NOAO/NSO Newsletter

NATIONAL OPTICAL ASTRONOMY OBSERVATORY/NATIONAL SOLAR OBSERVATORY

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Science Highlights

Director's Office

NOAO Gemini Science Center

Observational Programs

Data Products Program

Cerro Tololo Inter-American Observatory

Kitt Peak National Observatory

National Solar Observatory

Public Affairs and Educational Outreach

focus on>>>

More than 200 people attended the NOAO town hall meeting on January 10 at the American Astronomical Society (AAS) meeting in Austin, TX. Topics of discussion included the newly released report of the Renewing Small Telescopes for Astronomical Research (ReSTAR) committee, the need to be vigilant in maintaining dark skies at Kitt Peak, possible new ways for NOAO to help train the next generation of astronomers, and what new observing opportunities may be available for the US community as a result of the changing status of the United Kingdom in the Gemini Observatory partnership. Updates on several of these topics can be found in this issue of the *NOAO/NSO Newsletter*.

In order to provide a mechanism for more timely communication between NOAO and our community, we have just inaugurated a new electronic newsletter, called *Currents*. See the article on page 10 for more details, or email *currents-list-on@noao.edu* to subscribe.

We welcome your feedback at *currents@noao.edu* on the NOAO town meeting and the NOAO exhibit booth at the AAS meeting, and on what we might offer at future meetings to assist you with your observing and data products needs, now and in the future.

The NOAO town hall meeting at the January 2008 Austin AAS meeting attracted a significant audience.

<u>Correction</u>
The affiliation listed for Don Garnett on page 16 of the December 2008 *Newsletter* was incorrect. We apologize for the error.

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On the Cover

Supernova remnant DEM L316 and its surroundings in the Large Magellanic Cloud are shown in this combination image from the Gemini South Multi-Object Spectrograph (GMOS) [inset] and the Magellanic Cloud Emission Line Survey (MCELS).

The peanut-shaped nebula appears to be a single object, but the latest research indicates that it is likely comprised of two distinct gas and dust clouds formed by different types of supernova explosions. The high abundance of iron in the small bubble indicates that it is the product of a Type-Ia supernova, triggered by the infall of matter from a star onto a white dwarf; the larger, less iron-rich bubble appears to be the result of a Type-II supernova triggered by the collapse of a massive star.

The MCELS team surveyed both the Large and Small Magellanic Clouds, the closest major galaxies to the Milky Way, using the University of Michigan's 0.9-meter Curtis Schmidt telescope at Cerro Tololo Inter-American Observatory near La Serena, Chile.

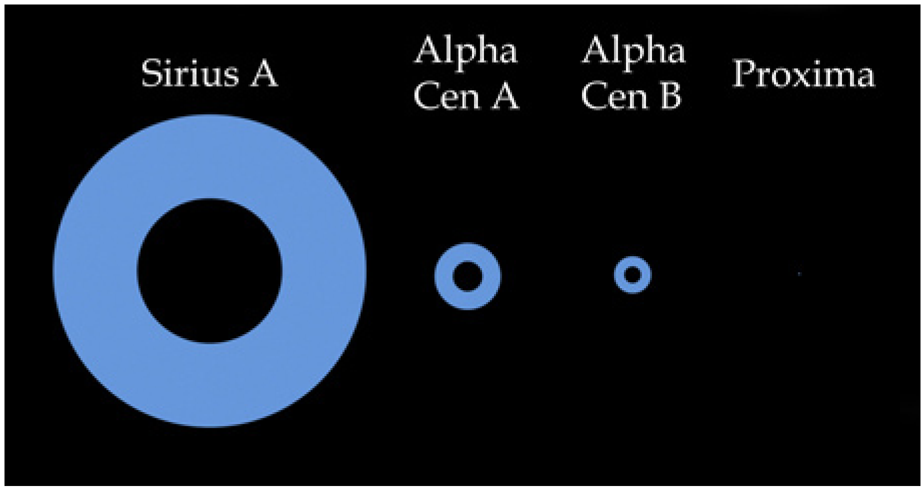
Gemini South image credit: Gemini Observatory/GMOS-South

MCELS image credit: S. Points, C. Smith, the MCELS Team, and NOAO/AURA/NSF

The Solar Neighborhood: Habitable Real Estate around Nearby Stars

Justin Cantrell & Todd Henry (Georgia State University)

Early astronomers looked to the Moon and saw a habitable world covered in vast oceans. Venus was once thought to be a swampy marshland enshrouded in clouds. Mars had grand canals built by advanced beings. Alas, none of these worlds has maintained their promise of rich life. Instead, the Solar System, once thought to be teeming with life, may be barren, although hope remains for environments under the icy crust of Europa, in the tiger stripes of Enceladus, under the Martian surface, or lurking somewhere as yet unidentified.



The relative sizes of traditional habitable zones are shown around four of the nearest stars. Sirius A is the brightest star in the night sky, while Alpha Centauri AB, and Proxima Centauri are three stars forming the nearest star system, which is a triple. At this scale, the habitable zone around the red dwarf Proxima is so small that it is only about the size of the period at the end of this sentence.

However, with the discovery of more than 200 extrasolar planets since 1995, the real estate market in our Solar System is no longer the only place we might look for evidence of life beyond Earth. Perhaps moons circling the gas giant planets found in stars' habitable zones could harbor life. Among the smaller and presumably solid-surfaced planets detected, only one world orbiting Gliese 581 may be in the habitable zone.

The term "habitable zone" (HZ) was first coined by Huang in 1959 as a region around a star where a planet could support life. Since then, there have been many definitions of habitability, most based on the presence of liquid water on the surface of a planet. The continuously habitable zone (CHZ) was introduced to put a temporal restraint on the habitability of a star.

To investigate the market in the solar neighborhood, we have determined the amount of habitable "real estate" for 62 stars nearer than 5 parsecs (pc). In defining our HZ requirements, we use an "Earth-like" model, assuming planets with atmospheres, radii, and albedos matching that of Earth. We define the HZ to be where liquid water is present at the present time (we do not include a continuously habitable zone). Following the work of Kasting et al. (1993), the inner boundary of our HZ is marked by the loss of water via photolysis and hydrogen escape, while the outer boundary of our HZ is set by the formation of CO_2 clouds that cool a planet's surface by increasing its albedo and lowering its convective lapse rate. The resulting inner and outer radii of the HZ correspond to temperatures of 285 K to 191 K, respectively. These values are based on empirical evidence that Venus has not had water for at least one billion years, and Mars may have been habitable around 3.8 billion years ago. These temperatures were chosen based on the effective temperature of an Earth-like planet that would lie just outside the orbit of Venus all the way out to the orbit of Mars. We then utilized the habitable zone equation from Kaltenegger et al. (2002) to find the inner and outer radii of the HZ for each star.

Similar to previous efforts, our first goal was to evaluate the HZ real estate for individual nearby stars, which is set by a combination of stellar temperatures and radii, and the distance of our Earth twin from a given star. We used photometric spectral energy distributions (SEDs) derived using available and new UBVRIJHK photometry from observations by the Research Consortium on Nearby Stars (RECONS) made at the CTIO 0.9-m and 1.5-m telescopes. For stars with radii measured via long-baseline interferometry, the radius was fixed and only the temperature was allowed to vary. We fit the photometry to GAIA models, which in most cases adequately address the significant offsets from blackbody emissions found in real stars, especially for the red dwarfs. In nearly every case, we were able to recover radii within 10% of the measured interferometric radii (when available), thereby allowing us to be confident that the derived temperatures and radii are reliable.

Our second goal is new—to compare the aggregate HZ real estate for each spectral type of star in the solar neighborhood. RECONS is in an ideal position to carry out this comparison, as our group uses the CTIO 0.9-m to measure trigonometric parallaxes for previously unknown nearby stars (Henry et al. 2006), and we keep track of the resulting nearby stellar census. Results indicate that although there is only one A spectral type and one F spectral type within 5 parsecs, their wide HZs provide significantly more real estate that is good for life than the more numerous but smaller parcels available around 44 M dwarfs. However, this calculation has been done using HZ areas, which is likely not the best measuring technique for HZs. Considering that planets are spaced logarithmically in

continued

The Solar Neighborhood continued

the solar systems found to date (i.e., planets cannot be found every 0.1 AU between the orbit of Venus and Mars in our Solar System, and two planets are not likely to be found in the same orbit), using HZ areas is likely less reliable than measuring real estate by linear AU. When doing so, the 44 M dwarfs en masse provide 3.3 linear AU of distance for habitable planets compared to 4.6 linear AU for A stars and 1.7 for G stars like the Sun.

We also are mapping out the HZ real estate in multiple star systems to see if a planet with two suns in its sky has a fair chance of remaining habitable. Good real estate was mapped out for a few noteworthy binaries at their most extreme moments—when a companion star was at perihelion to a planet in orbit around the star of interest. It turns out that for systems such as the G dwarf/K dwarf pair of Alpha Centauri AB and the double M dwarf of Gliese 65 AB, the shift in HZ inner and outer radii is less than 1%. Thus, habitable worlds could exist comfortably in many different types of stellar systems.

The table below lists the number of stars that were studied, by spectral type, within 5 pc. Shown are the number of stars per spectral type, the total habitable zone listed by area, and the linear Astronomical Units (AU) of habitable zone per spectral type. Taken together, these stars offer a vast 251 square AU of habitable real estate available for potential development by enterprising life-forms among our nearest neighbors. NL

Cumulative Habitable Zones for Stars within Five Parsecs

SpType	#Stars	HZ Areas (AU^2)	HZ Linear (AU)
A	1	177	4.6
F	1	49	2.4
G	2*	13	1.7
K	6	9	2.5
M	44	3	3.3

* Not including our Sun

Lyman-Alpha Emitting Galaxies at z = 3.1: Progenitors of Present-Day L* Galaxies

Eric Gawiser (Rutgers), Caryl Gronwall & Robin Ciardullo (Penn State), John Feldmeier (Youngstown State), & the MUSYC Collaboration

A multi-observatory, multi-wavelength study that began on the Blanco 4-m telescope at CTIO has produced the exciting result that Lyman-alpha emitting (LAE) galaxies at redshift 3.1 are the first high-redshift objects to be identified as the precursors of typical present-day galaxies.

Lyman-Alpha Emitters at z = 3.1

Our collaboration was forged after the NOAO Time Allocation Committee (TAC) pointed out that we were engaged in duplicate efforts to image the Extended Chandra Deep Field-South (ECDF-S) through a narrow-band filter of 5,000 Å. We then used a combination of US and Chilean observing time on the Mosaic II camera of the Blanco 4-m telescope at CTIO to obtain a deep (20-hour) exposure of the 31'×31' ECDF-S. Our narrow-band imaging was used to select a sample of 162 LAEs at z = 3.1 with emission line fluxes $>1.5\times10^{-17}$ ergs cm^{-2} s^{-1} and observed-frame equivalent widths >80 Å. We measured the continuum and emission-line luminosity functions and found that the LAEs have a median continuum magnitude of M_R = 27 and very blue continuum colors similar to those of Lyman-break galaxies (Gronwall et al. 2007, Gawiser et al. 2006b).

Archival Hubble Space Telescope images of the GOODS-South region taken with the Advanced Camera for Surveys show the LAEs to be small (0.5–2 kpc in half-light radii) with many showing clumpy structures. The best-fit Sersic profiles show a range from disk-like to bulge-like. In contrast to modern disks, the disk-like profiles are probably due to clumpy linear structures, in some cases, showing evidence of interaction or merging between multiple small galaxies (see figure 1).

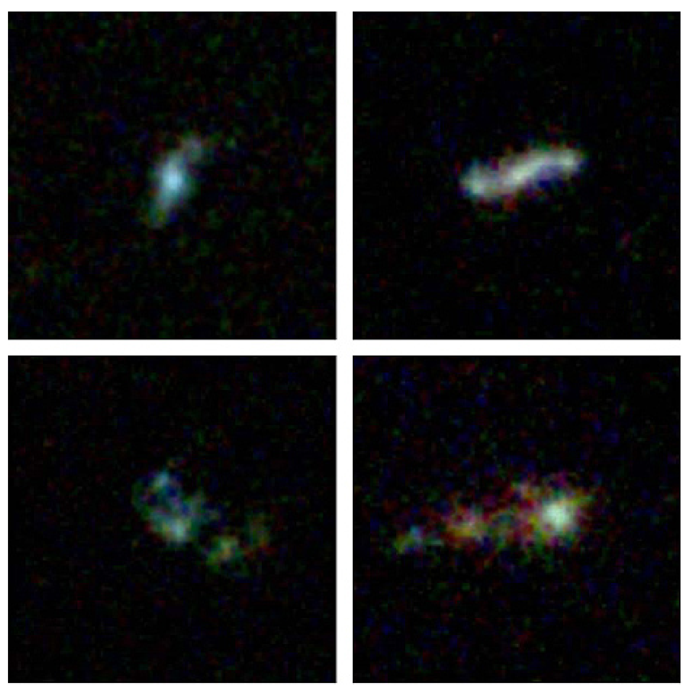


Figure 1: Lyman-alpha emitting galaxies 12 billion light years from Earth, as imaged by the Hubble Space Telescope's Advanced Camera for Surveys.
Credit: NASA, ESA, Caryl Gronwall/Penn State.

continued

Lyman-Alpha Emitting Galaxies continued

Spectroscopic follow-up determined precise redshifts for 60 of these objects at $3.08 < z < 3.13$ and showed no evidence for contamination from lower-redshift emission-line galaxies (Gawiser et al. 2007). Through a combination of NOAO-TSIP and Chilean time, we used the Inamori Magellan Areal Camera and Spectrograph (IMACS) on the Baade telescope at the Las Campanas Observatory at R ~ 1000 covering 4,000—9,000 Å. Each IMACS mask contained ~100 objects combining a range of MUSYC science projects and was observed for ~5 hours in order to reach a magnitude limit of $M_R \sim 23$ in the continuum.

Clustering Analysis

The LAEs exhibit a moderate spatial correlation length of 3.6 Mpc, corresponding to a bias factor of 1.7, meaning that their clustering is 1.7 times stronger than that of the underlying dark matter (Gawiser et al. 2007). This in turn implies a median dark matter halo mass close to 10^{10} $M_\odot$. It appears, however, that LAEs only occupy a few percent of the dark matter halos in this mass range, as their observed space density of 1.5×10^{-3} Mpc^{-3} is significantly less than the space density of dark matter halos in this mass range. The evolution of galaxy bias with redshift, as shown in figure 2, implies that LAEs at z = 3.1 evolve into present-day galaxies with L ~ L* (e.g., figure 3). Other z > 3 galaxy populations, including Lyman-break galaxies (LBGs), distant red galaxies, and active galactic nuclei (AGN) evolve into more massive galaxies (e.g., Francke et al. 2008, Quadri et al. 2007a).

