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Notable Quotes

Question: What would be the number one thing you'd advise men who just don't get the fashion "thing"? My husband is an astronomer, and you can tell by the way he dresses!

Carson Kressley: For novices, and astronomers, I like to employ the time-tested adage of "KISS"—Keep it simple, sister. Baby steps. Start with good looking classics from a traditional designer. Think blue blazers, flat front khakis, and oxford shirts…

—From a WashingtonPost.com online chat with Carson Kressley, the wickedly funny 'fashionista' from the Bravo Channel television show "Queer Eye for the Straight Guy," on 27 September 2004

~

"The satellite landed in our home. Maybe this means we'll have good luck this year."
—Huo Jiyu, the tenant of an apartment building in Penglai, a village in the southwestern Chinese province of Sichuan, which was hit by a kettle-shaped piece of a Chinese scientific satellite that crashed to Earth, according to the Tianfu Morning News, quoted by the Associated Press, 17 October 2004.

On the Cover

This image of the massive N11 complex in the Large Magellanic Cloud shows numerous star forming regions and shells blown out by supernovae and strong stellar winds. The color image was produced using three exposures taken in filters that highlight emissions from ionized atoms of hydrogen (red), sulfur (green), and oxygen (blue).

These data were taken with the University of Michigan Curtis Schmidt telescope at Cerro Tololo Inter-American Observatory near La Serena, Chile, as part of the Magellanic Clouds Emission Line Survey (MCELS).

Image Credit: Sean Points, Chris Smith and Mark Hanna, NOAO/AURA/NSF.

The American Astronomical Society (AAS) meeting in San Diego from 9–13 January 2005 is expected to be the largest in history, with more than 2,500 attendees.

Stop by the talks, poster sessions, and exhibit booths from NOAO, the NOAO Gemini Science Center, and the Large Synoptic Survey Telescope Corp. Learn about the latest news and developments in the LSST, the Thirty-Meter Telescope, the Dark Energy Camera, the MCELS survey, the NOAO Deep Wide-Field Survey, the SMARTS consortium, and interesting results from the Research Experiences for Undergraduates program.

Have you seen an interesting comment in the news or heard one during a NOAO-related meeting or workshop? *Please share them with the Newsletter Editor (editor@noao.edu).*

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Douglas Isbell, *Editor*

Section Editors

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Dave Bell	*Observational Programs*
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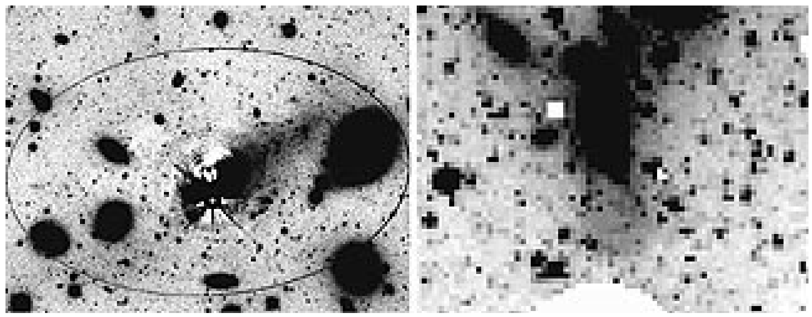
A Deep Imaging Survey for Intracluster Light

John Feldmeier (NOAO), Chris Mihos, Heather Morrison & Paul Harding (Case Western Reserve University)

Observing intracluster light (ICL), light from stars between the galaxies in a galaxy cluster, is a revealing way to study some of the processes that govern cluster galaxy evolution— processes such as galaxy encounters, cluster accretion, and tidal stripping. However, detailed data on ICL has been historically difficult to obtain due to its low surface brightness, which is usually 5–6 magnitudes below the brightness of the night sky at the maximum. In the past few years though, there has been an explosion of intracluster star research. There have been many detections of individual intracluster stars in nearby galaxy clusters, and also with the advent of high-quality CCDs, a renewal of deep surface photometry of intracluster light on more distant galaxy clusters.



On the left is our image of the center of the galaxy cluster MKW7, with the brightest cluster galaxy partially subtracted. The subtraction is not perfect due to the presence of a 12th magnitude star near the cluster core, but a tidal plume is clearly visible going up and to the right from the cluster center. The magnitude of this plume is V ~ -17, about equal to a small galaxy. On the right is a binned-up image of Abell 1914. There is a large tidal plume extending down from the cluster center. This plume is quite large (60 × 30 kpc), and has a total magnitude of V ~ -21. This plume is also seen in the weak lensing maps of this cluster by Dahle et al. (2002, ApJS, 139, 313).

Using the Kitt Peak 2.1-meter telescope, we have recently completed a survey of Abell clusters that is designed to measure the amount and spatial distribution of ICL. Our goal was to take a representative sample of galaxy clusters and to search each one for ICL. We were interested in seeing if the properties of ICL varied in a systematic way over such known cluster properties as richness, optical and X-ray morphology, and the presence of a cD galaxy. We were also interested in searching for the presence of intracluster tidal debris, which had been detected accidentally in studies of other galaxy clusters.

The observations were challenging since the uncertainty in deep surface photometry is generally dominated by systematic effects. We spent half of our observing time constructing a night sky flat taken at the same hour angle as our target clusters. We deliberately chose clusters far away from bright stars: approximately half of our candidate clusters were eliminated by this constraint. Because of the need for excellent sky flats, the data for this survey could only be taken in photometric conditions. After a total of 39 nights at the telescope over three years, we have high-quality data on 13 different galaxy clusters.

With half of the data reduced and published (Feldmeier et al. 2002, 2004), we have a number of interesting results. ICL appears to be present in all of the clusters we have surveyed. At least 10–20% of all stars in these galaxies are present in an intracluster component. So far, it appears that clusters that contain a luminous brightest cluster galaxy (such as Abell 1413) have a larger intracluster star fraction than galaxy clusters that do not.

In terms of its spatial distribution, the ICL in some clusters closely follows the distribution of the galaxies, while in other cases there are clear offsets between the galaxy distribution and the ICL distribution. This is most prominent in Abell 1914, which is believed to be undergoing a cluster merger. We also found numerous examples of tidal debris in the clusters, some of which are displayed here. Generally, we found plume-like structures, as opposed to the arc-like structures found by others. It is currently unclear if this is due to a selection effect, or by chance. Some of these plume-like structures contain a large amount of stellar luminosity: the largest plume in Abell 1914 has a total magnitude comparable to that of M31.

These results are in good agreement with numerical models of galaxy clusters, which predict that ICL is a generic feature, and is mostly produced by encounters between galaxies and the cluster potential as a whole. From our results, we suggest that the ICL may act as a dynamical "clock" of galaxy clusters, one that is complementary to other studies of galaxy clusters, such as X-ray substructure, weak lensing, and galaxy radial velocities.

Optical Interferometry of High-Luminosity Cool Stars

Stephen Ridgway (NOAO) & Guy Perrin (Observatory of Meudon)

Optical interferometry is just now at the point where systematic studies of stellar brightness distributions are possible. Studies of K and early M giants show that atmosphere models correctly predict their observed limb brightness profiles, at least to a first order. For several other classes of stars, optical interferometry is correcting even our basic understanding of their structure.

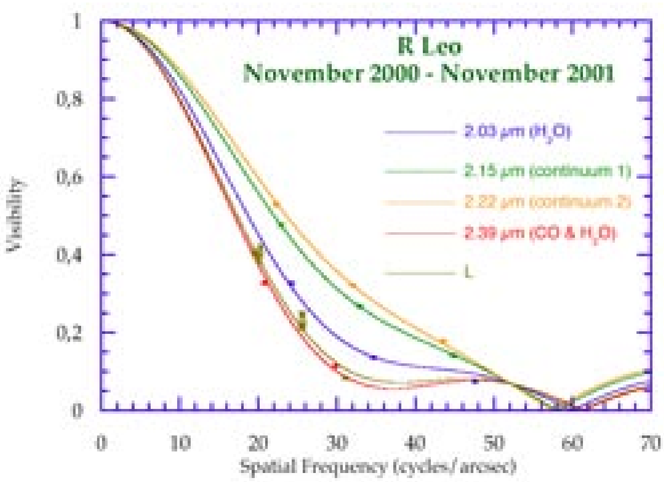


Figure 1. The observed visibility distributions differ strongly from a uniform or darkened disk, but are well matched by a simple two-component model. The strong variation of apparent size from band to band is clear from the differing characteristic widths.

Two examples are cool supergiants and AGB stars. Although these two stellar types are quite different in terms of stellar evolution, they have in common large radial sizes and extended, low-density atmospheres. Over a period of many years, rudimentary angular size measurements have yielded different diameters for these stars at different wavelengths. However, the measurements were both difficult to make and were carried out using different technologies, complicating the intercomparison of the measured diameters.

The key to interpretation was the direct interferometric measurement of Mira stars at 2 and 4 microns (see figure 1), with a single instrument—the FLUOR fiber beam combiner operating at the IOTA optical interferometer. The FLUOR beam combiner, which was first demonstrated at Kitt Peak in the early 1990s, combines spatial filtering and photometric calibration to give highly accurate visibility measurements. These measurements showed that the apparent sizes of Miras at 4 microns were typically 50% larger than the diameters at 2 microns. Analysis of these results, carried out by Antoine Merand in 2001, then a visiting student at NOAO, led to an empirical model with a very deep atmosphere.

This empirical model immediately gave several predictions. The brightness profile in the K band should deviate strongly from a standard uniform or darkened disk, and the appearance and visibility functions should vary strongly with wavelength within molecular bands—a phenomenon that was already known qualitatively but not understood quantitatively.

Remarkably, it was found that an even simpler empirical model was completely sufficient to account for the observations. This ultrasimple model consists of a central star with a thin molecular shell at high altitude (see figure 2). This model accounted for the variation of apparent stellar size from visible to thermal infrared, providing a diameter for the core star and both an altitude and a density for the high molecular layer.

The high layer is found to lie just inside the maser shell, and to have a density several orders of magnitude higher than the region responsible for the maser emission, showing that there is a strong radial density gradient between the two. The relative dimensions allow the ballistic time constant of the stellar pulsation to be calculated. This is found to differ enough from the pulsation

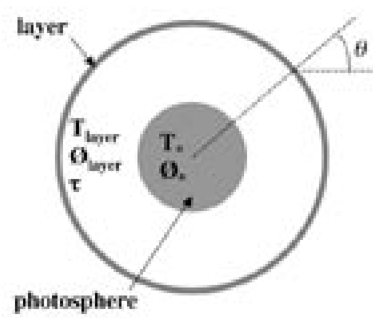


Figure 2. The ultrasimple model contains only two components—star plus thin shell. Most likely the actual atmosphere has an enhancement of molecular densities at high altitude, owing to lower temperatures in that region. The intervening atmosphere, though a stellar radius in thickness, is nevertheless relatively transparent.

continued

Optical Interferometry of High-Luminosity Cool Stars continued

periods to give strong nonperiodic effects, which are in fact observed. The free-fall time from the molecular layer is short enough that the stellar pulsation alone does not appear capable of maintaining the upper atmosphere. The stellar diameter is found to be consistent with pulsational models of fundamental mode oscillation, resolving a long-standing puzzle.

This much clearer view of the upper atmospheres of Mira stars is of great interest. Intermediate mass stars convert hydrogen into helium and then into light elements during their evolution. These elements are then returned to space in a strong mass-loss wind during the Mira phase. In fact, some 75% of the light elements in the Universe are probably produced from this source. The mechanism of the mass loss is not understood at all. The ability of optical interferometery to probe the atmospheric structure from the stellar surface up to several stellar radii offers strong constraints on the environment where dust formation and wind acceleration must take place.

Having extracted a model for the extreme Mira atmosphere, we can now turn to the less extreme supergiant case (see figure 3). There also, evidence is found for wavelength-dependent diameters, and again the model of a star plus molecular layer is quite successful, revising upward our estimate of the photospheric effective temperatures. In this case, we actually have visible images of the stellar surface, obtained with HST and ground-based speckle and interferometeric measurements. These visible images show a large disk with bright spots.

Now we can understand this disk as dominated by scattering from the high molecular layer, and the bright spots as due to regions where the molecular layer is thin or absent. Thus we are beginning to access the lateral inhomogeneities in the upper atmosphere. This ties in nicely with a long-standing puzzle—cool, high-luminosity stars typically show evidence of both high-temperature chromospheres and of low-temperature molecular shells. These may be occurring on a scale that is resolvable with existing instruments.

Additional details will be found in *A&A* 418, 675 (2004) and *A&A* 426, 279 (2004).

EDITOR'S NOTE: This research by Ridgway, Perrin and collaborators was the subject of a joint press release by the Journal Astronomy & Astrophysics and NOAO, which produced strong media coverage on Space.com (reprinted at Yahoo.com, MSNBC.com, and USATODAY.com), NewScientist.com, Physics.org, Astronomy.com, and various media outlets in France, Spain, Austria, Germany, Chile, and Venezuela; further coverage in popular astronomy magazines is likely.

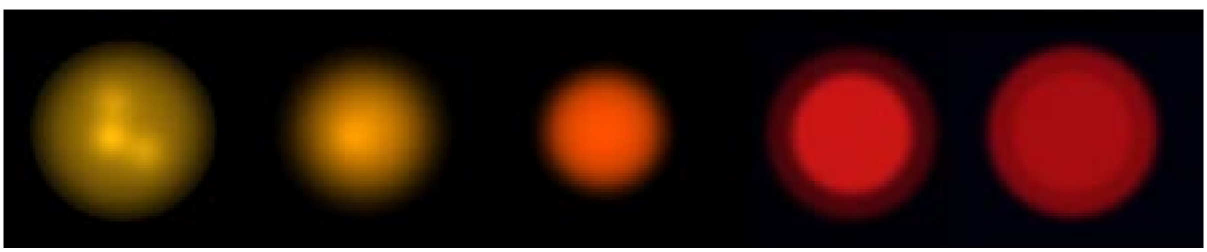


Figure 3. An idea of how the appearance of the supergiant alpha Ori varies with wavelength, from left to right: 700 nm, 905 nm, 1290 nm, 2200 nm, and 11200 nm. The first two are from actual interferometric image reconstruction by Young et al, MNRAS 315, 635 (2000), and the others are derived from our model interpretation of data from our own and other interferometric measurements.

Temperate Latitude Clouds on Titan

Henry Roe (Caltech)

In the thick atmosphere of Saturn's moon Titan, the second most abundant species after nitrogen is methane (3–7%). From the surface (T=93K, P=1.5 bar) up to the tropopause at 40 km altitude (T=70K, P=10^{-3} bar) conditions on Titan are near methane's triple point, just as conditions on Earth are near water's triple point. This leads to the existence of a methane meteorological cycle on Titan, analogous to water-driven weather here on Earth. Due to Titan's small angular size (~0.8 arcsec), imaging Titan and its clouds requires the high-angular resolution available with adaptive optics on a large telescope. We first directly detected Titan's clouds in

continued

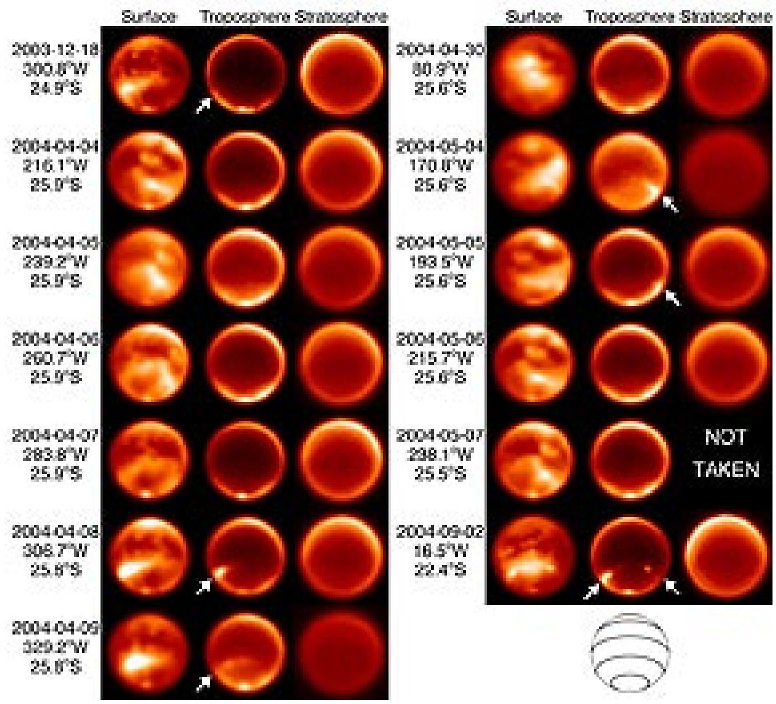
Temperate Latitude Clouds on Titan continued

December 2001, when we discovered clouds in Titan's south polar troposphere. We have reobserved Titan numerous times in the three years since first finding the south polar clouds and found that there is almost always cloud activity at the south pole.

