NOAO/NSO Newsletter

NATIONAL OPTICAL ASTRONOMY OBSERVATORY/NATIONAL SOLAR OBSERVATORY

ISSUE 99 — SEPTEMBER 2009

Science Highlights

Director's Office

NOAO Gemini Science Center

Observational Programs

Cerro Tololo Inter-American Observatory

Kitt Peak National Observatory

National Solar Observatory

Education & Public Outreach

This just in>>>

On August 6, at about 9 pm, the SOAR Adaptive Module (SAM) saw first light at Cerro Pachón. Through heavy clouds, with terrible seeing to be sure, but it did its job and improved the quality of the images (of one of the brightest stars in the Southern Hemisphere!)

SAM is a HUGE project that has been active since 2002; the first Concept Design Review was in Tucson in April 2003. There are few people at CTIO who have not contributed in one way or another, but several groups deserve special mention.

The SAM instrument is a new kind of Adaptive Optics instrument which exploits Ground Layer Seeing Compensation, a concept originated by Francois Rigaut, with a low-cost laser guide star that enables SOAR to provide adaptive correction in the optical in a cost effective way. Project Scientist Andrei Tokovinin made the creative connections between ground layer, Rayleigh lasers, and SOAR's characteristics to come up with the concept that became SAM.

The following engineering team was assembled to realize the concept:
- Optical Engineer - Roberto Tighe
- Mechanical Engineer - Patricio Schurter
- Software Engineer - Rolando Cantarutti
- Electronics and control engineers - Manuel Martinez, Eduardo Mondaca

Led by:
- Project Scientist - Andrei Tokovinin
- Project Manager - Nicole van der Bliek
- Project Advisor - Brooke Gregory

The SAM team would have been helpless without the participation of the following groups:
- The Designers - particularly Alfonso Cisternas and Rossano Rivera who carried the engineers' concepts to completion,
- The Machine Shop - whose abilities to realize designs in metal is a never-ending source of amazement to us,
- The Electronics Technicians - who were key in the integration of the mechanisms into the main module,
- The SOAR engineering and technical team, who counseled the SAM team on the interface to SOAR and who received and mounted SAM on SOAR this last week,
- The CTIO and NOAO management, who have supported the SAM project throughout these years.

We must not rest on our laurels: first light with a natural guide star is an important milestone but there is much to be done to reach the final goal of laser-guided, ground-layer-compensated adaptive optics. We look forward to the continued support of all of you in this exciting endeavor.

Nicole van der Bliek & Brooke Gregory

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On the Cover

An image of the open star cluster NGC 6520 and nearby dust cloud Barnard 86, in the constellation Sagittarius. The bright young stars of this cluster, which probably formed from gas related to the nearby dust cloud, stand out in contrast to the background of older stars of the bulge of our Galaxy. The larger image was taken on 24 June 2007 at the CTIO Blanco 4-meter telescope with B (blue), V (green), I (orange), and H-alpha (red) filters. The inset image was taken at the Gemini South telescope, using the Gemini Multi-Object Spectrograph. This image is 9.7 × 5.4 arcminutes. The color composite is made using the u-band (blue), g-band (cyan), r-band (yellow), and i-band (red).

Both of these images were released during the 100 Hours of Astronomy Webcast, "Around the World in 80 Telescopes" held 3–4 April 2009, during the International Year of Astronomy 2009.

Publication Notes

This *Newsletter* is presented in full and in color with active links online at *www.noao.edu/noao/noaonews/html*.

Solar Polar Vortex?

James C. LoPresto (Edinboro University of Pennsylvania), Wesley Gould (Case Western Reserve University), Claude Playmate & Eric Galayda (National Solar Observatory)

Differential rotation relative to latitude has been carefully observed on the Sun for many decades. We have expanded on these observations by taking data concentrating on the solar differential rotation very close to the poles. Typically, the differential rotation shows speeds of rotation of about 2000 m/s near the Equator and about 1000 m/s near latitudes of 80 degrees.

The differential rotation has undergone changes over surprisingly short periods of time. In short, the central latitudes have been somewhat constant, whereas the regions near the Equator and the poles have changed substantially in a semi-periodic fashion, which appears to be correlated with the solar magnetic cycle.

Keith Pierce and James LoPresto observed what appeared to be an increased spin in the 1970s and 1980s (see figure 1). The increases in spin appear to be short lived but occur during times of high magnetic activity. In a few cases, dramatic increases in spin approaching 400 m/s have occurred.

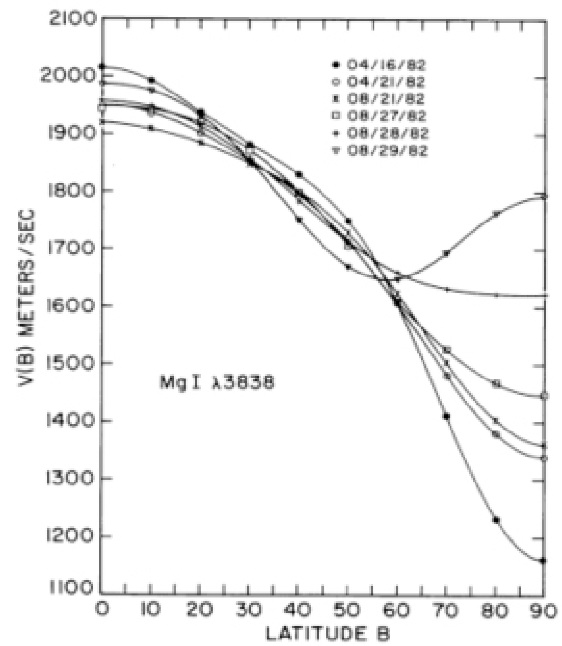

Figure 1: Differential rate of solar rotation.

Observations of the latitude dependent "spin" near the poles have been ongoing since 2003 using the McMath-Pierce Solar Telescope facilities at Kitt Peak. As expected, due to this time frame falling around Solar Minimum, little or no substantial spin change has been observed. These observations are continuing, and we expect to observe an increase in the Solar Polar Vortex Spin correlated to increased magnetic activity as we climb into Cycle 24.

These observations are made with the McMath-Pierce Vertical Spectrograph and the NSO Array Camera (NAC), a cryogenic 1024^2 infrared (InSb) array, which is sensitive in the 1–5 μm region. Our setup produces 2D spectra covering a small wavelength region near 1.58 μm. This wavelength window was selected as it shows both solar and telluric lines. The telluric lines are used as wavelength standards to measure the Doppler shifts of solar lines (see figure 2). Figure 3 shows a plot of the spectral region with the major solar lines marked. The narrow, evenly spaced lines are due to telluric CO_2.

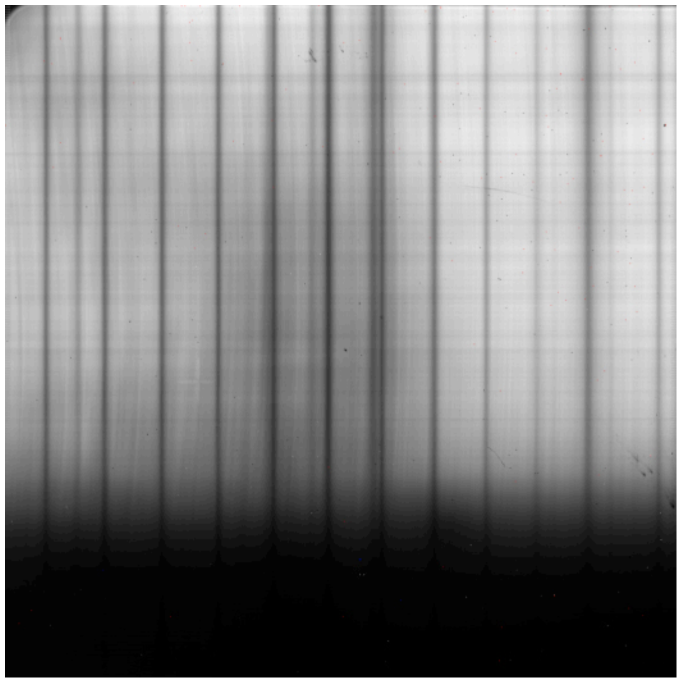

Figure 2: NAC solar limb spectra, 1575–1580 nm.

Self-written software is used to measure several horizontal cuts through the 2D spectra. From these, we acquire average profiles of all the absorption lines in the image. Bisectors are calculated for the solar lines, which are asymmetrically red-shifted due to granulation. The bottom of the C-shaped bisectors is arbitrarily chosen to define the wavelengths of the solar absorption lines. Then the symmetric profiles of the telluric lines are employed to define the wavelengths and calculate a Doppler velocity shift for each of the solar lines.

Observations made over the past six years exhibit a rotation speed (spin) of about 930±35 m/s at 85 degrees latitude.

From limited past experience, we expect spin rates to increase to values as high as 1300 m/s during the upcoming solar maximum. It will be quite interesting to track the polar rotation speed through the next cycle, especially in light of the extremely deep minimum that we are currently experiencing.

continued

Solar Polar Vortex? continued

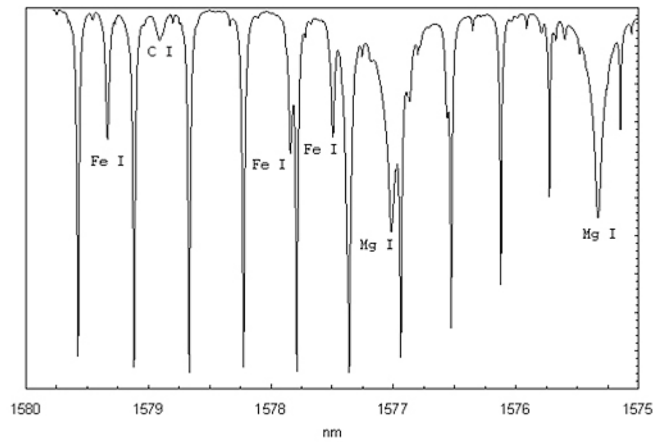

Figure 3: Solar spectrum 1575–1580 nm. The NAC dewar is shown in figure 4 sitting in position on the McMath-Pierce Vertical Spectrograph.

Figure 4: The NAC at the focal plane of the McMath-Pierce Vertical Spectrograph.

NEWFIRM Discovery of Warm Molecular Hydrogen in the Wind of M82

Sylvain Veilleux (University of Maryland), David S. N. Rupke (University of Hawai'i) & Rob Swaters (University of Maryland)

Galaxy-scale outflows of gas ("superwinds") are a ubiquitous phenomenon in both starburst galaxies and those containing an active galactic nucleus (Veilleux et al. 2005). The observational data set on these outflows is steadily increasing, but difficult issues remain. One vexing problem is how much different phases of the Interstellar Medium (ISM) contribute to the mass and energy of superwinds. Measurements have shown that winds contain cool (molecular or neutral), warm (ionized), and hot (highly ionized) material. However, the relative contribution of these phases to the total mass and energy of the wind is uncertain by an order of magnitude. The contribution from dust and molecular gas to the mass and energy in the wind is almost completely unknown. The impact of superwinds on their environments depends strongly on these quantities.

In an attempt to constrain the importance of the molecular component in winds, the NOAO Extremely Wide-Field Infrared Mosaic imager (NEWFIRM; Probst et al. 2008 and references therein) on the Mayall 4-meter telescope at Kitt Peak was used to search for warm H_2 in the prototypical galactic wind of M82. Total on-target integrations of 40 and 420 minutes were obtained over a period of four nights in November 2008 using the broadband K_s and narrowband H_2 2.124 μm filters, respectively. The data were reduced using NOAO NEWFIRM Science Pipeline v1.0 (Swaters et al. 2009).

The continuum-subtracted H_2 image of M82 is shown in figure 1. Immediately evident in figure 1 are H_2 filaments extending more than ~3 kpc above and below the plane of the galaxy disk, roughly coincident with the location of the galactic wind in M82. In figures 2 and

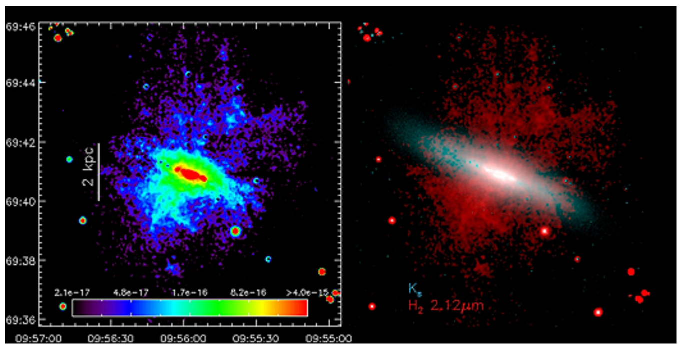

Figure 1: H_2 2.12 μm emission in M82.
(Left) "Pure" H_2 emission on a false-color scale.
(Right) H_2 (red)+K_s continuum (blue) emission. The H_2 data were continuum subtracted and smoothed with a 4" Gaussian kernel to bring out the large scale structure. The intensity scalings in this figure are "*a*sin*h*" from Lupton et al. (1999). The flux scale is in ergs s^{-1} cm^{-2} $arcsec^{-2}$. A distance of 3.53 Mpc for M82 was assumed.

3, our H_2 data are compared with the published Hα and 7.7+8.6 μm polycyclic aromatic hydrocarbon (PAH) images of Mutchler et al. (2007) and Engelbracht et al. (2006), respectively. The results of these comparisons favor ultraviolet excitation/heating (shock heating) as the principal H_2 emission process in the inner (outer) bright filaments of the wind, but other processes are probably at work in the fainter, more diffuse, PAH-emitting material where the H_2 emission is apparently suppressed relative to the PAHs.

continued

NEWFIRM Discovery of Warm Molecular Hydrogen continued

The detailed processes by which the disk ISM is entrained in the wind without destroying the molecular gas and mass-loading the wind in the process are not well understood. The mere presence of molecular material ~3 kpc from the disk provides strong constraints on the stability of wind-entrained clouds against photo- and thermal-evaporation, Kelvin-Helmoltz instabilities, and shedding events due to ablation. The time scale to bring such clouds out to a distance of 3 kpc is $\sim 10^7 (v_{H_2-\mathrm{outflow}}/v_{CO-\mathrm{outflow}})^{-1}$ yrs, assuming they entered the wind near the center and the warm H_2 material shares the same kinematics as the cold molecular material ($v_{CO-\mathrm{outflow}} \sim 100$ km s^{-1}, the average deprojected outflow velocity derived from the mm-wave CO observations of Walter et al. 2002). It is not clear how these clouds can survive for this long in the wind flow.

The total amount of warm H_2 gas entrained in the wind of M82 is only $M_{H_2} \sim 1.2 \times 10^4\ M_\odot$ and the total kinetic energy of this material $\sim M_{H_2} V^2_{H_2-\mathrm{outflow}} \sim 10^{51}$ ergs, assuming again that the warm H_2 material shares the same kinematics as the cold molecular material. This is four orders of magnitude lower than the kinetic energies of the entrained ionized Hα-emitting gas (Shopbell & Bland-Hawthorn 1998) and molecular CO-emitting material (Walter et al. 2002). The warm H_2 material is therefore not a dynamically important component of the outflow. However, a comparison between the H_2 emission and the distribution of the CO emission reveals that most of the features seen in CO are detected in H_2 but not the converse: as expected in photon-dominated regions (PDRs; Tielens & Hollenback 1985), the H_2 emission is more extended and probes clouds that are more diffuse (smaller A_V) and at larger distances from the nucleus than the CO emission. Deep H_2 2.12 μm observations such as these therefore represent a promising new method to study the elusive but potentially important molecular component of galactic winds.

A more detailed discussion of these results was recently published in the *Astrophysical Journal Letters* (Veilleux et al. 2009).

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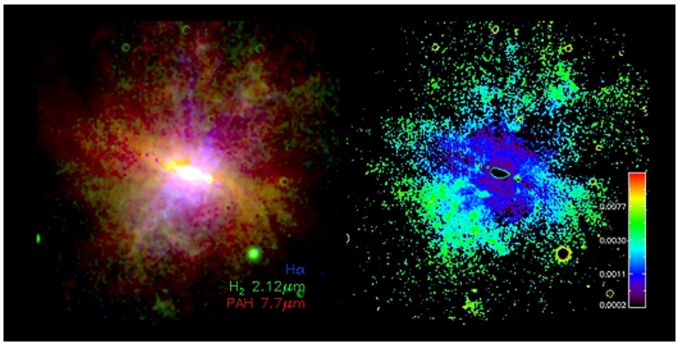

Figure 2: (Left) Three-color composite of M82: *Green:* H_2 2.12 μm emission (same as figure 1), *Red:* 7.7 + 8.6 μm PAH emission from Engelbracht et al. (2006), and *Blue:* *HST*/ACS continuum-subtracted Hα emission from Mutchler et al. (2007), smoothed to 0.2". See figure 1 for information on intensity scaling.
(Right) H_2-to-PAH emission ratio map in the brightest H_2 filaments. Black regions are of low S/N or affected by saturation effects. The absolute ratio scale is accurate to within a factor of only ~2 due to point spread function mismatch between the two wavebands, lack of color corrections for the Infrared Array Camera (IRAC) photometry, and stellar contamination to the 8 μm flux.

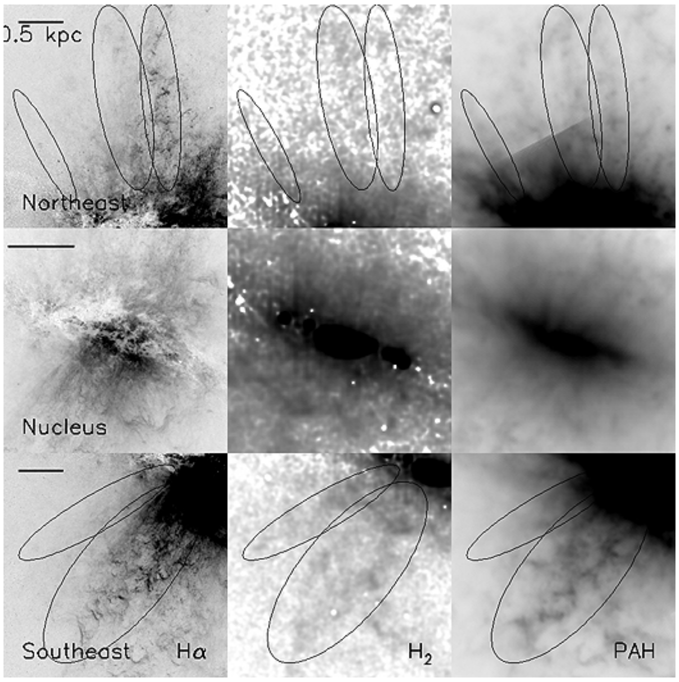

Figure 3: Large-scale images (2´ wide) that focus on three regions of coherent H_2 2.12 μm emission (central column; smoothed with 4" Gaussian kernel) and compare with the Hα (left; 0.2") and PAH (right) emission. Shown in the top, middle, and bottom rows are the northeast quadrant, nuclear disk region, and southeast quadrant, respectively. See figure 1 for information on intensity scaling. The ellipses delineate prominent radial filaments that appear in at least one waveband.

^{12}C Is Missing from the Hyades Open Cluster

Simon C. Schuler (NOAO), Jeremy R. King & Lih-Sin The (Clemson University)

The light elements carbon, nitrogen, and oxygen figure prominently in the chemistry of the Universe, showing up in interstellar molecules and dust, and they are the building blocks of life as we know it. They also play vital roles in stellar nucleosynthesis, from being the main products of ^{4}He burning (triple-α process) to being catalysts for the burning of H into He in the cores of stars (CN cycle). It is no wonder that astronomers have exerted much effort to the pursuit of understanding the production and evolution of these important nuclei.

The CN cycle as an energy source for stars was independently proposed by Hans Bethe and Carl von Weizsäcker in the late 1930s. While it was suspected that the proton-proton chain powers the cores of stars like the Sun, it was also thought that competing reactions that burn ^{1}H may exist. Bethe and Weizsäcker predicted that ^{12}C and ^{14}N can act as catalysts for the conversion of four ^{1}H nuclei into a ^{4}He nucleus via four successive proton captures:

$^{12}C(p,\gamma)^{13}N(e^{+}\nu)^{13}C$
$^{13}C(p,\gamma)^{14}N$
$^{14}N(p,\gamma)^{15}O(e^{+}\nu)^{15}N$
$^{15}N(p,\alpha)^{12}C$.

It is now believed that the CN cycle powers the cores of main-sequence (MS) stars more massive than the Sun. At high enough temperatures, the ON cycle,

$^{16}O(p,\gamma)^{17}F(e^{+}\nu)^{17}O$
$^{17}O(p,\alpha)^{14}N$,

can inject ^{14}N into the CN cycle at the expense of ^{16}O, creating what is known as the CNO bi-cycle.

The cyclic nature of the reactions above is evident; *there is no net loss of the CNO nuclei*. However, the relative number of each element changes due to differences in their lifetime to proton capture. For instance, the $^{14}N(p,\gamma)^{15}O$ reaction is the slowest of the CN cycle, and as a result, the abundance of ^{14}N nuclei builds up at the cost of ^{12}C.

At the cessation of core H burning, a star undergoes the first dredge-up, the deepening of its surface convection zone into its inner layers (Iben 1964), and material processed by the CN cycle in the core is mixed to the surface layers. This mixing alters the surface abundances of the now red giant branch (RGB) star, with the general expectation that the abundance of ^{12}C and the associated ^{12}C/^{13}C ratio are diluted while the abundance of ^{14}N is enhanced. If the convective envelope extends deep enough to reach layers where the ON cycle has been active, the surface ^{16}O abundance will also be reduced.