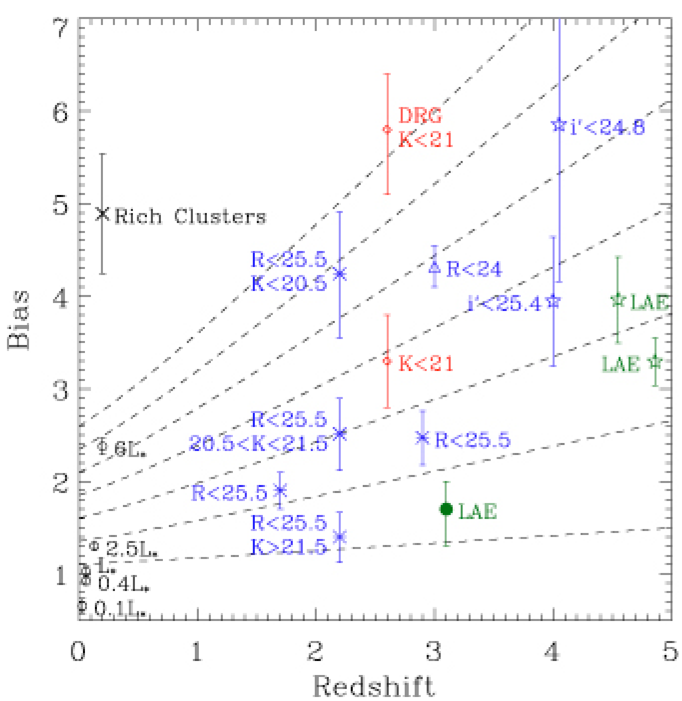


Figure 2: Tracks show the evolution of bias with redshift. The filled circle shows our result for the bias of LAEs at z = 3.1. Results from the literature are also shown for LAEs at z = 4.5 and z = 4.86 (stars); LBGs at z ~ 4 (stars); K-selected galaxies (diamonds); bright LBGs at z ~ 3 (triangle); and BM, BX, and LB galaxies (asterisks). Local galaxy clustering is shown for SDSS galaxies and for rich clusters. K-band limits are in Vega magnitudes. See Gawiser et al. 2007 for the original figure with complete references.

Star Formation Histories

Information at near-infrared (near-IR) wavelengths is very important as these bands trace the rest-frame optical light at high redshift. The 30'×30' ECDF-S field was covered up to a magnitude limit of K ~ 22 using the Infrared Sideport Imager (ISPI) on the CTIO Blanco 4-m telescope. This detector provides a field of view of 10.5'×10.5', one of the widest cameras available in the near-IR. Spitzer coverage includes a Cycle 2 Legacy Survey with IRAC (SIMPLE, PI van Dokkum) and MIPS 24-micron and 70-micron imaging from GTO observations (PI Riecke) and FIDEL (PI Dickinson).

Our rich, multi-wavelength data set has yielded significant advances in understanding the nature of LAEs. Only 30% of LAEs have sufficient stellar mass ($>3 \times 10^9$ $M_\odot$) to yield detections in deep IRAC images (Lai et al. 2008). Our two-population fit to the stacked spectral energy distribution of the IRAC-undetected LAEs found low stellar mass (~10^9 $M_\odot$), moderate star formation rates (~2 $M_\odot$/yr), a young component age of ~20 Myr, little dust ($A_V < 0.2$), and no evidence for a substantial AGN component (only 3/162 LAEs are detected in X-rays). The lack of ultra-high equivalent-widths in our z ~ 3 sample argues that the z ~ 3 LAEs do not represent primordial Pop III objects, even though they may be experiencing their first bursts of star formation.

The MUSYC Survey

MUSYC (the Multiwavelength Survey by Yale-Chile, PIs Gawiser and van Dokkum) is unique among the current generation of wide-deep surveys in having been optimized for the study of the high-redshift (z > 3) universe. This is achieved by imaging 1.2 square degrees spread over four fields (see figure 4) down to the spectroscopic limit for modern 8-m telescopes with coverage from U-band through K-band to trace both the Lyman and Balmer/4000Å breaks at z ~ 3 and prioritizing high-redshift candidates for spectroscopy.

Figure 3: Galaxy M74 (NGC 628) is representative of spiral galaxies that evolved from Lyman-alpha emitting galaxies in the early universe.
Credit: Todd Boroson/NOAO/AURA/NSF.

continued

Lyman-Alpha Emitting Galaxies continued

The 1.2-square-degree optical catalog contains 277,341 sources with a 50% completeness limit of M_R ~ 26.5. The fields were chosen to have the lowest possible Galactic reddening, HI column density, and dust emission at 100 microns. Additionally, these fields are accessible from Chile, making them a natural choice for follow-up studies with ALMA. The collaboration includes a total of 30 investigators from the US, Chile, and Europe plus six Ph. D. students. Detailed descriptions of the data reduction techniques are presented by Gawiser et al. (2006a), Quadri et al. (2007b), and Blanc et al. (2008). All data from this survey will be made public, with reduced images and catalogs already available from the narrow-band, broad-band optical and near-IR imaging. Instructions for download of the data and more information about the survey can be found at the Web page *www.astro.yale.edu/MUSYC*.

Figure 4: Optical images (UBR) of the four 30′×30′ fields in the MUSYC survey. Each field was imaged with the CTIO 4-m+Mosaic II, although these images of ECDF-S come from ESO 2.2-m+WFI.

Observation of Alfvén Waves in the Solar Corona

Steve Tomczyk, Scott McIntosh, & Phil Judge (High Altitude Observatory), Stephen Keil (National Solar Observatory), Tom Schad (NSO REU, Notre Dame, now a University of Arizona graduate student), Dan Seeley (NSO RET, Framingham High School), & Justin Edmondson (HAO REU, University of Michigan)

Why the solar corona reaches temperatures of millions of degrees while the solar surface (photosphere) is only a few thousand is a long-standing problem in solar physics. Hannes Alfvén first postulated the existence of oscillations of magnetized plasma in 1942. The Alfvén wave is an incompressible, transverse oscillation, which propagates along field lines, with magnetic tension as the restoring force. Alfvén waves were soon postulated as a possible source of the energy that heats the solar corona (Alfvén 1947, Osterbrock 1961).

To first order, Alfvén waves do not create detectable intensity fluctuations, and thus the imagers used for most coronal observations will not see them. Velocity fluctuations inferred from Doppler shifts of emission lines require spectrograph or narrow-band filtergraph measurements; most coronal work has been performed with spectrographs that cannot observe over a large enough field of view in a time that is sufficiently short compared to wave periods. Thus, in spite of their importance for coronal heating, definitive observations of Alfvén waves in the coronal plasma have been lacking.

The data used in this study were obtained with the Coronal Multi-channel Polarimeter (CoMP) attached to the Coronal One Shot (COS) coronagraph mounted on the Hilltop spar at Sacramento Peak. CoMP is a combination polarimeter and narrowband tunable filter, which can measure the complete polarization state of coronal emission lines in the near-infrared. Observations consisting of images of the corona between 1.05 and ≈1.35 solar radii (R_{Sun}) in the four Stokes parameters (*I, Q, U*, and *V*) at three wavelengths across the Fe XIII 1074.7 nm line (red wing, line center, and blue wing) were obtained every 29 seconds on 30 October 2005, between 14:15 UT and 23:33 UT. The spatial sampling was 4.5 arcsec per pixel. The Fe XIII 1074.7 nm line is formed at about 1.6 MK. After removing residual image motion between frames, we computed the velocity and intensity at line center by fitting Gaussians to the three wavelength points at each pixel. We also computed the degree of linear polarization (p) and the azimuthal direction of the magnetic field (ϕ) in the plane of the sky from:

$$p = \sqrt{Q^2 + U^2}/I, \quad \phi = 0.5\tan^{-1}(U/Q)$$

where ϕ has the well-known ambiguity of 180°, which does not affect our analysis, and a possible 90° ambiguity due to the van

continued

Observations of Alfvén Waves in the Quiet Solar Corona continued

Vleck effect (see, for example, Querfeld, Smartt 1984), which does not appear to have affected very many of our computed azimuths.

The first three panels in figure 1, show maps of mean intensity, velocity, and line width for the part of the corona that we have analyzed. This section of corona contained both active region loops and a coronal cavity. A movie of the velocity images reveals ubiquitous, quasi-periodic fluctuations with a root-mean-square amplitude of 0.3 km s^{-1}. Power spectral analysis of these velocity fluctuations results in a broad peak near five minutes. Phase analysis, performed by taking each pixel as a reference point and computing its cross-spectral with every other pixel in the surrounding area, showed that in regions of high coherence the phases had signatures of propagating waves with speeds of 1–3 Mm s^{-1}. Most of these waves were propagating outward and aligned well with the direction of the magnetic field.

To confirm this analysis, we performed a phase travel-time analysis (Jefferies, et al. 1994; Finsterle, et al. 2004; McIntosh, et al. 2004) to characterize the propagation characteristics of the wave modes. The data were Fourier filtered in time with a Gaussian filter with a central frequency of 3.5 mHz and a width (1/e folding) of 0.4 mHz. We then formed the cross-correlation map of the filtered time series at the current pixel with nearby pixels sufficient in number to capture all areas of high correlation. The cross-correlation function at each neighboring pixel is a Gabor wavelet that, when fitted, yields information about the group and phase travel times of the disturbance (Finsterle, et al. 2004).

We see from figure 2 (panel A) that the observed oscillations can have very long correlation lengths (the length of the oblong contour of high cross-correlation) and detectable widths. The "island" of high cross-correlation (CC > 0.5) also has a distinct direction that follows the apparent trajectory of the propagating wave as seen in the movie. Panel B of figure 3 shows the map of phase travel times in the neighboring pixels relative to the reference pixel; a negative travel time indicates the time taken for the disturbance to travel to the reference pixel and a positive travel time is the time taken from the reference pixel. By using the

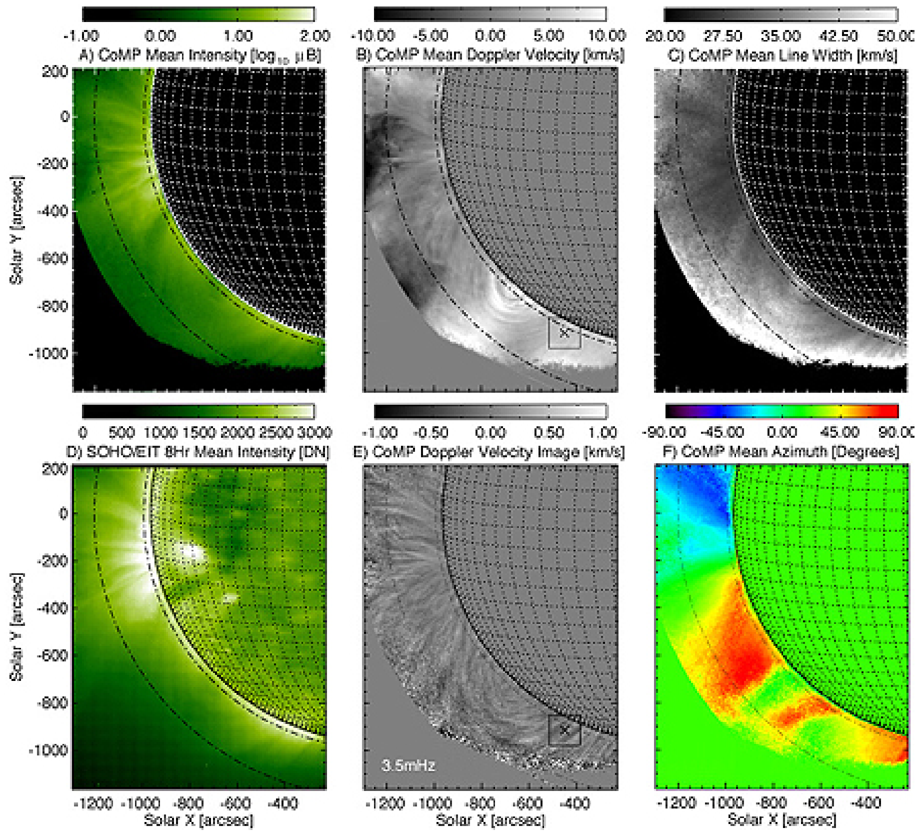


Figure 1: Context for images for the studied observations. From left to right, top to bottom, the CoMP observations of time-averaged intensity (A), Doppler velocity (B), line width (C), plane-of-sky azimuth (F), 3.5 mHz filtered Doppler velocity snapshot (E). In addition, we show the time-averaged SOHO/EIT 195.0 nm image over the same time (D). Each panel shows the location (X) and surrounding square region used for the example of travel-time analysis shown in figure 2. We also show the dot-dashed lines representing distances of 5% and 25% of the solar radius (above the limb) that are used as limits to our analysis.

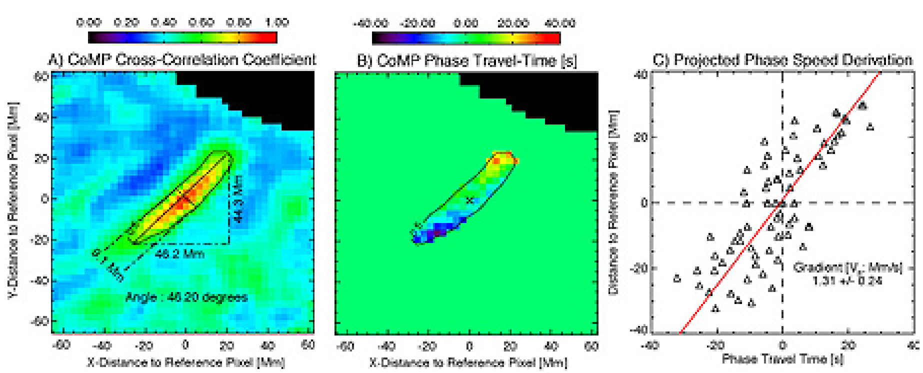


Figure 2: Travel-time analysis of CoMP Doppler velocity measurements for the region shown in figure 1. Panel A shows the map of cross-correlation coefficients in the square (25×25 pixels) region around (0″, 0″), the panels B and E of figure 1. The contour shown represents a level of 0.5 in the coherence of the time series and is used to isolate the properties of the oscillations detected. Panel B shows the map of computed phase travel times in the same region (the surrounding pixels are zeroed for clarity). Panel C demonstrates the scatter of phase travel time and distance to the reference pixel; the phase speed of the oscillation in this region is estimated from a least-squares fit.

continued

Observations of Alfvén Waves in the Quiet Solar Corona continued

island of high cross-correlation as a mask, we computed a correlation length of 45 Mm, a width of 9 Mm, a propagation trajectory of 46.2° (±4°), and a phase speed of 1.31 (±0.24) Mm s^{-1} at the reference pixel. This travel-time analysis was repeated successively at all pixels between 1.5 and 1.25 R_{Sun} (dot-dashed lines in figure 1) using each pixel as the reference pixel to extract wave properties at each point (figure 3). Since we also have the plane-of-the-sky azimuth of the coronal field, we can compare it with the direction of wave propagation (figure 4).