The occurrence and location of these south polar clouds can be explained by convection driven by the maximum annual solar heating of Titan's surface, which occurs at summer solstice (October 2002) in this region. In this scenario, the surface at the summer pole is heated by just a few Kelvin. This additional heating pushes the top of the convective layer up just enough to saturate methane and kick off moist convection and the formation of cumulus-like clouds. Until now all the clouds observed in Titan's troposphere have been found at far southern latitudes (60–90°S) and can be explained by this solar heating hypothesis.

To study Titan's south polar clouds and look for new types of clouds as Titan's seasonal cycle progresses, we are imaging Titan using NIRI/Altair on Gemini North as often as possible in three filters that probe varying degrees of atmospheric opacity. A program such as this, needing observations on as many nights as possible but only a few minutes of telescope time per observation, can only be accomplished under queue scheduling. In 2004A these observations revealed a new class of cloud on Titan at ~40°S latitude.

These new temperate latitude clouds cannot be explained by the same solar heating hypothesis as the south polar clouds. We are proposing that these temperate latitude clouds are either the result of transient surface events or a seasonal shift in global circulation. Examples of the first possibility include methane geysers, cryovolcanism, or



In the stratospheric probing images we see only the limb brightened stratospheric haze, with a seasonal north-south asymmetry. In the tropospheric probing images we see the stratospheric hazes limb brightened, a general brightening in the south due to the tropopause cirrus, the distinct south polar clouds (see especially April 9, although a cloud is near the south pole in every one of these images), and the new ~40°S clouds, which are especially apparent on April 8–9, May 4, and September 2. The new temperate latitude clouds are indicated with white arrows. In the surface probing images Titan's 22.5°/day rotation rate is apparent and the tropospheric clouds also appear. All images are from NIRI/Altair on Gemini North except December 2003 and September 2004, which are from Keck II. Sub-observer longitude and latitude are given. The wire frame at lower right is for a sub-observer latitude of 25.6°S. All images are scaled to show Titan at the same size, although its angular diameter ranged over 0.73–0.88 arcsec.

a geologic "warm" spot that would drive convection and methane cloud formation. In the second scenario, Titan's global circulation seasonally shifts from a single pole-to-pole cell to a more complicated structure that includes a zone of uplift and clouds near 40°S. Future observations should easily resolve which scenario is more likely. In the geology-dominated explanation, the clouds are expected to remain at 40°S, while in the circulation-dominated hypothesis, the clouds should move north over the next few years.

Titan's weather is watched by a collaborative effort between Caltech (H.G. Roe, M.E. Brown, E.L. Schaller), Gemini North (C.A. Trujillo), and Keck Observatory (A.H. Bouchez).

New Interest in an Old Line

Harrison Jones (NASA Goddard Space Flight Center)

The He I 1083-nm spectral line is of great interest to both solar and stellar physicists since it is formed at a crucial layer of a stellar atmosphere between the top of the chromosphere and base of the transition region, where the temperature begins an abrupt rise from surface (10,000 K) to coronal (1,000,000 K) values. Spectroheliographic images of He I 1083-nm equivalent width have been obtained at the NSO Kitt Peak Vacuum Telescope (KPVT) for 30 years, and show a wealth of solar phenomena including, in particular, coronal holes, a source of high-speed solar wind. In 1992, the capability for obtaining true imaging spectroscopy in this important line was initiated with the NASA/NSO spectromagnetograph (SPM) and now continues in more advanced form with the new SOLIS vector spectromagnetograph (VSM).

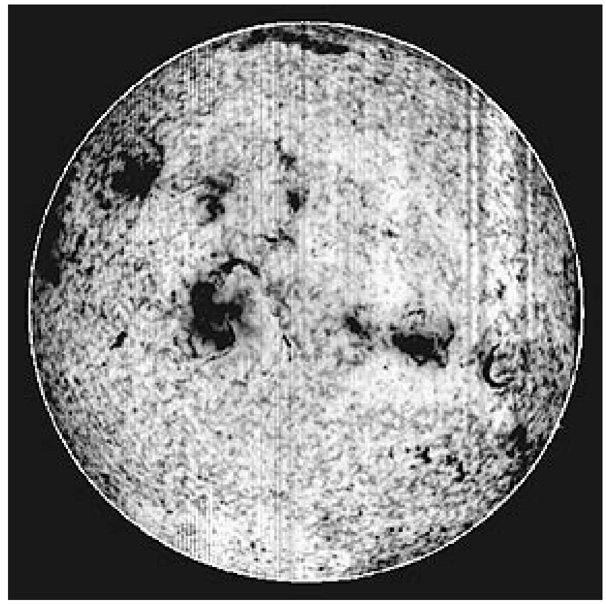


Figure 2. He I 1083-nm equivalent width, 2 February 2004. First reduced data from the VSM.

Spectroscopically, the 1083-nm line is very difficult to reduce and analyze since it is weak, highly variable in both space and time, and blended with nearby solar and telluric lines. Over several years, Olena Malanushenko (NSO) and I have obtained imaging spectroscopy of coronal holes and other interesting features with the SPM and have developed new techniques for dealing with the data. Results of this effort include the development of methods for removing spectral lines from flat-field images of the average solar spectrum (Jones 2003, *Solar Physics,* 218, 1) and for accurate separation of line and continuum using a well-calibrated standard (Malanushenko and Jones 2004, S*olar Physics,* 222, 43).

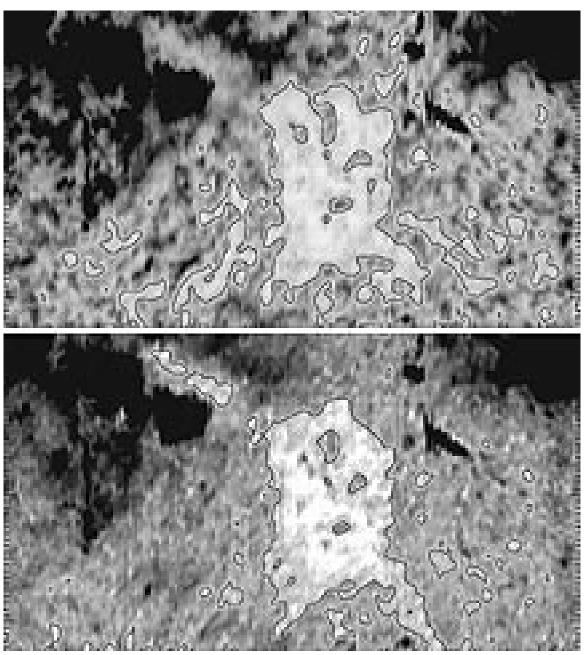


Figure 1. Top: He I 1083-nm central intensity with 1% contrast contour for SPM observations on 17 April 2000. Bottom: Sum of statistically normalized intensity and half-width images with 1-sigma contour.

Malanushenko and Jones (2004, *Solar Physics*, in press) have recently discovered that line width and central intensity are negatively correlated in the quiet Sun but have a different relation in coronal holes. As shown in figure 1, adding statistically normalized images of intensity and width (bottom panel) suppresses the appearance of chromospheric network and enhances the contrast between coronal holes and quiet Sun, areas which are often difficult to separate in images of central intensity alone (top panel). This characteristic promises to allow development of a new objective and automated method for coronal hole recognition.

In another important development, Malanushenko produced equivalent width images of the 1083-nm line from VSM observations in spite of strong fringing in the detectors. The first full disk 1083-nm image from the VSM, which replaces the KPVT and SPM, is shown in figure 2.

The Perfect Decade

Jeremy Mould

From the outset, we have all recognized that the current Decadal Survey, *Astronomy and Astrophysics in the New Millennium*, is ambitious. The survey committee saw revolutionary astronomy opportunities in diffraction-limited ground-based telescopes and the digital sky. There was a parallel movement to double the National Science Foundation (NSF) budget. Astronomy was also the beneficiary of some of the biggest philanthropic gifts to science. These were the conditions, perhaps, for a decade long astrophysics boom, the inverse of the perfect storm!

In response to the opportunity, we have seen an armada of new projects emerge from port: two candidates for the Giant Segmented Mirror Telescope (GSMT) and a flotilla of survey projects, including PanStarrs, the Dark Energy Survey, and the Large Synoptic Survey Telescope (LSST), complementing the spaceborne Joint Dark Energy Mission.

The Decadal Survey also entrusted to NOAO the task of leading community strategic planning for the US System of optical/infrared (O/IR) observing facilities, including the nurturing of public-private partnerships, and scaling up WIYN and SOAR by an order of magnitude. In response to an NSF request, and recognizing the size of the challenge, we have recently established a Long Range Planning Committee to develop a road map that can guide us to success with the decadal goals. The committee has the benefit of a chair who knows the community well, Caty Pilachowski, and membership that includes the chairs of the GSMT and LSST Science Working Groups. I'm grateful to Caty and to Roger Blandford, Julianne Dalcanton, Alan Dressler, Garth Illingworth, Rolf Kudritzki, Pat Osmer, Sara Seager, Chris Sneden, Michael Strauss, and Alex Szalay (see photo) for their willingness to help with this important activity.

Members of the Long Range Planning Committee during their November 11 meeting in Tucson.

The NSF briefing at the committee's first meeting in September identified two special challenges that face us. First, we are working in a larger context than the astronomy decadal survey. In the future, priority for public funding of facilities of the scale of GSMT and LSST will be assessed by the NSF over all scientific disciplines and national priorities, in an international context. A project that has a fundamental impact on high-energy physics, or on the life sciences in an astrobiological context, may thus command a higher priority than a pure astronomy project. The committee will be mustering our arguments to present the intriguing connections between astronomy and these other disciplines.

Second, the committee was told to plan for a flat operational budget. That means the resources to operate the new facilities will be derived from our existing workforce levels. We therefore foresee the need to retire some current facilities or devolve them to other groups able to continue their operation. The committee's road map will need to include those decision points too.

A third challenge became clear during the committee's deliberations. The nature of the opportunities that make the current Decadal Survey goals so attractive is to involve disciplines that carry out large projects in different ways. High-energy physics and space science are opposite poles when it comes to selecting between competing concepts. Computer science is different again. Physics experiments are finite and are more readily sequenced in order of tighter and tighter measurements. We need to absorb the best from this diversity of approaches to the tasks of planning and working together. More details of the first meeting are on the Web at *www.noao.edu/dir/lrplan/lrp-committee.html*.

The Long Range Planning Committee is currently in its input phase, receiving presentations and data from interested parties. Its goal is to produce a scientifically interesting and consensus-based road map; it is not a selection committee of any kind. The committee will seek feedback from the community before finalizing its report. The report is anticipated in Spring 2005, and it is expected to inform the Committee on Astronomy and Astrophysics (CAA) and the NSF astronomy division on a fully integrated road map that will include radio astronomy and solar physics.

New Guidelines for TSIP in FY 2005

Todd Boroson

Following the "Building the System from the Ground Up" workshop (*www.noao.edu/meetings/system2/system2_report.pdf*), the Telescope System Instrumentation Program (TSIP) guidelines have undergone major revision for the FY 2005 cycle. TSIP is the National Science Foundation (NSF) program, administered by NOAO, that awards funds to independent observatories to build instruments or upgrade capabilities, and returns observing time on those facilities to the broader astronomical community.

There are now two types of TSIP proposal—System Improvement proposals and System Access proposals. System Improvement proposals are aimed at providing instruments or upgrades that result in enhanced scientific capability, effectiveness, or efficiency. They may range from complete facility instruments to instrument improvements (including data reduction pipelines and data archives) to infrastructure upgrades. System Improvement proposals require telescope time equal in value to 50 percent of the funds awarded to be provided to the community through the NOAO telescope allocation process.

System Access proposals are a simple mechanism for independent observatories to sell telescope time. The time provided will be equal in value to 100 percent of the funds awarded.

The funding in FY 2005 is expected to include the annual allocation of $4 million, plus approximately $1.75 million being carried forward from previous cycles. In FY 2005, this funding will be divided into two portions, with up to one-fourth available for telescopes between 3 and 6.5 meters, and the remainder for telescopes of aperture 6.5 meters and larger.

FY 2005 TSIP proposals are due at the end of February, and new awards will be announced in May 2005.

LSST Update

Sidney Wolff

A major milestone for the Large Synoptic Survey Telescope (LSST) project is currently being finalized—a commitment to purchase the primary mirror with funds generously made available by a private donor. Private donations are key to purchasing long lead time items early in the project and achieving our goal of first light in 2012.

Over the past several months, the members of the LSST consortium (under the leadership of Tony Tyson, project director; Don Sweeney, project manager; and John Schaefer, president) have focused their efforts on establishing the science requirements, selecting a baseline optical design, letting the mirror contract, developing the design for the camera (via work being done at Department of Energy laboratories), initiating work on data management, and narrowing the list of possible sites.

A Science Working Group, chaired by Michael Strauss, has completed its report on the kinds of scientific programs that will be enabled by a survey capability with a figure of merit of

continued

LSST Update continued

AΩ > 250, where A is the aperture of the telescope and Ω is the field of view. That report, which is independent of the particular design that is adopted to achieve AΩ > 250, can be found on the NOAO Web site.

The LSST consortium has developed a set of requirements for the telescope and camera that would meet the goals set forth by the SWG as well as the three NRC studies that have recommended it, and these requirements are posted at *lsst.org*. Requirements for data management also will be posted as soon as they are completed. Community comment and input is invited; again, see *lsst.org* for how to contribute to LSST.

The baseline optical design provides a field of view with a diameter of 3.5 degrees. The tertiary is now flush with the primary, and the camera will be mounted between the secondary and tertiary. A drawing can be seen on the LSST Web page image gallery. The committee to advise the LSST Board on site selection has narrowed the choice to four sites: La Palma, San Pedro Martir, Las Campanas, and Cerro Pachón.

A series of poster papers at the January meeting of the AAS will provide updates on the project. Stop by, and we will be happy to answer your questions!

Regional Workshop on Public Facilities and the System at Yale

Todd Boroson

On October 9, about 60 astronomers from Yale University and a number of nearby institutions spent most of a day at a workshop on "Ground-based Optical Astronomy in the 21st Century." This meeting was organized by Charles Bailyn, who took advantage of the visits of a number of NOAO staff for the WIYN Board meeting on the previous day. Presentations focused on both current and future facilities, primarily those that are publicly funded and offer open access. A panel discussion in the final hour of the workshop raised concerns about availability of time on telescopes from small to large, the relationship between grant funding and telescope time, and the balance between education and research in the use of available facilities. The program of the workshop can be viewed at *www.astro.yale.edu/bailyn/workshopagenda.html*.

The NOAO System Project Office (syspo@noao.edu) would be happy to assist anyone who wants to put on a regional workshop by arranging for speakers from NOAO to attend and participate.

