>>>NOAO/NSO Newsletter

NATIONAL OPTICAL ASTRONOMY OBSERVATORY/NATIONAL SOLAR OBSERVATORY

ISSUE 94 — JUNE 2008

Science Highlights

Director's Office

NOAO Gemini Science Center

Observational Programs

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Cerro Tololo Inter-American Observatory

Kitt Peak National Observatory

National Solar Observatory

Public Affairs and Educational Outreach

AURA Selects David Silva as New Director of the National Optical Astronomy Observatory

In late March, the Association of Universities for Research in Astronomy (AURA) selected David Silva as the new director of the National Optical Astronomy Observatory. Dave will start a five-year term as director of NOAO on July 7

Dave brings a wide variety of experience to this appointment as NOAO director, from his current duties as Observatory Scientist for the Thirty Meter Telescope project in Pasadena, CA, to past responsibilities for data management and user support at the European Southern Observatory (ESO) in Germany. During a prior tenure at NOAO from 1991 to 1996, Silva served as project manager during the commissioning of the WIYN 3.5-meter telescope on Kitt Peak, and as a staff astronomer in the US office of the Gemini Observatory.

He received his PhD from the University of Michigan in 1991, following a bachelor of sciences degree from the University of Arizona. Dave succeeds Todd Boroson, who has served as interim director of NOAO since April 2007, following the departure of Jeremy Mould. (See related article on page 10.)

Dave's research interests include extragalactic stellar populations, the formation and evolution of elliptical galaxies, and digital stellar libraries. In his free time, he enjoys outdoor activities such as hiking, cycling, running, and skiing.

Dave is married to Paula Christianson-Silva (BSc, University of Arizona, 1983; MSc, University of Michigan, 1988). Christianson-Silva is nurse practitioner in a primary care practice. They have two teenage children in high school.

"Exploring the Universe is one of the great human endeavors, and the US national observatory has a flagship role to play in this exploration," Dave said in the March 25 NOAO press release announcing his selection. "Between an excellent staff, a commitment to revitalize its current facilities, an expanded program of joint endeavors with other world-class observatories such as the Gemini Observatory, and participation in the Large Synoptic Survey Telescope and Giant Segmented Mirror Telescope development programs, the future of NOAO looks brighter than it has in years. It's an honor to have the opportunity to lead NOAO during this exciting period."

The *NOAO-NSO Newsletter* is published quarterly by the **National Optical Astronomy Observatory**
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On the Cover

Omega Centauri Radiant in Infrared

Omega Centauri is the biggest and brightest of the 150 or so globular clusters that orbit the Milky Way galaxy.

The cover photo of this ancient cluster in the southern constellation Centaurus was made by combining a visible light image from the National Science Foundation's Blanco 4-meter telescope at Cerro Tololo Inter-American Observatory with infrared data from NASA's Spitzer Space Telescope. Visible-light with a wavelength of 0.55 microns is colored blue, 3.6-micron infrared light captured by Spitzer's infrared array camera is colored green, and 24-micron infrared light observed by Spitzer's multiband imaging photometer is colored red.

The team that took the Spitzer data believes that Omega Centauri might have a different origin than many globular clusters: it may be the core of a dwarf galaxy that was ripped apart and absorbed by our Milky Way long ago.

Where green and red overlap, the color yellow appears. Thus, the yellow and red dots are stars revealed by Spitzer. These stars, called red giants, are more evolved, larger and dustier than average. The stars that appear blue were spotted in both visible and 3.6-micron (near-infrared) light; they are less evolved, like the Sun. Spitzer found very little dust around any but the most luminous, coolest red giants, implying that the dimmer red giants do not form significant amounts of dust. The space between the stars in Omega Centauri was also found to lack dust, which means the dust is rapidly destroyed or leaves the cluster. *Image Credit: NASA/JPL-Caltech/NOAO/AURA/NSF*

The Tilted Solar Magnetic Dipole

A.A. Norton, G.J.D. Petrie &, N.-E. Raouafi

Astrophysical bodies often have magnetic axes not aligned with their rotational axes. For instance, the magnetic axes of Earth and Uranus have tilt angles of 11˚ and 60˚ with respect to their rotational axes. The Earth's magnetic field is attributed to interactions between the solid iron core, the outer molten core, and planetary rotation (Coe and Glatzmaier, 2006). Modeling shows that the same process (convection in a rotating shell of conducting fluid) can explain all dynamo-generated magnetic fields (Stanley and Bloxham, 2004). Another explanation is a primordial magnetic field, i.e., an axis direction 'frozen in' during formation.

The Sun has a magnetic dynamo acting in the interior, with toroidal bands of magnetism at the base of the convection zone being the source of sunspots. In discussing a "magnetic axis," we refer directly to the dipole component of the magnetic field. Of course, there are higher-order moments that are strongest near solar maximum, but their effect is more important at lower latitudes. As sunspots evolve and decay, flux is transported to the high latitudes, causing the polar magnetic reversal (Durrant, et al., 2004).

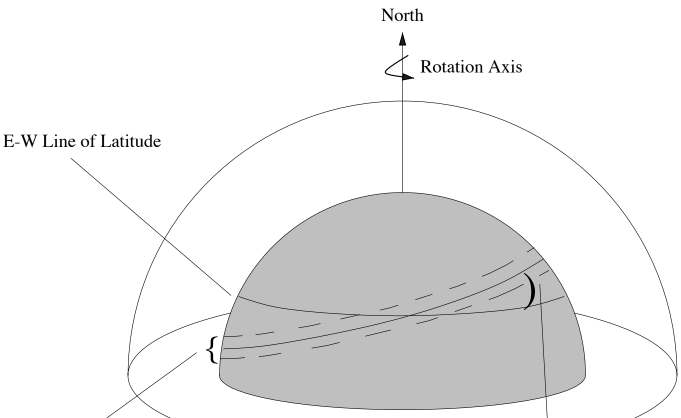

Figure 1: Schematic depicting only the Northern solar hemisphere, with the equator at the bottom. The toroidal band is tipped with respect to lines of constant latitude. The outer half-sphere represents the photosphere. The inner half-sphere represents the base of the convection zone.

We examine the tilt of the solar magnetic dipole near the 1996 solar minimum. We are motivated by the idea that a persistent tilted dipole may result from an MHD instability acting upon the toroidal magnetic bands in the interior (see figure 1). Non-axisymmetric eruption of sunspots mapping out an m=1 (or 'tilted band') pattern in longitude has been predicted by dynamo theory and observed in sunspot location patterns (Norton and Gilman, 2004). The decay of the follower spots and the pole-ward migration of flux could create polar caps misaligned with the N-S rotational axis (see figure 2).

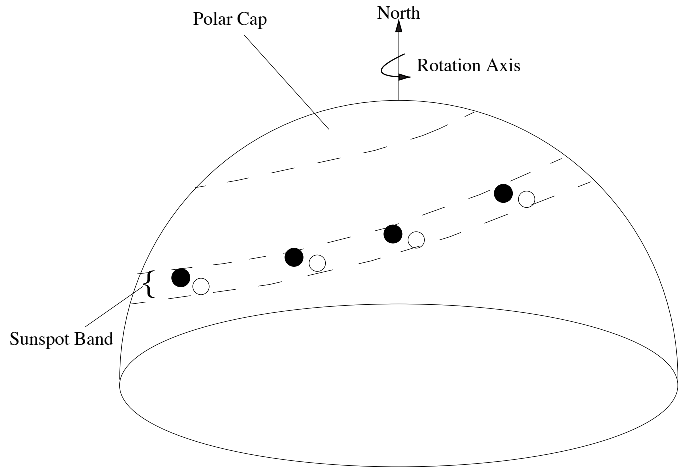

Figure 2: Sunspot locations trace out the location of the tipped toroidal band. Note, the angle is exaggerated compared to the expected 5-10°. An off-axis polar cap could result. We propose that this mechanism could cause the solar magnetic poles to be offset from the rotational axis.

Coronograph data from the Large Angle and Spectrometric Coronagraph Experiment (LASCO) are used to study the global coronal geometry for Carrington Rotations (CRs) 1900-1932 (Brueckner, et al., 1995). During this time, the streamers observed in the corona trace out the neutral line and the heliospheric current sheet is in its most simple configuration (Wilcox & Hundhausen, 1983). The streamer belts are seen in white light images as bright cusps initiating in the mid-latitudes, with cusp closure near the equator.

Simultaneously observed East and West limb streamer profiles are compared by cross-correlating the brightness as a function of latitude. To display the evolution of the dipole tilt, we plot the latitudinal displacement as a function of time (see figure 3). A damped sinusoidal pattern results for CRs 1915-1919, indicative of a dipole tilt with amplitude decreasing in time, which may be a signature of the descent toward solar minimum.

We also investigate the center-of-gravity (COG) of the magnetic polar caps and the polar coronal holes. We use Kitt Peak Vacuum Tower (KPVT) magnetograms and SoHO Extreme Ultraviolet Imaging Telescope data. To determine the COG, the edges of the polar holes are selected visually, with coordinates translated into latitude and longitude. A similar method is employed for the magnetic polar caps. For comparison, we use the potential-field source-surface (PFSS)

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The Tilted Solar Magnetic Dipole continued

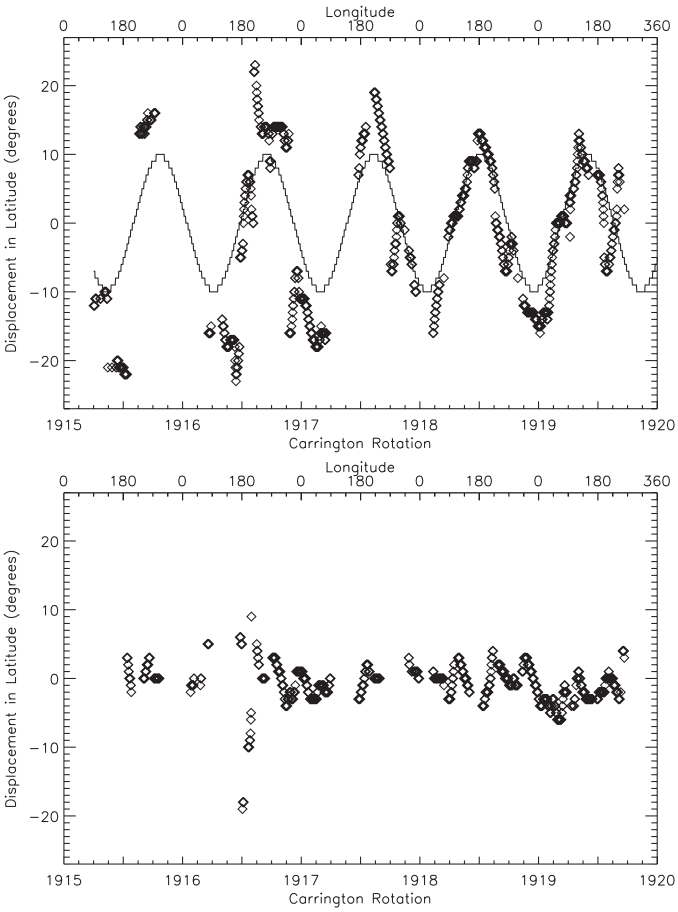

Figure 3: The displacement in latitude that results in the best cross correlation between streamers on the East and West limb of the sun (diamonds). A periodic signal is expected from a dipole geometry tilted with respect to the rotational axis. A 10° tilt is overplotted as a solid line for reference.

model, with KPVT magnetogram data as input, to model the coronal hole boundaries and the magnetic dipole term (see figure 4).

This research represents an effort to connect the current understanding of the dynamic magnetic field at the base of the convection zone with non-axisymmetry observed in solar surface magnetism. The mechanism outlined in figures 1–2 could contribute up to 10˚ to the tilt of the magnetic dipole. The equatorial streamers map out a sinusoidal structure in longitude and latitude about the equator for CR 1915-1919 with ~10˚ amplitude in latitude. The polar caps defined by the coronal holes and modeling exhibit a tilt with values ranging from 1 to 10˚ with an average value of 4–6˚.

These are acceptable amplitudes to result from the MHD instability of the toroidal bands. However, without the polar cap geometries determined from the unipolar magnetic regions as seen in surface flux (and not just as determined from the polar hole locations), the viability of the proposed mechanism for creating a non-zero magnetic dipole tilt at solar minimum remains in question. For a more in-depth treatment on this topic, see Norton and Raouafi, 2008 and Norton, Petrie and Raouafi, 2008.

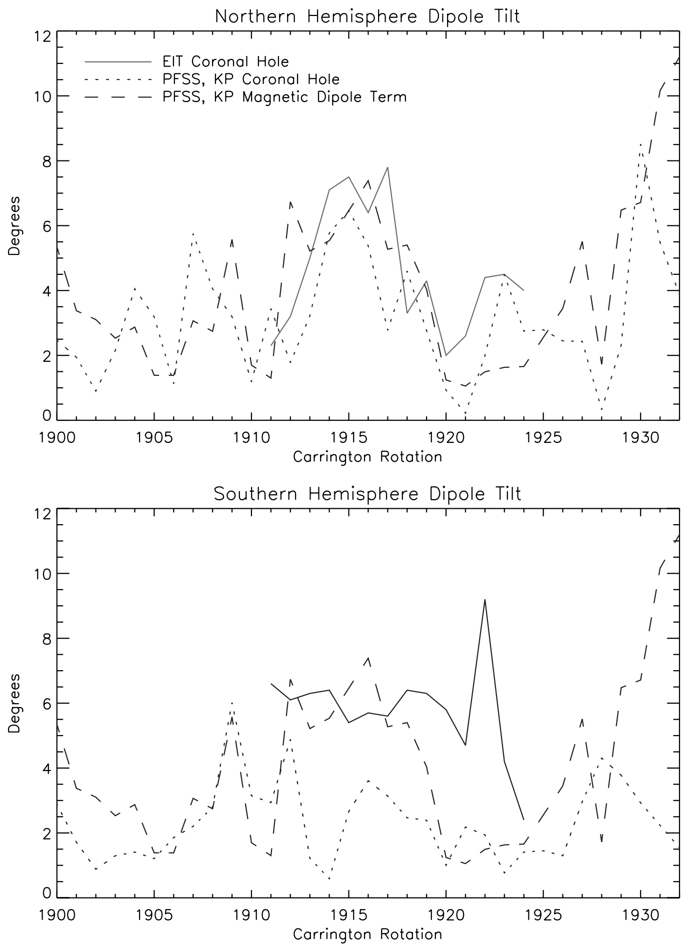

Figure 4: The tilt of the polar caps COG is plotted for CRs 1910-1932 determined from the observed coronal holes (red), the coronal holes from PFSS models (green), and the dipole terms (blue). [See online version for full color.] The values as calculated from the KPVT synoptic maps were determined to be too noisy.

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Watching the Production of Elements in Evolved Stars

Thomas Lebzelter, Michael Lederer & Bernhard Aringer (University of Vienna),
Ken Hinkle (NOAO), Sergio Cristallo & Oscar Straniero (INAF Teramo)

More than 90% of the mass of the human body consists of material produced during the late stages of stellar evolution. The wide variety of elements are created from stars of different masses.

One mode of dispersing heavier elements is by winds from Asymptotic Giant Branch (AGB) stars, which are an advanced evolutionary stage of low- and intermediate-mass stars. This enriches the interstellar medium, from where new stars and solar systems are formed, and eventually some of these elements make their way into our bodies. But for all this to happen, the elements must first be transported by some mixing process from deep in stellar interiors, where nucleosynthesis takes place, to the surface of the star. A study of this mixing phase—known as third dredge up—in low and intermediate mass stars is the subject of an ongoing observing project at Gemini South. First results have just been accepted for publication in *Astronomy and Astrophysics*.

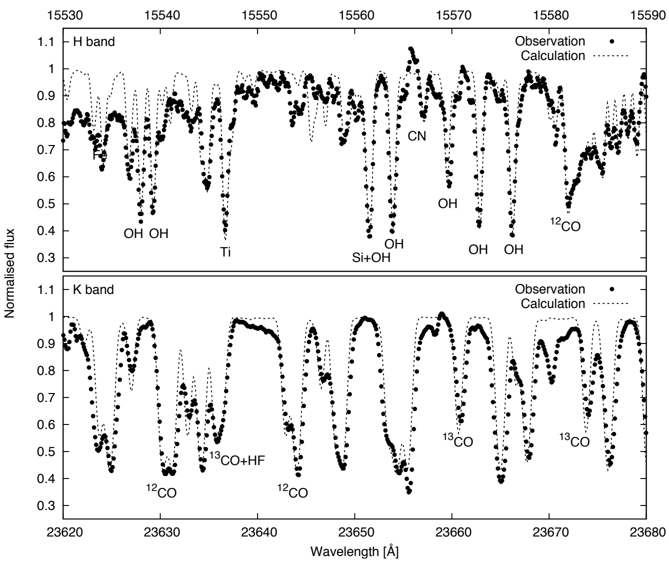

Figure 1: Example Phoenix spectra of an AGB star in the LMC cluster NGC 1846. Also plotted is a model spectrum with Teff = 3550K, log g = 0.25, C/O = 0.3, 12C/13C = 22 and reduced F abundance to illustrate the method of determining the stellar abundances. Additional information on the stellar parameters came from near infrared photometry and variability information.

During their lifetimes, stars of low and intermediate mass experience a number of deep-mixing events that change the elemental abundances at the surface. The first dredge up occurs on the way from the main sequence to the red giant phase, altering the surface composition by products of the incomplete Carbon Nitrogen Oxygen (CNO) cycle. The second dredge up occurs only in stars of intermediate mass after the He core burning phase. The third dredge up, finally, is a repeated process during the AGB phase. In the stellar interior, two burning shells surround an inert core of carbon and oxygen. The interplay between these two shells leads to short phases of increased He burning, pushing outward on the layers above. In the mixing that follows, the convective atmosphere can briefly reach into layers of the interior already enriched in processed material.

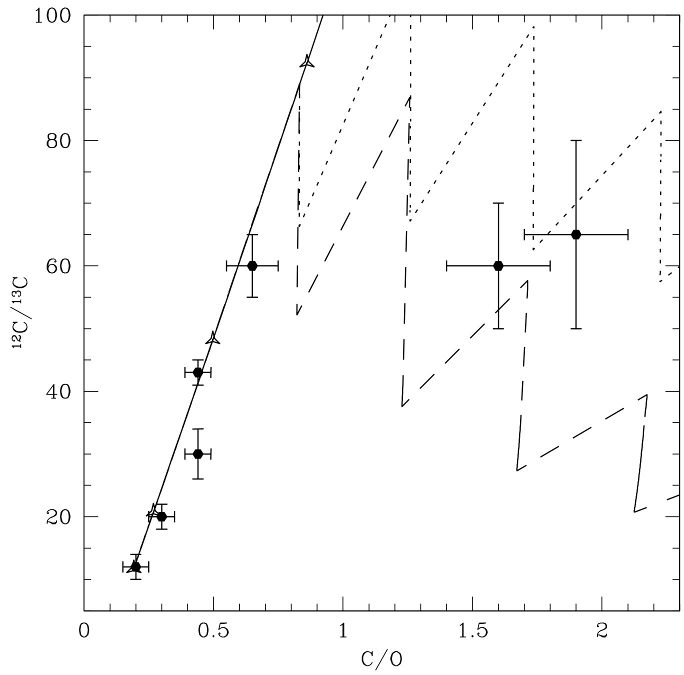

Figure 2: C/O versus 12C/13C for the AGB stars in NGC 1846. Observed values with error bars are marked by dots. Predicted values from models with and without extra-mixing are shown. Solid line refers to our reference model, while the dotted and dashed ones refer to models including an extra-mixing which affects the 13C abundance. All models assume [O/Fe] = +0.2 for all cluster stars (see Hill et al., 2000). Symbols along the model lines indicate the expected steps due to third dredge up events. It can be seen that there is quite a good agreement between observations and standard model for low C/O values, but for high C/O values the inclusion of extra-mixing becomes necessary.

Modeling of nucleosynthesis and mixing in the AGB phase of stellar evolution is a very active area in stellar astrophysics (Straniero et al., 2006). A difficulty in comparing models with observations is that the surface composition, as a result of mixing, is highly dependent on the mass of the star, and the mass of a field AGB star is typically very uncertain. However, star clusters offer a way out of this difficulty: we can derive the mass of a star at a given evolutionary status from global parameters of the cluster. We have studied the AGB stars in the cluster NGC 1846 belonging to the Large Magellanic Cloud (LMC). From work using ANDICAM at CTIO (among other instruments) we found a well-defined AGB mass of about 1.8 $M_{\odot}$ in NGC 1846 (Lebzelter & Wood, 2007).

Two indicators for mixing processes were investigated, namely the C/O ratio and the 12C/13C ratio. By mixing 12C (produced by He burning) to the surface, both ratios should be altered. Measurements

continued

Watching the Production of Elements in Evolved Stars continued

with the Phoenix spectrograph at Gemini South analyzed with our hydrostatic model atmospheres revealed for the first time an observed increase of both ratios as stars evolve up the AGB. The findings nicely agree with our model expectations as shown in figure 2.

