>>>NOAO/NSO Newsletter

NATIONAL OPTICAL ASTRONOMY OBSERVATORY/NATIONAL SOLAR OBSERVATORY

ISSUE 98 — JUNE 2009

Science Highlights

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Observational Programs

Science Data Management

Cerro Tololo Inter-American Observatory

Kitt Peak National Observatory

National Solar Observatory

Education & Public Outreach

Important Notices for:

All Readers

Help us conserve our financial resources during this time of reduced budgets and update our newsletter mailing list. NOAO is highly committed to keeping our astronomical community informed. However, the rising cost of postage and decreasing funding has caused us to examine the cost of mailing the *NOAO/NSO Newsletter*.

If you currently receive an copy of this *Newsletter*, and need to continue to do so, please send an email to *editor@noao.edu* confirming your mailing address. If we do not receive such an email by 1 August 2009, your address will be removed from the mailing list. We particularly request that foreign subscribers consider whether they need a paper copy.

Please note that the *NOAO/NSO Newsletter* is available online and in full color at www.noao.edu/noao/noaonews.html. This link provides access to back issues as well as the current issue, so you can always remain informed with what is happening at NOAO and NSO.

Libraries will continue to receive a paper copy of the *NOAO/NSO Newsletter*, although we appreciate any corrections to the mailing address.

WIYN Observers
New filters at WIYN replace older ones.
See *www.wiyn.org/observe/filters.html* for more information.

NEWFIRM Users
The following are now available:
- NEWFIRM reduced data sets. See page 23.
- NEWFIRM data reduction guidebook. See page 24.
- NEWFIRM chapter in *NOAO Data Handbook*. See page 24.

NOAO Survey Program Proposers
Letters of Intent are due soon. See page 18.

NSO Observing Proposers
Proposals for fourth quarter are due soon. See page 40.

Publication Notes

See the color versions of images presented in this Newsletter online at *www.noao.edu/noao/noaonews/html*.

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On the Cover

Abell 21, popularly known as the Medusa nebula. Also designated PK 205+14.1, Abell 21 is an old planetary nebula some 1,500 light-years away in the constellation Gemini. It is estimated to be over 4 light-years across. This image was taken on 24 October 2008 at the Mayall 4-meter telescope with the Mosaic camera, using [O III] (assigned a blue color) and H-alpha (orange) filters. The 100 Hours of Astronomy Webcast "Around the World in 80 Telescopes," held 3–4 April 2009 during the International Year of Astronomy 2009, was the means for releasing this image.

Abell 21 was first discovered and reported by George Abell in 1955 from his examination of the original Palomar Sky Survey plates. In that article, it was No. 16 in a list of 73. Abell renumbered it as No. 21 in a 1966 article of his in the Astrophysical Journal. (Credit: T. A. Rector, University of Alaska & NOAO/AURA/NSF)

Probing the Gas in Protoplanetary Disks with TEXES on Gemini-N

Joan R. Najita

The [Ne II] line at 12.81 microns has been suggested as a potential new probe of the planet formation region of circumstellar disks. It is a potentially powerful diagnostic because the neon in disks is expected to be fully in the gas phase and in atomic form. In addition, the 12.81-micron line probes warm, ionized gas, conditions which are believed to characterize the upper atmosphere of the inner disks surrounding classical T Tauri stars (Glassgold et al. 2007) and disk photoevaporative flows (Alexander 2008). Because it is sensitive to low column densities of gas, [Ne II] may also prove useful in identifying any residual gas surrounding weak-line T Tauri stars. Such measurements can potentially probe the dissipation timescale of gaseous disks and, thereby, constrain the timescale for giant planet formation.

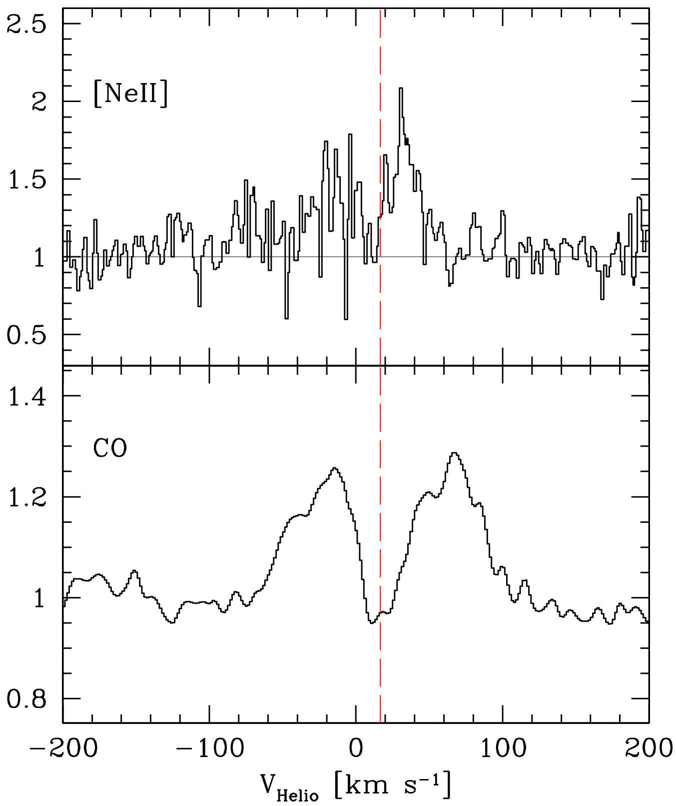

Figure 1: The 12.81-micron [Ne II] line profile (top) and the 4.9-micron CO line profile (bottom) of the T Tauri star AA Tau, both normalized to their respective continua. The vertical dashed line indicates the stellar velocity. The [Ne II] emission is centered near the stellar velocity, is broad (FWHM ~70 km/s), and is approximately double-peaked.

Observations with the Spitzer Space Telescope show that [Ne II] emission is, in fact, commonly detected from young stars, with line fluxes that are comparable to those predicted for disks (Glassgold et al. 2007). While the rough agreement between the predicted and observed line fluxes is consistent with a disk origin for the emission, stronger confirmation for this interpretation can be obtained by measuring resolved [Ne II] line profiles.

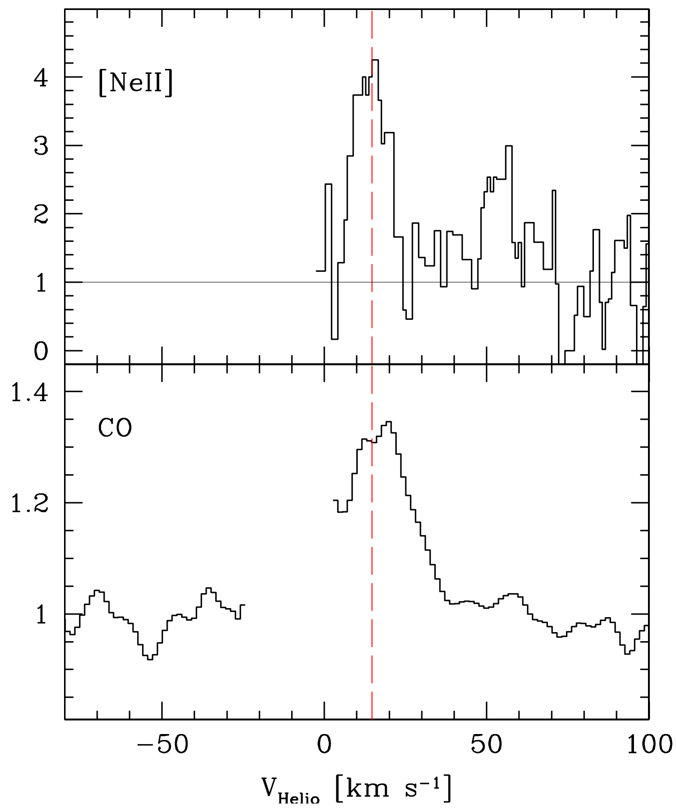

Figure 2: The 12.81-micron [Ne II] line profile (top) and the 4.7-micron CO line profile (bottom) of the T Tauri star GM Aur, both normalized to their respective continua. The vertical dashed line indicates the stellar velocity. The [Ne II] profile has a component of modest width (FWHM ~14 km/s) that is centered near the stellar velocity. There may be an additional emission component centered at ~40 km/s redward of the stellar velocity.

For that reason, we used the Texas Echelon Cross Echelle Spectrograph (TEXES) on Gemini North to study the [Ne II] line profiles of two young stars. TEXES is a sensitive, high resolution (R ~ 80,000) mid-infrared (5- to 25-micron) spectrometer. TEXES was offered at Gemini North as a visitor instrument in 2006B and again in 2007B, and our observations were carried out in 2007B. Our two targets, GM Aur and AA Tau, were known to show [Ne II] emission based on Spitzer spectroscopy and to have moderate to high system inclinations.

As reported in a paper recently accepted for the ApJ (Najita et al. 2009), we find that the [Ne II] emission from both sources is centered near the stellar velocity and is broader than the [Ne II] emission

continued

Probing the Gas in Protoplanetary Disks with TEXES continued

measured previously for the face-on disk system TW Hya (Herczeg et al. 2007). These properties are consistent with a disk origin for the emission we detect.

The increase in line width with increasing inclination strongly suggests that disk rotation (rather than photoevaporation or turbulence in a hot disk atmosphere) is primarily responsible for the line width. In the more highly inclined (non-face-on) systems that we studied, the [Ne II] emission is narrower than the CO fundamental emission from the same sources (see figures). If the widths of both diagnostics are dominated by Keplerian rotation, this suggests that the [Ne II] emission arises from larger disk radii on average than does the CO emission.

Interestingly, the equivalent width of the [Ne II] emission that we detected is less than that of the spectrally unresolved [Ne II] feature in the Spitzer spectra of the same sources. Variability in the [Ne II] emission or the mid-infrared continuum, a spatially extended [Ne II] component, or a very (spectrally) broad [Ne II] component might account for the difference.

Spatially extended [Ne II] emission is a distinct possibility. A recent study by van Boekel et al. (2009) using the Very Large Telescope (VLT) spectrometer and imager for the mid-infrared (VISIR) shows that the [Ne II] emission from the T Tau triplet is spatially extended and associated with a known outflow in the system. Although the systems we studied do not show similar strong outflow activity, a weaker extended component may be present. While an extended component may be present, our observations, obtained with a 0.6-arcsec slit, show that the emission within ±40 AU of the star likely has an origin in a gaseous disk, as expected theoretically.

These observations bring to a grand total of four the number of T Tauri [Ne II] emission sources that have been studied at high spectral resolution. Further measurements of resolved [Ne II] profiles are needed to determine whether the results obtained here apply to the majority of [Ne II]-emitting T Tauri stars. We therefore eagerly await a future opportunity to carry out such studies with TEXES on Gemini.

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van Boekel, R., et al. 2009, A&A, 497, 137 NL

NOAO 4-m Speckle Interferometry Observations of Massive Stars

Brian D. Mason & William I. Hartkopf (US Naval Observatory)

Massive stars appear to love company. Evidence continues to accumulate that the fraction of binary and multiple stars among the massive O- and B-type stars is much larger than that for solar type stars (see Zinnecker & Yorke 2007 and references therein). This difference in multiplicity properties may ultimately reflect differences in the star formation process between massive and low mass stars.

The observational evidence for the high incidence of binaries among the massive stars comes from both spectroscopic investigations of short-period systems and high angular resolution measurements of longer-period (and wide) binaries. Previous observations (Mason et al. 1998) made with the KPNO and CTIO 4-m telescopes and USNO speckle camera suggested that the true binary frequency may reach 100 percent among cluster stars, once account is made for the observational bias against detection of binaries with periods larger than those found spectroscopically but smaller than those found through high angular resolution measurements.

Ten years later (and armed with an improved detector) we decided it was an opportune time for follow up and expanded speckle observations. One system that was unobservable in the earlier effort, WR 146 (see figure 1), is now easily resolved into its constituent components. In Mason et al. (2009), we presented the results of this new speckle interferometric survey of Galactic massive stars, again made with the NOAO 4-m telescopes and USNO speckle camera, and sensitive to the detection of binaries in the angular separation regime between 0.03 arcsec and 5 arcsec with relatively bright companions $\Delta V < 3$). In this effort, new companions were first resolved for 14 OB stars. After combining our speckle data with published data on other visual companions detected through adaptive optics studies and/or noted in the Washington Double Star Catalog, as well as published information on radial velocities and spectroscopic binaries, a statistical analysis was made of the binary frequency among the subsample that are listed in the Galactic O Star Catalog (Maíz-Apellániz et al. 2007).

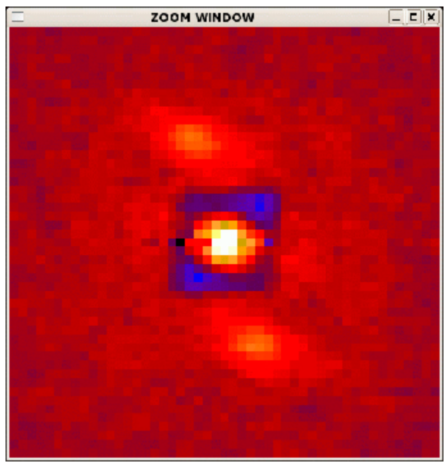

Figure 1: Directed vector autocorrelation of WR 146 = NML 1. The central peak is the zeroeth order correlation while the near symmetric (due to the small Δm) peaks represent the primary and the secondary. Both components are fainter than 16th magnitude in V band, a challenge for speckle interferometry. First resolved in 1996 at 168 mas by Niemela et al. (1998), it had closed to 157 mas by the time of this observation and to 136 mas in 2008.

continued

NOAO 4-m Speckle Interferometry Observations continued

Table 1: Binary Frequency of Galactic O-Stars

Category	Cluster/ Association	Field	Runaway
A. Visual Multiplicity			
No. systems	249	56	42
n = 2	50	11	9
n > 2	58	3	2
Total	43%	25%	26%
n = 1	141	42	31
Total	57%	75%	74%
B. Spectroscopic Properties			
No. Stars	272	56	42
SB3O	7	0	0
SB2O	40	3	3
SB1O	14	0	5
SBE	5	3	0
SB2?	15	4	1
SB1?	45	8	3
Less SB?	30%	15%	19%
Total	57%	46%	29%
C	97	21	30
Total	43%	54%	71%
U	49	17	0
C. Fraction with Any Companion			
Less SB?	66%	41%	37%
Total	75%	59%	43%

Notes to table:
SBn = spectroscopic binary (known or probable) with n companions
O = has a published orbit
E = exhibits eclipse or ellipsoidal light variations indicating a binary
n? = suspected binary with line doubling (n = 2) or with radial velocity variations > 35 k/s (n = 1)
C = constant velocity star
U = unknown status

These binary statistics are summarized in table 1. We caution that the sample is magnitude limited (and therefore biased to more luminous stars) and incompletely surveyed (for example, the Turner et al., 2008 adaptive optics work is limited to stars with declination >-42°). The stars are grouped into cluster/association, field, and runaway categories to compare their binary properties. For the immediate purpose of this work, we simply assigned any star that was not a field or runaway object to the cluster/association category. This includes stars described as more distant than some foreground cluster, since such stars generally reside along a spiral arm of the Galaxy, where cluster membership is common. The top section of table 1 summarizes the visual multiplicity properties of each category for the 347 unique, visual systems in the Galactic O Star Catalog. The results are presented in rows that correspond to the sum based upon the number of visual components *n* found. We divide the sample into single and multiple groups in determining the percentages with and without companions (making the tacit assumption that most of the visual companions are gravitationally bound and not line-of-sight optical companions).

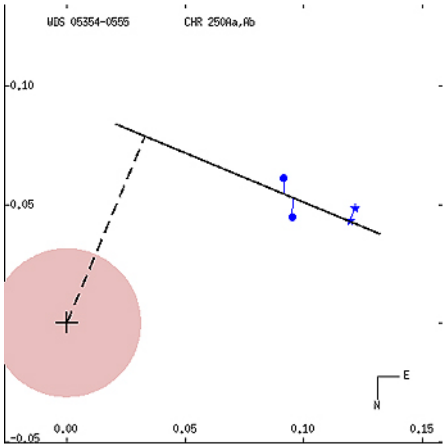

Figure 2: The relative motion of the components of ι Ori = CHR 250. The straight line is a rectilinear fit to the four measures, indicating motion to the east-northeast. The shaded circle indicates the ~30 mas resolution limit of a 4-m telescope, while the dashed line indicates the closest separation of the two stars assuming their relative motion is rectilinear. The stars appear to have reached a closest separation of 82 ±5 mas in 1969.7. Of course, the entire time span of observations of this pair is only about 11.5 years; we may instead be observing only a small arc of a long-period orbit.

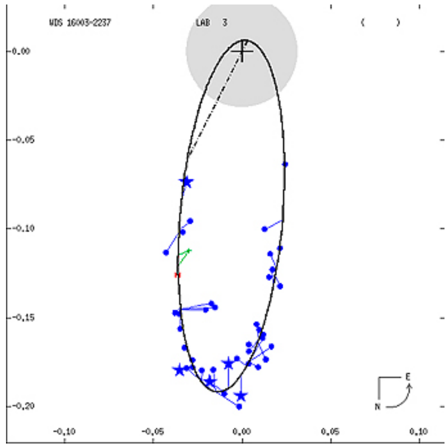

Figure 3: New orbit for δ Sco = LAB 3. The figure shows the relative motion of the secondary about the primary (indicated by a large "plus" sign); the *x* and *y* scales are in arcseconds. The solid curve represents the new orbit determination. The dot-dash line indicates the line of nodes. New measures are shown as filled stars and all other high resolution measurements as filled circles. Micrometer measures are indicated by small plus signs, the Hipparcos measure by a red "H." All measurements are connected to their predicted positions on the orbit by "*O* – *C*" lines. The north-east orientation of the orbit and the direction of motion are indicated in the lower right corner of the plot. The gray filled circle centered on the primary represents that region where the pair is too close to be resolved by speckle interferometry with a 4-m telescope.

The middle section of table 1 presents the corresponding sums for the spectroscopic binary properties for all 370 entries in the Galactic O Star Catalog. The percentages for each subgroup represent fractions with the unknown "U" status objects excluded from the totals. Finally, the lower section in table 1 shows the percentages for the presence of any companion (spectroscopic or visual) again excluding the stars with unknown spectroscopic status.

In addition to the study of the population multiplicity characteristics, detailed analysis was possible for some specific systems:

ι Ori: The complex dynamical relationship of AE Aur, μ Col, and ι Ori is one of the best examples of a binary-binary collision (Gies & Bolton 1986). As ι Ori is a known close pair (P = 29.13376 d; Marchenko et al. 2000), the much wider speckle component would be hierarchical if physical, with an estimated period of at least 40 y (Gualandris et al. 2004). As the high energy needed to eject AE Aur and μ Col with their runaway velocities seemed inconsistent with the less energetic dynamical interaction required for the CHR 250 pair (ι Ori) to remain bound, Gualandris et al. postulated that this pair was non-physical, despite their close proximity. Figure 2 shows a weighted least-squares, linear fit to the published data. It is worth noting that the data are also consistent with a long-period orbit, but one much longer than 40 y.

δ Sco: Bedding (1993) published the first set of orbital elements for δ Sco based solely on interferometric data. Miroshnichenko et al. (2001) obtained complementary radial velocity data that tied down *T* quite precisely and also gave a more accurate estimate of

continued

NOAO 4-m Speckle Interferometry Observations continued

the eccentricity, while adopting the values for period and semi-major axis obtained by Hartkopf et al. (1996). Since the 1996 solution, observations have covered over one additional revolution. A new orbital solution (figure 3) was determined, utilizing all available interferometric data and adopting the *T* and eccentricity values of Miroshnichenko et al. (2001).

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Comparing Magnetic Fields in the Solar Photosphere and Chromosphere at Equatorial and Polar Latitudes

Gordon Petrie (NSO) & Irina Patrikeeva (Northwestern University; 2008 NSO REU Student)

The Synoptic Optical Long-term Investigations of the Sun (SOLIS) Vector Spectromagnetograph (VSM) is unique, producing full-disk line-of-sight (LOS) magnetograms of the solar photosphere and chromosphere. It has done so daily since August 2003. Figure 1 shows a photospheric image (left) and a chromospheric image (right) from the same day. Light grey denotes positive magnetic field (outward from the Sun), and dark grey denotes negative field. These images are little more than an hour apart and their similarity is clear. Yet there are subtle differences: magnetic features appear slightly larger and are more diffuse in the chromosphere than in the photosphere. Furthermore, features close to the limb appear stronger in the chromosphere than in the photosphere.

The magnetic field of the solar corona is the cause of the most spectacular events in the heliosphere. Since the coronal field is very difficult to measure, global atmospheric field models and solar wind predictions are usually based on extrapolations from measurements of the photospheric field. While physical conditions in the chromosphere are closer to coronal conditions, chromospheric data have not been widely used because of their relative scarcity.