As a participant in this workshop, and as the organizer of previous national-level workshops (as well as AAS town meetings) that covered similar ground, I found this meeting to be an extremely effective forum for communication with a segment of the community that is often difficult to reach. Many of the participants were graduate students, postdocs, and junior faculty. Most of those attending were from small colleges, and their perspectives were somewhat different from what I hear at national meetings. The way the meeting was organized—running from 10 A.M. until 5 P.M., box lunches, and student assistance—made it relatively easy for people to participate, and it was inexpensive to stage.

While there are probably not that many places in the country where a regional meeting such as this one would attract as many attendees, I believe that there are a few, and that it would be worthwhile to organize more regional workshops, both to convey the federal optical astronomy program to an important segment of the community and to communicate their concerns to the staff of the national observatory. The NOAO System Project Office (*syspo@noao.edu*) would be happy to assist anyone who wants to put on a regional workshop by arranging for speakers from NOAO to attend and participate.

Q&A

Letizia Stanghellini
Associate Astronomer

Letizia Stanghellini joined the NOAO scientific staff in April 2004, along with her spouse, Mark Dickinson. Letizia came to NOAO from a European Space Agency staff position at the Space Telescope Science Institute (STScI). Before moving to Baltimore, she was an assistant astronomer at the Bologna Observatory in Italy. Letizia earned her master's degree and PhD from the University of Illinois in Urbana-Champaign, advised by Professor James Kaler; her thesis included observations with the Kitt Peak 2.1-meter telescope. Letizia previously taught physics and math in Italy, after receiving her undergraduate degree from the University of Bologna, where her adviser was Professor Alvio Renzini.

Letizia's research specialty is planetary nebulae, which she has been studying in an extensive campaign using the Hubble Space Telescope (HST) with collaborators Dick Shaw and postdoc Ting-Hui Lee (NOAO); Eva Villaver, Max Mutchler, Diane Karakla, and Chris Blades (STScI); Bruce Balick (University of Washington); and Anabel Arrieta (UIA, Mexico).

Q. What is the current focus of your research on planetary nebulae?
For the past eight years, my main focus has been on observations of planetary nebulae in the Magellanic Clouds. We have acquired several hundred orbits of data from the HST, including the current cycle. We are trying to understand the formation and evolution of planetary nebula in an environment where their distance is known.

The distances of planetary nebulae in our own galaxy are not known very accurately, even though they are much closer to us—perhaps a dozen in the Milky Way are known with an accuracy of 20 percent, and many others could be 50 percent off or more. We don't know the absolute brightness of their central star or their true size, so we wanted to obtain an "absolute probe." The only way to do it with current technology is in the Large Magellanic Cloud (LMC) and Small Magellanic Cloud (SMC).

With Hubble, you can resolve them spatially, and we know their distance with sufficient accuracy. We have observed about 100 objects to date, and we use an innovative technique of spectroscopy without a slit that gives us an image of the nebula in each spectral line, as well as the morphology in each line. Ground-based optical spectroscopy is extremely useful to complete the observations—with a 4-meter class telescope, they are point sources.

Q. What are the big questions in the field right now?
We don't have a good understanding of the lower limit for the mass of a Type Ia supernova; below that limit, [the death of a star] produces a planetary nebula.

There are also issues related to theories of single-star star formation. How much carbon and nitrogen are contributed into the interstellar medium for the next generation of stars from planetary nebula? They are probably a major source, but we need more precise measurements and distances to know.

Another major question is "how do bipolar planetary nebulae form?"—is it from a binary star, or magnetic fields, or is it from stellar rotation associated with higher-mass stars?

All these questions are completely open, and they require absolute measurements of the central star.

Q. There has been some recent research using the WIYN telescope and other facilities suggesting that binary stars are required progenitors of bipolar planetary nebula. Does your work support this trend?
We are finding some interesting variability in the shapes of planetary nebulae. In the LMC, about half of planetary nebulae have aspherical features; others are almost round or elliptical.

One of our results that was not a surprise, but is good to know, is that the shapes of planetary nebulae in the LMC are the same as those we have seen in our galaxy. The distribution is different, but that may be partly because the plane of the Milky Way obscures a large fraction of the population, many of which are probably bipolar.

continued

Q&A continued

There are several hints that the bipolar planetary nebulae are associated with a more massive population, but having a binary progenitor is not a necessity. Neither current observations nor theories give a full answer.

Q. What was attractive to you about a job on the scientific staff at NOAO?
It was clear to me when I visited here that NOAO is an organization that is looking forward, both in my science area and with ground-based astronomy in general, and it presented many possibilities. Very interesting new things are being discussed, and I could tell that NOAO is reinventing itself, both with current projects and new ones.

In addition, Dick Shaw is one of my closest collaborators. We had the same academic advisor and have worked together on the LMC planetary nebulae project for the past ten years—we are like professional brother-and-sister! So that was another strong motivation for moving here, along with people like George Jacoby and, now, John Feldmeier. We have initiated a "Planetary Nebula Forum" with our neighbors at Steward Observatory that meets on the first Friday afternoon of the month. It has been very charming, there are 10 or 12 people here who are really in love with the subject.

I still hold my staff position at the University of Bologna—it is very hard to get tenure in Italy and, in general, it is easy to keep the position in absentia. I could go back easily, which is why I continue to include that affiliation on my papers.

Q. What are your NOAO staff service duties?
My functional work is very interesting. It includes tasks for the New Initiatives Office and science operations.

In addition, I will be serving as chair of the galactic panel at the next telescope Time Allocation Committee (TAC) meeting. It's a lot of work, you can see the piles of proposals covering my desk! It is similar to the process at STScI, but the difference is that you can actually participate in scientific discussions—it is much more scientific than bureaucratic.

Very recently, I was asked to chair the NOAO Goldberg Fellowship search committee, and we are preparing to review applications.

Q. What could the Thirty Meter Telescope (TMT) and the Large Synoptic Survey Telescope (LSST) do for observations of planetary nebulae?
The TMT offers even better spatial resolution than the Hubble Space Telescope for infrared observations. This will enhance our study of the planetary nebulae in the Magellanic Clouds and beyond. The large collecting area of the telescope will allow spectroscopy of the nebulae at the faint end of the luminosity function for planetary nebulae in our Local Group of galaxies.

With the LSST, it will be interesting to look at stellar pulsations. Many current observations cross the instability strip, and it is not easy to determine their variations.

Q. How do you find life in Tucson?
I had only visited here once before moving. In June, I thought I would never get used to the heat…and now I am cold all the time, so I guess I have adjusted! The sky is beautiful and the sunsets are spectacular, just like I had been told.

I am an amateur artist in my spare time, and I have found a nice artist community, including a school at the Tucson Museum of Art. I can see it will be very interesting. We certainly have the "right light" here in the southwest.

Gemini Update

Taft Armandroff

The majority of the time on the Gemini telescopes is being used for scientific observations for the Gemini user community. For semester 2004B, science time will represent at least 70 percent of the total time. Instrument commissioning and system verification activities are underway at Gemini as described below. System verification is the final step in readying an instrument for TAC-approved science observing.

GNIRS

The Gemini Near InfraRed Spectrograph (GNIRS) has been commissioned and verified in its primary modes. During semester 2004B, system verification of the GNIRS integral field unit (IFU) and GNIRS's high spectral resolution mode (R = 18,000) is occurring.

Michelle

The mid-infrared imager and spectrograph Michelle is undergoing system verification in its spectroscopic mode during semester 2004B at Gemini North.

Hokupa'a-85

A new visitor instrument, Hokupa'a-85, is being commissioned at Gemini South during semester 2004B. Hokupa'a-85 is an 85-element curvature-sensing adaptive optics system. It was developed by the University of Hawaii, under the leadership of Mark Chun and Christ Ftaclas. Hokupa'a-85 is used in tandem with NOAO's ABU infrared imager. Among its benefits, Hokupa'a-85 provides demonstration, testing, and experience with the adaptive optics technology and methodology also used in the Near Infrared Coronagraphic Imager (NICI), a future facility instrument for Gemini South.

Semester 2005A Proposal Statistics

The NOAO Gemini Science Center (NGSC) saw enthusiastic demand from the US community for Gemini observing time for semester 2005A. One hundred twenty proposals were received for Gemini North: 60 for GMOS-North, 35 for NIRI alone, 12 for NIRI with the Altair adaptive optics system, and 22 for Michelle. One hundred fourteen US proposals requested Gemini South: 39 for GNIRS, 34 for GMOS-South, 24 for Phoenix, 23 for T-ReCS, and 1 for the Acquisition Camera. In total, 217 US Gemini proposals sought 475 nights on the two Gemini telescopes. The numbers of US Gemini proposals and nights requested represent record highs. The oversubscription factors of 5.1 at Gemini North and 4.2 at Gemini South demonstrate healthy community engagement.

Opportunities to Use the Gemini Telescopes to Observe the Deep Impact Comet Encounter

Verne Smith

Deep Impact is a NASA Discovery Program mission designed to intercept and study Comet Tempel 1 in July 2005, centered on an ambitious plan to strike the comet with a 370-kilogram copper projectile that will impact at a relative velocity of 10.2 kilometers per second. This event will take place when Comet Tempel 1 is about 0.9 astronomical units from Earth. The current nominal mission timeline calls for a Delta II launch in December 2004, followed by a six-month cruise to comet encounter. The planned encounter will take place on, or near, 4–5 July 2005, with the impactor being released from the flyby spacecraft about 24 hours before the Tempel 1 encounter. The flyby spacecraft will maneuver so as to observe the impact from a distance of about 500–700 kilometers. Instruments on the flyby spacecraft include high-resolution and medium-resolution optical CCD imagers (with respective scales of 1.4 meters per pixel and 7 meters per pixel at 700 kilometers). In addition, the flyby spacecraft has an infrared spectrometer with an HgCdTe array, having spectral sensitivity from 1.05 to 4.8 microns, and a spectral resolution of R = 216. The impactor itself carries a targeting optical CCD camera that will guide it to the comet. This camera will return images up to a few seconds before impact and provides a scale of 0.2 meters per pixel at 20 kilometers.

continued

Opportunities to Observe the Deep Impact Comet Encounter continued

Observers should be aware that the Gemini telescopes, and their deployed suite of instruments, will support the Deep Impact mission by reserving three nights on each telescope. These nights will be immediately before, during, and after the day of the impact. During the dates of the Tempel 1 encounter, the approximate positions of the comet will be from about 13 hours 35 minutes to 13 hours 40 minutes in right ascension and -9 to -10 degrees in declination. Observations on those nights will be coordinated with other national and international observatories, and access to them made available in a separate Call for Proposals to be released in early 2005. Keep an eye on the Gemini Observatory Web site (*www.gemini.edu*) for the proposal call.

More information on the Deep Impact mission can be found at *deepimpact.jpl.nasa.gov* and *deepimpact.umd.edu*.

Following the Aspen Process: Extreme Adaptive Optics Coronagraph

Jay Elias

The March 2004 *NOAO-NSO Newsletter* reported the results of the Aspen Workshop, which was convened for the purpose of outlining future research paths for the Gemini telescopes and identifying instrumentation essential to the pursuit of this research. Gemini has funded concept design or feasibility studies for four instruments identified as highest priority. In the September 2004 *NOAO-NSO Newsletter*, Ken Hinkle briefly described the high-resolution near-infrared spectrograph (HRNIRS), one of the two instruments for which concept designs are being developed. The second instrument for which concept designs are being developed is the Extreme Adaptive Optics Coronagraph (ExAOC).

One of the key research topics identified by the Aspen Workshop is the identification and study of planets orbiting around other stars. Studying these planets includes direct imaging and low-resolution spectroscopy, which, needless to say, is quite difficult, since even planets significantly larger than Jupiter are still much fainter than the star around which they orbit. The performance goal for the coronagraph is detection of planets 10^7 times fainter than the central star, inside a 1.5 arcsec radius of the star. For a star at 50 parsecs distance, a separation of 0.1 arcsec corresponds to the orbit of Jupiter. For a 5^{th} magnitude star, one must detect an object fainter than magnitude 22 at this separation.

In order to accomplish this difficult task, the instrument must rely on a combination of high-order adaptive optics, a coronagraphic capability, and excellent control of scattered light. This is best done in the near-infrared, where in addition giant planets should show maximum contrast with the star and where the planetary atmospheres should show strong methane bands.

ExAOC differs from other present and proposed Gemini instruments in that it is very much a special-purpose instrument. Although it may possibly prove useful for other projects, such as observations of active galactic nuclei or dust disks around young stars, this science is definitely secondary to the primary purpose of planet detection. It differs specifically from NICI, the coronagraphic imager now under construction (see the "NGSC Instrumentation Program Update" article that follows) in that it sacrifices versatility for maximum contrast at minimum separation.

As with HRNIRS, Gemini has selected two teams to carry out competitive design studies and will review the concepts early next year. One of the teams is led by Laird Close (Center for Astronomical Adaptive Optics, University of Arizona), with participants from other institutions within the Gemini partnership, including NOAO. The second team is led by Bruce Macintosh (Center for Adaptive Optics, University of California) and also involves several other institutions.

Two New NGSC Staff Members

Taft Armandroff

The NOAO Gemini Science Center (NGSC) is delighted to announce the arrival of two new scientific staff members who will contribute to supporting the US astronomical community in its use of the twin Gemini 8-meter telescopes. Please join us in welcoming Verne Smith and Tom Matheson to NGSC and NOAO.

Verne Smith assumed the duties of NGSC Deputy Director on August 1; he also holds an appointment as tenured astronomer. Verne is well recognized for his studies of stellar abundances and Galactic chemical evolution. An experienced user of Phoenix and Gemini, Verne is the author of three publications from Gemini observations. He is initially based in Tucson but will relocate to NOAO South in 2005. Verne will provide leadership for NGSC activities at NOAO South and will be active in supporting US users of Phoenix and GMOS. Among his current activities, Smith is exploring how stellar populations and chemical abundances research is enabled by the HRNIRS and WFMOS instrument concepts for Gemini.

Tom Matheson joined NOAO on September 1 as NGSC Assistant Astronomer. Tom moved to Tucson from the Harvard-Smithsonian Center for Astrophysics, where he was a postdoctoral fellow. He received his PhD from the University of California, Berkeley, in 2000. His PhD thesis topic was "The Spectral Characteristics of Stripped-Envelope Supernovae." Tom's main research interests are supernovae, supernova cosmology, and the relation between gamma ray bursts and supernovae. One of his NGSC duties will be to serve as instrument support scientist for GMOS, which he has been using to obtain spectroscopy of cosmologically interesting supernovae.

New NGSC staff members Verne Smith, NGSC Deputy Director (left) and Tom Matheson, Assistant Astronomer (right) in front of the NOAO Headquarters building in Tucson.

NGSC is currently recruiting two additional scientific staff members. Please see the NOAO Web pages for a description of these opportunities (*www.noao.edu/cas/hr/jobs/jobs_list.html*).

NGSC Instrumentation Program Update

Taft Armandroff & Mark Trueblood

The NGSC Instrumentation Program continues its mission to provide innovative and capable instrumentation for the Gemini telescopes in support of frontline science programs. This article gives a status update on Gemini instrumentation being developed in the United States, with progress since the September 2004 *NOAO-NSO Newsletter.*

NICI

The Near Infrared Coronagraphic Imager (NICI) will provide a 1- to 5-micron dual-beam coronagraphic imaging capability on the Gemini South telescope. Mauna Kea Infrared (MKIR) in Hilo is building NICI, under the leadership of Doug Toomey.

MKIR integrated all of the NICI components into the NICI dewar and carried out the second NICI cold test. This test demonstrated that all the NICI mechanisms and Hall-effect sensors are performing correctly at NICI's operating temperature. Proper thermal performance of the dewar was also proven. Good progress has been made on the NICI documentation deliverables.

As of the end of September, MKIR reports that 93 percent of the work to NICI final acceptance by Gemini has been completed. NICI is expected to be deployed on Gemini South in 2005.