We believe that the waves we observe are Alfvén waves because: a) the observed phase speeds (≈2 Mm s^{-1}) are much larger than the sound speed (≈0.22 Mm s^{-1}), therefore, the waves are not slow MA mode waves; b) the spatio-temporal properties of the velocity oscillations and the linear polarization measurements show that these waves propagate along field lines, which would not be the case for fast MA mode waves in the corona; and c) the associated intensity fluctuations are very small. Ⓝ

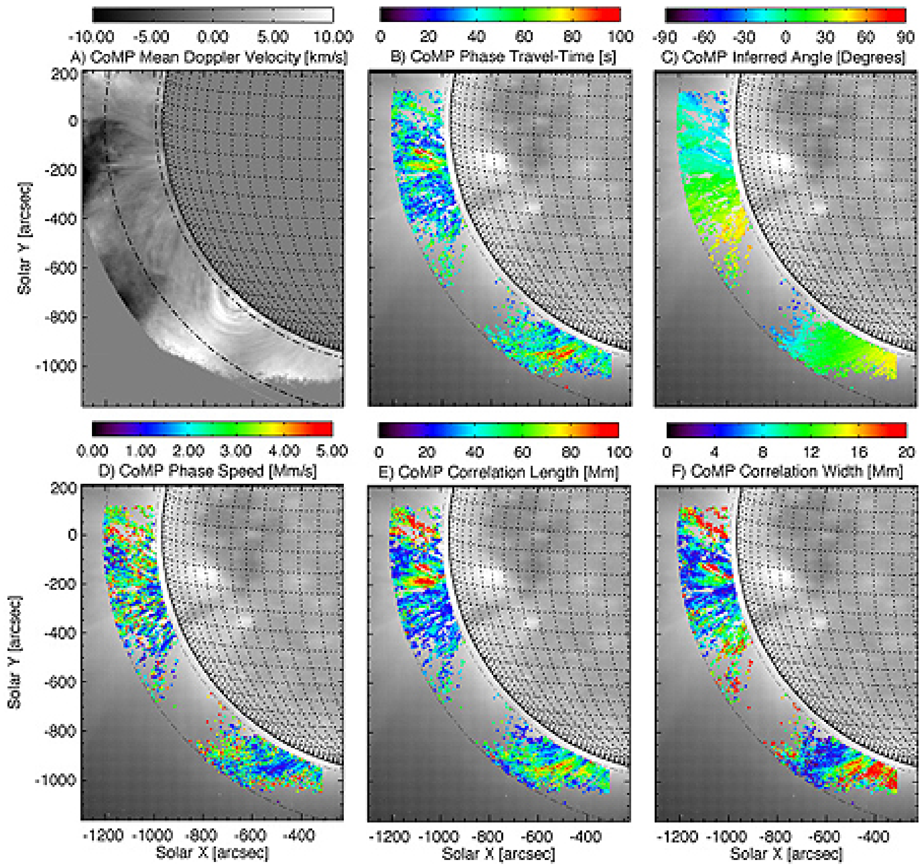


Figure 3: The results of the CoMP travel-time analysis for the 1.05–1.25 R_{Sun} range superimposed on the SOHO/EIT image shown in figure 1D. Panels B through F show the inferred wave travel time, propagation angle, phase speed, and correlation length and width, respectively. The points shown in each panel represent the analysis of pixels where we have >99% statistical confidence in the results and the signal-to-noise ratios of the observations are sufficiently high.

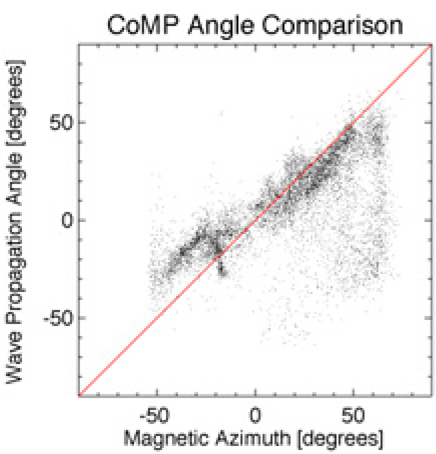


Figure 4: Comparison of measured field azimuth and the inferred wave propagation angle. The values on the abscissa are subject to a 90° ambiguity (van Vleck effect), a fundamental limitation of the information contained in the emission from magnetic dipole coronal lines, in the absence of knowledge of the "atomic alignment." The abscissa values plotted are those returned from a simple arctangent numerical function. Thus, for example, some of the points near 55˚can be justifiably placed at -55˚, and vice versa.

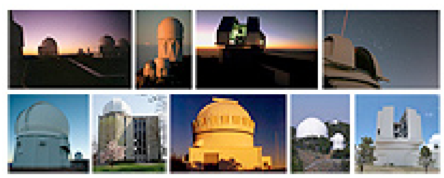
ReSTAR—An Exercise in Defining Community Needs

Todd Boroson

The NSF Senior Review report urged NOAO to ensure that community access to observing facilities remains scientifically balanced over all apertures, both in the present and in the future—into the era of Pan-STARRS, LSST, JWST, ALMA, GSMT, and the NVO. In response, NOAO formed the Renewing Small Telescopes for Astronomical Research (ReSTAR) committee and charged it with developing a prioritized, quantitative, science-justified list of capabilities appropriate to telescopes with apertures less than 6.5 meters, together with estimates of the number of observing nights needed. NOAO asked the committee to solicit input from the broad community to address the current needs and uses of such telescopes, and to attempt to predict how these needs will evolve over the next ten years. The ReSTAR committee concluded its work in December 2007 and issued its recommendations. The full report can be found on the NOAO Web site.

The committee was chaired by Caty Pilachowski (Indiana University), and it included members from a diverse set of institutions. However, the charge to the members was not to be representatives, but to use their contacts and experience to solicit input from as large a segment of the community as possible. The committee composed a Web-based survey and, through a variety of means, was able to elicit quite a large number of responses. Over 160 individuals wrote in, some adding input from other members of the group in which they worked. From this input, the committee was able to synthesize a blueprint of a system of facilities that they felt confident would satisfy most of those who considered themselves users (or potential users) of the ground-based optical/infrared (O/IR) system.

The report includes a fairly comprehensive overview of the kinds of science that can be done on small (<2 meters) and mid-size (2—6 meters) telescopes, categorized by discipline. Each set of problems includes a discussion of needed instrumental capabilities and needed operational capabilities. It is interesting to note that the uses of telescopes in this aperture range are not limited to the capabilities that we traditionally think of as being their strengths: wide-field imaging and multi-object spectroscopy, which are used for surveys to find samples for more detailed study later with larger telescopes. Instead, there is a broad set of interesting astronomical problems that can be solved through traditional types of observations on telescopes of this size, so long as they are equipped with modern, high-performance instruments. In addition, a significant fraction of the community sees the opening of the time domain as motivating the development of a global network of small and mid-size telescopes, operated to allow an array of follow-up observations at various cadences.



Of course, the findings of the ReSTAR study lead to a number of recommendations for various attributes of the system of facilities. A few of these that are particularly important for guiding NOAO's next steps follow (in my own paraphrasing):

- The number of nights needed on 2–4-meter telescopes for the broad community (no access restrictions) is the equivalent of about eight telescopes. Current availability is a bit less than half this number.

- The priority for improvements or enhancements should start with strengthening the infrastructure of the existing federal telescopes. Next, these telescopes should be equipped with modern, high-performance instruments. Then, new telescopes should be added to the system, either by incorporating non-federal telescopes by buying time or forming partnerships or building new telescopes.

- The instrumental capabilities that are the most highly desired are standard, "workhorse" capabilities, optical and near-IR imaging and spectroscopy at both medium and high resolution. These should be available on the telescopes to which the community has the most access.

- The non-federal telescopes can provide important complementary capabilities and can supply some of the additional access that is needed. These facilities should meet standards of usability that will guarantee successful community use.

- A new component of the system that will be needed in the future is a network of facilities able to carry out time-domain observations and follow-up on discoveries that come from LSST and other investigations that will open up the time domain.

If the ReSTAR report can be thought of as providing a blueprint, we now have to begin putting a program together to build this system (and we have to start by getting construction permits). NOAO will begin by submitting a white paper to the NSF that lays out the steps we would like to take over the next five years to begin to address the needs of the community that responded to ReSTAR. The infrastructure improvements are already in progress, but the program will include new instruments, new partnerships, and new telescopes. We think of this as a supplement to our core program (described in our proposal to renew our cooperative agreement). We will post this white paper for community discussion and comment as soon as we submit it to the NSF.

A final point to remember is that the ReSTAR discussion was limited to telescopes of less than 6.5 meters. The system needs to broaden its consideration—in terms of choices, such as what aperture telescope is best for certain capabilities, and in terms of how facilities of all sizes can work in complementary ways to answer scientific questions.

Therefore, NOAO will form a new committee—a large telescope version of ReSTAR—to solicit community input aimed at devising a similar blueprint for the large telescope piece of the system. Although this effort is in its early days, watch for announcements of chances to provide your ideas. Especially given the new opportunities within the Gemini partnership, I expect that this large telescope activity will have as much, if not more, influence as ReSTAR is having.

NOAO's New Program: The Process

Todd Boroson

The term of AURA's cooperative agreement to manage and operate NOAO is five years, and so every five years, we write a proposal to extend this agreement for the next term. The last time that there was a need for a new cooperative agreement, the NSF held a competition. This time, it was recommended by a management review, and accepted by the NSF, that this be a non-competed proposal. This decision turned out to be particularly fortuitous, because it came at a time when we were restructuring our program to be aligned with the recommendations of the Senior Review. Thus, we were able to discuss many of the ideas for the changing program with the NSF astronomy division (AST) staff, whose interpretation of the Senior Review report we are working to address.

Our cooperative agreement renewal proposal was submitted to the NSF 1 December 2007. With their permission, the NOAO section of the proposal is available through a link on our home page, or you can access it directly at *www.noao.edu/dir/ca/noao-coop-agreement.pdf*. I say "the NOAO section" because this is an AURA proposal to operate NOAO and NSO, and so we are only making public the part that describes the NOAO program in this new cooperative agreement period. If you read it, you will see many of the ideas that have been presented in the *NOAO/NSO Newsletter* over the last year, particularly the December 2007 edition, in which we tried to present a comprehensive overview of the NOAO section.

NSF/AST is now carrying out a review of the proposal. A committee has been formed, and they will be making site visits, starting with one to Tucson in late February. The new agreement is scheduled to start 1 April 2009 and run through 31 March 2014.

The New NOAO e-Newsletter: *Currents*

Joan Najita

NOAO now distributes an e-newsletter, *Currents*, which is intended as a sparkplug for communication between NOAO and our community. *Currents* provides updates—and solicits community input—on NOAO observing opportunities, and NOAO programs and policies, on a more rapid timescale than is possible with the quarterly *NOAO/NSO Newsletter*. The incentive for *Currents* comes from the NOAO cooperative agreement renewal proposal to the NSF, which describes the new five-year program for NOAO. The proposal, now available via a link on the NOAO home page (or directly at *www.noao.edu/dir/ca/noao-coop-agreement.pdf*), elaborates on the description of the new NOAO program that was given in the December 2007 *Newsletter* (*www.noao.edu/noao/noaonews/dec07/pdf/*).

In a nutshell, the renewal proposal reaffirms our mission of providing broad community access, based on peer review, to a complete and balanced System of state-of-the-art facilities, including telescopes of all apertures, and the data from these facilities. The proposal describes how NOAO is altering its program in order to better accomplish this mission. The proposal also describes the principles by which the System will evolve and the importance of maintaining an active dialogue with the community in setting the appropriate balance of capabilities. *Currents* is one of the mechanisms by which we aim to maintain that dialogue.

The First Issue
In the first issue of *Currents* (which was distributed in mid-February and is available at *www.noao.edu/currents)*, the *Program Update* ("ReSTAR and Beyond"), describes the recommendations of the Renewing Small Telescopes for Astronomical Research (ReSTAR) committee, which created a blueprint for developing a system of telescopes with apertures of 2–6 meters. A similar study focused on larger-aperture telescopes is on the horizon.

The *Gemini Update* ("The Gemini Opportunity") summarizes the recent news fluctuations regarding the Gemini partnership. It also raises the issue of how the Gemini partnership might evolve over the long term for the benefit of the US community.

The *Science Spotlight* ("Constraining the Cosmic Evolution of Type Ia Supernovae") illustrates how spectroscopy on a range of telescope apertures, from 1.5–10 meters, can be used to address an important problem at the frontier of astrophysics. In developing the System described in the cooperative agreement proposal, NOAO aims to make a similarly broad range of capabilities accessible to all astronomers in the community.

Contact Us
Is there a topic that you would like to see covered in a future *Currents*? If you are planning a regional astronomy meeting or department internal symposium, would you like someone from NOAO to give a presentation on our new program?

Please contact us at *currents@noao.edu*. We look forward to hearing from you! If you did not receive the first issue of *Currents* and would like to receive future issues, please send an email to *currents-list-on@noao.edu* to add yourself to the distribution list.

Gemini Observing Opportunities for Semester 2008B

Verne V. Smith

The NOAO Gemini Science Center (NGSC) encourages the US community to take advantage of Gemini observing opportunities for semester 2008B (1 August 2008–31 January 2009). US Gemini observing proposals are submitted to and evaluated by the NOAO Time Allocation Committee (TAC). As this article is prepared well before the release of the Call for Proposals (scheduled on or about February 16), the following list of instruments and capabilities are only our expectations of what will be offered in semester 2008B.

Please watch the NGSC Web page (*www.noao.edu/usgp*) for the formal Gemini Call for Proposals, which will list clearly and in detail the instruments and capabilities that will be offered, with a US proposal deadline of Monday, 31 March 2008.

NGSC anticipates the following instruments and modes on Gemini telescopes in 2008B:

Gemini North:

- Near-infrared Integral Field Spectrometer (NIFS)
- Near Infra-Red Imager (NIRI) and spectrograph with both imaging and grism spectroscopy modes
- Altair adaptive optics (AO) system in Natural Guide Star (NGS) mode, as well as in Laser Guide Star (LGS) mode. Altair can be used with NIRI imaging and spectroscopy and with NIFS integral-field unit (IFU) imaging and spectroscopy, as well as NIFS IFU spectral coronagraphy.
- Michelle, mid-infrared (7–26 microns) imager and spectrometer, which includes an imaging polarimetry mode
- Gemini Multi-Object Spectrograph (GMOS-North) and imager. Science modes are multi-object spectroscopy (MOS), long-slit spectroscopy, integral-field unit (IFU) spectroscopy and imaging. Nod-and-Shuffle mode is also available.
- All of the above instruments and modes are offered for both queue and classical observing. **It is important to note that classical runs are now offered to programs that are one night or longer and consist of integer nights.** The offer of one-night classical runs opens up the possibility of many more Gemini programs being eligible for classical observing, if the program PIs want to use this mode.
- More details on use of the Laser Guide Star (LGS) system can be found at *www.gemini.edu/sciops/instruments/altair/use-lgs*, but there are a few points that are emphasized here. Target elevations must be >40 degrees and proposers must request good weather conditions (Cloud Cover = 50% or better, and Image Quality = 70% or better, in the parlance of Gemini observing conditions). Proposals should specify "Laser Guide Star" in the Resources section of the Observing Proposal. Because of the need for good weather, LGS programs must be ranked in Bands 1 or 2 to be scheduled on the telescope.
- Time trades will allow community access to the high-resolution optical spectrograph, HIRES, on Keck, as well as to the Suprime-Cam wide-field imager and the infrared imager and spectrograph (MOIRCS) on Subaru

Gemini South:

- Thermal-Region Camera Spectrograph (T-ReCS) mid-infrared (8–26 microns) imager and spectrograph
- Gemini Multi-Object Spectrograph (GMOS-South) and imager. Science modes are multi-object spectroscopy (MOS), long-slit spectroscopy, integral-field unit (IFU) spectroscopy and imaging. Nod-and-Shuffle mode is also available.
- Phoenix, the NOAO high-resolution infrared spectrograph (1–5 microns) is available
- All modes for GMOS-South, T-ReCS, and Phoenix are offered for both queue and classical observing. **As with Gemini-North, classical runs are now offered to programs with a length of at least one or more integer nights.**

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

The percentage of telescope time devoted to science program observations in 2008A is expected to be greater than 85 percent at Gemini North and greater than 75 percent at Gemini South.