Modern models of stellar evolution quantitatively predict the expected changes in surface abundances of stars due to first dredge-up mixing as a function of mass and metallicity, and chemical abundance studies of near-solar metallicity giants based on high-resolution spectroscopy have in general verified the model predictions (e.g., Lambert & Ries 1981; Luck & Heiter 2007). However, standard models, those that include convective mixing only, are unable to reproduce the observed light element abundance patterns of low-mass ($M \leq 2.5\ M_{\odot}$), metal-poor giants brighter than the RGB bump. The C abundances of these giants are more heavily depleted than predicted by standard models, and their N abundances are enhanced. Also, they have ^{12}C/^{13}C ratios that are generally below 10, some as low as the equilibrium value of 3.5, whereas the predicted value is ~25 (e.g., Salaris, Cassisi, & Weiss 2002). The observed abundance patterns point to the action of an extra mixing episode that is not included in standard models.

To further test standard stellar evolution models, we have carried out a light element abundance study of three dwarfs and three giants in the Hyades open cluster (Schuler, King, & The 2009). The chemical homogeneity of open clusters makes them ideal targets for stellar evolution studies; the abundances of the MS dwarfs can be used as a proxy for the initial compositions of RGB giants in the same cluster. Any differences in the surface abundances can then be attributed to post-MS evolution. Such direct comparisons cannot be made with field stars.

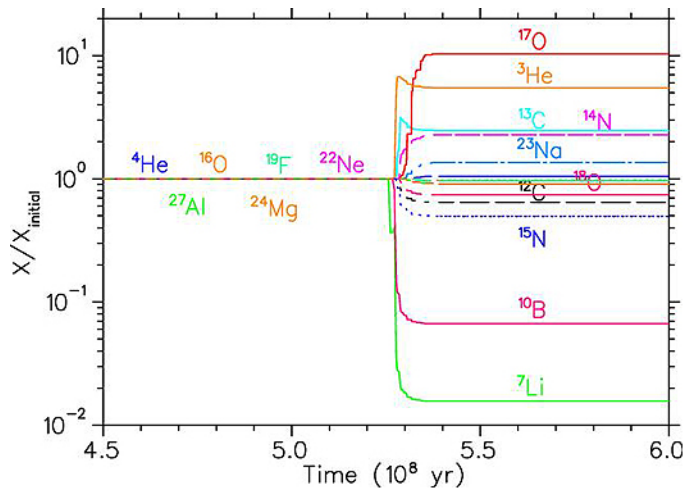

Figure 1: Evolution of the surface abundances of our 2.5 $M_{\odot}$ model as a function of time. Taken from Schuler, King, & The (2009).

We obtained high-resolution ($R = \lambda/\Delta\lambda = 60{,}000$), high-S/N spectra of the Hyades stars using the Harlan J. Smith 2.7-meter telescope and "2dcoude" cross-dispersed echelle spectrometer at the McDonald Observatory. Complementing our observations, we have used the Clemson-American University of Beirut (CAUB) stellar evolution code (e.g., The, El Eid, & Meyer 2007; El Eid, Meyer, & The 2004) to model the evolution of a 2.5 $M_{\odot}$ star (the estimated mass of the Hyades giants) with an initial metallicity matching that of the Hyades cluster. The model was run through the core He burning phase, approximately 785 Myr; the age of the Hyades is estimated to be 600 Myr (Perryman et al. 1998). The predicted evolution of the surface abundances is shown in figure 1.

The abundances of C and N, as well as Li, Na, Mg, and Al, were derived for the dwarfs and giants in a self-consistent fashion using synthetic

continued

^{12}C is Missing from the Hyades Open Cluster continued

spectrum fitting and equivalent width measurements (figure 2). Oxygen abundances derived using the same spectra were adopted from our previous work (Schuler et al. 2006). The CNO abundances within each group, the dwarfs and the giants, are highly consistent and show very little star-to-star scatter. Comparing the two groups, the C abundance of the giants relative to the dwarfs is depleted, the N abundance is enhanced, and the O abundance is unchanged, all of which are in agreement with the qualitative predictions of our model.

Quantitatively, the results are mixed. The observed N and O abundances are in excellent concordance with the model. The mean N abundance of the giants is a factor of 2.3 higher than that of the dwarfs, matching perfectly the predicted increase by a factor of 2.3 in the surface ^{14}N abundance. Also, as hinted at above, the model

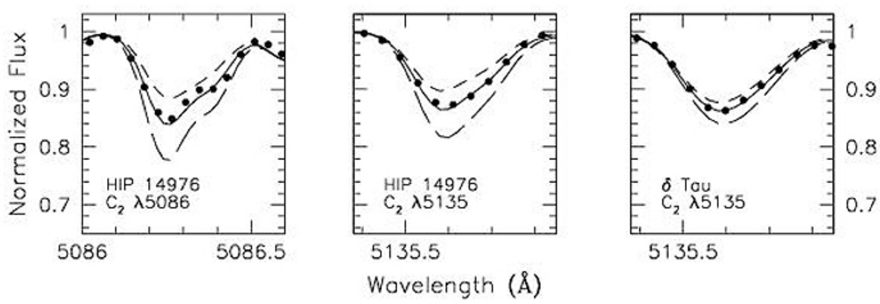

Figure 2: Here we show the synthetic spectrum fitting to observed C_2 lines in the spectra of the Hyades dwarf HIP 14976 and giant δ Tau. The solid line represents the best fit to the observed spectrum (dots), and the broken lines show ±0.10 dex, the best fit abundance. Taken from Schuler et al. (2009).

predicts that the first dredge-up did not extend deep enough in the Hyades giants to mix to the surface material processed by the ON cycle and that the surface ^{16}O abundance should remain unchanged; the observed dwarf and giant O abundances are indistinguishable. Also in agreement with the model is the observed ^{12}C/^{13}C ratio; prior studies have derived mean values of 21.0 ±1.8 (Tomkin, Luck, & Lambert 1976) and 25.8 ±1.4 (Gilroy 1989), matching well the predicted value of 23.4.

Astonishingly, despite the good agreement for the N and O abundances, the observed C abundance of the giants relative to that of the dwarfs was found to be a factor of 1.5, corresponding to 0.18 dex, lower than the model prediction! This difference represents a 6σ result in terms of the random uncertainties in the mean observed abundances. Possibly more important than the disagreement between the observed abundances and the model predictions, which may vary between the different stellar evolution codes in use today, is the empirical result that the sum of the CNO abundances of the giants (log N(C+N+O) = 8.91) does not equal that of the dwarfs (log N(C+N+O) = 9.01) as expected if the CNO bi-cycle is the only set of reactions affecting these nuclei.

We found that a similar discordance may exist between model predictions and the observed C abundances of RGB giants in the Galactic disk, as well. Mishenina et al. (2006) derived the abundances of numerous elements, including C, of disk giants and compared the results to models based on the STAREVOL stellar evolution code. Models assuming an initial C abundance of [C/Fe] = -0.15 or -0.20 fit the observed giant C abundances well, whereas models adopting [C/Fe] = 0 do not predict enough ^{12}C depletion. However, it is the latter models that should be the most appropriate ones to use, because the C abundances of disk dwarfs at the same metallicities as the giants observed by Mishenina et al., the best indicators of the initial C abundances of the giants, are typically [C/Fe] ≈ 0 (e.g., Bensby & Feltzing 2006). Thus, it appears that giants in the Galactic disk have also depleted more ^{12}C than predicted by standard stellar evolution models.

Internal and systematic uncertainties in our abundance analysis cannot account for low C abundances of the Hyades giants. Non-standard mixing, similar to that proposed to explain the anomalous C, N, and ^{12}C/^{13}C ratios of low-mass, metal-poor giants, does not work either; such mechanisms would affect elements other than just C. Non-standard mixing is also not supported by our newly derived Li abundances. Carbon burning, the fusing of two ^{12}C nuclei, is an important nuclear reaction in the cores of massive stars, but the core temperature and density of our 2.5 $M_\odot$ model never comes close to the values necessary for the reaction to occur.

So, where has the missing ^{12}C gone? If it has been depleted by the Hyades giants, the mechanism responsible seemingly depleted ^{13}C as well; this would be necessary to preserve the observed ^{12}C/^{13}C ratio at the expected value of ~24. Also, the depletion must have involved a reaction outside of the CNO bi-cycle; this would be necessary to account for the disagreement in the observed C+N+O abundances of the dwarfs and giants. Because no reaction meeting these two criteria is known, our observations may indicate that a heretofore unknown nucleosynthetic process may be active in the cores of near-solar metallicity 2.5 $M_\odot$ stars.

And the question remains: where has the missing ^{12}C gone?

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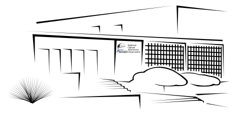


Director's News

David Silva

NOAO Long-Range Plan

The NOAO Long-Range Plan (LRP) for 2009–2013 is now available on the NOAO Web site (*www.noao.edu/dir/lrplan/2009-noao-lrp.pdf*). This is the first LRP revision since the NSF Senior Review. It incorporates themes and strategic objectives that have emerged from the recent period of vigorous community review and discussion about the mission and future direction of NOAO. The Senior Review recommendations form the basic framework, and then detailed planning has been influenced by the deliberations of several committees:

- Renewing Small Telescopes for Astronomical Research (ReSTAR),
- Access to Large Telescopes for Astronomical Instruction and Research (ALTAIR), and
- Future of NOAO;

as well as our regular oversight committees:

- AURA Observatory Council,
- NSF Program Review Panel, and
- NOAO Users' Committee.

The LRP defines high-level NOAO deliverables and how NOAO will be organized to make those deliverables possible. In the latter area, I draw your attention to the newly created NOAO System Science Center (NSSC) and NOAO System Technology Center (NSTC). The NSSC builds on the existing NOAO Gemini Science Center, Science Data Management, and various community engagement activities to create a group responsible for interfacing the US community to all the open-access science capabilities in the US Optical/Infrared (O/IR) System. The NSTC integrates a broad set of existing NOAO technology development activities, including our Large Synoptic Survey Telescope (LSST) team, to more efficiently use our engineering and technical resources to serve both internal and external needs. This reorganization embraces a key strategic directive from NSF—to further develop and support the emerging US O/IR System for the benefit of all.

The LRP summarizes what activities NOAO plans to support using our NSF base funding (e.g., operation of NOAO facilities on Kitt Peak and Cerro Tololo, user support for the US community engaged with Gemini and other major facilities within the US O/IR System, design and development of the telescope and site facilities for LSST). What activities we will support from supplementary awards *if such awards are granted* (e.g., annual REU program, new instruments for the Mayall and Blanco telescopes via the ReSTAR implementation program) are also summarized in the LRP. Planned funding in both areas is loosely based on out-year planning guidelines from the Executive Branch (the so-called President's Request), supplemented by regular discussions between NSF, AURA, and NOAO.

Circumstances and strategic objectives evolve with time, as does actual funding as opposed to planned funding. To that end, NOAO plans to update the LRP during the first quarter of each calendar year.

Fundamentally, the core mission of NOAO is to provide public access for qualified professional researchers, via peer review, to forefront scientific capabilities on telescopes operated by NOAO and other telescopes within the System. In support of this mission, NOAO is engaged in programs to develop the next generation of telescopes, instruments, and software tools necessary to enable exploration and investigation throughout the observable Universe, from planets orbiting other stars to the most distant galaxies in the Universe. Our LRP is a living document describing how we plan to do that. Feedback is welcome.

Budget Update

Every year about May, NSF instructs NOAO to plan for a budget target published by the Executive Branch of the Federal government. That budget target (the so-called President's Request) is reviewed, approved, or modified by Congress. Usually, NOAO has to commit to the target plan before those Congressional modifications are known. If Congress appropriates less money than the requested amount, the NOAO target plan is too expensive and NOAO has a problem. Unfortunately, we have that problem most years.

What happened in FY 2009? The official budget request for NOAO was $27.7 M. Alas, Congress decided not to pass an official FY 2009 budget until after the Federal election and NSF could only fund us at 90 percent of the FY 2008 level (0.9 x $24.6M = $22.1M) for the first six months of FY 2009. In fact, NSF warned us that that funding level might be held for all of FY 2009. An immediate cash-flow problem was created, and we had to make the painful decision to lay off staff, institute a hiring freeze, and constrain costs in other ways (see December 2008 *NOAO/NSO Newsletter* at *www.noao.edu/noao/noaonews.html*).

After various twists and turns, the NSF was finally able to tell us our official FY 2009 base budget in the third quarter of FY 2009—$25.6M. That's much better than the worst-case scenario ($22.1M), but $3.1M (11 percent) less than our original target. In other words, reducing our *base* program activities in late 2008 was the right thing to do, even though NOAO was fortunate to be awarded additional, one-time "stimulus" funding through the American Recovery and Reinvestment Act 2009 (see related ARRA article in this section).

So, as we approach the end of FY 2009, NOAO has escaped the worst, but we still have budget challenges ahead. In particular, we will enter FY 2010 with very little buffer from previous years. I will discuss the FY 2010 budget further in the next *Newsletter* issue. As always, I will update you as new information develops. Everyone at NOAO appreciates your patience and support during these uncertain times.

ReSTAR Brings US Community Access to Palomar 200-inch and New Optical Spectrograph

NSF has approved an initial award of $3M for the NOAO Renewing Small Telescopes for Astronomical Research (ReSTAR) program. The funds will be used in part to gain access for the US community on the 200-inch Hale Telescope and develop a new optical spectrograph for the NOAO 4-meter telescopes. ReSTAR (www.noao.edu/system/restar) is a community- and science-based initiative with the goal of addressing important science programs on 2- to 5-meter aperture class telescopes in the US Ground-based Optical/Infrared System. The process was prompted by the NSF Senior Review, which called for a revitalization of facilities in this class.

One of the main priorities spelled out in the ReSTAR final report was to gain more access to 4-meter-class facilities in the US System. To that end, NOAO has secured 23 nights per year for three years on Palomar's 200-inch Hale Telescope through an agreement with Caltech Optical Observatories. Approximately $0.9M of the $3M NSF ReSTAR award will be used to gain 200-inch access. This time specifically addresses the need for optical and near-infrared spectroscopic capability, which will be gained through the Double Spectrograph and TripleSpec, respectively. Another high priority was to develop modern spectroscopic capabilities on the NOAO 4-meter telescopes at CTIO and KPNO where most of the System time resides. NOAO will allocate approximately $1.5M toward a new optical spectrograph, which will be a clone of the Ohio State Multi-Object Spectrograph. About 55 percent of the allocation will go directly to Ohio State University. The remainder of the NSF award will be used to begin upgrading the existing detector and controller systems at CTIO and KPNO with an eye to enhancing reliability and significantly reducing exposure times. Gains in sensitivity are expected as well. The highest priority systems for upgrade are the Mosaic 1 at KPNO and Hydra at CTIO.

More information on the ReSTAR award and implementation is available on our Web site and through earlier editions of *Currents,* the NOAO electronic newsletter.

Infrastructure Renewal at NOAO and the American Recovery and Reinvestment Act

Robert Blum

The 2006 NSF Senior Review (SR) committee determined that the aging facilities provided by NOAO are not obsolete, but rather should be considered key components of the optical/infrared (O/IR) system of capabilities in the US and should be maintained in a manner that would allow these facilities to fully meet this responsibility. This was noted as being particularly true for telescopes in the 2- to 4-meter aperture range operated by NOAO at Cerro Tololo Inter-American Observatory (CTIO) and Kitt Peak National Observatory (KPNO). The SR recommended NOAO put renewed emphasis on supporting these facilities. The NSF was advised that NOAO should continue to develop new capabilities to be deployed on these existing telescopes. In response, NOAO established a science-based process to determine the priorities for development in this aperture range. The process, called Renewing Small Telescopes for Astronomical Research (ReSTAR), resulted in a series of recommendations, the highest of which was to attend to deferred maintenance and infrastructure needs required to assure safe, reliable, and efficient operations of NOAO (and other) telescopes.

Toward that end, NOAO submitted a proposal to the NSF seeking funds through the American Reinvestment and Recovery Act 2009 (ARRA) to address a much larger range of critical infrastructure renewal needs at KPNO and CTIO than those described in the ReSTAR report (see www.noao.edu/system/restar/). These needs go beyond the direct operation of telescopes (i.e., inside the dome), touch on all aspects of the operation at NOAO, and ultimately affect NOAO's ability to provide forefront research capabilities to the entire US community.

NOAO compiled a list of critical infrastructure upgrades/improvements and deferred maintenance items for its four major operations centers. The list covered mountain-top infrastructure items at CTIO and KPNO and base facility items at the CTIO operations and business centers in La Serena and at the KPNO operations base and NOAO headquarters in Tucson. Significant portions of the plan for CTIO will also benefit users of Gemini, SOAR, and eventually LSST. While the initial list of potential projects totaled $25M, NOAO's final proposal totals $5.6M in high-priority projects and purchases from that list.

continued

Infrastructure Renewal at NOAO continued

The proposal describes a program of renewal that will improve efficiency, safety, and reliability in operations and provide a solid starting point for viable operations of the National Observatory into the next decade and beyond. ARRA will, in the words from a US Department of the Interior news release, "…put a down payment on addressing long-neglected challenges so our country can thrive in the 21st century" (*www.doi.gov/news/09_News_Releases/051209_01*.) Figure 1 shows the size of NOAO's challenge schematically.

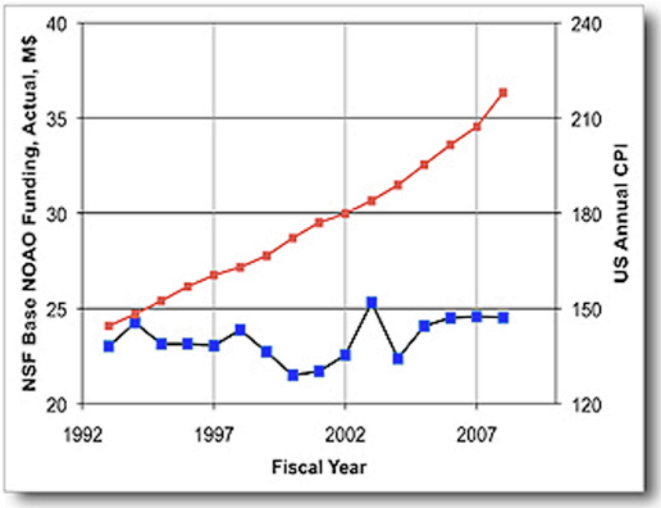


Figure 1: Fifteen-year comparison of NOAO base funds (bottom line) from NSF to US consumer price index (CPI, top line).

Clearly, base funding for NOAO has not kept pace with inflation. As a result, routine maintenance on many of NOAO's facilities, systems, and buildings (both on mountain tops and at base facilities) has been deferred. In the long run, this is an unsustainable situation that will lead to serious problems in supporting NOAO's primary mission of developing, deploying, and operating state-of-the-art capabilities to provide the highest quality of merit-based, open-access telescope time to the US astronomical community.

If the renewal plan is funded, NOAO expects to make significant expenditures on a very short timescale and finish all work within a period of three years (ARRA allows a maximum term of five years for spending). Figure 2 shows the proposed high-level spend plan of the $5.6M.

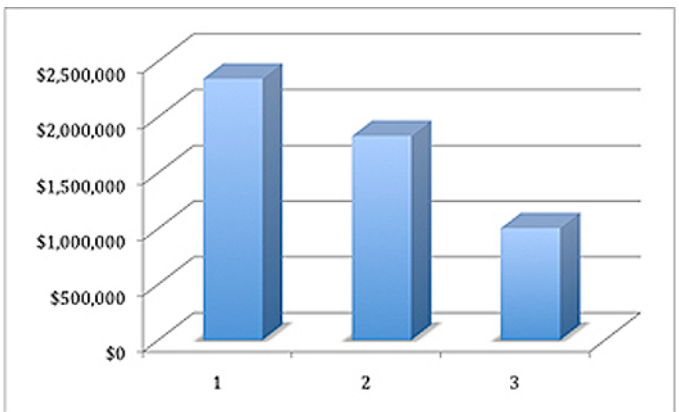


Figure 2: Program spend plan over three-year proposal period.

KPNO Infrastructure Renewal

Among the high priority projects proposed for Kitt Peak is the renovation of the water processing and distribution system that has been in use since the initial development of the National Observatory in 1960. This system provides all treatment, processing, and distribution of potable water to all buildings and facilities on the mountain, which include those directly operated by KPNO and the facilities of over 20 tenant observatories. With no changes since the original 1959 design, many components need to be modified or replaced to enable continued compliance with EPA drinking water regulations.

An environmental engineering firm will be hired to review the current system and design necessary changes to the processing, filtration, disinfection, storage, and water quality testing components. The firm will provide a prioritized list of components that need to be replaced and develop plans and specifications for contracted implementation. Where appropriate, the water storage and distribution systems will also be updated to ensure safe and efficient storage of the water and proper delivery to the end users.

Figure 3: Kitt Peak water system rain catchment basin (without any water in it). (Photo credit: NOAO/AURA/NSF)

A modest, but important project planned for Kitt Peak is the replacement of the handicapped access lift for the Kitt Peak Visitor Center (KPVC) public telescope. The KPVC operates a very popular public observing program and the dedicated access lift accommodates handicapped individuals or those requiring a wheelchair. The lift, in use for over 10 years, has broken down several times in the past few years, temporarily stranding occupants. A modern lift with updated operating mechanisms will be installed to restore safe access for handicapped individuals.

NOAO proposes to construct a maintenance facility on Kitt Peak that would minimize potential instrument damage from repeated transport between Kitt Peak and Tucson and provide a safe location for repair and maintenance activities of our current or planned instruments. These include the NOAO Extremely Wide-Field Infrared Imager (NEWFIRM) and the One Degree Imager (ODI) being built for the WIYN 3.5-meter telescope. Both of these instruments require a large, clean space for proper and safe maintenance. ODI has large filters and a focal plane array much larger than anything NOAO has supported in the past. Having a facility near the telescope in which to service an instrument like ODI is critical to reducing the risk of damage in transport.

continued

Infrastructure Renewal at NOAO continued

The facility, approximately 3,000 square feet, would incorporate clean rooms (we anticipate two, but options exist for one large room pending final design review) and instrument testing areas. The facility would have cranes for instrument movement and space for specialized tools and instrument support systems, including the ability to cool and fully operate the instruments to test all functions. This facility's cost is less than 10 percent of the ODI total cost.