The NICI filter wheel assembly is shown being inserted into the NICI dewar, in preparation for the second cold test.

FLAMINGOS-2

FLAMINGOS-2 is a near-infrared multi-object spectrograph and imager for the Gemini telescopes; it will be commissioned at Gemini North and used there for some period before being relocated to Gemini South. It will cover a 6.1-arcmin-diameter field at the standard Gemini *f*/16 focus in imaging mode, and will provide multi-object spectra over a 6.1×2-arcmin field. It will also provide a multi-object spectroscopic capability for Gemini South's multiconjugate adaptive optics system. The University of Florida is building FLAMINGOS-2, under the leadership of Principal Investigator Steve Eikenberry.

FLAMINGOS-2 is transitioning from the late fabrication phase of the project to the early part of the integration phase. Recent achievements include fabrication of the filter wheel and integration of the camera dewar components. As of September, 59 percent of the work to FLAMINGOS-2 final acceptance by Gemini has been completed.

The FLAMINGOS-2 MOS dewar that contains the masks for multi-object spectroscopy and the spacer.

continued

NGSC Instrumentation Program Update continued

Future Gemini Instrumentation

The next generation of instrumentation at Gemini will be the result of the community planning process that culminated in the Gemini workshop in Aspen, Colorado, in June 2003. Design studies are underway for a very capable high-resolution near-infrared spectrograph (HRNIRS) and an ambitious high-contrast adaptive optics system and associated imager/spectrograph capable of imaging warm planets around nearby stars (ExAOC). Gemini has funded two competing design studies for each of these two concepts. Gemini is also conducting feasibility studies for a very powerful wide-field multi-object spectrograph (WFMOS) and for a ground-layer adaptive optics (GLAO) program. Groups in the United States are participating strongly in both the design and feasibility studies. NOAO and the University of Florida form one HRNIRS design-study team, while the United Kingdom Astronomy Technology Centre and the University of Hawaii make up the other HRNIRS team. The University of Arizona and the Center for Adaptive Optics at the University of California are each leading independent design-study teams for ExAOC. Johns Hopkins University and NOAO are collaborators on the Anglo-Australian-Observatory-led WFMOS feasibility study. The University of Arizona is one of three institutions collaborating on the international GLAO feasibility study.

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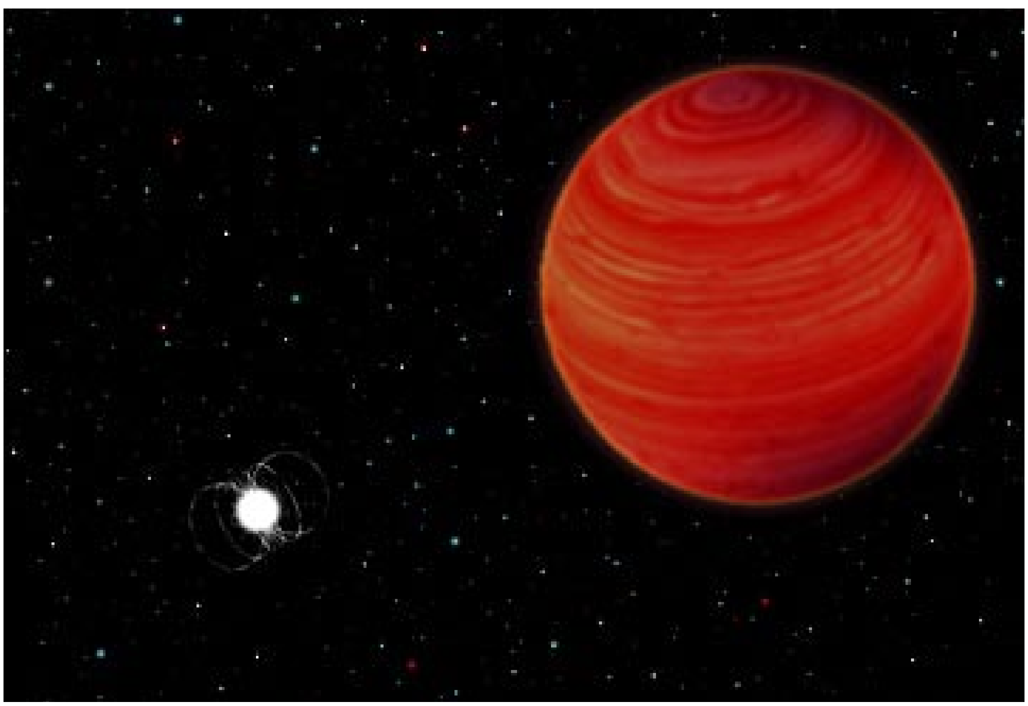


A joint Gemini Observatory-NOAO press release on 5 October 2004 highlighted observations by a team including Steve Howell of NOAO-WIYN and Thomas E. Harrison of New Mexico State University, who used the Gemini North and Keck II telescopes to peer inside the violent binary star system EF Eridanus. The team found that that one of the interacting stars has lost so much mass to its partner that it has regressed to a strange, inert body resembling no known star type. The unusual result was reported widely, including a story by Reuters wire service that appeared on CNN.com and ABCNews.com, plus other stories by Space.com, the New Zealand Herald, SkyandTelescope.com, and numerous Hawaiian newspapers.

Artwork: Gemini Observatory and Jon Lomberg.

NOAO Survey Program Letters of Intent Due January 31

Todd Boroson

There have been no new starts in the NOAO Survey Program in the last two years, as we have given the active surveys a chance to complete their observations. While a few surveys will still be observing in 2005, we expect to take proposals for new surveys in the 2005B cycle. This decision is contingent on the success of a review of the Survey Program that the AURA Observatories Council will be holding in January 2005. However, because of the lead time in soliciting letters of intent and proposals, we are planning to accept letters of intent and to inform letter writers if the review results in changes or further delays in the program. Full proposals will be due 15 March 2005.

Surveys are aimed at identification and study of complete, well-defined samples of objects that can yield both conclusions based on analysis of the survey data itself, and also provide important subsets for more detailed observations with larger telescopes. All survey teams are expected to work with the NOAO Science Archive project to ensure effective, timely community access to the survey data.

Investigators interested in applying for time under the NOAO Survey Program MUST submit a letter of intent by 31 January 2005 (by e-mail to *surveys@noao.edu*) describing the broad scientific goals of the program, the membership of the survey team, the telescopes and instruments to be requested, the approximate amount of time that will be requested, and the duration of the proposed survey. Up to 20 percent of the total telescope time at CTIO and KPNO may be awarded through the Survey Program, including time allocated in the earlier rounds to continuing programs. We are exploring the possibility of allowing surveys to begin on the Gemini telescopes; watch the Web site given below for an update on this.

A more detailed description of the Survey Program requirements and guidelines is available at *www.noao.edu/gateway/surveys/*. Proposals must be initiated using the NOAO Web proposal form at *www.noao.edu/noaoprop/noaoprop.html*, which will be available approximately 15 February 2005.

2005A Proposal Process Update

Dave Bell

NOAO received 497 observing proposals for telescope time during the 2005A observing semester. These included 217 proposals for Gemini, 135 for KPNO, 111 for CTIO, 34 for Keck, 10 for MMT, 8 for HET, and 2 for Magellan. Twenty-two of the Cerro Tololo proposals were processed on behalf of the Chilean National Time Allocation Committee (TAC), and 12 of the Kitt Peak proposals were processed on behalf of the University of Maryland TAC. Thesis projects accounted for 23 percent (112 proposals) of those received, and 15 proposals requested long-term status. Time-request statistics by telescope and instrument appear in the following tables. Subscription rate statistics will be published in the March 2005 issue of the *NOAO-NSO Newsletter*.

As of this writing, proposals are being reviewed by members of the NOAO TAC (see the following listing). We expect all telescope schedules to be completed by 7 December 2004, and plan to notify principal investigators of the status of their requests at that time. Mailed information packets will follow the e-mail notifications by about two weeks.

Looking ahead to 2005B, Web information and forms will be available on line in February 2005. The March 2005 issue of this *Newsletter* will contain updated instrument and proposal information.

2005A Instrument Request Statistics by Telescope

KPNO

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
4-m		**68**	**74**	**255.8**	**76**	**30**	**3.5**
	ECH	10	10	40	2	5	4
	FLMN	16	16	54	0	0	3.4
	MARS	3	3	10	6	60	3.3
	MOSA	17	21	59	40	68	2.8
	RCSP	21	21	84	28	33	4
	SQIID	3	3	8.8	0	0	2.9
WIYN 3.5-m		**30**	**34**	**94.2**	**60.7**	**64**	**2.8**
	DSPK	3	3	9	9	100	3
	HYDR	13	16	48.2	20	41	3
	MIMO	12	12	27.9	22.7	81	2.3
	SPSPK	1	1	5	5	100	5
	WTTM	2	2	4	4	100	2
2.1-m		**28**	**34**	**178.7**	**84**	**47**	**5.3**
	CFIM	11	13	73.5	53	72	5.7
	FLMN	5	6	23	6	26	3.8
	GCAM	8	10	61	25	41	6.1
	SQIID	4	4	11.2	0	0	2.8
	VIS	1	1	10	0	0	10
WIYN 0.9-m		**6**	**6**	**28**	**18**	**64**	**4.7**
	MOSA	6	6	28	18	64	4.7

CTIO

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
SOAR		**10**	**11**	**27.1**	**13.3**	**49**	**2.5**
	Goodman	4	5	14.3	8.3	58	2.9
	OSIRIS	4	4	7.8	0	0	2
	SOI	2	2	5	5	100	2.5
4-m		**63**	**68**	**231.7**	**76.5**	**33**	**3.4**
	HYDRA	14	15	52	11	21	3.5
	ISPI	20	21	61.7	2.5	4	2.9
	MOSAIC	16	17	68	45	66	4
	RCSP	13	14	46	18	39	3.3
	VIS	1	1	4	0	0	4
1.5-m		**4**	**5**	**18**	**2**	**11**	**3.6**
	CSPEC	4	5	18	2	11	3.6
1.3-m		**13**	**13**	**48.9**	**6.5**	**13**	**3.8**
	ANDI	13	13	48.9	6.5	13	3.8
1.0-m		**8**	**9**	**76.6**	**21.5**	**28**	**8.5**
	CFIM	8	9	76.6	21.5	28	8.5
0.9-m		**14**	**18**	**118.5**	**29.5**	**25**	**6.6**
	CFIM	14	18	118.5	29.5	25	6.6

GEMINI

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
Gemini North		**120**	**150**	**248.4**	**101.5**	**41**	**1.7**
	GMOSN	60	73	135.3	89.8	66	1.9
	Michelle	22	22	31.6	4.4	14	1.4
	NIRI	47	55	81.5	7.3	9	1.5

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
Gemini South		**114**	**137**	**226.4**	**33**	**15**	**1.7**
	AcqCam	1	1	0.3	0	0	0.3
	GMOSS	34	41	55.7	28.3	51	1.4
	GNIRS	39	44	59.5	1	2	1.4
	Phoenix	24	24	75.5	0	0	3.1
	TReCS	23	27	35.5	3.7	10	1.3

COMMUNITY ACCESS

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
Keck-I		**17**	**17**	**31.5**	**19.5**	**62**	**1.9**
	HIRES	7	7	11.5	2.5	22	1.6
	LRIS	9	9	18	17	94	2
	LWS	1	1	2	0	0	2
Keck-II		**19**	**20**	**32**	**12**	**31**	**1.6**
	DEIMOS	6	6	10	10	100	1.7
	ESI	2	2	3	1	33	1.5
	NIRC2	2	2	2.5	1	40	1.2
	NIRSPAO	1	1	1	0	0	1
	NIRSPEC	9	9	15.5	0	0	1.7

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
MMT		**10**	**10**	**29**	**9**	**31**	**2.9**
	BCHAN	6	6	18	2	11	3
	Hectochelle	2	2	4	0	0	2
	Hectospec	1	1	4	4	100	4
	MegaCam	1	1	3	3	100	3

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
Magellan-I		**2**	**2**	**5**	**0**	**0**	**2.5**
	IMACS	1	1	1	0	0	1
	PANIC	1	1	4	0	0	4

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
HET		**8**	**9**	**18.1**	**5.2**	**29**	**2**
	HRS	4	5	10	0	0	2
	LRS	3	3	5.3	5.2	98	1.8
	MRS	1	1	2.8	0	0	2.8

2005A TAC Members

Galactic (28–29 October 2004)
Margaret Hanson, Chair, University of Cincinnati
Letizia Stanghellini, Chair, NOAO
Sidney Wolff, Chair, NOAO

Lori Allen, SAO
Suchitra Balachandran, University of Maryland
Adam Burgasser, American Museum of Natural History
Ray Jayawardhana, University of Toronto
Jeremy King, Clemson University
Davy Kirkpatrick, Caltech/IPAC
Henry Lee, University of Minnesota
Ken Mighell, NOAO
John Monnier, University of Michigan
Bart Pritzl, Macalester College
Steve Ridgway, NOAO
Verne Smith, NOAO
Nicole van der Bliek, CTIO
Kim Venn, Macalester College
Lisa Young, New Mexico Tech

Solar System (1 November 2004)
Dave De Young, Chair, NOAO

Debra Fischer, San Francisco State University
William Hubbard, University of Arizona, LPL
Robert Millis, Lowell Observatory
Susan Wyckoff, Arizona State University

Extragalactic (2–3 November 2004)
Dave De Young, Chair, NOAO
Tod Lauer, Chair, NOAO
John Mulchaey, Chair, Carnegie Observatories

Lee Armus, Spitzer Science Center
Stephane Courteau, Queens University
Romeel Davé, University of Arizona
Roelof De Jong, STScI
Ian Dell'Antonio, Brown University
Arjun Dey, NOAO
Megan Donohue, Michigan State University
Harry Ferguson, STScI
Anthony Gonzalez, University of Florida
Brad Holden, Lick Observatory
Mark Lacy, Spitzer Science Center
Philip Pinto, University of Arizona
Malcolm Smith, CTIO
Adam Stanford, Lawrence Livermore National Laboratory
Lisa Storrie-Lombardi, Spitzer Science Center

"CATCH"— A Web-Based Clearinghouse for Community Telescope Information and Access

Katy Garmany & Todd Boroson

Where can one find information on all available community telescopes and their instrumentation? This question has been raised by various panels recently, who have expressed their view that NOAO could most logically provide a Web site that summarizes and links all the diverse observing opportunities and set expectations for the future (see the O/IR System committee report at *www.noao.edu/meetings/system2/system2_report.pdf*). This challenge has been accepted by the System Project Office and is in the planning stage. We envision a Web site that includes all NOAO facilities, the TSIP program (which so far has made public observing time available on Keck, HET, MMT, Magellan, and LBT), and other telescopes giving public access through NOAO—WIYN, SOAR, and SMARTS.

Not only will this site list the observing facilities offered through the NOAO proposal process, but it will also include other community access telescopes and instrumentation. In particular, it will identify opportunities offered through PREST (Program for Research and Education with Small Telescopes), a new National Science Foundation initiative. The PREST awards are for small (<2.5-meter) telescopes that offer both training and observing experiences, especially for graduate and undergraduate students. Four PREST awards were made in August (Michigan State, University of Toledo, University of North Carolina/CTIO, and Lowell/Boston University), and the next proposal opportunity will occur in January 2005.

The Web site will include time available, how and when to apply, instrument and detector capabilities, selection criteria, typical weather, lodging accommodations, and technical assistance or training available at the telescope. Also, feedback from observers on the performance of the facilities will be made available to potential proposers.

The most immediate need for this project is a snappy acronym—the best suggestion so far is CATCH (Community Access Telescope Clearinghouse). Send additional ideas to Katy Garmany (*garmany@noao.edu*) and win a prize!