Global atmospheric field models can apply as boundary conditions on the magnetic field component along either the radial direction or the observer's LOS. Initially, the LOS component was routinely used in practice. This approach relies on the model description being valid

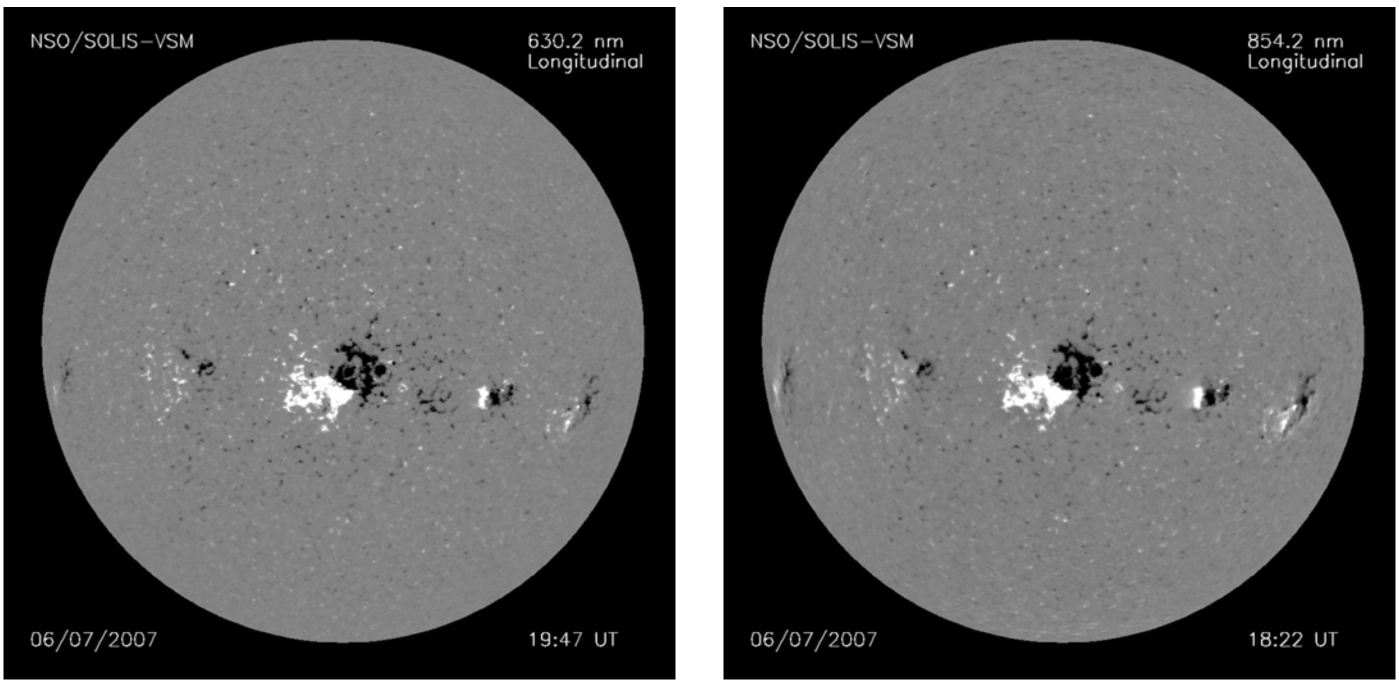


Figure 1: Full-disk, line-of-sight magnetograms of the solar photosphere (left) and chromosphere (right) taken approximately one hour apart.

continued

Comparing Magnetic Fields continued

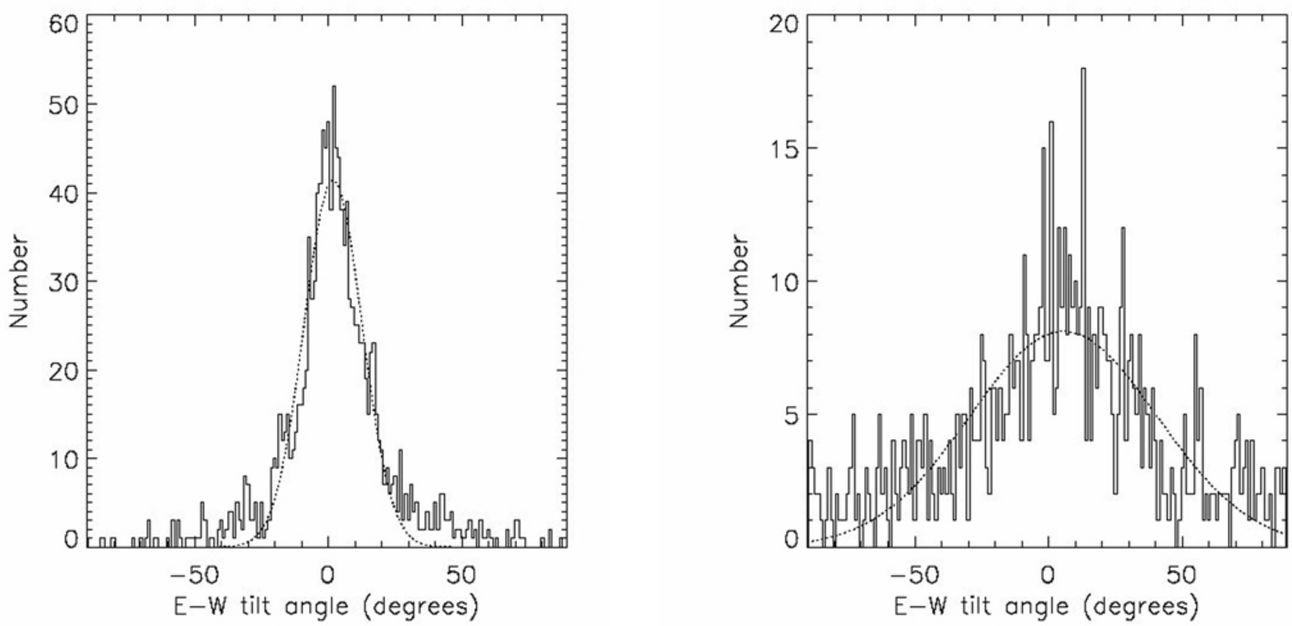


Figure 2. East–West tilt angles of low-latitude photospheric (left) and chromospheric (right) fields based on ≈3000 magnetograms.

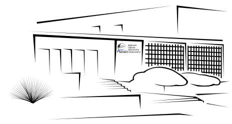
throughout the atmosphere, whereas conditions in the photosphere and corona differ greatly as far as forces and currents are concerned. Moreover, because of projection effects, nearly radial fields close to the poles are barely represented in LOS boundary conditions and are not well reproduced in the model. Some years ago, it was found that more successful models are produced if the boundary conditions are derived based on the assumption that the photospheric field is radial. In such models, the photospheric measurements are separated from the approximately force-free, current-free corona by a thin current layer that idealizes the transition region. This approach also naturally produces an enhanced polar field and, in practice, the calculated models are in much improved agreement with observations. Despite this success, the photospheric radial field assumption is often criticized because non-radial fields are often found in measurements, particularly in active regions, e.g., see the recently released vector field measurements from the VSM. Furthermore, Harvey et al. (2007) discovered a dynamic horizontal component of the photospheric field of the quiet Sun using GONG and SOLIS LOS data (see June 2007 *Newsletter*).

We obtained estimates of the East–West tilt angles of low-latitude photospheric and chromospheric fields based on around 3000 magnetograms. We rejected cases where fields were not characterized by a well-defined direction throughout their disk passage. Some fields evolved significantly during their disk passage, and some field structure was complex and did not have a prevalent field direction. In most cases, however, a good vector fit was obtained. The photospheric and chromospheric distributions of these East–West tilt angles are shown in figure 2. The photospheric histogram is clearly more peaked than the chromospheric one. The best-fitting Gaussians to the histograms had maxima at 1.8° and 5.5° and half-widths at 10.8° and 35°. We concluded that the magnetic fields in the solar photosphere and the chromosphere behave distinctly differently. Most of the photospheric field is nearly radial, while the chromospheric field is more complex and has no strongly preferred direction, expanding in all directions to a significant degree in a manner consistent with a canopy-like configuration.

A further issue is the sensitivity of the models to the fields that are most poorly observed of all: the polar fields. The two magnetic polar caps are large-scale flux distributions each dominated by a single polarity. However, the LOS field signal derived from photospheric line polarization is not strong enough to allow accurate information on the flux distribution near the poles. In models, the global large-scale structure is unfortunately dominated by the polar dipole component, which is particularly sensitive to boundary conditions for the polar fields. The sensitivity of the VSM and the high spatial resolution of the images allow us to sample the fields with better spatial resolution than has been possible in the past. The use of a chromospheric line allows us to estimate the polar field at chromospheric heights for the first time.

We did this not via forward models as in past studies, but by inverting the stereoscopic projections of the field vector at a given latitude along different lines of sight at different times of the year. The analysis revealed poleward monotonic increases in intensity and domination by a single polarity. The photospheric polar field structure was approximately steady between 2003 and 2008, while the chromospheric field appears to have been more time-varying, becoming approximately steady only approaching activity minimum in 2008. We found that the photospheric field was approximately radial in both polar caps between 2003 and 2008 and had peaked field intensity distribution, increasing poleward, and varying approximately as $B_{pole} \cos^n \theta$ with $B_{pole} = -5.3$ and $n = 8.8$ at the North pole, and $B_{pole} = 5.8$ and $n = 9.7$ at the South pole, where θ is the co-latitude. The chromospheric field tended to expand super-radially in the South during 2008.

A complete discussion on this topic has been accepted for publication in the *Astrophysical Journal*.



Director's News

David Silva

Engaging the Decadal Survey

Like most astronomy-related organizations, NOAO has been closely engaged with the Astro2010 decadal survey process in the last few months. Our strategic thinking continues to focus on the development of an optical/infrared (O/IR) system of ground-based facilities. This is a system allied for excellence in scientific research, education and public outreach, and funded by both federal and non-federal sources. For a more complete overview of the System, see "NOAO and the Ground-based O/IR System: A White Paper for the 2010 Decadal Survey" at *www.noao.edu/system/*.

Just in time for review by the appropriate Astro2010 panels, the Access to Large Telescopes for Astronomical Instruction and Research (ALTAIR) committee released its final report in mid-March (*www.noao.edu/system/altair*). Focusing on the 6- to 10-meter aperture range, the ALTAIR committee gave high marks to the Telescope System Instrumentation Program (TSIP), concluding that TSIP has been successful and well received by the community of non-federal observatories and the open-access observing community, alike. TSIP provides funds to the large aperture telescopes to develop new capabilities in exchange for observing time administered through NOAO. To date, some $24M in development funding has been allocated (approximately $3–4M per year). The ALTAIR committee recommended the annual TSIP budget be increased to $10M. The ALTAIR committee also identified an increase in US participation in Gemini as the most straightforward way to increase the number of open-access nights in this aperture range. This recommendation was contingent on a realignment of Gemini instrumentation to better meet US scientific interests, among other concerns. NOAO believes the ALTAIR report provides a framework that can help make Gemini a more effective observatory for all its partners. The ALTAIR report is the large aperture complement of the previously released report by the Renewing Small Telescopes for Astronomical Research (ReSTAR) committee, which covered the 2- to 5-meter aperture class (*www.noao.edu/system/restar*).

"A National Observatory for ground-based optical-infrared (O/IR) astronomy remains as necessary and relevant today as it was when NOAO was founded 50 years ago." So begins the white paper written by the Future of NOAO committee, also released in mid-March (see *www.noao.edu/system/future09* for the full report). After summarizing the essential roles of a national observatory, the Future of NOAO committee described a "roadmap to 2020" for NOAO. This roadmap includes continued leadership in the O/IR System development (following the recommendations of the ReSTAR and ALTAIR committees), unification of NOAO and Gemini, continued participation in the Large Synoptic Survey Telescope, engagement with one or more Extremely Large Telescope projects, and increased support for survey science and associated technologies.

Responding to a general suggestion by Astro2010, NOAO and Steward Observatory sponsored a town hall meeting in Tucson on March 14. A spirited crowd debated a wide range of topics, with emphasis on state-of-the-profession issues like demographics, career development, and tools (e.g., data archives). NOAO also organized the Giant Segmented Mirror Telescope Community Assessment Review (GCAR) panel and charged them to provide independent assessments of the current status of the Giant Magellan Telescope and Thirty Meter Telescope projects. Separate reports from the assessment committee for each project will be submitted to Astro2010.

Last but not least, NOAO scientists contributed to 27 Science and 10 State of the Profession white papers. This was a tremendous effort by NOAO staff, which will hopefully serve the Astro2010 panelists well.

NOAO and Gemini

It is clear from the final report of the ALTAIR committee that the US community-at-large has important concerns about the Gemini Observatory including, "(1) the lack of alignment between the Gemini instrumentation suite and the needs of the US community and (2) the time burden on proposers at all stages of the process to end up with scientifically useful data" (from the ALTAIR Report, Executive Summary). The recently released Gemini User's Survey carried out by Gemini themselves shows that users throughout the international Gemini partnership have similar concerns.

Motivated by such concerns, the Future of NOAO committee recommended that NOAO and Gemini be unified into a new observatory, for the benefit of all Gemini partners. Similar recommendations have been made in the past. They were controversial then, and they remain controversial now.

NOAO recognizes that it is not necessary for NOAO and Gemini to be unified to address the specific concerns documented by the ALTAIR committee. However, NOAO also recognizes that these concerns are real and that they reflect the careful thinking of the US community and its desire to remain engaged with an effective Gemini Observatory. NOAO hopes that the Gemini Observatory will respond to these concerns as quickly as possible. As one of the strongest advocates for Gemini in the US community, NOAO stands ready as always to help in any way it can.

Budget Update

Compared to six months ago, the NOAO budget situation is much brighter. At the time of this writing, firm numbers are still unavailable, but here is what we know.

The final FY 2009 budget allocation for NOAO will be larger than the FY 2008 alloca-

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Director's News continued

tion. This is very good news. Six months ago, a five percent reduction relative to FY 2008 was considered possible.

NSF has indicated that NOAO will receive significant funding from the American Recovery and Reinvestment Act (ARRA) for deferred maintenance and infrastructure improvement catch-up. This is also good news. NOAO has developed a long list of shovel-ready, bricks-and-mortar projects so we can move forward quickly when such stimulus money becomes available.

Our Phase 1 ReSTAR implementation proposal is still under review. If approved, this proposal would fund telescope maintenance projects, new 4-meter class optical and infrared spectrographs, new 4-meter class telescope partnerships, and studies of new 2- to 4-meter class science capabilities for possible implementation in later ReSTAR phases.

The FY 2010 budget proposed by NSF for NOAO is still unannounced.

Hopefully, all these budget numbers will become known in the next few weeks. And when that happens, we will discuss the numbers with you and what it means for NOAO and the community. Look for the latest information in NOAO *Currents*, our email newsletter.

Community Access to Ground-Based Optical Interferometer Arrays

Stephen Ridgway

The September 2007 *NOAO/NSO Newsletter* summarized the results of the NOAO Workshop on Ground-Based Optical Interferometry, held in mid-November 2006 (the resulting recommendations and roadmap may be found at: *www.noao.edu/meetings/interferometry/*). This article describes progress since that meeting.

Soon after the workshop, representatives of the active US interferometry facilities organized under the name United States Interferometry Consortium (USIC) with the intention of supporting the vision developed at the workshop. The USIC sponsored a series of splinter meetings at AAS and SPIE events over several years and, in May 2008, published an open invitation for participants in a number of working groups to develop white papers for the Astro2010 request for community input. These activities eventually attracted participation by more than 100 people, and some 20–30 who invested considerable time. In addition to Science, Technology, and State of the Profession papers, the USIC prepared one Activity paper: "MOISAIC: Milliarcsecond Optical/Infrared Science—Access to Interferometry for the Community." As suggested by the title, the proposal is centered on ensuring the health and productivity of interferometry as a community resource. The proposal invites Astro2010 to endorse peer-reviewed opportunities for array operations funding, with open community access and observer support services. The proposal also supports technology development and conceptual design of a next-generation array, the latter for consideration in a future decadal review. The USIC, its work, and its policy papers are thoroughly documented at its Wiki, *usic.wikispaces.com/*.

Interestingly, optical interferometry was featured or mentioned in more than 60 Astro2010 Science white papers and was the subject of a dozen Activity proposals.

In the meantime, the field of interferometry has not been standing still. New detection systems have improved wavelength coverage and angular and spectral resolution. In the last few years, the rate of acquisition of spatial frequency data has increased by two orders of magnitude, and it will further increase in the next two years. Deployment of imaging capability is underway and will be the subject of a *Physics Today* article, which should be in print contemporaneously with this *Newsletter*.

How does this impact NOAO? Interferometry, which developed as a private/university and/or mission-oriented activity, offers few opportunities for open access by the US community. And yet, as the capabilities of interferometry grow, open access offers the most effective use of those facilities. The ReSTAR and the ALTAIR reports both mention the importance of interferometry to research, but in neither case recommended it as a top NOAO priority. The MOISAIC proposal by existing facilities, to open their doors through a University Research Office or portal like the Telescope System Instrumentation Program, would offer an appropriately scaled activity, which NOAO could support by adapting existing Time Allocation Committee (TAC) procedures.

General visitor use of optical interferometry poses interesting challenges: for the allocation process, for the facility, and for the user. In order to explore these at limited cost and risk, NOAO and Georgia State University are planning to announce a one-time opportunity for visitors to propose through the NOAO TAC to obtain interferometric data from the Center for High Angular Resolution Astronomy Array. This will be formally announced on the NOAO Web site in time for the 30 September 2009 TAC proposal deadline.

Report on a Classical Observing Run

Fred Walter (State University of New York at Stony Brook)

I decided to request classical observing time when I proposed for time on Gemini South last year. There were multiple reasons. I enjoy travelling to mountaintops. The solitude is refreshing; the night sky reminds me of why we do astronomy in the first place. A more practical reason is that I had never observed with GMOS, or on Gemini, and I find I learn the quirks of instruments better and faster in person, rather than remotely. Queue observations rarely afford one the opportunity to respond quickly to mistakes/miscalculations. Finally, as a member of the AURA Observatory Council, I had heard gripes from some members of the community about how poorly their queue observations had been executed. This was an opportunity to investigate the system, and see if things were as bad as some said.

My proposal was accepted and, as they say, the hard work then began.

Observing Run Preparations—and Problems
At the outset, I was dubious about the need for filling out the Phase II specifications. After all, this was a classical run, and I would be present at the telescope. I am used to running things manually. But it was required, so I plunged in. Filling out the Phase II forms required a steep learning curve. Tom Matheson (the US National Gemini Office contact for this program) was extremely helpful and patient with me throughout the process. *[Ed. Note: NGSC provides Phase I and Phase II support for US classical programs. Support at the telescope is provided by Gemini.]* There are certainly areas where the process can be streamlined and simplified, but, by and large, the Phase II process worked well.

Problem number one arose when I attempted to enter the program parameters in the Observing Tool. I intended to use the B1200 grating at 8000 Angstroms, a regime that had never been tested, much less used. The Observing Tool returned all sorts of warnings and cautions, which I ignored. Tom arranged for some advance calibration frames to be taken, and the system did indeed have some efficiency out there.

At this point, I needed to register with the Gemini Science Archive (GSA) in order to download the B1200 calibration data, which resulted in problem two. I waited and waited, but never received a confirmation that my account had been activated. Tom sent me the data directly. Upon inquiring about access to the GSA on my arrival in La Serena, I was informed that I did indeed have an account—I just was never notified.

The third problem also involved a failure to communicate. In this case, the Observing Tool complained about too many guide stars. But I could not find them. The default window on my MacBook was so small that the table of wave-front sensor targets on the "Target Environment" page did not show, and I had no idea that it was missing. It took a couple of days of back and forth to figure out what the problem was.

Problem four arose when I attempted to add an unrelated target, essentially a Target of Opportunity (ToO), to the program. Since this was a classical run, I naively assumed that I would be able to modify the run within reason. Any real observer knows that the great "discoveries" are often made in garbage time—in twilight or through clouds, when one can observe those interesting objects for which no TAC in its right mind would allocate time. My request to add two ToO targets, one of which would be observed in twilight, was denied.

Figure 1: Signs of things to come?

The Observing Run
The run itself started on an inauspicious note. When I arrived at La Serena on Sunday, February 15, I was greeted by a building closed for fumigation (figure 1).

On Monday, February 16, the building was open. I discussed my program with Ruben Diaz (the Gemini contact scientist for this program), who had some good suggestions for working in the far red, where the night sky line background is large and the fringing is significant. I pled with Bernadette Rogers (Gemini South Head of Science Operations) for the ToO targets I wanted to observe, and she bumped my request up the chain of command. I later sat in on the daily afternoon telecon and got a good sense of how the Gemini operation worked.

The dorm on Cerro Pachón is new and very well designed. There was a herd of wild horses lingering outside the dorm (figure 2) on arrival, and they stayed for the two days I was there.

The observer needs to know that, unlike at Cerro Tololo, the dorm (figure 3) is located far from the restaurant (figure 4) and the telescopes. It is about a nice 1.5-mile run from the dorm to the summit,

Figure 2: Horses on siesta, outside the Cerro Pachón dorm.

continued

Report on a Classical Observing Run continued

Figure 3: The Cerro Pachón dorm, as seen from the road to the summit.

Figure 4: The restaurant at the "top of the Universe."

but, in general, you will need to coordinate with the telescope operator (the System Support Associate, or SSA) and the queue observer.

Once you are at the telescope and observing, the reason for investing all the effort in the Phase II specifications becomes apparent. The system is designed for queue operations. Efficiencies are made possible by having all the information needed to drive the telescope and instrument ready in advance. An advantage of this is that, as viewed by the observer, little critical thinking need be done at the telescope (at 3 am). Gemini is a ground-based telescope that thinks it is a spacecraft. It is high-tech, and when it works, it does so smoothly and almost autonomously. But it is complex—there are instrument failures—and it is located in a remote environment (the earthquake was one of the better ones I've experienced, and a 1.5-hour Internet failure showed why one should not rely completely on the Web).

You will be accompanied to the summit by the queue observer, whose job is to take over if conditions preclude the execution of your program. If you design your program with targets for marginal conditions, the queue observer is essentially superfluous. However, the queue observer will teach you how to operate the instrument and will help you maximize the efficiency of your observations.

Summary

I recommend that first-time observers take the trip to Mauna Kea or Cerro Pachón if practical. The experience gained from working together with the queue observer is clearly worthwhile. Being there affords one the ability to tweak the program as necessary to maximize the science. The scientific staff will appreciate it if you do—they are somewhat isolated and like to keep in contact with the outside world.

The entire staff acted professionally during my few days on Cerro Pachón and in La Serena. I thank T. Matheson (NOAO/NGSC) and R. Diaz (Gemini) for help with the preparations, B. Rogers and J.-R. Roy (Gemini) for eventually approving my observing plans, and E. Wenderoth and G. Gimeno (Gemini) for their assistance at the summit.

