A deep new image of part of the Virgo cluster, taken with the Mosaic-1 optical imager on the KPNO Mayall 4-m telescope, reveals monumental tendrils of ionized hydrogen gas 400,000 light-years long connecting the elliptical galaxy M86 (right) and the disturbed spiral galaxy NGC 4438 (left).

*Image Credit: Tomer Tal & Jeffrey Kenney/Yale University, NOAO/AURA/NSF*

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1 NOAO DIVISIONS

1.1 CERRO TOLOLO INTER-AMERICAN OBSERVATORY

Program Highlights

CTIO completed a key transition in November 2008 as Dr. Alistair Walker stepped down from the directorship of CTIO after serving five successful years. After taking a six-month sabbatical (beginning January 2009), Walker will return to the CTIO scientific staff and take up the role of Dark Energy Camera Instrument Scientist. Dr. R. Chris Smith stepped into the position of CTIO Director on November 10. Smith first joined the CTIO staff in 1991 as a postdoctoral fellow, and rejoined the staff in 1998 as permanent staff (tenure-track).

Status of FY09 Milestones

- Offer the 1.5-m high-resolution spectrograph as a user facility.

  Status: The refurbished ex-Blanco 4-m Echelle spectrograph was offered in the 2009A semester as a new fiber-fed, high-resolution, high-stability spectrograph with an iodine cell for extreme radial velocity precision. This instrument is being used for a detailed search for planets in the Alpha Centauri system. As a combined result of the large number of nights needed for the Alpha Centauri project and the popularity of this new instrument, the oversubscription on the CTIO 1.5-m hit a recent high of 3.38.

- Commission the Spartan IR Imager on SOAR.

  Status: The Michigan State-built Spartan IR Imager arrived in La Serena and was shipped to Cerro Pachón in the first quarter of FY09. Soon after, the SOAR staff confirmed that the camera had arrived without any damage and was ready to install on the telescope. Commissioning will run through the second and possibly third quarters of FY09.

1.2 KITT PEAK NATIONAL OBSERVATORY

Program Highlights

Both the Mayall 4-m and WIYN 3.5-m telescopes saw FY09 start with the beginning of routine science operations of new near-IR imagers. NEWFIRM is now being used by three NOAO Survey programs at the Mayall, all three focusing on the evolution and formation of galaxies and large-scale structures at intermediate and high redshift. WHIRC, a camera at WIYN capable of providing 0.3" images, was accepted in October by the WIYN Board as a new general-use instrument.

While KPNO looks forward to science results from its newest instruments, its older instruments continue to produce exciting new results. Jeff Kenney, Yale University, and colleagues used the combination of Mayall 4-m Mosaic-1 wide-field imaging and WIYN 3.5-m spectroscopy with Sparsepak to study a previously unsuspected high-speed collision between two galaxies in the
Virgo cluster (Cover image). A filter on the Mosaic-1 was used to reveal the light from Hydrogen-alpha (H-alpha) emission. The red filaments in the image show H-alpha emission with low velocities (similar to the velocities of the two colliding galaxies M86 and NGC 4438). The green filaments, seen near the edge-on spiral galaxy in the lower right (NGC 4388), show H-alpha emission with much higher velocities, suggesting that this galaxy might not be related to M86. The image and related spectroscopic measurements of the filaments provide striking evidence of a previously unsuspected high-speed collision between the two galaxies. Their results are presented in their recent paper (Kenney et al. 2008, ApJ, 687, 69L), “A Spectacular H-alpha Complex in Virgo: Evidence for a Collision between M86 and NGC 4438 and Implications for the Collisional ISM Heating of Ellipticals.”

The Kitt Peak Visitor Center (KPVC), effective 1 January 2009, will be administered as part of Kitt Peak National Observatory. Visitor statistics (see table) and status reports on KPVC-related milestones for this quarter and in future quarter reports will be included in the KPNO section.

### Status of FY09 Milestones

- Replace the thermal chiller system at the WIYN 3.5-m telescope.

  **Status:** A preliminary design is being prepared for review during the second quarter with the replacement system to be installed by the end of 2009.

- Complete the replacement of major dome subsystems at the Mayall 4-m telescope. Portions of this work have been enabled by the $150K FY08 budget supplement to KPNO from the NSF. Work to be completed includes refurbishing the 32 dome trucks of the dome, installing new emergency brakes for the dome shutter, and completing repairs on the dome rails that were begun in FY08.

  **Status:** A project team has been formed and is beginning the planning process for the refurbishment of these systems.

- Execute prototype versions of two new revenue-based programs at Kitt Peak: special public observing nights with the WIYN 0.9-m telescope and daytime behind-the-scenes “tech tours” of the major telescopes.

  **Status:** Several trial runs of using the WIYN 0.9-m telescope for special public observing nights were held and the results are being evaluated to help determine whether to make this program a
permanent option for the KPVC. The Mayall 4-m “tech tour” is in the development stage and is scheduled for testing in early February.

- Develop a working, online Kitt Peak Visitor Center gift store.

  **Status:** Approximately 90% of the necessary work for enabling the online gift store has been completed, but completion is on hold due to recent staff reductions. Means for completing the project are being evaluated.

### 1.3 NOAO GEMINI SCIENCE CENTER

**Program Highlights**

An observing program with time allocations from the U.S., Canada, and the U.K. used the Gemini North and Keck II telescopes to obtain the first-ever direct images identifying an exo-multi-planet system around a normal star. The Gemini images allowed the international team, led by C. Marois (Herzberg Institute of Astrophysics), to make the initial discovery, in October 2007, of two planets in a system belonging to the main-sequence star HR8799. Further images revealed a third planet in this exo-solar planetary system. Observations continued into the summer of 2008, with the detection and measurement of Keplerian motions of the three planets. On both telescopes, adaptive optics technology was used to correct in real-time for atmospheric turbulence to obtain these historic infrared images of an extra-solar multiple-planet system. The images were released in November 2008.