Dark Energy Camera Team Visits Chile

Timothy Abbott

Seven members of the Dark Energy Camera (DECam) team visited CTIO in October. Project director John Peoples, project manager Brenna Flaugher, camera and dewar specialist Greg Derylo, cryogenics and power specialist Del Allspach, mechanical designer French Leger, system integration specialist Peter Limon, and data acquisition specialist Todd Moore spent a week in La Serena and on Cerro Tololo.

The Dark Energy Camera will be a Blanco 4-meter telescope instrument. Photo credit: Milton Urzua/Gemini Observatory.

The team and local collaborators presented a briefing on the project to NOAO staff in Chile and engaged in extensive discussions. The instrument development team have considerable prior experience with the Sloan Digital Sky Survey telescope and instrumentation for it, and also draw on a large pool of expertise from high-energy physics. The latter is particularly relevant to building large detector systems and handling very high data throughput—the DECam will incorporate half a gigapixel of CCDs and be capable of producing an image in 17 seconds.

The camera will be integrated into Blanco telescope operations as a facility instrument and must be designed and built with this in mind. The DECam team's visit to La Serena has firmly established productive interaction with on-site staff and paved the way for evolution of the design according to the needs of both groups.

The visit included, of course, an inspection of the telescope and a tour of CTIO's facilities relevant to instrument construction. While our facilities cannot match those of Fermilab, from which most of the team's members originate, CTIO nevertheless expects to contribute to the program at a level more extensive than simply hosting the DECam. Our instrument construction and data management facilities and, of course, instrument design skills, provide considerable advantages to the project.

The DECam is the observational instrument for the Dark Energy Survey (DES) project, which has recently been assessed positively by the Blanco Instrument Review Panel (BIRP), led by George Jacoby and Constance Rockosi. This panel was assembled to review the responses to last year's Announcement of Opportunity to build new instruments for the Blanco telescope and to offer recommendations to the NOAO director. The DES was the only respondent and the panel recommended that the project proceed.

The DES aims to use 30 percent of the available Blanco time to pursue a high-precision, multibandpass survey of 5,000 square degrees of sky over the course of five years. The collaborating institutes are Fermilab National Accelerator Laboratory, the University of Illinois at Urbana Champaign, the University of Chicago, Lawrence Berkeley National Laboratory, NOAO, and the National Center for Supercomputer Applications. More information on the project can be found at *www.darkenergysurvey.org.*

SMARTS: Results and Upgrades

Alan Whiting

The Small and Medium-Aperture Research Telescope System (SMARTS) consortium will celebrate its second anniversary of operating telescopes on Cerro Tololo in February 2005. Scientific results from the initial period will be presented at a special session of the AAS meeting in San Diego, the month before. These presentations will range widely, from long-term photometry of distant asteroids and comets to determine their nature (binary? made of what materials?) to short-notice follow-up of gamma-ray bursts.

Immediately following the science session, there will be a planning meeting for future operations. The original SMARTS agreement expires in January 2006, and a new consortium proposal (perhaps with some new members) needs to be put together early in 2005.

In the shorter term, several of the SMARTS telescopes have upgrades planned or in progress:

- The ex-YALO 1.0-meter, which had not been used for many months, is now operating with a 512 × 512 CCD made by the Ohio State University group; late in 2004 a 4K CCD is scheduled for installation.
- CPAPIR (Camera Panoramique Proche Infra Rouge), a 2K infrared camera built by a group at the University of Montreal, is scheduled to undergo on-telescope tests in the north in November and to be installed on the 1.5-meter in early 2005. Its main task will be an infrared survey of the Milky Way plane (see *ftp.astro.umontreal.ca/cpapir*).
- Planning is in progress for a replacement to the venerable telescope control system of the 0.9-meter, to take place in early 2005.
- Neutral-density filters have been installed in ANDICAM on the 1.3-meter (ex-2MASS), allowing photometry of bright stars in four wavebands. We are ready for the next bright supernova!

SOAR Update

Steve Heathcote

Since the dedication ceremony in April, the SOAR team has been busy preparing the telescope and its instruments in readiness for science operation. Unfortunately, in this process we have encountered a significant, but fixable, problem with the telescope's active optical system (AOS).

SOAR's thin meniscus primary mirror is supported by 120 axial actuators, which can be adjusted to maintain its precise figure as the telescope points to different positions on the sky, and six passive lateral links that are simply supposed to carry an increasing fraction of the mirror's weight as the telescope moves to lower elevation. Using the Calibration Wavefront Sensor (CWFS) mounted at one of the telescope's Bent Cassegrain Foci, it is possible to measure the form of the wavefront delivered by the telescope, and then to calculate the optimal set of forces to apply to each actuator to minimize the departures from the perfect form. This works very well indeed, allowing the shape of the primary mirror to be adjusted, at a given position and moment in time, to deliver images limited by the prevailing seeing.

However, it was intended that in normal operation, the SOAR AOS would work "open loop" with the forces to be applied to each actuator being set by lookup tables, derived from measurements made in advance with the CWFS at a grid of positions on the sky. In contrast, other telescopes based on similar technology, such as Gemini, use a wavefront sensing guider to close their control loop, allowing continuous optimization of the mirror figure while observing. This option was not open to SOAR, essentially because of its smaller aperture, which means that a guide star would only rarely be bright enough to use for wavefront sensing.

As we collected data to populate the lookup tables it quickly became apparent that astigmatism, by far the largest residual aberration, had strong and unexpected dependencies on elevation, azimuth, and especially temperature. While the azimuth and elevation dependence have proven to be straightforward to model and include in the lookup tables, the temperature dependence has not.

continued

SOAR Update continued

Subsequent analysis, aided by 20/20 hindsight, shows that the root cause of this problem are the lateral links, which over-constrain the mirror and warping it in response to tiny position- and temperature-dependent distortions of the telescope structure. Consequently, the SOAR team is working with outside contractors to design and develop active lateral links that should fix this problem, allowing the telescope to be used as originally intended. However, the implementation of this definitive solution is likely still 9 to 12 months away.

In the meantime, we have refined the lookup tables to the point where they can be used to largely correct the azimuth and elevation dependence of the astigmatism. As a result, it is now possible to observe by tuning the AOS using a bright star close to each science target, then rely on the lookup tables to adjust the solution as the telescope tracks.

We are still determining how often it is necessary to take CWFS measurements in order to maintain good image quality, but we expect that in the worst case it will be necessary to do this for each new science target, and about once per hour thereafter, depending on how fast the temperature is changing. Each calibration measurement takes 5–10 minutes. Thus, while the observing efficiency will be lower than we would like, it should be possible to begin shared-risk science operations on a part-time basis starting in 2005A, and continuing until we are ready to install and test the new active lateral links.

In parallel, we have made considerable progress in preparing the SOAR instrumentation for science. As of November, both the SOAR Optical Imager (SOI) and the Ohio State Infrared Imager/Spectrometer (OSIRIS) are on the telescope, and we are in the process of characterizing them and measuring their performance. The Goodman Spectrograph also had a successful first engineering run in late August using a provisional CCD camera; work continues to prepare the science CCDs for use, but we expect that this instrument will be available by the middle of 2005B.

Consequently, a call for proposals for shared-risk "Early Science" time at SOAR was included in the NOAO 2005A proposal round, and met with a gratifying response from the community. These programs will be executed in service mode by SOAR staff, with the exact schedule depending on the progress of ongoing commissioning work. Successful applicants will be provided with the latest information on the status of the telescope and instruments closer to the time of observation, and will have the opportunity to refine the technical details of their program accordingly, in consultation with the SOAR staff. Up-to-date information can also be found on the SOAR Web site at *www.soartelescope.org*.

The UNC Burch Program Brings Astronomy Students to La Serena

Carrie Sweet & Bryan Zandt (University of North Carolina)

A little over a decade ago, University of North Carolina (UNC) alumnus Lucius E. Burch III initially funded the Burch Fellows Program, which continues to provide UNC undergraduate students with unique opportunities to study abroad. The vision of the Burch program is quite simple: to provide students with the resources required to spend a semester away from campus and delve into a specific field of interest. The Burch Field Research Seminars grant a small group of students time to research and "live" their passion in a manner that would be impossible in a normal classroom setting. The students are led by UNC professors in their curricular endeavors in a combination of course work and hands-on experience.

Burch Field Research Seminars have taken students around the world to study Mandarin in Beijing, the cultural role of food in Dijon, France, and documentary filmmaking in Bangkok. For a few students at UNC, one Burch Program integrated their course of study perfectly, satisfying interests in both astronomy and Spanish culture. This special program, titled "SOARing the Southern Skies of Chile," chose as its headquarters the beautiful seaside town of La Serena, Chile, because of its close proximity to the Cerro Tololo Inter-American Observatory.

Early this spring, 11 undergraduate students, one graduate student, and two UNC professors—Wayne Christiansen and

continued

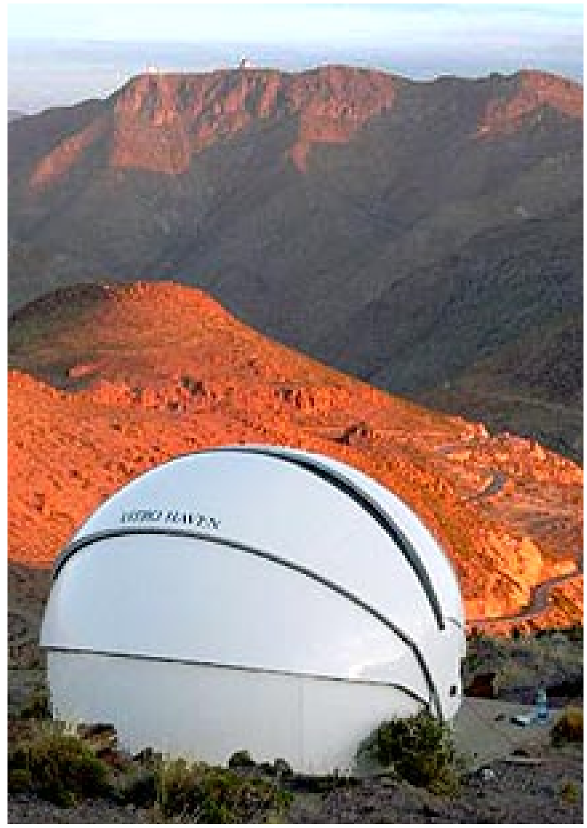
The UNC Burch Program continued

Gerald Cecil—began their extraordinary journey to Chile. "Not only is this the first year for this particular Burch program, but this is the first science study abroad program from UNC," says Christiansen. "We're trying to offer a solid science-based program along with the cultural aspects of living in a society different from the United States. We're very excited about it."

The goal of this program is to provide the students with the chance to dive into the fascinating world of pure, unadulterated astronomical observation, including both the early science of SOAR and the initial phases of the configuration of the PROMPT project. PROMPT, or Panchromatic Robotic Optical Monitoring and Polarimetry Telescopes, will consist of an array of six telescopes used in conjunction with NASA's SWIFT satellite and SOAR for quick detection and the study of gamma-ray bursts. "PROMPT is UNC's effort to leverage our part in SOAR in a very special way, by chasing gamma ray bursts," explains Christiansen. "We know that SOAR can't be on line all the time for gamma ray bursts, so PROMPT is able to act quickly to identify them and then interrupt SOAR for a 'target of opportunity observation,' if it is needed. The pot of gold at the end of the rainbow in SOAR and PROMPT is finding gamma ray bursts at very large distances, with redshifts on the order of 10."

The Burch students are taking three courses to supplement their research in Chile. One physics class focuses on the current oil-supported economy and the forms of nonrenewable/renewable resources in our society that we may be forced to develop in order to sustain an ever-increasing population when world oil reserves run dry. The program focuses on astronomical studies through two classes, one focusing on cosmic evolution, and the other geared toward observational astronomy. The observational astronomy course introduced and led students through the process of how astronomers collect and process data, in preparation for their use of the data they will gather with PROMPT and SOAR.

Besides course work and spending time on Cerro Tololo and Cerro Pachón, the Burch participants have traveled to other important astronomical sites, such as the twin Magellan Telescopes on Las Campanas and the VLT/VLTI on Cerro Paranal, on a trip through the Atacama Desert to San Pedro. The students are grateful to VLT and Las Campanas site directors Drs. Gilmozzi and Phillips for their support of these visits. They received superb technical briefings by Dr. Seifert (VLT) and Mike Fischer (VLTI), as well as an excellent lunch at the amazing residencia.



One of the PROMPT domes with SOAR and Gemini South in background. Photo credit: Gerald Cecil.

Student Anjni Patel comments, "This program has given me a unique opportunity to immerse myself in Chilean culture and explore the country. From mountains to oceans, deserts to glaciers, Chile could not offer more natural beauty." Professors Christiansen and Cecil hope to extend the program into the future, as PROMPT construction completes and will offer a whole new range of possibilities for students. "I couldn't think of a better place to spend a semester abroad," says student Adam Robert. "The skies of Chile are unparalleled in the world of astronomy."

The Burch program will conclude with a field trip in early December to the Patagonian region of southern Argentina, before the students return to the United States.

WIYN's Major Advances in Upgrades and New Instrumentation

Richard Green & Patricia Knezek

The last year has seen a significant ramp-up in technical efforts devoted to WIYN instrumentation and telescope performance. This has led to the best image quality seen at WIYN. Typical rms wavefront errors delivered to the sensor are under 100 nanometers, leading to regular imaging performance with 0.3–0.4 arcsec FWHM.

A part of the improvement in image quality was the re-aluminization of all three mirrors during the month-long summer shutdown for the new Hydra positioner installation (see below). The tight schedule forced the issue of completing some long-needed improvements to the mirror-handling cart, including new drive screws with higher precision control that made the jacking motion much smoother. The entire operation went smoothly and with much less stress than in previous removals. Site Engineer Charles Corson also completed maintenance of the mirror support system that included identifying and replacing some misbehaving components. He then did a superb job of realigning the telescope optics, putting the finishing touches on the process of significantly improving the telescope performance.

During the past two years, a dedicated team led by Patricia Knezek has done an outstanding job on the design, fabrication, and integration of a replacement for the Hydra fiber positioner (see figure 1). Some key components of the original positioner could no longer be replaced, leading to the risk of catastrophic failure. In addition, several improvements made to the design when implementing Hydra II for CTIO were also desirable upgrades for WIYN performance. During the full month of WIYN shutdown in August, the old positioner was removed, its gripper mechanism was transferred to the new system, and the new positioner was installed with a precision realignment scheme on the telescope. In the course of testing and commissioning this new positioner, several aspects of the long-frozen software control were brought to full working order. The first scheduled shared-risk science run was a definite operational success. A few further improvements planned for fiscal year 2005 will increase performance beyond its predecessor, while providing a maintainable system for a further ten years of active use.

Good news for WIYN came in the form of a successful proposal for nearly $400,000 by Margaret Meixner to the Director's Discretionary Research Fund at Space Telescope Science Institute (STScI). She won support there for a project to build a near-infrared camera specifically for the WIYN tip-tilt module. Margaret is leading the instrument design effort to provide a 2K × 2K HgCdTe detector with a scale of 0.09 arcsec per pixel. As demonstrated by her traveling camera NIRIM, WIYN can frequently produce near-diffraction-limited images in the near-infrared, which will be reasonably matched to the adopted scale. KPNO will provide a Monsoon controller for compatibility with the mountain forward look. The WIYN High-resolution IR Camera (WHIRC) team, led by principal investigator Ed Churchwell (University of Wisconsin), and co-investigators Margaret Meixner and Don Figer (fSTScI), and Patricia Knezek (WIYN), is also submitting an ATI proposal to the National Science Foundation for the remaining funds. This project is off to a vigorous start, with a goal of two years to deployment.