Postscript

In the end, my pleas did not fall on deaf ears—I was able to observe my ToOs, though it took the dispensation of the Deputy Director of Gemini and the formal awarding of a Director's Discretionary program ID number. The data from that observation, of the radial velocity variations of the H-alpha line of the inactive polar EF Eridani (figure 5), are simply spectacular.

This image is made from seventy-one 60-second integrations covering just over one orbital period. My goal is to determine the source of the H-alpha emission.

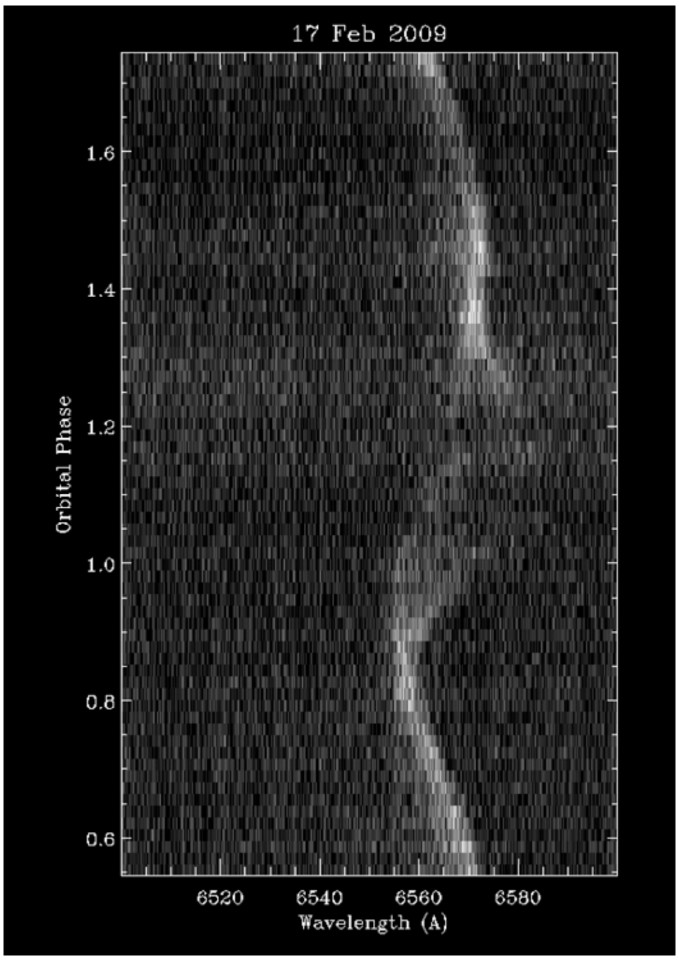


Figure 5: The trailed H-alpha spectrum of EF Eri in the low state (R ~ 18.5).

Visiting Gemini North: Graduate Students' Perspectives

Ross Fadely (Rutgers U.), Angela Speck, Daniel Caputo (U. Missouri) & Kenneth Hinkle (NGSC)

NOAO has historically encouraged the use of Kitt Peak National Observatory and Cerro Tololo Inter-American Observatory by thesis students. The NOAO Gemini Science Center is continuing this policy by advocating graduate student visits to the Gemini facilities. Here are reports from two graduate students. First, Ross Fadely (Rutgers University) reports on visiting Gemini North. Mr. Fadely's thesis project "A Gemini Search for Dark Matter Substructure" was granted queue time. He reports:

In December 2008, I flew to Hilo and started my visit at the Hilo Base Facility. I attended the daily (sometimes more frequent) meetings and quickly gained an appreciation for the hard work and sacrifices that contribute to each night's science. Planning at the 4 pm meeting includes scenarios for all possible weather conditions, correcting any faults that happened from previous nights, and even discussing the future of the telescope. After witnessing the demanding efforts required to run the observatory, I was convinced that the Gemini scientific staff must not have any time for research. Much to my surprise, the case was quite the opposite. Visiting with the scientists, I discovered that almost everyone there is able to keep up their research, a fact that was highlighted by scientific talks during my visit.

The days leading up to my time at the summit were ominous. Just a few days before, a large snowstorm hit the top of Mauna Kea. In addition, cirrus clouds had been plaguing observations the whole week prior. However, as the night of my visit approached, the weather changed and there were four photometric nights out of five. Time at the telescope was the most exciting of the visit. On a given night we would take up to six different types of observations—coronagraphic imaging of exoplanets, Near Infrared (NIR) Integral Field Unit (IFU) observations of compact galaxies, multi-object spectroscopy.… Being exposed to such a diversity of observations, I gained a deep appreciation for the difficulty of running such a wide array of instruments. However, the high point of my visit was being present when the last of my 2008B data, NIR observations of four gravitational lenses, were observed.

A more traditional scenario is for a student and advisor to observe together. Here is a report submitted by Angela Speck (University of Missouri) concerning a classical observing run carried out at Gemini North with her graduate student Dan Caputo. Mr. Caputo's thesis observations are entitled "NIRI/Altair Imaging of PAH bands around carbon stars: determining the formation and processing mechanisms of organic molecules."

Dan Caputo at the Mauna Kea summit at sunset.

This February, astronomers from the University of Missouri had the opportunity to use the Gemini North telescope for two nights of classical observing. Professor Angela Speck and her graduate student Dan Caputo were set to use NIRI in order to image PAH emission around carbon-rich stars. For Dan, this was his first time at a major telescope; his reaction: "Whoa, it's huge!" Upon seeing the scale of the dome, all Dan could think of was the Death Star; when told it could also fire a huge laser, the imagery and thoughts of total galactic domination were solidified. It was an inspiring experience to see the result of so many minds working together for the sake of understanding the Universe.

From a graduate student's perspective, being on top of Mauna Kea when collecting the data, rather than just downloading it, gives a real sense of ownership and pride. And seeing how everything works at the time of observation made all the struggles of the Phase II process make sense. Moreover, working with the Gemini staff directly and benefiting from their expertise in person, made the experience all the more rewarding. The mountain staff was extremely proficient and helpful, and when a technical issue arose, it was dealt with quickly. Seeing how the telescope is operated was a very good experience, particularly for Dan. For a graduate student to have experience using a world-class facility, and through the process, learning to understand the detail that is needed to make good observations and to recognize limitations in the data was incredibly edifying. We highly recommend classical observing at Gemini as an awe-inspiring, educational experience.

From the viewpoint of NOAO, we remind everyone that Gemini is a versatile facility that can be used for either queue or classical observing in both Northern and Southern Hemispheres. NOAO especially encourages graduate students and first-time Gemini users to propose for classical observing if it is appropriate for their observing program. For additional information, see: *www.noao.edu/noao/noaonews/jun08/pdf/94ngsc.pdf* and *www.noao.edu/noaoprop/help/policies.html#grads.*

US Community Usage of the Gemini Telescopes from 2004B to 2009A and a Look to the Future

Verne Smith, Katia Cunha & Dave Bell

The recently released Access to Large Telescopes for Astronomical Instruction and Research (ALTAIR) committee report (*www.noao.edu/system/altair/files/ALTAIR_Report_Final.pdf*) addressed issues related to US community open-access time on large telescopes having apertures in the range of 6.5 to 10 meters. This time includes Telescope System Instrument Program (TSIP) access to Keck I and II, the Magellan telescopes (Clay and Baade), the MMT, and past access to the Hobby-Eberly Telescope. In addition, the US community has approximately 40% of the observing time on the Gemini North and Gemini South telescopes, which results from the NSF-funded US partnership in the international Gemini Observatory. Two of several recommendations from the ALTAIR report involve both TSIP and US participation in Gemini: 1) increase the TSIP program, and 2) acquire a larger share of the Gemini telescope time provided the instrument suite can be evolved to be more in line with what US astronomers desire. Currently, Gemini access provides the lion's share of open-access large telescope time, accounting for about 200 nights per year in total on the two Gemini telescopes. In order to increase community awareness of what instruments Gemini has offered and to foster discussion over the coming months on possible future instrument capabilities for Gemini, this article presents and discusses historical time and instrument demand on both of the Gemini telescopes, as well as an eye towards future capabilities.

US Demand on the Gemini Telescopes

One straightforward and rather simple metric for a telescope is how heavily requested is the observing time. For the case of US Gemini requests, the oversubscription rates for the two Gemini telescopes for semesters 2004B through 2009B are plotted in figure 1. The oversubscription is defined simply as the ratio of the number of nights requested divided by the number of nights scheduled. The evolution of the oversubscription rate is, in general, similar for the two telescopes past 2005B, with an overall decline in the demand with time: the oversubscription rates stay roughly constant until 2007B and then decline through 2008B. Within the last year, the oversubscription factor on the two telescopes seems to have begun to rebound.

There are a number of issues that have affected the gradual decline in US requested time on Gemini. One point to note is that the average length of proposals has evolved towards smaller time requests, such that the total number of proposals received has not declined to the same extent as the requested time (but the total number of proposals has decreased). The loss of GNIRS on Gemini South significantly affected the US demand on that telescope, as will be discussed in the next section.

US Usage of Instruments

In beginning to plan for future instrument capabilities for the Gemini telescopes into the next decade, it is instructive to view how the US community has used the telescopes, that is, what instruments have been the most heavily used. The breakdown of US awarded nights

continued

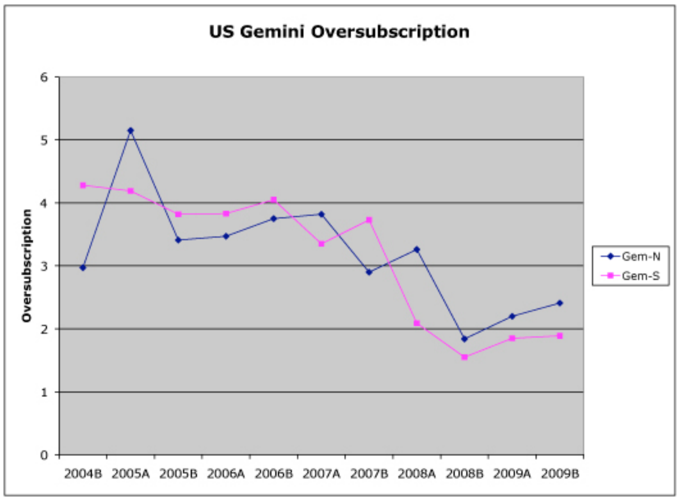


Figure 1: The oversubscription demand for US time on the Gemini telescopes for semesters 2004B through 2009B. The oversubscription rate = (number of nights requested) / (number of nights scheduled).

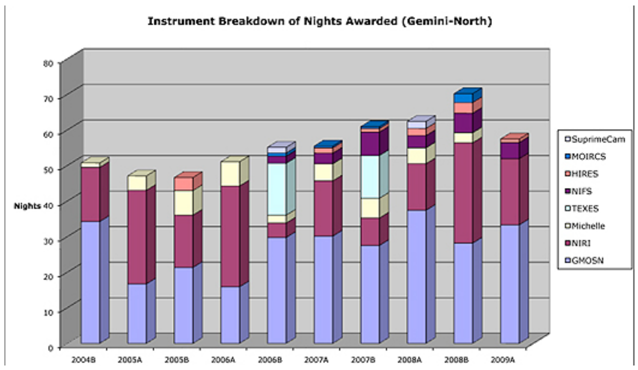


Figure 2: The number of US nights scheduled on Gemini North per instrument for semesters 2004B through 2009A.

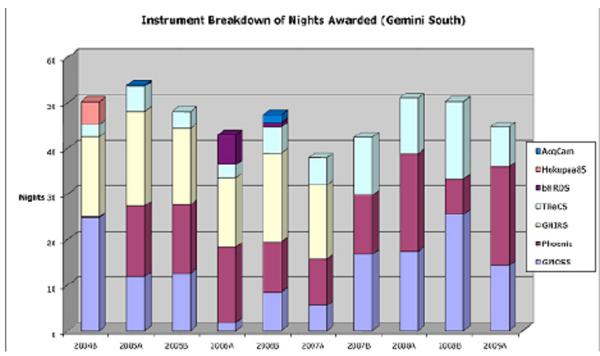


Figure 3: The number of US nights scheduled on Gemini South per instrument for semesters 2004B through 2009A.

US Community Usage of the Gemini Telescopes continued

per instrument since 2004B for Gemini North and Gemini South is shown in figures 2 and 3, respectively. Although these are awarded nights, it should be noted that statistics tracking the fraction of submitted proposals that are awarded time are nearly constant for the different instruments, thus the number of awarded nights closely maps the number of requested nights for that instrument.

There are a few points to take away for the instrument breakdown for Gemini North:

1. In general, GMOS-North is the instrument with the largest number of nights on Gemini North. It has been consistently the most heavily scheduled instrument since 2006B, and it continues its popularity through 2009A.

2. NIRI is a strong second and in some semesters (2005A, 2006A, and 2008B) it has more nights scheduled than GMOS-North. It went through its lowest number of scheduled nights, however, in 2006B and 2007B when TEXES, a very popular instrument with the US community, was a visiting instrument on Gemini North.

3. Time trades of up to five nights with each of the Subaru and Keck telescopes account for the time scheduled for SuprimeCam, MOIRCS, and HIRES. These time trades have been small, so the Gemini scheduled time has been necessarily small, although the HIRES time in particular has been heavily requested by the US community.

In the case of Gemini South, the following points are highlighted:

1. GNIRS, while in operation on Gemini South (until the accident which removed it from service in 2007A), was a very popular instrument with the US users, having a consistently large demand throughout the entire period between 2004B and 2007A. Phoenix was second to GNIRS in number of scheduled nights until 2007A.

2. Beginning in 2007B and continuing on, GMOS-South filled in some of the demand left by GNIRS, but Phoenix continued to be a popular instrument with more nights scheduled than GMOS-South in 2008A and 2009A.

3. T-ReCS saw more nights scheduled after 2008A with the loss of GNIRS. T-ReCS seems to have built a solid base of US mid-infrared (IR) users.

Near-Term Future Gemini Capabilities

With the historical usage of the Gemini telescopes discussed above, it is now worth highlighting the near-term new capabilities that will be arriving at Gemini during the remainder of calendar year 2009 and into 2010. Based on the historical trends presented in this article, it is expected that all of the near-term new capabilities will represent important new observing modes that will be of interest to US observers. The upcoming changes are:

- A repaired and refurbished GNIRS commissioned and deployed on Gemini North. GNIRS was the most requested instrument by US users when on Gemini South, and it is expected that it will be requested and used heavily on Gemini North. As this article is written, GNIRS is undergoing assembly and checkout at Gemini in Hilo, Hawai'i.

- Upgraded CCDs for GMOS on Gemini North. This upgrade for GMOS-North will result in detectors with significantly increased red sensitivity. GMOS represents one of the versatile "workhorse" instruments that the community counts on for routine optical imaging, along with single-slit, multi-object, and integral field unit spectroscopy, so increased sensitivity will revitalize its usage. The installation of new CCDs in GMOS-North will occur during semester 2009B.

- Delivery and commissioning of FLAMINGOS-2 on Gemini South. FLAMINGOS-2 will provide near-IR imaging and multi-object spectroscopy and is currently in the midst of final acceptance testing at the University of Florida (for an update, see the article in this section).

On a somewhat longer timescale (late 2010 and into 2011), a multi-conjugate adaptive optics (MCAO) system will be commissioned and made available for user use on Gemini South. The MCAO system will be used to feed both FLAMINGOS-2 and a high-spatial resolution imager, Gemini South Adaptive Optics Imager. Thus, if most of the above-mentioned capabilities proceed to telescope deployment as planned, the time period from early 2010 to the end of 2010 will see significantly enhanced observing opportunities for the Gemini community.

2012 and Beyond

Even as the Gemini Observatory continues to work on additional future instruments, such as the Gemini Planet Imager, this year will see the beginnings of community discussion on what should be included in the next round of instruments to build and deploy on Gemini in the years beyond 2012. NOAO is in the midst of planning for this discussion later in 2009, with these ideas to be presented for consideration at an NOAO Town Hall meeting during the January 2010 AAS meeting, which will be held in Washington, DC. We urge all of you to monitor the NOAO Web pages for the most recent announcements and updates, as well as to check the NOAO electronic newsletter, *Currents*, for articles concerning the next set of instruments for Gemini.

Band 3 Helpful Hint

Tom Matheson & Ken Hinkle

Band 3 Gemini programs are used to fill up the queue schedule. Hence, every semester, some Band 3 programs will not be observed or not be completed. Here are some strategies that will improve the chances for the success of a Band 3 program.

- Keep the program short. The more time a program needs, the less likely it is to be started. Gemini would prefer to complete programs rather than leave programs partly completed.

- Choose inferior observing conditions. Programs are scheduled to match weather statistics. The available time when seeing is good, skies are clear, and water-vapor content is low is scheduled for programs in Bands 1 and 2. If a program can take advantage of poor conditions when no other programs can be observed, then it has a greater chance of success.

- Be realistic about the observing conditions. The project must still be feasible. Setting all observing constraints to ANY typically is not realistic and will be flagged during the technical review.

Gemini's Poor Weather Queue

Susan Ridgway

"Ill blows the wind that profits nobody." – Henry VI, Part 3, Act 2, Scene 5

Variable weather conditions on Cerro Pachón and Mauna Kea create a great opportunity for observers who have targets that can be observed in queue mode under much poorer than average conditions. The Gemini North and Gemini South queues are often underfilled with conventional Band 1, 2, or 3 program targets for very poor but usable conditions. To supplement these, Gemini accepts proposals for a special "poor weather" (PW) queue at any time (not necessarily linked to the semester timings of the standard proposal process). These proposals must be submitted using the Gemini Phase I Tool (PIT), as they go directly to Gemini, not to any national Time Allocation Committee (TAC). If approved, these poor weather program targets (termed "Band 4") will ONLY be observed when no Band 1, 2, or 3 targets can be done. Also, programs can make it into the PW queue through the national TAC process. If a program is not granted Band 1, 2, or 3 status but has appropriate targets for Band 4, the national TAC can choose to send these on to Gemini as poor weather targets.

What observing constraints qualify a program for the PW queue?

- If you can use very poor seeing, non-photometric weather (and do not need low water vapor): i.e., Image Quality (IQ) = "Any;" Cloud Cover (CC) = 70%, 90% or "Any;" and WV = "Any." (Any phase of the moon is okay: i.e., SB can be 20%, 50%, 80%, or "Any.")

or

- If you can use very cloudy conditions (and do not need low water vapor): i.e., CC = 90% or "Any," and WV = "Any." (Any phase of the moon and any seeing conditions are okay—IQ can be 20%, 70%, 85%, or "Any.")

Thus, mid-infrared observations or any program needing photometric conditions are inappropriate for Band 4. However, programs that can tolerate either very poor seeing or very cloudy conditions can benefit from the existence of the PW queue.

To submit a poor weather proposal using the PIT, at the "submit" step, select "Poor Weather" from the list of partner countries. Poor weather time is not counted against any partner's time allotment. Enter the total time requested and then click "submit proposal" to send it off. These proposals are reviewed by Gemini, not the national TACs.

If your proposal is approved, it will go through the Phase II process required for all queue proposals; you will be assigned a National Gemini Office contact and a Gemini contact who will help you prepare your observations to be ready to enter the queue. Poor weather programs will be assigned a program ID for the semester in which they were submitted, and the targets will stay in the queue for the remainder of that semester. If targets from the proposal fill a necessary gap in the queue planning process, they can be retained over the semester boundary as arranged during the Phase I process and at the discretion of the Heads of Science Operations.

Some hints for getting the best out of the PW queue system:

The PW queue does fill up. Particularly if applying later into the semester, it is probably advisable to check the Gemini home page for "Science Operations Announcements" about openings in the PW queue or, if no information is available, to email the Heads of Science Operations about whether poor weather targets are needed at that time (and at what right ascensions the queue is least filled).

The ability to be scheduled is a key to getting poor weather targets observed—target observations with many timing constraints, for example, probably would not fare well. There are also no "completion" goals for poor weather programs—it is important to be sure you can get science out of any data taken without a guarantee of any percentage of your target list.

continued

Gemini's Poor Weather Queue continued

Gemini scientists experienced with poor weather proposals say that careful preparation of your Phase II, as well as keeping an eye on the progress of the program, can be a key to getting good science. As poor weather conditions are so much more variable than good weather conditions, consultation with your contact scientists about how to prepare your Phase II program with the most flexibility is even more important than for good weather programs. As an example, you might provide the observers with several alternate observations for the same target, depending on the exact CC conditions: e.g., for CC = 70%, integrate so long and use this guide star, but for CC = 90%, integrate longer and use this alternate guide star. The wave-front sensor star must be bright enough to be observed under poor weather conditions.

In summary, if you have targets that would be observable under the poor conditions outlined above, and are willing to put in a little more effort at the Phase II point to enable the best science results, the poor weather queue can be an excellent way to collect observations and help Gemini use all available time.

See the following Web page for details of the proposal submission process: *www.gemini.edu/sciops/observing-with-gemini-new/observing-modes/poor-weather*.

AAS Meeting in Long Beach, January 2009

Ken Hinkle & the NGSC Staff

The scheduling of the winter American Astronomical Society (AAS) meeting coincides with the Gemini proposal Phase II deadline. This allows NGSC to meet with anyone granted US Gemini time to help with Phase II preparation. Many problems can be resolved quickly in person. The AAS also gives us a chance to meet you and talk about Gemini. We encourage you to travel to Washington, D.C., next January for the winter AAS. The entire NGSC staff was present at the Long Beach meeting and we plan on being in Washington in 2010.