**Status of FY09 Milestones**

- Improve the communication links between NGSC/NOAO, the U.S. user community, and the Gemini Observatory. One part of this improvement is expanded access to the Gemini HelpDesk with the addition of an option to contact directly NOAO/NGSC staff astronomers for faster, more direct answers to questions, as needed by U.S. users. Another part of this effort will be through an increased emphasis on classical observing with the Gemini telescopes by U.S. astronomers.

  **Status:** Completed. Additionally, a direct contact to an NOAO/NGSC astronomer was announced via the NOAO/NSO Newsletter and with a link on the NGSC Web site www.noao.edu/usgp/. This direct contact can be either via e-mail or telephone. Beginning with semester 2009A, there is also an increased emphasis on classical observing for U.S. observers at Gemini, with 21% of 2009A U.S. programs being classical (compared to ~5–10% in previous semesters) and these programs amounting to 32% of U.S. observing time.

- Provide advice and expertise to the Gemini Observatory in support of the deployment of NOAO’s Phoenix spectrograph on Gemini-South during its continued availability as a Gemini visiting instrument over semesters 2009A and 2009B.
**Status:** Completed. A Memorandum of Understanding was completed and signed that insures that Phoenix remains available to the community through semester 2009B (the end of February 2010), with NOAO committed to provide support and expertise as needed.

1.4 SYSTEM DIVISION

1.4.1 System Development

**Program Highlights**

Key system development activities in this quarter included the submission of the final ReSTAR proposal to NSF and the final stages of the ALTAIR process. The ReSTAR proposal finalized the planning phase for this community-based process that seeks to renew the infrastructure and instrumental capabilities for system telescopes in the aperture range of 2–4 meters. The phase 1 implementation proposal includes resources for optical and infrared spectrometers for the NOAO 4-m telescopes, system access at Palomar and the Discovery Channel Telescope (DCT), development of an echelle spectrograph for DCT, and design studies for 2-m telescopes that would be part of the robotic system of telescopes for the Las Cumbres Optical Global Telescope.

The ALTAIR committee is assessing the community needs for access to 6.5-m to 10-m telescopes in a similar way to that which ReSTAR did for smaller apertures. This vital assessment will be used to inform NOAO’s input to the upcoming decadal survey in particular and the NOAO Long-Range Plan in general. The committee sponsored a survey of the community’s desires for instrument, observing, and data capabilities in this aperture range and received nearly 600 responses. Details of the survey results and committee recommendations will be given in a subsequent report due out in February 2009.

The Telescope Allocation Committee (TAC) activities this quarter consisted of follow-up correspondence with observers to address issues raised during the fall 2008 TAC meetings. In addition, planning was undertaken to transfer the leadership of the TAC process from L. Stanghellini, who will be on sabbatical leave during FY09, to D. De Young and T. Boroson. De Young will supervise the TAC process for the spring 2009 TAC meetings, and Boroson will supervise this process in the fall of 2009.

**Status of FY09 Milestones**

- Complete the preparation of the proposal to acquire funding to begin development of the instrumentation and telescope partnerships needed to address the ReSTAR recommendations. Following successful review and funding of this proposal for the initial three-year phase, begin carrying out this work.

**Status:** The ReSTAR proposal for phase 1 implementation was submitted to the NSF in November 2008.
• Assist the newly formed ALTAIR committee to develop a set of community, science-driven needs for capabilities and access to telescopes in the 6.5- to 10-m aperture range. Following the completion of this study and the delivery of this report, begin to develop a plan to address its recommendations.

**Status:** ALTAIR held its final face-to-face meeting in Dallas in November 2008. A draft report has been written summarizing the committee’s recommendations.

• Continue to engage the community in an effective dialog about the evolution of the system, in the context of the NOAO program.

**Status:** The NOAO director will make a presentation to the astronomical community at the NOAO Town Hall during the 213th AAS meeting in Long Beach in January 2009. Plans are being made for NOAO participation in one or more town halls to collect community input for the upcoming decadal survey (Astro2010).

### 1.4.2 System Instrumentation

**Program Highlights**

System Instrumentation (SI) provided considerable support to the NOAO proposal for the first phase of implementing the recommendations of the ReSTAR committee, mainly through development of approximate cost estimates for four new instruments. This proposal, submitted to the NSF in November 2008, requested a total of about $12M over a three-year period, of which slightly more than half would go to construction of the four new instruments for the System’s 4-meter telescopes. If funded, all of these instruments would be built through partnerships with other institutions.

SI also launched its first undergraduate clinic effort in collaboration with the Engineering program at Harvey Mudd College. Four undergraduate engineering students, two seniors and two juniors, are working on a concept for a new front-end for the CCD version of the MONSOON detector controller. The idea, originally conceived by NOAO Senior Engineer Peter Moore, will be turned into a prototype and tested by the student team. If successful, it should reduce the MONSOON contribution to total system readout noise to below 1 electron, thus allowing device-limited performance with new, ultra-low-noise CCDs just now becoming available. The status of the milestone related to this project is noted below.

**Status of FY09 Milestones**

• Complete lab integration and testing of the SAM Main Module, deliver it to SOAR, and begin commissioning it in natural guide star mode.

**Status:** Initial lab integration of the Main Module was completed in late December 2008 with the installation of the final version of the turbulence simulator needed for daily calibration of the system. Using this simulator, the team demonstrated closed-loop performance at the required frequencies, fully correcting the simulated turbulence to achieve a diffraction-limited test image.
This test fully demonstrated acceptable end-to-end performance of the complete Module. Immediately following the test, the Module was disassembled and the structural parts returned to the shop for anodizing. The team remains on schedule for delivery of the Main Module to SOAR around the start of the fourth quarter of FY09.

- Complete detailed design work of the SAM Laser Guide Star Module, begin fabrication, and order the laser and optics for the laser launch telescope.

**Status:** The laser was ordered and received in La Serena during this quarter. The team also completed and began implementing a laser safety plan for the La Serena lab. The opto-mechanical design of the laser launch telescope was completed, and a review of the design was scheduled for mid-January 2009.

- Complete a student engineering clinic project to design, prototype, and test an ultra-low-noise CCD front-end for MONSOON/TORRENT in collaboration with students and faculty at Harvey Mudd College.