Major progress was made in advancing the technology to produce wide-field CCD cameras with zonal fast guiding on-chip. George Jacoby leads WIYN in a collaboration with John Tonry and the PanSTARRS group at the University of Hawaii to develop

Figure 1. The WIYN Hydra team. Standing from left to right are George Jacoby, Gene McDougall, Dave Sawyer, Rich Gomez, Gary Muller, and Behzad Abareshi. Kneeling from left to right are Phil Massey, Charles Corson, and Dave Dryden. Missing from the photo are Di Harmer and Patricia Knezek.

continued

WIYN's Major Advances continued

orthogonal transfer array (OTA) CCDs. These 4K × 4K devices allow fast readout of individual ~500 × 500 pixel cells; the centroided position of a guide star can then be fed back to clock adjacent cells and move charge vertically or horizontally in either direction to achieve local fast guiding. WIYN is working with Dick Bredthauer of the commercial firm STA in close collaboration with PanSTARRS source Barry Burke at MIT Lincoln Laboratory (MITLL). Both groups staged initial foundry runs that were largely successful. The MITLL OTA has been demonstrated to image with its full format. The STA foundry devices will enter the testing phase before the end of 2004. The NSF ATI program granted WIYN the money to produce QUOTA, an 8K × 8K camera with OTA CCDs, planned for first light in 2006. All these steps are critical successes along the way to the production of a One-Degree Imager (32K × 32K) of OTA CCDs, planned for science operations in 2009. At its meeting in October, the WIYN Board reiterated its support for ODI development, and committed resources from the partner institutions for a strong effort in the current fiscal year.

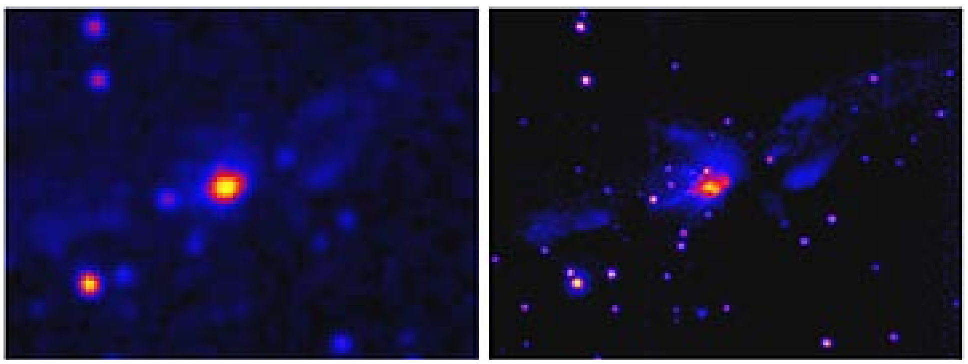
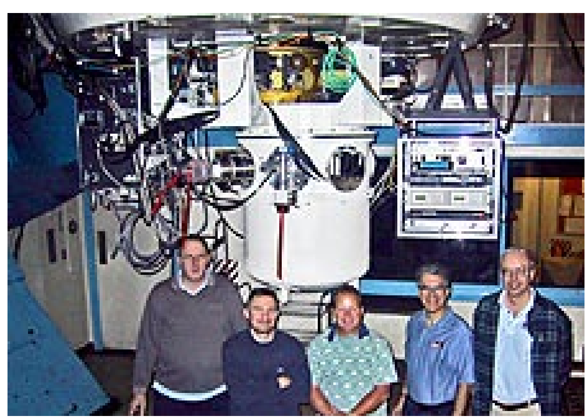


Figure 2. A comparison of the 2MASS (left) and WIYN/NIRIM (right) K_s images of the massive star-forming region G192.2.

First-Light Run for IRMOS a Major Success

Richard Green & John MacKenty

The long-time partnership of the Space Telescope Science Institute (STScI), Goddard Space Flight Center (GSFC), and Kitt Peak National Observatory (KPNO) was rewarded in September with a highly successful first-light run of the Infrared Multi-Object Spectrograph (IRMOS) on the Kitt Peak 2.1-meter telescope. This instrument uses a cold micromirror array as a programmable multislit mask. Principal investigator John MacKenty and his commissioning team were on the sky on the first night. The initial run allowed data acquisition to test throughput in all the bands with images and spectra (it is hot in z as well as K!), to map the geometry of the projection optics, and to test some designer slit configurations.



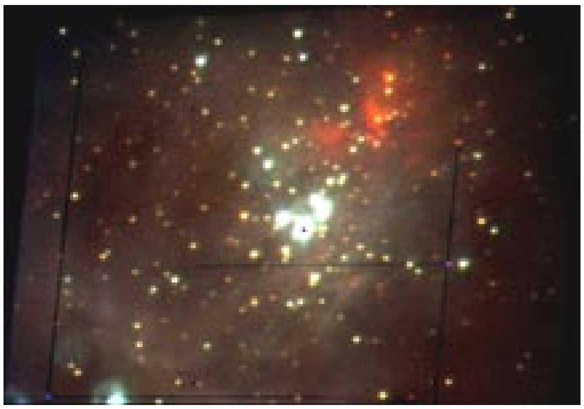
IRMOS on its first-light run. Left to right: Knute Ray, Ray Ohl, Tim Madison, Richard Green, John MacKenty (principal investigator).

The GSFC team went above and beyond to produce a state-of-the-art instrument. Ray Ohl has served as the technical team lead, pulling the project successfully through several challenging situations. Savoring the success of the development through participating in the

continued

First-Light Run for IRMOS continued

first-light run were engineers Joe Connelly and Knute Ray, technical support person Tim Madison, and project manager Leroy Sparr. Matt Greenhouse is the project co-investigator, supporting IRMOS technology development in the interests of the James Webb Space Telescope (JWST) program at GSFC.

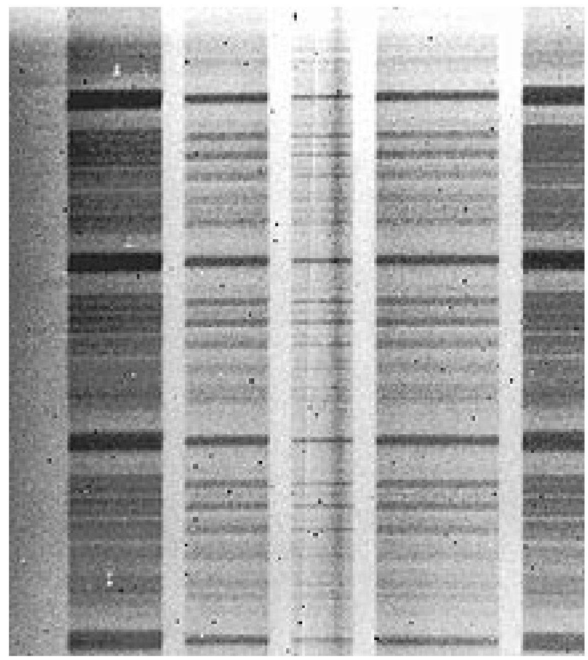


JHK composite of Orion. Some artifacts of the micromirror array are visible in this undithered image.

Thanks to careful prep work by Tony Abraham, Khairy Abdel-Ghawad, Will Goble (project lead), and Scott Bulau in Kitt Peak Engineering; Skip Andree, Bill Binkert, Mike Hawes, and the facilities crew; and Jim Hutchinson, Steve Lane, and Bill McCollam of Mountain Electronic Maintenance, the pre-observing support, setup, and alignment was very straightforward. As our instrument scientist, Dick Joyce had been running interference for months, and Bill Ditsler had made a special trip to GSFC to work on the instrument during assembly. Bill also made sure the flex rig facility was ready to receive the instrument and team on arrival. Hal Halbedel managed to create a new cadre of 2.1-meter telescope operators. We're also grateful to Paul Schmitt and the Major Instrumentation group for the loan of some critical vacuum equipment, and for the support of Central Facilities for careful handling.

At the 2.1-meter telescope, each micromirror in the 848 × 600 array subtends approximately 0.4 arcsec on the sky. Observers will be able to take an infrared image, then interactively design a custom slit mask from the image, and immediately begin taking multiple object spectra. Each of the J, H, and K bands is covered with a choice of gratings offering resolutions of approximately 300, 1000, and 3000. The initial measurement of the contrast ratio exceeded expectations.

The instrument has been scheduled for additional testing and engineering runs on the 4-meter and 2.1-meter telescopes in November. Future work will include reduction of background, and major improvements in user-interface software. Should progress continue at the current pace, the call for shared-risk proposals could come for 2005B.



Custom multislit H-band spectra of M31. The nucleus is visible in the central slit; galaxy signal is present in all slits. The slit widths were varied to compensate for the changing light profile of the galaxy, with the central width of 3 pixels = 1.1 arcsec, flanking slits of 7 pixels = 2.7 arcsec, and outer slits of 15 pixels = 5.3 arcsec. The (central) spectrum has R~1000; this is a single raw frame of a 100-second exposure.

KPNO and the University of Maryland—An Effective Partnership

Richard Green & Lee Mundy

As reported in the March 2002 *NOAO-NSO Newsletter*, Kitt Peak National Observatory (KPNO) solicited partnerships to maintain a vital flow of new instrumentation for the 4-meter telescope. After a series of reviews, a partnership was established between KPNO and the Astronomy Department at the University of Maryland. The department brought established expertise in astronomical software, particularly through their technical support of BIMA and CARMA, along with financial resources for critical instrument hardware purchases. In exchange for providing skilled personnel and much-needed financing, the department's 19 professorial faculty, some 40 research faculty, and large graduate student population were allocated 20 percent of the 4-meter nights scheduled for scientific observations. At the recommendation of the review panel, some of those nights can be exchanged for time on WIYN or the 2.1-meter telescope. Dedicated Maryland observing time began in Semester 2003B.

The initial focus of the partnership has been on the production of the NOAO Extremely Wide-Field Infrared Imager (NEWFIRM) as a scientific system. The NEWFIRM program will produce the camera hardware, the data acquisition hardware and software, and the data pipeline to go from raw data to calibrated images. Maryland resources have supported the purchases of large optics for the camera and augmentation of fabrication efforts, and will allow the acquisition of a suite of narrowband filters that were not in the baseline budget. Maryland personnel Rob Swaters and Brian Thomas are fully integrated into the NOAO pipeline development team; their participation has made the critical difference for meeting the delivery schedule. Sylvain Veilleux was the lead on the department's proposal, and provides oversight of Maryland personnel as well as coordination of the Maryland Time Allocation Committee (TAC) process. Sylvain also serves on the NEWFIRM science advisory committee, advancing a full intellectual partnership.

Oversight of the partnership is provided by the Committee on Maryland and NOAO Development (COMAND). Three members of this Board are provided by each institution. The current COMANDos are Lee Mundy, Sylvain Veilleux, and Stacy McGaugh of Maryland, and John Glaspey, Richard Green, and Dick Shaw of NOAO. The Board reviews and approves each year's operation plan and has developed a set of metrics to gauge the success of partnership efforts. The department has goals of enhanced scientific visibility and excellence in graduate training. KPNO must demonstrate valuable return to observers in terms of new capability. Given the burgeoning number of observational thesis projects and the demonstrable progress on the NEWFIRM pipeline, the Board members are confident that the success criteria will be well met.

Instrument shop supervisor Roger Repp with the NEWFIRM dewar shell delivered by the vendor.

From the NSO Director's Office

Steve Keil

It has been an exciting quarter at the NSO. The Advanced Technology Solar Telescope (ATST) construction proposal review at the National Science Foundation (NSF) went very well, with both the review panel and the write-in reviewers giving the proposal excellent marks in all areas. In addition to the science, technical, and management aspects of the proposal, the broader impacts of the ATST, namely education and outreach to such other disciplines as plasma physics, space weather, and terrestrial climate, were also well received. The panel recommended that the NSF pursue construction of the ATST as soon as possible. The next steps are to present the project to the NSF Major Research Equipment Facilities Construction (MREFC) prescreening panel, and then to the National Science Board for inclusion in the MREFC funding line.

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The ATST Science Working Group met in October and, after reviewing the final report of the Site Survey Working Group (SSWG), recommended that we pursue Haleakala, Hawaii, as the best site for building the ATST. Although all three of the final candidate sites (Haleakala; Big Bear Lake, California; and La Palma, Canary Islands, Spain) fared well in the final year of testing, Haleakala stood out in terms of the number of hours of outstanding seeing and its coronal skies. The SSWG final report can be found on the ATST Web site at *atst.nso.edu/site*. The project is now assessing other factors such as cost drivers, and environmental and cultural impacts of building on Haleakala.

✸

SOLIS is gearing up for full operations! The Vector Spectromagnetograph (VSM) is producing synoptic magnetic maps and will soon be publishing full-disk vector magnetograms. The Integrated Sunlight Spectrometer (ISS) is now installed on Kitt Peak and will be intercalibrated with the Ca K-line monitoring programs at the McMath-Pierce (Kitt Peak) and the Evans (Sacramento Peak) facilities, and the final instrument, the Full Disk Patrol, will soon be ready to join the VSM and ISS on Kitt Peak. The project looks forward to having a new postdoc on board by the time this is published.

✸

In October, an NSO workshop on "Large-Scale Structures and their Role in Solar Activity" brought together more than 50 scientists from 15 different countries at Sacramento Peak for lively discussions about large structures on the Sun. Topics ranged from coronal holes—how they are defined, what their physical properties are, and how they link to measurements at 1 astronomical unit and beyond—to how coronal fields can be measured in both the infrared and radio, new results on meridional flow and the solar dynamo, linking interior measurements with coronal observations showing a rush to the poles, and the formation of filament channels and filaments. Some of the workshop highlights are described in a following article.

✸

NSO welcomes some new members to its scientific staff. William (Bill) Sherry, a recent PhD from the State University of New York, will be working as a postdoc with Mark Giampapa on the evolution of activity and irradiance variability in solar-type stars through a joint University of Arizona/NOAO Astrobiology grant. Aleksandr Serebryanskiy (Ulugh Beg Astronomical Institute) and Sushant Tripathy (Udaipur Solar Observatory) are new GONGsters, as noted in the GONG section that follows. We are also pleased to be hosting Sumner Davis, Professor of Physics, Emeritus from the University of California at Berkeley, as a long-term visitor. Sumner, who is doing research on diatomic molecular spectra, has been a co-investigator on the NSF/Chemistry program that supports the McMath-Pierce FTS facility.

Good Science Usually Means a Good Mystery

Dave Dooling

"I sure would like to know what will happen behind that curtain, Cycle 24, and behind that curtain, Cycle 17 and earlier, before we had magnetograms," said Matthew Penn of the National Solar Observatory (NSO).

The questions spoke to the relatively short data sets available for studying the Sun. Sunspot drawings go back almost 400 years, but modern, objective data — such as magnetograms — are available for only the last half-century, and the best data, including satellite imagery, only for the last decade.

Penn was one of the organizers of "Large-Scale Structures and their Role in Solar Activity," the 22nd annual international science workshop in Sunspot, New Mexico, 18–22 October 2004. The

continued

Good Science Usually Means a Good Mystery continued

conference was cosponsored by the NSO, the National Science Foundation, the National Aeronautics and Space Administration, and the US Air Force Office of Scientific Research. More than 50 scientists from the United States, Great Britain, Angola, Switzerland, India, Russia, Serbia and Montenegro, Uzbekistan, the Czech Republic, and France attended.

Attendees at the NSO's 22nd annual international workshop at Sunspot gather outside the visitor center during a break. More than 50 scientists from around the world attended the week-long workshop.

"By large, we mean anything from the size of a sunspot—about the size of Jupiter—upward," said NSO's K. S. (Sankar) Sankarasubramanian, chair of the conference. "And the seven major topics started from the inside of the Sun and work outward."

"I thought this topic would be a good idea because it has never been discussed before," said NSO's Alexei Pevtsov. "These large-scale structures are an important part of solar activity in general."

The Jovian-scale theme of this year's workshop complements the thrust of the NSO's efforts to develop a 4-meter Advanced Technology Solar Telescope (ATST) that will see structures on the scale of cities on the surface of the Sun, since small-scale structures ultimately make up the larger ones, and because the two extremes influence each other.