However, as it is often the case in science, our results allude to topics not expected at the planning phase of a project. Of particular interest is our finding that the 12C/13C ratio reaches a saturation level close to 60 for high C/O ratios (especially for C/O>1). This cannot be explained by the standard model, which would suggest a steady increase of 12C/13C. Thus a way for producing 13C during these late stages is required. The most obvious explanation for this observational pattern is the occurrence of a mixing process able to bridge the radiative gap between the cool bottom of the convective envelope and the hot H-burning zone. A similar process has been posited to explain some abundance anomalies in red giants stars (e.g., see Charbonnel 1995, Nollett et al., 2003).

In spite of much observational evidence, a common consensus on the physical mechanism driving this mixing has not been established (explanations include rotational induced instabilities, magnetically induced circulation, gravity waves or thermohaline mixing). The scenario emerging from the evolutionary sequence of 12C/13C versus C/O in NGC 1846 is that of a moderate deep mixing, affecting the 13C surface abundance in the late part of the AGB only, when stars become C-rich. The abundance derived from O-rich stars in NGC 1846 are all compatible with the predictions of models with no extra mixing. In figure 2, models including this effect are also shown. Our observations set new constraints on the amount of matter and the maximum temperature reached by this mixing, and will help to reveal the nature of this effect.

Finally, the near-infrared spectra obtained at Gemini South allowed measuring the abundance changes of the light element fluorine, whose nucleosynthetic origin is not understood. We demonstrate that the fluorine abundance increases with C/O, strongly favoring AGB stars as the source of fluorine in the Universe.

Using the Phoenix spectrograph at Gemini South again during the previous two semesters, we are extending our study to a few other LMC clusters in order to test the effects of different mass and metallicity on the mixing. Data analysis is under way and we expect to be able to present further results in the near future.

The Magellanic Bridge: Tidal Debris in our Backyard

Jason Harris

The silent expanse of our intergalactic neighborhood is occupied by a few dozen small galaxies. The largest and most enigmatic of these dwarf satellites are the Large and Small Magellanic Clouds (LMC and SMC), a pair of galaxies whose star-formation histories have likely been driven by their mutual gravitational dance. On a timescale that is both incomprehensibly vast and cosmologically tiny, the LMC and SMC embrace, spin, and dip as they plunge through a complex and ever-changing repertoire of interplay.

In the forbidden light of atomic hydrogen gas, their secret dance is revealed: we see both the Magellanic stream, a long filament of gas trailing behind the clouds by as much as 100 kpc; and the Magellanic bridge, a tenuous connection between the two galaxies (see figure 1). Such bridge/stream structures are the tell-tale signs of past gravitational encounters: we see them often in both numerical simulations of colliding galaxies, and in many examples of close galaxy pairs throughout the Universe. The Magellanic system is by far the nearest such example, and so studying the residue of their encounter gives us a unique opportunity to study such collisions in great detail.

However, there is something quite mysterious about the tidal debris of the Magellanic system: while the contours of the Magellanic stream and Magellanic bridge are well-traced by atomic hydrogen gas, they seem to be completely devoid of tidally-stripped stars. Indeed, there are no known stars associated with the Magellanic stream, and while there are stars in the Magellanic bridge, as of yet the stars detected in the bridge have been exclusively young. This means they cannot have been tidally stripped as stars during the encounter that formed the bridge, because in that case, we would see the same admixture of stellar ages that we see in the Clouds themselves. Observationally, if the stars in the bridge had been tidally stripped, we should see a prominent red giant branch associated with the Magellanic bridge, because both clouds possess an abundant population of old red giant stars.

The search for tidally-stripped stars in the Magellanic system is not a trivial exercise in intergalactic bean-counting. The lack of tidally-stripped stars in the bridge and stream calls into question our basic understanding of their gravitational dance. If the structures we see in atomic hydrogen are indeed due to tidal interactions, then the tidal forces which produced them really should have stripped both stars and gas from the clouds into these structures.

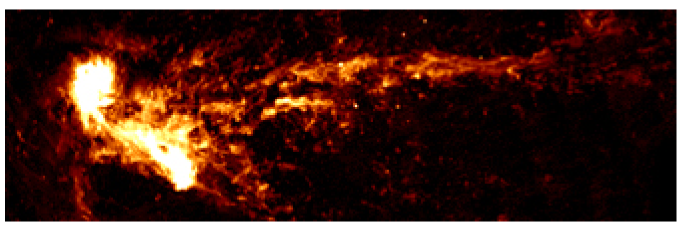

Figure 1: The distribution of HI gas in the Magellanic system. The LMC and SMC are the bright white blobs on the left of the image. They are connected by a bridge of HI gas, and trailed by the Magellanic stream, which extends more than 100 degrees behind the clouds. Image credit: Mary Putman

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The Magellanic Bridge continued

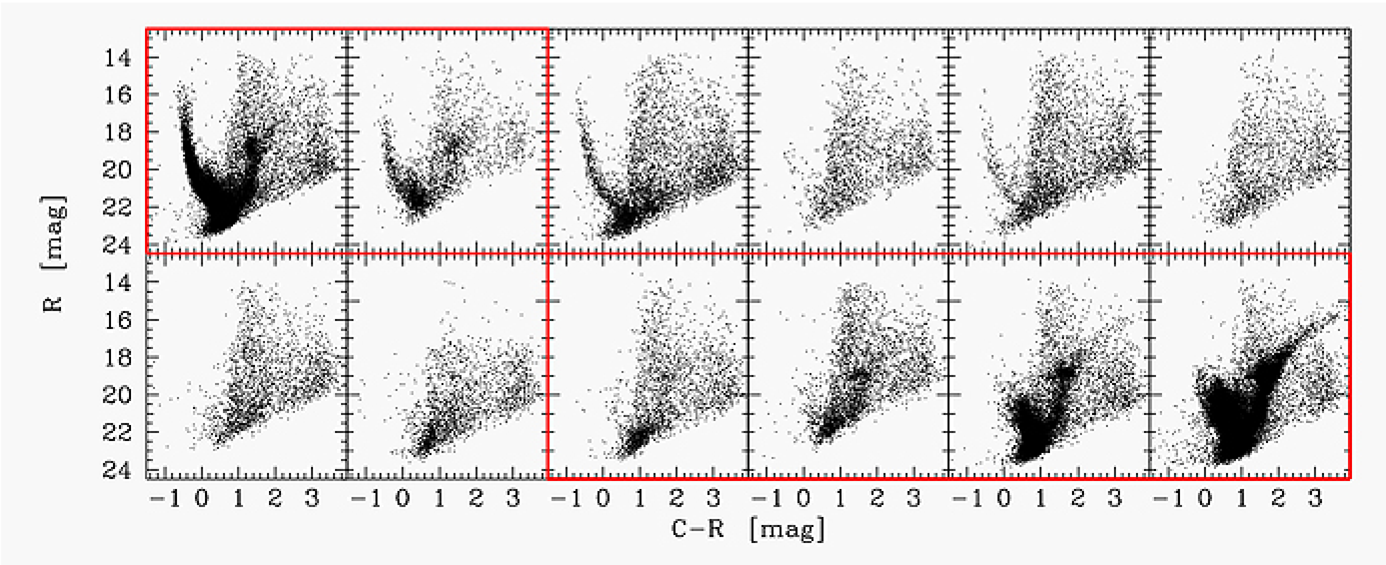

Figure 2: Color-magnitude diagrams for the 12 fields observed in the Magellanic bridge. The fields cover the inter-cloud region, from very near the SMC (upper left panel) to very near the LMC (lower right panel). I found a significant population of red giant stars only in the six fields nearest the SMC or LMC; these fields are outlined in red in the figure online.

Searching for Red Giants

In 2006, I used the Mosaic II camera at the CTIO Blanco 4-meter telescope to look for a tidally-stripped population of old red giant stars in the Magellanic Bridge. I obtained deep images of 12 fields spanning the inter-Cloud region, and constructed color-magnitude diagrams (CMDs) of the stellar populations therein (see figure 2).

These CMDs show that some of the fields do indeed possess a red giant population. However, only those fields that are close to either the LMC or SMC show red giant stars. The fields in the central regions of the Bridge do not show red giant branch stars. I conclude from this that the red giants in the "bookend" fields are components of the LMC or SMC, and are not associated with the Bridge. In fact, the surface density profile of red giants in the four fields nearest the LMC is perfectly consistent with previous measurements of the LMC's exponential disk.

From my 4-meter observations, it certainly looks as if there are no tidally-stripped stars in the Magellanic Bridge. However, there's one more potential plot-twist: the 12 fields I observed were strung along the HI filament of the Bridge like beads on a string. By restricting my search for red giants to these fields, I am inherently assuming that the tidally-stripped stars will be embedded in the tidally-stripped gas. This is a reasonable assumption, but it is conceivable that the stars and gas could have been separated after having been stripped, because the stripped gas will feel hydrodynamic drag forces from its motion through the Milky Way halo that the stripped stars would not feel.

To address this possibility, I mined the archive of the 2-micron All-Sky Survey (2MASS), constructing near-infrared CMDs for two sections of the inter-Cloud region. One section is coincident with the four of my 4-meter fields that are nearest the LMC. This is my control

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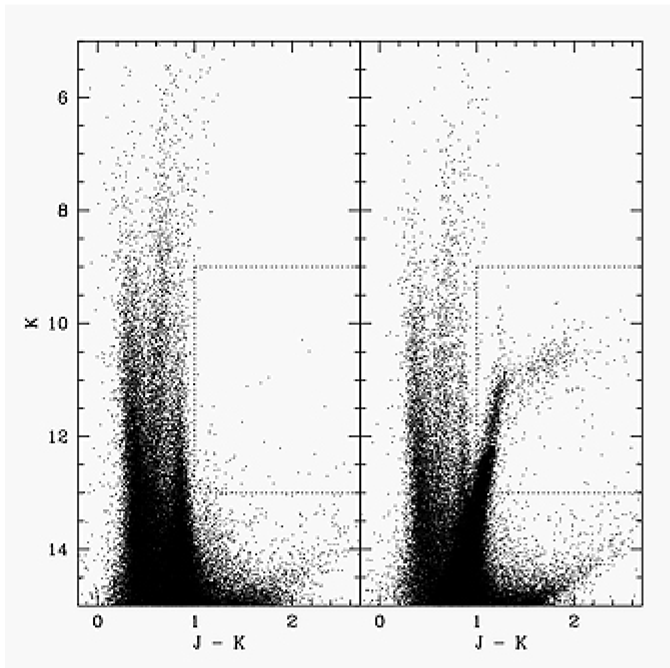

Figure 3: Near-infrared CMDs from 2MASS of two sections of the inter-cloud region: a large central area where bridge giants would be expected (left), and a smaller control area known to contain red giants belonging to the LMC (right). The dotted box in each panel highlights the region occupied by red giants and other evolved stellar populations.

The Magellanic Bridge continued

field, because I know these fields are "polluted" by red giant stars that belong to the LMC. The other section is larger than the control section by a factor of 10, and subtends the entire central portion of the inter-Cloud region, where I found no red giants in my 4-meter fields. By comparing these two CMDs from 2MASS (figure 3), it is immediately obvious that the red giant population seen in the control field is completely absent in the much larger central field. This result confirms that there is no tidally-stripped stellar population associated with the Magellanic Bridge.

The Young Bridge Population

It is somewhat confounding that there are no tidally-stripped stars in the Bridge; however, the upshot of this realization is that we now know that the young stars present in the Bridge must have formed in situ, from gas which had already been stripped out of the Clouds. That makes the Bridge stars by far the nearest example of stars formed in the wake of a tidal encounter, so they represent a golden opportunity to study tidally-triggered star formation in great detail. In addition, if we can measure the ages of the Bridge stars, we will have determined the timing of the tidal encounter itself, which has important implications for understanding the orbits of the Clouds, and their relationship to each other and to the Milky Way.

I have developed a star formation history analysis code (StarFISH) that can robustly determine the mixture of stellar ages present in a color-magnitude diagram, through statistical comparison with theoretical models. I applied StarFISH to the young stellar populations in the Bridge, and found that star formation was ignited between 200 and 300 Myr ago. Thus the tidal encounter that produced the Bridge must have occurred about 300 Myr ago.

How are we to understand a gravitational encounter between the Magellanic Clouds that selectively stripped only gas from the Clouds, leaving their stars intact? Since gravitational forces do not discriminate between stars and gas, there must have been a bias in the initial configuration of gas and stars in the pre-collision Clouds.

One plausible scenario is that the SMC possessed an envelope of HI gas that extended to much larger radii than its stellar population. Such HI envelopes are not unheard of among dwarf galaxies, so this is a plausible idea. Still, it may be difficult to understand how such a gas envelope could come to be if the LMC and SMC are long-term dance partners. In that case, we might expect that such an extended gas envelope would have been truncated by encounters long before 300 Myr ago. NL

The NEWFIRM Medium-Band Survey

Pieter van Dokkum (Yale), Danilo Marchesini (Yale), Ivo Labbé (OCIW), Gabriel Brammer (Yale), Ryan Quadri (Leiden), Mariska Kriek (Princeton), Marijn Franx (Leiden), Garth Illingworth (UCSC), Kyoung-Soo Lee (Yale), Adam Muzzin (Yale), Gregory Rudnick & Kate Whitaker (Yale)

There is good evidence that galaxy evolution was much more rapid in the 2.5 Gyr interval 1.5<z<3.5 than in the 10 Gyr since z=1.5. This epoch was characterized by strong starbursts, spectacular merging activity, and rapid black hole growth (e.g., Rudnick et al., 2006; Daddi et al., 2007). At the same time, some galaxies were not forming new stars at all (e.g., Kriek et al., 2006), even though gas and triggers for star formation were plentiful at this epoch. There was a much greater diversity of galaxies than in today's Universe, which looks somewhat humdrum in comparison.

Unfortunately, it is difficult to study representative galaxy samples at these early times, as familiar rest-frame optical spectral features are shifted into the near-infrared. Most studies of high-redshift galaxies have focused on blue star-forming galaxies, as they are relatively bright at optical (rest-frame ultraviolet) wavelengths (e.g., Steidel et al., 1996). However, the majority of massive galaxies are relatively red, and much too faint in the observer's optical for spectroscopy (e.g., van Dokkum et al., 2006). As a result, we either have to work with small, bright samples for which we can obtain near-IR spectra (see Kriek et al., 2008 for our Gemini survey of massive galaxies at z ~ 2.5), or rely on photometric redshifts derived from broadband photometry (e.g., Dickinson et al., 2003; Fontana et al., 2006, and many other studies). Although these photometric redshifts are sufficiently accurate for determining broad characteristics of galaxies (such as their luminosity function), they cannot be used to measure accurate rest-frame colors, stellar population parameters, or the local galaxy density.

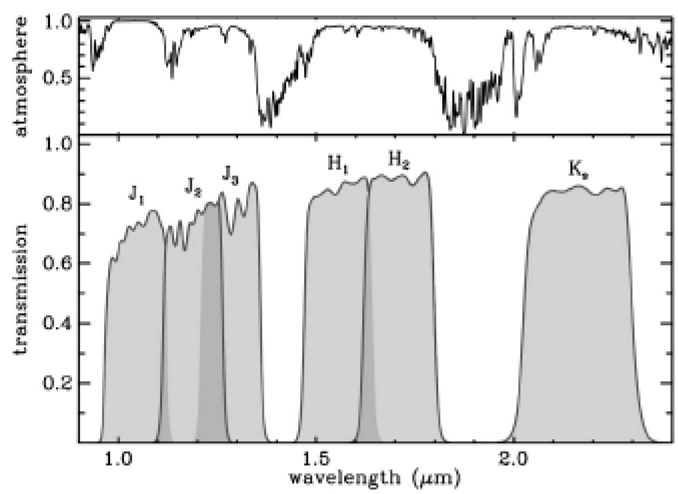

Figure 1: The transmission curves of the medium-band filter system that we designed and manufactured for NEWFIRM. The J_1, J_2, J_3, H_1, and H_2 filters together provide crude "spectra" with resolution R ~10 over the wavelength range 1-1.8 microns, offering a compromise between spectroscopy and broadband imaging.

continued

The NEWFIRM Medium-Band Survey continued

Inspired by the successful Classifying Objects by Medium-Band Observations 17-filter survey (COMBO-17), an optical medium-band imaging survey at redshifts 0<z<1 (Wolf et al., 2003), we are undertaking a project which will provide a sample of K-selected galaxies with accurate redshifts in the range 1.5<z<3.5 that is several orders of magnitude larger than what is available today.

We designed and manufactured a set of five custom medium-band near-IR filters for the NEWFIRM wide-field infrared imager on the Kitt Peak Mayall 4-meter telescope, which provide "spectra" with a resolution of R ~10 from 1-1.8, microns. The filters, shown in figure 1, pinpoint the location of the redshifted Balmer or 4000 Å break for galaxies at 1.5<z<3.5. Combined with broad-band optical- and K_S-band photometry, these filters should provide redshifts accurate to Δ(1+z) =0.02-0.03 at z>1.5, a factor of 3–4 better than is possible with broadband photometry alone.

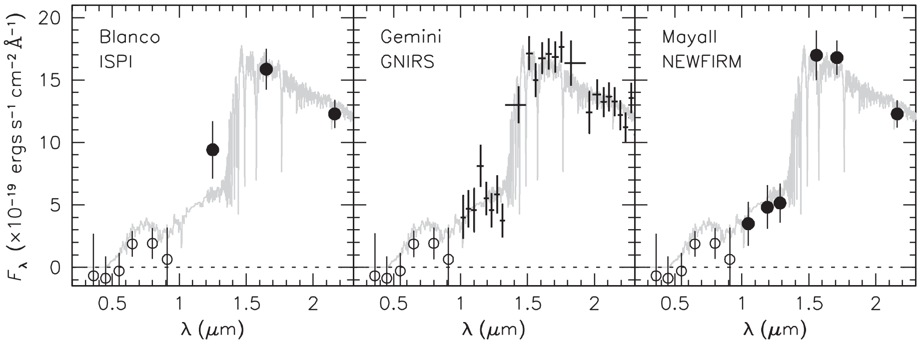

Figure 2: Comparison of "standard" broadband photometry from ISPI on the CTIO Blanco 4-meter telescope (left panel), near-infrared spectroscopy with the cross-dispersed GNIRS spectrograph on Gemini (middle panel), and medium-band imaging with NEWFIRM on the Kitt Peak Mayall 4-meter telescope (right panel). The grey model spectrum (repeated in each panel) is the best fit to the GNIRS data. The resolution offered by the medium- band filters is sufficient to locate the strong Balmer break in this galaxy.

This redshift accuracy is sufficient to isolate the sequence of "red and dead" galaxies in color-magnitude diagrams of high-z galaxies. Furthermore, by combining the redshifts with 2D spatial information, the local galaxy density can be determined, and the improved sampling of the Balmer-break region provides good constraints on the ages of the galaxies.

We proposed to do a deep NEWFIRM survey with these filters in fields that have excellent available data at other wavelengths. The NOAO Survey Time Allocation Committee generously awarded 34 nights. This allocation has been augmented by 30 nights through a WIYN/NOAO time trade. The primary fields are 28 arcmin x 28 arcmin areas in COSMOS and AEGIS. When the survey is completed, we will provide the reduced data to the community, as well as photometric catalogs, redshifts, stellar population parameters, and other ancillary products.

Our first run comprised 24 nights in a single block in March and April. Organizing the run was a fun challenge, with eight observers coming in at various times, a dedicated laptop and 6 terabytes of disk space for on-site reductions, and a wiki page where we kept our night logs, cookbooks, and a host of other information. We were very impressed with NEWFIRM: its wide field and excellent sensitivity are a delight, particularly to those of us who have many nights of experience with older, smaller field-of-view imagers on other telescopes! Despite somewhat mediocre seeing, the run was a success, in large part due to the stability of NEWFIRM and the excellent support of NOAO staff.

Figure 2 shows an example of the type of data we are collecting for thousands of galaxies. The left panel shows broad-band photometry from the NOAO Mosaic imager (optical) and the Infrared Side Port Imager (ISPI) (J, H, and K_S) of a galaxy in the Multiwavelength Survey by Yale-Chile (MUSYC) Sloan Digital Sky Survey (SDSS)1030 field (Quadri et al., 2007). The galaxy is bright in the near-IR (K_s = 19.0), but very faint in the optical (R=25.0). Using the photometric redshift code EAZY (Brammer et al., 2008), we derived a broad-band photometric redshift of $z_{broad} = 2.27^{+0.19}_{-0.46}$. This redshift places the object in the range 1.81<z<2.46 with 68 percent confidence, corresponding to an uncertainty of 0.8 mag in luminosity distance and of 1 Gyr in look-back time.

We had selected this object for follow-up spectroscopy with the cross-dispersed Gemini Near-Infrared Spectrograph (GNIRS). The binned Gemini spectrum is shown in the middle panel (from Kriek et al., 2006, 2008). The spectrum shows no emission lines but a prominent Balmer break, providing the first direct evidence of "red and dead" massive galaxies in the early universe. The location of the break places the galaxy at $z_{gnirs}=2.56^{+0.14}_{-0.02}$, just outside the confidence interval of the broadband data. The (very preliminary!) NEWFIRM medium-band data for this object are shown in the right panel. The filters unambiguously identify the strong Balmer break between the J_3 and H_1 filters, and the EAZY photometric redshift is $z_{nmbs} = 2.64^{+0.08}_{-0.13}$, a factor of three improvement in accuracy compared to the broadband redshift.