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

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

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

continued

Gemini Observing Opportunities for Semester 2008B continued

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

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

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

An Update on the Status of the UK within the Gemini Partnership and a Look to the Future

Todd Boroson & Verne V. Smith

The status of the United Kingdom as a member of the Gemini Observatory partnership has undergone a period of major uncertainty, beginning in November 2007 and continuing into mid-February 2008 (the time of the writing of this *Newsletter* update). The uncertainty began at the November 2007 meeting of the Gemini Board, where the Science and Technology Facilities Council (STFC) of the UK signaled its intent to withdraw from the Gemini partnership prior to the end of the current operating agreement, which expires on 31 December 2012.

This announcement initiated discussion between the STFC, the US National Science Foundation (which is the Executive Agency for Gemini), and the Gemini Board, culminating in a telecon meeting of the Board on 24 January 2008. The result of this Board meeting was that the UK was considered to have withdrawn from the Gemini partnership. The Board also instructed that all previously scheduled UK programs for semester 2008A be removed from the telescope schedule.

Further negotiations ensued between the STFC, Gemini Board, and the NSF. These negotiations led to an announcement on 11 February 2008 in which the NSF and the STFC agreed on terms for discussion of continued UK involvement in Gemini. This agreement of continued discussions led to the provisional reinstatement of UK programs on the telescopes for semester 2008A. The resolution states:

> *"Resolution 2008.Feb.09 The Board has received new correspondence from the STFC regarding the UK involvement in Gemini. The UK has committed to continue their Operations payments during 2008, and wishes to open negotiations with the Executive Agency and the Board to explore their options for continued participation in the Gemini Observatory.*
>
> *Therefore, the Board resolves to conditionally reinstate 2008A UK observing time allocations on both Gemini North and Gemini South.*
>
> *The Board asks that the Chair and Designated Members, including the UK, meet face-to-face at the earliest opportunity to further discussion of possible continued UK involvement in Gemini."*

It is expected that the issue of UK membership will be resolved before the 2008B proposal submission deadline (31 March 2008). Due to the time delay between writing this update and the March 1 mailing of the *NOAO/NSO Newsletter*, we urge the US community to check the NOAO Web site for the latest developments and, in particular, to read closely the 2008B NOAO Call for Proposals.

The Long-Term Partnership

The uncertainty in the future make-up of the Gemini partnership introduced by the membership issue with the UK draws attention to the fact that the composition of the Gemini partnership will quite likely be different in the time frame of the next operating agreement (beginning in 2013).

From the US perspective, we believe that it is in our community's interest to acquire as large a fraction as possible of the time that may become available due to partnership changes. Gemini time is highly oversubscribed (typically by a factor of 4–6 when calculated as nights requested divided by nights charged); we usually receive as many proposals for Gemini as for the Kitt Peak and Cerro Tololo telescopes combined; and, the community successfully turns Gemini observations into published papers. We also believe that a larger US share will result in a closer connection between Gemini and the US community, and this may affect future decisions about how to operate Gemini and what capabilities to provide. The current Gemini operating agreement expires at the end of 2012, so decisions that are made in the next couple of years will influence Gemini operations throughout the next decade.

These issues are significant ones, and, just as we have argued for the smaller telescopes, we believe that these issues are best considered in the context of the whole US system of ground-based optical/infrared facilities. It seems appropriate to convene a community discussion on exactly this point: What are the capabilities (instruments, observing modes, types of access, numbers of nights) that the community needs on the current generation of large telescopes, and how can Gemini and the non-federally-funded facilities best address these needs? This becomes the large-telescope version of the ReSTAR committee, and we are in the process of establishing this panel to solicit broad community input and to provide such a report by the end of 2008. Again, watch the NOAO Web site for the latest developments.

The Gemini-Subaru Time Exchange Program: Additional Observing Opportunities for the Gemini User Community

Verne V. Smith

The NOAO Gemini Science Center (NGSC) would like to remind US astronomers of the Gemini-Subaru time exchange program. This agreement exchanges classical observing time at Subaru for classical observing time at Gemini.

This program is currently in operation for semester 2008A and will continue for 2008B. The Subaru instruments currently available to the Gemini community are Suprime-Cam (wide-field optical imaging) and MOIRCS (near-infrared imaging and multi-object spectroscopy). In exchange, the Subaru community has access to both GMOS instruments (North and South) and NIFS. Joint proposals for Gemini time between the Japanese community and Gemini partners are permitted and encouraged. For more information on applying for time on Subaru through Gemini, see the Exchange Time section on the Call for Proposals Supporting Information Web page (*www.gemini.edu/sciops/ObsProcess/ObsProcCfP_background.html#Exchange_Time_*).

Keep an eye on both the Gemini Web site (*www.gemini.edu*) and the NGSC Web site (*www.noao.edu/usgp*) for current information about the Subaru exchange program. Semester 2008B proposals to NOAO will be due 31 March 2008, so US users interested in applying for Subaru time should keep this agreement in mind when planning their 2008B proposals. Questions about the Subaru exchange program can be directed to me (*vsmith@noao.edu*).

Classical Observing Available with Gemini Observatory

NOAO users should be aware that they can request classical observing programs with the Gemini telescopes. The only requirement is that such programs must be at least one night long. This option opens up the possibility of many Gemini programs being eligible for classical observing time if so desired by the Principal Investigator. Please note that classical proposals must request integer nights.

A second point to note is that classical proposers must specify both the observing conditions required to achieve the primary scientific goals of the program and an alternative set of poor-weather observations. During the classical run, if conditions are worse than those required by the main or alternate program, the time may be used for queue observations. In such an event, the classical time will not be rescheduled.

-Verne V. Smith

NGSC at the January 2008 AAS Meeting in Austin

Ken Hinkle & Sally Adams

The NOAO Gemini Science Center (NGSC) raffled off a $250 Amazon gift certificate at the January 2008 AAS meeting in Austin. Entry into the raffle required filling out an anonymous questionnaire that elicited feedback on observing with Gemini. There were over 200 entries into the lottery. At 2:00 pm on Friday, several of the NGSC staff randomized the lottery cards, and Nicole van der Bliek of NOAO South drew out the winning ticket. The ticket belonged to Matt Richter of the University of California, Davis.

NGSC greatly appreciates the time and effort that many of you spent in filling out the questionnaire. We were heartened to learn that 73 percent of the respondents were aware that NOAO is the gateway for the US astronomical community to the 8.1-meter International Gemini Observatory telescopes, especially since 46 percent of these respondents have never applied for Gemini telescope time. A more detailed discussion of the results gleaned from the questionnaires will be posted on the NGSC Web site in the near future and will be presented in a future *NOAO/NSO Newsletter* article. The raffle, along with other items such as updating our Web site (*www.noao.edu/usgp/*), was part of a continuing effort to inform the community of our role.

NGSC raffle winner Matt Richter at Gemini North during a very cold, snowy TEXES engineering run in February 2006.

Photos from the NOAO booth at the January 2008 AAS Meeting in Austin. Clockwise from lower-left corner: Bob Blum helping Douglas Richstone (University of Michigan) with his Phase II; Dara Norman helping Marcel Agüeros (Columbia University) with his Phase II; activity at the NOAO booth (NGSC is on the left and DPP at the far right); raffle frenzy; Verne Smith talking to David Ciardi (Caltech); Ken Hinkle helping Sean Brittain (Clemson University) with his Phase II; Dara Norman chatting with Ulysses Sofia (Whitman College); and in the center, Nicole van der Bliek draws the winning NGSC raffle ticket.

The Updated NGSC Web Site

Sally Adams

The NGSC Web site (*www.noao.edu/usgp/*) has been updated and rearranged with the goal of making it more user friendly. The new list of links is shown in the accompanying screen capture image, and several links are highlighted below.

What is NGSC? links to a page (*www.noao.edu/usgp/ngsc.html*) that contains information at a glance about who we are, what we do, recent news, support staff contact information, proposals, the Gemini HelpDesk, the Gemini Science Archive, publications (US Gemini and Gemini), and NGSC in the *NOAO/NSO Newsletter*. Articles in the newsletter are a primary vehicle by which much information about Gemini is communicated to the US community. If you click on "Recent Issues," you can easily scroll through the list of articles in each issue to find items of interest to you.

NGSC Instrument Pages links to a page (*www.noao.edu/usgp/instruments.html*) that lists current, retired, and next-generation Gemini instruments. The former are grouped as mid-infrared (mid-IR), near-IR, optical, and time-exchange instruments. Each Gemini instrument has links to the corresponding Gemini Web page, as well as any available US Gemini publications and NGSC brochures, posters, and newsletter articles.

US Publications links to a page (*www.noao.edu/usgp/usgp_publications.html*) that lists US Gemini publications by instrument. The page also contains a link to all papers based on Gemini Data, i.e., the Gemini Publications Web page. The "What is NGSC?" page has links to both of these pages, as well as to the general Gemini acknowledgment text and the specific Phoenix acknowledgment text.

NGSC Staff and Organization links to a page (*www.noao.edu/usgp/staff.html*) that lists the members of the US Gemini Science Advisory Committee, and US representatives to the Gemini Science Committee and the Gemini Board.

NGSC Meetings and Workshops links to a page (*www.noao.edu/usgp/calendar.html*) that lists recent meetings sponsored by NGSC and/or attended by NGSC staff.

Please take a minute to check out *www.noao.edu/usgp/* and send us your feedback (*sadams@noao.edu* or *usgemini@noao.edu*). We would appreciate your comments.

NGSC Instrumentation Program Update

Verne Smith & Mark Trueblood

The mission of the NGSC Instrumentation Program is to provide innovative and capable instrumentation for the two Gemini 8.1-meter telescopes in support of frontline science programs. This article gives an update on the progress made last quarter with Gemini instrumentation being developed under the oversight of the NGSC.

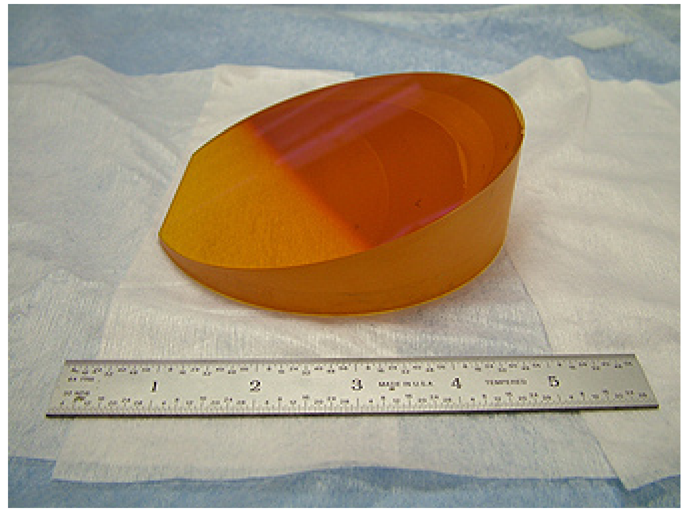
FLAMINGOS-2

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 held a quarterly review of the FLAMINGOS-2 instrument with the University of Florida team on January 30 at Gainesville. Shortly before this meeting, the Instrument Team reported progress in integration and testing of the instrument.

For the past few months, the Instrument Team has had problems in cooling the MOS Dewar. As each suspected cause was found and corrected, it was discovered not to have solved the problem, so the search for the culprit continued. Finally, the team was able to trace the cause to a thermal problem in the G10 ring that isolates the bench from the external ambient environment. By placing an additional thermal insulator between the end of the G10 ring and the bench, the thermal specification for the bench was achieved.

The figure shows the ZnSe prism for the R ~ 3000 grism that was delivered to the University of Florida two days before the January quarterly review. This completes the delivery of all optics for the instrument. This prism is a critical component of the grism, which will enable many of the exciting science programs that motivated the design of this instrument. It is now straightforward to complete fabrication of mounting hardware based on the as-built characteristics of the prism and to complete assembly of the air-spaced grism.



ZnSe prism to be used in the R ~ 3000 grism for FLAMINGOS-2. The ruler indicating the scale is labeled in inches.

Additional progress was made with cleaning up software and electronics issues, which should help in making the Pre-ship Acceptance Tests go smoothly. Due to the aforementioned MOS Dewar issues, these tests are expected to be delayed from late spring into summer.

As of January, the University of Florida team reports that 95 percent of the scheduled work for FLAMINGOS-2 final acceptance by Gemini has been completed.

2008B Observing Proposals Due 31 March 2008

Dave Bell

Standard proposals for NOAO-coordinated observing time for semester 2008B (August 2008–January 2009) are **due by Monday evening, 31 March 2008, midnight MST.** The facilities available this semester include the Gemini North and South telescopes, Cerro Tololo Inter-American Observatory (including SOAR), Kitt Peak National Observatory, and community-access time with Keck, Magellan, and MMT.

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

- **Web submissions**—The Web form may be used to complete and submit all proposals. The information provided on the Web form is formatted and submitted as a LaTeX file, including figures that are "attached" to the Web proposal as encapsulated PostScript files.
- **Email submissions**—As in previous semesters, a customized LaTeX file may be downloaded from the Web proposal form after certain required fields have been completed. "Essay" sections can then be edited locally and the proposal submitted by email. Please carefully follow the instructions in the LaTeX template for submitting proposals and figures.
- **Gemini's Phase-I Tool (PIT)**—Investigators proposing for Gemini time **only** may optionally use Gemini's tool, which runs on Solaris, RedHat Linux, and Windows platforms, and can be downloaded from *www.gemini.edu/sciops/P1help/p1Index.html*.

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

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

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

Community Access Time Available in 2008B with Keck, Magellan, and MMT

Dave Bell

As a result of awards made through the National Science Foundation's Telescope System Instrumentation Program (TSIP) and a similar earlier program, telescope time is available to the general astronomical community at the following facilities in 2008B:

- **Keck Telescopes**
  A total of 16 nights of classically-scheduled observing time will be available with the 10-meter telescopes at the W. M. Keck Observatory on Mauna Kea. This is a 100% increase over what has been offered in recent semesters. All facility instruments and modes are available, including the Interferometer. For the latest details, see *www.noao.edu/gateway/keck/*.

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

- **MMT Observatory**
  We currently expect up to 16 nights of classically-scheduled observing time to be available with the 6.5-meter telescope of the MMT Observatory. This would represent an increase of four nights over what has been available in the past. Previous requests have disproportionately used our allocation of dark and grey time, so bright-time proposals are particularly encouraged. For further information, see *www.noao.edu/gateway/mmt/*.

Community-access time at the Hobby-Eberly telescope is no longer available. A list of instruments we expect to be available in 2008B can be found at the end of this section. As always, investigators are encouraged to check the NOAO Web site for any last-minute changes before starting a proposal.

Two New NOAO Survey Programs

Tod R. Lauer

Two new NOAO survey programs have been initiated, with observations beginning in the first semester of 2008. Given the strong interest in the new near-infrared (NIR) survey capabilities offered by the advent of NEWFIRM, the recent call for NOAO survey proposals was especially competitive; 22 proposals were submitted in response to an announcement of opportunity for new survey programs.