Tucson Base Facility Renewal

The proposal for infrastructure renewal in Tucson is about 30 percent of the amount proposed for Kitt Peak and includes key system replacement/upgrade of the main building electrical system components, energy management systems, and computer room. Demands on the computer room are growing significantly and include hardware to support operations in Chile for the Dark Energy Camera (DECam) community pipeline.

CTIO Infrastructure Renewal

As at Kitt Peak, a major project at Cerro Tololo will be to renew the mountain-top water system. Built in 1976, this system is the source for all water for the observatory installations on both Cerro Tololo and Cerro Pachón. It consists of a deep well pump, 4.6 kilometers of steel pipe, three pump stations for pumping up a 1,200-meter water column, six water storage tanks, a water treatment plant and chlorinator, control system, and a pressurized tank for water distribution on the mountain. The proposed work involves replacement of the pumps and major maintenance and renovation of the storage tanks and pipes. Refurbishing this key infrastructure component would benefit all users of Tololo and Pachón, including Gemini, SOAR, and eventually LSST.

Another long overdue project is the renovation of the three dormitory buildings on Cerro Tololo: two for CTIO staff who work a "turno" (seven days on and seven days off) and one for visiting astronomers. One of the staff dormitories has storm damage that needs repair. The other staff dormitory and the astronomer dormitory need roof and other structural repairs. All three dormitories need interior renovation: the furniture, carpet, and paint have not been replaced in many years; much of the furniture dates back to the early 1970s. The proposed renovations will provide modern, comfortable living space and energy efficiencies that are important for the quality of the workplace environment for staff and visitors. The staff who spend significant time living on the mountain greatly deserve these long-delayed refurbishments.

Five houses on Cerro Tololo are used for longer-term project visitors, instrument teams, construction crews, and occasional visitor overflow from the dormitories. Three of these houses are out of operation due to storm damage and aging structures; the other two are in very poor condition. The proposed work includes repair and renovation of the interiors, including paint, furniture, and appliances. These facilities will be in demand during the commissioning and operations of the Dark Energy Survey, as well as other larger surveys. The renovated space will be available for Gemini and LSST instrument and commissioning teams as well.

Operations on Cerro Pachón are growing significantly with the advent of SOAR and Gemini and soon LSST. One project proposed to support this new operations base is a kitchen and dining facility to replace the temporary building used to serve meals near the summit of Cerro Pachón. This building already is used extensively by Gemini, SOAR, and NOAO staff and visitors, who typically eat in shifts due to the small amount of available space. With the expectation that the Pachón dining facilities will soon be used by LSST staff as well, a larger space is needed.

An instrument handling capability analogous to the one at KPNO is proposed for the Blanco 4-meter telescope Coudé room. Two new, large instruments will be coming to CTIO in the next two to three years: DECam and NEWFIRM, and two more instruments (TripleSpec and an Ohio State Multi-Object Spectrograph) may arrive soon thereafter as part of the projects proposed for ReSTAR. The improvements will include: a system of compressors and distribution lines to provide high-pressure compressed helium as a working gas to cryocooler cold heads, off-telescope facilities in which the instruments can be operated and tested without interfering with telescope operations, cranes for handling heavy precision instruments both inside and outside of the clean room, and ventilation and filtering for the Coudé room air to enable its use as a plenum for the clean room air-processing system. A clean room with excellent electrostatic characteristics for testing and maintenance of the instruments has been separately funded, apart from the ARRA proposal, and is under construction in preparation for the arrival of DECam.

A series of upgrades to the observing and maintenance infrastructure at the Blanco are also proposed. These include an expansion of the computing and console room to handle new systems for DECam and NEWFIRM, a repair of the Blanco coating facility, and an upgrade to the Blanco cooling system.

La Serena Base Facility Renewal

A host of modernization, upgrade, and renovation projects are proposed for the facilities in La Serena. As at NOAO North, these represent a smaller total investment than on Cerro Tololo, about 20 percent of the amount proposed for Chile. A modest but important expansion to the CTIO shop facilities is proposed to add space and capacity that is needed to support activities at Cerro Tololo, Gemini, SOAR, and LSST. This includes a new medium-sized milling machine.

Other proposed projects include renovation of the AURA "recinto" water system that supplies potable water to all the residents and staff working at CTIO, Gemini, and SOAR; lab equipment modernization and replacement; vehicle replacements for the 1990s era support vehicles; and security fencing.

The projects represented in the NOAO proposal to NSF for ARRA funds are an important and timely "down payment" on addressing the deferred maintenance that has accumulated over the last 15 or more years at the National Observatory. NOAO is committed to making the NSF facilities under its stewardship the best they can be, providing a safe and efficient environment for staff and visitors alike. While NOAO is hopeful that the ARRA proposal will be funded, at the time of this writing, NSF has not yet notified NOAO of a decision. Taking the optimistic view, NOAO is already working with NSF to ensure that plans are in place for continued attention to the infrastructure needs of the National Observatory so that it continues to be scientifically productive into the next decade.

Classical and Queue Observing Opportunities with the Gemini Telescopes for Semester 2010A

Verne V. Smith

Semester 2010A runs from 1 February 2010 to 31 July 2010, and the NOAO Gemini Science Center (NGSC) encourages the US community to propose for Gemini observing time for this semester. The Gemini Observatory provides unique opportunities in observational and operational capabilities, such as the ability to support both classically- and queue-scheduled programs. A couple of points to note: the Near Infrared Coronagraphic Imager (NICI) is one of the newer instruments on Gemini South, while the time-tested, near-IR, high-resolution spectrograph Phoenix will remain available on Gemini South in 2010A.

In an effort to increase interactions between US users and the Gemini staff, as well as observing directly with the telescopes and instruments, **NOAO strongly encourages US proposers to consider classical programs, which can be as short as 1 night, on the Gemini telescopes. NOAO will cover the travel cost to observe classically at Gemini for up to two observers.**

US Gemini observing proposals are submitted to and evaluated by the NOAO Time Allocation Committee (TAC). The formal Gemini Call for Proposals for 2010A will be released in early-September 2009 (close to the mailing time of this *Newsletter* issue), with a US proposal deadline of Wednesday, 30 September 2009. As this article is prepared well before the release of the Call for Proposals, the following list of instruments and capabilities are only our expectations of what will be offered in semester 2010A. Please watch the NGSC Web page (*www.noao.edu/usgp*) for the Gemini Call for Proposals, which will list clearly and in detail the instruments and capabilities that will be offered.

NGSC anticipates the following instruments and modes on Gemini telescopes in 2010A.

Gemini North

- NIFS: Near-Infrared Integral Field Spectrometer.
- NIRI: Near-Infrared Imager and spectrograph with both imaging and grism spectroscopy modes.
- ALTAIR adaptive optics (AO) system in natural guide star (NGS) mode, as well as in laser guide star (LGS) mode. ALTAIR can be used with NIRI imaging and spectroscopy and with NIFS integral-field unit (IFU) imaging and spectroscopy, as well as NIFS IFU spectral coronagraphy.
- Michelle, mid-infrared (7–26 microns) imager and spectrometer, which includes an imaging polarimetry mode.
- GMOS-North: Gemini Multi-Object Spectrograph and imager. Science modes are multi-object spectroscopy (MOS), long-slit spectroscopy, IFU spectroscopy, and imaging. Nod-and-Shuffle mode is also available.
- All of the above instruments and modes are offered for both queue and classical observing, except for LGS which is available as queue only. **It is important to note that classical runs are now offered to programs that are one night or longer, and which consist of integer nights.** The offer of one-night classical runs opens up the possibility of many more Gemini programs being eligible for classical observing, if the program principal investigator (PI) wants to use this mode.
- Details on use of the LGS system are under the "Call for Proposals" link at *www.gemini.edu/sciops/ObsProcess/ObsProcIndex.html*, but a few points are emphasized here. Target elevations must be >40 degrees and proposers must request good weather conditions (Cloud Cover = 50%, or better, and Image Quality = 70%, or better, in the parlance of Gemini observing conditions). Proposals should specify "Laser guide star" in the Resources section of the Observing Proposal. Because of the need for good weather, LGS programs must be ranked in Bands 1 or 2 to be scheduled on the telescope.
- Time trades will allow community access to the high-resolution optical spectrograph, HIRES, on Keck for up to five nights, as well as to the Subaru telescope for up to 10 nights. For the first time in the Gemini-Subaru time trade, a larger complement of instruments are now offered:
  - Suprime-Cam wide-field imager
  - Multi-Object Infrared Camera and Spectrograph (MOIRCS)
  - High Dispersion Spectrograph (HDS)
  - Faint Object Camera and Spectrograph (FOCAS)
  - Cooled Mid-Infrared Camera and Spectrograph (COMICS)
  - Infrared Camera and Spectrograph (IRCS), which can be used behind the NGS adaptive optics system AO188.

More details on the Subaru instruments can be found at *www.subarutelescope.org/Observing/*.
Note that the Subaru and Keck exchange nights will be scheduled in classical mode.

- Gemini Near-Infrared Spectrograph (GNIRS) commissioning during 2010A. The repair and refurbishment of GNIRS continues in Hilo, and it is planned that sometime during 2010A the spectrograph will be deployed on Gemini North to undergo commissioning on this telescope. GNIRS will not be available as a general user instrument in the 2010A Call for Proposals; however, its commissioning on Gemini North may affect the telescope schedule.

Gemini South

- T-ReCS: Thermal-Region Camera Spectrograph mid-infrared (2–26 microns) imager and spectrograph.
- GMOS-South: Gemini Multi-Object Spectrograph and imager. Science modes are multi-object spectroscopy (MOS), long-slit spectroscopy, IFU spectroscopy, and imaging. Nod-and-Shuffle mode is also available.

continued

Observing Opportunities with Gemini 2010A continued

- Phoenix, the NOAO high-resolution infrared spectrograph (1–5 microns), is expected to be available during 2010A, although the likely appearance of both FLAMINGOS-2 and the multi-conjugate adaptive optics system CANOPUS on the telescope may impact the scheduling of Phoenix. Users should keep an eye on either the Gemini Web site (*www.gemini.edu*), or the NGSC site (*www.noao.edu/usgp/*) for the most up-to-date information about Phoenix.
- NICI: Near-Infrared Coronagraphic Imager is available for general user proposals, although its use is restricted to good seeing conditions.
- FLAMINGOS-2 is now at Cerro Pachón and is expected to undergo commissioning on the telescope during 2010A; this commissioning may affect the telescope schedule.
- All modes for T-ReCS, GMOS-South, Phoenix, and NICI are offered for both queue and classical observing. **As with Gemini North, classical runs are now offered to programs with a length of at least one or more integer nights.**

Detailed information on all of the above instruments and their respective capabilities is available at:
www.gemini.edu/sciops/instruments/instrumentIndex.html.

The percentage of telescope time devoted to science program observations in 2010A is expected to be greater than 85 percent at Gemini North and greater than 75 percent at Gemini South.

We remind the US community that Gemini proposals can be submitted jointly with collaborators from other Gemini partners. An observing team requests time from each relevant partner. Multi-partner proposals are encouraged because they access a large fraction of the available Gemini time, thus enabling larger programs that are likely to have substantial scientific impact. Please note that all multi-partner proposals must be submitted using the Gemini Phase I Tool (PIT).

Note that queue-proposers have the option to fill in a so-called “Band 3” box, in which they can optimize their program execution if it is scheduled on the telescope in Band 3. Historically, it has been found that somewhat smaller than average queue programs have a higher probability of completion if they are in Band 3, as well as if they use weather conditions whose occurrences are more probable. Users might want to think about this option when they are preparing their proposals.

Efficient operation of the Gemini queue requires that it be populated with programs that can effectively use the full range of observing conditions. Gemini proposers and users have become increasingly experienced at specifying the conditions required to carry out their observations using the on-line Gemini Integration Time Calculators for each instrument. NGSC reminds you that a program has a higher probability of being awarded time and of being executed if ideal observing conditions are not requested. **The two conditions that are in greatest demand are excellent image quality and no cloud cover. We understand the natural high demand for these excellent conditions, but wish to remind proposers that programs that make use of less than ideal conditions are also needed for the queue.**

There is continuing need for proposals that can be run under the poorest conditions. To help fully populate the queue, a category of “Poor Weather” proposals has been established. Poor weather programs may be submitted for any facility instrument; for these proposals, neither the PI nor the partner country will be charged for any time used. For additional information, please see the link at:
www.gemini.edu/sciops/ObsProcess/ObsProcCfP_background.html.

NOAO accepts Gemini proposals via either the standard NOAO Web proposal form or the Gemini PIT software. We note to proposers who plan to use the PIT that NOAO offers a tool that allows proposers to view how their PIT proposal will print out for the NOAO TAC (please see *www.noao.edu/noaoprop/help/pit.html*).

Feel free to contact me (*vsmith@noao.edu*) if you have any questions about proposing for US Gemini observing time.

NICI: Open for Business

Ron Probst

The Gemini Near-Infrared Coronagraphic Imager, NICI, operated on the Gemini South 8-meter telescope, met its commissioning requirements in late 2008 and was “on sky” for science during December 2008–April 2009. It was advertised as a general user facility instrument for 2009B, and five US proposals were scheduled. The expectation is that NICI will continue to be available for 2010A.

The initial science time was dedicated to the NICI Planet Finding Campaign, a large-scale systematic survey of young nearby stars for substellar mass companions. An excellent description of NICI and of the Planet Finding Campaign science, written by campaign Primary Investigator Michael Liu (University of Hawai‘i), appears in the June 2009 issue of the *Gemini*Focus newsletter (*www.gemini.edu/node/27*, pp. 61-66). I had the pleasure of watching NICI in action for campaign science during several nights on Cerro Pachón in February 2009. The observing ran very smoothly, with Gemini instrument scientist and science team member Tom Hayward operating NICI on site, and other members of the science team interacting by video connection from Hawai‘i. While the observing program used a well-defined and simple protocol for its targets, operational experience was being gained and collective judgment calls made occasionally. The science team spent a lot of nights on site during the commissioning period, and their hands-on familiarity was apparent in these real-time interactions. Commissioning experience had provided a couple of simple metrics of image quality, from the visible light Peripheral Wavefront Sensor and from the raw infrared (IR) science images. This enabled a quick decision, and efficient switch to other queue instruments, when seeing conditions degraded one night.

continued

NICI: Open for Business continued

Although optimized for coronagraphic imaging, NICI can also be used in noncoronagraphic mode as an adaptive optics-enabled imager for high spatial resolution, narrow field imaging at 1–2.5 microns (its 3- to 5-micron capability is not offered yet). US observing programs with NICI in 2009B include searching for satellites to asteroids, probing the circumstellar environment of post-AGB binaries, and characterizing the weather on Titan. There are surveys for stellar multiplicity and for planetary mass companions in a stellar sample that are complementary to the Planet Finding Campaign survey, illustrating the wide range of science that NICI enables in both coronagraphic and noncoronagraphic modes.

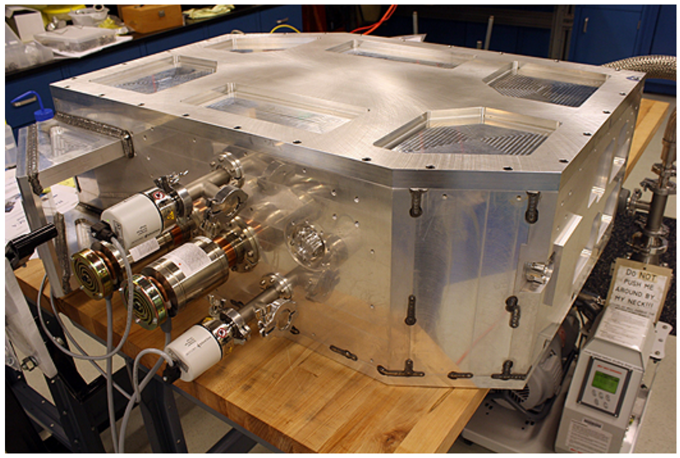
For further information on NICI, contact Ron Probst (rprobst@noao.edu), the NGSC contact scientist for NICI.

May 2009 Gemini Board Meeting and Its Impact on WFMOS and the Aspen Program

Verne Smith

The Gemini Board held its most recent semi-annual meeting on 12–13 May 2009, where one of the agenda items was to act on a report from the Gemini Observatory concerning the results of design studies for the Wide-Field Multi-Object Spectrograph (WFMOS). Due primarily to the issue of cost, the Board was forced to decide not to proceed with construction of WFMOS. The Board resolutions arising from the May 2009 meeting are available in their entirety online (www.gemini.edu/science/resolutions/GBOD/gbod05.09_resolutions.pdf). It is worth quoting here Board Resolution 2009.A.1 concerning WFMOS:

> *The Board acknowledges receipt of the results of the WFMOS design studies in a report from the Observatory. The Board also acknowledges receipt of a draft of the Memorandum of Understanding between NAOJ [National Astronomical Observatory of Japan] and the Gemini Partnership describing the obligations and expectations of implementing and operating the WFMOS instrument on Subaru, the principles guiding the execution of WFMOS science (both campaign and PI driven) opportunities, and the mechanism for time exchange and access to the Gemini telescopes both North and South.*
>
> *The Board recognizes there is strong science support in the Gemini community for the development of WFMOS, intense interest in developing an effective collaboration with NAOJ, and strong science motivation for the project. However, WFMOS has significantly increased in cost, and the Gemini Partnership can identify neither the necessary resources to proceed to WFMOS PDR, nor the totality of funds required in the out-years to successfully complete the instrument. The Board regretfully terminates the WFMOS Aspen initiative.*
>
> *The Board unequivocally endorses the GPI project as the completion of the Aspen program.*
>
> *The Board wishes to express its deep appreciation for the extraordinary effort of the Gemini Observatory, our partner communities, as well as our colleagues at NAOJ. The Board does recognize the engagement between the Gemini partnership and NAOJ and the communities they represent as being enormously beneficial to the expanding international nature of astronomy, and more importantly, the development of strong friendship and aspiration for collaborations to advance science. The Board greatly values the developing scientific partnership between the Gemini and Subaru communities, as manifest in the first ever joint Gemini/Subaru science conference in May 2009, and remains open to exploring areas of mutual interest and benefit to further strengthen this partnership.*



The Integral Field Spectrograph Dewar, part of the GPI hardware under construction. (Photo credit: James Larkin/UCLA)

There is also a statement about WFMOS from Gemini Director Doug Simons at www.gemini.edu/node/11260.

As noted in the Board Resolution, the termination of WFMOS leaves the Gemini Planet Imager (GPI) as the remaining instrument under development as part of the Aspen program. Currently, GPI is planned to be deployed at the telescope (probably Gemini South) sometime in 2011. The figure above shows part of the GPI hardware under construction, the Integral Field Spectrograph (IFS) Dewar. The GPI IFS is a 1- to 2.5-micron spectrograph, with a Hawaii-2-RG detector, with a spectral resolution of R ~ 45 (at the nominal H-band operating wavelength), being built by James Larkin at Universtiy of California, Los Angeles.

Extraordinary NICI Images of Eta Carinae

Roberta Humphreys, University of Minnesota

Eta Carinae (η Car) was imaged with the Gemini Near-Infrared Coronagraphic Imager (NICI) during its 2009 "spectroscopic event." Every 5.5 years the very luminous and massive star η Car experiences a "spectroscopic event" during which its high excitation emission lines decline and even disappear over several weeks. These rapid spectroscopic changes are also accompanied by a brief decrease in its flux. Although these events are not fully understood, they most likely result from a mass ejection in the equatorial region when an otherwise undetected companion star passes through the dense wind and close to the extremely massive primary.

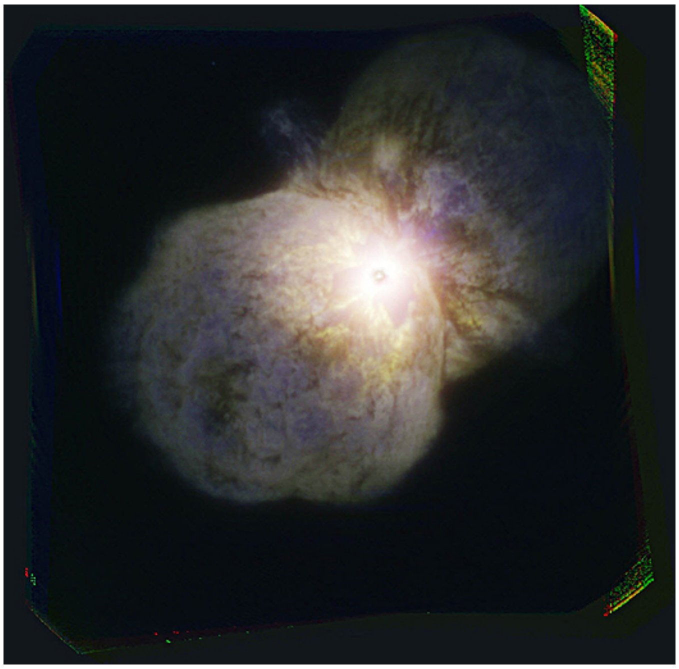


Figure 1: An η Car image from combined NICI Br γ, [Fe II], and H_2 observations. (Image credit: Principal Investigator Kris Davidson)

Although η Car had been imaged previously in the near-infrared, it had not been observed during one of these events. We observed η Car with NICI on Gemini South in February 2009, just after the spectroscopic minimum. Adaptive optics and Spectral Difference Imaging were used with the narrowband filters for Brackett (Br) γ, [Fe II], and molecular hydrogen (H_2) together with the corresponding continuum filters. The spatial resolution is competitive with the Very Large Telescope using the Nasmyth Adaptive Optics System and Near-Infrared Imager and Spectrograph (VLT/NACO) and better than the Hubble Space Telescope using the Near Infrared Camera and Multi-Object Spectrometer (NICMOS).