Photos of the NOAO booth at the January 2009 AAS meeting in Long Beach. Clockwise from lower-left corner: Susan Ridgway (NGSC) helps Ohad Shemmer (University of North Texas) with his Phase II; Tom Matheson (NGSC) and Abi Saha (NOAO) ham it up for the camera; AURA President Dr. William S. Smith at the adjacent AURA booth; Verne Smith (NGSC Director) discusses atmospheric transmission in the infrared with Jeff Crane (Carnegie Observatories) and Peter Frinchaboy (University of Wisconsin-Madison); Sally Adams (NGSC; off camera) greets Chick Woodward (University of Minnesota); and Dara Norman (NGSC) helps Paul Thorman (University of New Mexico) with his Phase II.

NGSC Instrumentation Program Update

Verne Smith & Mark Trueblood

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

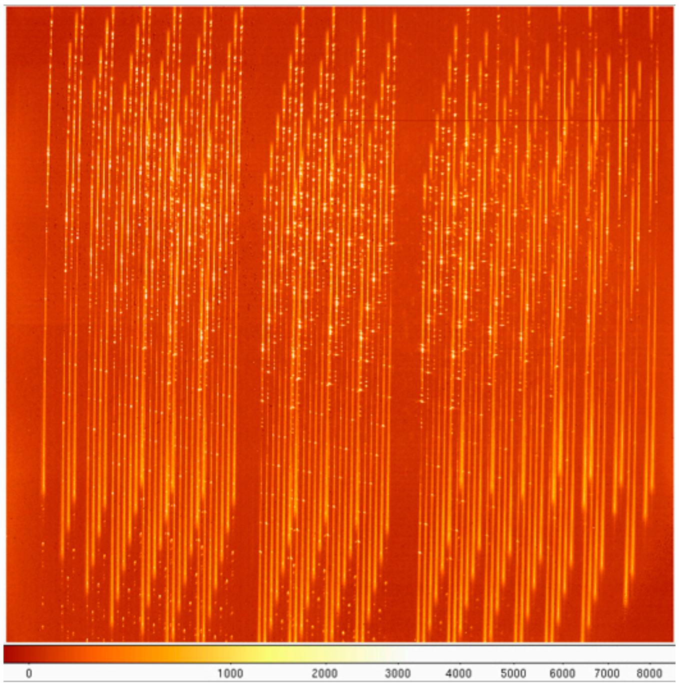
FLAMINGOS-2

The Florida Multi-Object Imaging Near-Infrared Grism Observational Spectrometer (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.

Considerable progress was made at the second Pre-ship Acceptance Test (AT) held in Gainesville, Florida, 15–18 December 2008. At the end of that test, approximately three-quarters of the requirements had been successfully tested and passed. However, several test items remained at the conclusion of that week of testing, due primarily to mechanical misalignments and other issues.

Since then, the University of Florida FLAMINGOS-2 Team has been hard at work improving the performance and reliability of mechanisms and testing the instrument to ensure that it will pass its remaining acceptance tests.

As a result, a third AT is scheduled (as of this writing) for 5–8 May 2009. Assuming the remaining test items are completed, the instrument will be partially disassembled (e.g., electronics cabinets and the Dewars removed from the mounting frame), major subsystems placed into large shipping containers, and the instrument shipped



FLAMINGOS-2 multi-object spectrum of sunlight plus krypton line source formed using a pinhole mask during testing.

to Cerro Pachón in Chile. Arrival is expected in June. This will be followed by a period of reassembly and checkout in the Gemini instrument lab accompanied by training of Gemini instrumentation personnel by the University of Florida FLAMINGOS-2 Team. After checkout in the instrument lab, the instrument will be mounted on the Gemini Instrument Support Structure and Final Acceptance Testing will proceed.

2009B Proposal Update

Dave Bell

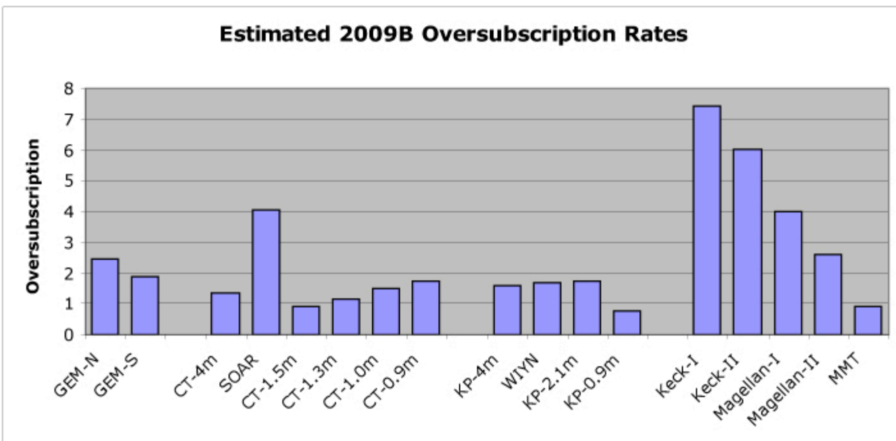
NOAO received 419 observing proposals for telescope time during the 2009B observing semester. Observatory and panel breakdown statistics, estimated telescope oversubscription rates (nights requested / nights expected to be available), and time-request statistics by telescope and instrument appear in the chart and table below. Final subscription rate statistics will be published in the September 2009 edition of this *Newsletter*.

As seen in the chart below, Keck continues to be the most heavily oversubscribed resource. MMT and Magellan subscription rates vary greatly due to small-number statistics, so it would be dangerous to draw conclusions regarding community interest from a single semester (e.g., In 2009A, MMT was the most oversubscribed of the three 6.5-meter telescopes). The rate for the Mayall 4-meter telescope is lower than recent semesters, with more nights now available, and the SOAR rate is higher, with fewer nights available due to a major shutdown for re-aluminization. When available time changes significantly, as in these cases, there is often a one-semester jump or drop in oversubscription that will adjust back in the following semesters. A discussion of historical Gemini subscription rates can be found in the NGSC section ("US Community Usage…") of this *Newsletter.*

Proposals were reviewed in May by members of the NOAO Time Allocation Committee (see list on next page). Telescope schedules should be completed by 11 June 2009, and principle investigators will be notified of the status of their requests at that time.

Looking ahead to 2010A, Web information and forms will be available online around August 15. The September issue of this *Newsletter* will contain updated instrument and proposal information.

NOAO Observing Proposals 2009B	
Total Number	**419**
Extragalactic	189
Galactic	183
Solar System	47
Gemini	179
KPNO	94
CTIO	84
Keck	56
Magellan	15
MMT	7
Thesis	93
Long-term	16



NOAO Survey Program Letters of Intent Due July 31

Tod R. Lauer & Dave De Young

Proposals for the next round of the NOAO Survey Program are due 15 September 2009. Investigators interested in applying for time under the Survey Program MUST submit by 31 July 2009 a letter of intent (by email to *surveys@noao.edu*) describing the broad scientific goals of the program, the members and institutions of the survey team, the telescopes and instruments to be requested, the approximate amount of time that will be requested, and the duration of the proposed survey.

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

Up to 20 percent of a particular telescope resource at CTIO and KPNO may be awarded through the Survey Program, including time allocated in the earlier rounds to continuing programs. A more detailed description of the Survey Program requirements and guidelines is available at *www.noao.edu/gateway/surveys/*. Proposals must be initiated using the NOAO Web proposal form at *www.noao.edu/noaoprop/noaoprop.html*, which will be available approximately 15 August 2009.

"What's Happening to My Proposal?"
(An Overview of the NOAO Scheduling Process)

Dave Bell

In the March 2009 *Newsletter*, Letizia Stanghellini presented an overview of the NOAO Time Allocation Committee (TAC) process, in which ~400 observing proposals are discussed, assessed, and ranked. Immediately following the TAC meetings, the scheduling process begins in which the TAC comments and rankings are used to produce classical telescope schedules and observing queues. This process currently involves over fifty instruments on eighteen telescopes at nine observatories, each with its own set of constraints. One common characteristic is that the rankings and time available cannot be used immediately to determine a strict cutoff rank, above which all programs can be accommodated. Instead, schedulers must use the TAC results to attempt to maximize each telescope's scientific return while meeting the constraints imposed by each observatory, telescope, instrument, and program.

When assigning a night, the scheduler considers target coordinates, lunar phase, and other constraints imposed by the scientific program (e.g., time-critical or coordinated observations). Also important, however, are constraints imposed by limited observatory resources, such as minimizing instrument changes and ensuring that sufficient staff expertise will be available to support new observers. As most telescopes are shared, schedulers usually must consider all this while balancing the demands of several partner institutions. In some cases, these concerns will require trimming or augmenting a program by a night or two, or skipping over a program to a lower ranked one that fits better. In most cases, the top-ranked programs will be assigned nearer to their optimal dates and be allowed to drive the instrument schedule.

You might ask, "Why was I scheduled in June when my targets are up in March?" Most likely there was a good reason—other programs also needed March, or perhaps you had the only March request for a less popular instrument and scheduling it then was not optimal. The scheduler determined that you would have enough available targets or ancillary science to make productive use of the nights, even if they are not ideally suited. If your program had not been deemed meritorious, it would, perhaps, have been replaced with another with June targets, so that should be some consolation.

For telescopes that are largely queue-scheduled, the process is much simpler and less time consuming. Care must still be taken not to overload the queue with programs needing the same limited resources or conditions. As is the case for classically scheduled nights, virtually all Gemini queue programs of higher rank will make it into the queue, but programs in Band 3 will often be selected if their tolerance for non-ideal conditions is less restrictive than some higher ranked programs.

This scheduling process runs in parallel at each observatory, sometimes requiring a few iterations of producing draft schedules and having them approved by several parties. Completed schedules are collected at NOAO and entered in our database, and, finally, schedules and an approved program list are published on the Web and notifications sent out by email. Usually, this will occur about one month after the TAC meetings, though in some semesters a last-second issue (like an instrument problem) will require a major rewrite causing target release dates to be missed. Your patience is appreciated during this difficult and time-consuming process. If your program does not make it onto the schedule, you are encouraged to resubmit. As subscription rates and the other factors discussed above will fluctuate, proposals that could not be scheduled in one semester will often fare better in another.

2009B Time Allocation Committee Members

Solar System (April 30-May 1, 2009)

David Trilling, Chair, Univ. of Arizona, Steward
Travis Barman, Lowell Observatory
Joe Harrington, Univ. of Central Florida
Amanda Hendrix, CalTech, JPL
Bill Merline, Southwest Research Institute
Beatrice Mueller, Planetary Science Institute

Extragalactic (May 4-5, 2009)

Jill Bechtold, Chair, Univ. of Arizona, Steward
Romeel Dave, Chair, Univ. of Arizona, Steward
Tod Lauer, Chair, NOAO
Mariangela Bernardi, Univ. of Pennsylvania
John Blakeslee, Herzberg Institue of Astrophysics
Ranga-Ram Chary, Spitzer Science Center
Mike Eracleous, Pennsylvania State Univ.
Karl Gebhardt, Univ. of Texas, Austin
Andy Howell, Univ. of Toronto
Lisa Kewley, Univ. of Hawai'i, IfA
Jennifer Lotz, NOAO
Casey Papovich, Texas A & M Univ.
Tom Statler. Ohio Univ.
Daniel Stern, Caltech/JPL
Alan Stockton, Univ. of Hawai'i, IfA
Louis Strolger, Western Kentucky Univ.
Pieter van Dokkum, Yale Univ.
Liese van Zee, Indiana Univ.

Galactic (May 6-7, 2009)

Ata Sarajedini, Chair, Univ. of Florida
Jeff Valenti, Chair, STScI
Sidney Wolff, Chair, NOAO
Bob Blum, NOAO
Howard Bond, STScI
Michael Briley, Univ. of Wisconsin
Geoffrey Clayton, Louisiana State Univ.
Anne Cowley, Arizona State Univ.
Moshe Elitzur, Univ. of Kentucky
Chris Johns-Krull, Rice Univ.
Jennifer Johnson, Ohio State Univ.
Steve Kawaler, Iowa State Univ.
Sebastien Lepine, American Museum of Nat. History
Phil Massey, Lowell Observatory
Simon Schuler, NOAO
Bill Sherry, NSO
Tammy Smecker-Hane, Univ. of California, Irvine
Stefanie Wachter, Spitzer Science Center

2009B Instrument Request Statistics by Telescope Standard Proposals

Gemini Observatory

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
GEM-N		**118**	**153**	**151.4**	**48.4**	**32**	**1**
	GMOSN	50	63	69.1	43.4	63	1.1
	MOIRCS	1	1	2	0	0	2
	Michelle	21	29	21.6	0	0	0.7
	NIFS	11	11	15.6	0	0	1.4
	NIRI	41	47	39.4	2	5	0.8
	SuprimeCam	2	2	3.8	3	80	1.9
GEM-S		**73**	**93**	**104.2**	**48.7**	**47**	**1.1**
	GMOSS	37	45	54.5	44.7	82	1.2
	NICI	9	10	14	0	0	1.4
	Phoenix	10	14	12.4	0	0	0.9
	TReCS	18	24	23.3	4	17	1

Kitt Peak National Observatory

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
KP-4m		**44**	**51**	**192**	**53.5**	**28**	**3.8**
	ECH	2	2	13	0	0	6.5
	FLMN	5	5	21	0	0	4.2
	MARS	1	1	2	0	0	2
	MOSA	11	14	50.5	43.5	86	3.6
	NEWFIRM	13	14	56.5	0	0	4
	RCSP	13	15	49	10	20	3.3
WIYN		**22**	**29**	**94.2**	**23**	**24**	**3.2**
	HYDR	5	6	15	9	60	2.5
	MIMO	4	8	40	6	15	5
	OPTIC	5	5	13	8	62	2.6
	SPSPK	1	1	4	0	0	4
	VIS	2	2	6	0	0	3
	WHIRC	5	7	16.2	0	0	2.3
KP-2.1m		**29**	**40**	**231**	**61**	**26**	**5.8**
	CFIM	10	16	92	53	58	5.8
	ET	3	7	49	0	0	7
	FLMN	3	3	19	0	0	6.3
	GCAM	10	11	54	8	15	4.9
	SQIID	1	1	3	0	0	3
	VIS	2	2	14	0	0	7
KP-0.9m		**4**	**4**	**15**	**6**	**40**	**3.8**
	MOSA	4	4	15	6	40	3.8

Cerro Tololo InterAmerican Observatory

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
CT-4m		**35**	**42**	**178**	**95.5**	**54**	**4.2**
	HYDRA	9	10	36	18	50	3.6
	ISPI	6	6	41.5	0	0	6.9
	Mosaic	20	22	91.5	77.5	85	4.2
	RCSP	3	3	6	0	0	2
	VIS	1	1	3	0	0	3
SOAR		**30**	**33**	**114.6**	**38**	**33**	**3.5**
	Goodman	15	16	62.1	20	32	3.9
	OSIRIS	7	7	18.5	0	0	2.6
	SOI	10	10	34	18	53	3.4
CT-1.5m		**4**	**5**	**19**	**0**	**0**	**3.8**
	CSPEC	4	4	18	0	0	4.5
	FECH	1	1	1	0	0	1
CT-1.3m		**8**	**8**	**35.3**	**0**	**0**	**4.4**
	ANDI	8	8	35.3	0	0	4.4
CT 1.0m		**6**	**8**	**71**	**43**	**61**	**8.9**
	CFIM	6	8	71	43	61	8.9
CT-0.9m		**10**	**16**	**59**	**29.9**	**51**	**3.7**
	CFIM	10	16	59	29.9	51	3.7

Community Access Observatories

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
Keck-I		**31**	**33**	**52.5**	**18.5**	**35**	**1.6**
	HIRES	15	17	27.5	4	15	1.6
	IF	5	5	5.5	0	0	1.1
	LRIS	10	10	18.5	14.5	78	1.9
	NIRC	1	1	1	0	0	1
Keck-II		**30**	**33**	**42.1**	**9.5**	**23**	**1.3**
	DEIMOS	6	6	10.5	8.5	81	1.8
	IF	5	5	5.5	1	18	1.1
	NIRC2-LGS	3	4	3.5	0	0	0.9
	NIRC2-NGS	5	5	5.1	0	0	1
	NIRSPAO-NGS	1	1	1	0	0	1
	NIRSPEC	11	11	15.5	0	0	1.4
	OSIRIS-LGS	1	1	1	0	0	1
Magellan-I		**9**	**9**	**20**	**16**	**80**	**2.2**
	IMACS	8	8	18	16	89	2.2
	PANIC	1	1	2	0	0	2
Magellan-II		**6**	**6**	**13**	**4**	**31**	**2.2**
	MIKE	4	4	7	0	0	1.8
	MagE	2	2	6	4	67	3
MMT		**7**	**8**	**13.9**	**9**	**65**	**1.7**
	BCHAN	2	2	6	6	100	3
	Hectochelle	4	4	4.3	0	0	1.1
	Hectospec	2	2	3.6	3	83	1.8

The Science Data Management Program

Christopher J. Miller & Elizabeth Stobie

In 2002, NOAO recognized the need to ensure that data taken at NOAO facilities be made available to the community. To address the trends of increased data volumes and their archival value, the NOAO 2002–2006 Long Range Plan introduced the Data Products Program (DPP). The long-term direction of the program foresaw a shift away from core IRAF software development to archive software and applications.

In the 2003 NOAO Long Range Plan, DPP identified its major goals: build an NOAO archive; build image reduction pipelines for Mosaic and the NEWFIRM wide-field infrared imager; and build the data management infrastructure to store, protect, and serve the data from the optical/infrared (O/IR) community.

In October 2008, DPP was re-organized to become the Science Data Management (SDM) program. In this process, the broad mission to meet the software and data management needs of the O/IR astronomical community was re-scoped into a set of specific mandates for the immediate and near-term future needs of the NOAO community. So where do things stand today with respect to the original DPP major initiatives?

The NOAO Science Archive debuted in 2002 and provides public access to over 70,000 science-ready, PI-reduced images from 15 different NOAO Survey Programs and community programs. *www.archive.noao.edu/nsa*

A Data Transport System (DTS) replaced the tape-based "Save The Bits" safe store. The DTS on spinning disk contains over 2.3 million files and 19 terabytes of compressed data dating back to 2004. This system now forms the backbone of the NOAO Archive.

The NOAO Archive now provides Web-based access to all NOAO raw data and pipeline-reduced Mosaic data (nearly 300,000 files as of June 2009). Besides secure access for primary investigators (PIs) to their proprietary data, thousands of public Mosaic and NEWFIRM raw data sets and ~1.5 million Virtual Observatory science-ready images are accessible. *www.portal-nvo.noao.edu*

The NEWFIRM Quick Reduce Pipeline (QRP) has been integrated into the NEWFIRM data acquisition system at the telescope so that observers can view their data in near real time. *www.noao.edu/ets/newfirm*

The new NOAO mandate to SDM is focused on the current and near-term future needs of the NOAO community. These mandates will advance the current SDM infrastructure to include the newest NOAO instrumentation: NEWFIRM and the Dark Energy Camera (DECam), both of which require a working and scalable archive, as well as science pipelines to provide on-the-fly reduced data sets to observers. This is precisely the mission DPP started in 2003. Past progress made by DPP is enabling SDM to move quickly.

SDM is working hard to create a NEWFIRM science pipeline as well as a NEWFIRM IRAF software package and guide to data reduction. Both of these efforts are nearing completion. In the 2009B observing semester, NEWFIRM observers will be provided access to their pipeline-reduced NEWFIRM images for science verification. In this *Newsletter*, we announce the availability of the first draft of the NEWFIRM guide to data reduction and an associated IRAF package.

Next on the horizon: DECam will be integrated into the current SDM infrastructure. In doing so, SDM will improve its data transport system to move the large volume of DECam raw data from CTIO to Tucson and the National Center for Supercomputing Applications (University of Illinois at Urbana-Champaign) on a nightly basis. The DECam nightly data volume will be significantly larger than all other CTIO data combined. At the same time, SDM will be integrating the DECam Community Pipeline into its infrastructure so that DECam observers will have quick access to their reduced datasets. In tandem with the pipeline integration, SDM will make enhancements to the NOAO Archive to facilitate fast and easy access to DECam raw and reduced data sets.

By the end of 2010, SDM envisions that NOAO PIs will routinely use the NOAO Archive to query and retrieve their raw NOAO data; Mosaic and NEWFIRM PIs will utilize their pipeline-reduced data products in their scientific analyses; and SDM will be ready to operate the DECam Community Pipeline.

In the meantime, we encourage everyone in the astronomical community to try the NOAO archives (*www.archive.noao.edu*). On your next observing run, leave your tapes and DVDs at home and use the archive to electronically transfer your data to yourself and your collaborators. Use the NOAO Archive to download and evaluate some of the publicly available Mosaic reductions. As always, we are eager to hear your comments, questions, and suggestions: email *vohelp@noao.edu*.

The New NOAO Archive

Christopher J. Miller & Elizabeth Stobie

The Science Data Management (SDM) program within NOAO is pleased to announce the release of the new NOAO Archive (available at *www.archive.noao.edu*). NOAO principal investigators (PIs) can now access their raw data taken on NOAO instruments within 24 hours of their observations.

No more tapes or DVDs. SDM protects and serves your raw data electronically.

Formerly known as the Data Products Program (see related article in this *Newsletter*), SDM has a long track record of safely storing data taken on NOAO instruments through its "Save The Bits" (iSTB) software. Behind the scenes on most NOAO instruments, iSTB moves data from the mountaintops to spinning disks in Tucson, AZ, and La Serena, Chile. A third copy of every file is placed in deep storage at the National Center for Supercomputing Applications.

SDM has completed its goal to modernize this system and provide Web-based archival access to raw data for all NOAO PIs as well as to the public. The proprietary period of all data is protected in accordance with NOAO policy (*www.noao.edu/noaoprop/help/datarights.html*). New users of the system will receive an email from SDM asking them to register one time with the Single-Sign-On services of the US Virtual Observatory (*www.us-vo.org*) to access their proprietary data. After this one-time initial registration, NOAO PIs can access any data from future observing runs as well. The NOAO Archive is accessible via a Firefox browser at: *www.archive.noao.edu*.

