFAIRS AND EDUCATIONAL OUTREACH (PAEO)

FY06 Milestones

- Train a new class of Teacher Leaders in Research-Based Science Education (TLRBSE) and complete the first round of TLRBSE-Spitzer teacher observations and analysis.

  Completed successfully; second round of RBSE-Spitzer observing underway (with a total of 18 teachers involved).

- Host the kick-off training workshop for the “Astronomy From the Ground Up” program in spring, 2006.

  Completed with a very successful event on Kitt Peak from April 19–21, 2006. For more, see the June 2006 NOAO/NSO Newsletter, pages 44-45.

- Complete the development of Hands On Optics (HOO) modules 4–6 and work with the Western U.S. MESA states and various science centers across the country on the long-term sustainability of HOO at these sites.

  Fully accomplished. All six kits were completed, a commercial vendor was established through competitive bidding, more than a dozen HOO workshops led by PAEO staff were conducted across the country, and two time-intensive new efforts at local Tucson Boys & Girls Clubs were initiated.

- Recruit at least 200 members for the new Kitt Peak Membership Group.

  Development of TLRBSE is limited by the reduced FY06 budget.
Over 116 members and climbing. Support staff time limited due to competing duties and loss of part-time office assistant; hired another in October 2006.

- Activate the KPNO Explosive Transient Camera (ETC) building as a new site for the Kitt Peak Nightly Observing Program and other public outreach activities

  Building was made safe for the public, repainted, new floors put down, and furniture and equipment were purchased. Public program use is underway, with no impact on nearby Kitt Peak tenants.

- Update or replace at least three displays in the KP Visitor Center and KPNO telescope galleries

  Completed new 2.1-m telescope lobby display, Sun clock, outdoor signs, and new Mayall 4-m poster installed at the visitor center and in 4-m public entrance.

- Develop a prototype student-teacher research activity on characterization of near-Earth objects using LSST Design & Development phase education/public outreach funding, and draft a detailed plan with the American Museum of Natural History on how to field test public interactivity with large image displays

  In progress, with ongoing support from LSST EPO funding. Work with AMNH has been transitioned to a lower-cost effort locally and collaboration with a UA graduate student in planetary science/science education is underway.

- Conduct at least two ASTRO-Chile events; develop a near-term strategic plan for outreach in Chile