NOAO surveys are observing proposals that require the generation of a large, coherent data set in order to address their scientific research goals. Surveys may run for up to three years and can receive larger blocks of time than are usually awarded in the standard, observing-time allocation process. In return for the large allocation of resources, the survey teams are required to deliver their reduced survey data products to the NOAO Science Archive for follow-on investigations by other interested astronomers.

A key part of the evaluation of the survey proposals is understanding the likelihood that interesting follow-on investigations can be done with the data products that will not be conducted as part of the survey team's primary scientific goals. Overall, the Survey Time Allocation Committee graded the proposals in three categories, with the final grades comprising a weighted sum of 50 percent for quality of the primary scientific goals, 25 percent for the archival-research value of the data products, and 25 percent for the credibility of the survey management plan.

The two new surveys selected are, "The NEWFIRM Medium-Band Survey: Accurate Redshifts for 40,000 K-Selected Galaxies," Principal Investigator (PI) Pieter van Dokkum (Yale University), and "A NEWFIRM Survey of the SDWFS/NDWFS Field," PI Anthony Gonzalez (University of Florida).

The van Dokkum et al. survey will use NEWFIRM at the Kitt Peak Mayall 4-meter telescope to obtain high-precision photometric redshifts of K-band selected galaxies in the COSMOS and AEGIS survey fields. The scientific goals are a broad census of the luminosity function, masses, colors, and spatial distribution of galaxies over roughly $1 < z < 4$. Since most of these galaxies are too faint to be observed with standard NIR spectroscopy, photometric redshifts are critical for determining their properties. A key part of the survey design is to use five medium-band filters to both enhance the redshift precision (in conjunction with the already available optical photometry) and greatly reduce the incidence of "catastrophic" redshift errors.

The Gonzalez et al. survey uses NEWFIRM at the Mayall 4-meter telescope to build on the deep optical and NIR photometry available from the NOAO Deep Wide-Field Survey and the mid-infrared observations obtained from the Spitzer Deep, Wide-Field Survey. Scientific goals include identifying the first generation of galaxy clusters, detecting primordial galaxies, probing the formation of the most massive galaxies, as well as searching for new examples of the Y-class of extremely cold brown dwarfs.

Observing Request Statistics for 2008A Standard Proposals

	No. of Requests	Nights Requested	Average Request	Nights Allocated	DD Nights (*)	Nights Previously Allocated	Nights Scheduled for New Programs	Over-subscription for New Programs
GEMINI								
GEM-N	156	190.69	1.22	58.44	0	0	58.44	3.26
GEM-S	73	106.67	1.46	51.06	0	0	51.06	2.09
CTIO								
CT-4m	49	161.7	3.3	109.5	4	0	109.5	1.48
SOAR	10	29.1	2.91	29	0	0	29	1.00
CT-1.5m	6	25.3	4.22	27.6	0	7	20.6	1.23
CT-1.3m	4	12.92	3.23	9.19	0	0	9.19	1.41
CT-1.0m	13	94	7.23	92	0	0	92	1.02
CT-0.9m	17	44.51	2.62	28.95	0	0	28.95	1.54
KPNO								
KP-4m	65	234.9	3.61	60	0	2	58	4.05
WIYN	32	107.8	3.37	54	3	0	54	2.00
KP-2.1m	20	108.9	5.45	97	0	0	97	1.12
KP-0.9m	6	27	4.5	12	0	0	12	2.25
Keck/HET/LCO/MMT								
Keck-I	19	27.6	1.45	6.5	0	0	6.5	4.25
Keck-II	22	26.5	1.2	3.5	0	0	3.5	7.57
HET	7	8.4	1.2	8.4	0	0	8.4	1.00
Magellan-I	2	4	2	2	0	0	2	2.00
Magellan-II	6	10	1.67	3	0	0	3	3.33
MMT	12	27	2.25	13	0	0	13	2.08

*Nights allocated by NOAO Director

CTIO Instruments Available for 2008B

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

Imaging	Detector	Scale ("/pixel)	Field
4-m BLANCO			
Mosaic II Imager	8K×8K CCD Mosaic	0.27	36'
ISPI IR Imager	HgCdTe (2K×2K 1.0–2.4mm)	0.30	10.25'
4-m SOAR[2]			
Optical Imager	E2V 4K×4K Mosaic	0.08	5.25'
OSIRIS IR Imaging Spectrograph	HgCdTe 1K×1K	0.33, 0.14	3.2', 1.3'
Goodman Spectrograph	Fairchild 4K×4K CCD	0.15	7.2' diameter
1.3-m [3,4]			
ANDICAM Optical/IR Camera	Fairchild 2K×2K CCD	0.17	5.8'
	HgCdTe 1K×1K IR	0.11	2.0'
1.0-m[5]			
Direct Imaging	Fairchild 4K×4K CCD	0.29	20'
0.9-m[6]			
Direct Imaging	SITe 2K×2K CCD	0.40	13.6'

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

[2] The amount of science time available on SOAR in 2008B will be at least 50%. The spectral resolutions and slit lengths for the OSIRIS imaging spectrograph correspond to its low-resolution, cross-dispersed, and high-resolution modes, respectively. In the cross-dispersed mode, one is able to obtain low-resolution spectra at JHK simultaneously. The Goodman spectrograph is expected to be available in single-slit mode. Imaging mode is also available, but only with U,B,V,R filters.

Please consult the NOAO Proposals Web pages for the latest information.

[3] Service observing only.

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

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

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

Gemini Instruments Expected to be Available for 2008B

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

GEMINI SOUTH	Detector	Spectral Range	Scale ("/pixel)	Field
Phoenix	512×1024 Aladdin Array	1–5µm R<70,000	0.085	14" slit length
GMOS-S	3x2048×4608 CCDs	0.36–1.0µm R~670–4400	0.072	5.5' 5" IFU
T-ReCS	320×240 Si:As IBC	8–26µm R~100, 1000	0.09	28" × 21"

*Please refer to the NOAO Proposal Web pages in March 2008 for confirmation of available instruments.

KPNO Instruments Available for 2008B

Spectroscopy	Detector	Resolution	Slit	Multi-object
Mayall 4-m				
R-C CCD Spectrograph	T2KB/LB1A/F3KB CCD	300–5000	5.4'	single/multi
MARS Spectrograph	LB CCD (1980×800)	300–1500	5.4'	single/multi
Echelle Spectrograph	T2KB/F3KB CCD	18000–65000	2.0'	
FLAMINGOS[1]	HgCdTe (2048×2048, 0.9–2.5µm)	1000–1900	10.3'	single/multi
IRMOS[2]	HgCdTe (1024×1024, 0.9–2.5µm)	300/1000/3000	3.4'	single/multi
WIYN 3.5-m[3]				
Hydra + Bench Spectrograph[9]	T2KA CCD	700–22000	NA	~85 fibers
SparsePak[4]	T2KA CCD	700–22000	IFU	~82 fibers
2.1-m[10]				
GoldCam CCD Spectrograph	F3KA CCD	300–4500	5.2'	
FLAMINGOS[1]	HgCdTe (2048×2048, 0.9–2.5µm)	1000–1900	20.0'	
Exoplanet Tracker (ET)[5]	CCD (4K×4K, 5000–5640 Å)	See Note [5]	Fiber (2.5")	

Imaging	Detector	Spectral Range	Scale ("/pixel)	Field
Mayall 4-m				
CCD Mosaic-1	8K×8K	3500–9700 Å	0.26	35.4'
NEWFIRM[6]	InSb (mosaic, 4–2048×2048)	1–2.3µm	0.40	28.0'
SQIID	InSb (4–2048×2048)	JHK	0.39	3.3'
FLAMINGOS [1]	HgCdTe (2048×2048)	JHK	0.32	10.3'
WIYN 3.5-m				
Mini-Mosaic[7]	4K×4K CCD	3300–9700 Å	0.14	9.3'
OPTIC[7]	4K×4K CCD	3500–11000 Å	0.14	9.3'
WHIRC[8]	VIRGO HgCdTe (2048×2048)	0.9–2.5µm	0.10	3.3'
2.1-m[10]				
CCD Imager[11 & 12]	T2KB CCD	3300–9700 Å	0.305	10.4'
SQIID	InSb (4–512×512)	JHK	0.68	5.8'
FLAMINGOS[1]	HgCdTe (2048×2048)	JHK	0.61	20.0'
WIYN 0.9-m				
CCD Mosaic-1	8K×8K	3500–9700 Å	0.43	59'

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

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

[3] A new Volume Phase Holographic (VPH) grating, 740 l/mm, is now available for use. Please contact Di Harmer for information.

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

[5] Exoplanet Tracker (ET) is an instrument provided by Dr. Jian Ge of the University of Florida and his colleagues. It enables very high precision measurements of radial velocities for suitably bright enough targets. Details regarding this instrument are available via our instrument Web pages. It is capable of providing Doppler precision of 4.4 m/s in 2 minutes for a V = 3.5 mag. G8V star.

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

[7] OPTIC Camera from U of Hawaii is anticipated to be available through an agreement with Dr. John Tonry of the University of Hawaii. This instrument may be assigned to those that request to use Mini-Mosaic if this substitution still meets proposed imaging needs and making such an assignment would further observatory support constraints. Fast-guiding mode of operation of OPTIC is now a supported mode for NOAO users of the instrument.

[8] WHIRC, built by Dr. Margaret Meixner (STScI) and collaborators, will be available for shared-risk use during 2008B. WHIRC is currently undergoing acceptance testing and commissioning with the WTTM module. Using WHIRC with the WTTM module is not likely to be available during 2008B, and those proposing to use the instrument should not depend on the availability of this mode. However, if commissioning is completed in time, we might offer this mode for use in late 2008B. Please watch *www.noao.edu/kpno/WHIRC_instrument.htm* for updates.

[9] The Bench Spectrograph is undergoing upgrades to a new CCD and a new spectrograph collimator. Proposers should assume existing capabilities for their proposals. Please watch *www.wiyn.org/instrument/bench_upgrade.html* for updates.

[10] Proposers should note that the 2.1-m will not be available for two weeks in September, during which time some major maintenance work will be performed.

[11] While T2KB is the default CCD for CFIM, use of F3KB may be justified for some applications and may be specifically requested; scale 0.19"/pix, 9.7'×3.2' field.

[12] If T2KB is unavailable, CFIM may be offered with T1KA (scale 0.305"/pix, 5.2' field) or with F3KB to best match proposal requirements. *www.noao.edu/kpno/ccdchar/ccdchar.html*

MMT Instruments Available for 2008B

	Detector	Spectral Range	Scale ("/pixel)	Field
BCHAN (spec, blue-channel)	Loral 3072 × 1024 CCD	0.32–0.8μm	0.30	150"
RCHAN (spec, red-channel)	Loral 1200 × 800 CCD	0.5–1.0μm	0.30	150"
MIRAC3 (mid-IR img, PI inst)	128 × 128 Si:As BIB array	2–25μm	0.14, 0.28	18.2, 36"
MegaCam (optical imager, PI)	36 2048×4608 CCDs	0.32–1.0μm	0.08	24'
Hectospec (300-fiber MOS, PI)	2 2048×4608 CCDs	0.38–1.1μm	R ~1K	60'
Hectochelle (240-fiber MOS, PI)	2 2048×4608 CCDs	0.38–1.1μm	R ~32K	60'
SPOL (img/spec polarimeter, PI)	Loral 1200 × 800 CCD	0.38–0.9μm	0.2	20"
ARIES (near-IR imager, PI)	1024×1024 HgCdTe	1.1–2.5μm	0.04, 0.02	20", 40"
SWIRC (wide n-IR imager, PI)	2048×2048 HAWAII-2	1.0–1.6μm	0.15	5'
CLIO (thermal-IR AO camera, PI)	320×256 InSb	H, K, L, M	0.05	16×13"

Magellan Instruments Available for 2008B

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
Magellan I (Baade)					
PANIC (IR imager)	1024×1024 Hawaii		1–2.5μm	0.125	2'
IMACS (img/lslit/mslit)	8192×8192 CCD	R~2100–28000	0.34–1.1μm	0.11, 0.2	15.5', 27.2'
MagIC (optical imager)	2048×2048 CCD		BVRI, u'g'r'i'z'	0.07	2.36'
Magellan II (Clay)					
LDSS3 (mslit spec/img)	4096×4096 CCD	R~200–1700	0.4–0.8 μm	0.19	8.25' circ.
MIKE (echelle)	2K×4K CCD	R~19000–65000	0.32–1.0μm	0.14	
MagE (echellette)	2K×2K E2V	R=4100	0.31–1.0μm	0.30	

Keck Instruments Available for 2008B

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
Keck 1					
HIRESb/r (optical echelle)	3× MM-LL 2K×4K	30k–80k	0.35–1.0μm	0.19	70" slit
NIRC (near-IR img/spec)	256 x 256 InSb	60–120	1–5μm	0.15	38"
LRIS (img/lslit/mslit)	Tek 2K×4K, 2xE2V 2K×4K	300–5000	0.31–1.0μm	0.22	6x8'
Keck 2					
ESI (optical echelle)	MIT-LL 2048 × 4096	1000–6000	0.39–1.1μm	0.15	2x8'
NIRSPEC (near-IR echelle)	1024 × 1024 InSb	2000, 25000	1–5μm	0.18 (slitcam)	46"
NIRSPAO (NIRSPEC w/AO)	1024 × 1024 InSb	2000, 25000	1–5μm	0.18 (slitcam)	46"
NIRC2 (near-IR AO img)	1024 × 1024 InSb	5000	1–5μm	.01–.04	10–40"
OSIRIS (near-IR AO img/spec)	2048 × 2048 HAWAII2	3900	0.9–2.5μm	0.02–0.1	0.32–6.4"
DEIMOS (img/lslit/mslit)	8192 × 8192 mosaic	1200–10000	0.41–1.1μm	0.12	16.7×5'

Interferometer

IF (See *msc.caltech.edu/software/KISupport/*)

LEGO Robotic Telescopes at the January 2008 AAS Meeting

Rob Seaman

NOAO's implementation of the VOEvent transient-alert messaging protocol from the National Virtual Observatory (NVO) was demonstrated at the Austin AAS meeting using robotic telescopes based on LEGO MINDSTORMS (*mindstorms.lego.com*) technology. Each of two interoperating telescopes was constructed of lightweight K'Nex girders driven by LEGO alta-azimuth servo motors. The second-generation MINDSTORMS NXT CPU is a 32-bit ARM microprocessor running LabVIEW. In addition to three servo ports and four sensor ports, the NXT communicates via USB 2.0 and wirelessly via Bluetooth.

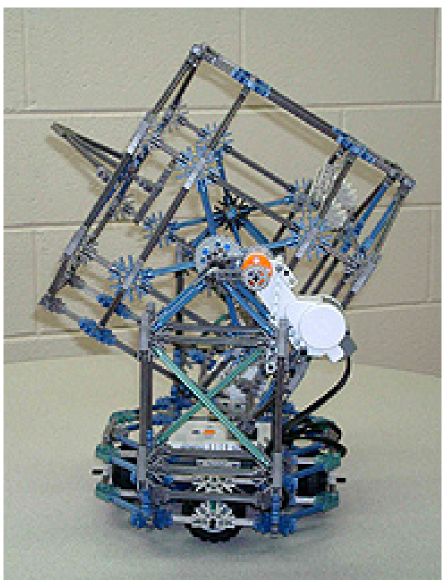


Figure 1: Model alt-azimuth telescope built from K'Nex and LEGO MINDSTORMS NXT components. Nylon bushings permit the two building systems to interoperate.