The NEWFIRM data in figure 2 represent only ~40 minutes of exposure time with each of the filters. In our primary fields, we already exceed this by factors of 10–20, and we expect to have photometry of comparable quality for all K_S<21.5 objects in the NEWFIRM fields when the survey is completed. As no similar studies are currently planned with other telescopes, the final archive of well-sampled spectral energy distributions and accurate redshifts for thousands of faint objects will be a unique resource for studies of the high-redshift universe. NL

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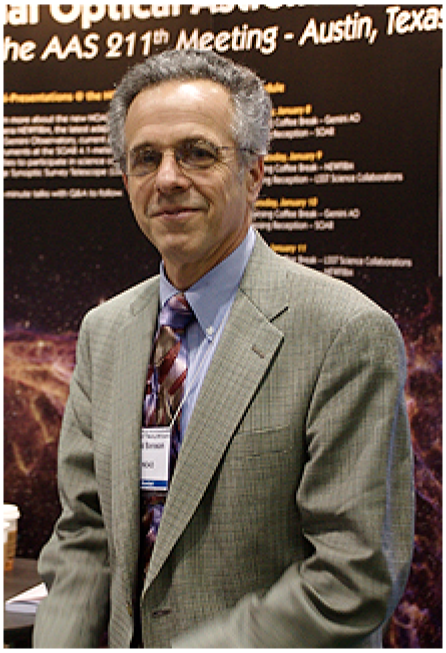
So long...and thanks for all the fish

Todd Boroson

I wanted to write a short note to summarize my thoughts about handing the job of NOAO director over to Dave Silva on July 7. I am very happy that Dave applied for—and accepted— the position. Beyond that, I am pleased that we had an outstanding group of applicants, all of whom clearly thought that the future of NOAO is important, and applied because they wanted to do something meaningful to contribute to this future.



Eighteen months ago, the NSF Senior Review report was about to appear. Many people (both within NOAO and outside) thought that the thrust of the recommendations would be to accelerate our evolution within a fixed budget to focus more and more on the large new national initiatives at the expense of the older facilities. I had certainly come to the conclusion that this was a choice that had to be made. We couldn't do everything, and we had to put our resources into the things that could not (or should not) be done without community participation at the federal level.

However, the Senior Review really laid out the context for a different paradigm—one in which the two separate parts of our mission that represent the two separate extremes of the community are no longer in conflict. After an initial sense of bewilderment, I began to realize that this was really possible. We have a prime opportunity to bring the ground-based optical/infrared (O/IR) community closer together than ever before.

I believe that the following ideas are key to a renewed national structure for ground-based O/IR astronomy in the US:

The goal of supporting the best science must be interpreted as both helping to answer the most important scientific questions and involving the largest-possible fraction of the community who are engaged in scientific research. These are often not the same, but they must be considered equally important.

Keeping the 2–4 meter (and even the 6.5–10 meter) facilities active and at the state-of-the-art technologically is financially irrelevant to federal participation in the largest projects. These projects will require the better part of a billion dollars for significant community participation. Saving a few million on the current facilities will not help, but would drastically reduce the capability of many in the community to carry out their research.

There are synergies and complementarities of many types between different facilities. Exploiting the strengths of public and private, small and large, ground and space, will provide a system of capabilities for the US community that is the most effective and most efficient for carrying out their scientific research.

All these ideas point back to balance—a balance that can emerge from a continual engagement of all segments of the community. Much of what I have tried to do in the last 18 months is aimed at beginning this engagement. I know that doing this effectively takes a lot of effort, and it is much easier to imagine that leadership means knowing the right answer. I have found otherwise.

I believe that the NOAO scientific staff, including our new director, see this period as a special moment in NOAO's existence, a moment at which we have the opportunity to create something uniquely powerful for doing science—not because we have more resources, but because everyone will be pushing in the same direction. I look forward to helping Dave guide this engagement in the most effective ways that he can.

The NOAO Road Show

Todd Boroson

As part of our renewed effort to talk with astronomers throughout the country to inform them about our program and to better understand their needs, I gave a presentation to the Mid-American Regional Astrophysics Conference (MARAC) in Kansas City, MO, in April. The invitation came originally from Angela Speck (University of Missouri), a member of the NOAO Users Committee, but it was reinforced by Bruce and Barbara Twarog (University of Kansas), two of the conference organizers. This was exactly the sort of opportunity that I had been looking for: astronomers in large departments encounter a lot of visitors, while those in small departments are more isolated.

The meeting was great. It included faculty and students from the two universities mentioned above, as well as Truman State University, Missouri State University, Washburn University, Kansas State University, the University of Nebraska, Baker University, Benedictine College, and Luther College. Talks covered research on dark energy, dust around evolved stars, instabilities in magnetized rotating neutron stars, and a number of education-related projects.

The talk I gave was aimed at accomplishing three goals: (1) provide a description of the NOAO program so that anyone—particularly students—would realize the range of capabilities, services, and support that we offer, (2) explain how our program has changed since the NSF Senior Review so that those who had been NOAO users in the past would understand what was different since their last experience, and (3) identify issues or decisions where we really need community input to proceed. I think the talk was successful in all three areas, and I got some good ideas from discussions during the meeting with a number of participants.

Overall, I thought this was a worthwhile experience, and I intend to look for additional opportunities for NOAO staff to make these sorts of visits. If you would like to have someone from NOAO come to your department or regional conference to make a presentation and interact with the people there, please email us at *currents@noao.edu*.

Announcing ALTAIR

Todd Boroson

The Renewing Small Telescopes for Astronomical Research (ReSTAR) committee recently concluded its study of the needs of the US community for capabilities on small and mid-size telescopes. In consultation with the NSF astronomy division, NOAO staff are developing a detailed plan to implement the recommendations in the ReSTAR report, including providing increased community access to small and mid-size telescopes and renewing their instrumentation.

As the next activity aimed at understanding how to build a balanced national system of optical/infrared ground-based facilities, we have initiated a new committee charged to perform a similar task for telescopes in the 6.5–10 meter aperture range. This committee, named Access to Large Telescopes for Astronomical Instruction and Research (ALTAIR), is scheduling its first meeting for mid-June.

Like ReSTAR, ALTAIR will attempt to gather input from as broad a spectrum of the US astronomical community as possible. The committee has been asked to evaluate the community's immediate needs for large telescopes—amount of time, instrumental capabilities, observing modes—and to predict how those needs might evolve over the next decade. Also like ReSTAR, the members of the committee are not solely individual representatives, but are expected to use their contacts within the community to draw wider input, and to use their experience and wisdom to synthesize this input into a set of reasonable, justifiable recommendations. The committee's charge, meeting reports, and links to other relevant information will be available on the NOAO Web site.

Larry Ramsey (Penn State University) has agreed to chair ALTAIR, and the membership includes:

Daniel Eisenstein (University of Arizona)
Heidi Hammel (Space Science Institute)
Terry Herter (Cornell University)
Lynne Hillenbrand (Caltech)
David Koo (University of California at Santa Cruz)
Tom Matheson (NOAO)
Andy McWilliam (Carnegie Institution of Washington)
John Monnier (University of Michigan)
Lisa Prato (Lowell Observatory)
Seth Redfield (Wesleyan University)
Tom Soifer (Spitzer Science Center)
Joan Najita (NOAO)

I note that ReSTAR is considered successful because of the large volume of community input that went into the formulation of its recommendations. I hope that when you hear about opportunities to communicate your ideas to ALTAIR, you will do so with the same positive energy and attention to detail.

Classical Observing with Gemini

Sean Brittain (Clemson University) & Ken Hinkle (NGSC)

If your observing program has targets that can be observed over the course of an entire night, and the observing conditions required are not extreme, consider requesting a classical run. The minimum time request for a classically scheduled Gemini proposal is now one night.

Classical and queue observing have complementary advantages. In classical observing, you have the opportunity to observe directly with the 8.1-meter Gemini telescopes, and such real-time experience provides special insight into the capabilities of both the instrumentation and the telescope. The observing program can be tailored to match these capabilities, as well as to take advantage of results gleaned from the observations as they come in. In addition, you could visit the Gemini offices to interact with staff who have a great deal of experience and insight into the instruments, and learn more about reducing your Gemini data. In a series of articles, we will report on the experiences of several Gemini classical observers. Our first report is from Sean Brittain.

Steve Margheim (Gemini staff), Ken Hinkle (NGSC visitor), and Matt Troutman (Clemson thesis student) in the Gemini South control room. Photo credit: S. Brittain

In March, doctoral student Matt Troutman and I [Sean Brittain] traveled from Clemson to observe two nights with Phoenix on Gemini South. I assumed overall responsibility for running Phoenix while Matt reduced the observations as they were taken. We learned that taking high-resolution CO spectra in the M-band presents a number of unique challenges.

For starters, the sky is bright, nearly 0th magnitude per square arcsec. Superimposed on the thermal continuum are water lines whose strength can vary on timescales of a few minutes. Finally, the slit of the Phoenix spectrograph is 0.34 arcsec, so the throughput of the instrument is extremely sensitive to the seeing. The observing strategy (integration time and setting choice) is tightly coupled to the observing conditions. We found that classical observing provides an important benefit in terms of fine-tuning our observing strategy to match the weather conditions. By reducing the data in real time, one can be sure to integrate until the requisite sensitivity has been achieved.

In addition to determining how long to observe, we used real-time data reduction to decide what to observe. The spectral grasp of Phoenix at five microns is fairly small, 10 cm^{-1}, and our program requires several different grating settings.

In March, we undertook a survey of Herbig Ae/Be stars. After observing a few targets with the first grating setting, we used the reduced spectra data to select stars with CO detections that warranted further observations. This dramatically improved the efficiency of our survey. Such real-time decision making is very difficult to capture in queue observing, but it is routine during classical runs. The Gemini System Support Associate and staff scientist who were present at the telescope provided outstanding support for our decisions. Our run was an efficient use of the time awarded, and was highly productive scientifically.

The UK Status within the Gemini Partnership: Resolved through 2012

Verne V. Smith

The uncertain status of the United Kingdom (UK) as a Gemini partner, which began with a 16 November 2007 announcement from the UK Science and Technology Facilities Council (STFC), was resolved in statements released near the end of February 2008 from both the STFC and the Gemini Board. As part of our continuing effort to keep the US community abreast of this situation, we present the STFC announcement and a corresponding Gemini Board resolution:

STFC Announcement: 27 February 2008
(see *www.scitech.ac.uk/PMC/PRel/STFC/GemUpdate.aspx)*

"The Science and Technology Facilities Council has reaffirmed the UK's position as a full member of the Partnership under the terms of the current Gemini Agreement. The Gemini Board welcomes this statement. The Board acknowledges the STFC's need to address its

continued

UK Status within the Gemini Partnership continued

budgetary constraints and notes that, under the terms of the Agreement, the UK is entitled to seek to sell some of its telescope time both within the partnership and, subject to the approval of the Board, outside the current partnership. The Board has directed the Observatory to continue the UK as a full partner, participating in all subsequent observing semesters, and all relevant committees and functions of the Observatory."

Gemini Board Resolution: 25 February 2008
"A written communication from the STFC Designated Member has recommitted the UK position as a full Partner under the Gemini Agreement, with all the rights, privileges, and responsibilities that membership brings. The Gemini Board recognizes and welcomes the UK position, its commitment to full participation in the Gemini Partnership and its intent that this commitment extend through to the end of the current Gemini Agreement. With respect to Aspen, the STFC has represented to the Board that the STFC is committed to providing its share of the currently approved program. Consequently, the Board directs the Observatory to continue the UK as a full partner, participating in all subsequent observing semesters, and all relevant committees and functions of the Observatory."

The current Gemini Agreement continues through 31 December 2012 and the STFC statement indicates that the UK will remain a full partner throughout this time period. We note, however, that the STFC statement includes a sentence acknowledging that the UK is entitled to sell some of its telescope time. Based on the stated intent from the UK, NOAO has begun to gauge community interest in the possibility of the US buying some fraction of any offered UK time. As a first step, we sought community input on two key questions using the April 2008 issue of the new NOAO electronic newsletter *Currents* (*www.noao.edu/currents/*):

- Bearing in mind that any purchase will need to be accompanied by a marginal budgetary commitment, is there a strong need for the US to acquire additional nights on Gemini and should this be set as a high priority for NSF?

- Is there a benefit in seeking to acquire these through an additional ***share*** of Gemini as an alternative to simply ***buying nights***?

The issue of possible increased US access to the Gemini telescopes will be part of the discussions that will be led by the newly formed Access to Large Telescopes for Astronomical Instruction and Research (ALTAIR) committee. This council is a large-telescope version of the ReSTAR committee, with ALTAIR convening community-wide discussion and soliciting input on the following point: What are the capabilities (instruments, observing modes, type of access, numbers of nights) that US observers need on the current generation of 6.5- to 10-meter telescopes, and how can Gemini and the non-federally-funded facilities best address these needs?

NOAO/NGSC encourages you to provide your views on what sorts of public-access capabilities, and in what amount, are needed on the current generation of large telescopes. Watch the NOAO Web site (*www.noao.edu*) for information on how to provide your input to the ALTAIR committee. As always, feel free to contact me (*vsmith@noao.edu*) with your thoughts or comments on any issues dealing with US access, current or future, to the Gemini telescopes.

The US Community and Their Gemini Usage: Some Results from the NGSC Questionnaire at the January 2008 AAS Meeting

Verne V. Smith

The NOAO Gemini Science Center conducted a survey via anonymous questionnaire at the January 2008 meeting in Austin, Texas. The intent was to sample community knowledge of, usage of, and level of satisfaction with US Gemini access.

A total of 219 meeting attendees completed the questionnaire. Of this number, 44 were either non-researchers or students who had not yet started observing programs, 14 were theorists who did not use telescopes, and 13 did not use ground-based optical/infrared (O/IR) data. That left a sample of 148 astronomers who observed with ground-based telescopes. This pool of astronomers who conduct ground-based observing programs were split almost evenly between those who had never applied for Gemini observing time and those who had: 69 had not applied for time and 79 had. Of the 69 non-Gemini using astronomers, the reasons for not having applied for Gemini time are distributed as follows:

If you have not applied for time, then why not? (69 respondents)

Most of their research is done on smaller telescopes	46%
They have access to other large telescopes	22%
The Gemini instrument complement lacks what they need	17%
The oversubscription factor is too large	15%

The range of responses above reflects the diversity of the US community of users, with a substantial fraction conducting research on smaller telescopes and another significant set of users with access to non-federally funded 6.5- to 10-meter class telescopes, as well as public TSIP access to these large telescopes.

The 79 astronomers who had applied for Gemini time consisted of 22 who had never gotten a proposal approved through the TAC and 57 who had a program (or programs) that had been scheduled on

continued

US Community and Their Gemini Usage continued

the Gemini telescopes. Given the historical oversubscription factors (by time) of ~3–5 for Gemini, the fact that some 72 percent of those who had applied were on at least one Gemini program attests to some tenacity among proposers. Of the 57 astronomers who had been on scheduled Gemini programs, 47 considered their programs to be "successful," nine said their programs had been "unsuccessful," and one just had their first program scheduled for Semester 2008A.

If you have been granted Gemini telescope time, were the observations successful? (57 respondents)

Successful	82%
Unsuccessful	16%
Awaiting 2008A	2%

The definition of "successful" certainly varies from one user to another, but one part of everyone's definition would presumably include a complete, or nearly complete, data set meeting the quality specifications of the proposer. The successful versus unsuccessful rates should then map approximately into the Gemini Observatory program completion statistics, which are presented in considerable detail at *www.gemini.edu/sciops/statistics*.

Using Gemini's condensed compilation of completion rates averaged over Semesters 2005A–2007A, the average completion rate for Band 1 programs was 86 percent, Band 2 was 64 percent, and Band 3 was 35 percent, with the time breakdown within the bands being 30 percent, 30 percent, and 40 percent for Bands 1, 2, and 3, respectively. The definition of "completion" from Gemini is 100 percent of program data for Bands 1 and 2, and 75 percent for Band 3. Using these completion statistics over the 2005–2007 timeframe, the global program completion rate, across all bands, was about 60 percent. This completion rate is less than the fraction of Gemini users who said that they had had successful programs, which may suggest that some fractional datasets, not counted as complete programs by Gemini, are useful to the astronomers.

If your program was unsuccessful, then why? (9 respondents)

Scheduled in Band 3 (or 4):	78%
Weather (on classical runs):	22%

The responses to this question bear out the fact that Band 3 programs have the lowest completion rates, while the biggest threat to classical programs is the weather.

If you consider that one, or more, of your programs was successful, has it led to a peer-reviewed paper? (48 respondents)

Yes:	75%
No:	25%

Among those who considered themselves to have had successful programs carried out, but who had not published a paper, the most common reason given was simply not enough time to have completed the analysis and then written a paper. Nonetheless, the fact that 75 percent of Gemini users who had successful programs also were on published papers that were based on their Gemini observations indicates a healthy use of the data.

Astronomers who observe with Gemini, whether queue or classical, must complete Phase II files. These files, which specify the details of their observations, are passed directly to the telescope and instrument during the execution of the program. The Phase II process involves interactions between the program Principal Investigator, and both NOAO/NGSC staff and Gemini staff. These interactions usually take place via email. One question asked whether user concerns that were raised with either NOAO/NGSC or Gemini staff were answered adequately.

If you have communicated comments to NOAO, NGSC, or Gemini, were they addressed satisfactorily? (41 respondents among users who had Gemini programs or who had applied for time)

Yes:	83%
No:	17%

Among the group of respondents who had never applied for Gemini time, 17 reported that they had sent comments or questions to Gemini, NGSC, or NOAO on Gemini-related matters and 14 (82 percent) reported satisfactory responses, while three (18 percent) reported unsatisfactory responses: similar to the experiences of the Gemini users. While the rate of satisfied questioners is good, the 17–18 percent of those who feel that their questions or comments were not addressed is of concern. A formal, but simple, process by which Gemini users can quickly communicate their experiences, questions, and problems to both NGSC and Gemini is under development and will be introduced for programs in Semester 2008B.

One of the major resources of Gemini is the Science Archive. It is important that the community be aware that all Gemini data are available after a proprietary period (*www.gemini.edu/sciops/data/dataSciArchIndex.html*). One question dealt with community awareness of the archive.

Are you aware of the Gemini Science Archive?

Among the Gemini users (anyone who has requested time—79 respondents):

Yes:	78%
No:	22%

Among the non-Gemini users who are ground-based observers (63 out of 69 replied to this question):

Yes:	36%
No:	64%

Among the non-Gemini users who are not ground-based observers (25 out of 27 replied to this question):

Yes:	32%
No:	68%

Among the non-Gemini users who are primarily students who have not yet begun observing programs, or "others" who are not observers (37 out of 44 replied to this question):

Yes:	30%
No:	70%

continued

US Community and Their Gemini Usage continued

The responses to this question are interesting; the veteran Gemini users contain a healthy fraction who are aware of the Gemini Science Archive, although it will be useful to educate the 22 percent of this group who were not yet aware of the archive's existence. What is perhaps somewhat surprising is the result that the groups who do not conduct ground-based observing, mostly beginning students or educators, are nearly as aware of the Gemini Archive as the die-hard ground-based observers who do not use Gemini. It is clear from the responses to this question that it will be useful to work to engage the user community in taking advantage of the Gemini Archive.

On a final note, the question was asked "Is there some type of observational capability that you would like Gemini to offer?" This question resulted in 30 responses from ground-based observers, with a considerable variety of suggestions. The most requested capability, based on multiple specific responses, was for high-resolution spectroscopy, both optical and near-infrared, with 18 requests out of a total of 30 (10 requests for optical and 8 for infrared). Perhaps this is not too surprising, as the only high-resolution optical or near-IR spectrograph that is offered on Gemini is Phoenix, which is an NOAO visiting instrument on Gemini South, and is a single-order echelle with limited wavelength coverage in one integration.

Surveys such as this one, although non-scientifically sampled, do provide some insight into the collective thoughts of the user community. NGSC staff will use the results to help us define topics of interest to the community, to better understand complaints that should be addressed, and to guide discussions on the future of US access to Gemini.

Consider a Poor Weather Proposal

Katia Cunha & Ken Hinkle

To most efficiently operate its telescopes, Gemini Observatory needs programs that can be observed under the full range of usable observing conditions. For obvious reasons, most proposers do not request the poorest conditions. To use this telescope time, Gemini created a category of "Poor Weather Proposals." Cursory information on what constitutes poor weather proposals and how to submit them are listed here.

Poor weather programs must have conditions matching the following observing constraints:

Image Quality (IQ) of "any" and Cloud Cover (CC) of 70 percentile (non-photometric).

Cloud Cover of 90 percentile (typically 2 magnitudes of cloud cover) with no restriction on IQ conditions.