**Status:** The clinic project was launched successfully. The students presented a mid-year progress report in December 2008, which showed they are making acceptable progress in their design work and are on track to produce the prototype before the end of the academic year as planned.

### 1.4.3 Giant Segmented Mirror Telescope Program Office

**Program Highlights**

Efforts within the Giant Segmented Mirror Telescope Program Office (GSMTPO) have been focused on two primary areas: providing input to the upcoming decadal survey (Astro2010) and completion of site survey efforts.

NOAO is organizing an independent community assessment of the technical status of the two U.S.-based extremely large telescope projects: the Thirty-Meter Telescope (TMT) and the Giant Magellan Telescope (GMT). This assessment will be held as two three-day reviews during the last week of April 2009. The reviews will provide separate reports on the status of the two projects and of their paths toward readiness for a Major Research Facility Preliminary Design Review. Details of the process have been discussed with the two projects. The panel was largely assembled at the end of December 2008. Portions of this assessment are funded under SPO-10.

AURA/NOAO is sponsoring a workshop on science with adaptive optics (AO), which will be held as a “meeting within a meeting” at the June 2009 AAS meeting in Pasadena. The workshop is intended to familiarize the broad community with the adaptive optics capabilities available for use at U.S. observatories, by presenting talks on science programs currently being carried out with AO, together with overview talks describing current capabilities at major observatories.

The site survey work continues to wind down, with removal of equipment and site restoration of an additional Chilean site (Cerro Tolonchar) completed in November. At this point, measurements are continuing on only one site (Cerro Armazones), which is the TMT southern candidate site. Most of the AURA-owned equipment will be relocated to Cerro Tololo to support
NOAO South. Work on the papers describing the survey results continues; the papers have not yet been submitted for review by the appropriate scientific journals.

**Status of FY09 Milestones**

  
  **Status:** A draft of the revised Design Reference Mission process (renamed Science Capability Requirements) was developed; the process is largely on hold due to limited resources and overlap with other Astro2010-related activities.

- Support for community assessment of GMT and TMT by an external review panel, to be held in the spring of 2009.
  
  **Status:** The assessment process was defined and described to the projects; a panel was recruited (some members pending).

- Removal of site survey equipment from Cerro Tolonchar.
  
  **Status:** Completed.

- Submission for publication of initial site survey results.
  
  **Status:** The papers are still in draft form; submission is expected during the second quarter of FY09.

**1.4.4 Science Data Management**

**Program Highlights**

The Data Products Program (DPP) saw many changes this quarter. Chris Smith, its head of program, became director of CTIO and Betty Stobie, the program manager, became the interim head of program. DPP was reorganized and rescoped with a revised mission and a new name. The new name, Science Data Management, alludes to the short-term mandate (the next 18–24 months) from NOAO management to meet the immediate data management needs of NOAO and its community, including the Dark Energy Camera. Further details of this mandate will be included in the June issue of the NOAO/NSO Newsletter. The reorganization and new mandate affect the need for and resources available to accomplish some program milestones included in the NOAO Annual Program Plan FY 2009.

In October 2008, four staff members attended the Fall International Virtual Observatory Alliance Interoperability meeting in Baltimore, Maryland. In November, a 24-bit implementation of Ximtool was released and demonstrated at the Astronomical Data Analysis Software and Systems (ADASS) Conference. It was released publically after the conference. Seven staff members supported this ADASS Conference in Quebec City, Canada, with two oral and four poster presentations, the hosting of two BOFs, demonstrations of current IRAF capabilities including the newly released Ximtool, and by moderating the conference tutorial on the technologies behind Google Sky and the World Wide Telescope. Two staff members who serve on the ADASS Program Organizing
Committee participated in the planning of the current program and preparations for the 2009 conference and chaired sessions in the conference. Also in November, Stobie attended the fall Dark Energy Survey collaboration meeting at Ohio State.

Status of FY09 Milestones

- Operations of a functionally complete version of the end-to-end (E2E) data management system, including data capture, transport, archiving, pipeline processing, and access.

  **Status:** The Archive and Portal teams delivered major new releases of their subsystems, which are two of the elements of the E2E v1.2 system. Our quality assurance specialist built several automated test suites to validate system readiness for deployment early next quarter. E2E v1.2 deployment has been delayed by the departure of two of the archive programming staff (2/3 of the group) and the disruption resulting from the Data Products Program being reorganized and rescoped.
2 NOAO-WIDE PROGRAMS

2.1 LARGE-APERTURE SYNOPTIC SURVEY TELESCOPE

Program Highlights

The review of applications from the U.S. astronomy and physics communities for joining the Large-Aperture Synoptic Survey Telescope (LSST) science collaborations was conducted and completed under the aegis of NOAO. Forty proposals (with a total of sixty-six individual applicants) were evaluated by an independent panel of astronomers and physicists. Based on their recommendations, twenty-six of the proposals were accepted, thus adding thirty-six new members to the ten current LSST science collaborations. The LSST acquisition of the CALYPSO telescope on Kitt Peak has been supported by both technical and scientific staff at NOAO. Internal reviews were held for telescope and site, and for LSST calibration procedures as part of the project-wide, internal reviews in preparation for the Preliminary Design Review. Analysis of the thermal conditioning of the primary-tertiary mirror has been completed.

Technical progress this period was good. Detailed design support of the LSST primary/tertiary mirror and the secondary mirror was provided by NOAO engineers. An internal engineering team was formed to focus on the primary cell analysis and design and began working toward a subsystem review in the next quarter. The Chilean authorities granted AURA, on behalf of LSST, the necessary environmental permits that clear the way for LSST construction and operation on Cerro Pachón.

Status of FY09 Milestones

- Site and Facility: Develop the request for proposal for the Summit Facility Architectural and Engineering (A&D) Services contract.

  **Status:** The prerequisite task of developing the excavation plan was completed and the building permits were received from Chilean authorities finalizing earlier efforts to file necessary Environmental impact declarations for the construction and operation phases.

- Dome: Complete the final analysis of the calibration screen position within the dome.

  **Status:** Preliminary concepts for a back-illuminated dispersion screen and a direct-illuminated system were developed and are being evaluated against requirements.