The original NXT telescope (figure 1) was developed for the workshop, "Hot-wiring the Transient Universe" (*www.cacr.caltech.edu/hotwired*), hosted by the NOAO Data Products Program in June 2007. We anticipate using these models for future tutorials and demonstrations of autonomous astronomy technologies such as VOEvent. Any demonstration of Virtual Observatory technology can be difficult precisely because, being vir-

continued

The LEGO telescopes, demonstrated by Rob Seaman (left), were a popular attraction at the NOAO exhibit booth during the January 2008 AAS meeting in Austin.

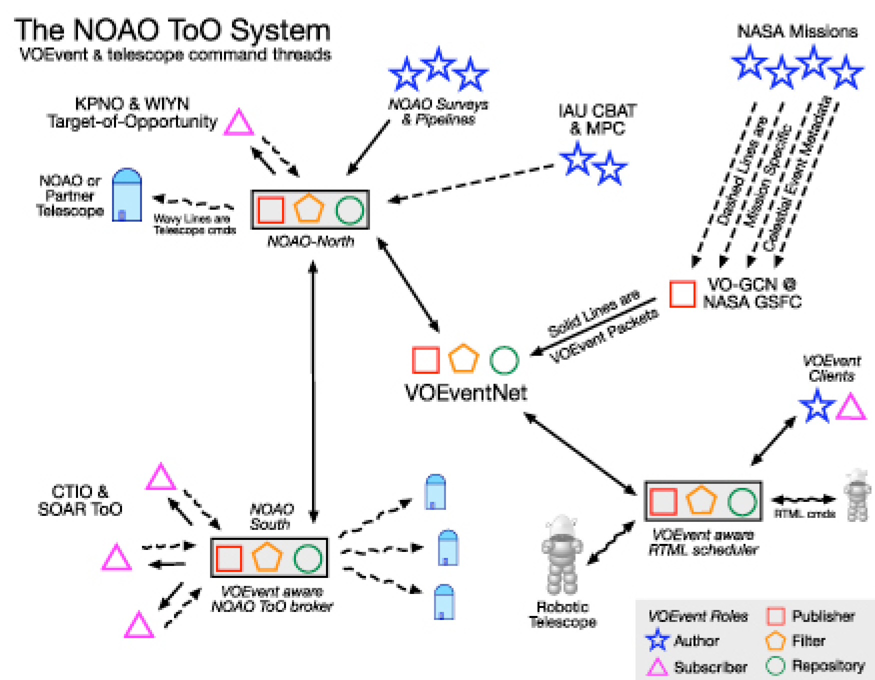


Figure 2: The NOAO Target-of-Opportunity observing system, layered on the VOEvent protocol of the National Virtual Observatory.

LEGO Robotic Telescopes at the AAS continued

tual, such a demonstration tends to be highly conceptual. Our experience with these LEGO models shows that physical models grab an audience's attention and generate discussions leading in many directions.

At the Data Products Program (DPP) area of the NOAO booth in Austin, the two telescopes were configured to play an astronomical version of the game "Simon Says." The telescope "Simon" would simulate the discovery of some transient celestial phenomenon such as a supernova or gamma-ray burst. A message describing the location and characteristics of the discovery was then passed wirelessly to the telescope "Theodore," which would slew to the same location, simulating a follow-up observation. In the real world, for instance in the US astronomical "System," the two telescopes would be connected through the VOEventNet (figure 2).

NOAO's interest in VOEvent is both to publish events such as supernovae from the ESSENCE survey program as well as to provide Target-of-Opportunity facilities to our observing community. Data from transient observations flow into the NOAO Science Archive (NSA). DPP is a major partner in the NVO, providing access through our Portal (*nvo.noao.edu*) and VO Client interfaces to NSA and community data holdings.

NATIONAL VIRTUAL OBSERVATORY

The Fourth National Virtual Observatory Summer School

Chris Miller

The National Virtual Observatory (NVO) will hold a nine-day, hands-on summer school for students to work alongside experienced NVO users and software specialists. The goal of this school is to help researchers discover, access, visualize, and analyze data from within a virtual observatory (VO) environment. The school will also have sessions on how to become a publisher of VO data and how to apply VO high-performance computing capabilities to your research needs.

Anyone interested in learning how to use the VO for astronomical research is encouraged to apply. Applications will be accepted after 15 April 2008. Please visit: *www.us-vo.org/summer-school/2008/*

Date and Location:

2008 NVO Summer School
3–11 September 2008
Santa Fe, NM

Howard Lanning
(1946–2007)
In memory of our valued and respected friend and colleague

Staff of the Data Products Program
National Optical Astronomy Observatory

Goodman Spectrograph Commissioning at SOAR

Sean Points (NOAO), J. Christopher Clemens, & Brad Barlow (University of North Carolina)

With the delivery of its new CCD camera, commissioning of the Goodman High Throughput Spectrograph is now proceeding apace. The new camera manufactured by Spectral Instruments contains a 4K × 4K Fairchild CCD to cover the 320–850 nm range with a pixel size of 15 microns/pixel.

The Goodman Spectrograph, built by J. Christopher Clemens (University of North Carolina, Chapel Hill) and collaborators, is an imaging, multi-object spectrograph for the SOAR 4.1-meter telescope. It employs all-transmissive optics and Volume Phase Holographic (VPH) gratings to achieve the highest-possible throughput for low-resolution spectroscopy over the specified wavelength range. In imaging mode the plate scale is 0.15 arcsec/pixel and the field of view is 7.2 arcmin in diameter. The initial complement of imaging filters includes U, B, V, and R on the Kron-Cousins system.

In spectroscopic mode, the Goodman Spectrograph will be able to obtain spectra of multiple objects simultaneously over a field of 3.0 × 5.0 arcmin using multi-slit masks. A carousel-style mask changer, holding up to 36 masks, will allow the slit plates to be accurately and reproducibly located at the instrument's entrance aperture. The instrument has been initially deployed with a complement of five fixed, long slits with widths of 0.45, 0.84, 1.03, 1.35, and 1.68 arcsec. These are each 5 arcmin long, but can be fitted with optional decker plates.

Since delivery of the new camera to Chile in September 2007, the spectrograph has undergone three short integration and testing runs in September, November, and December 2007, resulting in significant progress toward the commissioning of the instrument. The bulk of the software and computer integration with the telescope has been completed. The observing interface has been tested, and suggestions based on the commissioning tests are being integrated.

Three-color image of NGC 1300 taken with the Goodman Spectrograph in imaging mode during its November 2007 commissioning run.

Further commissioning tests of the Goodman Spectrograph are planned for the 2008A semester, with the anticipation that it will be available for community use in imaging and long-slit mode during the 2008B semester on a shared-risk basis.

Once these basic modes of operation have been commissioned, work will begin to enable multi-slit spectroscopy. The mask-cutting machine, to be shared with Gemini South, has already been installed and is under test in La Serena.

DES/DECam Status Report

Timothy Abbott

The Dark Energy Survey (DES) underwent two major external reviews during the past two months. The December review was under the auspices of the directors of NOAO, Kitt Peak National Observatory (KNPO), and Cerro Tololo Inter-American Observatory (CTIO); Fermilab; and the National Center for Supercomputing Applications (NCSA). The January review was conducted by the Department of Energy (DOE) Office of Project Assessment, within the Office of Science, at the request of Dennis Kovar, the acting head of the DOE Office of High Energy Physics, and Wayne Van Citters, the head of the NSF Division of Astronomical Sciences.

The Directors' review generated a number of healthy recommendations that are being implemented. The closeout presentations from the joint NSF/DOE review were most encouraging, because they recommended that DOE pursue Critical Decisions 2 and 3a. The former establishes the baselines for technical performance, cost, and schedule. The latter will allow the DOE Office of High Energy Physics to release the already-appropriated FY 2008 funds for long-lead procurements for the instrument construction. These recommendations will be in the report that will be submitted to Dennis Kovar and Wayne Van Citters.

The Blanco 4-meter telescope at Cerro Tololo which will host DECam.
Credit: T. Abbott

Progress on the Dark Energy Camera (DECam) has been solid on all fronts. All five camera lens blanks appear to be of exceptional quality and have been brought to within 1 millimeter of their final figure. They are currently in storage awaiting the award of a contract to the selected figuring vendor. Parts of the prototype cryogenic system have been purchased, and this system will be assembled and tested at Fermilab. Charge-coupled device (CCD) production continues apace, and Fermilab has quickly developed considerable expertise in their characterization and test. Simultaneously, the front-end electronics team has developed and refined a higher-density version of MONSOON to drive the 70 CCDs in the imager focal plane, while the opto-mechanical design is rapidly converging. The data management team centered at NCSA is meeting their data challenges with aplomb. CTIO is on-track with development of a new telescope control system for the Blanco 4-meter telescope and establishment of a procedure for repair of the primary radial-support system based on a complete understanding of the intrinsic causes of the problem.

The DES will hold a collaboration meeting in La Serena in April, during which the various groups will come together to further discuss the scientific goals of the project. Two technical workshops will be held that same week: one on integration, installation, and commissioning of the instrument; and the other on the front-end electronics.

First light for the completed instrument is anticipated to be acquired in semester 2011A. A document defining the NOAO community science needs for DECam may be found on the CTIO home page *www.ctio.noao.edu/* (or at *www.ctio.noao.edu/diroff/DECam_Community_Use_v2-3.pdf*). See the CTIO section of the September 2007 *NOAO/NSO Newsletter* for further discussion of this topic.

The Ongoing Renewal of KPNO

Buell Jannuzi

As we get ready to enter the 50th year of the Kitt Peak National Observatory (KPNO), we are continuing our efforts to renew our relationships with the communities we rely on for support, and to modernize and augment the facilities we provide for research and education. We are renewing our staff through new hires and additional training (see companion story). We are working to modernize our infrastructure, telescopes, and instruments. The observatory will be well-positioned to continue as a key component of the system of capabilities that NOAO provides to the community (see related story in the Director's Office section).

KPNO is situated on Kitt Peak in the Schuk Toak District of the Tohono O'odham Nation. The mountain, known as Iolkam Duag or Ioligam Doag to the O'odham, is part of a range of mountains that are sacred to them and an important part of the Tohono O'odham cultural heritage.

Tohono O'odham Nation Chairman Ned Norris, Jr., Schuk Toak District Chairwoman Phyllis Juan, and representatives of the Councils of the District and Nation visit the WIYN 3.5-meter telescope during their tour of Kitt Peak National Observatory 3 December 2007. Credit: J. Glaspey

Over the past year, KPNO and the NOAO educational outreach office have worked with various groups of the Tohono O'odham community to develop further educational programs with the students and teachers of the schools serving the Nation's children and adults. Many of these programs take advantage of the observatory's telescopes to share the wonders of the night sky with the people of the Tohono O'odham Nation. In December, we hosted a tour of the observatory for representatives of the District and the Nation's executive and legislative governments so that they could learn more about the programs that we make available to the people of the Nation and the operations of the observatory, including the telescopes of the National Solar Observatory. In February, we attended the Schuk Toak District Council meeting to review our existing programs with the O'odham and begin the process of developing new collaborations that will address common goals, including improved science education of the Nation's youth. We will continue to work with the Tohono O'odham Nation, the host of our astronomical research and educational activities.

The Kitt Peak All Sky Camera (KASCA) has been installed on the roof of the administration building and will be going into operation in late February.

The long-term potential of our observatory also depends on the continued support of the local governments of Arizona to help protect the dark skies that helped attract the many observatories that now operate in Arizona (which represent a total investment of more than $1 billion in infrastructure, see the related story regarding a new study of astronomy's economic impact on Arizona). Recently we have had several productive meetings with representatives of Pima County to investigate how the existing, strong Outdoor Lighting Code (which is shared by the City of Tucson) might be modified to make it easier for all to support and follow as the technologies that need to be regulated evolve. We have received very constructive suggestions and support from County Supervisor Sharon Bronson and county staff in the Sustainability and Development offices. In the months ahead, we will be holding similar meetings with representatives of governments to the north and south of Pima County, whose outdoor lighting codes are also critical to the preservation of the dark skies the observatory currently enjoys.

We continue to make progress on renewing the telescopes and observatory infrastructure. Some new computers have been installed at the Mayall 4-meter telescope, in part to support the arrival of the newly commissioned wide-field, near infrared imager NEWFIRM, by improving the system that coordinates the communication between all

continued

The Ongoing Renewal of KPNO continued

the instruments and the telescopes. A new Kitt Peak All-Sky Camera (see photo) has been mounted on the administrative building on Kitt Peak and will be providing images via the Web by the publication date of this *NOAO/NSO Newsletter*. A differential image-motion monitor (DIMM) identical to one installed at our sister observatory in Chile, Cerro Tololo Inter-American Observatory, has been assembled and will be deployed on the mountain during the next two months. This will allow improved monitoring of the site characteristics for comparison to the delivered image quality at each of our telescopes.
A new clean-room facility suitable for the changing of filters in NEWFIRM, which will avoid the need to take the instrument to Tucson just to change filters, has been designed and is being purchased. Progress on additional projects will be provided in future *Newsletter* articles.

While we prepare for the future, we are also preparing to celebrate the past 50 years of your national observatory. On 1 March 1958, Kitt Peak was selected as the site for the national observatory, and on 15 March 1960, Kitt Peak National Observatory was dedicated. Historically we have celebrated our anniversary using 1958 as our founding year, but for this 50th anniversary, we will continue celebrations through 2010, the 50th anniversary of our dedication. The extended timeline allows us to hold a series of events to include all the diverse groups that have been critical to the successes of the national observatory.

We are already discussing the topic with the Tohono O'odham Nation and our own staff to obtain their ideas about how we should celebrate the anniversary of the national observatory and the landmark concept that it be open to all astronomers based on the merit of their scientific proposals. We are also eager for your suggestions. Please send your suggestions to the chair of the KPNO 50th Anniversary Steering Committee, Elizabeth Alvarez (*ealvarez@noao.edu*), and watch the NOAO Web site and *NOAO/NSO Newsletter* for updates in the months ahead.

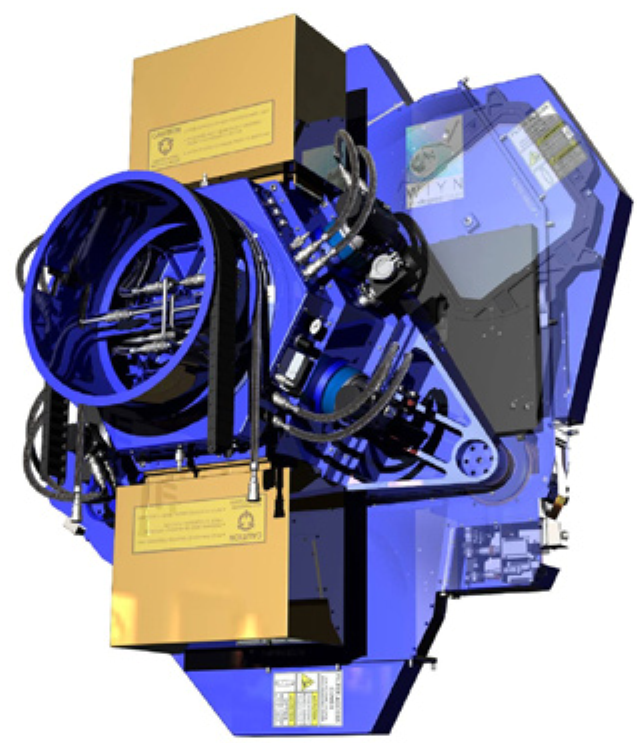
Gary Muller Wins Design Contest Grand Prize—Again!