In addition, all poor weather queue programs must have the Water Vapor (WV) set to "any." However, the Sky Brightness (SB) can be specified and poor weather programs can therefore request dark time.

Poor weather programs can be submitted at any time during the semester. They must be submitted using the Phase I Tool (PIT). In the PIT, select "Poor weather" from the dropdown menu in the "Submit" tab. These proposals are submitted directly to Gemini and reviewed by the Gemini Head of Science Operations, not by the national Time Allocation Committees. The Poor Weather Queue is reset at the start of each semester, thus a program is usually activated for one semester only.

Additional information about Poor Weather Proposals is available on the Gemini Current Call for Proposals Web page (click the link to Poor Weather under General Highlights) and on the Current Queue page (click a link under Poor Weather Queue Summary on the left). The URLs of these Web pages are: *ww.gemini.edu/sciops/ObsProcess/ObsProcIndex.html* and *www.gemini.edu/sciops/schedules/schedCurrQueueIndex.html.*

Detailed Aspects of Technical Reviews for GMOS, NIRI, and NIFS

Bob Blum & Tom Matheson

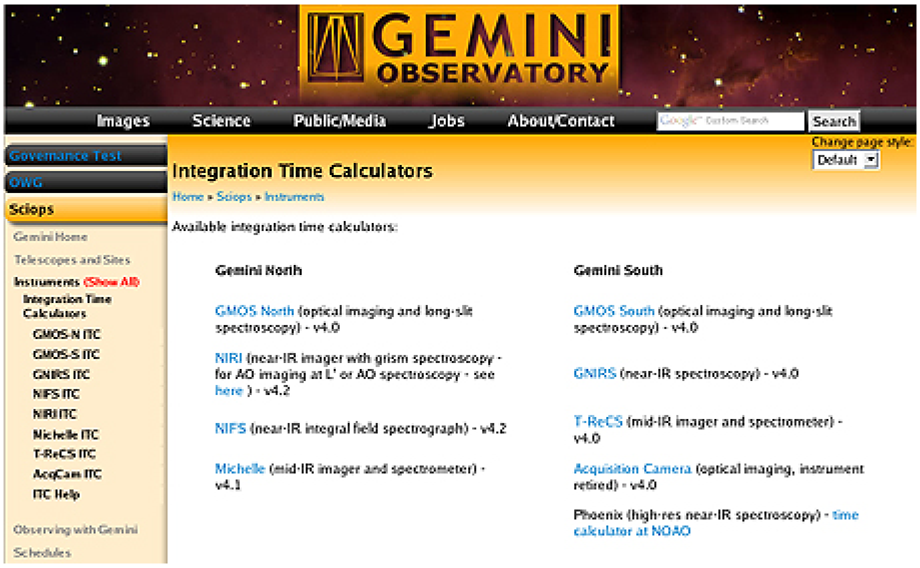
All proposals for use of the Gemini telescopes that request some portion of their time from the US share of the partnership are submitted to the NOAO Time Allocation Committee. Each of these proposals is reviewed by a member of the NOAO Gemini Science Center (NGSC) staff for technical feasibility. A general description of the process can be found in the June 2007 issue of the *NOAO/NSO Newsletter* on page 15 (*www.noao.edu/noao/noaonews/jun07/pdf/90ngsc.pdf*). Proposals should include detailed descriptions of the observations in the Technical Description section (and possibly the Experimental Design section) of the NOAO proposal form or the Technical Justification section of the Gemini Phase I Tool.

There are four main areas to consider for the technical justification: instrument configuration, source magnitudes and spectral energy distribution, expected signal-to-noise ratio (S/N) based on exposure time and observing constraints, and telescope/instrument overhead. All of these issues except the overhead are included in the Gemini Integration Time Calculator (ITC) for each instrument, so that can be a guide to the information that should be included in the technical section of a proposal. The overhead necessary for observations for each instrument is described in the instrument pages on the Gemini Web site. Beyond these broad areas of discussion, if there is some other part of the design of your program that is crucial to the success or failure of the observations, please include that in the technical description as well.

In this first of a series of articles on detailed aspects of technical reviews, we will describe some of the main points that should be addressed for GMOS, NIRI, and NIFS. Other instruments will be discussed in future articles.

Gemini Multi-Object Spectrograph (GMOS)

For GMOS, the chief concern of the technical review is whether or not the observations described can be done in the requested amount of time. To determine this, the ITC is the best guide. Proposals will often contain justifications based on "previous experience" with large telescopes. While this experience is certainly valuable, the relative efficiencies of the telescope/instrument combinations at Gemini will not be the same as at other facilities. This is especially true given the control over observing conditions allowed by the queue-based schedule. Proposals should include a discussion of results from the ITC.



Integration time calculators available at the Gemini Web site. These should be used when developing the technical justification for a proposal.

In order to replicate the ITC results of the proposal, the inputs used with the ITC should be part of the technical discussion. The nature of the source is important. This includes magnitude (and filter in which the magnitude is measured) and how this brightness is distributed (point source or extended). In addition, the assumed spectral energy distribution should be described. For line-emission sources, the line flux, line width, and background need to be included. The instrumental configuration is called for in other parts of the proposal, but gratings, filters, slit widths (or IFU), and central wavelengths should still be described. The binning of the CCD is also important.

The description of observational constraints is critical to the technical evaluation of the proposal. Make sure that the constraints chosen for the program are the ones used when experimenting with the ITC. Image quality (IQ), cloud cover (CC), and sky background (SB) should all be specified. Note that for GMOS, water vapor (WV) should be set to "any" as it is not significant for optical observations (and you don't want to restrict your program to a specific WV constraint for no reason).

Overheads for various aspects of GMOS observation can be found on the GMOS Web pages (e.g., *www.gemini.edu/sciops/instruments/gmos/sensitivity-and-overheads*). The main source of overhead is acquisition. There are also overhead considerations for read-out and instrument configuration changes. Overhead for acquisition is charged each time the object is observed. For long series of exposures (over four hours), reacquisition is necessary, so more acquisition time should be included in the program budget. For masks, another potential source of overhead is pre-imaging done with GMOS. If images from other sources are available, they can be used under some circumstances. If the goal is multi-object observations, then pre-imaging should either be included in the time request, or a description of existing images is necessary. Some calibrations should be included in the overhead. Others, such as special standard stars, need to be included as separate observations. Look at the baseline calibrations provided for GMOS to see if there is anything

continued

Detailed Aspects of Technical Reviews for GMOS, NIRI, and NIFS continued

else needed (*www.gemini.edu/sciops/instruments/gmos/calibration*). If so, it should be included explicitly.

Nod-and-shuffle observations add some complications. The time to nod the telescope and shuffle the frames electronically adds overhead to the observation, typically about a 25 percent increase in observation time. Longer nods may require more overhead. Consult the nod-and-shuffle Web pages for more information (*www.gemini.edu/sciops/instruments/gmos/nod-and-shuffle*).

The S/N calculation for nod-and-shuffle is also slightly different. The 'sky aperture' used by the ITC should be set to 1 to reflect the pixel-by-pixel subtraction used by nod-and-shuffle. The gain of nod-and-shuffle is a tremendous reduction of systematic residuals around night-sky emission lines, but this comes at the cost of a slight increase in noise from the sky subtraction overall as the sky subtracted is a single pixel, not the average of many as it is with traditional long-slit spectroscopy.

Near-Infrared Imager (NIRI)/ Near-Infrared Integral-Field Spectrograph (NIFS)

For NIRI and NIFS, the key input for a technical review is similar to other instruments: accurate line fluxes and/or magnitudes with which to compute S/N with the ITCs. Observers should explicitly state the inputs they used for the ITC. This includes whether or not the source is a point source. If not, describe the source in terms of a uniform surface brightness or a Gaussian (don't forget the FWHM) and total integrated magnitude. For lines, the total line flux must be given (integrated over wavelength or velocity) and the level of background as well. The latter should be given as flux density and the former should include a line width (preferably an FWHM in kilometers per second).

Often, observers expect a line to contribute the entire broadband magnitude flux. This should be made clear so that a proper source spectral energy distribution can be used, for example an H II region. Alternately, express the magnitude in a total line flux as mentioned above, but be clear about the expected continuum contribution.

For adaptive optics observations (NIRI/NIFS + ALTAIR), the resulting quality of the observation will depend critically on the brightness of the natural guide stars (NGS) and their position. If the laser guide star (LGS) is to be used, the NGS will only be used for tip-tilt (TT) correction and can be much fainter. In all cases, NGS or LGS, the guide star should be within 25 arcsec of the target. It is important at the technical review phase to identify actual stars that will be used to demonstrate that the observations are feasible. Check the ALTAIR Web pages (*www.gemini.edu/sciops/instruments/altair/?q=sciops/instruments/altair*) for the details of the guide star brightness ranges of NGS stars (R < 15 for NGS, R < 18 for LGS). Always remember to check the guide star brightness in combination with the requested observing conditions.

For AO observations with the LGS, the user must select CC=50 and IQ=70. Worse conditions will not allow stable use of the LGS. The NGS can be used under heavier cloud and worse IQ, but may have stability issues. For lower Strehl images with NGS, one could pick either IQ=85 or CC=90, but not both and only for very bright guide stars.

If AO is not used, it is still important to consider the brightness of guide stars with respect to the requested observing conditions. Faint stars won't work in bad seeing or with thick cloud. Faint guide stars may need gray time sky background (SB=80) in order to be used (this applies to both AO and non-AO observations). Apart from this, SB=ANY is the default for all NIR observations.

Finally, check the declination of your target for use with the LGS. Only declinations which give telescope elevations > 40 degrees are allowed (for example, the Galactic center cannot be observed with the LGS since its elevation is only ~30 degrees). The limit is imposed by the LGS zoom assembly, which keeps the laser spot focused as the apparent altitude of the sodium layer changes with telescope zenith distance. See the ALTAIR pages for more details (www.*gemini.edu/sciops/instruments/altair/use-lgs#Elevation*). NL

NGSC Instrumentation Program Update

Verne V. Smith & Mark Trueblood

FLAMINGOS-2

FLAMINGOS-2 is a near-infrared multi-object spectrograph and imager for the Gemini South telescope. FLAMINGOS-2 will cover a 6.1-arcmin-diameter field at the standard Gemini f/16 focus in imaging mode, and will provide multi-object spectra over a 6.1 × 2-arcmin field. It will also provide a multi-object spectroscopic capability for Gemini South's multi-conjugate adaptive optics system. The University of Florida is building FLAMINGOS-2 under the leadership of Principal Investigator Steve Eikenberry.

The NGSC scheduled a quarterly review of the FLAMINGOS-2 instrument at Gainesville with the University of Florida team on May 7. Shortly before this meeting, the Instrument Team reported progress in integration and testing of the instrument.

Work on the detector readout electronics and camera Dewar wiring has lowered the overall noise figure to acceptable levels. The University of Florida team reports achieving a median read noise of approximately 9.7 electrons RMS for a single read referenced from a CDS pair. The work on grounding also eliminated other problems the team had been experiencing with the detector readout electronics.

After receiving the high resolution (~3000) grating for the grism, the team performed various tests on the grating. Extensive arc lamp and continuum source data were taken, and analysis is under way. Preliminary results indicate that the central wavelength and resolution match expectations in all orders of interest (3, 4, 5, and 6 corresponding to the use of Ks, H, J, and J-lo filters).

Since the previous *Newsletter* article, the Instrument Team has continued to experience problems in cooling the Multiple Object Spectroscopy (MOS) Dewar. Although a probable cause for the lack of cooling

continued

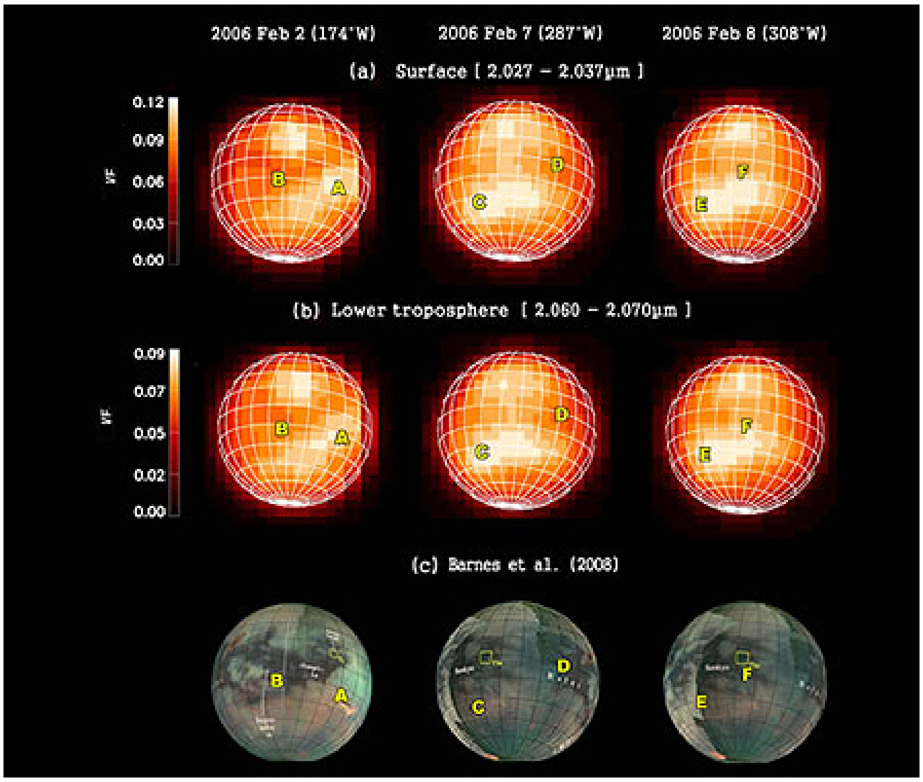
NGSC Instrumentation Program Update continued

was previously found in an unexpectedly high thermal conductivity of the G-10 thermal isolation system, the steps to rectify this situation permitted the MOS Dewar to achieve the desired temperature but not to maintain it, indicating other problems could remain. To address the issue, the team is adding a second cold head to the MOS Dewar to increase the overall cooling capacity of this fast-turnaround element of the system.

If testing demonstrates that this approach resolves the MOS Dewar issue, then the team will make some final adjustments before performing the tests required for the Pre-ship Acceptance Test. Assuming these go well, Pre-ship Acceptance Testing will then proceed later this summer.

As of April, the University of Florida team reports that 96 percent of the scheduled work to FLAMINGOS-2 final acceptance by Gemini has been completed.

Does Methane Rain Down on Titan?



A team of astronomers has used infrared spectral images of Saturn's moon Titan, acquired with the Gemini North 8-meter telescope, to dispute an earlier claimed detection of widespread morning methane drizzle.

This figure shows infrared images of Titan observed on February 2, 7, and 8, 2006 with the Near-infrared Integral Field Spectrograph (NIFS) on Gemini North. The images in the first row are at 2.027-2.037 microns, where Titan's atmosphere is nearly transparent and surface features are thought to be revealed clearly. The second row of images covers 2.060-2.070 microns, where the atmosphere is less transparent and absorption by haze and liquid methane could be influential. The images in the third row, made from a Mercator map of observations by the Visual and Infrared Mapping Spectrometer (VIMS) on the Cassini spacecraft in orbit around Saturn (Barnes et al.,2008), correspond to views of the surface of Titan from Earth at the times of the Gemini observations.

Major geologic features (marked A through F) on the NIFS images are seen to occur at the same places on the VIMS images. The pairs of images in the top two rows illustrate the difficulty of detecting temporal atmospheric effects such as variable haze and localized methane drizzle.

Astronomers at the University of California at Berkeley recently reported direct detections of methane drizzle over a large region of Titan, based on comparisons of infrared images of the moon made in 2005 at the Very Large Telescope and in 2006 at the W.M. Keck Observatory on Mauna Kea.

Independently, a team including Sang Joon Kim (Kyunghee University, Korea), Laurence Trafton (University of Texas), and Tom Geballe (Gemini Observatory) were interested in studying other aspects of the atmosphere of Titan. This group used NIFS and the adaptive optics system Altair.

Using the same comparison technique as the Berkeley team, they too found regions of apparent excess absorption at some locations on Titan. However, in their data set, these regions—some of which were the same as seen by the Berkeley team—were now afternoon locations and also were locations on which the surface of Titan is bright. The team also found that excess emission tended to be correlated with regions on Titan where the surface is darker.

They concluded that there is no spectroscopic evidence for widespread methane drizzle, or that such drizzle is a morning phenomenon. This does not mean that drizzle does not occur, but rather that remote detection of it, particularly via this technique, is much more difficult than first thought.

For more details, see "No Evidence of Morning or Large-scale Drizzle on Titan," by Sang J. Kim, Laurence M. Trafton and Thomas R. Geballe, 20 May 2008, *ApJL* 679, L53-L56.

Graphic credit: Gemini Observatory

2008B TAC Members

Solar System (1-2 May 2008)
David Trilling, Chair, University of Arizona, Steward Observatory
Travis Barman, Lowell Observatory
Drake Deming, NASA Goddard Space Flight Center
Amanda Hendrix, Caltech, Jet Propulsion Laboratory (JPL)
Renu Malhotra, University of Arizona, Lunar & Planetary Lab
Bill Merline, Southwest Research Institute

Extragalactic (5-6 May 2008)
Jill Bechtold, Chair, University of Arizona, Steward Observatory
Mark Dickinson, Chair, NOAO
Richard Green, Chair, Large Binocular Telescope Observatory
Mariangela Bernardi, University of Pennsylvania
John Blakeslee, Herzberg Institute of Astrophysics
Karl Gebhardt, University of Texas, Austin
Michael Gregg, Lawrence Livermore National Laboratory
Andy Howell, University of Toronto
Lisa Kewley, University of Hawaii, Institute for Astronomy
Mark Lacy, Spitzer Science Center
Jennifer Lotz, NOAO
Knut Olsen, NOAO
Casey Papovich, Texas A&M University
Greg Rudnick, NOAO
Tom Statler, Ohio University
Daniel Stern, Caltech, JPL
Louis Strolger, Western Kentucky University
Liese van Zee, Indiana University

Galactic 1 (7-8 May 2008)
Ata Sarajedini, Chair, University of Florida
Jeff Valenti, Chair, Space Telescope Science Institute
Kim Venn, Chair, University of Victoria
Bob Blum, NOAO
John Carr, Naval Research Laboratory
Geoffrey Clayton, Louisiana State University
Anne Cowley, Arizona State University
Orsola de Marco, American Museum of Natural History
Moshe Elitzur, University of Kentucky
Don Garnett
Inese Ivans, Carnegie Observatories
Chris Johns-Krull, Rice University
Jennifer Johnson, Ohio State University
Steve Kawaler, Iowa State University
Sebastien Lepine, American Museum of Natural History
Phil Massey, Lowell Observatory
Raghvendra Sahai, Caltech, JPL
Tammy Smecker-Hane, University of California, Irvine

2008B Proposal Process Update

Dave Bell

NOAO received 347 observing proposals for telescope time during the 2008B observing semester. These included 135 proposals for Gemini, 81 for KPNO, 79 for CTIO, 44 for Keck, 12 for Magellan, and 11 for MMT. Thesis projects accounted for 30 percent (105 proposals) of those received and 25 proposals requested long-term status. Time-request statistics by telescope and instrument appear in the tables below. Subscription rate statistics will be published in the September 2008 edition of this *Newsletter*.

As of this writing, proposals are being reviewed by members of the NOAO Time Allocation Committee (see the following listing). We expect all telescope schedules to be completed by 13 June 2008, and plan to notify principal investigators of the status of their requests at that time. Mailed information packets will follow the email notifications by about two weeks.

Looking ahead to 2009A, 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 Survey Program Letters of Intent due July 31

Letizia Stanghellini & Dave Bell

Proposals for the next round of the NOAO Survey Program are due 15 September 2008. Investigators interested in applying for time under the Survey Program MUST submit by 31 July 2008 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 both conclusions based on analysis of the survey data itself, and 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 the total telescope time at CTIO and KPNO may be awarded through the Survey Program, including time allocated in the earlier rounds to continuing programs. 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 2008.

NEWFIRM information, including scheduling policy, is available at *www.noao.edu/ets/newfirm/*. Limited time is available for new surveys requesting NEWFIRM in 2009A and 2009B. Bright time requests for NEWFIRM are not supported in 2009A.