- Reflective Optics: Collaborate with LSST’s primary mirror vendor to develop the polishing and test plans for the mirror.

  **Status:** A detailed thermal model of the mirror was developed and analyzed to determine the thermal support system requirements for the M1M3 mirror cell. The rear surfacing processing design was presented to the LSST group and approved pending some final details on the process design for the hard point locations.
• LSST Science Collaboration Support: Complete the review of Science Collaboration member proposals.

**Status:** Completed. Twenty-six proposals were accepted (see above).

• Science Mission and Requirements: Participate in development of LSST Science book.

**Status:** NOAO scientists participated in a four-day LSST consortium-wide meeting to assemble a Science Book for LSST. Data acquisition and analysis for testing and validating the photometric calibration strategy for LSST continued with NOAO scientist participation.

• Systems Engineering: Provide LSST with a project system engineer.

**Status:** Completed. C. Claver, the LSST telescope scientist, was assigned to the LSST project office as project system engineer.

### 2.2 EDUCATION AND PUBLIC OUTREACH

**Program Highlights**

The mission of the Public and Educational Outreach Program (PAEO) was redefined this quarter to more closely match the NOAO core mission. PAEO was split into Kitt Peak Visitors Center (KPVC) and Education and Public Outreach (EPO). The new EPO group is headed by S. Pompea, who reports to NOAO Interim Deputy Director Robert Blum. Among the new directions for the EPO program is an emphasis on the core mission to broaden participation in the NSF enterprise by underrepresented groups. Toward this end, K. Garmany was appointed as co-diversity advocate. The EPO program has been further tasked to concentrate on activities related to local outreach in the areas of La Serena and Tucson, and to engage the professional research community.

The goal of the International Year of Astronomy 2009 (IYA2009) Dark Skies Working Group is to raise public awareness of the impact of artificial lighting on local environments by getting people involved in a variety of dark-skies programs. EPO staff member, C. Walker, lead the IYA2009 Dark Skies Working Group in the creation of programs to meet that goal. The programs include teaching about dark skies, thematic events on light pollution at star parties, a photography contest, involving citizens in star hunting programs, and raising awareness about the link between light pollution and public health. NOAO hosts and EPO staff member M. Newhouse designed the official Web site for the presentation of these programs. The status of this project is described below.

<table>
<thead>
<tr>
<th>Public Outreach Information Requests &amp; Inquiries</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information requests/inquiries about astronomy/science (phone calls, e-mails, and walk-ins/requests for posters, bookmarks, brochures, etc.)</td>
<td>280</td>
</tr>
<tr>
<td>Requests and inquiries for use of NOAO images</td>
<td>212</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>492</strong></td>
</tr>
</tbody>
</table>
The Kitt Peak Visitor Center (KPVC), effective 1 January 2009, will be administered as part of Kitt Peak National Observatory. Visitor statistics and status reports on KPVC-related milestones for this quarter and in future quarter reports will be included in the KPNO section.

**Status of FY09 Milestones**

- Lead national efforts related to IYA2009, particularly program coordination with the Astronomical Society of the Pacific (ASP) and the Association of Science-Technology Centers (ASTC), national events and publicity, the Galileoscope telescope kit educational program and related optics education, and national/international dark-skies awareness programs. Take full advantage of related IYA opportunities in Chile.

  **Status:** Pompea continued his work as U.S. IYA program manager. He worked with ASP on the release of the IYA Discover Guides and gave a talk via phone and Internet to the ASP/NASA Night Sky Network of amateur astronomy clubs on cornerstone IYA programs. The “Get Involved” guides for many different audiences were completed and posted on the Web. Pompea worked with ASTC to establish a network of sites for IYA in science technology centers in the U.S. and abroad. The Galileoscope educational telescope kit finished its final optical design review at Photon Engineering in Tucson, and some final optical measurements were made at the University of Arizona Optical Sciences centers through two graduate students there. Mold production will begin next quarter. Development of Galileoscope educational materials continued with an anticipated finish date of late January 2009. An IYA press conference with press release took place at December’s American Geophysical Union meeting in San Francisco and led to several newspaper articles. IYA2009 Dark Skies programs were completed and placed on the official IYA2009 Dark Skies Awareness Web site at www.darkskiesawareness.org.

- Broaden participation in NOAO programs within both the astronomical community and the general public, through new mentoring programs and creative public outreach.

  **Status:** Following a request from AURA, the NOAO Director appointed EPO’s K. Garmany and NGSC’s D. Norman to be the co-diversity advocates at NOAO. They began learning about AURA’s action plan for diversity and planning future steps that should be taken. With NOAO support, Norman organized a luncheon at the AAS meeting in January to address recruitment and retention issues for minority scientists.

- Redesign the NOAO Web site to create a more attractive and more useful portal for the astronomy community and the public.

  **Status:** A redesigned NOAO Web site was released to the public 31 December 2008. There were two main goals for the site: create separate home pages for the general public and astronomers, and reorganize and revise the content in many places. The first goal has been accomplished, and work is now proceeding on the second goal.

- Celebrate the 50th anniversary of Kitt Peak National Observatory, in concert with the Tohono O’odham Nation and other interested stakeholders.
Status: Planning is underway. Items with artwork commemorating the anniversary, such as baseball caps, mugs, patches, and pins, are available for sale.

2.3 ADMINISTRATION AND INFRASTRUCTURE

2.3.1 NOAO Site Safety Report

This quarter the NOAO Tucson facilities experienced two industrial injuries. The first injury was a back strain suffered when an employee slipped on a ramp. In the second case, an employee slipped in a stairway and suffered a sprained arm and broken thumb. Anti-slip material was installed in both areas. For this quarter, Kitt Peak had no industrial injuries and the Tucson site had two.

In preparation for the arrival of the SOAR Adaptive Optics Module-Ultraviolet (SAM-UV) laser in La Serena, Chile, A. Tokovinin, R. Tighe and C. Gessner developed the SOAR laser safety program in October. During this time, the project team was presented with complete documents that included the SOAR Laser Safety Program, Laser Standard Operating Procedures for the lab, SAM-UV Laser Safety Briefing for Visitors, and other supporting documents. These documents can be found at: www.ctio.noao.edu/new/Telescopes/SOAR/Instruments/SAM/ao_fl_archive.html. E. Serrano volunteered to be the onsite Laser Safety Officer for the SOAR UV laser project.