At these wavelengths we can penetrate the dusty, mottled, outer envelope of the bipolar lobes of the Homunculus. Figure 1 shows the combined image from all three narrowband filters. A focal plane mask covers the central star to prevent saturation. The "butterfly" pattern found a few years ago by Chesneau et al. (2005) can be seen just below the star. The nature of this feature and its geometric relation to the southeast lobe and the equatorial debris is not known. One of our goals is to compare the NICI images with the earlier VLT/NACO images (Chesneau) and NICMOS images (Smith and Gehrz 2000) to measure the possible motions of the filamentary pattern in the "butterfly" and determine its expansion, orientation, and age.

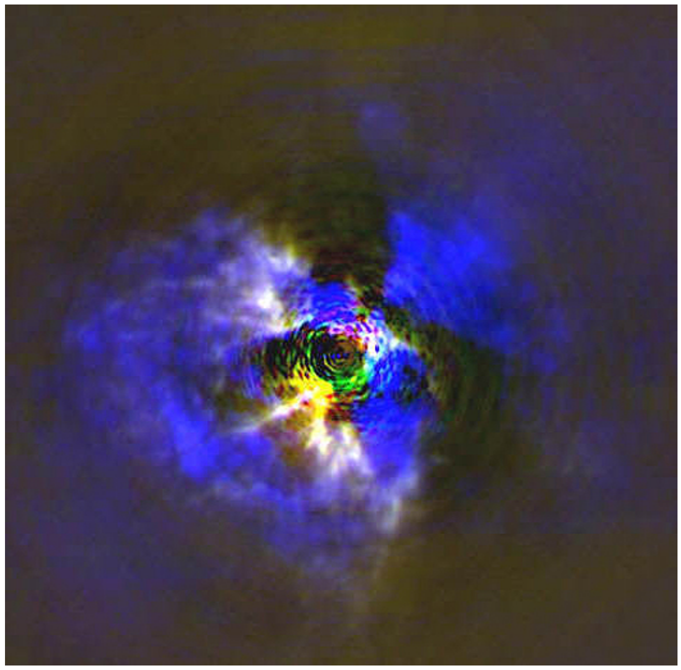


Figure 2: The combined continuum-subtracted η Car image: Br γ (red), H_2 (green), and [Fe II] (blue). (Image credit: Principal Investigator Kris Davidson)

Figure 2 is the combined continuum-subtracted image from all three filters, Br γ (red), H_2 (green), and [Fe II] (blue). This figure shows the inner region. Br γ and H_2 have essentially the same distribution and outline the "butterfly" structure. [Fe II] is quite different and shows a bi-polar distribution similar to the Homunculus. We suspect that it is tracing the "little Homunculus" previously seen only spectroscopically (Ishibashi et al. 2003). The little Homunculus is a bipolar outflow believed to have formed in η Car's second 1890s eruption.

The members of our group are Principal Investigator Kris Davidson and Roberta Humphreys (University of Minnesota), John Martin (University of Illinois-Springfield), and Etienne Artigau (Gemini South). Artigau and Martin planned these observations, and Artigau reduced the data. Olivier Chesneau and Nathan Smith provided their earlier VLT/NACO and NICMOS images for this study.

GSA Helpful Hint: Data Packing in Archive

Tom Matheson

The Gemini Science Archive (GSA) is the primary mechanism for distributing data from the Gemini Observatory to principal investigators (PIs). In order to use the Archive, you must first register at the GSA Web site: (*www1.cadc-ccda.hia-iha.nrc-cnrc.gc.ca/usertools/*).

On the home page of the GSA Web site (*www1.cadc-ccda.hia-iha.nrc-cnrc.gc.ca/gsa/*), there is a pull-down menu titled "Proprietary Data Access" that you can use to select "Access your PI Data." You then use the Gemini program ID and the program key to get access to your data. This key is the same one used as a password with the Observing Tool during the Phase II process. Note that this is not the same as the user name and password you used to register with the Archive. You can have multiple PI programs associated with your Archive account.

Once you have authenticated your access, the program ID will appear on the "Access your PI data" Web page. You can then click on the program ID and choose either "List datasets," which shows all individual science frames, or "View packages," which opens a list of data packages, each with science and calibration frames. Occasionally, data packages are not complete. If you want to see a list of all data frames for your program, use the "List datasets" button. In the table with all the science frames, one column is titled "All Program Obs." and contains the word "List" as a link in each row. If you click on this link, the Archive will open a table that contains all data frames associated with your program ID.

Kyoto 2009 Joint Subaru/Gemini Science Conference

Ken Hinkle

The Subaru and Gemini Observatories held a jointly sponsored science conference May 18–22 at Kyoto University, Japan. This meeting is the third in a series of Gemini science conferences. The intent of these conferences is for users from the member countries to discuss current Gemini science results, capabilities, and future research goals and to explore possible collaborations. Additionally, this meeting was aimed at providing an opportunity for the Subaru and Gemini communities to compare research conducted at the two observatories. In part, the interest in developing a connection between the Subaru and Gemini communities stemmed from the planned WFMOS collaboration (see article on Gemini Board Meeting in this section).

The conference covered a wide range of scientific topics. Overall, there were about 50 talks and 100 posters. Oral sessions covered cosmology, large-scale structure, galaxy formation, black holes, AGN, compact objects, solar system, exoplanets, star formation, and interstellar medium. The posters spanned a yet broader range of topics. There were also talks on the current status and future plans of the Subaru and Gemini Observatories.

The science sessions ran from Monday through Thursday. Friday was devoted to a Gemini users' meeting. Sessions in the users' meeting covered operations status and plans, current instrumentation, users' survey and publication statistics, and future instrumentation plans.

A brief report of the meeting and the proceedings are available at *www.gemini.edu/node/11261* and *www.kusastro.kyoto-u.ac.jp/kyoto2009/proc.html*, respectively.

Participants at the joint Subaru/Gemini Science Conference in Kyoto, Japan, May 2009. (Photo Credit: Gemini Observatory)

NGSC Instrumentation Program Update

Verne Smith & Mark Trueblood

The Florida Multi-Object Imaging Near-Infrared Grism Observational Spectrometer (FLAMINGOS-2) is the last instrument to be built under our agreement with Gemini in which NOAO issued contracts to the institutions that built the instruments. Thus, the NGSC Instrumentation Program's mission to provide innovative and capable instrumentation for the Gemini telescopes in support of frontline science programs is now complete. Starting with the Gemini Planet Imager (GPI), Gemini began direct contracting and control of its instrumentation built in the US. Since FLAMINGOS-2 has been shipped from the institution that built it (see below), this is the final article in this series from the NGSC. Future articles from other authors will discuss progress of FLAMINGOS-2 in its commissioning on the Gemini South telescope and other aspects of the Gemini instrumentation program.

This article gives a status update on Gemini instrumentation being developed under the oversight of the NGSC, with progress since the June 2009 *NOAO/NSO Newsletter*.

FLAMINGOS-2

FLAMINGOS-2 is a near-infrared multi-object spectrograph and imager for the Gemini South telescope. FLAMINGOS-2 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 multi-conjugate adaptive optics system. The University of Florida is building FLAMINGOS-2 under the leadership of Principal Investigator Steve Eikenberry.

FLAMINGOS-2 passed the third and final series of Pre-ship Acceptance Tests held in Gainesville, Florida, 5–8 May 2009. Some minor changes were made as a result of the tests, and then the instrument was crated and shipped to Cerro Pachón, Chile, arriving at the Gemini South site July 2. Figure 1 shows the instrument leaving the University of Florida.

Since then, the University of Florida FLAMINGOS-2 Team has been hard at work unpacking the shipping crates and assembling and checking out the instrument. They will execute a series of laboratory tests to ensure that everything survived the trip, and then the instrument will be mounted on the Gemini South telescope for Final Acceptance Testing and Commissioning. Figure 2 shows the instrument being assembled in the Gemini instrument lab in Chile.

Figure 1: FLAMINGOS-2 Principal Investigator Steve Eikenberry (with gloves) and his team as they load the shipping crates into a semi-trailer for transport to Chile. (Photo credit: University of Florida/Department of Astronomy)

Figure 2: The FLAMINGOS-2 Team assembling the instrument in Chile. (Photo credit: University of Florida/Department of Astronomy)

2010A Observing Proposals Due 30 September 2009; Survey Proposals Due 15 September 2009

Dave Bell

Standard proposals for NOAO-coordinated observing time for semester 2010A (February–July 2010) are **due by Wednesday evening, 30 September 2009, midnight MST**.

Proposals for new Survey programs are due by 15 September 2009, and require a letter of intent to have been sent in July. The facilities available this semester include the Gemini North and South telescopes, Cerro Tololo Inter-American Observatory (including SOAR), Kitt Peak National Observatory, and community-access time with Magellan, MMT, the Hale Telescope and the Center for High Angular Resolution Astronomy Array.

Proposal materials and information are available on our Web page (*www.noao.edu/noaoprop/*). There are four options for submission:

Web submissions—The Web form may be used to complete and submit all proposals. The information provided on the Web form is formatted and submitted as a LaTeX file, including figures that are "attached" to the Web proposal as encapsulated PostScript files.

File upload—A customized LaTeX file may be downloaded from the Web proposal form, after certain required fields have been completed. "Essay" sections can then be edited locally and the proposal submitted by uploading files through a Web page at: *www.noao.edu/noaoprop/submit/*.

Email submissions—A customized LaTeX file may be downloaded from the Web proposal form, after certain required fields have been completed. "Essay" sections can then be edited locally and the proposal submitted by email. Please carefully follow the instructions in the LaTeX template for submitting proposals and figures. Please use file upload instead of email if possible.

Gemini's Phase I Tool (PIT)—Investigators proposing for Gemini time **only** may optionally use Gemini's tool, which runs on Solaris, RedHat Linux, OS X, and Windows platforms and can be downloaded from *www.gemini.edu/sciops/P1help/p1Index.html*.

Note that proposals for Gemini time may also be submitted using the standard NOAO form, and that proposals that request time on Gemini plus other telescopes **MUST** use the standard NOAO form. PIT-submitted proposals will be converted for printing at NOAO, and are subject to the same page limits as other NOAO proposals. To ensure a smooth translation, please see the guidelines at: *www.noao.edu/noaoprop/help/pit.html*.

The addresses below are available to help with proposal preparation and submission:

Web proposal materials and information	*www.noao.edu/noaoprop/*
Request help for proposal preparation	*noaoprop-help@noao.edu*
Address for thesis and visitor instrument letters, as well as consent letters for use of PI instruments on the MMT	*noaoprop-letter@noao.edu*
Address for submitting LaTeX proposals by email	*noaoprop-submit@noao.edu*
Gemini-related questions about operations or instruments	*usgemini@noao.edu*
	www.noao.edu/gateway/gemini/support.html
CTIO-specific questions related to an observing run	*ctio@noao.edu*
KPNO-specific questions related to an observing run	*kpno@noao.edu*
MMT-specific questions related to an observing run	*mmt@noao.edu*
Magellan-specific questions related to an observing run	*magellan@noao.edu*
Hale-specific questions related to an observing run	*hale@noao.edu*

Community Access Time Available in 2010 with the CHARA Optical Interferometer Array

Steve Ridgway

NOAO and Georgia State University are announcing a one-time opportunity for observations with the Center for High Angular Resolution Astronomy (CHARA) Array at Mt. Wilson Observatory. About 50 hours will be available during calendar year 2010. Observations will be carried out by CHARA staff. This is intended primarily for scientists who would benefit from a small amount of data and wish to gain experience with optical interferometry capabilities.

Requests should be submitted using the standard NOAO proposal form by selecting "CHARA" in the telescope list, and entering "nights requested" as a decimal assuming 10 hours/night (e.g., 1.6 nights = 16 hours). Proposals must be submitted by the standard 2010A deadline of 30 September 2009. Note that this one-time call covers all of calendar year 2010, as opposed to the six-month period of February–July 2010 for other resources in the 2010A proposal cycle.

For more information, see *www.noao.edu/gateway/chara/*.

Community Access Time Available in 2010A with Magellan, MMT, and Hale

Dave Bell

As a result of awards made through the National Science Foundation's Telescope System Instrumentation Program (TSIP) and Renewing Small Telescopes for Astronomical Research (ReSTAR), telescope time is available to the general astronomical community at the following facilities in 2010A:

- **Magellan Telescopes**
  A total of five nights will be available for classically-scheduled observing programs with the 6.5-meter Baade and Clay telescopes at Las Campanas Observatory. For updated information on available instrumentation and proposal instructions, see *www.noao.edu/gateway/magellan/*.

- **MMT Observatory**
  Twelve nights of classically-scheduled observing time is to be available with the 6.5-meter telescope of the MMT Observatory. Previous requests have disproportionately used our allocation of dark and grey time, so bright time proposals are particularly encouraged. For further information, see *www.noao.edu/gateway/mmt/*.

- **Hale Telescope**
  Twelve nights of classically-scheduled observing time will be available with the 200-inch Hale Telescope at Palomar Observatory. Community access users may propose for the Double Spectrograph (a red and blue channel optical spectrograph) and TripleSpec (a near-infrared 1–2.5 μm spectrometer). For more information, see *www.noao.edu/gateway/hale/*.

General community access to the Keck telescopes will not be available in 2010A, but time will continue to be available with the HIRES spectrograph through a trade between Gemini and Keck. A list of instruments that we expect to be available in 2010A can be found at the end of this section. As always, investigators are encouraged to check the NOAO Web site for any last-minute changes before starting a proposal.

Observing Request Statistics for 2009B Standard Proposals

	No. of Requests	Nights Requested	Average Request	Nights Allocated	DD Nights (*)	Nights Previously Allocated	Nights Scheduled for New Programs	Over-subscription for New Programs
GEMINI								
GEM-N	154	151.01	0.98	59.55	0	0	59.55	2.54
GEM-S	93	108.42	1.17	56.4	0.5	0.25	56.15	1.93
CTIO								
CT-4m	48	174	3.62	139	0	9	130	1.34
SOAR	33	114.6	3.47	35.5	0	0.5	35	3.27
CT-1.5m	5	15.8	3.16	26.6	0	9.5	17.1	0.92
CT-1.3m	8	25.6	3.2	15.45	0	0	15.45	1.66
CT-1.0m	11	59	5.36	81	0	0	81	0.73
CT-0.9m	17	70.95	4.17	69.35	0	25	44.35	1.6
KPNO								
KP-4m	53	199	3.75	144	0	7	137	1.45
WIYN	30	94.8	3.16	60.5	0	10	50.5	1.88
KP-2.1m	40	231	5.78	148	0	0	148	1.56
KP-0.9m	4	15	3.75	12	0	0	12	1.25
Keck, MMT, Magellan								
Keck-I	33	52	1.58	8	0	0	8	6.5
Keck-II	33	42.1	1.28	7	0	0	7	6.01
Magellan-I	9	20	2.22	6	0	0	6	3.33
Magellan-II	6	13	2.17	4	0	0	4	3.25
MMT	8	13.92	1.74	13.5	0	0	13.5	1.03

*Nights allocated by NOAO Director

Gemini Instruments Expected to Be Available for 2010A

GEMINI NORTH	Detector	Spectral Range	Scale ("/pixel)	Field
NIRI	1024×1024 Aladdin Array	1–5µm R~500–1600	0.022, 0.050, 0.116	22.5", 51", 119"
NIRI + ALTAIR (AO- Natural or Laser)	1024×1024 Aladdin Array	1–2.5µm + L Band R~500–1600	0.022	22.5"
GMOS-N	3×2048×4608 CCDs	0.36–1.0µm R~670–4400	0.072	5.5' 5" IFU
Michelle	320×240 Si:As IBC	8–26µm R~100–30,000	0.10 img, 0.20 spec	32"×24" 43" slit length
NIFS	2048×2048 HAWAII-2RG	1–2.5µm R~5000	0.04×0.10	3"×3"
NIFS + ALTAIR (AO- Natural or Laser)	2048×2048 HAWAII-2RG	1–2.5µm R~5000	0.04×0.10	3"×3"

GEMINI SOUTH	Detector	Spectral Range	Scale ("/pixel)	Field
Phoenix	512×1024 Aladdin Array	1–5µm R<70,000	0.085	14" slit length
GMOS-S	3×2048×4608 CCDs	0.36–1.0µm R~670–4400	0.072	5.5' 5" IFU
T-ReCS	320×240 Si:As IBC	8–26µm R~100, 1000	0.09	28"×21"
NICI	1024×1024 (2 det.) Aladdin III InSb	0.9–5.5µm Narrowband Filters	0.018	18.4"×18.4"

EXCHANGE	Detector	Spectral Range	Scale ("/pixel)	Field
HIRES (Keck)	3×2048×4096 MIT-LL	0.35–1.0µm R~30,000–80,000	0.12	70" slit
MOIRCS (Subaru)	2×2048×2048 HAWAII-2	0.9–2.5µm R~500–3000	0.117	4'×7'
Suprime-Cam (Subaru)	10×2048×4096 CCDs	0.36–1.0µm	0.2	34'×27'
HDS (Subaru)	2×2048×4096 CCDs	0.3–1.0µm R~90,000	0.138	60" slit
FOCAS (Subaru)	2×2048×4096 CCDs	0.33–1.0µm R~250–7500	0.104	6' (circular)
COMICS (Subaru)	6×320×240 Si:As	8–25µm R~250, 2500, 8500	0.13	42"×32"
IRCS (Subaru)	1024×1024 InSb	1–5µm R~100–20,000	0.02, 0.05	21"×21", 54"×54"
IRCS+AO188 (Subaru)	1024×1024 InSb	1–5µm R~100–20,000	0.01, 0.02, 0.05	12×12", 21"×21", 54"×54"

CTIO Instruments Available for 2010A

Spectroscopy	Detector	Resolution	Slit
CTIO BLANCO 4m			
Hydra + Fiber Spectrograph	SITe 2K×4K CCD, 3300–11,000Å	700–18000, 45000	138 fibers, 2" aperture
R-C Spectrograph [1]	Loral 3K×1K CCD, 3100–11,000Å	300–5000	5.5'
SOAR 4.2m			
OSIRIS IR Imaging Spectrograph [2]	HgCdTe 1K×1K, JHK windows	1200, 1200, 3000	3.2', 0.5', 1.2'
Goodman Spectrograph [1,3]	Fairchild 4K×4K CCD, 3100–8500Å	1400, 2800, 6000	5.0'
CTIO/SMARTS 1.5m [4]			
Cass Spectrograph	Loral 1200×800 CCD, 3100–11,000Å	<1300	7.7'
Fiber echelle spectrograph	SITe 2K×2K CCD, 4020–7300Å	20000–42000	2.4" fiber

Imaging	Detector	Scale ("/pixel)	Field
CTIO BLANCO 4m			
Mosaic II Imager	8K×8K CCD Mosaic	0.27	36'
NEWFIRM [5]	InSb (mosaic, 4-2K×2K, 1–2.3μm)	0.4	28.0'
ISPI IR Imager	HgCdTe (2K×2K 1.0–2.4μm)	0.3	10.25'
SOAR 4.2m			
SOAR Optical Imager (SOI)	E2V 4K×4K Mosaic	0.08	5.25'
OSIRIS IR Imaging Spectrograph	HgCdTe 1K×1K	0.33, 0.14	3.2', 1.3'
Spartan IR Imager [6]	HgCdTe (mosaic 4-2K×2K)	0.068, 0.041	5.2', 3.1'
Goodman Spectrograph [3]	Fairchild 4K×4K CCD	0.15	7.2' diameter
CTIO/SMARTS 1.3m2 [7]			
ANDICAM Optical/IR Camera	Fairchild 2K×2K CCD	0.17	5.8'
	HgCdTe 1K×1K IR	0.11	2.0'
CTIO/SMARTS 1.0m [8]			
Direct Imaging	Fairchild 4K×4K CCD	0.29	20'
CTIO/SMARTS 0.9m [9]			
Direct Imaging	SITe 2K×2K CCD	0.4	13.6'

[1] The R-C Spectrograph should be out-performed by the Goodman Spectrograph on SOAR, in general. A comparison guide is available.

[2] The spectral resolutions and slit lengths for the OSIRIS imaging spectrograph correspond to its low-resolution, cross-dispersed, and high-resolution modes, respectively. In the cross-dispersed mode, one is able to obtain low-resolution spectra at JHK simultaneously.

[3] The Goodman Spectrograph is available in single-slit mode. Imaging mode is also available, but only with U, B, V, and R filters.

[4] Service observing only.

[5] Please see *www.noao.edu/ets/newfirm/* for more information. Permanently installed filters include J, H, and Ks. Please see NEWFIRM Web pages for updates on availability/schedulability of other filters.

[6] Some modes of the Spartan IR imager may be available. Please consult the NOAO Proposals Web pages for the latest information.

[7] Service observing only. Proposers who need the optical only will be considered for the 1.0-m unless they request otherwise. Note that data from both ANDICAM imagers is binned 2×2.

[8] Classical observing only. Observers may be asked to execute up to 1 hr per night of monitoring projects that have been transferred to this telescope from the 1.3-m. In this case, there will be a corresponding increase in the scheduled time. No specialty filters, no region of interest.

[9] Classical or service, alternating 7-night runs. If proposing for classical observing, requests for 7 nights are strongly preferred.