2008B Instrument Request Statistics by Telescope

Gemini Observatory

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
GEM-N		**93**	**113**	**125.5**	**44.5**	**35**	**1.1**
	GMOSN	43	54	61.4	38.1	62	1.1
	MOIRCS	3	3	2.4	0	0	0.8
	Michelle	12	13	13.4	0	0	1
	NIFS	7	7	6.7	1	14	1
	NIRI	33	34	36.4	0.5	1	1.1
	SuprimeCam	2	2	5	5	100	2.5
GEM-S		**48**	**59**	**75.7**	**24.6**	**32**	**1.3**
	GMOSS	31	38	40.8	24.6	60	1.1
	Phoenix	8	8	16.9	0	0	2.1
	TReCS	13	13	17.9	0	0	1.4

Kitt Peak National Observatory

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
KP-4m		**40**	**47**	**203**	**60**	**30**	**4.3**
	ECH	4	4	26	0	0	6.5
	FLMN	3	3	20	0	0	6.7
	MARS	1	1	2	2	100	2
	MOSA	9	13	49	30	61	3.8
	NEWFIRM	13	13	60	10	17	4.6
	RCSP	8	10	34	18	53	3.4
	VIS	3	3	12	0	0	4
WIYN		**17**	**20**	**67.5**	**32.5**	**48**	**3.4**
	HYDR	8	9	30.5	17.5	57	3.4
	MIMO	3	3	8	5	63	2.7
	OPTIC/Other	6	7	27	10	37	3.9
	SPSPK	1	1	2	0	0	2
	WHIRC						
KP-2.1m		**23**	**28**	**152**	**39**	**26**	**5.4**
	CFIM	11	13	62	33	53	4.8
	ET	2	4	32	0	0	8
	FLMN	1	1	7	0	0	7
	GCAM	9	10	51	6	12	5.1
	SQIID	23	28	152	39	26	5.4
	VIS	11	13	62	33	53	4.8
WIYN-0.9m		**2**	**2**	**6**	**2**	**33**	**3**
	MOSA	2	2	6	2	33	3

Cerro Tololo Inter-American Observatory

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
CT-4m		**42**	**48**	**165.5**	**69.5**	**42**	**3.4**
	HYDRA	9	11	35.5	13	37	3.2
	ISPI	8	10	29.5	2	7	3
	MOSAIC	20	22	84.5	54.5	64	3.8
	RCSP	4	4	11	0	0	2.8
	VIS	1	1	5	0	0	5
SOAR		**13**	**13**	**45.6**	**8**	**18**	**3.5**
	Goodman	2	2	4.6	4	87	2.3
	OSIRIS	2	2	8	0	0	4
	SOI	9	9	33	4	12	3.7
CT-1.5m		**6**	**7**	**51**	**6**	**12**	**7.3**
	CSPEC	6	7	51	6	12	7.3
CT-1.3m		**7**	**7**	**26.5**	**0**	**0**	**3.8**
	ANDI	7	7	26.5	0	0	3.8
CT-1.0m		**5**	**7**	**59**	**24**	**41**	**8.4**
	CFIM	5	7	59	24	41	8.4
CT-0.9m		**11**	**16**	**91.9**	**30.5**	**33**	**5.7**
	CFIM	11	16	91.9	30.5	33	5.7

Community Access Observatories

Telescope	Instrument	Proposals	Runs	Total Nights	Dark Nights	% Dark	Avg. Nights/Run
Keck-I		**20**	**21**	**38.3**	**13.5**	**35**	**1.8**
	HIRES	10	11	23.3	2	9	2.1
	IF	4	4	3.5	0	0	0.9
	LRIS	6	6	11.5	11.5	100	1.9
Keck-II		**29**	**30**	**35**	**6**	**17**	**1.2**
	DEIMOS	5	5	6	3	50	1.2
	ESI	3	3	5	3	60	1.7
	IF	4	4	3.5	0	0	0.9
	NIRC2-NGS	4	4	4	0	0	1
	NIRSPEC	10	10	11.5	0	0	1.1
	OSIRIS-LGS	3	3	4	0	0	1.3
	OSIRIS-NGS	1	1	1	0	0	1
Magellan-I		**7**	**7**	**15**	**7**	**47**	**2.1**
	IMACS	6	6	12	7	58	2
	PANIC	1	1	3	0	0	3
Magellan-II		**5**	**5**	**11**	**5**	**45**	**2.2**
	MIKE	5	5	11	5	45	2.2
MMT		**11**	**11**	**18.7**	**9.4**	**50**	**1.7**
	BCHAN	1	1	3	3	100	3
	Hectochelle	1	1	1.8	0	0	1.8
	Hectospec	8	8	12.9	6.4	50	1.6
	SPOL	1	1	1	0	0	1

The Growing NOAO Science Archive

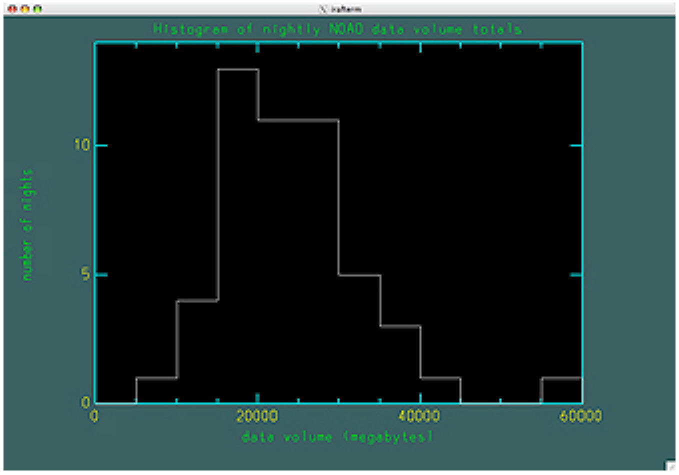
Rob Seaman & Irene Barg

Since the NOAO Science Archive first began operating in April 2002, many milestones have been achieved. NOAO Survey Program data now comprise 1.5 terabytes. These holdings represent one of the founding archives of the National Virtual Observatory, and the volume of NOAO Survey data is projected to grow by about one terabyte per year.

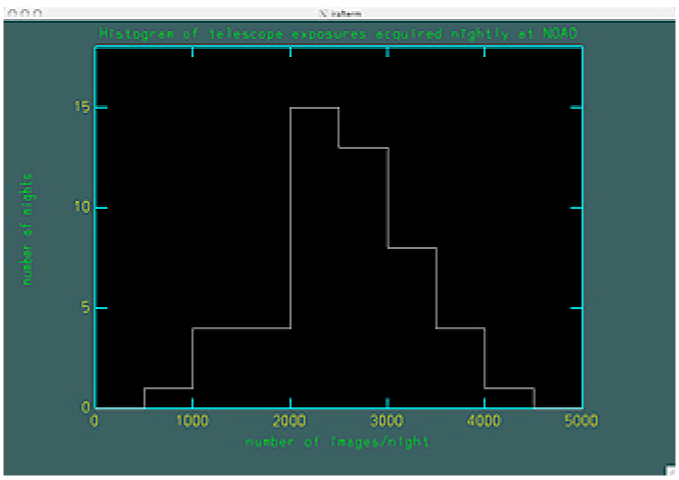
The NOAO Data Cache Initiative (DCI) has been an important transitional stage from the venerable Save the Bits (STB) safestore to the next-generation NOAO End-to-End system, which is currently being commissioned to manage our telescopes' raw and pipeline-processed data among our six geographically distributed sites. The DCI holdings contain data reaching back to August 2004, and number about 2.3 million compressed files and more than 19 terabytes. For comparison, the STB system utilizes 10,000 exabyte tapes that hold about five million images and 40 terabytes dating back to 1993.

Today's larger cameras generate 40 percent more images per year than those of a decade ago, with two to three times more pixels to store and serve. So while the NOAO archive has collected 60 terabytes of data over the past 15 years, we expect it to double in size over the next five years (just before the flood of pixels from the next generation of wide-field imagers).

With the commissioning of the NOAO Extremely Wide-Field Infrared Imager (NEWFIRM), the archive has seen new nightly records set with each new lunation. The histograms in the two figures below cover about a two-month sample from NOAO telescopes in both hemispheres. A "typical" night at NOAO adds about 2,500 images and 25,000 megabytes to the archive holdings, but with a large variance depending on the evolving instrumentation mix, age of the Moon, the weather, and, of course, on the particular observing programs scheduled.



Histogram of nightly NOAO data volume totals



Histogram of telescope exposures acquired nightly at NOAO

The 2008A semester saw NOAO's busiest night yet at 56,027 megabytes. On a clear, dark night with both Mosaic cameras and NEWFIRM operating, this record may soon be eclipsed. When regular pipeline operations commence, the record will be obliterated. This is but a small taste of what is to come with the Dark Energy Camera at the Blanco telescope and the One-Degree Imager at WIYN.

These data volumes are reported as compressed using the familiar gzip algorithm. For NOAO data, this averages to a compression ratio of about 57 percent. NOAO has been evaluating FITS tile compression using the Rice algorithm as an alternative. Rice provides a compression ratio in the mid-40 percent range, and is a much faster algorithm. Most significant, the FITS tiling convention leaves the image headers readable. Software such as Bill Pence's CFITSIO library (see *heasarc.gsfc.nasa.gov/docs/software/fitsio/fpack*) can read and write such compressed images on the fly, raising the possibility that the first copy of the original data can be written already compressed and that the file need never be explicitly uncompressed afterward. IRAF support for Rice compression is being tested.

The latest milestone challenging the archive team is commissioning the complex and robust systems needed to automatically ingest these unrelenting streams of science metadata into searchable databases layered on Virtual Observatory (VO) technologies. This VO infrastructure permits the NOAO Portal to provide secure access to a principal investigator's proprietary data. Watch as we keep on growing to meet the need.

Accessing Astronomical Data via NOAO

Christopher Miller

The NOAO Data Products Program End-to-End system (E2E) is maturing into a fully-deployed operational phase. This E2E system moves data from all NOAO telescopes (on three mountaintops on two continents) into a storage archive where the data can be queried electronically for pipeline processing and user access. The users' entry point into the E2E system is the NOAO National Virtual Observatory (NVO) Portal, through which they access the NOAO imaging data as well as data from astronomical archives distributed all over the world.

Specific NOAO principal investigators (PIs) were asked to help beta-test our E2E system by accessing their raw and pipeline-reduced Mosaic and NOAO Extremely Wide-Field Infrared Imager (NEWFIRM) data from the past two semesters. There use of the system provided much-needed input on how to improve it. We at DPP would very much like to thank them for their efforts.

Throughout this testing process, DPP has continued to improve the archive and its ability to move and manage image metadata. The NOAO Mosaic and NEWFIRM pipelines continue to process nightly data, which is then provided to the PIs for scientific validation. Finally, the NOAO NVO Portal was recently upgraded and includes new features for the astronomer:

- Updated Virtual Observatory (VO) archive data (SDSS, GALEX, CHANDRA, XMM, HST, ESO INT, NOAO)
- The ability to upload coordinate lists and find VO image data at those locations
- A new "Time View" to graphically see when data were taken
- A new "Query View" where uses can query the ever-growing NOAO Archive (see article in this section)
- Safe and secure access to PI proprietary data
- No software to download or install—just open up your Firefox browser: *www.nvo.noao.edu*

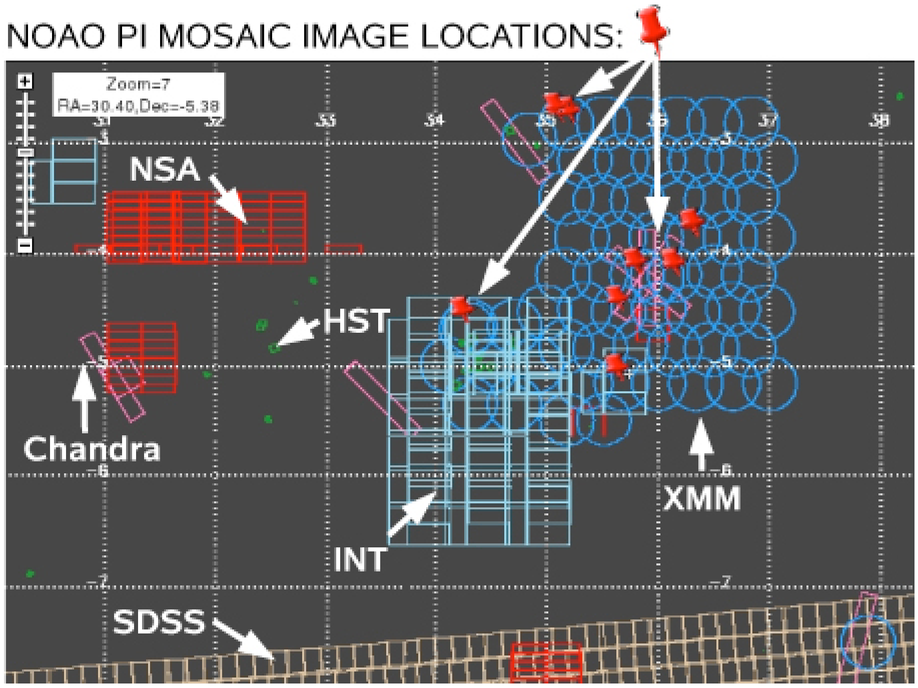


Figure: The NOAO NVO Portal showing a region of the sky containing VO data (HST, SDSS, XMM, Chandra, and NSA). The PI's data locations are shown as the pushpins.

In the near future, the E2E system will finish its "beta" phase and move into normal operations. When it is fully deployed, the community as well as PI astronomers will be able to discover and access raw and reduced data for the Mosaic and NEWFIRM instruments. As always, we are very much interested in your comments and suggestions (*vohelp@noao.edu*). If you have not already tried it, visit *www.nvo.noao.edu* and see what NOAO and the VO have to offer.

US Ambassador Visits NOAO South

Chris Smith

The new US Ambassador to Chile, Paul E. Simons, paid an overnight visit to the AURA facilities on Cerro Tololo and Cerro Pachón on 19 April 2008. Ambassador Simons recently arrived in Chile, and was excited to come to La Serena to visit our facilities in northern Chile. Chris Smith hosted the ambassador on behalf of both AURA and CTIO, together with Steve Heathcote, director of the Southern Astrophysical Research (SOAR) telescope, and Jean-René Roy, deputy director of the Gemini Observatory.

The visit included tours of SOAR, Gemini, and various telescopes at CTIO, together with a quick stop at the future site of the Large Synoptic Survey Telescope. The ambassador was joined by two Fulbright scholars and former CTIO summer students: Gabe Brahmer and Guillermo Damke. Gabe participated in the 2001 CTIO Research Experiences for Undergraduates program and is now a PhD student at Yale University, spending this year working at the University of Chile in Santiago. Guillermo participated in the 2006 CTIO Prácticas de Investigación en Astronomía program and is currently working as a data analyst at CTIO. He will start his PhD at the University of Virginia in September 2008.

Figure 1: Ambassador Simons hears about the variety of operational arrangements that CTIO supports on Cerro Tololo, from those operated wholly by CTIO to our support of US university facilities on site.

Figure 2: SOAR Director Steve Heathcote points out unique features of the telescope to the ambassador, accompanied by Fulbright scholars Gabe Brahmer and Guillermo Damke.

Figure 3: Gemini Deputy Director Jean-René Roy describes the operation of the Gemini South 8-meter telescope.

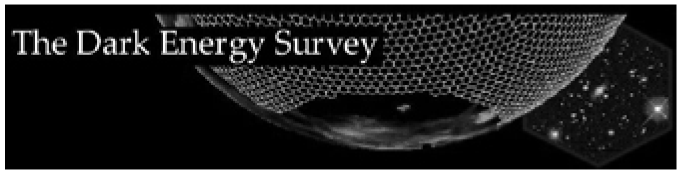
The April 2008 Dark Energy Survey Collaboration Meeting

Christopher Miller

The Dark Energy Survey (DES) collaboration held its semi-annual meeting in La Serena from April 23–26. Over 50 international visitors arrived from 20 different organizations spread over three continents.

The DES collaboration meetings provide an opportunity for this large and very distributed project to have face-to-face contact on a regular basis. Each DES participant organization will host at least one meeting over the course of the project. This was the first chance for many of the collaboration members to see the site where the Dark Energy Camera (DECam) will be placed—on the Blanco 4-meter telescope at Cerro Tololo Inter-American Observatory.

The Local Organizing Committee included Chris Miller, Tim Abbott, Chris Smith, and Alistair Walker from CTIO. Leonor Opazo and Ximena Herreros did most of the real work in coordinating the meeting.



Two additional technical meetings were held during the days before the larger collaboration meeting: a front-end electronics team meeting and an integration-and-installation team meeting. Ricardo Schmidt and Tim Abbott organized these two groups, who spent much of their time on Cerro Tololo working out the more challenging details of integrating the large DECam instrument onto the Blanco telescope.

CTIO Staff Changes

Alistair Walker

Over the past several months, there have been a number of staff changes at CTIO, both on the mountains and at our La Serena headquarters. As reported in the March 2008 *NOAO/NSO Newsletter* by KPNO Director Buell Jannuzi, these changes have two primary sources. One is normal staff turnover; the other is the outcome of implementing the recommendations of the NSF Senior Review, whereby CTIO and KPNO were directed to modernize their facilities and provide state-of-the art instrumentation.

On Cerro Tololo, both Blanco 4-meter telescope operators, Mauricio Fernandez and Angel Guerra, have retired after many years of outstanding service. Their skill and dedication at the Blanco telescope is one of the primary reasons that visiting astronomers invariably give top ranking to their technical support team in their after-run evaluations. Our telescope operators have nighttime responsibility for the safety of the facility and personnel, and are also our direct interface with the visiting astronomers. We wish Mauricio and Angel all the best for the future.

Claudio Aguilera, Alberto Pasten, and Mauricio Rojas are our new operators, who will work at either the Blanco or Southern Astrophysical Research (SOAR) telescope. We are broadening the tasks undertaken by the telescope operators, so they will also be trained in instrument set-up and support, in addition to their regular activities. Claudio and Alberto previously worked on the small telescopes for the Small and Moderate Aperture Research Telescope System (SMARTS) consortium, so we also welcome Jose Velasquez and Manuel Hernandez as the two replacement SMARTS operators.

SOAR is in a phase of instrument commissioning, which is expected to last for at least the next two years, so new electronic technician Guillermo Dubo will assist in these activities along with day-to-day maintenance of the facility. On Tololo, we have employed electrical technician Nelson Ogalde, who will begin by instituting a comprehensive preventive maintenance plan for the many electrical systems at the Blanco telescope.

Daniel Holck has just begun as a junior optical engineer. He will have a diverse set of responsibilities, including the optical well-being of the smaller telescopes and assisting our optical engineer, Roberto Tighe, with the Blanco and SOAR telescopes.

A few months ago, Marco Bonati, a senior computer programmer, returned to CTIO after several years working on astronomical instrumentation at Caltech. Marco is a CCD controller expert, and will support both our present Arcon and Leach controllers, as well as work on the development of the new NOAO Monsoon controllers. These controllers operate with the NOAO Extremely Wide-Field Infrared Imager, and—soon— the Dark Energy Camera. We plan to retrofit the Tololo Arcon controllers with Monsoon systems as soon as possible.

Finally, a few statistics: CTIO has always been perceived to have a very stable staff, a consequence of an exciting and fulfilling work environment for its employees, coupled with good staff-management relations, and a competitive remuneration package. However, over the last several years, our advantage in these respects over other employment opportunities has been eroded. With the impact of budget constraints and previous uncertainties about the future of CTIO, we have seen greater staff turnover than in previous decades.

It is interesting to note, considering all NOAO staff in Chile, that exactly half (46 of 91) of our staff began employment in 2000 or later. Of the remainder, one person started in the 1960s, 14 in the 70s, 16 in the 80s and 14 in the 90s. I hope that the renewed emphasis on the importance of CTIO as determined by the Senior Review and exciting upcoming projects like LSST will convince outstanding new employees, such as those listed above, that they can have fulfilling long-term careers at CTIO.

Celebrating Our National Observatory

Elizabeth Alvarez & Buell T. Jannuzi

On 1 March 1958, Kitt Peak was selected by the National Science Foundation as the site for the US national observatory. In June 1959, Arlo Landolt from Indiana University (now Dr. Landolt of Louisiana State University) became the first graduate student to use Kitt Peak for his thesis research, observing with a 16-inch telescope. For accommodations, he enjoyed a small trailer.

Roughly a year later, on 15 March 1960, Kitt Peak National Observatory (KPNO) was dedicated. A lot of additions and improvements have occurred over the past 50 years, including the construction of the world's largest solar telescope in 1962 (the McMath-Pierce), the development of Cerro Tololo Inter-American Observatory in Chile as the counterpart of KPNO for the southern skies, and the creation of the international partnership that became the Gemini Observatory. The National Optical Astronomy Observatory has enabled many important discoveries, numerous advances in the design of telescopes and instruments, and the training of thousands of young astronomers.

We are celebrating KPNO's 50th anniversary in parallel with other major milestones in astronomy and space science. On 31 January 1958, the US sent its first Earth satellite, Explorer I, aloft as part of the US program for the International Geophysical Year (IGY) 1957-1958. IGY was highly leveraged to advance scientific understanding of our planet. Astronomers are now seeking similar success with the International Year of Astronomy in 2009.

The International Dark-Sky Association (IDA) is celebrating the 20th anniversary of their first annual general meeting this June (*www.darksky.org*). Fifty years ago, the Flagstaff, Arizona City Council passed the world's first outdoor lighting ordinance. This community's commitment to preserving access to the night sky earned it the honor of being designated by the IDA as the first International Dark-Sky City.

We plan to celebrate our national observatory in conjunction with these other opportunities for public outreach. We look forward to including you in the various celebrations that will start this year and continue through March 2010, the 50th anniversary of the dedication of the observatory. This extended timeline for our celebrations allows us to hold a series of events to include all the diverse groups that have been critical to the success of the observatory, including the Tohono O'odham Nation.