C. Gessner presented the Project and Team Safety review and progress during the NSO ATST Systems Design Review held at the Tucson facility, November 4–7.

Insurance policies for AURA, WIYN, SOAR, and LSST were bound on October 1, and AURA’s Umbrella and Excess insurance was bound in November. Notable changes included an extension of U.S. liability insurance for AURA Nurses and Emergency Medical Personnel in Chile, an increase of the liability limit from $1M to $5M for LSST, general liability insurance for the newly acquired Calypso telescope facility, and substantial premium credits from the Hartford Eligible Policyholder Settlement Fund.

Rich Griesser from Clifton Gunderson Technology Systems visited CFO December 11 to review our methodology for electronic security of the Keyscan system and authorization. There will be no recommendations for us related to the Keyscan system.

2.3.2 NOAO Director’s Office

Program Highlights

This quarter had four key foci. First, an NOAO-wide rescoping plan was developed and implemented in reaction to the NSF budget restrictions imposed by the Congressional Continuing Resolution. Second, there were several oversight committees to engage including the NOAO Users’ Committee, NSF Program Review Panel and the AURA Observatory Visiting Committee. In addition, the NOAO director participated in Gemini and LSST Board meetings. Third, the NOAO director engaged directly with his staff in Chile over the course of two trips spanning three weeks total in La Serena. Finally, a number of activities related to the 2010 decadal survey (Astro2010)
occurred, including a meeting of the AURA Decadal Survey Steering Committee (J. Toomre, chair) and launching of the Future of NOAO committee (T. Beers, chair).

**Status of FY09 Milestones**

- Engage the Decadal Survey, in coordination with AURA, to present the role of NOAO in developing an open access system with a balanced set of science capabilities across the 2- to 30-m aperture range. In this context, explain the current and potential NOAO roles in LSST and GSMT design, development, construction, and operations. Participate in the deliberations of the AURA committee on the Evolution of the Ground-based O/IR System.

  **Status:** The Future of NOAO committee was launched with T. Beers (Michigan State) as the committee chair. Details about the committee and its purpose may be found at www.noao.edu/system/future09.

- Initiate the Renewing Small Telescopes for Astronomical Research (ReSTAR) implementation plan, as funding permits. The highest priorities are new, medium-resolution optical and near-IR spectrographs for the Mayall and Blanco 4-m telescopes.

  **Status:** A ReSTAR implementation funding proposal was submitted to NSF.

- Prepare for and engage with the Observatory Visiting Committee (OVC) appointed by AURA. As appropriate, work with AURA on implementing OVC recommendations.

  **Status:** The OVC visited NOAO North in Tucson in mid-December. They will visit NOAO South in La Serena in January 2009 and issue their report after that.

- Work with the NOAO Executive Committee and AURA to develop and execute a constrained program, as necessary, due to cash flow restrictions related to the Federal budget cycle.

  **Status:** A plan was developed, reviewed by various AURA committees and the NSF Program Review Panel, approved, and executed. During this quarter, NOAO operated at a cash-flow restriction of almost 90% of the FY08 quarterly cash flow.

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

  **Status:** For looking outward, an EPO advisory committee was appointed to maximize NOAO impact in broadening participation in the NSF science enterprise. For looking inward, K. Garmany and D. Norman were appointed as NOAO Diversity Co-advocates. Both activities will ramp up further in the second quarter of FY09.
2.3.3 Central Administration Services

Program Highlights

During the first quarter of FY09, Central Administrative Services (CAS) engaged in the annual year-end process. This includes oversight and closeout of not only NOAO-related activities, but those entities for which CAS provides business services: AURA Corporate, WIYN, SOAR, and LSSTC. This affects all areas of administration. In addition, annual reporting to NSF and other federal and state agencies is required. This quarter also included preparations for the upcoming calendar year-end processes, such as tax and benefit reporting due in the second quarter.

Due to the federal continuation-level budget, NOAO implemented a small reduction in force along with a hiring freeze on open positions. The direct affect on CAS is that two positions have not been filled at this time: a Human Resources benefits specialist and a sub-awards and contracts officer. The workload and staffing needs will be revisited once the federal budget situation stabilizes.

One favorable economic affect has been the reversal of the downward trend of the U.S. dollar relative to the Chilean peso; however, it is still very unpredictable as illustrated in the chart below.

CAS renegotiated a new agreement with CIGNA to provide continued medical coverage for NOAO North employees and increased coverage to the expatriates at NOAO South. Significant development progress was made on the Web-based budgeting system and upgrades to the purchasing (Reqless) and expenditure reporting (CASNET) systems were finalized.

Status of FY09 Milestones

- Assist AURA and NSF with negotiation of our next five-year cooperative agreement.

  Status: CAS provided correct budget tables and other information per the National Science Board request to AURA. Furthermore, new tables have been prepared for separating NSO and NOAO into two viable budgets and agreements. Timing of this is still to be determined by NSF.
2.3.4 Central Facilities Operations

Program Highlights

NOAO North: Central Facilities Operations (CFO) has been focusing on two main areas in conjunction with routine maintenance. These areas consist of space re-engineering and staff relocation. Remodeling of the old Photo Lab area was completed (see figure below), with the creation of five office spaces, one of which will be used for a multi-person visitor area. The second multi-visitor office is undergoing a furnishing upgrade. Besides providing the necessary additional space for current/visiting scientific staff, these changes provided a new corridor for better egress. In addition, a new air handling system was installed for the second floor engineering and LSST areas to replace the one that failed this past summer.

The NOAO Cleaning and Greening program was active this quarter. Two committees were formed. The first will review and recommend changes to the current recycling program; the other will recommend remodeling changes to the employee lounge. Recommendations are to be available next quarter.

NOAO South: No new activity to report.