KPNO Instruments Available for 2010A

Spectroscopy	Detector	Resolution	Slit Length	Multi-object
Mayall 4m				
R-C CCD Spectrograph	T2KB/LB1A/F3KB CCD	300–5000	5.4'	single/multi
MARS Spectrograph	LB CCD (1980×800)	300–1500	5.4'	single/multi
Echelle Spectrograph	T2KB/F3KB CCD	18,000–65,000	2.0'	
FLAMINGOS[1]	HgCdTe (2048×2048, 0.9–2.5μm)	1000–1900	10.3'	single/multi
IRMOS[2]	HgCdTe (1024×1024, 0.9–2.5μm)	300/1000/3000	3.4'	single/multi
WIYN 3.5m				
Hydra + Bench Spectrograph[3]	STA1 CCD	700–22,000	NA	~85 fibers
SparsePak[4]	STA1 CCD	700–22,000	IFU	~82 fibers
2.1m				
GoldCam CCD Spectrograph	F3KA CCD	300–4500	5.2'	
FLAMINGOS[1]	HgCdTe (2048×2048, 0.9–2.5μm)	1000–1900	20.0'	

Imaging	Detector	Spectral Range	Scale ("/pixel)	Field
Mayall 4m				
CCD Mosaic-1	8K×8K	3500–9700 Å	0.26	35.4'
SQIID	InSb (3-512×512 illuminated)	JHKs	0.39	3.3'
FLAMINGOS[1]	HgCdTe (2048×2048)	JHK	0.32	10.3'
WIYN 3.5m				
Mini-Mosaic[5]	4K×4K CCD	3300–9700 Å	0.14	9.3'
OPTIC[5]	4K×4K CCD	3500–10,000 Å	0.14	9.3'
WHIRC[6]	VIRGO HgCdTe (2048×2048)	0.9–2.5μm	0.10	3.3'
2.1m				
CCD Imager[7]	T2KB CCD	3300–9700 Å	0.305	10.4'
SQIID	InSb (3-512×512 illuminated)	JHKs	0.68	5.8'
FLAMINGOS[1]	HgCdTe (2048×2048)	JHK	0.61	20.0'
WIYN 0.9m				
CCD Mosaic-1	8K×8K	3500–9700 Å	0.43	59'

[1] FLAMINGOS Spectral Resolution given assuming 2-pixel slit. Not all slits cover full field; check instrument manual. FLAMINGOS was built by the late Richard Elston and his collaborators at the University of Florida. Dr. Steve Eikenberry is currently the PI of the instrument.

[2] IRMOS, built by Dr. John MacKenty and collaborators. Availability will depend on proposal demand and block scheduling constraints.

[3] The Bench Spectrograph has recently been upgraded. A new CCD (STA 1), a new collimator, and two new Volume Phase Holographic (VPH) gratings, (740 l/mm and 3300 l/mm), are now available for use. Dispersion and wavelength range remain essentially the same in the upgraded system. However, observers should view *www.wiyn.org/instrument/bench_upgrade.html* for details on changes in throughput and instrumental resolution, as well as new options such as binning and gain choices, to help plan observations.

[4] Integral Field Unit, 80"×80" field, 5" fibers, graduated spacing.

[5] OPTIC Camera from University of Hawai'i is anticipated to be available at WIYN in 2010A through an agreement with Dr. John Tonry of the University of Hawai'i. At the present time, the exact time period of its availability is not defined. This instrument may be assigned to those that request to use Mini-Mosaic if this substitution still meets proposed imaging needs and making such an assignment would further observatory support constraints. Fast guiding mode of operation of OPTIC is now a supported mode for NOAO users of the instrument.

[6] WHIRC, built by Dr. Margaret Meixner (STScI) and collaborators, will be available for use during 2010A. Observers contemplating use with WTTM correction should consult with Dick Joyce or Lori Allen for details.

[7] While T2KB is the default CCD for CFIM, use of F3KB may be justified for some applications and may be specifically requested; scale 0.19"/pix, 9.7'×3.2' field. If T2KB is unavailable, CFIM may be offered with T2KA (scale 0.305"/pix, 10.4' field) or with F3KB to best match proposal requirements. *www.noao.edu/kpno/ccdchar/ccdchar.html*

MMT Instruments Available for 2010A

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
BCHAN (spec, blue-channel)	Loral 3072×1024	R~800–11,000	0.32–0.8μm	0.3	150" slit
RCHAN (spec, red-channel)	Loral 1200×800	R~300–4000	0.5–1.0μm	0.3	150" slit
Hectospec (300-fiber MOS, PI)	2 2048×4608	R~1000–2000	0.38–1.1μm		60'
Hectochelle (240-fiber MOS, PI)	2 2048×4608	R~34,000	0.38–1.1μm		60'
ARIES (near-IR imager, PI)	1024×1024 HgCdTe		1.1–2.5μm	0.04, 0.02	20", 40"
CLIO (thermal-IR AI camera, PI)	320×256 InSb		H,K,L,M	0.05	16×13"
MIRAC3-BLINC (mid-IR img+nuller, PI)	128×128 Si:As BIB		2–25μm	0.09	11.5"
PISCES (wide n-IR imager, PI)	1024×1024 HgCdTe		1–2.5μm	0.18	3.1'
SWIRC (wide n-IR imager, PI)	2048×2048 HAWAII-2		1.0–1.6μm	0.15	5'
SPOL (img/spec polarimeter, PI)	Loral 1200×800	R~300–2000	0.38–0.9μm	0.2	20"

Magellan Instruments Available for 2010A

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
Magellan I (Baade)					
PANIC (IR imager)	1024×1024 Hawaii		1–2.5μm	0.125	2'
IMACS (img/lslit/mslit)	8192×8192	R~2100–28,000	0.34–1.1μm	0.11, 0.2	15.5', 27.2'
MagIC (optical imager)	2048×2048		BVRI, u'g'r'i'z'	0.07	2.36'
Magellan II (Clay)					
LDSS3 (mslit spec/img)	4096×4096	R~200–1700	0.4–0.8μm	0.19	8.25' circ.
MIKE (echelle)	2K×4K	R~22,000	0.32–1.0μm	0.12–0.13	5" slit
MIKE Fibers (echelle)	2K×4K	R~16,000	0.32–1.0μm	0.12–0.13	20–23', 256 fibers
MagE (echellette)	1024×2048 E2V	R~4100	0.31–1.0μm	0.3	10" slit

Hale Instruments Available for 2010A

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
Double Spectrograph/Polarimeter	1024×1024 red, 2048×4096 blue	R~1000–10,000	0.3–1.0μm	0.4–0.6	128" long, 8×15" multi
TripleSpec	1024×2048	R~2500–2700	1.0–2.4μm	0.37	30" slit

CHARA Instruments Available for 2010

	Beam Combiner	Resolution	Spectral Range	Beams
The CHARA Array consists of six 1-m aperture telescopes with baselines from 30 to 330 meters	Classic	Broadband	H or K	2
	MIRC	40	H or K	4
	Vega	1700	45 nm in V or R	2

Blanco Shutdown 2009

Timothy Abbott

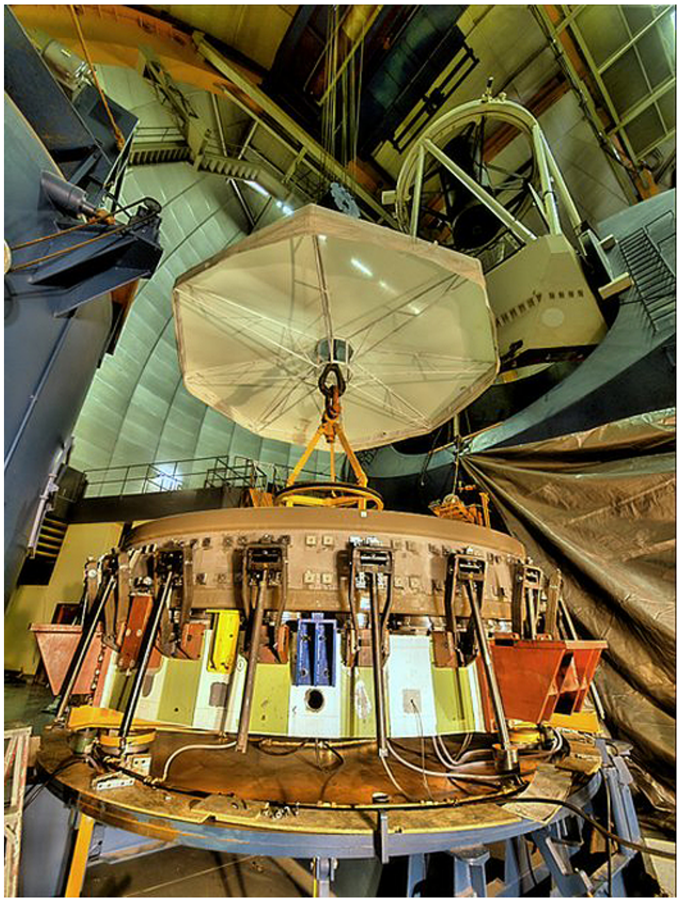
In April and May, the Blanco 4-meter telescope was closed down for one of its longest and most ambitious shutdowns to date. The primary goal was to fix a long standing issue in which the radial supports would fail, at the rate of about one a year, resulting in small, but uncontrolled and unpredictable movements of the primary mirror in its cell. In addition, this shutdown was part of an ongoing effort to prepare the Blanco for the arrival of the Dark Energy Camera (DECam), optimizing it for survey use and to obtain the highest quality images.

All 24 radial support mounting brackets were replaced with those of a new, stronger design and were re-sited over fresh, undamaged glass. Very close attention was paid to mechanical alignment and tuning. All 96 bearings were replaced. We also produced and installed a set of radial definition units incorporating load cells to constrain any residual movements of the primary on its cell.

It is no exaggeration to suggest that this system has the complexity of a Swiss watch and more, and this shutdown was the culmination of many months of study and preparation. It seems to have paid off because the amplitudes of movements of the primary mirror have been reduced from around 2 millimeters to less than 0.25 millimeters. Importantly, these remaining movements appear to be at least partially predictable, allowing for compensation via the active alignment controls of DECam.

Initial optical tests showed the presence of previously unseen quadrafoil distortion, which we traced to the new radial definition units. This was disappointing and forced us to back them off so that they act as soft stops against any future primary mirror movements, but this was not before they had performed a valuable task of demonstrating that the counterweight system is very precisely balanced with residual errors of around 30 kilograms out of 15,000 kilograms.

It was planned to re-aluminize the primary mirror during this shutdown, but problems with the chamber made the acquisition of a coating of suitable quality unreliable, and it was decided to defer this step until next year. We do not consider this to be a critical problem as our program of wet-washing and CO_2 cleaning of the primary mirror appears to have produced a near-constant reflectivity after the first year's inevitable decline following a fresh re-aluminization.



The Blanco 4-meter telescope, dismantled for the shutdown.
(Photo credit: Timothy Abbott)

Overall, we believe this shutdown has been very successful and a significant step towards our goal of achieving the telescope's full potential as an observing instrument, and we are grateful for our observers' forbearance as we pursue it.

SAM: The Push to First Light

Brooke Gregory & The SAM Team

Since the early days, prior to the first conceptual design of the SOAR Adaptive Module (SAM), the project schedule has suffered a number of extensions to the expected pace of development. Since September 2007, however, we have been on track for a first light mid 2009; since December 2008, it has been on the calendar of SOAR. That deadline is now upon us.

The initial integration of the SOAR system in the laboratory (with satisfactory tests of closed loop performance and flexure) was declared to be complete in December 2008. At that point, the instrument was completely dismantled and sent back to the shop for anodizing and painting, as well as to make a number of modifications developed on the basis of experience with the instrument during integration and testing.

SAM re-emerged in April and final integration began. The last few weeks have been devoted to generating punch lists, which have grown faster than they shrank.

- In recent months a noise developed in the deformable mirror which necessitated urgent consultation with the mirror manufacturer, CILAS, as to the cause. This behavior has been observed as well at the Very Large Telescope and requires a modest tightening of the internal mounting screws.
- The week of July 20, the optical high-resolution camera (which will be used for instrument verification on the telescope) was incorporated in its final configuration for the first time, and optical tests indicated that a 60 percent Strehl was achieved. This involved another first: the non-common path errors were measured and quickly compensated for with small offsets in the wavefront sensor software.
- July 29, the environmental shutter (to protect the optics from dust and nesting birds) operated successfully for the first time.

In the end, the tendency of the list to shrink gained the upper hand, and we moved ahead with the final preparations for first light. SAM was moved out of the lab (it fit through the door after all), was placed in a big wooden shipping container, left its birthplace, and made its way up the mountain to its new home. It was lifted up to the Optical Nasmyth platform, fitted to the Instrument Support Box (especially modified in June to accommodate SAM), and cabled into the SOAR telescope.

Note added in press: SAM sees first light on 6 August 2009. Read *Currents* for updates on SAM.

Spartan Infrared Camera Commissioning Update

Jayadev Rajagopal, Steve Heathcote, Sean Points (CTIO/SOAR) & Ed Loh (Michigan State University)

We last reported on the commissioning of the Spartan Infrared Camera on SOAR in the March 2009 issue of the *NOAO/NSO Newsletter*. Spartan's focal plane has four "Hawaii-II" 2048 × 2048 pixel HgCdTe detectors, with two plate scales offering angular resolution up to 43 milliarcseconds per pixel and a field of view up to 5 × 5 arcminutes. Commissioning has been progressing on schedule. In May, we replaced one of the engineering-grade detectors with a science-grade detector and added a set of narrowband filters. We tested Spartan in this configuration through June. During July 20–24, we opened up the instrument once more to add in the last of the four detectors and complete the complement of filters for the near future. We now have, in addition to broadband Y, J, H, and K, line and continuum filters covering Br-gamma, Fe II, H_2, CO, He I and C IV. The instrument is now ready for further characterization, this time in its complete configuration. Although things are bound to get a little hectic with the arrival of the SOAR Adaptive Module, in August and the scheduled aluminizing run for the primary mirror, we are optimistic about having Spartan available for the community, at least on a shared-risk basis, by the 2010A semester.

Farewell & Welcome—Staff Changes at CTIO

Chris Smith, Brooke Gregory & Nicole van der Bliek

On 1 October 2009, Andrea Kunder and John Subasavage will start at CTIO as postdoctoral fellows. John will be the first CTIO/SMARTS Postdoctoral Fellow, specifically supporting the small telescopes on Cerro Tololo on behalf of both CTIO and the Small and Moderate Aperture Research Telescope System (SMARTS) consortium. Andrea will be a CTIO Postdoctoral Fellow, and she will participate in more general CTIO support.

John Subasavage obtained his PhD from Georgia State University in 2007, where he was involved with the Cerro Tololo Inter-American Observatory Parallax Investigation (CTIOPI) project since his arrival in 2000. John's research is focused on nearby stars and, in particular, white dwarfs, for which he makes ample use of the SMARTS telescopes. For example, medium resolution spectroscopy obtained at the 1.5-meter telescope was used to identify previously unknown, nearby white dwarfs. Subsequently, accurate V-, R-,

continued

Farewell & Welcome continued

and I-band photometry of these newly identified white dwarfs, obtained at the 0.9-meter, was used in combination with the 2-Micron All-Sky Survey J-, H-, and K-band photometry and model atmospheres to determine "photometric" distances of these newly identified white dwarfs. In 2007, John became the 0.9-meter coordinator for the SMARTS consortium, and at CTIO, he will spend 50 percent of his time supporting the SMARTS telescopes and being the CTIO liaison to the SMARTS consortium.

Andrea Kunder recently obtained her PhD from the Dartmouth College Physics & Astronomy Department. Her thesis is an investigation of the formation of the Milky Way and the structure of the Galactic Bulge using RR Lyrae stars, which are Population II standard candles. Andrea spent two summers at the Lawrence Livermore National Lab working with massive compact halo object (MACHO) data, in which she compiled a catalog of 3700 RR Lyrae stars. During her astronomy career, she has especially enjoyed working with astrophysicists at institutes in Germany, Hungary, and, most recently, India.

We are looking forward to their contributions, both in support of activities on the mountains and in enriching the scientific and general staff environment in La Serena!

On July 8, Edgardo Cosgrove quietly retired from the staff of CTIO & SMARTS Telescope Operations after 35 years of service to the observatory. He helped generations of astronomers use photographic plates, photoelectric photometers and teletypes, filters, prisms and gratings, image intensifiers, videoconferences, CCDs, and exotic infrared detectors. When SMARTS was created he was key, with Arturo Gomez, in making it a success. Edgardo was trained as a teacher of chemistry, and as such he was an enthusiastic educator of new observers at Tololo and of new colleagues in TELOPS. He set an example, which will be missed, in providing helpful documentation of instruments, telescopes, and procedures. His colleagues on the summits and in the offices of the observatory wish him the best in his retirement years.

Students Wanted for 2010 CTIO REU Program

The Cerro Tololo Inter-American Observatory (CTIO) offers six undergraduate research assistantships in La Serena, Chile, during the northern winter semester through the NSF-funded Research Experiences for Undergraduates (REU) program. The CTIO REU program provides an exceptional opportunity for undergraduates considering a career in science to engage in substantive research activities with scientists working at the forefront of contemporary astrophysics.

Student participants will work in close collaboration with members of the CTIO scientific and technical staff on specific research projects, such as galaxy clusters, gravitational lensing, supernovae, planetary nebulae, stellar populations, star formation, variable stars, and interstellar medium. The CTIO REU program emphasizes observational techniques and provides opportunities for direct observational experience using the state-of-the-art CTIO telescopes and instrumentation.

Participants must be enrolled as full-time undergraduate students during the REU program and must be citizens or permanent residents of the United States.

The program will run for 10 weeks, from approximately 11 January to 22 March 2010. A one-week observing run on Cerro Tololo, a three-day field trip within Chile, and attendance at the 2011 American Astronomical Society conference in Seattle, WA, are included in the program. In addition, a modest stipend and subsidized housing are provided.

Complete applications, including applicant information, official transcripts, and two or three letters of recommendation should be submitted no later than 9 October 2009.

For more information (and an application), please check *www.ctio.noao.edu/REU/reu.html*. Women and candidates from underrepresented minorities particularly are encouraged to apply.

San Juan Fire Successfully Suppressed
A Thank You to Those Who Protected Our Facilities

Buell T. Jannuzi

Two years after the "Alambre" fire was contained (13 July 2007), we again had to restrict access to Kitt Peak while firefighters protected the observatories and facilities on the mountain. The "San Juan" fire began on Tuesday afternoon, July 14, and was reported by staff returning to Tucson at the end of their workday. Thanks to lessons learned from the "Alambre" fire, our excellent staff knew what to do.

Recently, the observing assistants (OAs) had attended a periodically-scheduled refresher course led by Hal Halbedel. OAs Halbedel and Karen Butler coordinated with Mike Merrill and secured domes from the smoke. Steve Lane and Dawn Clemons began to monitor the fire status and kept regular reports flowing to both John Dunlop and Chuck Gessner. Staff compiled a list of individuals on the mountain as preparation for an evacuation, if necessary. Throughout the firefighting efforts, Gessner served as our liaison with our official contacts in the Tohono O'odham Department of Public Safety, Guy Acuna and Chuck Kmet, to determine the threat to the facilities on Kitt Peak. Early in the morning of Wednesday, July 15, the fire began spreading toward the access highway, State Road 386, and we made the determination that non-essential staff should leave the mountain.

Firefighters use a pullout along the road up to the Mayall 4-meter telescope to get an overview of the situation further down the mountain. (Photo credit: Dawn Clemons)

Smoke and fire along State Road 386, the main road up to the observatory. (Photo credit: Dawn Clemons)

Over the next few critical days, Clemons, Shelby Gott, Halbedel, Jim Hutchinson, Kristin Reetz, George Will, Fred Wortman, and Alfredo Zazueta provided continuous updates on the fire's progress, looked after instruments, moved heavy equipment as needed, and provided on-site assistance to the fire response team. Meanwhile, Dunlop, Gessner, Merrill, Liz Alvarez, Nanette Bird, Mark Newhouse, Rich

continued

San Juan Fire Successfully Suppressed continued

Fedele, and others helped to maintain communications and update tenants, observers, and staff on the situation. Pete Delgado, Tohono O'odham Executive Office, and I handled communications with the media on behalf of the Tohono O'odham Nation and the observatories, respectively.

The fire would take the rest of the week to contain. A Sunday afternoon rainfall dumped much needed water on top of the mountain and on the fire below. By Monday, July 20, the fire was no longer a threat to the mountaintop or to the access road. The Kitt Peak staff, including the Visitor Center staff, did a great job getting operations back to normal, and the summer shutdown work started on schedule. We brought observers back to the mountain to prepare for their scheduled programs that night. On Tuesday, July 21, we were able to reopen the mountain to the general public.

This fire posed a major threat to the observatories, getting to within one mile of MDM Observatory. Fortunately, the access highway from mile markers 4 through 8 was successfully used as a firebreak, which assisted in halting the approach of the fire. We are very grateful to the efforts of the 109 members of both the Tohono O'odham Nation's Fire Response Team and Darrel Miller's Type 3 response crew in containing the fire. We appreciate the efforts and support of all who helped deal with this challenge. We also appreciate the patience of the tenant observatories whose operations were disrupted by the fire. My sincere thanks to all who helped! NL

Two Science Symposia in March 2010 to Help Celebrate 50th Anniversary of Our National Observatory

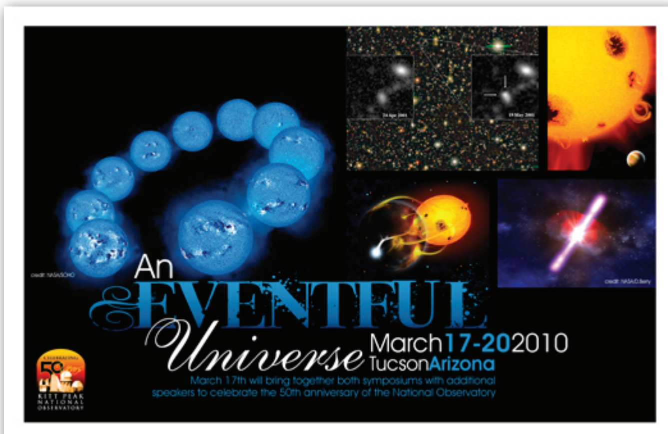
Tod Lauer & Lori Allen

As part of our celebrations of the 50th anniversary of our National Observatory, two science symposia will be held in Tucson in March 2010. "From First Light to Newborn Stars" will be held March 14–17 and followed by "The Eventful Universe" March 17–20. The common day of March 17 brings together both symposia in the context of the role played by our National Observatory in furthering scientific progress both in the past and future.