Numerous KPNO 'alumnae' have already contacted us with stories, facts, and pictures from the earlier days of the observatory. We encourage you share your thoughts, memories, photos, and suggestions with us as well. Tell us your ideas about the best ways to celebrate the anniversary of the landmark concept of a national observatory open to all based on the intellectual merit of their proposals.

We have formed a steering committee to inform the planning of our anniversary events. Members include: Elizabeth Alvarez (committee chair), Rich Fedele, Buell Jannuzi (KPNO Director), Bill Livingston, Jennifer Lotz, Vera Rubin (Carnegie Institution of Washington), Bill Schoening, Malcolm Smith, Steve Strom, and Karen Wilson.

Please send your suggestions regarding how we should be celebrating the 50th anniversary of KPNO to *ealvarez@noao.edu*, and watch the NOAO Web site for updates in the months ahead.

NEWFIRM in 2008A: (Nearly) All Science, All the Time

Ron Probst & Mark Dickinson

Whew! As we write this at the end of April, the NEWFIRM wide-field infrared imager is in standby mode on the Mayall 4-meter telescope after 67 continuous on-sky nights.

Following the current dark time Mosaic run, NEWFIRM will spend 19 more nights on the sky to finish its Semester 2008A schedule. Almost all of this time—79 nights—is for user science, and this work is going well. It was immediately apparent at the start of this run in February that we had successfully transitioned from getting the instrument system working and characterized, to learning how best to use it for science.

NEWFIRM's many external science users have made important contributions to this by exercising the system intensively, including a couple of observing protocols that pushed the scripted observing tools in unanticipated directions. Some weaknesses in the observer interface software have been identified and improved. We have survived a guide-probe camera failure (changed out on the telescope) and a recalcitrant cryogenic filter wheel (calling for attentive observer use, pending in-Dewar adjustment). Apart from these relatively minor problems, the observing hardware and software have been very robust, cranking out wide-field infrared images hour after hour, night after night. One such image is shown in figure 1.

continued

NEWFIRM in 2008A continued

Figure 1: This image of IC342, a low surface brightness face-on spiral galaxy with an active nucleus, is a composite of 30 minutes of dithered images in the J and H pass-bands and 60 minutes using the Bracket-gamma filter. IC 342 fits within the field-of-view of NEWFIRM (See online version for false-color version of image).

Looking at some usage figures for Semester 2008A, NEWFIRM is in use for 12 science programs with a large number of participating investigators. Twenty-two nights for five programs have been assigned to Kitt Peak's instrumentation partners, the University of Maryland and operations partner Clemson University, through a combination of partner and Time Allocation Committee-assigned time. The total set of science programs divides into three distinct time assignment groups: short (1–4 nights); medium (11–14 nights); and one very large survey program with 24 nights assigned in 2008A. Regardless of length, in almost all cases, the NEWFIRM data are being acquired as part of larger, multiwavelength programs that address multiple science goals. The NEWFIRM data, (and usually related data obtained on other instruments) will also flow into public archives, with a promise of high future utility.

The science being pursued ranges from discovery of nearby brown dwarfs to a search for primordial galaxies. A lot of effort is going into the characterization of galaxy formation and the evolution of structure in the crucial redshift range $1 < z < 3$, since optical diagnostics have redshifted into the near infrared over this range in look-back time. The stellar content of the outer regions of nearby, well-resolved galaxies is another research direction, and determining the populations of individual stars in Milky Way clusters and star forming regions is a third. Extensive NEWFIRM data will complement data obtained with the Spitzer Space Telescope and Chandra X-ray Observatory. Ground-based telescopes such as WIYN and Subaru are providing optical imaging and spectroscopy. The multiwavelength approach to answering critical science questions is fully upon us, and NEWFIRM is a prime participant.

The NEWFIRM system has been designed from the start for high-efficiency survey science, and it is gratifying to see this being done intensively. It's equally gratifying for us to support the training of the next generation of observers. In 2008A, NEWFIRM is being used for three PhD thesis projects. In addition, the Principal Investiagators (PIs) of several survey programs have incorporated graduate and undergraduate students into their observing teams to provide a valuable learning experience for them.

The largest NEWFIRM survey program is the subject of a separate article in the Science Highlights section of this *Newsletter*. This program brings up an operational issue: it (and some others) utilize sets of PI-funded custom filters. As anticipated, we can not simultaneously accommodate all NEWFIRM filters, including these custom sets, in the Dewar. This leads to science-driven availability decisions. The set of narrowband zero-redshift emission line filters was not scheduled for use in 2008A. Proposal pressure will drive their availability in 2008B. These are the 1.64 micron [Fe II], 2.12 micron H2, and 2.17 micron Brackett-gamma filters.

The NEWFIRM data reduction pipeline project, led by Rob Swaters from the University of Maryland, with NOAO contributions from Frank Valdes (pipeline group lead) and Mark Dickinson (pipeline scientist), has waited patiently for the large datasets necessary to test their reduction software. This group has been very busy since getting their wish a couple of months ago.

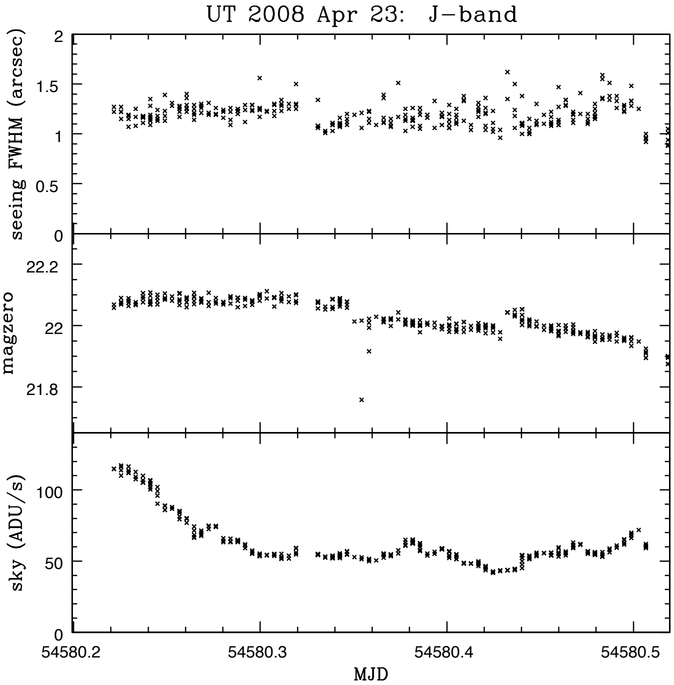
The first development, which went into operation during 2008A, is the Quick-Reduce Pipeline (QRP), which operates at the telescope. The QRP processes data shortly after they are taken in order to provide feedback to the observer. It performs linearization, dark and sky subtraction, flat-fielding, astrometric and photometric calibration, and registration and stacking of dithered images. The stacked images are delivered to the observer, and pipeline review Web pages are created that make it easy to quickly inspect the results of the processing. The QRP measures a variety of data quality parameters for each image, including the sky brightness, seeing FW HM, photometric zero point, and a nominal photometric 'depth' based on a combination of these parameters. These make it easy to track the data quality during the night or log it afterward (see figures 2 and 3 on the following page).

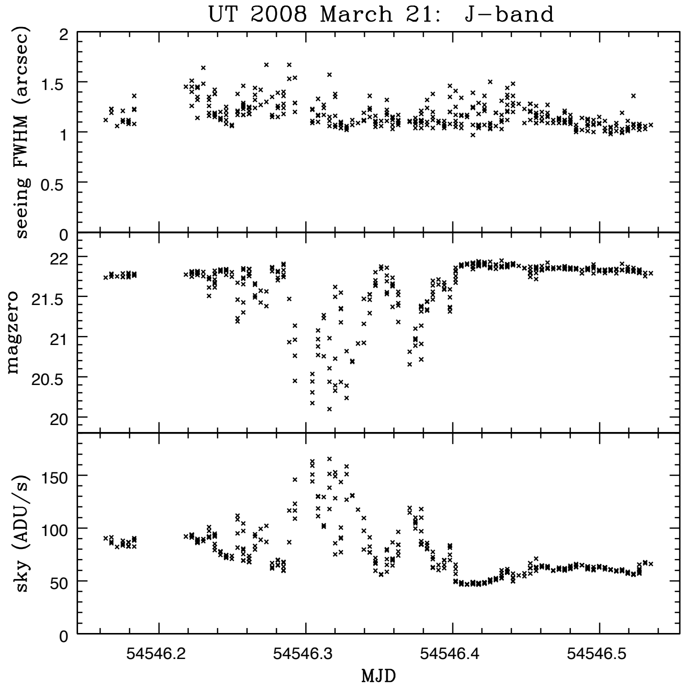
The QRP takes several shortcuts in order to speed the processing. For example, it does only single-pass sky subtraction, and does not (yet) mask latent images imprinted onto the arrays by bright stars. These and other improvements are going into the NEWFIRM Science Pipeline, which will run downtown in Tucson and process data after a night or block of nights is completed, using the best procedures and calibration data available. The Science Pipeline is now under development and will be deployed for 2008B. Data products from the science pipeline will be stored in the NOAO Science Archive, from which they will be retrievable by the observer and—after the proprietary period—by the entire community.

During the northern summer, we expect to do a filter change in NEWFIRM and to adjust the misbehaving filter wheel. The pipeline group will finish the deliverable version of the Science Pipeline software. Then NEWFIRM will go back onto the 4-meter telescope in the fall as a fully delivered facility instrument.

continued

NEWFIRM in 2008A continued





Figures 2 and 3: Data quality parameters measured by the NEWFIRM Quick-Reduce Pipeline during two nights at the Mayall 4- meter telescope. Middle-of-the-night cloudiness is evident in the photometric zero point and the sky background levels shown in figure 3.

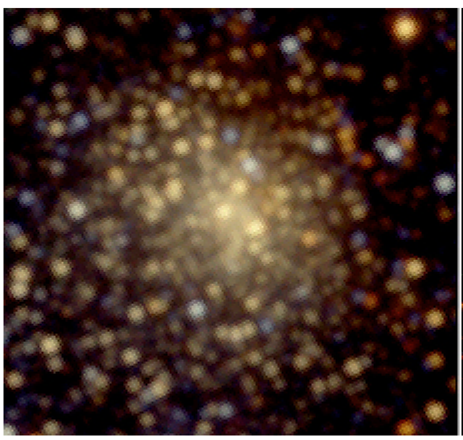
WHIRC Work Continues at WIYN

Dick Joyce & Margaret Meixner (STScI)

The WIYN High-Resolution Infrared Camera (WHIRC), built by Margaret Meixner (Space Telescope Science Institute) and collaborators, has made excellent progress toward completing its commissioning as a WIYN facility instrument. WHIRC utilizes a 2K x 2K Raytheon 'Virgo' array and 13 broad- and narrowband filters for high spatial resolution (scale 0.1 arcsec per pixel) imaging in the 0.9–2.5 micron range. In conjunction with the WIYN Tip/Tilt Module (WTTM), WHIRC should provide (under good conditions) near diffraction-limited image quality in the Ks band.

During observing runs in January, February, and March 2008, the majority of the performance requirements were demonstrated and the instrument is close to meeting all the acceptance criteria for being a facility instrument. The performance of the detector is now well-characterized. We have established a detector bias that provides both good well depth and linearity. The observer's interface has been redesigned for use by visiting astronomers, and both it and the observing planning tool have been extensively tested. During the January run, J band images as good as 0.29 arcsec FWHM were measured.

WHIRC has already been used on three shared-risk science runs, and initial reports suggest that the users are pleased with the performance of the instrument. Several additional runs are scheduled this semester, and WHIRC will again be offered for shared-risk observing in 2008B.



Figures 1-2: Images of the GLIMPSE gGlobular cluster from the Two Micron All-sky Survey (left) and a WHIRC image of the same field (right). The colors in both images are J, H, and Ks (represented by blue, green, and red, respectively; see online version). WHIRC image courtesy of Matt Povich and Jennifer Stone.

continued

WHIRC Work Continues at WIYN continued

The major remaining issues are the commissioning of WHIRC with WTTM in active tip/tilt mode and the continuing efforts to mitigate intermittent detector noise. Careful work by Charles Corson and Maureen Ellis has traced the source of the noise to the instrument rotator power supply, and steps to reduce this pickup are in progress. The integration of WTTM with WHIRC, particularly for guided dithering, will continue during future T&E runs, but it may not be completed for visitor use in Semester 2008B.

Many people have contributed their expertise in the effort to get WHIRC to its present state. Charles Corson, Pat Knezek and Heidi Schweiker have been involved in the interfacing to the WIYN telescope and the continuing effort with WTTM integration. Behzad Abareshi and Dave Mills continue to be involved in the software integration and user interface issues. Maureen Ellis and Ron George have been fighting the battle (successfully!) to identify and mitigate the detector noise. Bill Ditsler, Ken Don, Mark Hunten, Jim Hutchinson and Bill Ball have all helped deal with mechanical and electronic issues, often on short notice.

Further information on WHIRC, including a link to the current version of the User's Manual, can be found at *www.noao.edu/kpno/manuals/whirc/WHIRC_0804.htm*.

WHAM Departs Kitt Peak

Matt Haffner & Ron Reynolds (University of Wisconsin)

After just over 11 years of continuous operation, the Wisconsin H-Alpha Mapper (WHAM) left Kitt Peak this April. WHAM's tenure on the mountain was extremely successful and has produced a string of new results, including its primary goal, the first all-sky spectroscopic mapping of the ionized gas in the Milky Way.

WHAM's wide-field Fabry-Perot spectrometer, combined with the excellent dark site at Kitt Peak, resulted in one of the most powerful instruments on Earth for exploring diffuse optical emission. In addition to studying the interstellar medium, its observations have aided progress on studies of the microwave background. WHAM is a completely remote instrument and is routinely used by observers as far away as Australia. Such a capability made operations efficient, flexible, and inexpensive for a project of this size. Without a doubt, our success as a remote facility was enabled by the considerable infrastructure and the excellent, responsive staff at KPNO.

Resting in greener pastures this summer and fall for a maintenance overhaul, WHAM will be moving to CTIO before it is exposed again to a Wisconsin winter In early 2009, WHAM will begin observations again to complete the all-sky survey and hunt for new discoveries in the southern sky.

WIYN Bench Spectrograph Upgrade

Pat Knezek & John Glaspey

WIYN Observatory is undertaking a significant upgrade to its Bench Spectrograph, which feeds the Hydra multi-fiber spectrograph and the SparsePak Integral Field Unit. This upgrade ultimately includes a new collimator, a new CCD plus electronics, and two new high-efficiency transmission gratings. Changes are happening very quickly now, and the Bench Upgrade team has established a Web page with status reports to help observers plan for their observing runs. Please visit *www.wiyn.org/instrument/bench_upgrade.html*. Assuming there are no delays, the upgrade should be completed by early September 2008.

An important part of the Bench Upgrade has been replacing the T2KA CCD in the spectrograph, which in turn was brought to the Bench when the T2KC device failed. We are actively commissioning a new CCD named STA1, a 4000 x 2600 device with 12 micron pixels from Semiconductor Technology Associates Inc. This device has very high quantum efficiency, providing approximately a 30 percent advantage over the T2KA system (see the CCD QE Values diagram on the Web page listed above). Under control of one of the new MONSOON systems being produced at NOAO, it has low noise—approximately 3.4 electrons in the imaging area. Operated at 152K, it has less than one electron of dark current per pixel per hour, although there are some 'hot pixels' that will need to be corrected during processing of the data. As part of this entirely new system, there will be a simple graphical user interface for the observer that will have all of the functionality of the old IRAF Control Environment (ICE) system. The initial users have acquired high-quality science data with Sparsepak and Hydra.

Another component of the upgrade was the acquisition of two Volume Phase Holographic (VPH) transmission gratings. The first of these, an anti-reflection coated 740 l/mm grating, has now been in regular use for almost two years. The second, a currently uncoated 3300 l/mm grating, underwent a commissioning run at the end of March 2008. Preliminary results indicate that even uncoated, this grating outperforms the echelle grating by a factor of ~2 in the appropriate wavelength regime (~460 – 550 nm in first order). Current plans are to release the grating in shared-risk mode for Semester 2008B, and for general use in Semester 2009A.

The final significant component of the upgrade is a new, all-refractive collimator. This collimator will increase the throughput of the spectrograph by at least 60 percent. At the time of writing, the mechanical portion of the collimator is almost completely fabricated, and the lenses for the collimator are being polished. The Bench will be unavailable to observers August 11–31 when the team will install, integrate, and commission the new collimator.

Director's Corner

Steve Keil

It is again time for solar physicists to begin planning for the next decade and to provide inputs to the pending astronomy decadal survey. As a result of the 2000 decadal survey, the Advanced Technology Solar Telescope (ATST) is nearing the construction phase and has recently entered the NSF Major Research Equipment Facilities Construction program. Now that the next review is starting to get organized, the solar community needs to think carefully about the ground- and space-based projects and programs we would like pursue in the next decade. Development of Multi-Conjugate Adaptive Optics systems to fully utilize the field-of-view of ATST and other ground-based telescopes should certainly be a high priority for solar astronomy. I am sure there are many other ideas floating around, and we should ensure that they are considered in the upcoming decadal survey.

Speaking of reviews, several have been keeping NSO busy during the past quarter. The AURA proposal for the 2009-2014 cooperative agreement with NSF to operate NSO and NOAO was reviewed in March. and a decision from NSF is pending. As part of the follow-up to the NSF Senior Review, all NSF observatories are undergoing a cost review. NSO has provided written material for the review and will have on-site visits of the review committee in late June. ATST continues its series of system-level reviews of all aspects of the telescope in preparation for a final review this winter. The ATST science working group is meeting from May 13 – 15 to continue the development of experiments and observing sequences for ATST. During April, AFRL/RVBXS (the Air Force group) at Sac Peak was kept busy supporting an evaluation of the suitability of Improved Solar Observing Optical Network (ISOON) to be implemented as a multi-station network. The Air Force is also evaluating Global Oscillation Network Group (GONG) and Synoptic Optical Long-term Investigations of the Sun (SOLIS) as systems for meeting their need for monitoring of solar conditions.

The University of Arizona–NSO Solar Physics Summer School will be held the week of June 16. The school provides an intensive one-week course in topics related to the physics of the Sun for advanced undergraduates and beginning graduate students. The purpose of the school is to provide a basic introduction to solar physics. There will be approximately 15 – 20 lectures. Topics include solar radiative transfer, helioseismology, the solar interior (dynamo, convection zone), chromospheric and photospheric magnetic fields, solar magnetohydrodynamics, the origin and heating of the corona and solar wind, flares, CMEs, and high-energy charged particles. There will also be tours of the facilities and opportunities to observe the Sun directly.

At Sac Peak, some new instruments are arriving and some older instruments are departing. The High Altitude Observatory (HAO) has begun installing their Prominence Magnetograph (PROMAG) on the 16-inch″ coronagraph in the Evans Solar Facility at NSO/Sac Peak. PROMAG will map the vector magnetic field in prominences once it is completed this summer. The NSO Coronal One-Shot (COS), along with the HAO Coronal Magnetic Polarimeter (COMP), was removed from the Hilltop Spar and is being moved to Hawaii, where it will continue to make full polarizations measurements of coronal spectral lines. The University of Hawaii Facility Infrared Spectrograph (FIRS) is nearing completion at the Dunn Solar Telescope, after completing a successful engineering run this winter. The joint HAO/NSO SPINOR project made substantial progress this past quarter and should become available as a shared-risk instrument in the final quarter of the year.

At the McMath-Pierce, the NSO Array Camera (NAC) has expanded its operating modes by using single-frame reads from the camera to allow short (millisecond) exposures, and by upgrading the polarimeter control scheme to allow rapid (10 millisecond) liquid-crystal chopping. New infrared granulation movies have been produced with the use of single-frame read mode, and lower-noise vector magnetograms are expected from the polarimeter upgrade. Near real-time flat and dark image correction has made the NAC more user friendly.

SOLIS participated in support of the Whole Heliospheric Interval (WHI) during March 20–April 16. The WHI is an international coordinated observing and modeling effort to characterize the three-dimensional interconnected solar-heliospheric-planetary system during Carrington Rotation 2068. The specific goals of the WHI included the characterization of the 3D solar minimum heliosphere and tracing the effects of solar structure and activity through the solar wind to the Earth and beyond. SOLIS was one of 14 solar instruments participating, along with 19 heliospheric and 18 geospace instruments. SOLIS carried out investigations that involved observations of low-latitude coronal holes and observations of the quiet Sun near the Equator as a baseline for future observations of active regions.