Public access to thousands of NEWFIRM and Mosaic raw images.

For non-PIs, the NOAO Archive utilizes the NOAO Virtual Observatory (VO) Portal (*portal-nvo.noao.edu*) to provide easy access to a variety of VO imaging archives like SDSS, HST, XMM, and Chandra. Non-PIs can also query for thousands of NEWFIRM and Mosaic raw data taken during the scientific verification stage of the NOAO Archive project (prior to 1 January 2008). As time goes on, more and more data will become public in the NOAO Archive as the standard 18-month proprietary periods expire.

Quicker science results via automatically reduced imaging data for Mosaic.

The NOAO Archive has also integrated the Mosaic pipeline into its operations. The pipeline runs automatically on all Mosaic data taken on the Blanco and Mayall 4-meter telescopes. Once the data are pipeline-reduced, the calibrated images, stacks, masks, and master calibrations are all ingested back into the NOAO Archive. PIs can access their reduced Mosaic data within 48 hours after the end of their observing run. Anyone interested in examining the quality of the data products from the Mosaic pipeline should read the *NOAO Data Handbook* and download examples from the non-proprietary, reduced data available in the NOAO Archive.

No more media. No more worries of lost data. No more reasons to store extra copies. Analyze the reduced Mosaic data within 48 hours of the observing run.

The NOAO Archive was designed and developed to meet the needs of both the NOAO community and the astronomical community at large. It forms the basis for future SDM mandates such as the inclusion of pipeline-reduced NEWFIRM images as well as access to raw and reduced data from the Dark Energy Camera.

On future observing runs, keep an eye out for an email from NOAO announcing the availability of data for your run from the NOAO Archive. SDM is always interested in the user experience, so please send feedback to *vohelp@noao.edu*.

NEWFIRM Reduced Data Sets Are Now Available

Principal investigators (PIs) observing with NEWFIRM will be receiving emails from NOAO Science Data Management regarding the availability of their pipeline-reduced data products. The NEWFIRM Science Pipeline is undergoing science verification, and PIs are encouraged to download and examine their reduced images. Please send all feedback to: *vohelp@noao.edu*.

The NEWFIRM Guide to Data Reduction Is Now Available

Science Data Management announces the first draft version of a NEWFIRM data reduction guidebook. This guide utilizes the new near-infrared IRAF external package called NFEXTERN. Users can download publicly available NEWFIRM raw data sets using the Archive to try out the new guide and the new IRAF package.

Please send feedback to: *vohelp@noao.edu*

The NEWFIRM Guide to Data Reduction is at: *www.noao.edu/ets/newfirm.*

The NFEXTERN IRAF Package is at: *iraf.noao.edu/extern.html.*

NOAO Data Handbook Updated

Dick Shaw

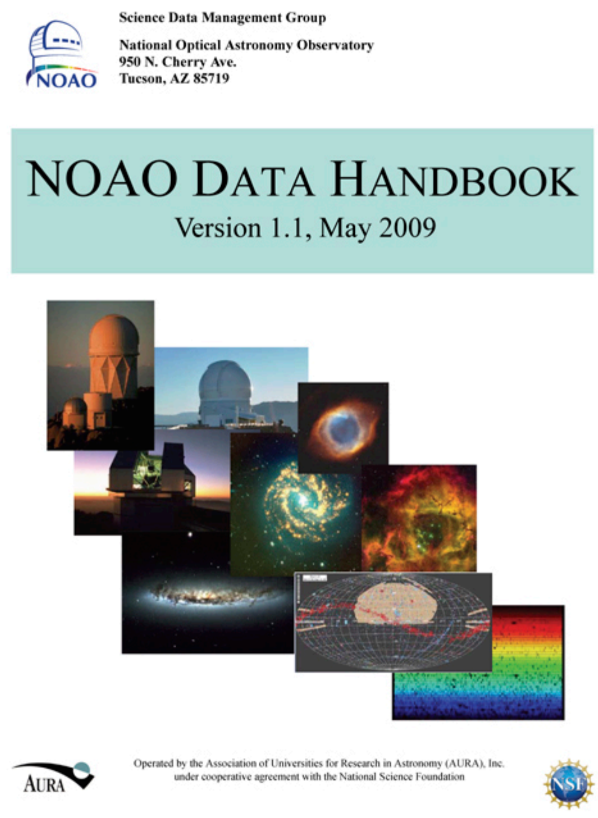
A new version is now available of the *NOAO Data Handbook*, which describes the scientific content and structure of archived data products and the means to access them from the Archive. The content of the handbook includes:

A chapter on archived NOAO data products with:
- a summary of the data types and processing levels;
- a description of the formats;
- a description of the archive registration process; and
- detailed examples of how to query, access, and download raw or reduced data from all instruments using the NOAO VO Portal.

A chapter on the Mosaic cameras with:
- an overview of the instruments and their most common operating modes;
- a description of the data products that are produced by the Mosaic pipeline reductions;
- a description of the pipeline processing steps, including the creation of Master Calibration files; and
- a summary of the accuracies to be expected in the reduced science products, plus instrument foibles.

A new chapter that covers data products from the NEWFIRM camera will be released soon. The Handbook provides enough detail for principal investigator teams of NOAO observing programs to make informed use of these data products and services for scientific analysis. Likewise, it will enable general Virtual Observatory users, who may not be familiar with the instruments (or who may be new to the optical/infrared wavelength regime), to make scientific use of these data products.

Access the latest version of the *NOAO Data Handbook* at: *www.archive.noao.edu/help.html.*



Speckle Interferometry at SOAR

Andrei Tokovinin

Speckle interferometry is an observing technique that reaches diffraction-limited resolution in the visible, for relatively bright targets. This method has a well-established niche between long-baseline interferometers (higher resolution on even brighter stars), adaptive optics in the near-infrared, and the Hubble Space Telescope. Nearly all modern observations of visual binaries are done with speckle.

Two successful speckle runs have been completed at the SOAR 4.1-meter telescope in October 2008 and April 2009. A very simple camera (Tokovinin & Cantarutti, 2008, PASP, 120, 170) with electron-multiplication CCD, interfaced to a standard PC via USB (figure 1) was used to acquire a series of short-exposure images where individual photon events stand above the readout noise. The pixel scale is 15 milliarcseconds. With narrowband filters, binaries of V = 10 magnitude are easily accessible. The software developed by R. Cantarutti has the full functionality required for operating this instrument and, most importantly, a built-in quick-look image processing to evaluate the result immediately after taking the data.

Accumulation of the data cube takes only a few seconds. With optimized strategy, more than 100 stars per night can be observed, beating in productivity current adaptive optics systems and resolving binaries down to a 20-milliarcsecond separation. Hundreds of binaries were measured during two SOAR runs. A dozen new components or sub-systems were discovered, changing our view of nearby multiple stars. Owing to its high dynamic range, our camera detects close companions that are five magnitudes fainter than their primary stars. It delivers relative astrometry accurate to one milliarcsecond, as well as relative photometry of close binaries.

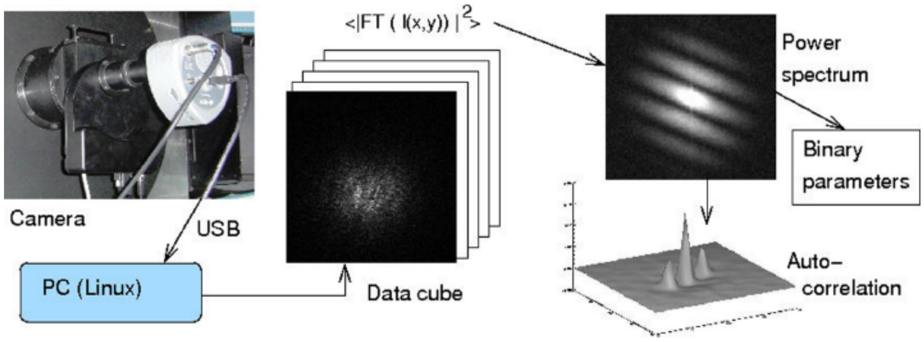


Figure 1: Data flow from telescope through image processing to final result. The binary FIN 334Aa illustrated here had separation of 0.102 arcseconds.

The speckle camera has been developed for work with the SOAR Adaptive Module (SAM). The number of photons per speckle is inversely proportional to the cube of the image size, so a gain of two times in resolution translates to eight times in sensitivity. We shall further boost the sensitivity by using wider filters (this is prevented now by the lack of an atmospheric dispersion corrector) or a better detector. While SAM by itself will not reach the diffraction limit in the visible (especially with a laser guide star), its combination with the speckle camera will bridge this gap, opening a unique science opportunity. Figure 2 illustrates this future capability with the data taken under 0.5-arcsecond seeing in April 2009. Meanwhile, the stand-alone speckle camera can be used as a "visitor instrument" at SOAR.

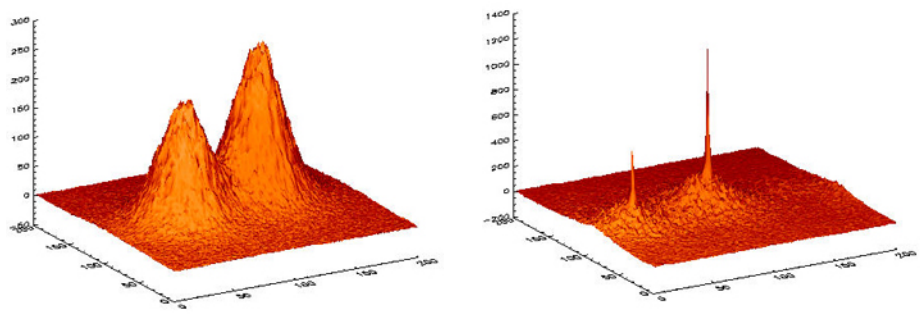


Figure 2: Short-exposure images of the 1.08″ binary star were co-added with re-centering on the global centroid (left), or on the brightest pixel, selecting the sharpest 10 percent of images (right). The latter method, recently dubbed "lucky imaging," is slowly gaining popularity. Here it is applied at the SOAR 4.1-meter telescope at a 540-nanometer wavelength under very good seeing. Similar performance will be achieved routinely by pre-compensating images with SAM, as was already demonstrated at the Palomar 5-meter telescope.

Final Integration & Testing of the SOAR Adaptive Module (SAM) Preparing for Commissioning in NGS Mode

The SAM Team

After a successful first integration & testing round, the SOAR Adaptive Module (SAM) was disassembled to permit last modifications and improvements, products of the analysis of the instrument performance during the testing. The main module was anodized in our shops, and is now colored a distinguished gray on the outside, while the inside is painted black. In mid-April the main module returned to the laboratory where SAM will be re-assembled, aligned, and tested during the coming months. SAM is on schedule to be taken to the SOAR 4.1-meter telescope for the first commissioning run in August, during which the instrument will operate in Natural Guide Star mode.

During the break in testing for modifications and anodizing, Roberto Tighe and Andrei Tokovinin made extensive laboratory tests on the recently received 10-Watt ultraviolet laser, which has passed all requirements successfully. This will permit the design of the laser box to proceed.

For updates and pictures on the integration of SAM, go to: *www.ctio.noao.edu/new/Telescopes/SOAR/Instruments/SAM/.*

Andrei Tokovinin and Roberto Tighe working in the Optics Laboratory with the Laser Test Set-up.

WHAM Installed on Cerro Tololo

Matt Haffner & Ron Reynolds (University of Wisconsin)

After an extremely successful eleven years surveying the northern sky from Kitt Peak, the Wisconsin H-Alpha Mapper (WHAM) began operation from CTIO in March. A smooth port arrival and two-week installation was made possible by outstanding help from CTIO and AURA Observatory Support Services staffs. Final testing and commissioning of WHAM's fully-remote observations are progressing with full operation expected by mid-year.

WHAM will devote much of its first two years at Cerro Tololo to finishing an all-sky Balmer-alpha spectroscopic survey of the diffuse ionized gas of the Milky Way. However, its multi-wavelength, wide-field Fabry-Perot spectrometer has proved to be an extremely powerful tool for a variety of astronomical and aeronomy projects. In particular, from its new southern location, WHAM will not only be exploring the unique features of the southern Galaxy, but will also be able to study the extended ionized environment of the Magellanic Clouds, Bridge, and Stream.

WHAM being tested during full moon at Cerro Tololo with the Blanco 4-meter telescope in the background. (Image credit: Alex Hill)

More information about the project can be found at: *www.astro.wisc.edu/wham/*

50 Years Serving the Astronomy Community

Elizabeth Alvarez & Buell T. Jannuzi

From left to right: Arlo Landolt at the KPNO 16-inch telescope in 1959. Arlo Landolt at KPNO in March 2009. Photo by Doug Williams. In honor of Arlo Landolt's 50 years of observing at KPNO, during his latest run in April 2009, Buell Jannuzi (left) presented Arlo (right) with a composite showing aspects of past visits.

In the midst of celebrating our 50-year anniversary, we at KPNO have been honored to have two special friends and colleagues observing here again this semester. Seeing Arlo Landolt and Vera Rubin, both well known for their service in astronomy, reminds us why astronomers wanted a national observatory and of the continued services it provides to our community.

In June 1959, Arlo Landolt, then from Indiana University, became the first graduate student to use Kitt Peak for his thesis research. His inaugural observations were with the observatory's 16-inch telescope (see "The NOAO 16-Inch Telescopes" in this section). For accommodations, he enjoyed a small trailer. Less than a year later on 15 March 1960, Kitt Peak National Observatory was dedicated.

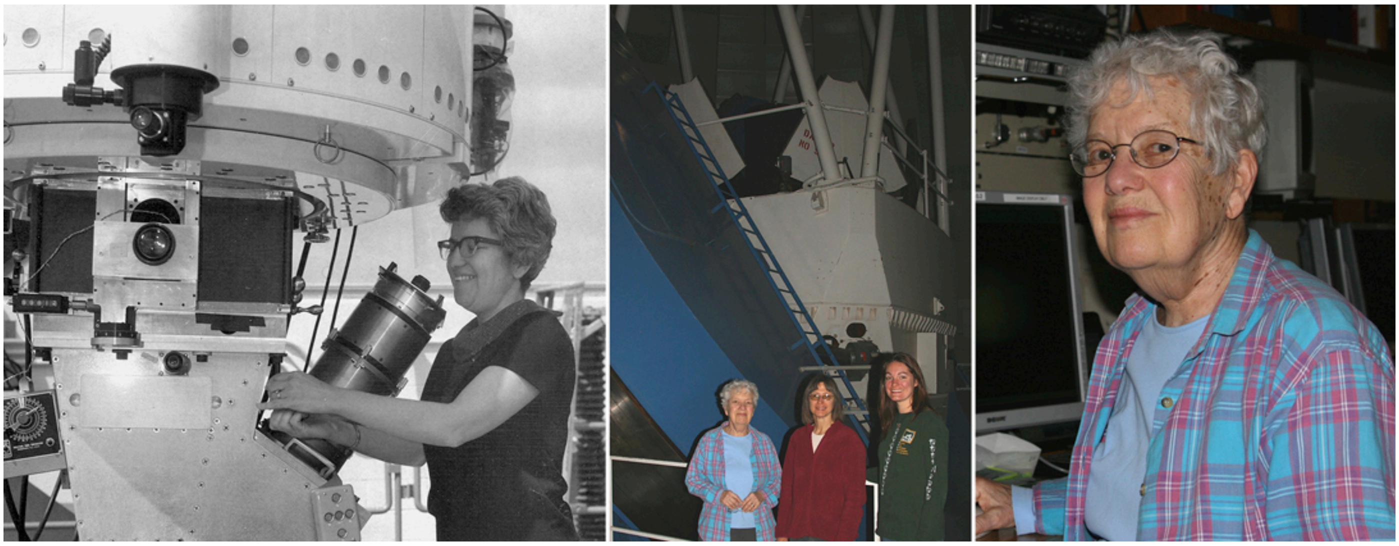
As Arlo related to us via email:

> Prior to the invention of the national observatories concept, only a handful of U.S. astronomers from half a dozen or so institutions had…access to telescopes, period, let alone telescopes at good climate sites. I was fortunate to be a graduate student at an institution, Indiana University, which had two faculty members interested in and working toward the concept of a national optical observatory: Frank K. Edmondson and John B. Irwin. Edmondson more from the administrative point of view and Irwin pushed for a high altitude site in a good climate that would be conducive to high quality photometric work. This was UBV photoelectric work, in the mid-1950s.
>
> My career has been spent at a large public state university in a poor climate for astronomical observations, so being able to observe for 50 years at Kitt Peak and Cerro Tololo has allowed me to participate in the fun and excitement of optical observational astronomy. I've been able to obtain high quality data via state-of-the-art instrumentation on projects of value to the community. The historical necessity of being on the mountain site at the telescope has facilitated the interaction with astronomers from around the country, and to some extent, from around the world. Networking, made more interesting and meaningful by interactions with leading observers of the era, Stromgren, de Vaucouleur, Aller, Kraft, etc., proved inspiring. Such networking is of inestimable importance in science, teaching, and community service.
>
> One cannot overemphasize how the need to be at the telescope facilitated interactions with other astronomers. Cloudy nights spent in the library and kitchen talking astronomy were of the highest educational value. Such interactions broadened one's perspective as to projects of importance from the solar system to the stars, to galaxies, and to the cosmos. Further, the necessity of being at the telescope meant one learned first-hand about data acquisition, and gained a feeling obtainable no other way to the reasonableness of and quality of the data, learned from experiencing the environment in which the data were taken.

Arlo, now at Louisiana State University, is using the KPNO 2.1-meter telescope this semester for his ongoing program of establishing photometric sequences over a 35-year period, using CCDs these days instead of photomultiplier tubes. He notes that, "Along the way arose opportunities for the serendipitous discovery of interesting objects like the discovery of the first known variable white dwarf star and the discovery of the variability of the helium/hydrogen-deficient stars. Others had similar good fortune… made possible by state-of-the-art equipment located in good climates, together with adequate opportunities to observe, a

continued

50 Years Serving the Astronomy Community continued



From left to right: Vera Rubin at the KPNO 2.1-meter telescope, using the Department of Terrestrial Magnetism image tube spectrograph, which was designed and built by the Carnegie Institution of Washington (1965–1970). Vera Rubin, Deidre Hunter, and Megan Jackson at KPNO in April 2009. Photo by Daryl Willmarth. Vera Rubin at KPNO in April 2009.

combination that enables such worthwhile discoveries of scientific interest."

Our national observatory was founded in 1958 with the help of the Tohono O'odham Nation and funding from the National Science Foundation. The new national observatory provided peer-reviewed access to the opportunity to conduct astronomical research based on the merit of the ideas of the researchers proposing to use the facilities. Such access enabled researchers their first equal access to world-class facilities. Among the researchers to utilize our facilities with distinction is Vera Rubin, whose work at Kitt Peak demonstrated the important role of Dark Matter in determining the properties of galaxies.

This April, we enjoyed seeing Vera Rubin on the mountain again as well. Working with her were graduate student Megan Jackson (George State University) and Deidre Hunter (Lowell Observatory). Megan is a participant in the Lowell Observatory pre-doctoral program and working on her thesis program (on the stellar structure of dwarf irregular galaxies) with Deidre and Vera. Deidre has worked with Vera for many years, including early in her career as a post-doctoral researcher. In the center image above, three generations of astronomers, Deidre, Megan, and Vera are at the Mayall 4-meter telescope before their night of observing in April 2009. For 50 years KPNO has been serving the needs of all astronomers and we work to ensure that this proud legacy will continue in the future.

As we have been marking the first 50 years of KPNO, we have enjoyed hearing from many of you about your past experiences with the observatory. Please share your reminiscences and what the observatory has meant to you at *www.noao.edu/kp50*. NL

The NOAO 16-Inch Telescopes

John Glaspey, Don Carona (Texas A&M University) & Buell T. Jannuzi

The astronomical community has an ever-increasing appetite for more observing time on telescopes of all apertures, small or large. Today, large aperture certainly means 8 to 10 meters, but soon it might refer to primary mirrors with diameters of 20, 30, or 42 meters. The new "small" might be 4-meter primary mirrors. Fifty years ago, however, the immediate goals of the new national observatory were more modest. The early operational telescopes at what became KPNO and CTIO were only 16 inches in aperture.

While many of us think of the long-used Boller & Chivens (B&C) telescopes, the first two 16-inch telescopes deployed by KPNO were designed by Aden Meinel and Bill Baustian and built by the Phemco Corporation of Phoenix, the first home of the staff of KPNO (figure 1). These two telescopes originally were built and used for site testing on Kitt Peak (figure 2) and Hualapai Mountain. Later they were used for photoelectric photometry. The one on Kitt Peak was used by Arlo Landolt, the first visiting observer at KPNO in 1959, even before the observatory had been dedicated!

A few years later, as both KPNO and CTIO grew, KPNO received one complete B&C 16-inch and a second mount, while the two Phemco telescopes, by then labeled #1 (figure 3) and #2, were shipped to Chile. The first 16-inch at CTIO had also been one of the first at KPNO! The B&C telescopes at Kitt Peak became the #3 and #4 0.4-meter tele-

continued

The NOAO 16-Inch Telescopes continued

scopes. One of us, John Glaspey, has fond memories of using all four telescopes: for project work at Kitt Peak and thesis observations at CTIO. Regular use of the first two 16-inch telescopes at Cerro Tololo revealed weaknesses in the performance of the control electronics and drive trains—both of which were upgraded—and new B&C mounts eventually replaced the original Phemco mounts.

Figure 1: Aden Meinel (left) and Bill Baustian (center) inspecting the two original 16-inch telescopes at the Phemco shop in Phoenix.

Figure 2: The 16-inch telescope trailer being towed to the summit of Kitt Peak in early 1957.

Figure 3: The #1 16-inch telescope at Kitt Peak, 1964.