"The Eventful Universe" explores the time-axis in observational phenomena. Topics will include the extra-galactic: detection of gamma-ray bursts, supernovae in distant galaxies, and variable AGN; the galactic: variable stars, novae, and cataclysmic events; and the solar system: the detection of near-earth asteroids and Kuiper Belt Objects. A common theme will be understanding the best observational strategies for detecting, characterizing, and following up on all transient events. The meeting format will include several break-out sessions, to promote discussion and exploration of individual classes of objects or detection methodologies.

"From First Light to Newborn Stars" will focus on the physics of star formation in galaxies, including the Milky Way, nearby galaxies, and galaxies at high redshift. The meeting format will include both plenary session talks on major topics of interest to both galactic and extragalactic researchers, as well as plenty of time for in-depth discussion of both theory and observation within smaller groups. Major themes include star formation on galactic scales, star formation in extreme environments, and star formation in low-metallicity conditions. Some time will be devoted to discussion of future capabilities and their requirements for advancing our understanding of star formation.

Additional information can be found at www.noao.edu/kp50.



NEWFIRM: Looking Back, Looking Forward

Ron Probst

As I write, NEWFIRM is off the Mayall 4-meter telescope for a filter change and minor maintenance after another busy and productive semester on sky. By the end of December 2009, it will have been in use for competitively-selected science for four full semesters. During that time, by my count, it will have been scheduled for 316 nights of science observing in 39 different programs with 31 different principal investigators (PIs), and a much larger number of observer users including graduate and undergraduate students. This includes science time allocated to our partner, the University of Maryland, for their contribution to building the instrument.

Scheduled scientific use in 2009B is lower than in previous semesters, 56 nights versus an average of 86. This reflects completion of two major survey programs undertaken by A. Gonzalez (University Florida) and by P. van Dokkum (Yale), first announced in the March 2008 *NOAO/NSO Newsletter*. However, a new survey program to be led by D. Kelson (Observatories of the Carnegie Institution of Washington) will start this semester (2009B; see March 2009 *Newsletter*), and the number of first-time PI users (eight) is as high as the previous average.

Some of the science being done with NEWFIRM has been presented in previous *Newsletters*. See the June 2008 *Newsletter* for a Science Highlights article on the van Dokkum et al. medium-band redshift survey, and the December 2008 *Newsletter* for coverage of R. Gutermuth's imaging survey of nearby molecular clouds. Rapid progress from raw data to scientific results has been aided by the delivery of the quick-reduce and scientific automated reduction pipelines, as reported in the June 2008 and December 2008 *Newsletter* and the June 2009 *Newsletter*. These were included as key components right from the start of the NEWFIRM program. Most recent is an article in the Science Highlights section of this issue of the S. Veilleux et al. discovery of warm molecular hydrogen in the wind of M82.

In early 2010, NEWFIRM will be moved to the Blanco 4-meter telescope. We expect it to be on the sky by mid 2010A for four semesters of observing the southern skies. This includes survey programs, of which the Kelson program is one. This move takes advantage of a window of opportunity in advance of delivery and commissioning of the Dark Energy Camera. The scientific programs of NOAO users often require access to the entire sky, multi-wavelength data sets, with components obtained from ground- and space-based observatories. We expect that our users will obtain a very high scientific return from balanced access to the entire sky with NEWFIRM's powerful and still new capabilities.

Site Protection

Elizabeth Alvarez & Connie Walker

As part of ongoing efforts to maintain the quality of dark skies near all our observatories, staff members Elizabeth Alvarez and Connie Walker participated in the conference on light-emitting diodes (LEDs) and solid state lighting held 27 May–4 June 2009 by the International Commission on Illumination (CIE, www.cie.co.at). An independent, non-profit, professional organization, CIE is devoted to worldwide cooperation and the exchange of information on all matters relating to the science and art of light and lighting, color and vision, and image technology. With strong technical and scientific foundations, CIE is accepted as representing the best authority on the subject and as such is recognized by the International Organization for Standardization (ISO) as an international standardization body. Our goal for the meeting was to discuss two main issues with CIE lighting professionals and present information from the perspective of our observatories.

Minimizing energy use goes hand in hand with dark skies protection. Smart lighting minimizes wasted light and energy by using only as much light as is needed, where it is needed, and when it is needed. Until recently, these first-order corrections minimized skyglow. Now, in a quest to further minimize energy use, lighting professionals are modifying these first-order corrections. One instance is to use luminaires that emit light just above the horizontal. With further horizontal throw of the light from a luminaire, fewer luminaires may be needed. While this can minimize skyglow directly over the installation, lighting designers had not considered how light propagates through the atmosphere from cities to further distances, such as where our observatories, rural communities, or natural wilderness areas are located. As light propagates through more of the atmosphere, the probability of scattering increases, and the resultant skyglow increases by surprisingly large amounts (C. Walker, C. Luginbuhl, R. Wainscoat, Proceedings of the 2009 CIE Symposium on LEDs and Solid State Lighting, submitted). We will continue to advocate the use of fully shielded fixtures to minimize skyglow beyond the installation itself when considering quality design and environmental impact.

LEDs are being used increasingly for outdoor lighting; they are becoming common in billboards where light is emitted near (or above) the horizontal and can contribute greatly to skyglow. Hoping to conserve energy, communities are replacing street and area lighting with white LEDs, which are usually blue LEDs with a phosphor to emit green and red light and a strong blue peak around 450–460 nanometers. They emit a lot of light in bluer wavelengths (450 nanometers) than previously common lamps such as high-pressure sodium lamps, which have a spectral range centered around 589 nanometers with the bulk of the emission coming at green and red wavelengths and almost no blue light being emitted. With this shift toward the blue end of the

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Site Protection continued

spectrum, astronomy is hit twice. Not only is the night sky naturally darker below 555 nanometers when the moon is down, but the bluer wavelengths are scattered more due to the strong wavelength dependence (λ^{-4}) of Rayleigh scattering. In addition to astronomy observations, many species of animals appear to be affected more by blue and white light compared to redder light sources. We raised these issues with the CIE lighting community (R. Wainscoat, E. Alvarez del Castillo, Proceedings of the 2009 CIE Symposium on LEDs and Solid State Lighting, submitted) to encourage product solutions that will minimize interference with astronomical observations and photobiological processes.

Due to the urgency of current economic challenges as well as the energy and environmental awareness of our communities, both of these issues are hot topics in lighting. Astronomers must contribute our expertise as well if we expect the lighting community to find solutions that will not damage our window to the universe. Work continues, led by the International Astronomical Union's Commission 50 (*iau.org/science/scientific_bodies/commissions/50/*) on the protection of existing and potential observatory sites. Please contact us (*ealvarez@noao.edu, cwalker@noao.edu*) if you are willing to contribute your time and expertise. NL

Tohono O'odham Horse Camp on Kitt Peak

Alfredo Zazueta

About 40 kids and adults enjoyed the cooler environment of Kitt Peak's picnic grounds as they attended the summer session (June 26–28) of the Sells Boys & Girls Club horse camp. Led by Director, Elder Silas "Si" Johnson, Sr., the purpose of the horse camp is to help Tohono O'odham kids reconnect with their heritage, broaden their horizons, and reinforce community values of the Tohono O'odham culture.

Alfredo Zazueta (KPNO Mountain Central Facilities) officially welcomed the campers on behalf of the observatory. KPNO supported the horse camp for the third year in a row by preparing the site, covering food costs, and operating portable telescopes for a star party staffed by Katy Garmany (EPO), John Glaspey and Sabrina Pakzad (KPNO), Tim Purdy (GONG), and Davin Flateau (KPNO REU program). While the skies that night allowed only a peek at the moon, campers saw what things look like through telescopes and asked questions about astronomy and the observatory.

(Left) Tim Purdy (GONG) and (right) Davin Flateau (Summer REU student) showed kids various views through a telescope. (Photo credit: K. Garmany)

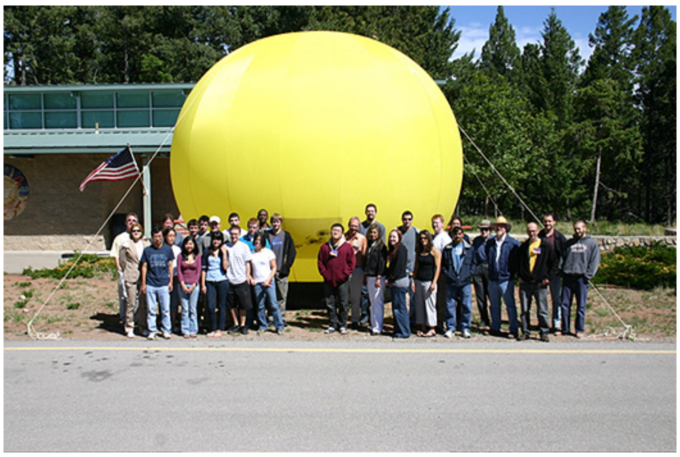
Alfredo Zazueta was also one of the Tohono O'odham adults actively participating in the program to support the kids; he relates the following sentiments. "On behalf of all the children, Si Johnson, and the numerous Tohono O'odham members who attended the 2009 Horse Camp, we would like to say thank you. It is always a success story when Horse Camp comes to an end here at Kitt Peak. The outreach to our nation's youth is very important in keeping the teachings of our culture alive. With the help of the Professors (Horses) as well as our elders, knowledge, personal growth, and constant encouragement were passed on. Katy Garmany and her crew were very helpful in showing a little of what Kitt Peak is about with the time and conditions they were given.…[A] big thank you for their time and support. Everything went fine, and the [mountain] Facilities Crew prepared well for it. Once again, thank you for next year's invitation."

Director's Corner

Steve Keil

The spring quarter was a very eventful and exciting one for NSO and our partners on the Advanced Technology Solar Telescope (ATST) project. The National Science Foundation (NSF) held the Final Design Review (FDR) of the project as one of the last steps before beginning construction. The review panel recommended to NSF that the project is ready to begin construction immediately. Finalization of the Environmental Impact Study (EIS) and final approval to begin spending from the National Science Board (NSB) are the remaining steps. In the meantime, Congress appropriated construction funds that included $146M in American Recovery and Reinvestment Act (ARRA) funds, and $7M in FY 2009 funds. So once we have the approved EIS and NSB decision, we can begin construction immediately.

The joint University of Arizona/NSO Summer School in solar physics was held again this summer at Sacramento Peak. Thirty-five students (see below) attended the course which covered all aspects of solar and heliospheric physics. Topics covered in this course include solar radiative transfer, helioseismology, solar interior, chromospheric and photospheric magnetic fields, solar magnetohydrodynamics (MHD), corona and solar wind, and high-energy charged particles. The two lectures presented by Gene Parker on MHD theory were a highlight of the course.



Students and instructors from the fourth annual 2009 Summer Solar Physics School pose in front of an 18-foot Sun balloon at the Sunspot Astronomy and Visitors Center at NSO/Sunspot. The balloon—complete with a panel showing sunspots seen through the McMath-Pierce and Dunn Solar Telescopes—represents the Sun at a scale of 1:250 million in the Sunspot Solar System Model. The balloon plus planet models and classroom activities form the "Sun on Wheels" component that can take the model to schools and events to attract future solar scientists. (Photo credit: Dave Dooling, NSO/AURA/NSF)

As NSO and its partners gear up to build ATST, we plan to ramp down new instrument development programs for our current flagship facilities: the Dunn Solar Telescope (DST) and the McMath-Pierce Solar Telescope. During ATST construction, operations at these facilities will concentrate on support of science using the array of new instrumentation that has been brought on line over the past few years. In addition, the facilities will be used to prototype and develop instrumentation and operation plans for ATST. NSO has provided strong support for the Hinode (Solar B) mission and is preparing to provide similar support to the Solar Dynamics Observatory (SDO). Below is a brief discussion of current capabilities to provide users with a current list of what is available to support their observations. More detailed information is available at the NSO Web site (*www.nso.edu*) and in our annual report and program plans also available on the Web.

Instruments at DST

All instrumentation at the DST is fed by adaptive optics (AO), and the current suite of instruments has been built to take advantage of diffraction-limited observations.

IBIS

The Interferometric BIdimensional Spectrometer (IBIS) is an imaging spectrometer built by the solar group of the University of Florence in Arcetri, Italy. IBIS delivers high spectral resolution (20 milliAngstroms), high throughput and consequently high cadence. In collaboration with NSO and the High Altitude Observatory (HAO), the Arcetri group upgraded IBIS to a vector polarimeter. The wavelength range of IBIS extends from visible to near-infrared (IR) and allows spectroscopy and polarimetry of photospheric and chromospheric layers of the atmosphere.

DLSP

The Diffraction-Limited Spectro-Polarimeter (DLSP) built in collaboration with HAO and operated at the DST is an innovative grating polarimeter specifically designed to meet the high spatial and temporal requirements pursued in solar spectro-polarimetry. With the excellent imaging properties of the instrument and the efficient performance of the high-order AO system, we achieve a spatial resolution of 0.4 arcseconds on a regular basis. The DLSP only observes the 630.15- and 630.25-nanometer Fe I lines.

SPINOR

The Spectro-Polarimeter for Infrared and Optical Regions (SPINOR) is also a joint NSO/HAO program that upgraded the previous Advanced Stokes Polarimeter (ASP) at the DST. SPINOR extends the long wavelength range of the ASP from 750 nanometers to 1600

continued

Director's Corner continued

nanometers with new cameras and polarization optics, provides improved signal-to-noise and field-of-view, and replaces obsolete control equipment. SPINOR is the primary DST research spectropolarimeter, providing access to spectrum lines across the visible and near-IR spectrum. SPINOR provides the capability of combining up to three diverse spectral ranges into a single observation.

FIRS

The Facility IR Spectropolarimeter (FIRS) is a collaborative project between NSO and the University of Hawai'i Institute for Astronomy (IfA) and provides a facility-class instrument for IR spectropolarimetry at the DST. FIRS takes advantage of the diffraction-limited resolution provided by the AO system for a large fraction of the observing time at IR wavelengths. A diffraction-limited, achromatic-reflecting Littrow spectrograph allows for diverse wavelength coverage. A unique feature of FIRS is the multiple-slit design, which allows high-cadence, large field-of-view scans (four times faster than SPINOR and DLSP)—a vital feature for studying dynamic solar phenomena such as flares. The high-order Echelle grating allows for simultaneous multi-wavelength observations and thus 3D vector polarimetry.

ROSA

Finally, the Rapid Oscillation in the Solar Atmosphere (ROSA) instrument is a joint program between NSO and Queen's University Belfast. ROSA is a synchronized, multi-camera, high-cadence, ground-based solar imaging system. The system includes six high-speed cameras. ROSA's high speed imaging (30 frames per second) is ideal for studying photospheric and chromospheric waves, flares, and rapid changes in the solar magnetic field. The ROSA commissioning run at the DST was successfully completed in August 2008.

With this set of instruments, the DST will provide users the tools to attack problems of atmospheric dynamics and magnetism in the photosphere and chromosphere as well as provide collaborative support to SDO.

McMath-Pierce Instruments

Instrumentation at the McMath-Pierce can now be fed by an adaptive optics system that is optimized for the IR.

NAC

The NSO Array Camera (NAC) is a closed-cycle cooled, InSb 1024 × 1024-pixel camera that routinely obtains images and spectroscopy from 1000 to 5000 nanometers, and polarization data in the window of 1000 to 2200 nanometers. The NAC has replaced the aging NSO Near-Infrared Magnetograph (NIM) instrument. In 2008, the NAC instrument obtained science data at several wavelengths from 1200 nanometers through 4666 nanometers, including short-exposure, high-resolution granulation images from 1000 to 2200 nanometers. The NAC is now available to the solar community as a facility instrument at the McMath-Pierce. The NAC can be used in conjunction with the full Stokes polarimeter as well as direct imaging.

IFU

The Integrated Field Unit (IFU) is an instrument developed for AO-corrected IR observations with the McMath-Pierce vertical spectrograph. D. Ren (California State University Northridge) and C. Keller (Utrecht University) are co-investigators on this project that divides a 2D field of 6.25 × 8 arcseconds into 25 slices to produce a 200-arcsecond-long slit with a width of 0.25 arcseconds for diffraction-limited spectroscopy and polarimetry in the IR. The IFU is designed to be used over the 0.8- to 5.0-micron range and is optimized for 1.56-micron observations of the strongly Zeeman-split ($g = 3$) Fe I line. The IFU was tested on the main spectrograph at the McMath-Pierce telescope during 2008 and will become a user instrument there in 2009.

With this array of new instrumentation and its strong synoptic programs provided by SOLIS and GONG, NSO provides first-class optical facilities for investigating all aspects of the Sun and for collaboration with space observations. As a reminder, the NSO Telescope Allocations Committees meet quarterly with deadlines announced in the AAS and Solar newsletters as well as on the Web at *www.nso.edu/general/observe/submit.html*.

Comings and Goings

Departures

After almost two years at Sac Peak as a National Research Council Fellow, Tim Howard, Nicole, and their dog Kimo left Sunspot in mid-June to move to Boulder, CO, where Tim has joined the Southwest Research Institute. Tim has promised that we have not seen the last of him at Sunspot and that he plans to continue the coronal mass ejection (CME) research he has been doing with James Tappin. He will continue to visit Sac Peak occasionally for that purpose. We wish him well in this new phase of his career.

We're sorry to report that Joann Henry has left NSO's employment at the Sunspot Astronomy and Visitor Center. Joann has worked as a hostess/cashier at the Visitor Center, as well as assisting in housekeeping and the kitchen. She will be missed by all the staff. Fortunately, she is not leaving Sunspot, so we'll continue to see her around.

New Faces

NSO welcomes William McBride to the staff in Sunspot. He will take over the Electronics Technician/Engineer position vacated by Tony Spence at the Dunn Solar Tower. His responsibilities will include maintaining all of the electronic components at the telescope and assisting in any upgrades and on-going projects. Bill will live at Sunspot.

We also are pleased to have Walter Allen, Jr. join our staff in Tucson as a postdoctoral research fellow. NSO is not new to Walter as he spent the summer of 2005 as an Air Force Space Scholar in residence at NSO/Sac Peak. He received his PhD in physics from Howard University this past spring and is now working with the GONG program on a Helioseismic and Magnetic Imager related project.

ATST Passes Final Design Review

The ATST Team

The Advanced Technology Solar Telescope (ATST) project passed its Final Design Review (FDR) in May, and the Environmental Impact Statement (EIS) process moved towards closure. The FDR, held May 18–21 in Tucson, was conducted by the National Science Foundation (NSF) to provide a final look at all management and technical aspects of the ATST design, with particular emphasis on identifying risks that might impact cost and schedule, and ensuring that adequate margins are provided for those risks.

The FDR committee examined ATST from a number of perspectives, such as how AURA plans to contract for the various packages and how funding from the American Recovery and Rehabilitation Act will be handled. The committee also reviewed the status of technical issues raised at the November 2008 Systems Design Reviews.

Putting ATST in the context of the fourth decadal survey to plot roadmaps for ground-based astronomy in the coming years, NSO Director Steve Keil noted that ATST has been endorsed in past surveys: "We've been working on this (ATST) a long time, so I think we're ready to start building it." Keil noted that management and operations are important issues that NSO is still defining. If approved, as ATST construction gets under way, NSO is to proceed with a plan to consolidate staff, with operations near the ATST site (on Maui, if approved) and at another location to be determined. The data policy "probably is the most discussed item."

While the committee found the designs of the ATST itself to be highly mature and advanced, the science instruments are less so, but to a purpose. Members of the science team said that it would be premature to lock them down this early in the program. Science instruments take three to five years to develop. With ATST first light expected in 2017, instrument designers have another two years to take advantage of advances in detectors and other technologies before committing to something specific. "We want to avoid having outdated instruments," said Michael Knölker, director of the High Altitude Observatory. These will be reviewed at the Science Working Group meeting September 9–11 in Boulder at the High Altitude Observatory.

In the end, the committee announced that it was endorsing the project: "The panel is recommending to the National Science Foundation (NSF) that this project be funded," said Chairman Paul LaMarche. "Period. The rest is details." The final recommendation is expected to be sent to the National Science Board in July for consideration at its August meeting. Meanwhile, the ATST team is working on specific "details" that were raised during the review.

Upcoming work includes Systems Design Reviews for the Global Interlock System (GIS) in September and for the Observatory Control System (OCS), Data Handling System (DHS), and Instrument Control System (ICS) November 3–4.

On a separate track, the Supplemental Draft (SD) Environmental Impact Statement (EIS) was published in the Federal Register on May 8 and is open for a 45-day comment period. EIS public meetings were held on Maui on June 3–4, followed by Section 106 (cultural impact) consultations on June 8–10. The Final EIS is planned to be published at the end of July, and, after a 30-day "cooling off period", a Record of Decision by NSF is anticipated.

"Despite the soft-sounding words 'Supplemental' and 'Draft,' this is the most consequential document to be generated by this process to date," said facilities engineer Jeff Barr. "Supplemental, in this case, means it's the whole thing again, tuned up, augmented, and now including the road impacts. Draft is really in-name-only, as the Final EIS, by the very nature of the process, can only incorporate minimal revisions. This is a big milestone that set the timetable in motion."

Before the SDEIS was published, the Region IX (San Francisco) office of the US Environmental Protection Agency (EPA) dropped its objections to the ATST project. Previously it rated the Draft Environmental Impact Statement (DEIS) as "Environmental Concerns—Lack of Information." In a June 18 letter to the NSF, EPA upgraded the rating. The SDEIS "contains substantially more information on impacts to Haleakalā National Park and other resources and is much improved.…The SDEIS adequately addresses our previous concerns and requests for additional information, and we are rating the preferred alternative of the SDEIS as Lack of Objections."

SOLIS/VSM

Kim Streander & The SOLIS Team

The recent (April 2009) release of inverted vector magnetic field data from the Synoptic Optical Long-term Investigations of the Sun/Vector Spectromagnetograph (SOLIS/VSM) has initiated constructive critiquing among the solar community. In particular, concerns were expressed regarding: 1) apparent "rings" around active regions when displaying the line-of-sight field inclination, 2) a need to adjust the gray scale when displaying the Milne-Eddington full-disk images on the Web, and 3) a desire to see a comparison between data taken with the VSM and Hinode, the "gold standard."