"If you look at a filament in high resolution," Sankar said, referring to immense ribbons of cool gas that stand above the solar surface, "you see that it has a lot of small-scale structures present. How do these small flows in filaments affect whole filaments?"

Sankar and Pevtsov said that a comprehensive understanding of the physics of the large-scale solar activity is necessary to understanding the 11-year sunspot cycle, variations in solar irradiance, and solar control of space weather. Thus, Penn and other scientists wish they had more data from solar cycles that preceded modern instrumentation, so they could come closer to predicting what future cycles might do.

"Overall it is really exciting that we have some ability to predict amplitudes and the timing of cycles," Penn said during the wrap-up session. But different techniques don't always match. "When the results from studies using local correlation tracking and helioseismology are compared, we see some agreement but some predictions disagree." Similar themes were found throughout the workshop, with each session highlighting differing observations of—and explanations for—the same solar phenomena. Data for the answers, he said, will come from higher-resolution observations extending into the infrared as well as visible portion of the spectrum.

"Global magnetic field patterns clearly depend on small magnetic fields," Penn said. "We want to know the structure of the magnetic field lines. The thought that we will measure magnetic fields on the solar surface and in the solar atmosphere with high resolution using the ATST a decade from now is very exciting."

Other issues covered at this workshop included

- What is the role of large-scale structures in solar activity?
- What is the physical relationship between patterns observed in different layers of solar atmosphere?
- How are photospheric and coronal structures related to the underlying dynamo or circulation in the convective zone?

Proceedings from the conference will be published in 2005 by the Astronomical Society of the Pacific in the ASP Conference Proceedings Series.

ATST Project Developments

Thomas Rimmele, Jeremy Wagner & the ATST Team

The ATST Science Working Group met in October to review the Site Survey Working Group's final report (see *atst.nso.edu/site*), and has recommended Haleakala, Hawaii, as the best site for building the ATST. We plan to announce the primary site selection by mid-December. We have received and responded to the input resulting from a positive face-to-face review of the construction phase proposal held at the National Science Foundation (NSF) in late August. We are also moving toward Systems Design Review in March 2005. The project continues to address the various design aspects of the telescope and supporting systems. The Wavefront Correction and High-level Controls and Software teams have made significant progress in the last quarter. We have also made considerable progress in developing the designs of the optical systems, including thermal control of the M1 Assembly and the enclosure.

ATST Wavefront Correction

"Wavefront correction" includes several critical subsystems that ensure the ATST's imaging performance will meet specifications. The project has focused on defining these subsystems and developing detailed specifications for each of them. The subsystems include:

(a) A high-order adaptive optics (AO) system. This subsystem corrects atmospheric seeing at rates greater than 2 kilohertz. The baseline design has a 1,313-actuator deformable mirror (DM) and a fast tip-tilt mirror.

(b) Correlation trackers. Both the Nasmyth and coudé stations will be equipped with tip-tilt sensors that can be used to provide image motion compensation at a fast rate.

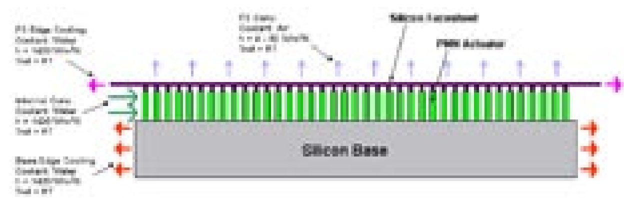
(c) An active optics (aO) system. The main task is to correct slowly changing aberrations that may arise from gravitational and thermal deformations.

(d) Alignment. The current concept for keeping the ATST's off-axis optical system aligned requires wavefront measurements at several points within the extended field of view.

(e) Blending. Information from different wavefront sensors (e.g., AO and aO) will be conditioned (e.g., low-pass filter) and combined by the wavefront control system, which then drives the corrector elements.

AO is integrated into the telescope optical train. The advantage of this approach is the ability to easily feed all coudé lab instrumentation with an AO-corrected beam. Locating the DM in its current position achieves this goal in an efficient way, i.e., with a minimum number of reflections. However there are a number of concerns related to thermal control, in particular thermal control of the DM.

Deformable Mirror (M5) — The solar heat load on the ATST deformable mirror requires that the deformable mirror be thermally controlled to a narrow temperature range around ambient temperature. The ATST project contracted with Xinetics for a subscale deformable-mirror thermal design and analysis. The objective of this work was twofold: 1) to perform a thermal and thermomechanical analysis to understand the cooling needs and parameters; and 2) to address the practicality of a 5.1-millimeter actuator spacing while providing provisions for cooling. The figure illustrates the various cooling approaches. Xinetics has a very high level of confidence that an adequate thermal scheme can be implemented with the actuator spacing that ATST requires.



Cooling approaches for the ATST deformable mirror.

Tip-Tilt Mirror (M6) — Physik Instrumente (PI) recently developed a tip-tilt platform for EOST/Keck with requirements similar to ours, using a 244-millimeter-diameter silicon carbide (SiC) mirror. While the tilt range and bandwidth specifications fall short of our requirements, PI feels that they can come close to our expectations with limited design changes.

Risk Mitigation — The deformable mirror and the AO wavefront sensor (WFS) camera were considered the highest risk factors for wavefront correction. The DM risk mitigation was addressed through the contract with Xinetics. The AO WFS camera has unique requirements that are not currently available commercially, including a detector larger than 800 × 800 pixels and frame rates greater than 2,000 frames per second with streaming output. To mitigate this risk, we

continued

ATST Project Developments continued

contacted several vendors, and after extensive conversations with each group, concluded that these requirements are in fact achievable, and the technology is currently being developed. Therefore, a potentially costly camera design study is being postponed while we monitor technology development.

Wavefront Correction Tasks — Much progress has been made regarding the number and location of wavefront sensors needed for the wavefront control tasks described above. The preliminary plan calls for the following at Nasmyth: (a) multiple-field aO sensor for telescope alignment and M1 figure; and (b) a correlation tracker (CTK) for disk and limb observations. The preliminary plan for the coudé lab includes (a) a multiple-field aO sensor for telescope alignment and M1 figure; (b) a correlation tracker for disk and limb observations; and (c) an AO wavefront sensor for correcting residual optical aberrations (not corrected by aO), as well as self-induced and atmospheric seeing.

The AO and aO systems will provide Zernike terms to the wavefront control system that in turn provides signals to the mount control system, mirror controllers, tip-tilt mirror, and the deformable (AO) mirror. The aO wavefront sensors will provide "static" wavefront measurements for multiple fields of view averaged over the fast-changing seeing, which is needed for alignment and M1 figure control.

Software

As described in detail in the September 2004 *NOAO-NSO Newsletter,* the principal design effort for the software group continues to be the ATST Common Services, a set of communications libraries and protocols used to send messages between the ATST computer systems.

Additional software design work has begun on several of the ATST telescope subsystems, including the mount, enclosure, acquisition, and wavefront control systems. Each of these packages has undergone a basic design requirements review, and a preliminary design for each has been developed. The mount and enclosure control systems requirements are typical of current nighttime telescopes, and their associated designs do not vary from this standard. The wavefront control system has been designed to meet the ATST requirements for adaptive and active optics, guiding, and system alignment. The acquisition system has been designed to meet our wide-field viewing requirements.

The observatory control system (OCS) is following a phased design that initially concentrates on the features needed first by the telescope control and instrument control systems during construction and commissioning. Implementation of this design is layered on top of support provided by the common services and data handling systems. The top-level OCS design effort is underway, and work on the definition and alpha design of ATST Experiments—the key component in representing laboratory-style operations of the ATST—is nearing completion.

M1 Assembly

Since the Conceptual Design Review (CoDR) in August 2003, several changes have been made to the design of the M1 Assembly. These include an increase in the number of lateral support actuators to improve the optical figure performance at high zenith angles and reduce the amount of active force correction needed in these orientations, and refinements to the M1 thermal control system to improve our ability to maintain the optical surface temperature within the desired range of 0°/-2°C of ambient. Work still continues in the thermal control area; analysis and design studies have been performed to consider reducing the thickness of the M1 substrate from 100 millimeters to around 75 millimeters and utilizing conductive cold-plate cooling on the rear of the M1 substrate in lieu of the baseline air-jet cooling. A reduction in M1 substrate thickness significantly reduces the thermal response time of the mirror, and discussions with blank fabricators and polishers indicates that there is no significant cost, schedule or performance impact in going to a 75-millimeter thickness.

An M1 Assembly workshop was held in early November to provide a comprehensive review of changes that have occurred since CoDR, bringing the design to a point where it can be transferred to industry for final design and construction.

Enclosure Thermal System

Work continues on the enclosure cooling system development. M3 Engineering of Tucson is wrapping up the thermal system preliminary design work initiated early this year. Credible schemes for cooling the carousel, shutters, and lower enclosure have been developed that include equipment and operating cost estimates. M3 has also developed an "active ventilation" system that uses propeller fans to flush the interior of the enclosure when outside wind speeds are low.

continued

ATST Project Developments continued

The enclosure carousel outer surface is cooled (maintained near ambient temperature) via an array of air-handing units suspended underneath the observing floor of the enclosure. Chilled air from these units circulates within the walls of the carousel to remove heat from the dome exterior. The shutters are cooled by chilled water-glycol flowing through "plate-coil" shields that are attached to the outer surfaces of the shutters.

Upcoming Milestones

Our efforts continue to be focused on developing designs to mitigate identified risk areas and preparing for the systems design review scheduled for late March 2005. We have responded to input received from the August peer review of the construction proposal. We continue to update our Web site and encourage anyone interested to visit periodically it for the latest information.

SOLIS

Jack Harvey & the SOLIS Team

The third quarter of 2004 was very productive for the SOLIS project. The main highlights were the installation of the Integrated Sunlight Spectrometer (ISS) in its environmentally-controlled room on Kitt Peak, first closed-loop operation of the guider used for the Full Disk Patrol (FDP) and Vector Spectromagnetograph (VSM), first data flow directly from the VSM to the Storage Area Network (SAN) and data processing system, resumption of FDP camera operations, and several positive reports from community users of the VSM data.

The ISS was installed in a room one floor beneath the SOLIS instrument. The room is temperature and humidity stabilized to minimize drift in observations with the high-resolution spectrograph. The instrument is mounted on an air-supported optical table to minimize vibrations. Pending installation of the optical fibers that feed sunlight into the instrument, it is being tested for stability using various laboratory emission line sources. Tests, which are done by remote operation over the Internet from Tucson, have shown that variations of barometric pressure are the major source of observed wavelength changes. The figure shows the instrument in its new home.

The two-meter focal length, double-pass Integrated Sunlight Spectrometer (ISS) is now installed in a temperature-stabilized room in the Kitt Peak SOLIS Tower (KPST). The rack at the left contains control electronics and lamps that feed light into the instrument via optical fibers. Shown here with the ISS are (from left) Ed Stover (NSO/SOLIS) and Mike Hawes (NOAO).

Observations with the SOLIS VSM continued on Kitt Peak as permitted by weather and personnel availability. The observing program was restricted by a requirement to record each day's observations to a 134-gigabyte disk. This restriction was removed at the end of the quarter when replacement of a defective controller card allowed first operation of our SAN data system. This enabled observations to be reduced in a matter of minutes rather than hours. Several improvements to the data reduction pipeline were made. Corrections for the most significant VSM camera artifacts (an unstable dark level and electronic cross talk at a 0.5 percent level) were implemented.

continued

SOLIS continued

A new algorithm for reducing chromospheric magnetograms made with the Ca II 854.2-nanometer line was developed and successfully tested. A way of dealing with sensor fringing that affects He I 1083-nanometer observations was developed. These algorithm developments will be applied to previous observations that have been archived to tape. To do this efficiently, a small Linux cluster has been set up in Tucson that duplicates the capabilities of the larger and faster data reduction system on Kitt Peak.

VSM calibration activities continued and a few special observations were made at the request of outside users. In addition, regular synoptic measurements are being used more widely in the community. For example, a solar and heliospheric weather forecasting model developed by Lockheed Martin uses VSM data when the flow of similar data from the SOHO spacecraft is interrupted. At least two other heliospheric models regularly use VSM data. Neil Sheeley and Yi-Ming Wang of the Naval Research Laboratory have developed a widely-used model that extrapolates the surface magnetic field distribution outward from the Sun. They used their model with VSM input data to map the locations at a height of 2.5 solar radii where the magnetic field direction changes from outward to inward. These maps were compared with observations using the Large Angle and Spectrometric Coronagraph (LASCO), and Sheeley and Wang report that, "The fit between the simulated and observed coronal meanderings was about as perfect as one could ever imagine. This seems to be a spectacular triumph for the SOLIS [magnetic] fields [measurements] (as well as the coronal model)." See also the science highlight by Harrison Jones earlier in this *Newsletter,* which includes a full-disk 1083-nanometer image from the VSM.

The FDP cameras were restored to health, allowing resumption of work to complete FDP assembly. The FDP is used as a test bed for the SOLIS limb guider. This guider is unique and is designed for use in both the VSM and FDP. It employs linear CCD arrays placed in the same focal plane as the entrance slit of the VSM spectrograph slit. While this design avoided a complicated folding of the VSM telescope focal plane and has the advantage of guiding on exactly the same image being observed, the development of the guider has proven to be difficult. Thus, achieving closed-loop guiding with the FDP was a happy event.

Solar MHD: Theory and Observations— A High Spatial Resolution Perspective

The 2005 NSO Summer Workshop to Honor Bob Stein

18–21 July 2005, Sunspot, New Mexico

With theory being pushed by exciting new observational results, and great new facilities soon to appear on the scene, it seems like a fine time to get together at Sac Peak to confront theory with those observations, and to use the occasion to celebrate Bob Stein's contributions to the field on the eve of his retirement.

The "Sac Peak Summer Workshop" hasn't been held in the summer in recent years, and we thought that we would try to avoid academic year responsibilities and to involve the flood of summer students, plus July is a great time to enjoy the pine forest at 3,000 meters!

For more information, see *nso.edu/general/workshops/2005,* or contact John Leibacher (*jleibacher@nso.edu*) or Han Uitenbroek (*huitenbroek@nso.edu*).

GONG

John Leibacher & the GONG Team

The local helioseismology science pipeline, which we highlighted with the first six solar rotations worth of flow maps in the last issue of this *Newsletter*, has really started to flow, with 20 rotations now and we anticipate that **there should be 37 continuous solar rotations of science products available by the time that you read this!** (That's 1,000 earth rotations!) In addition, a second—lower-resolution, but more deeply penetrating—pipeline has come on line, with 25 solar rotations of data already analyzed (see figure 1). For the truly impatient, who can't wait to see what is going to be rotating around the limb of the Sun in a week or two, we should shortly have near-real-time images of the farside of the Sun available on line. And, there is additional new helioseismic science coming, and well-calibrated magnetograms as well.

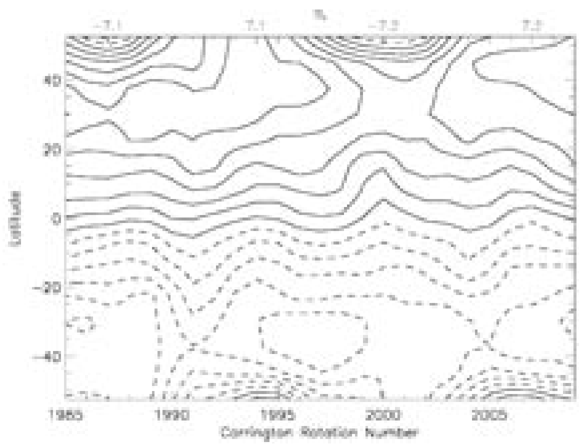


Figure 1. The evolution of meridional circulation at a depth of 28 Mm during a two-year period, January 2002–December 2003, derived from large-aperture ring diagram analysis of the GONG continuous data. The contours range from approximately -40 m/s to 40 m/s (dashed lines correspond to negative values). Countercells in the northern and southern hemisphere can be seen coinciding with maximum values of the B_0 solar angle, the angle of the solar rotation axis toward Earth.