Once the demand for these 16-inch telescopes diminished, they were closed. However, since new instruments or telescopes are expensive relative to budgets at smaller astronomy departments, resourceful astronomers have been finding new homes for these telescopes and extending their scientific and educational lifetimes. The 0.4-meter telescopes have been gradually transferred to other interested institutions, where they are in active use. The Pontifícia Universidad Católica in Chile received one of the CTIO 0.4-meter telescopes, Missouri State the other, and Georgia State University (GSU) is the home of the #4 KPNO 0.4-meter telescope (figures 4 and 5).

Most recently, Texas A&M University (TAMU) has taken possession of the #3 KPNO 0.4-meter. The design of the #3 was different from the others in that it had an f/7.6 Cassegrain focus, identical to that of the 84-inch, so that new instruments could be tested prior to going on to the larger telescope. After its retirement from science on Kitt Peak, the #3 spent several years on display in the Kitt Peak Visitor Center, but then was stored on the ground floor of the Mayall 4-meter telescope building.

In early 2008, Darren DePoy, Nicholas Suntzeff, and Don Carona contacted KPNO and inquired if the telescope might be available for use as part of the growing astronomy program at TAMU. On 17 March 2009, KPNO staff members Will Goble and Mike Hawes worked with Don Carona of TAMU to load the telescope onto a truck for transport to Texas. This historic telescope was delivered to the TAMU campus the next day and is going to be refurbished and put into service again, continuing to support science, education, and outreach in astronomy.

continued

The NOAO 16-Inch Telescopes continued

It will become a centerpiece of an astronomy program at the Physics Teaching Observatory at TAMU to benefit both undergraduate and graduate students. It will also enrich public programs and be used by area schools, youth organizations, local astronomy clubs, and other members of the community.

While the original 16-inch telescopes have left KPNO and CTIO, the dome of the old #4 is still in active service. It is now home to a comparable 16-inch Meade telescope, used as part of the very popular Kitt Peak Visitor Center Nightly Observing Program (*www.noao.edu/outreach/nop/*). NL

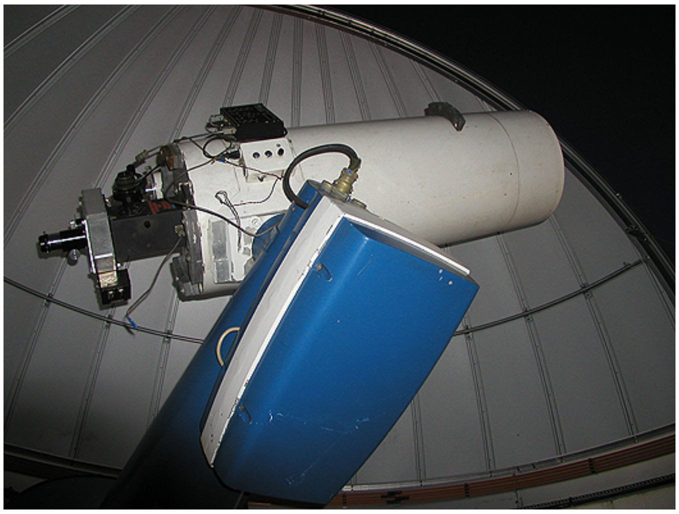


Figure 4: The #4 0.4-meter telescope in the dome at Georgia State University, April 2009. Photo courtesy of Noel Richardson.

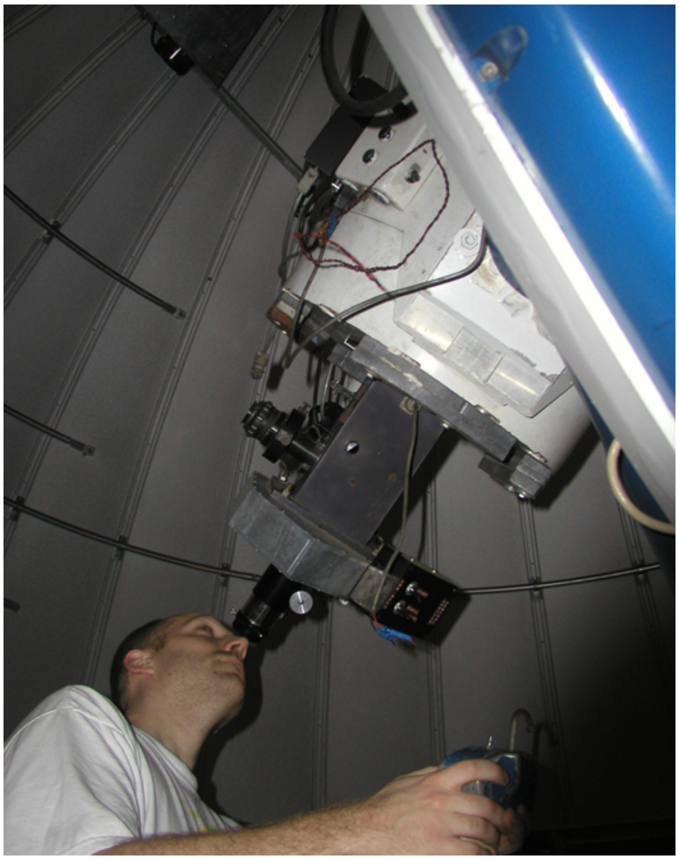


Figure 5: GSU graduate student Stephen Williams using the 16-inch telescope, April 2009. Photo courtesy of Noel Richardson.

Frank Kelley Edmondson • 1 August 1912–8 December 2008

Caty Pilachowski (Indiana University)

Ed. Note: This article was adapted from a longer article available at: *www.noao.edu/news/edmondson-obit.php*.

Frank Kelley Edmondson, a key player in the creation of the Association of Universities for Research in Astronomy (AURA) and the Kitt Peak National Observatory (KPNO), passed away on Monday, 8 December 2008. He was 96.

Born in 1912, Edmondson received his Bachelor of Science in 1933, Masters in 1934 for work at Lowell Observatory in Arizona, and his Doctorate from Harvard in 1937, studying under astronomer Bart Bok. He began his research career in 1934 working at the Lowell Observatory as an observing assistant to Clyde Tombaugh, joined the Indiana University faculty in 1937, serving as chair of the Department of Astronomy from 1944–1978, and retired in 1983, but continued his work there until just a few years ago.

Professor Edmondson is known for his remarkable skill as an educator. He taught the subject of astronomy to literally thousands of students, often taking advantage of his knowledge of music to introduce astronomical topics with appropriate musical selections.

The astronomical community recognized Edmondson for his contributions to American astronomy through the founding of AURA and KPNO in the 1950s. These institutions transformed astronomy in the US by providing access to major research telescopes to astronomers from all institutions based on the merit of their research ideas. Following the formation of AURA, Edmondson served as a Program Director for Astronomy at the National Science Foundation, helping to assure funding for the new national observatory. He served as President of AURA from 1962 until 1965, and served on the Board of Directors of AURA from 1957 until he retired in 1983. Following his retirement, Edmondson

continued

Frank Kelley Edmondson continued

wrote a book on the history of AURA, *AURA and its US National Observatories*, published in 1997. In 2007, he commemorated the founding of AURA by naming an asteroid, Aurapenenta, in honor of the 50th anniversary of AURA.

Edmondson devoted his career to service. In addition to his work with AURA and the founding of the national observatories, he served as treasurer of the American Astronomical Society for 21 years, from 1954–1975, was a leader of the Minor Planet Center of the International Astronomical Union (IAU), serving as its President from 1970–1973, and chaired the US National Committee of the IAU in 1963–1964.

Edmondson enjoyed the many coincidences that sparked new connections and initiatives in his career. He liked to say that he was the right person in the right place at the right time. That was almost always true, and often because Edmondson himself understood and anticipated what would be needed, and made sure to be ready with an answer or guidance. He has been an inspiration to generations of students and colleagues and helped truly change the face of American astronomy. NL

Viewing the Sun at the prime focus of the McMath Solar Telescope (now the McMath-Pierce Solar Facility) at the Kitt Peak National Observatory near Tucson, Arizona, on 20 November 1964. From left to right: William B. Harrel, AURA Vice President, Leland J. Haworth, Director of the National Science Foundation, Eugene Johnson, Chairman of the Papago Tribal Council, Frank K. Edmondson, AURA President, and Nicholas U. Mayall, Director of the Kitt Peak National Observatory.

42 Years of Service to KPNO

Michael Merrill

Vitold "Skip" Andree (left) received his 40-Year Service award from NOAO Director David Silva (right) at the annual State of KPNO and NOAO gathering held for mountain staff on April 1. Skip has had a long and illustrious career in supporting science at KPNO. Starting as a "trainee" in the instrument shop at KPNO in 1967, he soon became an instrument maker. He has worked on many KPNO instruments, including spectrographs currently deployed at the 4-meter and the 2.1-meter telescopes. Larry Randall transferred Skip to work with Jim DeVeny maintaining telescopes and instruments in support of the observers on Kitt Peak.

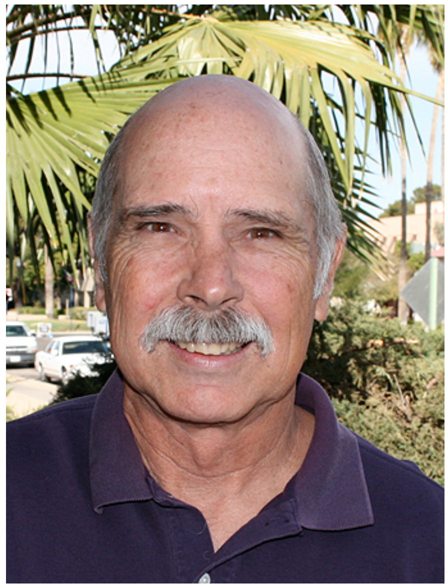
In 1993, Skip transferred to Kitt Peak (Mountain) Science Operations where he became the lead support person for instrument changes and updates. Cited in numerous journal articles for his excellent support of both Kitt Peak and visitor instrumentation, Skip is still actively applying his instrument maker expertise to maintain, tweak, and improve our instruments and telescopes. The WIYN Bench Spectrograph, Professor Jian Ge's Exoplanet Tracker (University of Florida), and Don Figer's detector tests are the most recent of a long line of instrumentation that has benefited from his master workmanship. Skip currently serves as Assistant to the Supervisor of Mountain Science Support. We greatly appreciate Skip's dedication and talented service to the National Observatory.

New filters at WIYN replace older ones.
See *www.wiyn.org/observe/filters.html* for more information.

New Faces at KPNO

Dr. Lori E Allen

Bellina Cancio



Fredrick (Rick) McCloskey

In the last few months we have been fortunate to add several talented people to the staff of Kitt Peak National Observatory.

Dr. Lori E. Allen joined the staff of NOAO in April 2009 as an Associate Scientist. Lori comes to us from the Harvard-Smithsonian Center for Astrophysics where she was an integral part of the instrument team for the Infrared Array Camera (IRAC) on the Spitzer Space Telescope. Lori's primary research interest centers on the formation and evolution of stars and planetary systems. Lori will initially be helping to support users of WHIRC at the WIYN 3.5-meter and NEWFIRM at the Mayall 4-meter telescopes.

Ms Bellina Cancio is a new Office Assistant based on the mountain. She will be supporting the efforts of the Kitt Peak Support Office and the Kitt Peak Visitor Center. Visiting astronomers might meet her in the mountain administration building when they pick up their keys at her office or sign up for a shuttle back to Tucson. Bellina is a member of the Tohono O'odham Nation. She previously worked for both the Carondelet Health Network and the Desert Diamond Casino in their accounting and payroll offices. Stop in and introduce yourself while on Kitt Peak.

Frederick (Rick) McCloskey has joined Kitt Peak Engineering as a Senior Engineer. Rick brings skills developed through many years of experience in the development of new instrumentation and support systems. His more recent accomplishments include the successful completion of the Phoenix Mars Lander payload test-bed and the Cassini VIMS remote sensing instrument's ground data system for the University of Arizona and NASA. Rick will be providing both technical and project support for the development of the WIYN One Degree Imager instrument project.

The Maryland-NOAO Instrument Partnership (2003–2009)

Sylvain Veilleux (University of Maryland) & Buell T. Jannuzi

Seven years ago, with the encouragement of the NSF and AURA, NOAO requested proposals from the community to partner with the national observatory to improve instrumentation and/or telescope capabilities at KPNO and CTIO. Of the proposals that were selected, one came from the University of Maryland with the goals of helping NOAO complete the development, construction, and deployment of a new, wide-field, near-IR imager (NEWFIRM) and of working with NOAO to develop data reduction pipelines and data archiving capabilities at NOAO.

By all measures, the Maryland-NOAO instrument partnership has been a resounding success. NOAO and the astronomical community have benefited from the use of Maryland resources and staff to support the development of NEWFIRM; the One Degree Imager (ODI), an innovative, wide-field optical imager; and the NOAO Science Archive (NSA). University of Maryland funds also were used to help support NOAO's share of the costs of constructing ODI for WIYN. The University of Maryland procured key hardware components for NEWFIRM and acquired a suite of narrowband filters that were not affordable in the baseline budget. Maryland personnel Rob Swaters, Tracy Huard, and Brian Thomas became fully integrated into the NOAO pipeline and NSA development teams. Their participation made the critical difference for meeting the delivery schedule of the quick-reduce pipeline with the commissioning of NEWFIRM. They

continued

The Maryland-NOAO Instrument Partnership continued

Participants and instructors of the 2007 Kitt Peak Summer School

helped with, and often led, the design, implementation, and testing of several aspects of the NOAO High-Performance Pipeline System (NHPPS) and the NSA.

The NHPPS, now in routine operation, is used to process data obtained with Mosaic and NEWFIRM on the 4-meter telescopes at KPNO and CTIO. The data processing carried out by NHPPS consists of two components: a Quick-Reduce Pipeline that reduces data in near real time at the telescope and a Science Pipeline that provides in-depth data reduction at the end of an observing block. Examples of NEWFIRM data processed by NHPPS were discussed in the December 2008 *NOAO/NSO Newsletter* (#96, pp. 1 and 21–22; Gutermuth & Dickinson).

From the point of view of Maryland, this partnership has had a direct, positive impact on the quantity and quality of the science produced by members of the Department of Astronomy. It allowed Maryland astronomers and students to (1) explore new avenues of research including high-reward projects that would perhaps have been considered too risky by a national Time Allocation Committee, (2) quickly respond to new discoveries and targets of opportunity, and (3) undertake large thesis and non-thesis surveys with a guarantee of telescope time.

Under this partnership, 11 professorial faculty, 11 research faculty (i.e., post-docs and research scientists), 16 graduate students (including 13 PhD theses), and 3 undergraduate students from Maryland used the KPNO facilities. Thirteen papers directly involving KPNO data have been published so far under this partnership (11 of these papers have Maryland graduate students as first authors); many more are in preparation. A necessarily incomplete list of scientific highlights includes the successful monitoring of comet Tempel 1 between February and July 2005 in support of the Deep Impact mission (M. A'Hearn, PI), an extension of the "Cores to Disks" Spitzer Legacy Program to shorter, near-infrared wavelengths (S. Chapman, PhD thesis; L. Mundy, advisor), a study of the density profiles of the dark matter halos in low-surface brightness galaxies and low-mass dwarf galaxies (R. Kuzio de Naray, PhD thesis; S. McGaugh, advisor), and a spectroscopic survey for superwinds in massive starbursts (D. Rupke, PhD thesis; S. Veilleux, advisor).

The Maryland-NOAO partnership also has had a direct positive impact on the technical capability of Maryland's Department of Astronomy. It helped strengthen the Department's software expertise in the areas of optical and near-infrared data reduction and archiving, complementing the already strong software group at millimetric wavelengths associated with the Combined Array for Research in Millimeter-wave Astronomy (CARMA) collaboration. The lead role assumed by the Maryland personnel in the development of NHPPS and NSA helped create an in-house resource group with the highest level of expertise capable of advising Maryland users and collaborators, as well as members of the astronomical community-at-large, on all aspects of the analysis of Mosaic and NEWFIRM data. It also helped position the Maryland software group for similar projects at national or private observatories in the future.

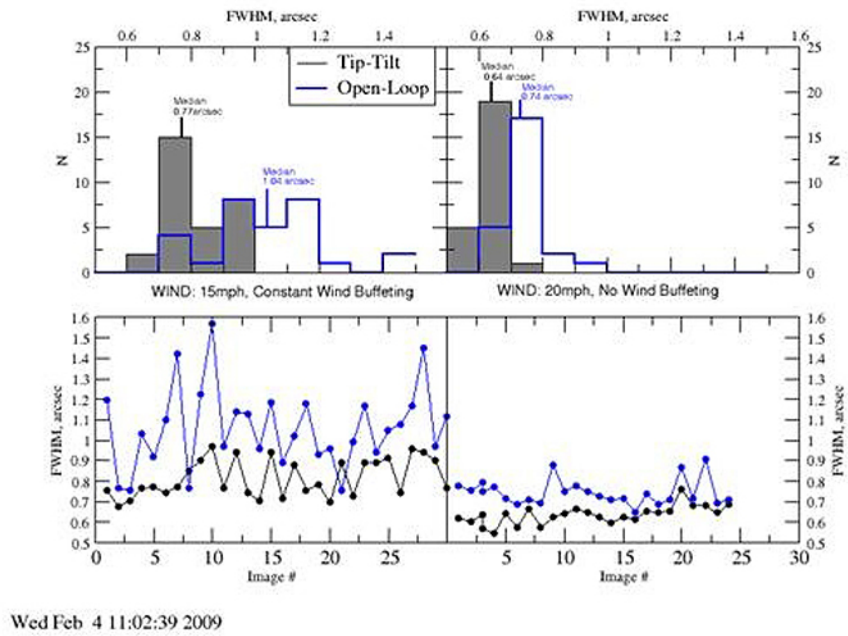
Maryland graduate student Rachel Kuzio de Naray in the Mayall 4-meter telescope control room.

The Maryland-NOAO partnership increased the visibility of the Department within the College and the University. It was branded by the administration as an excellent example of successful collaboration between a University and a national laboratory. No doubt it will be regarded as a model to follow in future partnerships in which the University of Maryland becomes engaged. For KPNO, the partnership helped keep the Mayall a competitive, modern facility by helping to ensure the arrival of NEWFIRM. Maryland's critical involvement in the development of the first "real-time" pipelines in use for our instruments has helped continue the development of the modern science capabilities of KPNO. Finally, the returning users of our facilities from Maryland provided valuable, close ties to a segment of our user community and valuable feedback and suggestions from experienced users of our facility. If and when we enter into new partnerships, we will endeavor to repeat the success of the Maryland-NOAO partnership.

WHIRC Update

Dick Joyce & Heidi Schweiker

The WIYN High-Resolution Infrared Camera (WHIRC) has been used for several observing runs this semester, including the first visitor use with the WIYN Tip-Tilt Module (WTTM). WHIRC is available for use with WTTM on a shared-risk basis, being contingent on the availability of WIYN support personnel for operating WTTM. In addition, maintenance on any problems that occur during the night may be deferred until the following day. Our experience to date suggests that WTTM can produce improvements in seeing-limited image quality similar to those seen at visible wavelengths (0.1–0.15 arcseconds in FWHM), but can be especially effective in removing the effects of wind shake, as shown in the figure. We strongly suggest that prospective WHIRC/WTTM observers become familiar with the limitations on guide star brightness and guide field published on the WHIRC Web site and the User's Manual to determine in advance of their run whether their science fields will be amenable to WTTM operation.



Results of two tests to measure the FWHM improvements from turning on WTTM correction, using 10-second exposures in the H band. The results are consistent with the predicted improvements of 0.1–0.15 arcseconds and even more significant when wind buffeting is a factor. Courtesy C. Corson and H. Schweiker.

The Data Reduction Manual has been revised to include several new tasks:

An IRAF script "prepares" the raw data for reduction by renormalization for multiple Fowler samples, linearity correction, recalculation of the World Coordinate System coefficients for instrument rotator offset angle, and stripping off the reference rows and columns.

A pupil ghost template, used with the Mosaic reduction task "rmpupil" appears to do a good job of eliminating this artifact, although we have not yet verified this photometrically.

Fringes seen in the Paschen-beta (and occasionally H) filters can be removed using the Mosaic reduction task "rmfringe."

The Zemax optical distortion model has been incorporated into a database file that can be used with the task "geotran" to correct for the small distortion if one is making large image mosaics.

The dual-instrument capability of the WIYN Instrument Adapter System (IAS) port lends itself to the use of WHIRC in combination with an optical imager (MiniMo or the Orthogonal Parallel Transfer Imaging Camera, OPTIC) mounted at the CCD port. Obvious applications include combined optical/infrared (IR) observations of science targets or nights split between optical and IR observers. This can be done in principle, requiring only moving the WTTM Pickoff Mirror in the IAS out of the beam and switching computer operation over from WHIRC to the optical imager (or vice versa). This process, however, involves powering down one instrument and powering up the other, as well as switching computer interfaces. There are potential stability issues for both instruments shortly after being powered up and the risk of lost observing time, which will be difficult to quantify until we gain some experience in this process. If science and weather considerations permit, we suggest that observers planning to use both WHIRC and MiniMo/OPTIC try to accomplish their program by successive, rather than split night, use of the imagers.

Observer support is also a potential problem. The WHIRC/MiniMo/OPTIC instrument scientists and the Operations Coordinator have, therefore, established the following policy:

> Current policy requires anyone wishing to use both WHIRC and either optical imager during a run to be fully proficient with at least one of the instruments and, therefore, require no instrument start-up support. In this sense, a proficient observer is one who has used the instrument at least once in the past year and has had a full start-up by qualified WIYN personnel within the past three years. Furthermore, observers are required to fully discuss their plans for each instrument use in the comment section of the ORPF and to contact the appropriate WIYN staff six weeks prior to their run to discuss the details of their observations. These discussions will include the potential risks in degraded performance and observing inefficiency, and it will be assumed that observers carrying out a dual-instrument program will understand and accept these risks.