Status of FY09 Milestones

- Remodeling and building modifications at NOAO North:
  - complete the modification of the Photo Lab area for new offices,
  - expand the La Quinta Conference room to accommodate larger groups,
  - re-engineer space to accommodate staff changes including the engineering area, and
  - begin the computer room cooling upgrades.
Status: The modification of the Photo Lab area for new offices is complete. Two offices are now occupied by two of the emeriti staff. Another office is being furnished as a multi-occupant visitor office.

- Provide organizational support for the NSF Large Facilities Workshop and AST Safety conference to be held 14–17 April 2009.

Status: The NSF Facilities and AST Safety Workshop is now scheduled for 14–17 April 2009 at the University Marriott Hotel in Tucson, AZ. NOAO is hosting this workshop and more information can be found at: www.noao.edu/nsf.

2.3.5 Computer Infrastructure Support

Program Highlights

CIS North: After a long struggle, the Computer Infrastructure Support (CIS) staff in Tucson achieved a stable version of an expanded-capacity email server and put it into production. An effort began to replace the servers adass.org and taurus with up-to-date hardware and OS installations. Finally, the collection of NOAO-Tucson servers were upgraded to the latest stable version of FreeBSD: 6.4 and 7.1.

CIS South: At NOAO South, there have been no major failures in the LAN, WAN, or international link. CIS South is purchasing parts to upgrade the central servers and ensure that the email server is accompanied by a warm spare and continually backed up. An offsite backup will also be made. The search for new disk spares for the Sun systems has not been successful yet, but the search continues. This summer CIS South has three interns that will work on converting the SOAR Web site to Plone. Once that is complete the attention will turn to the Cadias, IPCC, and CTIO Web sites. There have been no major failures at Las Campanas, apart from scheduled shutdowns and system fire-fighting.

Status of FY09 Milestones

- Continue to give personnel access to further education that will enhance their productivity.

Status: E. Toro completed the Cisco CCNA certification; and R. Cardemil attended a VoIP course.

- CIS-S: Assist with the integration of the Yale Survey camera on La Silla into the AURA data infrastructure.

Status: Yale continued to research the most ideal Microwave equipment for the La Silla-Tololo link and have now settled on a 2.4-Ghz system. Yale staff should be visiting with CIS-South staff in the coming month to discuss locations of the radios and antenna on Tololo. A Memorandum of Understanding has been signed by both parties.

- CIS-S: Finish the VoIP installation in Chile with installation on Cerro Tololo and the integration with AOSS. Improvements will continue in VoIP communication to the U.S. via Tucson.
Status: Major advances in the migration of the telephony to VoIP have made. SOAR on Pachón and the new hotel are fully functional. Tololo is 80% completed and La Serena is 95% complete. Most of the problems between La Serena and Tololo have been solved so U.S. international calls can be made over this link. The issue of billing on this new system is resolved and is being undertaken by a contracted service in Santiago. AOSS is satisfied with the format of the reports. Some purchases will be required to ensure 100% sparing in the three locations: Tololo, Pachón, and La Serena. The goal for the next quarter is to have this project completed along with all documentation.

- CIS-N: Continue to upgrade the Tucson network infrastructure with the goal of providing multiple 1-Gbit connections into each room backed up by multiple-gigabit backhaul to the network core.

Status: New Ethernet switches were installed near room 76 (newly constructed offices) and in rooms B-51 and 150 to provide Gigabit connections to offices and labs in their vicinity. Wireless Access Points were installed in the CAS building and room B-23.
3 SCIENTIFIC PROGRAM ORDERS AND AMENDMENTS

3.1 SPO #5 AST-0335461 TELESCOPE SYSTEM INSTRUMENTATION PROGRAM (TSIP)

During this quarter, Blum and Trueblood continued to oversee all active TSIP programs: MOSFIRE infrared multi-object spectrometer (Keck), Next Generation Adaptive Optics (Keck), Adaptive Secondary for Magellan (Steward Observatory), MMIRS infrared multi-object spectrometer (Harvard Smithsonian CfA), One-Degree Imager (WIYN), MODS2 Optical Spectrograph for LBT (Ohio-State), and system access for the MMT (Steward Observatory). TSIP facilities continue to be highly subscribed by the U.S. community as seen in the number of proposals to the NOAO TAC. NOAO is waiting for permission from the NSF to place the next call for TSIP programs.

3.2 SPO #6 AST-0336888 ADAPTIVE OPTICS DEVELOPMENT PROGRAM

- Sub-Award #C33002T “Development of the Next Generation Optical Detectors for Wavefront Sensing.” NSF approved a one-year, no-cost extension until 31 December 2009 to allow completion of the fabrication and testing of the phase 2 device as originally described in the proposal.

- Sub-Award #C33003T “Pulsed Fiber Laser for Guide Stars.” Lawrence Livermore National Laboratories (LLNL) was contacted by Evans & Sutherland to investigate using part of the LLNL development efforts with the current E&S fiber laser systems to produce a low-cost 589-nm fiber laser. Discussions are ongoing.

- Sub-Award #C33005T “Compact Modular Scalable Versatile LGS Architecture for 8–100-m Telescopes.” During the course of the Center for Adaptive Optics annual retreat, initial discussions were held about moving the Adaptive Optics Development Program's laser to Palomar Observatory for on-sky tests after the repackaging is complete at the end of June 2009.

3.3 SPO #7 AST-0432601 SUPPORT FOR CONFERENCES, SYMPOSIA, WORKSHOPS AND OTHER MEETINGS

No activity to report for this quarter.

3.4 SPO #9 AST-0551161 LARGE SYNOPTIC SURVEY TELESCOPE PROJECT

No activity to report on the sub-award to LSSTC. For project activity please refer to: lsst.org/lsst/about/reports.
3.5 SPO #10 AST-0443999 GIANT SEGMENTED MIRROR TELESCOPE PROJECT

Thirty Meter Telescope (TMT) Support
Funding under the sub-award has been used to support efforts in key areas throughout the project. Particular highlights include:

**Project Management:** A major focus of the Project Management Office during the report period was comprehensive revision of the project construction schedule and cost estimate to support the partnership business plan. A complete bottom-up revision of the schedule was completed, which included a funding-paced design phase through September 2011 and a technically-paced construction phase after October 2011. Corresponding “then year” cost estimate revisions were implemented. The TMT Board reviewed the project’s schedule and cost during this period and provided direction on target project finish dates. System engineering implemented a DOORS-based requirements management system, and the modeling group completed a major analysis of the performance of the TMT design. The Project Management Office carried out employment, contracting, financial, audit, and purchasing functions during the report period. The Project Risk Register function and System Safety Plan were initiated during this period.