John Cavin (WIYN/University of Wisconsin)

WIYN Senior Mechanical Engineer Gary Muller won the Grand Prize in the SolidWorks Design Contest 2007 for the mechanical design of the WIYN One-Degree Imager (ODI). Gary had previously won the contest in 2001 for the design of the Gemini Near-Infrared Spectrograph (GNIRS). The announcement was made in January before an audience of 4,700 participants at the SolidWorks World 2008 conference. The press release may be viewed at *www.pr-inside.com/powerful-observatory-camera-model-wins-r401747.htm*.

The ODI design consists of approximately 500 individual drawings and 17,000 parts. The completed ODI camera will be approximately 7.5 feet high and will weigh approximately 2,500 pounds. ODI consists of a forward corrector, Atmospheric Dispersion Compensators, a nine-position filter mechanism, a shutter, a Dewar assembly, and the controller electronics (see figure). The Dewar assembly houses a 16-inch square silicon carbide plate that mounts the 64 Orthogonal Transfer CCDs (OTCCDs) that make up the one-Gigapixel focal plane. The Dewar also provides vacuum and cooling for the OTCCDs to -110 ±1°C.

Gary used SolidWorks to document the entire design and is using the tools available in the NOAO machine shop to transfer the design electronically to the computer-controlled machines for fabrication. We congratulate Gary on another excellent instrument design and his international recognition as one of the nation's top mechanical engineers.



Rendering of the WIYN ODI designed by Gary Muller.

KPNO Staff Changes

Buell Jannuzi

During the past year, we have been hiring new staff at Kitt Peak National Observatory and our downtown facilities for two reasons. The first is to cover positions of staff members who retired or moved on to new positions. The second is to expand our workforce to be able to undertake the modernization projects recommended by the NSF's Senior Review report and proposed in the five-year AURA renewal proposal submitted to the NSF. Here are some of our recent hires.

We welcome Karen Ray and Mario Lanning to the staff of the Central Facilities Office (CFO). As a secretary, Karen covers the position held by Susan Davidson, who retired after nearly thirty years of outstanding service to NOAO. Visitors will notice that Karen's many duties include supporting observers and docents who go to Kitt Peak by issuing General Services Administration (GSA) licenses and shuttle vehicle keys. As an information systems technician, Mario supports CFO and Kitt Peak with computer support and Web design, general installation and oversight of the energy and access control systems equipment, wiring and minor programming of low-voltage systems, and support to the video conferencing and PBX systems.

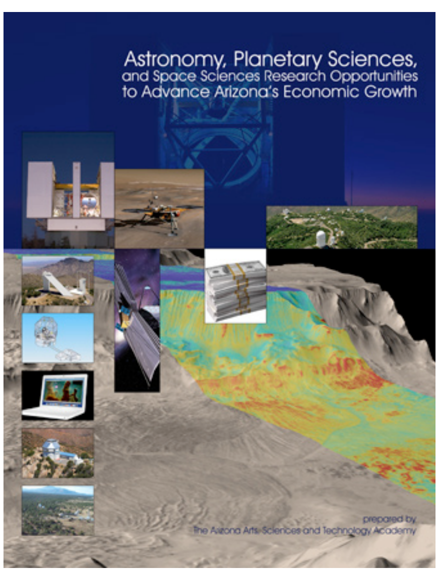
William (Bill) Ball joined our outstanding Electronic Maintenance team as a technician associate supporting the mountain instruments and telescopes. Bill spent two years in private industry following nine years at NOAO, where he worked with Al Fowler in the Infrared (IR) Research and Development Lab during the ALADDIN and Orion InSb detector development projects. Well-versed in cryogenic operations and IR-array controllers, Bill brings expertise matched to both existing and planned instrumentation.

Observing Assistants (OAs) Ed Eastburn and Hillary Mathis recently left KPNO for new positions with Pima County and the WIYN Observatory 0.9-meter telescope, respectively. We appreciate the excellent service they provided to the observatory. We have been fortunate to cover those positions with two new OAs who joined the staff in February. David Summers was an OA at KPNO from 1992–1995 and has operated facilities in New Mexico. Kristin Reetz has prior astronomy experience at Lowell Observatory.

We are pleased to announce that Alonzo Yeppa moved from our mountain facilities crew, where he worked as a custodian, to a new position as an observing support technician. Alonzo is working with Skip Andree and Bill Binkert to learn how to operate our telescopes, change the instruments, and generally support our observing operations.

Finally, we welcome Michael Kindschi, who joined Kitt Peak Engineering as a mechanical designer. Michael is assisting in both our continuing maintenance efforts and our modernization projects.

New Study Scopes Out Annual Impact of Astronomy and Space Sciences on Arizona



A new study of the economic impact of astronomy, space science, and planetary science on the state of Arizona found an annual impact of $252.8 million, about equal to the once-per-decade influx from professional football's recent Super Bowl held in Phoenix. The sector employs 1,830 people in Arizona, with secondary employment that produces a total of 3,300 jobs. The cumulative investment in facilities, land, and instruments was found to be $1.19 billion, with another $635.7 million planned or underway.

The study, which included significant input and support by NOAO and NSO, was conducted for the Arizona Arts, Sciences and Technology Academy (AASTA) by the University of Arizona's Eller College of Management. The study project oversight committee was chaired by AASTA member Robert Millis, director of Lowell Observatory, with vice-chairs Michael Drake (University of Arizona) and Ronald Greeley (Arizona State University). Articles and editorials related to the report—including its recommendation for actions related to preserving the state's dark skies—have appeared in a variety of media outlets, including the Arizona Republic and Arizona Daily Star newspapers.

The report and related materials can be found at *www.aasta.net/*.

From the Director's Office

Steve Keil

The NSO 2008 Program Plan is now available on the NSO Web site at *www.nso.edu/general/docs/*. Highlights include preparations for a final baseline review of the Advanced Technology Solar Telescope (ATST) in anticipation of a construction start in 2009. The concentration of this review is on defining work packets that will support requests for proposals for major sub-systems (e.g., primary mirror, telescope structure, enclosure) and completion of the Environmental Impact Statement.

Major elements of the program at Sunspot are instrumentation for the Dunn Solar Telescope (DST), critical hardware replacement, and storage-area network upgrades required to meet the increased data rates generated by instruments such as the Arcetri Interferometric Bidimensional Imaging Spectrometer (IBIS) and the Queens University, Belfast, Rapid Oscillation in the Solar Atmosphere (ROSA) cameras. In Tucson, the focus is on completing the Synoptic Optical Long-term Investigations of the Sun (SOLIS) instrumentation and data analysis pipeline, and data acquisition with the NSO Array Camera in the region of 1–5 microns at the McMath-Pierce telescope, as well as improved guiding and upgrading of the Adaptive Optics (AO) system. The NSO GONG++ staff will continue the development of new magnetic and helioseismology products and now are using their data handling experience to help with the SOLIS data pipeline.

In addition to its traditional uses for probing the secrets of the Sun's interior, the GONG high-resolution upgrade, GONG++, has added several new features to this very productive network. These include maps to probe the inhomogeneous and intermittent structure below the surface. These maps are serving as guidance for modelers of magneto-convection, an early warning of active region formation, and helping us understand the connectivity between the deep layers where magnetic field is generated and the atmospheric layers where the field dominates the solar plasma.

Another new GONG product is one-minute cadence line-of-sight magnetograms and intensity images in the 6768 Å Ni line. These magnetograms are obtained every minute around the clock and provide a unique and unprecedented record of the solar magnetic field. They are providing support for STEREO and are being used to generate source-surface extrapolations of the magnetic field in the corona. Finally, GONG is now providing active region maps of the farside of the Sun.

As many of you are aware, the NSF Senior Review recommended that NSO seek to obtain the majority of the network operating funds from external (non-NSF) sources, otherwise they recommended that the network be closed one year after the Solar Dynamics Observatory (SDO) begins returning helioseismology data; SDO is currently scheduled for launch in January 2009. For those who have not seen GONG products recently, please visit our Web site at *gong.nso.edu*. We seek your help in identifying potential funding partners.

As ATST advances through the approval process for a construction start, NSO is considering how it will handle the data stream that the ATST will generate. Questions such as the level at which the data should be stored—raw, partially processed (e.g., flat fielded and polarization calibrated), or fully processed (e.g., intensity, velocity, magnetic-field maps)—are being discussed. Data will be stored as part of the NSO digital library and made available to the Virtual Solar Observatory.

NSO plans to make all ATST data open. Thus, another important issue is the length of time Principal Investigator (PI) and thesis data should be proprietary. Note that we are considering several modes of operation: queue observing, in which a proposal accepted by the Telescope Allocation Committee is conducted at a time when the conditions are optimal for the science; campaign modes in conjunction with other ground and space assets; and a PI mode, in which the scientist comes to the telescope for specialized observations. Your inputs on any aspects of data handling are welcome.

NSO/Sacramento Peak will host three visitors this spring. Gianna Cauzzi and Kevin Reardon from the Arcetri Observatory in Florence, Italy, will be here for approximately six months beginning in February along with their two children. They will be working and consulting with the staff on IBIS data. In addition, they will participate in ATST planning and discuss possible contributions from Italy. Kevin will also be working on ATST data handling. Rob Rutten, now emeritus from the University of Utrecht in the Netherlands, will arrive in late February accompanied by his wife Rietje. Rob will be working on a book as well as participating in IBIS data analysis. We extend our welcome and hope all have a productive stay at the Peak.

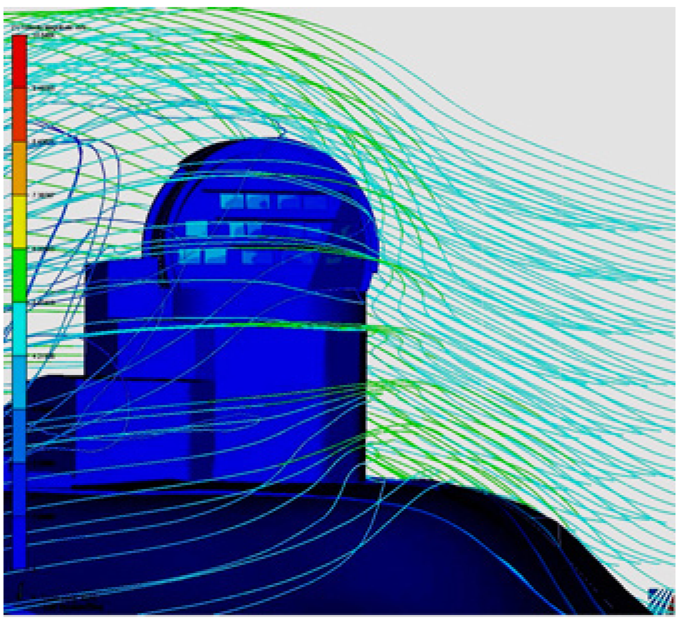
NSO is also pleased to welcome John Britanik, who will be helping to develop instrument control software and data processing algorithms for advanced solar instrumentation projects at the McMath-Pierce facility on Kitt Peak. John comes to us from Sandia National Laboratories, where he was a principal member of the technical staff. Prior to their move to Albuquerque in 2001, Tucson was home to John and his wife, Lana, a former GONGster who has accepted a software engineer position with NOAO. We're delighted to have John and Lana back with us.

Protecting ATST from the Sun

LeEllen Phelps & the ATST Team

A paradoxical challenge in designing the world's largest solar telescope is protecting it from the Sun so that it can produce the world's best solar science data. Minimizing atmospheric seeing effects—turbulent fluctuations of the index of refraction within the atmosphere along the optical path—will be a key factor in the ultimate success of the ATST.

To address this challenge, the ATST design incorporates active thermal controls throughout the observatory. Our various studies and experiments have shown that if the temperatures of these components can be maintained close to or slightly below the ambient air temperature, self-induced seeing can be controlled within the error-budget allocations.

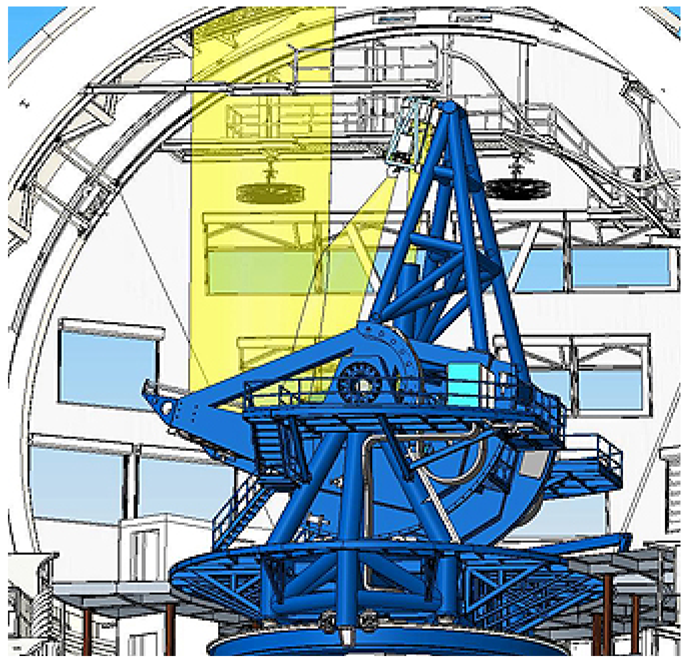


Computational fluid dynamics models depict the prevailing southwesterly wind flow around and over the ATST enclosure, and the resulting air stagnation on the enclosure's leeward side. (Credit: LeEllen Phelps and NSO/AURA/NSF)

Thermal control for the enclosure starts with a shape that minimizes the surface area normal or near-normal to the Sun. In combination with a white concrete apron surrounding the base of the enclosure, this reduces the thermal load that must be removed from the carousel (the rotating part of the enclosure) by more than 50 percent from the baseline configuration. The carousel surface temperature is actively controlled by covering all surfaces that receive insulation with plate coil heat exchangers. Chilled heat-transfer solution is circulated through the plates to maintain the surface temperature at, or slightly below, ambient temperature.

Thermal modeling of the ATST enclosure to correctly size equipment and estimate performance has been based on covering all of the external surfaces with a white coating having a solar reflectivity of 84 percent and a thermal emissivity of 93 percent. These are typical values for white titanium-oxide or zinc-oxide paints. The properties of traditional white coatings and paints are known to degrade with time as they are exposed to the elements. The thermal coating system for the ATST is based on test results of samples weathered on the Haleakalā High Altitude Observatories site.

Two coatings have been identified for ATST: one for the areas that receive the most direct insulation and are nearest the light path, and a second for the bulk of the surface area. It is cost prohibitive to use the higher-performance coating over the whole facility.