Finally, the WHIRC home page (*www.noao.edu/kpno/manuals/whirc/WHIRC.htm*) has been updated and reorganized. One can obtain the latest versions of the manuals and reduction files from this site. As always, comments are welcome.

Director's Corner

Steve Keil

ATST

Is there an end in sight? After a decade of preparing to build the Advanced Technology Solar Telescope (ATST), it appears we may be rapidly approaching the beginning of construction. The NSF final design review (FDR) of the project prior to a construction start was held on 18–22 May 2009. The final environmental impact study should be completed this July, allowing NSF to reach a Record of Decision on building ATST on Haleakalā before the beginning of FY 2010. The past several months have seen a series of systems-level design reviews of major telescope subsystems in preparation for the FDR. Needless to say, we are very excited about getting started on construction and looking forward to the science that ATST will produce.

SOLIS

SOLIS has achieved a milestone with the recent release of full-disk vector magnetograms after solving some of the difficult issues with flat fielding and full-disk inversions. To view the data, visit *solis.nso.edu/solis_data4.html* and click the *List of Available Milne-Eddington Inverted Vector Observations* link. SOLIS has collected these data with the Vector Spectromagnetograph (VSM) starting in 2003 and will process the backlog as time allows. New data are being reduced and put online as they are obtained. The full-disk vector magnetograms provide a new tool for more accurately modeling the overlying magnetic field structure, looking for unstable magnetic configurations, and comparing with coronal data. In addition to the VSM data, Integrated Sunlight Spectrometer (ISS) data are also available on the Web at: *solis.nso.edu/solis_data4.html*.

Decadal Survey

We would like to express our appreciation to those of you who submitted solar white papers to the astronomy and astrophysics decadal survey Astro2010. There were a substantial number of Science white papers covering many of the unsolved problems in solar and solar/stellar physics and the need for new observing tools to address them. A solar sub-panel for this survey does not exist, but hopefully these papers will give solar a high level of visibility during the survey process. The white papers are available at *wso.stanford.edu/wsowiki/Astro2010WhitePapers*.

Awards

The 2009 AURA Service award was presented to Ron Kroll for his outstanding service managing the daily operations, maintenance, and servicing of the hardware and software systems of the instruments comprising the GONG worldwide network. Ron Kroll has served as the GONG Operations Manager for the past twelve years. During that time he has accumulated close to 600,000 frequent flier miles, making three to six international trips per year performing routine and not-so-routine maintenance and servicing of the instrument systems. Ron has been very effective in leading the GONG operations team and interacting with the site host personnel in the 24/7 day-to-day operations, demanding a high degree of attention in order for the GONG program to continue supplying high-quality helioseismic and magnetic field data to the scientific community.

Mark Warner is the recipient of the AURA Technical Achievement award for his outstanding leadership in the Advanced Technology Solar Telescope (ATST) mechanical design effort. Mark is lead mechanical engineer and is responsible for many unique and innovative elements of the ATST. The ATST's innovative design brings together many new elements for an AURA facility: large off-axis solar telescope, integrated adaptive optics and wavefront correction, large rotating coudé lab, and extensive thermal control. Mark was personally responsible for the design of the Telescope Mount Assembly, which features an optical support structure accommodating a four-meter cooled off-axis mirror, silicon carbide cooled secondary mirror, and other optical support elements for 11 feed mirrors. The design also includes a 16-meter diameter rotating instrument laboratory where a suite of large instruments will reside. (See figure 1.)

Figure 1: Steve Keil (center) with 2009 AURA Service award recipient Ron Kroll (left) and AURA Technical Innovation award recipient Mark Warner (right).

The AURA Science award this year goes to the team of Gianna Cauzzi, Kevin Reardon, Thomas Rimmele, Alexandra Tritschler, Han Uitenbroek, and Friedrich Wöger for their scientific exploitation of the Interferometric BIdimensional Spectrometer (IBIS) to reveal new aspects of photospheric and chromospheric structure and waves, heating of the chromosphere, current sheets above sunspot umbra, and for contributions to the understanding of the complex structure and evolution of sunspots. In the past few years, the team has made a major investment of effort to implement full Stokes polarimetry with IBIS. The many complexities involved—the complicated polarization calibration of the telescope and instrument, properly compensating for atmospheric distortions, and dealing with the large volumes of multi-dimensional data—have required pushing the limits of observa-

continued

Director's Corner continued

Figure 2: Steve Keil (left) congratulates Friedrich Wöger as part of the team who won the AURA Science award for 2009.

Figure 3: Steve Keil (left) presents an award to Thomas Rimmele for his contributions to the IBIS project.

tional solar physics. This has produced exciting new results both for the solar photosphere as well as in the largely unexplored regime of the chromospheric magnetic fields. (See figures 2 and 3.)

Finally, an NSO Team award goes to the Dunn Solar Telescope (DST) instrumentation development and operations team for innovative development and implementation of several state-of-the-art instruments that have led and will continue to lead to new scientific discoveries in observing the Sun at high resolution. The DST technical and observing staffs have performed outstanding work to develop and support instrumentation for the Dunn Solar Telescope that employs innovative concepts and will substantially enhance scientific productivity and increase the potential for scientific discovery for the entire solar community. These new instruments, which are interfaced to the DST adaptive optics systems, are now the "work horses" in solar physics and are producing intriguing results about photospheric and chromospheric structures, magnetic fields, and energy transport. Team members are Chris Berst, Steve Fletcher, Scott Gregory, Craig Gullixson, Steve Hegwer, Wayne Jones, Brady Jones, Mark Komsa, Ron Long, and Kit Richards (DST Instrument Engineering Group), and Mike Bradford, Joe Elrod, and Doug Gilliam (DST Operations Team). (See figure 4.)

New Faces

We're pleased to welcome Brian Harker-Lundberg, who joined us as an NSO post-doctoral research fellow in January. Brian comes to us from Utah State University, where he received his PhD in physics in December 2008. Brian is no stranger to NSO, as he has spent the past few summers at Sacramento Peak working on his thesis project with thesis co-advisor K.S. Balasubramaniam (former NSO astronomer, now an Air Force astrophysicist in residence at Sac Peak). Brian is in Tucson, investigating solar photospheric vector magnetic fields using the SOLIS VSM.

Figure 4: The NSO Team award recognized members of the DST instrumentation development and operations team. Shown receiving their awards are (from left): Wayne Jones, Brady Jones, Stephen Hegwer, Scott Gregory, Steve Keil (presenting awards), Craig Gullixson, Ron Long, Mark Komsa, Kit Richards, and Steve Fletcher.

ATST Optical Design Enhanced

The ATST Team

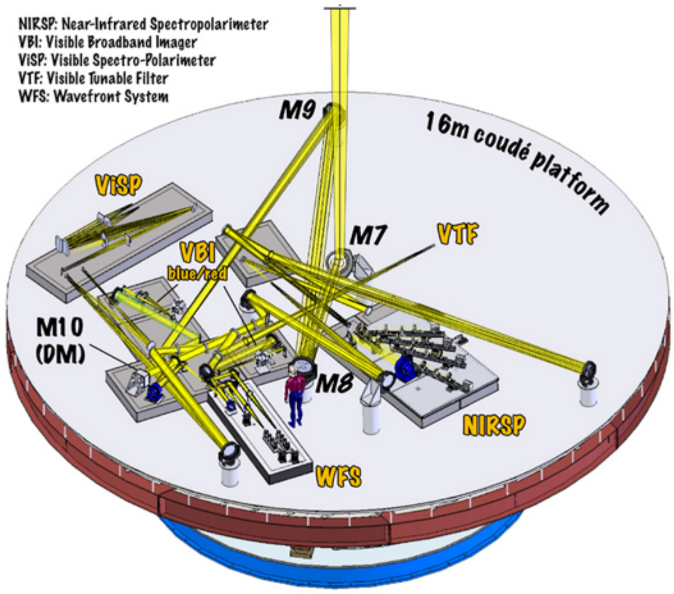
The optical path and coudé level of the Advanced Technology Solar Telescope (ATST) have been significantly modified to optimize their designs for instruments and science users. "We have a configuration that meets the requirements from the ATST Science Working Group (SWG) and for the most part is in a single plane," said ATST Instrument Scientist David Elmore, who joined NSO in 2008. The new design, which was being refined at this writing, is to be presented at the Final Design Review with the National Science Foundation in Tucson, May 18–21, and at the next Science Working Group (SWG) meeting in Boulder in late summer 2009.

For the past several years, the baseline design has incorporated an optical tower standing in the middle of the coudé platform. The tower supported fold and power mirrors—M7 through M13—including the deformable mirror, M9, for the high-order adaptive optics (HOAO). The new design eliminates the tower and three mirrors, and it makes M10 the deformable mirror and last one in the series before light goes to the instruments.

Elmore explained that the changes came after the SWG set a series of use cases at its May 2008 meeting. "The instrument use cases showed that we needed to operate multiple instruments simultaneously," Elmore said. "That requirement led to a rethinking of how we would distribute light to the instruments in the coudé lab."

The first result was eliminating the tower. "The optical design of the tower did not lend itself to distributing light to multiple instruments simultaneously," noted Elmore. Next, Project Scientist Thomas Rimmele determined that the deformable mirror could be adjusted to provide the same corrections that were supplied by M7 and M8, two off-axis conics.

In the new design, M7 is a flat at the center of the coudé platform and directly under the beam coming down from the telescope level. M7 folds the beam to a horizontal path, directing it to M8 (a power mirror) and M9 (another flat) and finally to M10. The new arrangement also places the Wavefront System, including the HOAO,



The planned placement of the ATST's commissioning, or "first light," instruments on the coudé platform. Significant space remains for development of new instruments. By comparison, the coudé platform of the Dunn Solar Telescope, which served as the prototype for ATST, is 12 meters wide. (Scott Gregory, NSO/AURA/NSF)

Active Optics, and context imager, on a bench that is easily serviced. Elmore added that M8 and M9 are at the correct positions for easy upgrades to deformable mirrors for a future multi-conjugate adaptive optics system that would improve ATST's ability to compensate for atmospheric blurring.

"Now we can run three to four science instruments at a time," Elmore explained. "It also simplifies the platform because we are working at conventional table heights." The design still allows for vertical fold paths, about 2.8 meters up to the bottom of the air handling system in the ceiling, for other instruments.

SOLIS/VSM Inverted Vector Magnetic Field Data Now Available

Kim Streander, Aimee Norton, & The SOLIS Team

We are pleased to announce that inverted vector magnetic field data from the SOLIS/VSM (Synoptic Optical Long-term Investigations of the Sun/Vector Spectromagnetograph) instrument are now available at: *solis.nso.edu/*. Both full-disk data and smaller field-of-view data containing active regions are available. The data are inversions of Stokes *I*, *Q*, *U*, and *V* profiles of the Fe I 630.1 and 630.2 nanometer lines using a Milne-Eddington (ME) model atmosphere and a least-squares minimization code originally developed at the High Altitude Observatory. The azimuth values have the 180-degree ambiguity removed, thanks to code and kind assistance from Manolis Georgoulis (Johns Hopkins University).

Data are available daily (weather permitting) beginning 1 April 2009. Also available is a sample of data from March 2008 containing several active regions near the Equator (see figures 1 and 2). Milne-Eddington inversions of vector observations taken since 2003 will be produced as time and personnel resources permit.

continued

SOLIS/VSM Inverted Vector Magnetic Field Data Now Available continued

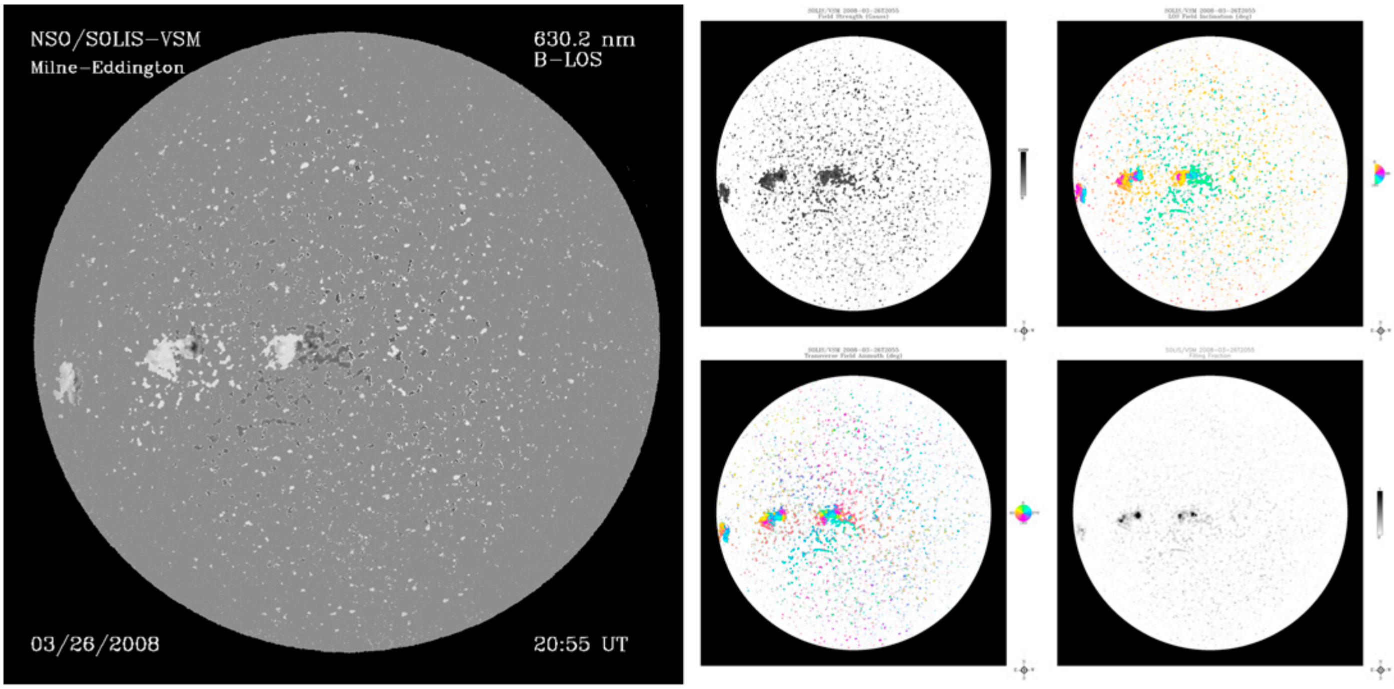


Figure 1: Sample data from March 2008 containing several active regions near the Equator.

Please note that data are only inverted if the observed polarization signal is above a threshold. A value of zero indicates that the signal was below the threshold value and no attempt was made to invert the data. Many areas contain zero values. Data without the discontinuity resulting from thresholding can easily be obtained by merging the ME data with the "Quick-Look" (QL) data, essentially filling in the missing ME data with the QL data. QL data values are determined using a weak-field approximation.

We acknowledge, with gratitude, the assistance and guidance of a VSM Vector Working Group: Christoph Keller (Chair, Utrecht), Manolis Georgoulis (Johns Hopkins University), Jack Harvey (NSO), Carl Henney (AFRL/Boston University/NSO), K. D. Leka (NorthWest Research Associates), Aimee Norton (James Cook University/NSO), Nour-Eddine Raouafi (Johns Hopkins University), Kim Streander (NSO), and Roberta Toussaint (NSO) in developing the pipeline for producing inverted vector data. Further information, including file-name description, data format, and caveats, can be found on the NSO Web site at: *solis.nso.edu/solis_data.html*.

The data result from inversions of Stokes, *I*, *Q*, *U*, and *V* profiles of the Fe I 630.1 and 630.2 nanometer lines using a Milne-Eddington model atmosphere and a least-squares minimization code. The azimuth values have the 180-degree ambiguity removed. Note that data are only inverted if the observed polarization signal is above a certain threshold.

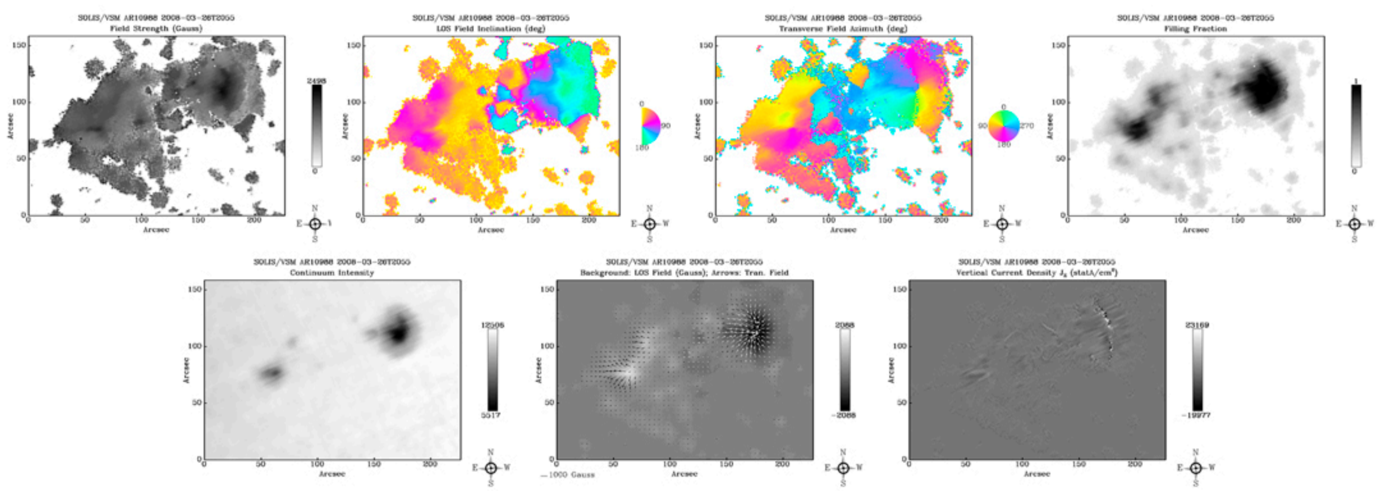


Figure 2: Results from the Milne-Eddington inversion for active region 10987; the sunspot region near disk center on 26 March 2008 is shown with magnetic field strength, inclination, azimuth, filling factor, continuum intensity, line-of-sight magnetic field, and vertical current density.

The Global Oscillation Network Group (GONG)

Frank Hill & The GONG++ Team

Introduction

The first quarter of 2009 was spent ramping up for the development of an H-alpha observing system. Funds from the Air Force Weather Agency (AFWA) arrived in late December, and the GONG++ team hit the ground running on January 1. The loan of a camera and a filter were scheduled to verify our selection, and lenses were obtained for a complete optical layout. After rigorous testing, which identified some issues and potential risks with the original design, adjustments and modifications were made that demonstrated the system would work well. The program conducted a preliminary design review of the optical breadboard system and, with no obvious show-stoppers, the review team gave the go-ahead for the development of a prototype system.

GONG's high-cadence magnetograms continue to attract the attention of the community. A new set of data products, one-minute network-merged magnetograms and Carrington rotation synoptic maps, are now available for downloading at: *gong.nso.edu*.

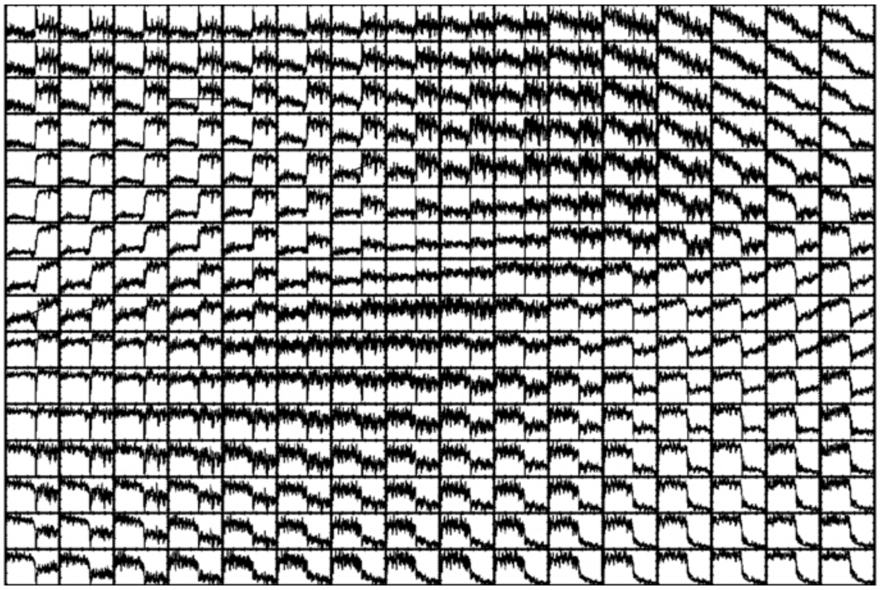


Figure 1: Line-of-sight magnetic field changes over a four-hour period centered at 1829UT on 12 December 2006, the start time of an X6.5 flare in AR10930. Each plot corresponds to one pixel, and the mosaic covers most of AR10930. There are systematic patterns to the changes, which should yield information about flare mechanisms.

Science Highlights

Gordon Petrie has been working to extend the earlier results of Jack Harvey and Jeff Sudol, which demonstrated that the photospheric magnetic field changes during a flare. Gordon, along with Jack and Jeff, has been compiling a large number of magnetic-field time series for various flares. An example is shown in figure 1, which is a mosaic of longitudinal magnetic field changes over a four-hour period centered on a large X6.5 flare. Depending on the location, the field exhibits all possible variations: increases, decreases, and relatively unchanged. Correlating these variations with the morphology of the active region should provide additional insight into the flare mechanism.