**Adaptive Optics (AO) Systems:** The TMT AO group continued to develop: (1) requirements and interface documents, (2) performance estimates, and (3) cost and schedule estimates for the TMT AO systems. The group continued to monitor the TMT partners and suppliers that are developing the individual AO subsystems and components.

**Site Access:** TMT submitted its Environmental Impact Assessment (DIA) for construction at the Armazones site in Chile. The resolution with the approval of the TMT’s DIA was issued 3 December 2008. Negotiations are underway to gain long-term access to the Armazones site (Region of Antofagasta, Chile).

Other efforts underway are aimed at eventually obtaining the Environmental Impact Statement and Conservation District Use Permit for the Mauna Kea site.

**Telescope Department:** The TMT Telescope Department includes the Controls, Optics, and Structures groups. Work during this quarter covered development of the segmented primary, secondary, and tertiary mirrors. The tasks included visits to vendors and to other observatories with large telescopes as well as design and prototyping efforts. Vendor study contracts were placed where appropriate for risk reduction or improved cost estimates. The telescope department also recruited the additional engineering staff needed to carry out the tasks leading up to initiation of construction.

Giant Magellan Telescope (GMT) Support
AURA’s funding to Carnegie under the sub-award is directed mainly towards reduction of risk in the most critical area of development, namely fabricating and testing the off-axis primary mirror segments. Carnegie is applying the funds received from AURA primarily to payments on a contract with the University of Arizona’s Steward Observatory Mirror Laboratory (SOML) to develop four different testing methods for the off-axis segments and to procure the equipment necessary for the testing. In addition, Carnegie is using funds under amended sub-award to carry out several other long-lead-time risk reduction tasks: detailed measurement of the turbulence profile above the chosen site at Campanas Peak accompanied by wind flow modeling using the current design for the
enclosure and site modifications; modeling the dynamic response of the telescope structure to rapidly changing seismic and wind loads; simulating the performance of the adaptive optics system; design of the seven-segment adaptive secondary mirror; and development of conceptual designs for candidate science instruments.

In November 2008, GMT held a regular quarterly review of progress on the first off-axis segment and the testing methods. The review indicated that satisfactory progress is being made in all areas. In particular, the first testing method (surface profilometry using the “Laser Tracker Plus” system) is essentially completed and in regular use to monitor progress of the loose abrasive grinding. Additionally, installation of equipment for the second testing method (full-aperture interferometric measurement) is well underway. Also in November 2008, GMT issued a general call for Letters of Intent to propose for instrument conceptual design studies. The call provides for limited participation by non-GMT-partner institutions.

Other Activities

**Laser Development:** Funding has been provided to support development of sodium lasers for future use on large or extremely large telescopes. These funds will be combined with funds from the W. M. Keck Observatory and the European Southern Observatory (ESO). ESO is acting as the overall lead in this effort, and Keck is acting in representation of the four observatories involved (Keck, TMT, GMT, and NOAO). The end result should be two (possibly three) design studies and fixed-price cost proposals, which should provide additional options for observatories in need of lasers for advanced adaptive optics systems.

**GSMT Community Assessment:** Funds under this award are being used to support non-payroll expenditures in support of the assessment described in section 1.4.3.

### 3.6 SPO #11 AST-0647604 CTIO RESEARCH EXPERIENCES FOR UNDERGRADUATES (REU)

The CTIO Research Experiences for Undergraduates (REU) program began the 2009 fiscal year with a new director, Ryan Campbell. Work this quarter focused on selecting students for the 2009 REU and Practica de Investigación en Astronomía (PIA) programs. The six REU and two PIA students selected will arrive at CTIO in early January to begin their research projects.

Plans and preparations were finalized for the students from the 2008 REU and PIA programs to attend the January 2009 American Astronomical Society (AAS) meeting in Long Beach, California.

### 3.7 SPO #13 AST-0754223 KPNO RESEARCH EXPERIENCES FOR UNDERGRADUATES (REU)

The 2008 Annual Project report for the “NSF Research Experiences for Undergraduates Site Program in Astronomy at Kitt Peak National Observatory” (AST 0754223) was submitted and
accepted in December 2008. The report is available at:
www.noao.edu/education/reu/kpnoreu2008ar.pdf