The "rings" around active regions (shown in figure 1) were a by-product of applying an IDL interpolation scheme used in SOLIS data for, among other operations, slit correction and P-angle rotation. The SOLIS Milne-Eddington (ME) procedure inverts only those pixels where the polarization is above a computed threshold, and non-inverted pixels are set to zero. This threshholding caused the existing cubic convolution interpolator to produce incorrectly skewed values whenever there were zero values in the 16-point interpolation neighborhood, because these zero values were treated as real data. This

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SOLIS/VSM continued

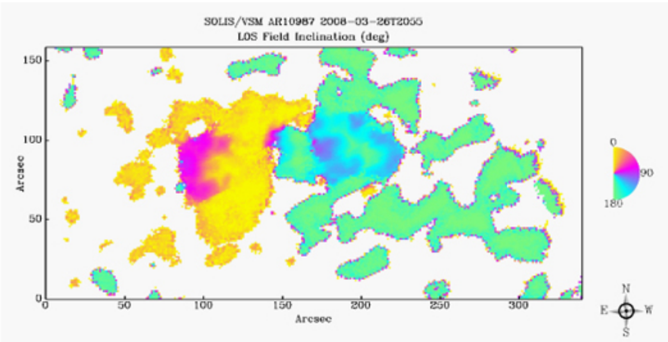


Figure 1 **Original cubic convolution**

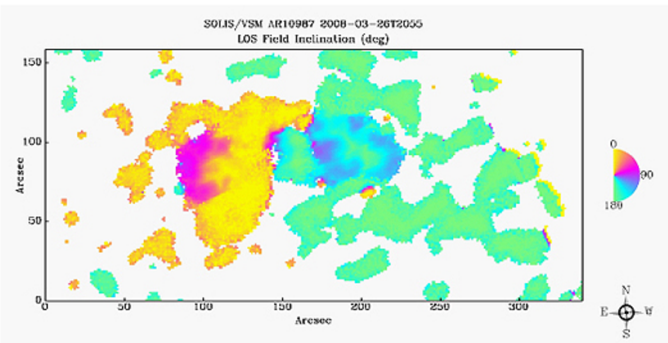


Figure 2 **Hybrid**

resulted in artificial rings around the islands of data after interpolation, which can be seen most clearly in the inclination plots.

The solution, figure 2, was to use a hybrid cubic/bi-linear interpolation algorithm written by John Britanik that used the usual cubic convolution when all 16 points in the interpolation neighborhood are non-zero, and gracefully degraded to a bi-linear interpolation otherwise. The bi-linear interpolation algorithm considers only the surrounding four points in the interpolation neighborhood. It gracefully degrades, such that if one neighbor is zero, a triangular form of bi-linear interpolation is used. If two neighbors are zero, then the simple linear interpolation is used, and if three neighbors are zero, then the non-zero neighbor is used as the "interpolated" value. The interpolated value is set to zero if all four neighbors are zero. The resulting output is free of the artificial rings.

Recent improvements to the Milne-Eddington inversion and plotting routine have greatly improved the appearance of the full-disk ME images on the Web (see figures 3 and 4). The field-strength estimate returned by the ME inversions was improved in areas outside of sunspots by using the quick-look field estimates as an initial guess. Previously, the inversions used a constant value of 1200 gauss, which resulted in field strengths that were too high in regions outside of sunspots. In addition, the displayed ME plots did not have the filling fraction applied, and a non-linear scaler that had been added to emphasize plage resulted in saturation around areas of high magnetic-field strength. The current code has had the scaler removed, filling fraction applied, and the min and max recomputed with a 0.6 multiplier to enhance contrast so the ME images look more like the quick-look images. We

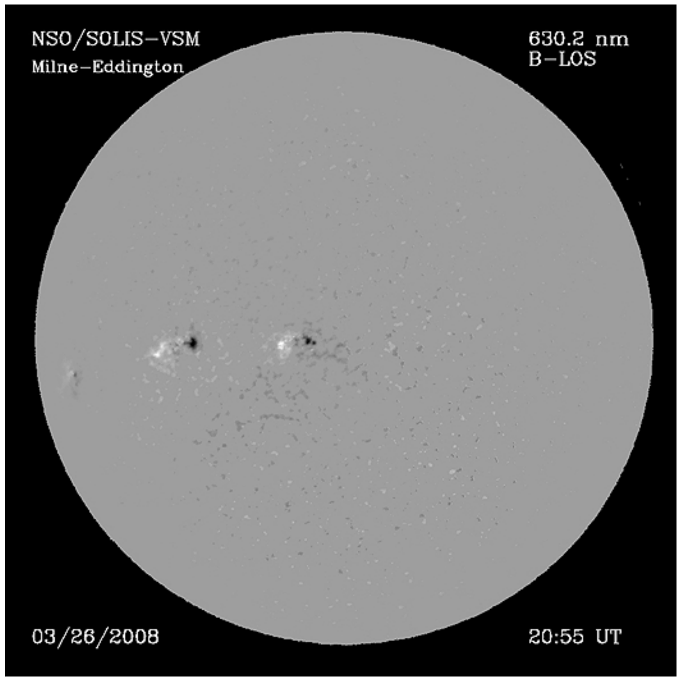


Figure 3

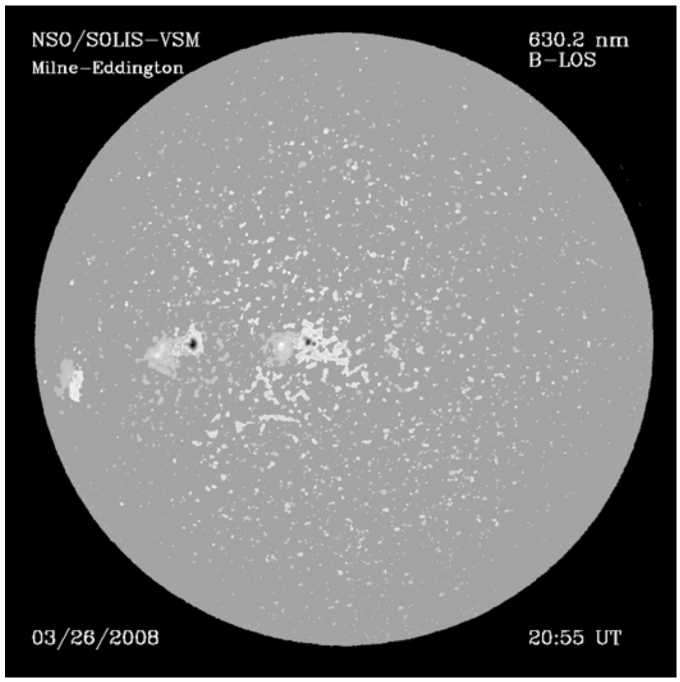


Figure 4

have since received favorable comments from the solar community for the improved appearance of ME data on the Web.

At the suggestion of the National Solar Observatory Users Committee, Jack Harvey found an existing data set that could be used for comparing inversion techniques between the SOLIS VSM and Hinode. Hinode is a Japanese mission developed and launched by ISAS/JAXA,

continued

SOLIS/VSM continued

with NAOJ as domestic partner and NASA and STFC (UK) as international partners. It is operated by these agencies in cooperation with ESA and NSC (Norway). A preliminary comparison between the two data sets (figure 5) shows remarkable similarities when considering the different image resolutions and an approximate 6.5-hour time difference. Additional data sets and analyses will be compared over the next several months.

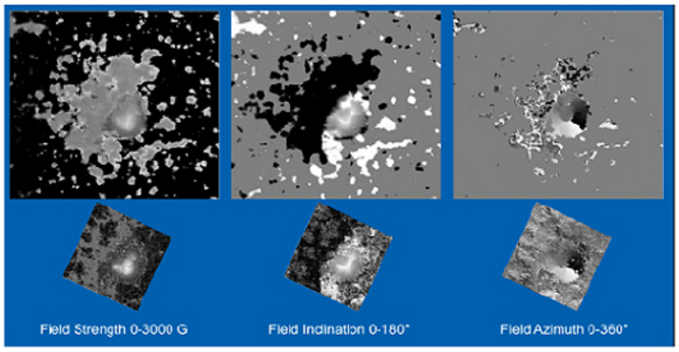


Figure 5: Milne-Eddington inversions of Stokes spectra taken 2 May 2007 with the SOLIS/VSM at 20:32 UT (upper, 1.125" pixels in poor seeing) and with the Hinode SP in fast scan mode at 14:00 UT (lower, 0.32" pixels). Azimuths have been disambiguated for the 180-degree ambiguity.

Fourier Transform Spectrometer
The Kitt Peak Fourier Transform Spectrometer (FTS) has returned to operational status for obtaining high-resolution infrared solar absorption spectroscopy. Mike Dulick has spent the last several years repairing electrical component damage caused from a major power failure. In addition, he has rebuilt the components controller using printed circuit boards rather than wire wrap, repaired the infrared detectors, and made numerous mechanical improvements to the scanning mechanism. In March 2009, the instrument was set up to resume observations for Curtis Rinsland. The FTS on Kitt Peak has provided an important long-term record of atmospheric constituent measurements and an archive of those measurements in the infrared since 1977, which is maintained at NASA/Langley Research Center in Hampton, VA. The spectra obtained with the refurbished FTS are the first recorded in five years and were obtained with the east auxiliary telescope of the McMath-Pierce telescope on 20 days between March and June 2009. Individual spectra cover 750–1300 or 1850–5000 cm^{-1} and were recorded with a maximum optical path difference of 62.489 centimeters.

Measurements recorded over a range of solar zenith angles have been used to retrieve total columns of tropospheric and stratospheric constituents. Fits to the measured spectra have been performed, and they indicate that the spectra obtained since the instrument returned to operational status are nearly free of channeling, and the instrument line-shape function is well reproduced taking into account the measurement parameters. Rinsland is currently in the process of submitting a paper that updates the time-series measurements of total columns for six atmospheric species and their analysis for seasonal cycles and long-term trends.

GONG ++

Frank Hill & The GONG++ Team

It has been a busy summer so far. The Air Force Weather Agency (AFWA) H-alpha (Hα) project is moving along toward its preliminary design review, our magnetic-field measurements are being integrated into a space-weather tool, and we have had some very interesting scientific results, one of which resulted in substantial press coverage. In addition, we have added a new staff member and have hosted two summer students and a teacher.

AFWA Hα Project
All ten cameras have been received and are undergoing tests performed by Matthew Richardson, our summer intern from Vanderbilt University. So far they all look good. Matthew has also tested all of the lenses and beam splitters and produced an inventory list that compiles all of the characteristics of the individual optics, helping to identify the selection of components to be used in the final systems. The mechanical design has been finalized and the prototype back plate for the calibration wheel box is being fabricated in the machine shop. A spare DayStar Hα filter was sent to the manufacturer for refurbishment of its polarizers and electronics, and it is expected to return by the end of July. Two prototype workstation/data acquisition systems have been received and are undergoing testing.

The software development is also proceeding. We have corrected an eight-hour-long observing sequence for image motion and rotation with generally good results. There is, however, a small residual translation error that we are investigating. For a complete analysis, we will need to transfer the image rotation data from the existing instrument system to the Hα computer. This cannot be done until we integrate the prototype into the overall system at the engineering site. Progress has also been made on an image-sharpening kernel.

We now anticipate that the Hα prototype system will be installed at the GONG engineering site, in Tucson, by the first of August and will be taking data on a regular basis soon after. A preliminary design review (PDR) is tentatively scheduled for early September. Once the PDR has been approved by AFWA, we will begin negotiations for the operational support.

Magnetic Field Data
The Air Force Research Laboratory (AFRL) in Albuquerque is developing a data assimilation system to continually update the Wang-Sheeley-Arge solar-wind model, which will be used by the National Oceanic and Atmospheric Administration's Space Weather Prediction

continued

GONG ++ continued

Center to provide forecasts of geomagnetic storms. The system will use the ten-minute GONG magnetograms as the input. In addition, we are working with AFRL to produce data products that they need for this system. In particular, we will soon be routinely returning images of the standard deviation of the magnetograms that will be used to assign a noise level to every pixel in the input data.

Work to improve the magnetic-field measurements continues, particularly in the area of site-to-site variations and measurements of the field near the solar poles. A new method is being developed that will simultaneously fit the data from all six sites to a common model of the solar variation. If this first-order approximation is sufficient, the site-dependant offsets can be determined and used to adjust the network zero-point error.

Science Highlight
Rachel Howe has been comparing the evolution of the torsional oscillation during the current deep and extended solar minimum, preceding cycle 24, and the last minimum, 1995–1997, which preceded cycle 23. The torsional oscillation is a flow in the East-West direction that is slightly faster (about 5 meters per second) than solar rotation, and that migrates from the poles down to the Equator over a period of some 17 years. The active regions and sunspots occur on the boundary of the torsional oscillation flow and follow its migration in latitude. As seen in figure 1, the torsional oscillation for the current minimum has taken about 2.5 years to migrate from latitude 35 degrees to latitude 25 degrees. This can be compared with the 1.5 years taken by the torsional oscillation from the previous cycle to cover the same range. The current minimum is also now about one year longer than the last one, so there is a correlation between the migration rate of the torsional oscillation and the length of the minimum. In addition, the torsional oscillation from the last cycle (23) has persisted at the Equator longer than that of the cycle before it (22). Finally, since the solar-activity level rose rapidly shortly after the torsional oscillation from cycle 23 reached 25 degrees latitude, the true onset of cycle 24 may occur in the near future. These observations indicate that some properties of the activity cycle may be predictable from the evolution of the torsional oscillation leading up to it.

This result, published in Astrophysical Journal Letters 701 (2009) L87-L90, was announced at the meeting of the Solar Physics Division of the American Astronomical Society in Boulder, Colorado, during June, and was the subject of a press conference that generated considerable interest among the media.

Operations
The major operations activity of the previous quarter was the preventive maintenance trip to Mauna Loa in June. The primary issue was to address the frequent oscillation of the turret pitch head. This problem has appeared occasionally since a tighter-fitting turret seal was designed and implemented. Although previous work addressed this issue with seeming success, the problem has continued to reappear at Mauna Loa. This time the seal was modified with a Teflon surface, which was to mate with the rubber seal and impart less friction to the pitch head; however, the replacement did not remediate the oscillations. Coincidently, it was noted that the shaft of the pitch motor did not turn smoothly and that its resistance to motion could be at least part of the cause. So a replacement turret was quickly shipped to the

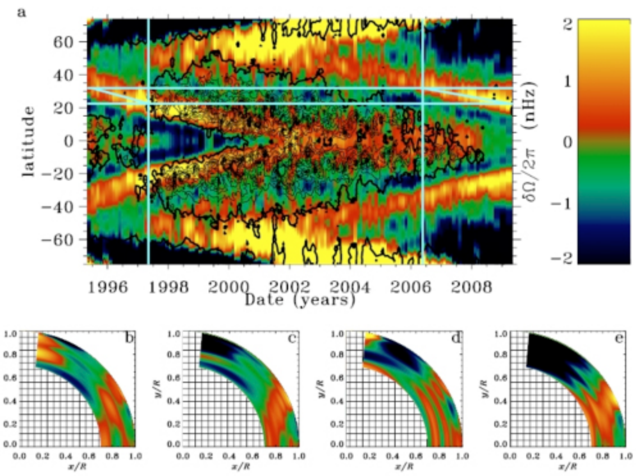


Figure 1: The evolution of the torsional oscillation (TO), a flow inside the Sun that migrates from the poles to the Equator during the course of the solar cycle. We have found that the TO for the current cycle, which appeared in 2003, is moving more slowly towards the Equator than it did for the previous cycle. The extra length of time is reflected in the extended minimum of the solar cycle that is ongoing. (a) Rotation-rate residuals at $0.99R_o$ from the Michelson Doppler Imager and GONG. Overlaid contours show the gross longitudinal magnetic field strength from Kitt Peak Vacuum Telescope/SOLIS, at 5 gauss intervals. The leftmost solid vertical light-blue line shows the date, 1997.3, at which the low-latitude flow configuration best matches that in the most recent (2009.2) data set, and the rightmost vertical line shows the date, 2006.4, where it best matches that in the earliest data set (1996.5). The horizontal lines show the respective location of the flow bands and the slanted lines schematically indicate the migration of the equatorward branch. The lower panels show 12-month averages of the rotation-rate residuals in the r, θ plane for epochs starting at (b) 1995.5, (c) 1996.3, (d) 2006.5, and (e) 2008.2.

team on site. With the new turret installed and the optical system re-aligned, problematic pitch behavior was still observed. A spare pitch head, which arrived with the team, was installed and the pitch behavior was improved considerably. As with past experience, it remains to be seen if the problem will reappear yet again.

Processing to date includes time series, frequencies, merged velocity and rings through GONG month 138 (centered at 23 November 2008), with a fill factor of 0.93. Last quarter, the GONG Data Archive distributed 383 gigabytes of data.

All GONG data products can be obtained at: gong.nso.edu/data

Project News
We are pleased to welcome Walter Allen to the GONG staff. Walter recently received his PhD from Howard University, and he will be working with us on new developments of our local helioseismology ring-diagram pipeline, and he will be porting the ring-diagram and farside-map pipelines into the Solar Dynamics Observatory/Helioseismic and Magnetic Imager data processing system.

We are hosting two students and one teacher this summer. As mentioned earlier, Matthew Richardson from the Vanderbilt/Fisk program

continued

GONG ++ continued

is working on testing components of the Hα system. James Keane, a Research Experiences for Undergraduates (REU) student from University of Maryland College Park, is working with Gordon Petrie on calculating magnetic East-West tilt-angle distributions in the solar photosphere and chromosphere. Finally, Helena Freedlund, a teacher from La Rue County Middle School, Hodgenville, KY, is working with Irene González Hernández on finding a relationship between the far-side seismic signal and the magnetic complexity of active regions. (See figure 2.)

Figure 2: New faces around GONG. Left to right: Matthew Richardson, summer intern from Vanderbilt/Fisk; Helena Freedlund, summer Research Experiences for Teachers teacher from La Rue County Middle School, Hodgenville, KY; Walter Allen who has joined our staff from Howard University; and James Kean, REU student from University of Maryland College Park. (Photo credit: Emily Acosta, NOAO/AURA/NSF)

We provided a lecture on space weather and a tour of the Kitt Peak solar facilities and the GONG instrument to 16 members of AFWA 25 OWS/WXAS from Davis-Monthan Air Force Base on June 5. Figure 3 is a picture of the group at the McMath-Pierce Telescope, along with Matthew Richardson.

Figure 3: Members of AFWA 25 OWS/WXAS from Davis-Monthan Air Force Base visited the National Solar Observatory McMath-Pierce Solar Telescope on Kitt Peak on 5 June 2009. Our summer intern, Matthew Richardson, is at the far left. A lecture on space weather and a tour of the Kitt Peak solar facilities and the GONG instrument was provided. (Photo credit: Frank Hill, NSO/AURA/NSF)

First Quarter Deadline for NSO Observing Proposals

The current deadline for submitting observing proposals to the National Solar Observatory is November 15 for the first quarter of 2010. Information is available from the NSO Telescope Allocation Committee at P.O. Box 62, Sunspot, NM 88349 for Sacramento Peak facilities (*sp@nso.edu*) or P.O. Box 26732, Tucson, AZ 85726 for Kitt Peak facilities (*nsokp@nso.edu*).

Instructions may be found at: *www.nso.edu/general/observe/*

A Web-based observing-request form is available at: *www2.nso.edu/cgi-bin/nsoforms/obsreq/obsreq.cgi*

Users' manuals are available at: *nsosp.nso.edu/dst/* for the Sac Peak facilities and *nsokp.nso.edu/* for the Kitt Peak facilities.

An observing-run evaluation form can be obtained at: *ftp.nso.edu/observing_templates/evaluation.form.txt*.

Proposers are reminded that each quarter is typically oversubscribed. It is to the proposer's advantage to provide all information requested to the greatest possible extent no later than the official deadline. Observing time at the national observatories is provided as support to the astronomical community by the National Science Foundation.

A ROSA View of the Sun

Thomas Rimmele & The Queen's University Belfast ROSA Team

High-cadence observations of astronomical sources are a growing field within astrophysical science. There is a clear need for high-cadence observations of the Sun. Many research topics, in particular those related to the dynamic Sun and the heating of its outer regions, involve the observations and modeling of wave phenomena and explosive events captured within very short timescales. High-cadence observations are also important for post-facto image reconstruction. Post-facto reconstruction requires a large number of images for the production of a single image at diffraction-limited resolution. These short-exposure images must be accumulated over timescales sufficiently short that solar features remain unchanged.

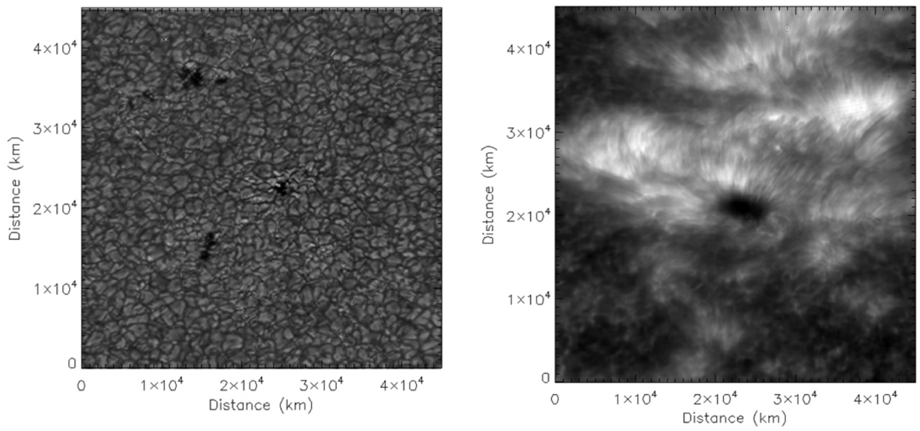


Figure 2: (Left) Small pores observed in the white-light (4170 Angstroms) with a temporal resolution of 0.03 seconds. (Right) The decaying active region NOAA 11012 observed in Ca II K with a temporal resolution of 0.1 seconds.