The heart of the new magnetograms—the new polarization modulator circuitry—has delivered a factor of ten decrease in the uncertainty of the magnetogram zero point, which exceeds what we need to make real measurements of large-scale photospheric field changes that could affect the structure of the coronal. A team has been identified and a design review is forthcoming. The goal is to have the upgrade operational for the entire network well before the February 2006 launch of the STEREO mission, which will observe coronal mass ejections in three dimensions. While these improvements will bring the performance to the design goals and enable studies of the large-scale structure of the solar atmosphere, we are already getting exciting new results on significant flare related changes in the magnetic field (see figure 2).

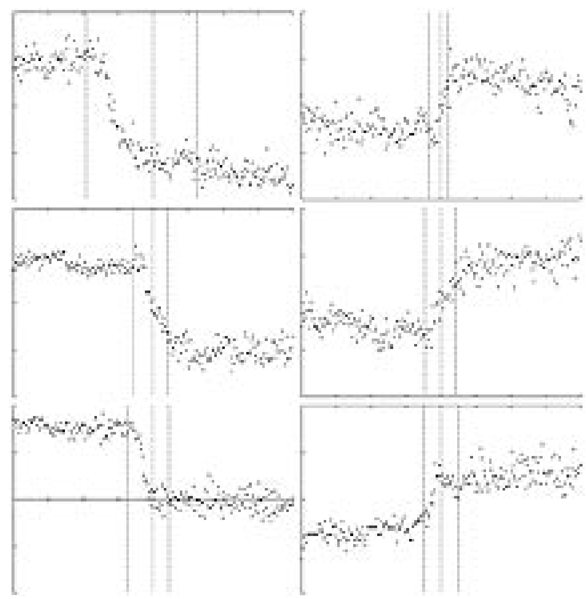


Figure 2. Six examples of the abrupt and persistent changes in the longitudinal magnetic field during X-class solar flares observed by GONG. Magnetic field strength is plotted in 100 gauss increments along the vertical axis. Time is plotted in 30-minute increments along the horizontal axis. The dashed vertical lines in each plot denote the start, the peak, and the end of the flare according to the GOES soft X-ray flux measurements.

The production of near-real-time farside images of the Sun from GONG's network is right around the corner. Currently, the engineering site at Tucson and the remote sites at Big Bear and Tenerife are capturing and transferring the 200 × 200 images back to Tucson, where farside maps are being produced and delivered on line. The remaining sites will be added over the next month and the resultant farside maps will be available via our Web site; stay tuned!

continued

GONG continued

The GONG Program welcomes a new staff member, Sushant Tripathy, who has joined us from the Udaipur Solar Observatory. Sushant is working on short-term temporal variations in the frequencies and changes in ring properties across the disk, as part of the NASA SOHO/MDI guest investigator program. Sushant has been in Tucson as a GONG visitor on several occasions, and we are happy to have him and his family back on a full-time basis.

The Program also has another new face: Aleksandr (Sasha) Serebryanskiy. Sasha is from the Ulugh Beg Astronomical Institute in Tashkent, Uzbekistan, and he has joined us for a year under a NATO/NSF postdoctoral fellowship. Sasha's primary field of study is local helioseismology.

Annie Malanushenko, from the University of St. Petersburg, worked with GONG as a summer intern on the development and production of the farside images. Annie has since returned to Russia to continue her course work, but continues to collaborate with local staff and our partners at Northwest Research Associates (Charlie Lindsey and Doug Braun).

After the GONG 2004 Meeting at Yale University in July, GONG hosted several visitors who spent considerable time in Tucson working with our staff: Hannah Schunker from Monash University, Olga Burtseva from Tashkent, and Ashok Ambastha from Udaipur, India, who left well equipped with GONG data.

On the departure side, Chirag Shroff, who has worked as GONG's real-time programmer, supporting the real-time instrument control and data acquisition systems for GONG's network of instruments, left for the commercial world in San Diego. We wish you the best!

Chirag Shroff (left) with Ron Kroll.

Sites, Instruments, and Engineering

Operations events of the third quarter of 2004 centered on the preventive maintenance (PM) trip to El Teide (Tenerife, Spain) and the discoveries made during that visit. The trip took place during the second half of August and included the installation of earthquake protection hardware on the optical table, a new UPS unit, and upgraded camera power supplies, amplifier chassis, and filter/interferometer assembly.

The work progressed well, but along the way a number of anomalies were found. The first involved an issue with the filter-oven temperature, which had been noted at the previous PM and was already on the to-do list for this visit. Measurements indicated the oven temperature had changed such that the filter transmission was starting to be affected, however attempts to adjust the temperature did not improve the filter transmission and in the end no change was effected.

A second anomaly was discovered after the installation of a new camera power supply: an unusual artifact was introduced into dark images, which appeared to vary with time at an unacceptable level. The modification to the power supply causing the problem was identified and undone. This discovery is the source of some concern because similarly modified power supplies have already been installed at other sites. The good news is that significant work was done on site to make and test various modifications to determine which configuration minimized the artifacts and remained stable over time. At present, an acceptable solution is being tested at Tucson, and we expect to be able to implement it during the upcoming PM trips.

Another discovery of note was that the resistance measurements on the turret motors and cabling indicated that there is some breakdown in the insulation between the turret motor power and ground. Although the equipment continues to run, it is felt that this is an indication of a worsening condition, which might be further aggravated by the upcoming winter weather. In order to prevent a full-blown failure, which could result in damage to the motors and possibly other electronics, as well as untold instrument downtime, the turret will be replaced in short order. Fortunately, a refurbished and upgraded turret has been tested and is available for deployment. The plan is to revisit El Teide in November to replace the turret and filter oven and perform the required modifications to the camera power supplies. The calibration lens slide, which seems prone to emitting an uncomfortable squeal, will also be replaced.

continued

GONG continued

The Udaipur instrument was shut down most of the days due to seasonal monsoon conditions, but when attempts were made to operate, the turret pitch motor would not enable. Troubleshooting, which continued for several weeks, uncovered a faulty command board, and that fixed the pitch problem. We now have a tracking problem, which could be a related issue, and it is being addressed in a PM visit to Udaipur in progress.

Data Processing and Analysis

We have now completed ring diagram analysis of 20 Carrington rotations, 16 of which are consecutive. Data for an additional 17 rotations has been merged and ring processing is under way. By the time you read this we should have flow maps for a total of 37 consecutive rotations!

In the last quarter, the GONG distributed 442 gigabytes in response to 21 requests. Mode frequencies for GONG months 87 through 89 (ending 12 February 2004) are now available. The data reduction team is maintaining the cumulative backlog at 139 days. Installation of the automated image rejection (AIR) module is now under way. After verification and acceptance, which will be finished by the end of December, AIR will become part of the production pipeline, and will allow further reduction of the delay between data collection and delivery of the frequencies.

GONG is sporting a new look at our Web site (*gong.nso.edu*). After what must have felt like pulling teeth, the GONGsters were cajoled into switching over to the new NSO Web template, creating a more attractive and efficient site—thanks to all for pushing! We still have many revisions, updates, and a lot of new information and science to include.

We began the implementation of our long-term computing hardware plan to address GONG's expanded science and service requirements. Five new Linux workstations and one server have arrived and are being installed. Work has begun on rewriting the spherical harmonic decomposition module to take advantage of the new systems.

"GONG the Tapestry" graces the walls of the newly remodeled GONG Data Management and Analysis Center, framed by quilt artist Molly Dodd (left) and her proud mom.

The refurbishment of the DMAC building is reaching completion. We have nearly doubled our office space, transforming eight offices, a large bullpen area, and a conference room, into 16 single-person offices (some even with windows). While the data processing group has shrunk, the science and analysis group has grown with the help of much-appreciated outside funding support.

NOAO-Trained Teachers to Observe with Spitzer

Douglas Isbell & Stephen Pompea

NOAO has teamed with the Spitzer Science Center (SSC) to offer a dozen graduates from NOAO's advanced teacher professional development program a unique chance to make research-quality observations with NASA's Spitzer Space Telescope.

Known as the "NASA Spitzer Space Telescope Observing Program for Students and Teachers," the project was germinated in a series of informal discussions that began in earnest at the January 2004 AAS meeting in Atlanta. Applications were solicited in September using the RBSE/TLRBSE list-serve, and twelve teachers from the NOAO Research Based Science Education (RBSE) and its successor, Teacher Leaders in Research Based Science Education (TLRBSE), were selected from 37 highly qualified applicants. Just a few weeks after their selection, the teachers got started with a kick-off workshop in Tucson from November 18–20.

"The Spitzer outreach team was interested because they know that Spitzer observing opportunities are a valuable resource, and they wanted to make the most out of the director's discretionary time reserved for educational outreach," says Stephen Pompea, an astronomer and the manager of science education at NOAO. "We saw a chance to offer another exciting and challenging research experience to our RBSE/TLBSE community, including the chance to work closely with some of the best infrared astronomers in the world."

Key staff members involved with the NOAO side of the program include Pompea, Steven Croft, Connie Walker from the NOAO educational outreach group; Don McCarthy of the University of Arizona; and Steve Howell, Jeremy Mould, and Steve Strom from the NOAO scientific staff, with more astronomers likely to be added. Doris Daou of the SSC outreach staff is managing the SSC side of the program, in coordination with SSC Director Thomas Soifer. SSC science staff will be involved as sponsors for each team of teachers. The SSC Observer Support Team will help the teachers in understanding the telescope and instrument capabilities, as well as in their observation planning stage.

"We wanted to bring the Spitzer Space Telescope mission to the classroom, and give this great opportunity to teachers and students from all over the country," Soifer said. "This effort is another example of how NASA and its projects help prepare the next generation of American scientists, and space scientists in particular."

Further teacher training and science observations planning sessions will occur at the January 2005 AAS meeting in San Diego, where the teachers will attend a planning workshop given by the SSC Observer Support Team. They also will be given the opportunity to meet with Spitzer scientists to learn more about the telescope, its different instruments, and possible science observation ideas. Once the observations are taken, the teachers will visit the SSC in Pasadena, California, to meet again with the Spitzer scientists and start working on the data. During this visit, they each will be accompanied by two students.

The RBSE/TLRBSE teachers selected for the Spitzer project are:

Jeff Adkins	Deer Valley High School	Antioch, CA
Howard Chun	Cranston High School	East Cranston, RI
Lauren Chapple	Traverse City East Junior High School	Traverse City, MI
Harlan Devore	Cape Fear High School	Fayetteville, NC
Anthony Maranto	Phillips Exeter Academy	Exeter , NH
Steve Rapp	Linwood Holton Governor's School	Abingdon, VA
Theresa Roelofsen	Bassick High School	Bridgeport, CT
Babs Sepulveda	Lincoln High School	Stockton, CA
Linda Stefaniak	Allentown High School	Allentown, NJ
Timothy Spuck	Oil City Area Sr. High School	Oil City, PA
Beth Thomas	East Middle School	Great Falls, MT
Cynthia Weehler	Luther Burbank High School	San Antonio, TX

Watch the TLRBSE Web page (*www.noao.edu/outreach/tlrbse*) for more program news.

ASTRO-Tucson Fall 2004 Workshop Largest Yet

Douglas Isbell & Connie Walker

The ninth annual training workshop for Project ASTRO-Tucson was held on 17–18 September 2004, again located in a handy meeting room at the University of Arizona (UA). It featured 70 registrants (with 66 attendees), including 33 teachers and 37 astronomer-partners, making it the largest-ever Tucson workshop and perhaps the largest in the history of the national ASTRO program.

Highlights of the workshop included a scale-model solar system demonstration on the UA student mall, a talk on different group learning styles and techniques by Janelle Bailey of the UA Conceptual Astronomy and Physics Education Research Team, a "kinesthetic astronomy" activity led by Mike Zawaski of the Space Science Institute in Boulder, and an inspirational talk on the solar system and its wonders by David Levy. A spectacular sunset at Kitt Peak was a harbinger of a mostly cloudy evening, but even less-than-ideal viewing conditions could not put a damper on the group's enthusiasm.

"I came back from the workshop in Tucson flabbergasted!" said one written evaluation. "As an educator since 1990, I have been to many workshops, training seminars, et cetra, and have many times put together and presented information for educators. I have never been involved in such a well put-together and worthwhile training. I literally felt that every minute I spent at the workshop was invaluable and enriching.

"The activities had the potential to be intimidating (phases of the moon) but the way they were presented in conjunction with our astronomer was fun and interesting. I realized how many misconceptions I had about the solar system and greater universe, and these misunderstandings were [previously] carrying over into my instruction."

To date, more than 360 teachers and astronomers have been trained by Project ASTRO-Tucson in the best methods to bring hands-on, astronomy-oriented activities into science classrooms. More than 6,400 students were directly impacted by ASTRO classroom visits this past year, with well over 150 active astronomer-teacher partnerships.

Attendees at the fall 2004 Project ASTRO-Tucson workshop observe and record the appearance and location of the setting sun, next to the SARA telescope.

ASTRO-Tucson project coordinator Connie Walker (second from right) leads a workshop activity on lunar phases, inside the pier of the Mayall 4-Meter Telescope.

The 2005 REU Program at the Kitt Peak National Observatory

Kenneth Mighell

Each summer a group of talented college students come to Tucson to participate in astronomical research at Kitt Peak National Observatory (KPNO) under the sponsorship of the National Science Foundation (NSF) Research Experiences for Undergraduates (REU) Program. The KPNO REU program provides an exceptional opportunity for undergraduates considering a career in science to engage in substantive research activities with scientists working in the forefront of contemporary astrophysics.

Each REU student is hired as a full-time research assistant to work with one or more KPNO staff members on specific aspects of major on-going research projects at NOAO. As part of their research activities, these undergraduates gain observational experience with KPNO telescopes, and they develop expertise in astronomical data reduction and analysis. They also take part in a weekly lecture series and a field trip to New Mexico to visit the National Solar Observatory at Sacramento Peak and the Very Large Array in Socorro. At the end of the summer, the students share their results with the Tucson astronomical community through a series of oral presentations. In addition, as part of their internship experience, all six of our 2004 REU participants will be presenting posters about their astronomical research projects at the January 2005 AAS meeting in San Diego.

We anticipate being able to support six REU positions during the summer of 2005. As required by the NSF, student participants must be citizens or permanent residents of the United States. The KPNO REU positions are full-time for 10 to 12 weeks between June and September, with a preferred starting date of early June. The salary is $455 per week and additional funds are provided to cover travel to and from Tucson at the beginning and end of the summer.

Further information about the KPNO REU 2005 program, including the online application form, can be found at *www.noao.edu/kpno/reu*. Completed applications (including official transcripts, and two or three letters of recommendation) must be submitted to KPNO no later than 21 January 2005.

"Nebulosa Del Ojo De Gato"

This image of the Cat's Eye Nebula (NGC 6543) from the Advanced Camera for Surveys on the Hubble Space Telescope was the subject of a 9 September 2004 Hubble Heritage press release. The image reveals striking details about the bull's eye pattern of eleven or more concentric rings, or shells, around the central star. Each "ring" is actually the edge of a spherical bubble seen projected onto the sky.

Observations suggest that the central star in the nebula ejected its mass in a series of pulses at 1,500-year intervals. These convulsions created dust shells that each contain as much mass as all of the planets in our solar system.

This image was taken as part of a recent study by a team including Hugo Schwarz of Cerro Tololo Inter-American Observatory. The study suggests that such rings are much more common than previously thought, and indeed may be the rule rather than the exception.

Image credit: ESA, NASA, HEIC and the Hubble Heritage Team (STScI/AURA).