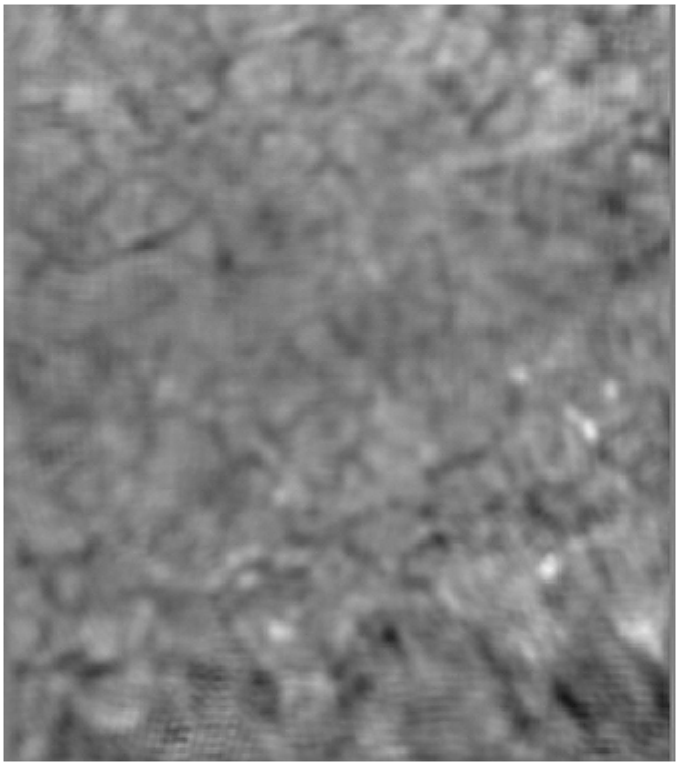
GONG is continuing to pursue space-weather research paths and is currently developing subsurface flows fields and farside imaging as predictors of surface activity. GONG is also improving the high-cadence magnetic field products, and evaluating the feasibility of installing a continuous, high-cadence H-alpha capability. Candidates for a new camera and data acquisition system are being studied.

NSO would like to extend our best wishes to Ed Carlton, who retired from working in the Sunspot Visitor Center;, Robert Radcliffe, who worked at the Dunn Solar Telescope as an instrument technician;, and well as David Salabert, who left the GONG program for the IAC in Tenerife. We would like to welcome Joan Henry, who will be working in the Visitor Center.

New High-Resolution Quiet-Sun Images at 4667 nm

Matt Penn, Claude, Plymate, &and Eric Galayda

New imaging observations have been made at the McMath-Pierce Solar Telescope on Kitt Peak using the NSO Array Camera. With a narrowband filter centered at 4667 nm, which includes several very strong CO absorption lines, very rapid exposures were taken during good seeing at the disk center quiet Sun on 21–23 March 2008. Individual exposure times on the order of 20 milliseconds were obtained using the single-frame read mode of the NAC camera. Adaptive optics was not used, but the atmospheric seeing was excellent during the observations. After extensive correction for background variation and flat-fielding, the raw images showed solar granulation, as well as bright features in the intergranule dark lanes.



The figure shows a reconstructed image from the center of the solar disk on 22 March 2008 produced with the multi-object, multi-frame blind iterative deconvolution (MOMFBD) procedure described in Noort, et al. (2005). The intensity is scaled between ± 2 percent around the mean intensity. Features at the telescope diffraction limit (0.8 arcsec) are seen in the image, which measures roughly 45 × 35 arcsec across. While the granulation contrast is low, the bright intergranule features (middle of image, right side) show contrast of 3 percent or greater. These features resemble the magnetic bright points seen in high-0resolution G-band images, and a time sequence from March 23 showing similar small-scale bright features reveals that they have a lifetime that far exceeds the granulation turn-over time; currently it is thought that they represent locally heated regions of high magnetic field where the CO molecule is dissociated and the absorption spectrum is absent.

An image of the solar granulation from 22 March 2008 taken with the McMath-Pierce telescope and the NAC at 4667 nm (which includes several strong CO absorption lines). The field measures 45 × 35 arcseconds, and details at the diffraction limit of the telescope (0.8 arcsec) are visible. The granulation has low contrast, but bright points in the dark intergranular lanes are visible near the right edge of the field. Time sequences from March 21 – 23 show similar small-scale bright points, which have long lifetimes and are thought to be similar to the G-band bright points.

SOLIS

Aimee Norton, Kim Streander, Carl Henney & the SOLIS team

The Solar Optical Long-term Investigations of the Sun (SOLIS) team supported Whole Heliospheric Interval (WHI) observing efforts from March 20 through April 16 by taking data simultaneously with other ground- and space-based telescopes.

WHI was an internationally coordinated, four-week observing effort designed, in part, to showcase 2008 as the International Heliosphysical Year. Observations and data analysis will be followed by modeling efforts to characterize the three-dimensional, interconnected, solar-heliospheric-planetary system.

The emphasis for each of the four weeks of WHI was: linking the corona to the solar wind as observed by the Ulysses spacecraft, the origin of the slow solar wind, understanding the coronal hole boundaries and low-latitude coronal holes and characterization of the quiet sun. The entire time period corresponds to solar Carrington Rotation 2068.

The Sun was cooperative, providing the desired solar features for our studies, (i.e., an equatorial coronal hole during the third week

continued

SOLIS continued

(see figure 1) and very little magnetic activity (i.e., without sunspots) during the fourth week). We look forward to the scientific advances made through these coordinated, collaborative efforts.

Six additional spectra from the SOLIS Integrated Sunlight Spectrometer (ISS) have been calibrated for spectral dispersion. The wavelength regions recently calibrated are the Ca II K, Ca II H, He I 1083.0 nm, CN 388.4 nm, C 538 nm and Mn 539.4 nm spectral bands, as seen in figure 2. Fluxes were normalized to reference values in the Fourier Transform Spectrometer flux atlas. The data are now publicly available on the SOLIS Web page. NL

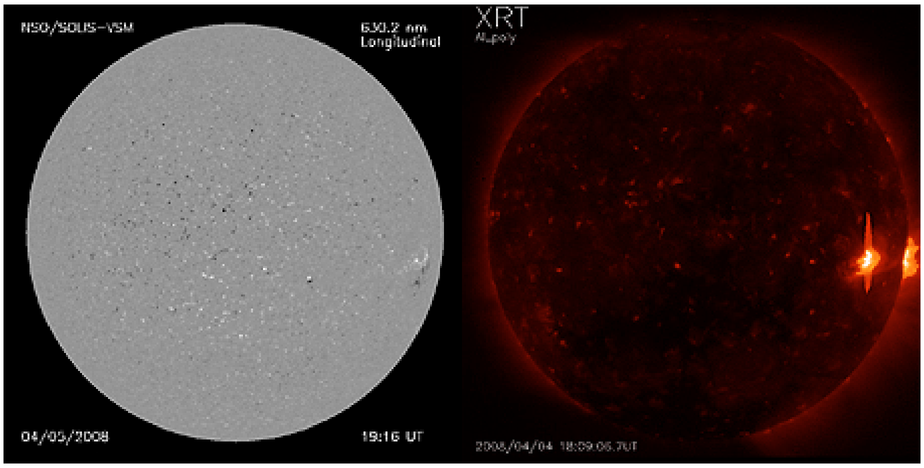


Figure 1: A SOLIS VSM full-disk solar image (left) and Hinode XRT X-ray image (right) for 5 April 2008. These represent only two out of a suite of ~30thirty participating instruments. SOLIS VSM image is depicted in grayscale indicating the line-of-sight magnetic flux as observed in the photosphere with the 630 nm Fe I lines. White/black indicate positive/negative polarity of magnetic fields. Hinode XRT image shows the X-ray intensity with visible coronal holes at the South Pole and another near 30 degrees southern latitude.

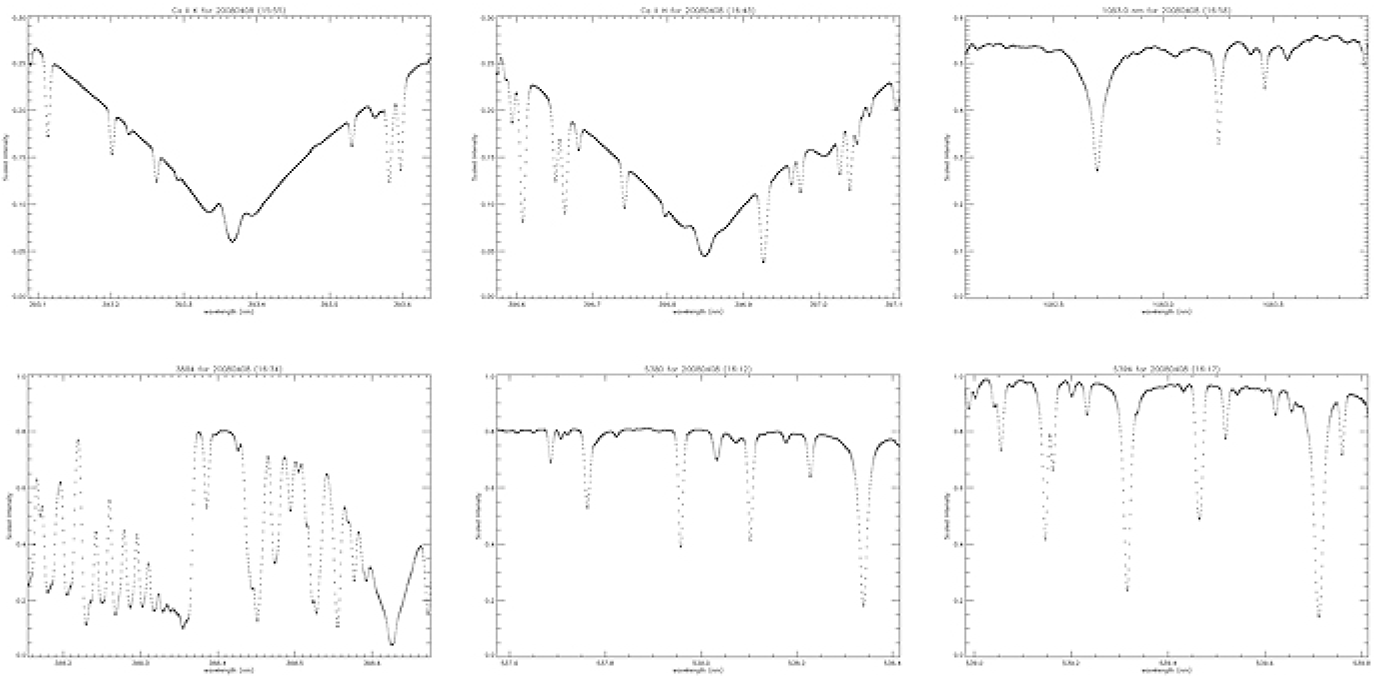


Figure 2: Sample spectra measured by the ISS. Shown are spectra from the (upper) Ca II K, Ca II H, He I 1083.0 nm, (lower) CN 388.4, C 538.0 and Mn 539.4 nm. The daily ISS program acquires numerous spectral bands, including the six shown here. Construction of the Full Disk Patrol continues, with the alignment being complete, excepting the objective lens and final beamsplitter.

GONG++

Frank Hill & the GONG++ Team

The Global Oscillation Network Group (GONG) continues to focus its efforts on new space-weather tools, applications, and data products. GONG's high-cadence magnetograms continue to capture the attention of the community and funding agencies, and are eliciting interest in wider participation in operational support of GONG. In addition, progress in the development of active-region prediction tools is sparking queries from additional potential partners.

Recently, we developed a calibration between the farside signal and the magnetic field strength and area of large active regions, which has enabled us to produce synoptic maps that incorporate an estimate of the farside field. These front-side "plus" farside synoptic maps should improve the field extrapolations and solar-wind predictions. Looking below the surface with one of GONG's standard helioseismic data products, a 16-degree across three-dimensional subsurface map of horizontal flow, we can now determine various fluid dynamics quantities that tell us how the plasma is moving apart (divergence) and the twistedness (vorticity) of the flows. A statistical study of some 400 active regions found that if the region is associated with a combination of high vorticity and high surface magnetic field, then there is a very high probability of strong flare activity. We now have a quantitative measure of flare occurrence probabilities, which is what space-weather forecasters really need for a timely warning, as shown below.

The GONG 2008/SoHO 21 meeting will be hosted by University of Colorado Atmospheric Research/High Altitude Observatory (UCAR/HAO) and held in Boulder, Colorado, 11-15 August 2008. As implied by the title, "Solar-stellar dynamos as revealed by helio- and astero-seismology," this meeting will cover all areas of helio- and astero-seismology, with emphasis on what these research topics have taught us about the dynamo generation of solar and stellar magnetic fields. For registration, abstract submittal, and general information about the meeting, visit *gongsoho08.ucar.edu/*.

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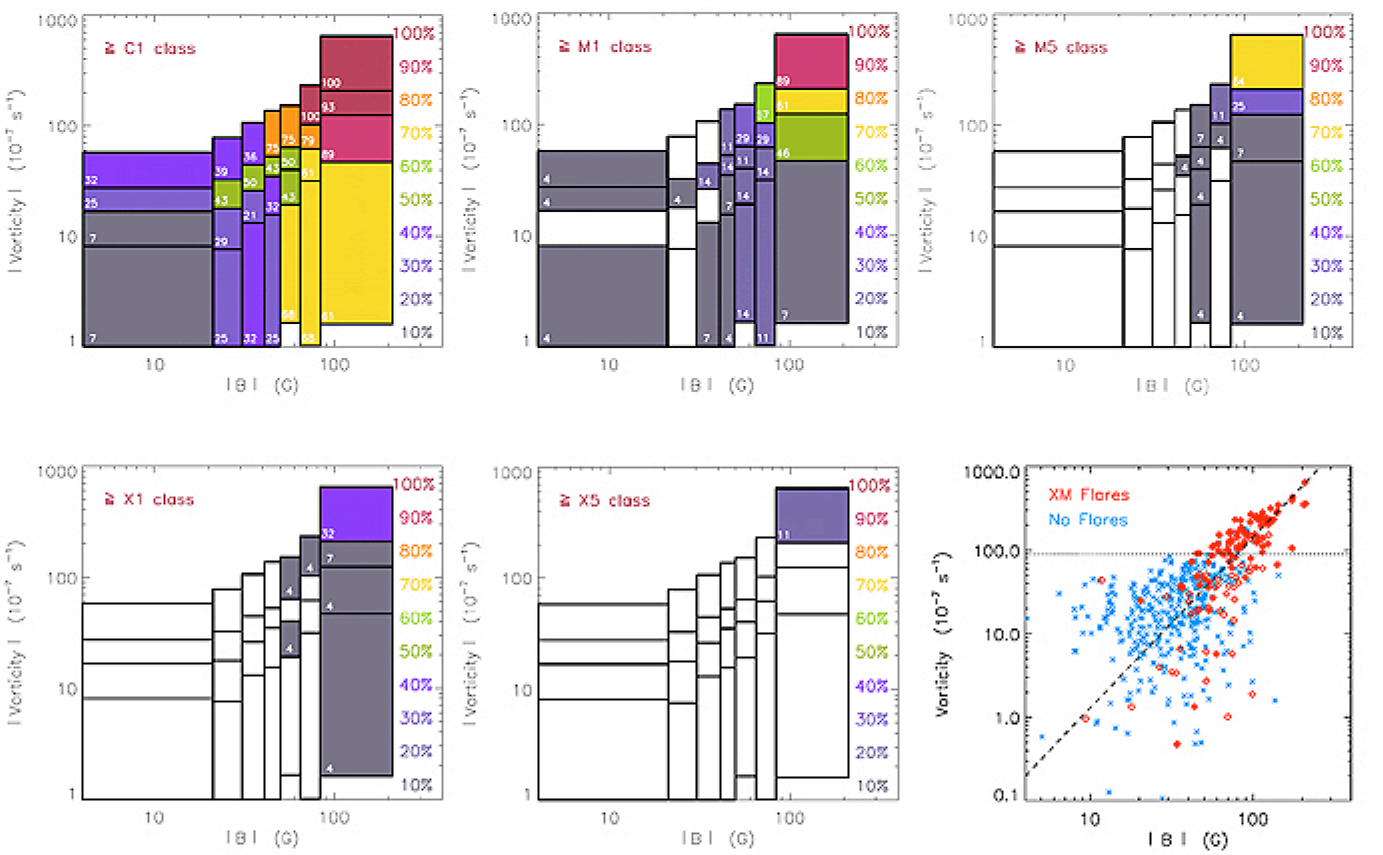


Figure caption: The lower right panel shows the surface magnetic field B and vorticity of approximately 400 active regions . Dark symbols indicate active regions that produced flares, while light symbols show active regions that did not flare. The preponderance of flares occur when the active region has high values of both B and vorticity. The remaining panels divide up the active regions so that each box contains an equal number of points. The numbers in the bins are the percentage of active regions with at least one flare with a magnitude above the indicated class. Grey scales indicate the probability levels in steps of 10%, white is 0%. It is clear that the strongest flares again occur when both B and vorticity are high. This suggests that measuring the subsurface vorticity will become a useful way to identify active regions that potentially could produce dangerous flares.

GONG++ continued

Science Highlights
Most of the GONG scientific staff attended the Solar Dynamics Observatory/Helioseismic and Magnetic Imager (SDO/HMI) team meeting in Napa, California March 24–28. With the launch of SDO—NASA's first international "Living With a Star" mission—only about one year away, a joint meeting was planned to unite co-investigator teams from the entire SDO mission and others beyond those core teams who are committed to actively participating in the science investigations. Discussion was mainly centered on planning those activities that need to be completed before launch and during the first two years of the mission. The agenda also featured a series of scientific and technical working groups to discuss how the SDO data will be best accessed, distributed, and analyzed, and what tools are needed to best stimulate scientific discoveries. Details of the meeting can be found at *hmi.stanford.edu/TeamMeetings/Mar_2008/*.

Congratulations to Rachel Howe, Rudi Komm, K.S. Balasubramaniam, and Gordon Petrie who have finished editing the proceedings for last year's NSO/Sac Peak Workshop, "Subsurface and Atmospheric Influences on Solar Activity," PASP Conf. Series 383, ed. R. Howe, R.W. Komm, K.S. Balasubramaniam, and G.J.D. Petrie, San Francisco: Astron. Soc. Pacific, 2008. The proceedings include nine GONG staff-authored papers.

Network Operations & Engineering
Most of the efforts so far this year have been directed toward preparing for a series of preventive maintenance (PM) trips to El Teide in March and Cerro Tololo Inter-American Observatory (CTIO) in April. The schedule was contingent on modifications and outcomes of tests of the CCD cameras.

With two cameras readied with time to spare, a trip to Big Bear observatory was undertaken to replace its camera, which was operating at a high temperature due to a failed cooling fan. The returned camera was repaired, tested, and readied for the CTIO trip. Unfortunately, problems with the existing CTIO camera appeared, and attempts to alleviate the trouble before the El Teide trip were unsuccessful. Having two neighboring sites down simultaneously would have seriously compromised the network duty cycle, so a quick trip to CTIO was needed to replace the ailing camera. Although there was some overlap in the work at the two sites, the CTIO camera replacement went quickly and allowed the site to provide coverage well before the completion of the El Teide PM, which was completed without a hitch. At the time of this writing, a team is visiting CTIO for its regularly scheduled annual maintenance.

In between planning for maintenance trips, various instrument problems have demanded some attention. One such problem began last fall when new air conditioning units were installed at Udaipur. The new units had larger capacity and drew more power than the original units. This resulted in a rapid discharge of the batteries. The problem prompted an upgrade to the UPS communications code, which facilitated enhanced monitoring and UPS programming capabilities that allowed the problem to be diagnosed and fixed remotely.

Long-term testing of the prototype clean-air system upgrade (now at 11+ months) continues at the Tucson engineering site. We hope for at least a year between required maintenance so that we can service the clean-air pumps during our annual site visits. The modification to the upgraded waveplate hardware (a small circuit board) has been running at Tucson and was installed at Big Bear last month. It appears that the modification is working properly, and should provide better noise immunity in the waveplate circuit. We have had some success with the prototype workstation, which replaced the ones currently operating at the sites. The workstation appears to operate properly, but we have had some difficulty implementing serial communications with the data and instrument chassis. We have ordered a serial card for the workstation, which is expected to solve this issue.

H-alpha images were collected on March 28 using a possible GONG replacement camera and a filter borrowed from the SOLIS/FDP instrument. The good news is the images were sufficient to prove that we are able to collect H-alpha images with the GONG instrument.

Data Processing, Software Development & Analysis
The GONG Data Archive Web page has a new look and GONG data users have a new interface for querying and downloading data products. Six terabytes of GONG products are available for immediate download from *gong2.nso.edu/dsds*. Your feedback is welcome as we try to improve the accessibility of GONG data products. Please check it out and let us know what you think.

The DMAC Software Maintenance and Development group continues to work on the near-real-time Magnetogram Pipeline. The spurious periodic variation of the polar magnetic field in our hourly synoptic maps has been traced to the method of correcting noise at the limb. Until a new "pixel tossing" algorithm can be developed, Gordon Petrie has developed a technique to fit and remove the periodicity and, along the way, has also improved our pole-filling routine. Using these modifications, we are reprocessing 18 months of data to replace all existing online magnetogram pipeline results. For additional information please see *gong.nso.edu/data/magmap*. Tom Wentzel is currently experimenting with a Fourier-transform technique to filter out the noise at the limb.

Processing to date includes time series, frequencies, merged velocity and rings for GONG Month 125 (centered at 13 August 2007), with a fill factor of 0.91.