Network Operations & Engineering

The problem with turret oscillations at Mauna Loa and Tucson has continued into 2009. The cause seems to be modified turret seals, which appear to impart increased friction against the moving surfaces and result in an ill-tuned mechanical servo system. Alternatives to the current grease sealer and possible changes to the gain setting of the guider feedback are being investigated. A preventative maintenance (PM) trip to Big Bear occurred in March, and in addition to routine tasks, the filter/interferometer assembly was replaced. This procedure requires a subsequent optical alignment. Instances of turret oscillations were observed during the system check-out, keeping the turret oscillation problem a top priority.

In mid-February, one of the calibration wheels in the Learmonth instrument began malfunctioning. Alan Brockman, our site representative there, has been invaluable in troubleshooting the situation. A workaround solution was found, and we are again collecting calibration data. A PM team will head south to Learmonth in late April.

Eric Yasukawa, a long-term observer and original GONGster at Mauna Loa Observatory, retired recently after 37 years of service.

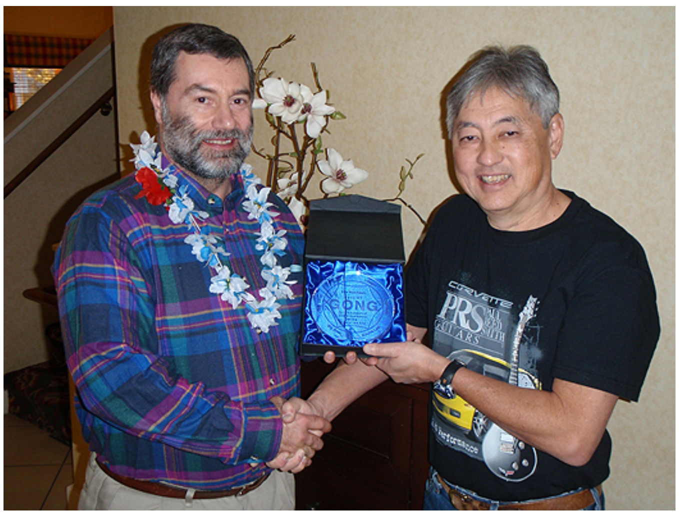


Figure 2: Eric Yasukawa (right), a long-term observer and original GONGster at Mauna Loa Observatory, accepts the infamous "Hero of GONG" (HOG) award from Ron Kroll (left). Yasukawa retired recently after 37 years of service.

continued

GONG continued

service. Ron Kroll presented Eric with the infamous "Hero of GONG" (HOG) award (figure 2). Congratulations and best wishes to Eric!

Testing the camera and filter for the new H-alpha system has been a top priority. We quickly found that the original optical design, which placed the filter near a focus, resulted in an image dominated by structures within the mica inside the filter. Jack Harvey redesigned the optics to place the filter away from a focus, which removed the artifacts from the image and also produced a better point spread function. We originally chose to evaluate a cooled camera, but had problems when the seals failed in the test camera and allowed condensation to form on the CCD window. This raised concerns about operating in high humidity environments, such as our Australia and India sites. In addition, we were told that the seals had only a three- to five-year lifetime. As a result, we expanded our tests to include a cooled and an uncooled version of the same camera. At the exposure times that we expect to use, there is very little difference between the cooled and uncooled camera performance. With the new optical design and uncooled camera, we obtained a one-hour sequence of images that looks pretty good, even with a quiet Sun. (See figure 3.)

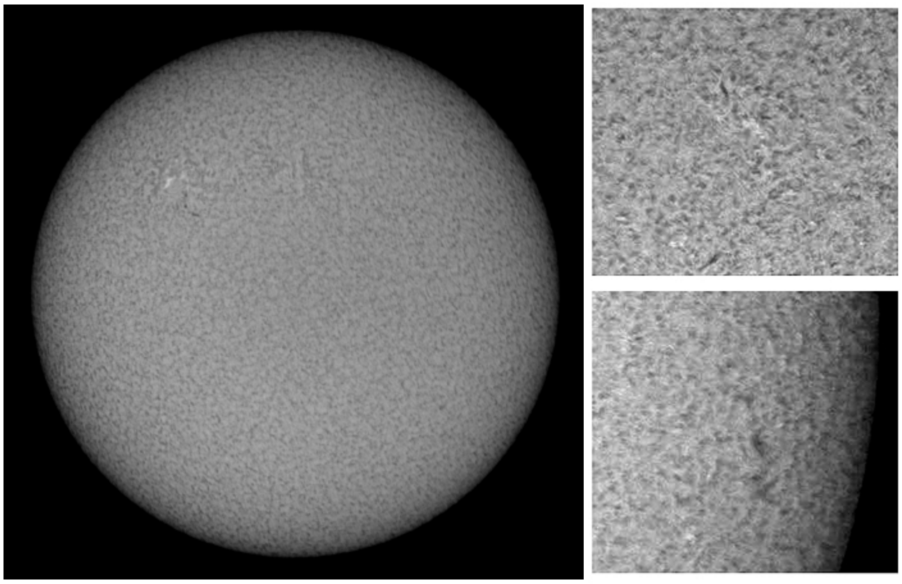


Figure 3: Solar image in H-alpha (656.3 nanometers) using a breadboard GONG H-alpha system. This is one frame of an eight-hour sequence taken on 13 May 2009. The filter had a bandpass wider than what will be used in the final systems and seeing conditions were poor. Noteworthy are the extreme quietness of most of the disk, which has been characteristic of the unusually prolonged minimum of solar activity, and the presence of a small, bright active region and dark filament in the upper left quadrant. This small active region is one of the first of the new solar cycle to show sunspots. The insets are of magnified portions to show the few and weak areas of activity present during the current minimum.

Data Operations and Software Development & Analysis

The new Data Management and Analysis Center (DMAC) Magnetogram Pipeline has been implemented. From calibrated site magnetograms, we are processing one-minute cadence network-merged magnetograms and Carrington rotation synoptic maps. As data are processed over the next few weeks, Carrington rotation 2047 (post-modulator upgrade) onward will be available for downloading at: *gong.nso.edu/data/dmac_magmap*.

Being able to monitor various GONG systems in real time is a critical aspect of operations. GONG monitoring Web pages can be found at *monitor.nso.edu*. There you will find the current status of the network instruments, calibration, and various data reduction pipelines.

Processing to date includes time series, frequencies, merged velocity and rings through GONG month 137 (centered at 18 October 2008), with a fill factor of 0.8. Last quarter, the GONG Data Archive distributed 550 gigabytes of data. All GONG data products can be obtained at: *gong.nso.edu/data*. NL

Fourth Quarter Deadline for NSO Observing Proposals

The current deadline for submitting observing proposals to the National Solar Observatory is 15 August for the fourth quarter of 2009. 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*.

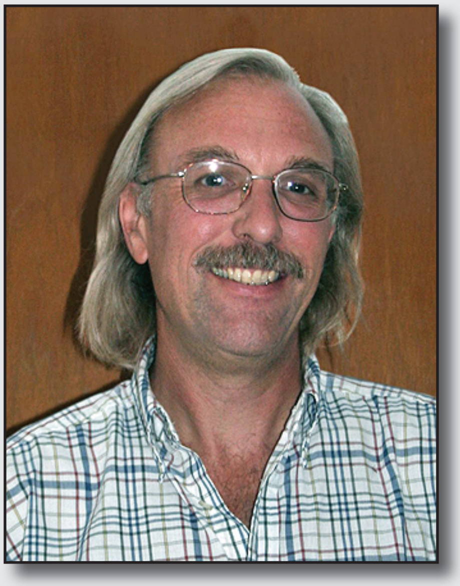
Proposers are reminded that each quarter is typically oversubscribed. It is to the proposer's advantage to provide all information requested to the greatest possible extent no later than the official deadline. Observing time at the national observatories is provided as support to the astronomical community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

In Memoriam of Clifford G. Toner
8 December 1959–29 March 2009

Frank Hill

Cliff Toner passed away unexpectedly at home in Tucson, Arizona, on 29 March 2009. For most of his career, Cliff was involved with the Global Oscillation Network Group (GONG), a facility of the National Solar Observatory in Tucson, Arizona.

Cliff was born on 8 December 1959 in New Westminster, British Columbia, Canada. After receiving his B.S. in Physics & Astronomy at the University of British Columbia at Vancouver in 1981, he went on to the University of Western Ontario in London, where he worked with David F. Gray, receiving his PhD in 1988 on "The Time Variability of Spectral Line Asymmetries and Equivalent Widths for the G8 Dwarf ξ Boo A: Evidence for a Starpatch."



After graduate school, Cliff accepted a post-doctoral position at the Institute for Astronomy at the University of Hawai'i in Honolulu, where he worked primarily with Barry LaBonte leading to the discovery of halos of enhanced high-frequency acoustic power surrounding solar active regions.

Cliff joined the GONG project in 1991 and tackled the critical problem of merging the data from the six GONG sites. In parallel, he and Stuart Jefferies developed an algorithm to measure the radii of full-disk solar images to a relative precision of 0.01 percent by determining the zero points of the Hankel transform of the image. As a by-product of the algorithm, the modulation transfer function (MTF) of each image was also obtained, and this led Cliff to develop a merging scheme based on the MTF of every image. It proved to be a very effective approach, and both the radii measurement and the merging algorithm remain in daily use in the GONG processing pipeline.

Cliff also developed a sophisticated optimization scheme that determined the network-wide relative orientations of the GONG images, and then pinned down the absolute value with drift scans. He further refined the solutions to compensate for irregularities in the camera rotator units. As a result of these algorithms, Cliff was able to co-align all of the GONG images to a precision and accuracy of 0.02 degree, as verified by his observations of the transits of Mercury and Venus.

Without these complex and clever strategies and these extremely important algorithms, it would have been impossible for the GONG data to be merged into a single uniform time series of adequate accuracy for precision helioseismology. Cliff's tireless, selfless work behind the scenes was essential for the success of GONG. Cliff also developed the scheme for merging the GONG high-cadence magnetograms, and was working on determining the radii of the forthcoming GONG H-alpha data just prior to his untimely death.

Cliff was a very tall man, and colleagues at Hawai'i enjoyed the sight of him riding around the campus on a small moped. Everyone who met him loved him for his patience and willingness to help out. As one of his colleagues from his stay in Hawai'i, K. D. Leka, recalled, "Cliff was the embodiment of a 'gentle giant'; so tall, yet so soft-spoken and patient, and I just recall a sense of his always being ready to help any living thing. … It was always with a smile that he'd greet me when we ran into each other after the 'Hawai'i days'; we'd swap some stories, kid updates, but only recently we were more in touch as I'm now playing with GONG data. I was heartened to hear he was working on the magnetogram merging, because I knew it would be done really well with his attention."

Cliff was a caring and loving person, an excellent scientist, and a hero of GONG. He will be sorely missed by everyone who knew him. He is survived by his wife, Nelsey; children, Ariel, Nathaniel, Miranda, and Kayl; a sister, Gloria; and brothers, Ethan and Emanuel.

Schuk Toak District Day

Katy Garmany

First, a brief primer for readers who are not familiar with the Tohono O'odham Nation: The Nation consists of 11 districts, nine of which are contiguous. Kitt Peak National Observatory is located in the Schuk Toak district. Each district is self governing somewhat in the manner that states in the US are. This year, the observatory was invited to set up a booth at the Schuk Toak District Day, April 26. So early Sunday morning, Nanette Bird, John Glaspey, and Katy Garmany headed out for the Schuk Toak district headquarters, about five miles west of the Kitt Peak turnoff. We wanted to make sure we were set up in time to see the parade, which begins the day. We succeeded, although not without help and duct tape from neighboring booths!

Our booth had a panel of favorite images from various Kitt Peak telescopes, as well as a series of historical photos that John has been unearthing in planning for the 50th anniversary celebration. For the occasion, we had folding flying disks printed that we gave to everyone, a solar telescope, and various handouts about the Kitt Peak Nightly Observing program. We brought along a Meade 8-inch telescope, which we pointed at the Mayall 4-meter telescope, about 7 miles to the southeast.

Close to 200 people stopped by the booth. The Chairman of the Tohono O'odham Nation, Ned Norris, came by, as did Schuk Toak District Chairwoman Phyllis Juan and Miss Tohono O'odham, Amy Juan. Everyone enjoyed looking at the telescopes on Kitt Peak through our telescope, and all were surprised to see that they were upside down. This led to fun discussions about what direction is up in astronomy.

The day was a great deal of fun (not to mention the fry-bread, or popovers as they are referred to by our O'odham friends). Next year, we will bring duct tape.

Clockwise from top left: Nanette and some visitors look for sunspots, but alas, none today! Eliano Francisco, age 7, checks out the 4-meter on Kitt Peak about seven miles away. Miss Tohono O'odham Nation (right), Amy Juan (a relative of Kitt Peak Mountain employee, Alfredo Zazueta), reminded the crowd of Ioligam, the O'odham name for Kitt Peak. Miss Tohono O'odham Rodeo Queen and her attendants rode in the parade. We were busy all day.

Galileoscopes Are in Production!

Stephen Pompea

Figure 1: Galileoscope being used for viewing Venus (through the tree) for an urban star party at Dupont Circle in Washington DC. The telescope was designed for good stray light rejection to encourage its use in large cities. (Photo S. Pompea)

Figure 2: The Galileoscope is a key project for the US and IYA2009 effort.

The student telescope kits developed by the US team for the International Year of Astronomy 2009 (IYA2009) are now in production thanks to the hard work of the Galileoscope team: Doug Arion of Carthage College, Rick Fienberg of Phillips Academy, and Stephen Pompea of NOAO. The manufacturing effort is led by Thomas Smith of Merit Models of Racine, Wisconsin, the manufacturing partner for the project. The achromatic refracting telescope provides a magnification of 25x with the Plössl eyepiece and 50x with the included Barlow lens, which can also serve as an eyepiece when the telescope is used in the Galilean configuration.

The development process started nearly two years ago, with much of the initial work done by volunteers of the US Telescopes Kits and Optics Challenges Working Group in coordination with the international Galileoscope task group, headed by Rick Fienberg. The final optical design and the stray light analysis of the telescope were done by working group members Scott Ellis and Rich Pfisterer of Photon Engineering LLC of Tucson in collaboration with NOAO. Photon Engineering is well known to the astronomical community for their design and analysis work on the Large Synoptic Survey Telescope, Advanced Technology Solar Telescope, the Apache Point 3.5-meter telescope, and the Optical System for Imaging and Low-Resolution Integrated Spectroscopy for the Gran Telescopio CANARIAS.

The educational program for the Galileoscope builds on the NSF-funded NOAO/SPIE/OSA Hands-On Optics program and a similar program for Boys & Girls Clubs funded at NOAO by the Science Foundation Arizona. NOAO's Rob Sparks led the work on the assembly instructions, the optics education activities, and the observing guide, which are posted online and being translated for use worldwide. The Galileoscope has been received with great interest by many countries celebrating the IYA2009 and has received excellent reviews for its optical quality and educational usability. More information on this IYA2009 cornerstone project can be found at *www.galileoscope.org*.

GLOBE at Night Reaches a Record Number of Dark-Skies Observations

Connie Walker (NOAO) & Doug Isbell (US IYA Single-Point-of-Contact)

The global citizen-science campaign GLOBE at Night 2009 recorded 80 percent more observations of the world's dark skies than the program's previous record—including double the number of digital measurements—thanks in large part to active participation and publicity from the network of 140 countries currently celebrating the International Year of Astronomy 2009 (IYA2009).

Now in its fourth year, GLOBE at Night encourages people everywhere to observe the prominent constellation Orion at least once over a two-week period and compare the number of stars that are visible using their unaided eyes with a series of charts that show how Orion would appear in skies ranging from very dark to very bright. The program is designed to aid teaching about the impact of excessive artificial lighting on local environments and the ongoing loss of a dark night sky as a shared natural resource for much of the world's population.

The 2009 campaign, held from March 16–28, garnered 15,300 geographically "mappable" measurements of Orion, nearly 7,000 more than the previous record of 8,491 that were contributed in 2007. Only one percent of the 15,456 observations in 2009 were "flagged" as not mappable. The percentage of flagged observations was reduced markedly this year thanks to a new online tool that helps identify the country from which the observation originated.

Measurements were received from more than 70 countries in the 2009 campaign, with 17 countries reporting more than 100 Orion measurements. About 73 percent of the total measurements came from the United States (approximately 11,270 observations), including all 50 states and the District of Columbia, followed by Chile (about 900), the Czech Republic, and the United Kingdom (both over 200). Other countries reporting more than 100 observations were Argentina, Australia, Canada, Colombia, Finland, Germany, Macedonia, Mexico, Poland, Romania, South Africa, Spain, and Turkey.

In addition, 19 countries contributed another 1,474 "mappable" digital measurements using hand-held Sky Quality Meters (SQMs). Two-thirds of the SQM measurements were from the US, with nearly 200 from Chile. Romania and Mexico followed with over 70 and 60 SQM measurements, respectively.

The full data set will be posted soon for download and local use at *www.globe.gov/GaN/analyze.html*; a map viewer that can compare GLOBE at Night data across the years is already available there.

GLOBE at Night is a collaboration between the National Optical Astronomy Observatory (NOAO) in Tucson, AZ; The Global Learning and Observations to Benefit the Environment (GLOBE) Program, in Boulder, CO; the Environmental Systems Research Institute, Inc. in Redlands, CA; the International Dark-Sky Association in Tucson, AZ; and the Centro de Apoyo a la Didáctica de la Astronomía in Altovalsol, Chile. For more information on GLOBE at Night, see *www.globe.gov/GaN*.

GLOBE at Night is a centerpiece of the Dark Skies Awareness cornerstone project, which is one of 11 global cornerstone projects of IYA2009. The Dark Skies Awareness cornerstone project is being led by NOAO. For more information on a variety of IYA2009 dark-skies awareness programs, including its three primary star-hunting projects, a planetarium show, a presence in Second Life, and joint programs with US national parks, amateur astronomers and some of the greatest environmental photographers in the world, see *www.darkskiesawareness.org*.

KPNO REU Students Going to Graduate School

Ken Mighell

Five of our former KPNO Research Experiences for Undergraduates (REU) students will start graduate school next fall. Our hearty congratulations to:

Tim Arnold (Ohio State University, REU 2008), who will be going to the University of Arizona.

Tiffany Meshkat (University of California at Los Angeles, REU 2008), who will be going to the University of Leiden in the Netherlands.

Rosalie McGurk (University of Washington at Seattle, REU 2007), who will be going to the University of California at Santa Cruz and received an NSF Graduate Research Fellowship.

Josiah Walton (University of Arkansas at Fayetteville, REU 2007), who will be going to the University of Illinois at Urbana-Champaign and received an NSF Graduate Research Fellowship.

Matthew Zagursky (University of Maryland, REU 2008), who will be going to the University of Hawai'i.

Technology Skills for Arizona Teachers: The AstroBITS Program

Katy Garmany

Do you remember learning astronomy in school? Quite probably not. Many people receive little instruction because astronomy is not a typical curriculum subject, yet the magic of astronomy can be a powerful motivator for students. Students today are surrounded by examples of technology such as digital picture phones and cameras, computer games, and medical imaging tests and the list goes on. But with no experience in understanding this technical world, it is difficult for students to aspire to careers in technical fields. To address this challenge, the EPO group at NOAO applied for and received a multi-year grant, Building Information Technology Skills through Astronomy (AstroBITS), from Science Foundation Arizona to help Arizona teachers learn how to incorporate the excitement of astronomy into their science classes. Science Foundation Arizona (SFAz), an organization funded by both state and private sources, is seeking new ways to bring information technology and science into Arizona classrooms and to help build a highly skilled workforce. EPO is well-suited to address this challenge as a result of the experience we have gained running a very successful national teachers program, Research Based Science Education (RBSE), for over 10 years.

Figure 1: Arizona teachers enjoying their observing run at Kitt Peak.

The most effective way to reach students starts with their teachers, so this program recruits middle school and high school science and math teachers from around the state of Arizona. Building on the rich astronomical data sets and image processing tools currently in use by teachers in the RBSE program, AstroBITS stresses that without measurements there is no science. And while the particular skills and experience are related to astronomical imagery, they can be expanded to include medical imagery, optics, biology, geology, and other fields. The teachers selected for AstroBITS have come from a cross section of Arizona schools, including the Tohono O'odham Nation, a rural school in Dewey, Flagstaff, and Tucson schools serving primarily Native American populations.

The workshop begins with the teachers spending two nights on Kitt Peak where they are introduced to the observatory and the night sky. They first observe visually, using the visitor center telescope under a roll-off roof—the warm nights of June are ideal for this experience. Then the CCD camera is attached, and they take images through different filters of objects they have chosen. During the afternoon, they visit other telescopes. We appreciate our colleagues who have generously shared their time and programs with us!

The group meets the following week at the NOAO offices; teachers are fascinated to walk the halls and see what astronomers post on their doors. At this time, we supply everyone with a laptop (supported by SFAz) to enable them to work both during the workshop and while at home. We introduce them to the free image processing program ImageJ and explore what constitutes a CCD image. Visits to different departments on the campus of the University of Arizona demonstrate how much of modern astronomy, and indeed all science, relies on accurate measurements.

Figure 2: A student of teacher Nicole Snook, at Toltecalli Academy, Tucson, working on an image processing program.

Astronomy offers an ideal opportunity to model collaborative work via telecommunication. We have modeled this for the teachers, showing them how to access and reduce data from their home or school. They return to NOAO every other week during the summer for several days of increasing exposure to astronomical science and data analysis. Using the lure of astronomical images, the teachers develop classroom projects, based on various suggestions from the AstoBITS staff, but also allowing for their own creative ideas. The primary connection is through image processing: digital imagery is ubiquitous in technology these days, and learning that the basis of this is all in mathematical manipulation of images is the first step.

We stay in close contact with our teachers during the school year and encourage them to chat frequently with us and with each other in the summer workshop. Many teachers and school administrators have expressed a desire to make this program available to a larger audience, and as a result, we are in discussions with Science Foundation Arizona about expanding the program this summer to include more teachers.