  Major video workshop conducted in May 2006, along with several smaller coordination sessions. Group also took part in the global GLOBE at Night program in February 2006. Budget plan for FY07 includes elements of strategic plan.
### ACRONYMS AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>A-RBSE</td>
<td>Astronomy Research Based Science Education</td>
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<td>AAAC</td>
<td>Astronomy and Astrophysics Advisory Committee</td>
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<td>ADA</td>
<td>Americans with Disabilities Act</td>
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<td>ALMA</td>
<td>Atacama Large Millimeter Array</td>
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<td>AMNH</td>
<td>American Museum of Natural History</td>
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<td>AO</td>
<td>Adaptive optics</td>
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<td>AODP</td>
<td>Adaptive Optics Development Program</td>
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<td>AOSS</td>
<td>AURA Observatory Support Services</td>
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<td>AST</td>
<td>Astronomy Division</td>
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<td>ATST</td>
<td>Advanced Technology Solar Telescope</td>
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<td>CAA</td>
<td>Committee on Astronomy and Astrophysics</td>
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<td>CAS</td>
<td>Central Administrative Services (NOAO)</td>
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<td>CATCH</td>
<td>Community Access Telescope Clearing House (NOAO)</td>
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<td>CCD</td>
<td>Charge-coupled device</td>
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<td>CFD</td>
<td>Computational fluid dynamics</td>
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<td>CFO</td>
<td>Central Facilities Operations (NOAO)</td>
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<td>ChaMPlane</td>
<td>Chandra Multi-wavelength Plane Survey</td>
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<td>CIS</td>
<td>Computer Infrastructure Support</td>
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<td>CoDR</td>
<td>Conceptual Design Review</td>
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<td>CONAMA</td>
<td>Comisión Nacional de Medio Ambiente</td>
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<td>CTIO</td>
<td>Cerro Tololo Inter-American Observatory</td>
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<td>DECam</td>
<td>Dark Energy Camera</td>
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<tr>
<td>DIMM</td>
<td>Differential Image Motion Monitor</td>
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<td>DOE</td>
<td>Department of Energy</td>
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<td>DPP</td>
<td>Data Products Program (NOAO)</td>
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<td>DRM</td>
<td>Design Reference Mission</td>
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<tr>
<td>ELT</td>
<td>Extremely Large Telescope</td>
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<td>EPO</td>
<td>Education and Public Outreach</td>
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<td>ESO</td>
<td>European Southern Observatory</td>
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<td>ETC</td>
<td>Explosive Transient Camera</td>
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<tr>
<td>ETS</td>
<td>Engineering and Technical Services (NOAO)</td>
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<td>FEPS</td>
<td>Formation and Evolution of Planetary Systems</td>
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<tr>
<td>FHiRE</td>
<td>Fiber High Resolution Echelle</td>
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<tr>
<td>FITS</td>
<td>Flexible Image Transport System</td>
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<tr>
<td>FTE</td>
<td>Full-Time Equivalent</td>
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<tr>
<td>GEMS</td>
<td>Great Explorations in Math and Science</td>
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</table>
GONG — Global Oscillation Network Group
GMT — Giant Magellan Telescope
GSMT — Giant Segmented-Mirror Telescope
GWFMOS — Gemini Wide Focus Multi-Object Spectrograph
HOO — Hands-On Optics (NOAO)
HR — Human Resources
IR — Infrared
IRAF — Image Reduction and Analysis Facility
IRMOS — Infrared Multi-Object Spectrometer
ISPI — Infrared Side Port Imager (NOAO)
JWST — James Webb Space Telescope
KPNO — Kitt Peak National Observatory
KPVC — Kitt Peak Visitor Center
LAPLACE — Life and Planets Astrobiology Center
LBT — Large Binocular Telescope
LCO — Las Campanas Observatory
LGS — Laser Guide Star
LPL — Lunar and Planetary Laboratory (U. Arizona)
LSST — Large Synoptic Survey Telescope
MCAO — Multi-conjugate Adaptive Optics
MESA — Math, Engineering, and Science Achievement
MIP — Major Instrumentation Program (NOAO)
MIRES — Mid-IR Echelle Spectrograph
MMIRS — MMT and Magellan Infrared Spectrograph
MMT — Multiple Mirror Telescope
MOSFIRE — Multi-Object Spectrograph for InfraRed Exploration
MREFC — Major Research Equipment and Facilities Construction (NSF)
NCSA — National Center for Supercomputing Applications
NEWFIRM — NOAO Extremely Wide Field Infrared Imager
NGSC — NOAO Gemini Science Center
NICI — Near-Infrared Coronagraphic Imager
NIO — New Initiatives Office (AURA)
NOAO — National Optical Astronomy Observatory
NOP — Nightly Observing Program (NOAO)
NSA — NOAO Science Archive
NSTA — National Science Teachers Association
NSO — National Solar Observatory
NVO — National Virtual Observatory
ACRONYMS AND ABBREVIATIONS

O/IR — Optical/Infrared
ODI — One-Degree Imager (WIYN)
ORD — Observatory Requirements Document
OTA — Orthogonal Transfer Array
PAEO — Public Affairs and Educational Outreach (NOAO)
PREST — Program for Research and Education with Small Telescopes
PROMPT — Panchromatic Robotic Optical Monitoring and Polarimetry Telescopes
QUOTA — Quad Orthogonal Transfer Array Camera
REU — Research Experiences for Undergraduates (NSF)
SAC — Science Advisory Committee
SAM — SOAR Adaptive Module
SCOPE — Southwestern Consortium of Observatories for Public Education
SMARTS — Small and Moderate Aperture Research Telescope System
SOAR — Southern Astrophysical Research Telescope
SOML — Steward Observatory Mirror Lab
SPIE — Society of Photo-optical Instrumentation Engineers
SRD — Science Requirements Documents
SWG — Science Working Group
TAC — Time Allocation Committee
TCS — Telescope Control System
TLRBSE — Teacher Leaders in Research Based Science Education
TMT — Thirty Meter Telescope
TOUA — Tohono O’odham Utility Authority
TSIP — Telescope System Instrumentation Program
UPS — Uninterruptible power supply
WFS — Wide-Field SurveyWave front Sensor
WHIRC — WIYN High-resolution Infrared Camera
WIYN — Wisconsin-Indiana-Yale-NOAO 3.5-m telescope