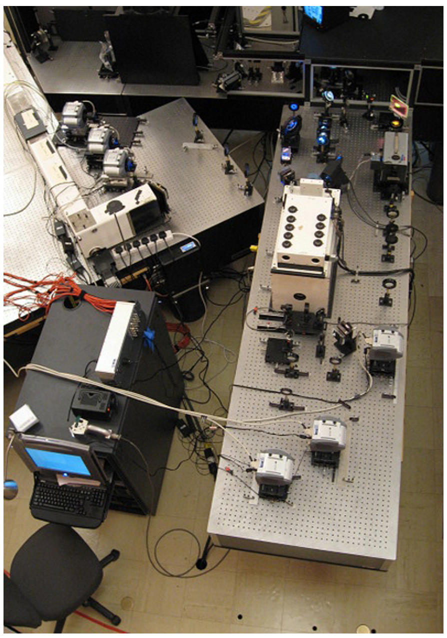


Figure 1: ROSA observing setup at the DST. Six ROSA cameras are mounted at the exit of various broadband and narrowband filters, including the Universal Birefringent Filter in its polarimetric mode, an Hα filter and a G-band and a Ca II K filter. (Photo credit: by T. Rimmele)

The Rapid Oscillations in the Solar Atmosphere (ROSA) imaging system will soon become available to the community as a common user instrument at the Dunn Solar Telescope (DST). ROSA has been funded by the United Kingdom's Science and Technology Facilities Council and Queen's University Belfast. The instrument will be available on Port4 at the DST and can be used in combination with the high-order adaptive optics (AO). ROSA consists of six cameras able to take up to 30 frames per second simultaneously in six different wavelengths (see figure 1). The cadence can be increased to as many as 200 frames per second by windowing the charge-coupled device (CCD).

The ROSA detectors are 1K × 1K electron-multiplying CCDs, which are thermoelectrically cooled. The cameras provide an absolute electron-multiplying gain, at all temperatures, and variable readout speeds up to 35 megaHertz. The quantum efficiency of the cameras peaks at 6000 Angstrom decreasing to 40 percent at 4000 Angstrom. The cameras are triggered externally with a precision control unit (PCU) that can synchronize the cameras to within 50 microseconds. Up to 16 cameras can be connected to the PCU, and up to four different triggers may be used.

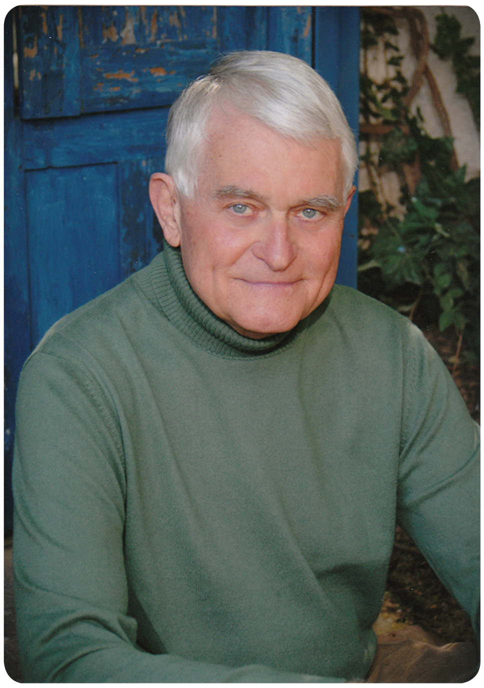
A user interface has been developed for ROSA to run under Linux. Through a Web browser, the user can access camera functions such as exposure times, frame rates, cooling, shutter control, and gain settings.

Each camera is connected to a server with a storage capacity of approximately 1.1 terabytes. The data can be transferred to external media via LTOs or EXT3-formatted hard drives equipped with a Universal Serial Bus adaptor. A user-friendly data-reduction pipeline has been designed to incorporate all stages of data preparation. A dedicated 64-bit ROSA cluster, complete with over 40 processing nodes, passes the raw data through a specifically written set of routines. Output files consist of speckle-reconstructed images, which are de-stretched to remove atmospheric image warping, normalized to remove variations in light levels during the observing sequence, and rigidly co-aligned. Sample images obtained from the ROSA commissioning run are shown in figure 2.

In Memoriam of John A. Eddy 25 March 1931–10 June 2009

Barbara Eddy

John A. (Jack) Eddy, a long-time employee of the National Center for Atmosphere Research (NCAR) and the University Consortium for Atmospheric Research (UCAR), whose pioneering research into the history of the Sun challenged earlier concepts of solar behavior, died on 10 June 2009 at his home in Tucson, Arizona, after a long battle with cancer. He was 78, and for the past six years was a member of the National Solar Observatory in Tucson.



Eddy's 1976 paper confirming the reality of a 70-year period in the life of the Sun in which sunspots all but disappeared from its face came as a surprise in solar physics, which had long viewed the Sun as a more constant star whose variations were limited to a regular 11-year cycle in the number of sunspots and other signs of solar activity. In making the case for the anomaly (which he called the "Maunder Minimum"), he gathered and interpreted data from a wide variety of sources. This included first-hand accounts from: extant historical observations of the Sun going back to the telescopic observations of Galileo and other contemporary scientists of the 17th and early 18th centuries; historical reports of the aurora borealis observed in past centuries in Europe and the New World; visual observations of sunspots seen with the unaided eye at sunrise and sunset in dynastic records from the Orient; existing descriptions of the eclipsed Sun; and measurements of carbon-14 in dated tree rings. In the last of these (which can be used as a proxy indicator of solar activity), he found evidence of other similar periods of solar quiescence in the distant past, the most recent an even longer span, from about 1450 until 1540, which he named the "Spörer Minimum." Both the Maunder and Spörer minima fell during the coldest parts of the Little Ice Age, which suggested a meaningful connection between the longer term behavior of the Sun and of the Earth's mean surface temperature.

Eddy also came to be known for his work in the astronomy of the early Indians of the American plains, and particularly the astronomical alignments of the Bighorn Medicine Wheel in Wyoming and the Moose River wheel in southern Saskatchewan. He was as well a pioneer and champion of the application of historical data in the solution of modern problems in astronomy, and served as President of the Historical Astronomy Division of the American Astronomical Society and of the Commission on Historical Astronomy of the International Astronomical Union. Later in his career, he left astronomy to work for twenty years on behalf of national and global efforts to understand global environmental changes of the present and the distant past.

He chaired many national and international scientific committees, was a respected teacher, a sought-after speaker and "popularizer" of science, and the author or editor of six books and more than 150 scientific papers. Eddy received the Arctowski Prize for Solar-Terrestrial Physics from the National Academy of Sciences, the James Arthur Prize in Solar and Solar Terrestrial Physics of the Harvard-Smithsonian Center for Astrophysics, and was made a Fellow of the American Association for the Advancement of Science.

John Allen Eddy was born in Pawnee City, Nebraska, in 1931 and in 1949 was admitted as a midshipman at the US Naval Academy in Annapolis, Maryland. Upon graduation in 1953, he served for four years at sea as a line officer on aircraft carriers during the Korean War and later in the Persian Gulf as navigator and operations officer on a destroyer in the Atlantic Fleet. In 1957 he left active service in the Navy to enter graduate school at the University of Colorado in Boulder, where in 1962 he was awarded a PhD in Astro-Geophysics.

Eddy worked for 28 years as a teacher and research scientist at the High Altitude Observatory in Boulder and as a scientific visitor at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts; later as the founder and Director of the Office for Interdisciplinary Earth Studies at UCAR; as Chief Scientist and Vice President for Research at a consortium of universities and research institutions in Michigan; and as a founder and Editor, with his wife Barbara, of CONSEQUENCES, a scientific journal supported by five federal agencies to explain in popular terms the nature and eventual impacts of global environmental changes of all kinds. Upon moving to Tucson and until the time of his death, he worked for NASA at the National Solar Observatory.

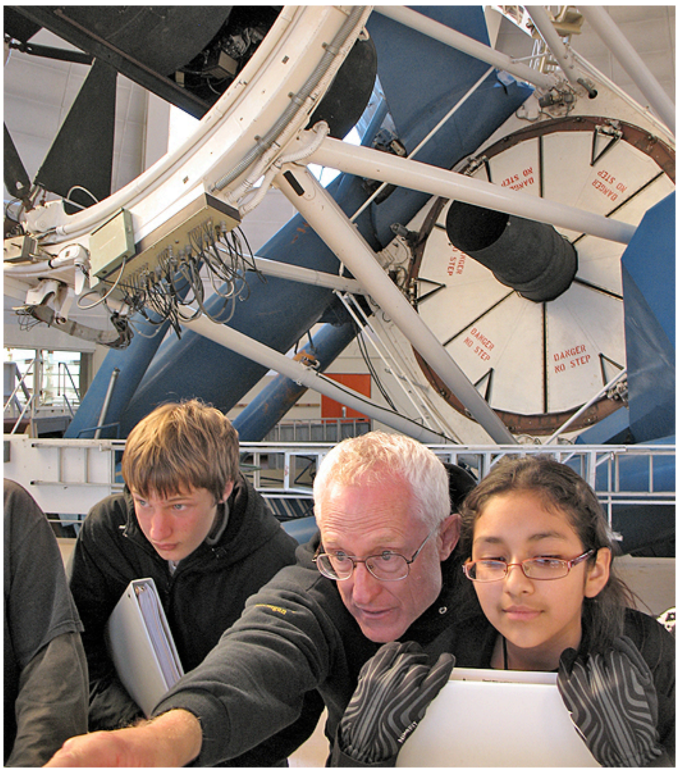
Eddy is survived by Barbara, his beloved wife of 17 years; four children from an earlier marriage to Marjorie Bratt Eddy: Alexandra Eddy of Longmont; Amy Gale of Highlands Ranch, Colorado; Jack Jr. of Laguna Beach, California; and Elisabeth Walker of Kirkland, Washington; a brother Robert, of Longmont, Colorado, and a sister, Lucille Hunzeker, of Humboldt, Nebraska.

A Memorial Service was held on Saturday, June 27, at St. Philip's in the Hills Episcopal Church in Tucson.

Astronomy Camps 2009 on Kitt Peak

Katy Garmany (NOAO) & Don McCarthy (Steward Observatory)

Imagine what it would be like if you were a young teen spending a week at Kitt Peak National Observatory as a junior astronomer. For over 20 years, Dr. Don McCarthy, Steward Observatory, has run residential Astronomy Camps (Camps) on Mt. Lemmon for teens and adults. This year three Camps were held at Kitt Peak National Observatory (KPNO) to take advantage of additional telescope facilities and darker skies: Beginning Camp for junior high-school students, Advanced Camp for high-school students, and a Camp for students from a school in Mexico. These weeklong events utilized astronomy as a teaching tool so students could experience science, engineering, and math in action.



Noah Shenker, Don McCarthy, and Dayanara Sixkiller at the Mayall 4-meter telescope. (Photo credit: Don McCarthy)

McCarthy and his staff offered a rich experience including multi-wavelength observing both day and night; hands-on experiments in physics, astronomy; and engineering; hiking the Solar System to scale (down the old road!); and a chance to have fun getting to know other students from around the world. In this immersion experience, campers acted like real astronomers: watching the night sky, operating research-class telescopes and instrumentation, keeping nighttime hours, interacting with leading scientists, interpreting their own observations, investigating their own questions and curiosities, and, most importantly, having fun. These Camps emphasized a hands-on learning approach, and activities were driven by student involvement and interest. The students also contributed to KPNO by undertaking service projects each day.

Beginning Campers remove weeds from the Kitt Peak volleyball court as one of their daily service projects. (Photo credit: Don McCarthy)

This summer teenagers from 18 states, seven Arizona cities, and four foreign countries (Honduras, India, Mexico, and Spain) traveled to Kitt Peak. During a typical day at the Beginning Camp, students conducted experiments in science and engineering and performed astronomical observations at night. At the research-oriented Advanced Camp, the students undertook specific projects in CCD imaging and spectroscopy at multiple wavelengths using many different facilities on Kitt Peak. The third Camp involved students from the Tecnológico de Monterrey school in Hermosillo, Mexico, in a combination of all these activities. Each Camp included 24 students (campers), Director McCarthy, and up to 11 additional adult counselors. Many of the counselors are now professional astronomers who became hooked on astronomy when they attended the Camps.

The campers undertook many different types of observations, some of which are illustrated below. With the McMath-Pierce solar telescope, they measured spectroscopic velocities of convective granulation cells, monitored the daily development of four small sunspots, and watched the sunset. At the WIYN 0.9-meter telescope, they obtained multi-band CCD images of the asteroid 2059 (Baboquivari) and measured its V-, R-, and I-band colors for the first time. Images were also obtained for projects involving pattern speed of spiral galaxies, chemical evolution of nebulae, quasar photometry, and cometary activity. The Bok 2.3-meter telescope was used for visible spectroscopy of comets, planetary nebulae, quasars, and T Tauri stars. With the

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Astronomy Camps 2009 on Kitt Peak continued

Arizona Radio Observatory's 12-meter dish, each camper mapped his/her own Infrared Dark Cloud with the 3-millimeter Atacama Large Millimeter Array prototype receiver. Finally, with the Kitt Peak Visitor Center (KPVC) 16- and 20-inch telescopes used for the EPO-run Nightly Observing and Advanced Observing Programs, the campers not only took pretty pictures but also recorded the transit of an extrasolar planet (TrES-3) and obtained the light curve of the rapidly pulsating variable star CY Aqr. Campers will continue to work on these projects as they pursue both local and national science fair competitions.

Beginning Camper Alan Francisco prepares to launch his team's Newton's Car down a line of relatively frictionless wooden dowels. Hopefully, this car will take the best advantage of Newton's Laws and travel the farthest. (Photo credit: Don McCarthy)

This first experience in hosting campers who are much younger than most visitors to the mountain was very positive. All of the Kitt Peak staff who interacted with the students were very impressed, hopefully paving the way for future Astronomy Camps.

Special efforts were made to recruit applicants from local Tohono O'odham students, and we were pleased to have two attend the Beginning Camp and one the Advanced Camp. Scholarships were provided by adults who have attended Astronomy Camp as well as by NASA through Space Grant and Near InfraredCamera/James Webb Space Telescope education funds. Dayanara Sixkiller, in the Beginning Camp, wrote the following letter after her experience:

Dear Kitt Peak Observatory,

Thank you for allowing the Astronomy Camp to take place within your facilities. I was so impressed with the staff, facilities, and getting to work with some of the world's largest telescopes. I did not want to leave.

At astronomy camp we learned so much. It was an experience I will recommend to anyone who is willing to work hard and tough it out. Patience and an open mind are needed to work late observing stars and constellations. When my new friends began chatting on our 2009 camp forum, we discussed what objects we wished to see at camp. I was interested in The Cat's Eye Helix and Black Hole. Unfortunately the skies had other plans for us. We had the perfect view to see Saturn and its rings. We saw the Bee Hive, Virgo, and Leo constellations. I also enjoyed the inflatatable planetarium. I was so excited to see an animated comet shower.

We had the opportunity to experiment with liquid Nitrogen and magnets, and what happens to an oxygen balloon in liquid nitrogen. We made liquid nitrogen ice-cream, which turned out to have an odd taste, to many people stirring the pot. Everyone was adding their own ingredients to the same pot. Would not recommend 25 kids to make anything you want editable. It does not work well.

We also had the opportunity to visit The Pima Air and Space Museum. I got to show people what I know about planes, and they shared what they knew. We were just conversing a lot and that helped us learn more about each other. On the way back from Tucson we had even more fun than we did at the museum. We were chatting away but also were napping for the long night ahead of us.

I made a lot of friends at camp. I still keep in contact with them. We had fun at camp and, I think they will come back next year.

I wish to thank your kitchen staff for the delicious food they prepared. I give them 20 thumbs up. My favorite meal was the chili and beans. It reminded me of my home meals.

I had a great experience at camp this year and I will come back next year and have even more fun than this year's camp.

Dayanara Sixkiller AKA blue rassberry 11

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Dayanara Jo Sixkiller

Astronomy Camp is grateful to all the personnel from Kitt Peak National Observatory and Steward Observatory, both on the mountain and downtown, who worked very hard to make a positive impact on the lives of a new generation of astronomers and leaders. The Camps are sponsored by The University of Arizona Alumni Association. More information can be found at *astronomycamp.org*.

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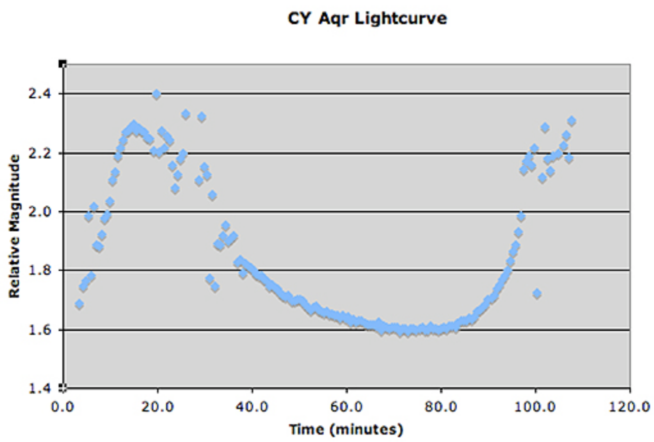
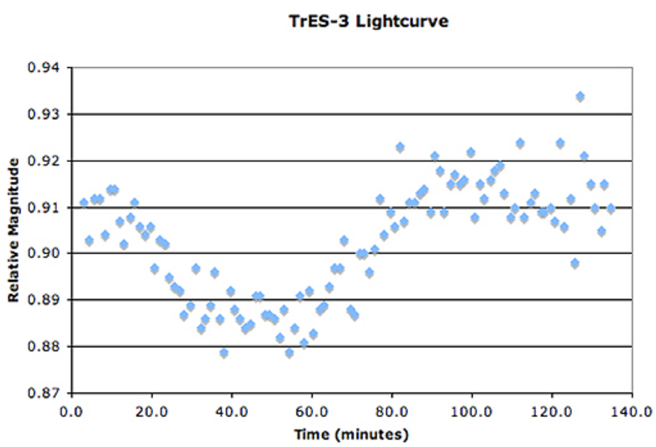
Astronomy Camps 2009 on Kitt Peak continued

Astronomy Camps' Science Results

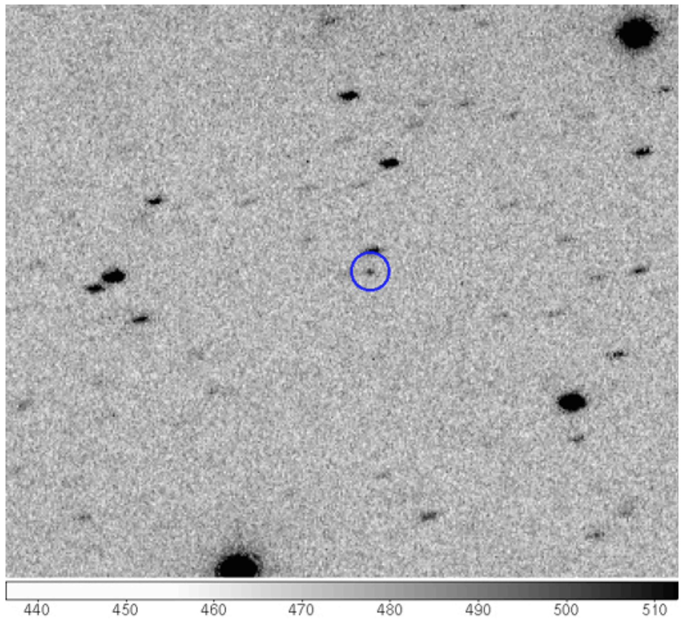
The Crescent Nebula (NGC 6888) imaged through the KPVC 20-inch telescope by Beginning Campers Radhika Arora, Anna Carter, Madeleine Fort, and Joshua French, with assistance from Steve Peterson.



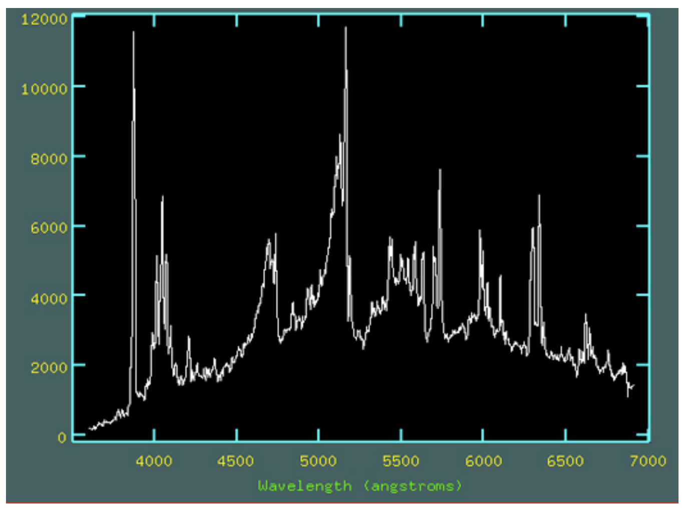
Light curve of the pulsating variable star CY Aqr obtained by a team of Advanced Campers led by Nancy Thomas at the KPVC 20-inch telescope with assistance from Kevin Bays.



Light curve of the transiting extrasolar planetary system TrES-3 obtained by a team of Advanced Campers at the KPVC 20-inch telescope with assistance from Flynn Hasse.



An R-band CCD image of asteroid 2059 (Baboquivari) obtained by the Advanced Campers with the WIYN 0.9-meter telescope and processed by Eric Hooper. This object is very faint (V = 22.2) and required stacking images of a moving object so background stars appear streaked.



Visible spectrum of Comet Garradd (C/2008 Q3) obtained at the Bok 2.3-meter telescope by a team of Advanced Campers led by Brianna Smart with assistance from Tim Bowers and Betsy Green.