4 TELESCOPE PROPOSAL AND ARCHIVED DATA STATISTICS

4.1 SUMMARY OF 2009A TELESCOPE PROPOSAL STATISTICS

<table>
<thead>
<tr>
<th>KPNO Telescope</th>
<th>Proposals</th>
<th>Total Nights</th>
<th>Dark Nights</th>
<th>% Dark</th>
<th>Avg. Nights/Run</th>
<th>Nights Granted</th>
<th>Over-subscription Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>KP 4-m</td>
<td>44</td>
<td>198.5</td>
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<td>45</td>
<td>3.7</td>
<td>43</td>
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<td>WIYN</td>
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<td>62</td>
<td>3.2</td>
<td>40</td>
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<td>KP 2.1-m</td>
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<td>57.0</td>
<td>33</td>
<td>5.3</td>
<td>117</td>
<td>1.49</td>
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<tr>
<td>KP 0.9-m</td>
<td>3</td>
<td>13.0</td>
<td>6.0</td>
<td>46</td>
<td>4.3</td>
<td>10</td>
<td>1.30</td>
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<table>
<thead>
<tr>
<th>CTIO Telescope</th>
<th>Proposals</th>
<th>Total Nights</th>
<th>Dark Nights</th>
<th>% Dark</th>
<th>Avg. Nights/Run</th>
<th>Nights Granted</th>
<th>Over-subscription Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT 4-m</td>
<td>43</td>
<td>174.0</td>
<td>67.0</td>
<td>39</td>
<td>3.6</td>
<td>62.0</td>
<td>2.81</td>
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<tr>
<td>SOAR</td>
<td>11</td>
<td>53.4</td>
<td>13.8</td>
<td>26</td>
<td>2.7</td>
<td>46.0</td>
<td>1.16</td>
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<td>CT 1.5-m</td>
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<td>5.0</td>
<td>19.4</td>
<td>3.38</td>
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<td>0</td>
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<td>CT 1.0-m</td>
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<td>81.0</td>
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<tr>
<td>CT 0.9-m</td>
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<td>21</td>
<td>3.9</td>
<td>24.3</td>
<td>3.07</td>
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<table>
<thead>
<tr>
<th>Gemini Telescope</th>
<th>Proposals</th>
<th>Total Nights</th>
<th>Dark Nights</th>
<th>% Dark</th>
<th>Avg. Nights/Run</th>
<th>Nights Granted</th>
<th>Over-subscription Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gemini-N</td>
<td>95</td>
<td>125.8</td>
<td>48.3</td>
<td>38</td>
<td>1.0</td>
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<td>Gemini-S</td>
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<td>83.0</td>
<td>16.8</td>
<td>20</td>
<td>1.3</td>
<td>44.70</td>
<td>1.85</td>
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<table>
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<th></th>
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<tbody>
<tr>
<td>Keck-I</td>
<td>31</td>
<td>49.5</td>
<td>13.5</td>
<td>27</td>
<td>1.5</td>
<td>8.0</td>
<td>6.19</td>
</tr>
<tr>
<td>Keck-II</td>
<td>27</td>
<td>41.5</td>
<td>11.0</td>
<td>27</td>
<td>1.4</td>
<td>5.5</td>
<td>8.09</td>
</tr>
<tr>
<td>Magellan-I</td>
<td>3</td>
<td>3.3</td>
<td>3.0</td>
<td>91</td>
<td>1.1</td>
<td>3.0</td>
<td>1.10</td>
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<tr>
<td>Magellan-II</td>
<td>6</td>
<td>11.0</td>
<td>2.0</td>
<td>10</td>
<td>1.8</td>
<td>4.0</td>
<td>2.75</td>
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<td>MMT</td>
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<td>36.5</td>
<td>19.0</td>
<td>52</td>
<td>2.4</td>
<td>10.5</td>
<td>3.48</td>
</tr>
</tbody>
</table>

Of the 385 proposals received, 110 (29%) were thesis projects, 15 requested long-term status, and 11 requested survey status.
### 4.2 USAGE OF ARCHIVED DATA

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

<table>
<thead>
<tr>
<th>Archive Data Retrieval Activity (ftp site)</th>
<th>NOAO Science Archive Web Site Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Date</td>
</tr>
<tr>
<td>Retrieved (GB)</td>
<td>Bandwidth (GB)</td>
</tr>
<tr>
<td>Files Retrieved</td>
<td>Pages Viewed</td>
</tr>
<tr>
<td>Unique Visitors</td>
<td>Unique Visitors</td>
</tr>
<tr>
<td>Oct-08</td>
<td>Oct-08</td>
</tr>
<tr>
<td>29.51</td>
<td>26.21</td>
</tr>
<tr>
<td>246</td>
<td>53,370</td>
</tr>
<tr>
<td>18</td>
<td>875</td>
</tr>
<tr>
<td>Nov-08</td>
<td>Nov-08</td>
</tr>
<tr>
<td>2.36</td>
<td>19.59</td>
</tr>
<tr>
<td>341</td>
<td>27,738</td>
</tr>
<tr>
<td>11</td>
<td>949</td>
</tr>
<tr>
<td>Dec-08</td>
<td>Dec-08</td>
</tr>
<tr>
<td>307.45</td>
<td>31.50</td>
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<tr>
<td>300</td>
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<tr>
<td>19</td>
<td>892</td>
</tr>
<tr>
<td>Total: 339.32</td>
<td>Total: 77.30</td>
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<tr>
<td>887</td>
<td>130,100</td>
</tr>
<tr>
<td>48</td>
<td>2,716</td>
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</table>

The second set of tables below illustrate access to and usage of non-proprietary raw data from the NOAO Science Archive (R3) and proprietary raw data from the Science Data Management (SDM) End-to-End (E2E) system.

<table>
<thead>
<tr>
<th>NOAO Portal Data Retrieval Activity (ftp site)</th>
<th>NOAO Portal Web Site Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Date</td>
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<tr>
<td>Retrieved (GB)</td>
<td>Bandwidth (MB)</td>
</tr>
<tr>
<td>Files Retrieved</td>
<td>Pages Viewed</td>
</tr>
<tr>
<td>Unique Visitors</td>
<td>Unique Visitors</td>
</tr>
<tr>
<td>Oct-08</td>
<td>Oct-08</td>
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<tr>
<td>282.74</td>
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<tr>
<td>1,065</td>
<td>3,312</td>
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<tr>
<td>11</td>
<td>394</td>
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<tr>
<td>Nov-08</td>
<td>Nov-08</td>
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<tr>
<td>516.41</td>
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<td>3,457</td>
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<tr>
<td>14</td>
<td>384</td>
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<tr>
<td>Dec-08</td>
<td>Dec-08</td>
</tr>
<tr>
<td>932.44</td>
<td>192.35</td>
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<tr>
<td>121</td>
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<tr>
<td>6</td>
<td>417</td>
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<tr>
<td>Total: 1,731.59</td>
<td>Total: 1,335.51</td>
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<tr>
<td>4,643</td>
<td>8,456</td>
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<td>1,195</td>
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</tbody>
</table>
The NOAO SkyNode provides access to catalogs and is complementary to the NOAO Science Archive, which provides access to images. SkyNode receives a simple SQL query and passes it to a backend database engine. The result is then passed back through the Web server. The most important number in the table below is “Unique Visitors.”

<table>
<thead>
<tr>
<th>Date</th>
<th>Bandwidth (MB)</th>
<th>Pages Viewed</th>
<th>Unique Visitors</th>
</tr>
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<tr>
<td>Oct-08</td>
<td>26.21</td>
<td>3,939</td>
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<td>Nov-08</td>
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<td>Total</td>
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