Program News
David Salabert has departed for a new position at the Instituto de Astrofisica de Canarias in Tenerife, Canary Islands, Spain. David, with John Leibacher and Thierry Appourchaux, developed a new peak-finding method during his time with us that estimates the parameters of oscillation modes at low signal-to-noise ratios at low frequencies. The method has added about 30 extremely precise mode determinations to the set that can be fitted and has improved the precision of the inversions below the convection zone. The analysis was highlighted in the December 2007 issue of the NOAO/NSO Newsletter. We plan to continue testing the method, and to transition the development code into production software over the next six months or so. Congratulations and good luck to David in his new position.

In late April, we welcomed Rafa Garcia and Savita Mathur (CEA, Saclay) for an intensive 10-day course in GONG data acquisition and analysis with Irene Gonzalez Hernandez.

continued

GONG++ continued

They will pursue the elusive and much sought g modes, which Rafa has pursued for over a decade and were central to Savita's thesis.

The second year for GONG's International Research Experience for US Graduate Students to Study Astronomy/Astrophysics in India (IRES 2008) is off to a good start. Sponsored by the NSF Office of International Science and Engineering (OISE), the IRES program takes place in Bangalore, India, under the auspices of the Indian Institute of Astrophysics (IIA). We have four confirmed participants for the 2008 summer school: Andrea Kunder (Dartmouth College), Eric Larson (University of Colorado), Driss Takir (University of North Dakota), and Catharine Wu (New Mexico State University). We also have IIA mentors: Prof. S.P. Bagare, Prof. S. Giridhar, Dr. U.S. Kamath, and Prof. S.K. Saha. This year's school runs from June 11-August 6. For more information, visit the Web site at *eo.nso.edu/ires/*.

Left to right, Andrea Kunder of Dartmouth College, Erik Larson of the University of Colorado, Driss Takir of the University of North Dakota, and Catherine Wu of New Mexico State University.

Fourth Quarter Deadline for NSO Observing Proposals

The current deadline for submitting observing proposals to the National Solar Observatory is 15 August 2008 for the fourth quarter of 2008. 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*).

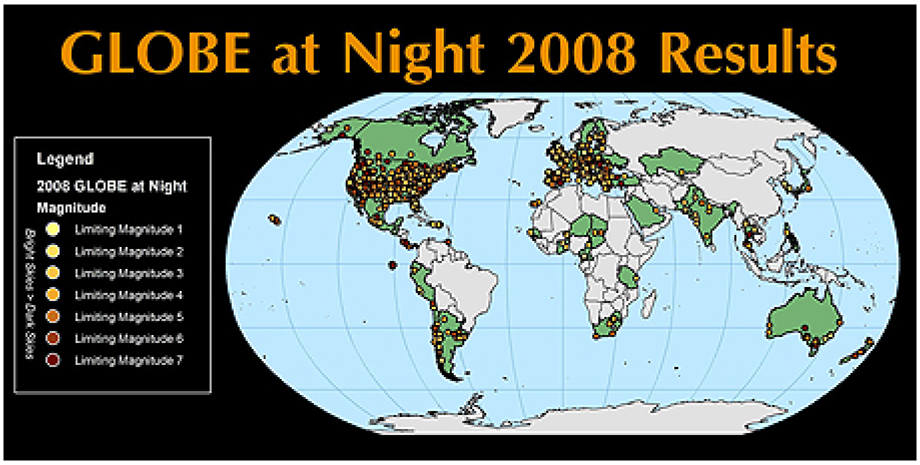
Instructions may be found at *www.nso.edu/general/observe/*. A Web-based observing-request form is available at *www2.nso.edu/cgi-bin/nsoforms/obsreq/obsreq.cgi*. Users' manuals are available at *nsosp.nso.edu/dst/* for the Sac Peak facilities and *nsokp.nso.edu/* for the Kitt Peak facilities. An observing-run 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.

GLOBE at Night 2008 and Earth Hour Results a Solid Step Toward IYA 2009

Connie Walker & Douglas Isbell

The international star-hunting activity known as GLOBE at Night inspired 6,838 measurements of night-sky brightness by citizen scientists around the world, including 660 digital measurements using handheld sky-quality meters.



The third edition of GLOBE at Night was held from February 25 to March 8, with assistance from the educational outreach networks of the Astronomical Society of the Pacific (ASP) to help spread the campaign to amateur astronomers and science centers.

The 2008 campaign received measurements from 62 countries, surpassing last year's total of 60 countries. Just over 4,800 of the measurements came from the United States (with 48 states and the District of Columbia reporting at least one measurement). Observers in Hungary submitted the most measurements (380) from outside the US, followed by Romania, the Czech Republic, Costa Rica, and Spain, all with over 100 observations; Canada was next largest, with 95 measurements reported.

A representative world map of GLOBE at Night 2008 observations is available at *www.noao.edu/outreach/press/pr08/pr0805.html*. See the related story in this *Newsletter* section on a GLOBE at Night 2008 measurement campaign in northern Chile.

These basic numbers fall roughly midway between the 2007 and 2006 results from GLOBE at Night, which may result from several factors. While we have just begun to analyze the data, we have strong anecdotal evidence from our citizen-scientist network in North America that they experienced abnormally cloudy skies this year. The timing of the March new Moon this year—which is required to give everyone sufficiently dark skies to properly observe the constellation Orion—also fell further into summer vacation for our partners in Chile and some other Southern Hemisphere countries, which made it more difficult to attract large numbers of students.

The classic GLOBE at Night program directs students, families, and the general public how to observe and record the number of stars visible in the constellation Orion, as seen from different locations. Observers report their results online by comparing their view of Orion with a set of template images on the program's Web site, which shows the number of stars in the constellation for a range of visibilities from bright skies to very dark.

The digital version of GLOBE at Night takes advantage of low-cost digital sky-quality meters manufactured by Unihedron of Ontario, Canada, which can make a highly repeatable direct measurement of integrated sky brightness.

Both the "classic" GLOBE at Night exercise that anyone can have fun doing with their unaided eyes, and the digital effort will be conducted again in March 2009, as one of several start-hunting efforts connected to the "dark-skies awareness" cornerstone program of the International Year of Astronomy (IYA) 2009.

Next year, GLOBE at Night will occur in the latter half of March 2009. These dates should provide better conditions for schools in the Southern Hemisphere, and will likely coincide with Earth Hour 2009 on March 28.

The World Wildlife Fund (WWF), which organized and coordinated the inaugural global version of Earth Hour on Saturday evening, March 29, 2008, reported that an estimated 36 million Americans took part in this effort to turn off lights for one hour as a way to reduce energy waste and related carbon emissions. According to a survey by Zogby International, approximately 16 percent of the US adult population reported taking part in Earth Hour, and 78 percent were aware of the event, which took place globally in more than 400 cities in 35 countries across all seven continents.

Beyond the four official US flagship cities of Atlanta, Chicago, Phoenix and San Francisco, WWF estimates that more than 100 cities and towns across the nation took part in the event, including Tucson. Iconic landmarks in the US going dark included the Golden Gate Bridge, Sears Tower, Empire State Building, Coca-Cola billboard in Times Square, Bank of America Plaza (Atlanta), US Airways Arena (Phoenix), Alcatraz and others turned off their lights to symbolize the need to take action on climate change.

continued

GLOBE at Night 2008 and Earth Hour continued

There were indications from data taken before, during and after the event by the new all-sky camera at Kitt Peak National Observatory that the event demonstrated a positive impact on dark skies toward Phoenix. The same camera also appears to show that regular lighting curfews in Tucson have a measurable impact in maintaining dark skies in southern Arizona.

A first look at results from GLOBE at Night 2008 was presented by project leaders who attended the March 2008 meeting of the National Science Teachers Association in Boston. More detailed analysis of the GLOBE at Night 2008 data will be presented at the May 31-June 4 annual meeting of the Astronomical Society of the Pacific in St. Louis, to be held jointly with the American Astronomical Society. The meeting's primary focus is national and regional training and planning related to IYA 2009. See *www.astrosociety.org/events/meeting.html* for more details.

For more information and access to the data sets, see the program's Web page at *www.globe.gov/globeatnight*, or contact *globeatnight@globe.gov* or *outreach@noao.edu*.

Information about the emerging global plans for the IYA 2009 is available at *www.astronomy2009.org*.

GLOBE at Night is a collaboration among NOAO, the Centro de Apoyo a la Didáctica de la Astronomía (CADIAS) in Chile funded by NOAO and the Gemini Observatory (see related article), the Global Learning and Observations to Benefit the Environment (GLOBE) Program, Boulder, CO; Environmental Systems Research Institute, Inc. (ESRI); and the International Dark-Sky Association (IDA).

A GLOBE at Night 2008 Campaign Around Cerro Tololo

David Orellana, Daniel Munizaga & Michael Warner

During the GLOBE at Night 2008 campaign, two of us from Centro de Apoyo a la Didáctica de la Astronomía took a set of measurements of the night-sky brightness in the region around Cerro Tololo with a pair of Unihedron sky-quality meters (SQMs), supplied via the NOAO Public Affairs and Educational Outreach office in Tucson. Our SQM readings were taken at 46 points distributed around Cerro Tololo, spaced mainly along valley roads at roughly 10-kilometer intervals.

The aim of this pilot study was to define a model for making, summarizing, and distributing a baseline dataset of simple, yet reasonably reliable, electronic SQM measurements to compare with naked-eye observations being made in the region at night by the general public. Ultimately, this will contribute to integrating the educational community into the study of the heritage of the night sky, and the relation of humankind with the environment, by means of an integrated set of observational activities consistent with the local high-school curriculum.

We also hope to support public policy efforts to inform local, regional and national authorities about the impacts of the application of the Chilean DS686 "norma lumínica" lighting regulations. These regulations are designed to governare the development, preservation and future sustainability of the environmental heritage of the skies over the Coquimbo (IVth) Región of Chile.

The measurements were made between March 3–6, using two SQMs selected from a set of seven SQMs calibrated on February 29. These measurements were taken in public places along access roads to communities in the Elqui and Limari valleys.

Using one GPS, two SQMs, a watch, flashlight and data table, the measurements were taken starting one hour after sunset (after 10 pm) until 3:30 am the following morning. The measurement routine was

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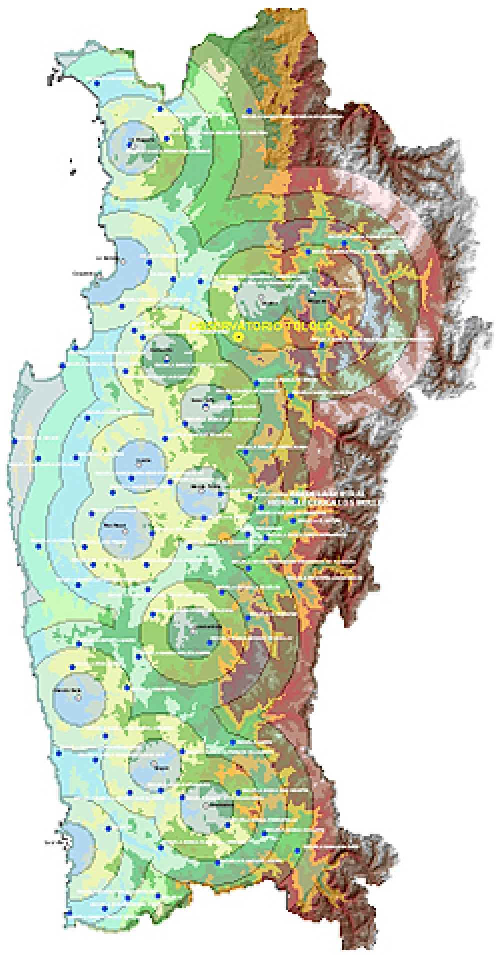

Figure 1: Territorial map of the Coquimbo Region, with successive concentric rings of radii increasing in steps of 10 kilometers drawn around the main communities.

GLOBE at Night 2008 Campaign Around Cerro Tololo continued

to note the time, coordinates, and altitude with the GPS, and readings with the two SQMs simultaneously – avoiding, where possible, the light from street lamps (this was not possible in the central squares). The main sector incorporated the 65 kilometers around Cerro Tololo Inter-American Observatory (see figure 1).

These data were first transferred to an Excel spreadsheet. A simple Comma Separated Values (.cvs) archive was created containing three columns of decimal numbers: latitude, longitude, and SQM reading. The .cvs archive was then converted into a GPS Exchange Program (.gpx) archive using the freeware application GPSBabel. The .gpx archive could then be loaded directly into Google Herat, enabling the creation of figure 2.

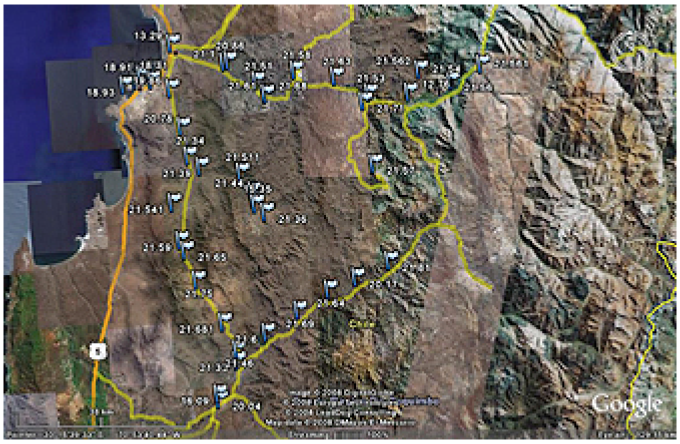

Figure 2: Google Earth map, showing the readings taken with SQM # 1401.

In order to obtain a uniform grid in meters, the decimal coordinates were converted into Universal Transverse Mercator (UTM) coordinates using the Mapsource application for Garmin GPS. These were then used by the Matlab program, which extrapolates the sparse 3D measurements into a uniform 100x100 grid as shown in figure 3. For SQM magnitude readings below 20, a gain of 1/10 was applied; for example, an SQM reading of 15 is displayed with a value of 19.5 = 20-(20-15)/10. Such bright readings were often affected by street lamps in the field of view of the SQMs and would have distorted the 3D grid.

We judge this first data-collection experience to be quite successful, and we look forward to adding to our baseline measurements over the next several years, as we share our results with local schools and government agencies.

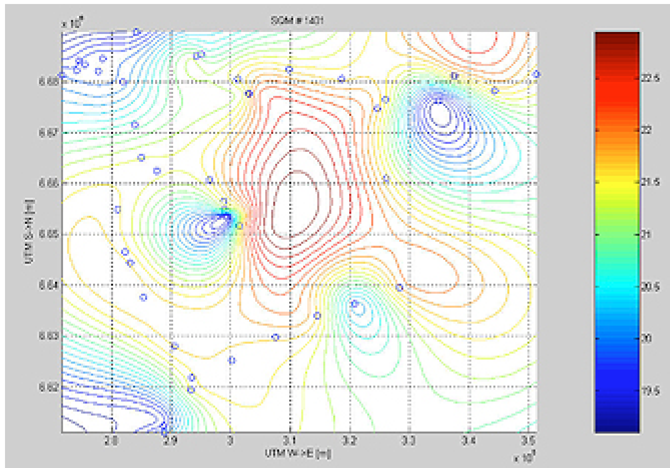

Figure 3: Contour model, in UTM coordinates, using Matlab (data from SQM # 1401).

New Exhibit on Telescope Mirror Technology

Thanks to expert design work by a Kitt Peak Visitor Center docent and key contributions from the Steward Observatory Mirror Laboratory, a completely revised exhibit on large telescope mirrors has been installed at the visitor center.

The attractive exhibit includes information on the Large Synoptic Survey Telescope and both Giant Segmented Mirror Telescope projects, as well as an actual mirror-mold core, related hardware, and a one-tenth scale model of the WIYN 3.5-meter mirror provided by the Steward mirror lab. The finished exhibit represents collaborative efforts of the NOAO Photo/Imaging department and public outreach staff, members of LSST Corporation, and Kitt Peak maintenance staff, all acting upon the inspired vision of visitor center volunteer docent Barclay Ward, a retired professional exhibit developer. Stop by the Kitt Peak Visitor Center during your next trip to the mountain to see how this exhibit contributes to a more insightful experience for our public guests.

High Fire for LSST

Suzanne H. Jacoby (LSST Corporation)

The combined primary/tertiary mirror for the Large Synoptic Survey Telescope (LSST) experienced a successful "high fire" over the weekend of 28-29 March 2008 at the University of Arizona (UA) Steward Observatory Mirror Lab (SOML). After reaching a peak temperature of approximately 1165 ºC (2125 ºF) in a flawless casting, the LSST mirror will now anneal and cool gradually to room temperature over the following 100 days in the slowly rotating mirror lab oven.

In mid-August, the cooled mirror blank and cores (which together weigh 85,000 pounds) will be lifted from the furnace and turned on end so the cores can be removed. A total 16,000 pounds of glass will be removed from the faceplate and backplate of the mirror during grinding and polishing. The finished mirror will weigh about 35,900 pounds.

Figure 1: UA Mirror Lab Director Roger Angel, the National Science Board's Steven Beering, LSST Director Tony Tyson, Purdue University Physicist Ian Shipsey, University of Chicago Cosmologist Rocky Kolb, and LSST Project Manager Don Sweeney pose in front of the spinning oven in which the LSST primary mirror is being cast.

High fire marks the critical first step in fabricating the key optical components of LSST, the unique wide-field survey telescope expected to see first light in 2014 from Cerro Pachón in Chile. This exciting milestone was also a great excuse for a party! To celebrate high fire and increase the visibility of LSST, a day-long program of talks, tours, and interactions took place in Tucson. More than 300 people toured the mirror lab throughout the day and 150 VIP guests attended the high fire festivities.

The UA Flandrau Science Center served as home base for the event, with LSST exhibits in the lobby and informational presentations in the planetarium theater in the morning. LSST System Scientist Zeljko Ivezic, (University of Washington) spoke about "Breakthrough Science of LSST," pointing out the particular realms in which the James Webb Space Telescope, Giant Segmented Mirror Telescope, and LSST will lead us forward. Victor Krabbendam (LSST/NOAO), Project Manager for Telescope and Site, spoke about visiting Cerro Pachón, and how its peak known as El Peñon was selected as the home for LSST. His multimedia tour appealed to both the scientists and the world travelers in the room.

Welcoming remarks at the event luncheon were delivered by LSST Board Chairman John P. Schaefer, UA President Robert N. Shelton, and UA Steward Observatory Director Peter Strittmatter. In the early afternoon, Edward 'Rocky' Kolb (University of Chicago) gave a dynamic talk titled "The Quantum and the Cosmos." Rocky presented a cosmologist's point of view in describing how LSST will take us back in space and time to the origin of the Universe, and an increased understanding of dark matter.

UA Regents Professor and Mirror Lab Scientific Director Roger Angel then shared a bit of history of the mirror lab and insight into the unique challenges of casting the LSST M1/M3 monolith. Small groups led by SOML and LSST experts toured the lab throughout the afternoon, and enjoyed seeing the LSST glass spinning in the furnace, as well as views of the fold-sphere mirror and mirror number one from the Giant Magellan telescope project on the polishing floor.

Figure 2: Charles Simonyi talks about his experience as a space tourist at the event dinner. In the foreground is a scale model of the LSST telescope, a gift presented to Simonyi in appreciation of his fund's generous contribution to the project.

Festivities continued with cocktails and a celebratory dinner that evening. Music was provided by the eight-member UA HarpFusion ensemble. Tables were beautifully decorated at the Marriott University Park with rose petals, individual pieces of etched LSST glass for each guest, and menu cards illustrated with cactus photographs from the collection of John Schaefer. LSST Project Manager Don Sweeney welcomed guests with opening remarks and presented a model of the LSST to featured speaker Charles Simonyi in appreciation of his substantial contribution to the project. After dinner, Tony Tyson, Professor of Physics, UC Davis and LSST Director, talked about "LSST and the Dark Side." Charles Simonyi ended the evening with a fascinating and personal presentation about his experiences as the fifth civilian space flight traveler to the International Space Station in April 2007.

continued

High Fire for LSST continued

The mirror casting and surrounding celebration both unfolded flawlessly and set new standards for telescope-themed entertainment. A large number of people contributed to the day's success, including many students, docents from Kitt Peak and SOML, and others who volunteered their time to make the project look good. Guests enjoyed the informality of the day, Tucson's perfect March weather, and the opportunity to mingle amid the people and locations making scientific history with LSST.

More information, including a video of the glass melting in the oven, can be found at *www.lsst.org/News/highfire_event.shtml*.

A month after the event, LSST moved into new offices just across Cherry Avenue from NOAO, on the 5th floor of Steward Observatory.

New contact information:

LSST Corporation
933 North Cherry Avenue
Tucson, AZ 85721
520-881-2626 (LSST main number)
520-881-2627 (fax)
www.lsst.org

Figure 3: At a tent outside the Steward Observatory Mirror Lab, Project Coordinator Karen Kenagy preps the volunteers who helped guests and provided LSST branded t-shirts and water bottles. These volunteers included a dozen docents from the Kitt Peak Visitor Center.

New NOAO and Kitt Peak 50th Anniversary Bookmarks