A computer model of the ATST illustrates the large cross-section available for air flow to ensure that the carousel and Telescope Mount Assembly stay close to ambient temperature. (Credit: LeEllen Phelps and NSO/AURA/NSF)

The coating system for the most critical areas is AZJ-4020 white epoxy thermal-control coating manufactured by AZ Technology. Initial test results indicate a solar reflectance of just over 86 percent and near-normal emittance of 97 percent after one year of weathering. The bulk of the enclosure surface will use Energy Seal Acu-Shield, a white acrylic elastomeric coating manufactured by Advanced Coating Systems, Inc. Three-year test results reported by the Energy Star® Roof Products Program indicate an initial solar reflectance of 86 percent, and then 84 percent after three years of weathering. Emittance is not reported in the program, but ATST test results indicate an initial near-normal emittance of 94 percent and verify an initial solar reflectance of 86 percent.

In addition to rejecting any incident heat load, the enclosure must protect the telescope while allowing the wind to flush the optical

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Protecting ATST from the Sun continued

surfaces. Toward this end, the enclosure is designed to be highly ventilated. Passive flushing is provided by 32 independently controllable vent gates, along with the carousel rear access door and the carousel entrance aperture. This provides an area of just over 200 square meters for ventilation. The active ventilation system for the carousel interior has two parts that work in tandem: fans mounted on the interior of the carousel, and exhaust fans that pull air through the floor at the base of the Telescope Mount Assembly. The fans selected for the baseline design provide 22,377 cubic feet per minute of free-air displacement using four airfoil fans. They provide an estimated one-meter-per-second breeze throughout the carousel when not competing with wind. The fan motors will be encased in a water jacket to remove waste heat.

Most recently, modeling efforts have centered on optimization of the cooling system for the lower enclosure, looking for an approach that would allow us to avoid building the utility tunnels to the nearby utility buildings, and otherwise reducing the costs and complexity of the baseline active cooling system. Thermal-mass concepts were considered for maintaining the lower enclosure surface temperatures near ambient. Two cases were developed in the RadTherm thermal modeling program to establish surface temperatures of a number of different thicknesses of concrete in different seasonal circumstances.

Winter is considered the worst case, since the Sun is lower in the sky and illuminates the walls of the lower enclosure more directly. The other case considered was intended to be representative of the most common conditions during excellent seeing at the site: Sun at 15 degrees from the horizon, wind from the northeast at 5–6 meters per second, and ambient temperature of 13 degrees Centigrade. Using site-survey data for both cases revealed that significant sub-cooling occurs through the night. Computational fluid dynamic analyses including the effects of surface temperatures were performed to examine how this might affect the ATST optical path. The results show that any affects of lower enclosure sub-cooling do not extend to the optical path, and that the concept is quite effective in keeping the surface temperatures within range in the high end. NL

SOLIS

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

The SOLIS team was excited to capture the first sunspots of Solar Cycle 24 on 4 January 2008, when a small sunspot group of the new cycle polarity appeared in the Sun's northern hemisphere. (The GONG++ data from this day were used by the National Oceanic and Atmospheric Administration (NOAA) to announce the new solar cycle, see the accompanying GONG++ article.) Since the SOLIS instruments were specifically designed to study the long-term changes wrought by the 11-year sunspot cycle, we are eager to document in scientific detail the onset of the new cycle.

Recent results from the telescope include those from Raouafi, Harvey, and Henney (2008), who used magnetograms from the Vector Spectromagnetograph (VSM) to study the latitudinal distribution of magnetic-flux elements as a function of latitude in the solar polar caps. They find that the density distribution of the magnetic flux, normalized by the surface of the polar cap and averaged over months, decreases close to the solar poles. This trend is more pronounced when considering only flux elements with relatively large size. This research has implications for the latitudinal extent and strength of the meridional flows that bring the magnetic flux from lower to higher solar latitudes, resulting in the solar-cycle reversal. The results are also of importance in studying polar structures contributing to the fast solar wind, such as polar plumes.

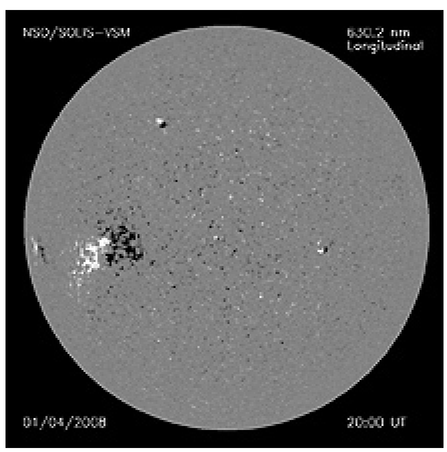

Figure 1: A full-disk solar image with gray-scale indicating the line-of-sight magnetic flux as observed in the photosphere with the 630 nm Fe I lines on 4 January 2008. White/black indicate positive/negative polarity of magnetic fields. It is interesting to note that the hemispheres are slightly out of sync with one another. Remnants of the old Solar Cycle 23 magnetism are still appearing in the southern hemisphere near the equator as the new Solar Cycle 24 magnetism appears at higher latitudes in the northern hemisphere.

Several improvements have occurred in the calibration of VSM polarization data. For quite some time, the VSM calibration waveplate and polarizer rotation mechanisms have been experiencing position repeatability problems. During a thorough investigation, we discovered that the motors were underpowered due to a wiring problem. Correction of the error has ensured proper positioning of calibration motors, which, in turn, simplifies observing procedures as manual intervention to correct for random positional errors is no longer required.

In addition, algorithms have been developed to remove unwanted fringing in the Stokes polarization data. Due to imperfect modulation of the polarized states and small spatial offsets in the optics, fringes often appear and cause problems in the data interpretation. Once the fringe pattern, both its amplitude and phase, is fitted, the fringes can be effectively removed in order to supply a clean spectrum to the community.

continued

SOLIS continued

The recently purchased Sarnoff cameras have passed qualification testing and new camera mounting hardware has been fabricated. Software interfaces are now being modified to incorporate this data acquisition system (DAS) into the current operating system, with a goal of replacing the cameras within the next few months.

The Kitt Peak SOLIS Tower (KPST) storage area network (SAN), which supports the SOLIS real-time data acquisition and processing, was purchased eight years ago and was supported up until recently. Recent disk failures had become more frequent, and rebuilding the current system had limited observations. Work was recently completed on upgrading the KPST SAN to a RAID-1 in order to avoid data loss when one SAN disk fails and to have parts that are serviceable.

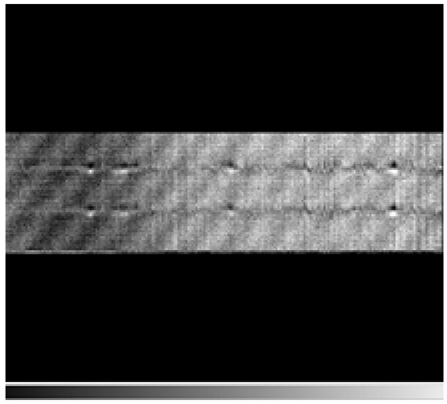

Figure 2: Diagonal fringing in Stokes V polarization can be seen simultaneously with the real Zeeman-splitting magnetic signal of the Fe I spectral lines at 630.1 and 630.2 nm.

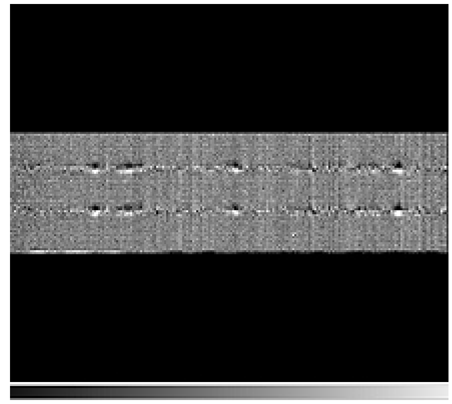

Figure 3: Once the amplitude and phase of the fringe pattern is fit, the fringes can be effectively removed so that a "clean" spectra is analyzed.

GONG++

Frank Hill & the GONG++ Team

The last quarter has seen continued increase in the use of the GONG++ magnetograms by the scientific community. The data are now being used in the Air Force Research Laboratory Wang-Sheeley-Arge solar wind model, by the STEREO and Hinode research teams, and in the Center for Integrated Space Weather Modeling program. Individual non-GONG++ user research programs have also begun to utilize the near-real-time, Web-accessible magnetograms, with the main focus being naturally on observations of rapid variations in the magnetic field.

The enthusiastic acceptance of the GONG++ magnetograms from outside the helioseismology research community has been welcomed and should increase the prospects that GONG++ will succeed in identifying outside operational funding as recommended by the NSF Senior Review. On the research-funding front, we have had some good news with the recent award of a three-year continuation of our NASA SOHO Guest Investigator program.

Science Highlights

On 4 January 2008, the National Oceanic and Atmospheric Administration (NOAA) announced that the first sunspot of the new Solar Cycle 24 had been observed. The data they used for this announcement was a GONG++ magnetogram obtained at the Mauna Loa Observatory; this image can be seen in figure 1. Magnetic fields associated with Cycle 24 had been spotted previously, notably with NSO's SOLIS instrument (see the December 2006 *Newsletter*), but those fields failed to create a sunspot. The onset of Cycle 24 had been predicted to occur in March 2008 with an error of ±6 months, so this sunspot is right on time! The outgoing Cycle 23 was one of the longer cycles (13 years), and it will be interesting to watch Cycle 24 unfold to test the prediction of its strength.

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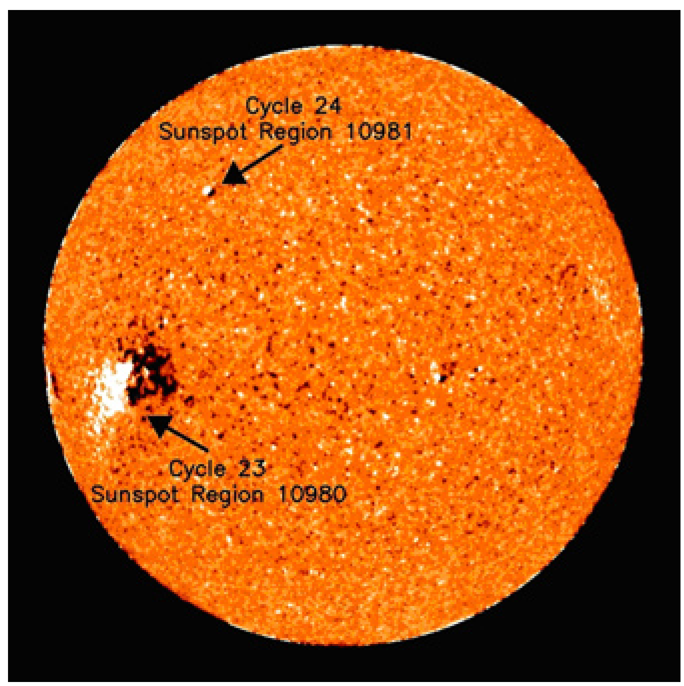

Figure 1: This GONG++ magnetogram, obtained at Mauna Loa on 4 January 2008, shows the first appearance of a sunspot associated with the new activity Cycle 24. The sunspot, labeled with its official NOAA number of 10981, can be seen near the top of the image. The high-latitude location (27° north), and the negative polarity leading to the right in the northern hemisphere, indicate that this spot is from the new solar cycle. A spot from Cycle 23, number 10980, is also evident on the disk. The image annotations are courtesy NOAA/NWS/SWPC.

GONG++ continued

Irene González Hernández has been investigating the meridional flow below the solar surface. This flow is in the north–south direction, and is thought to be a key component of the solar dynamo mechanism that maintains the solar activity cycle. There are some localized "bumps" in the meridional flow velocity as a function of latitude, as seen in figure 2. The latitude of these bumps is the same as the latitude where the sunspots emerge and evolve, so it is plausible that the bumps and the sunspots are related.

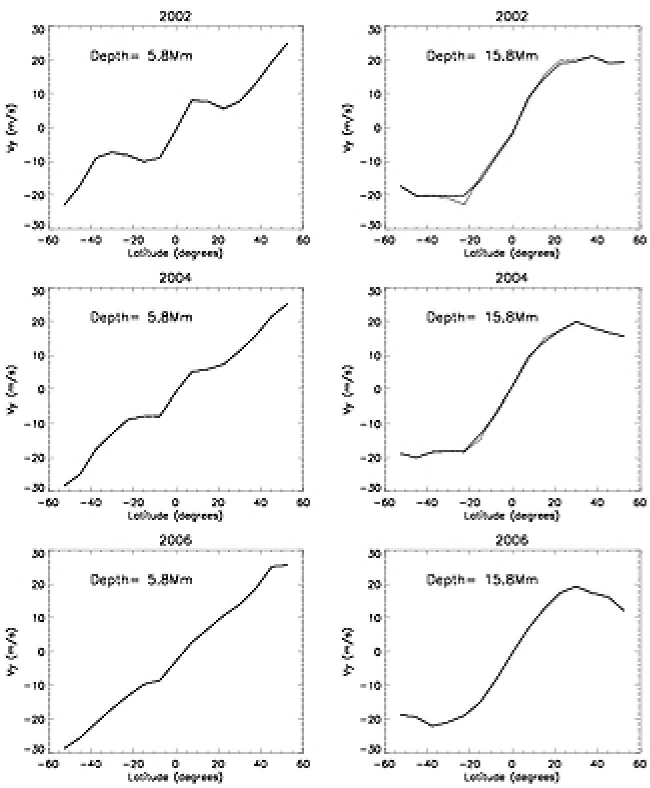

Figure 2: The north–south meridional flow averaged for three different years (2002 top, 2004 middle, and 2006 bottom) and two depths (5.8 Mm left, 15.8 Mm right) obtained by applying ring-diagram analysis to GONG++ continuous data. The flows were calculated: a) using all data available (solid thick line) and b) excluding the areas of concentrated magnetic activity such as active regions (faint thin line). Close to the surface, the flows show localized "bumps" at the latitudes corresponding to the active belts that move toward the equator as the solar cycle progresses toward minimum. The characteristics of the bumps are not affected by the removal of areas of high activity, so the bumps are not caused by organized flows around the active regions or artifacts from the magnetic field, but arise from a global pattern of circulation in the active latitudes. The graphs also show that the amplitude of the meridional increases toward solar minimum, particularly close to the surface. Preliminary analysis of a subset of the data using another local helioseismology technique (time-distance) seems to confirm these results.

However, there has been a question as to whether the meridional flow bumps are local active-region flows, or even artifacts of the surface activity, with the magnetic field contaminating the velocity signal. Recently, González Hernández completed an analysis in which she masked out the surface active regions and determined the meridional flow from regions where no activity was present. She found that the bumps were still present and unchanged in the flow, thus suggesting that these features are real global features of the solar internal velocity field, and are neither local flows nor artifacts. We think that the meridional flow bumps are related to the east–west zonal flow known as the torsional oscillation.

Network Operations & Engineering

In the last quarter of 2007, preventive maintenance (PM) teams visited Udaipur and Mauna Loa. In addition to the usual tasks, a problem with the waveplate synchronization circuit was found in the new waveplate hardware while it was being installed at Udaipur. A considerable reduction in the circuit noise was seen when an apparently extraneous ground cable was removed. This change will be made at the remaining five sites. An additional improvement will be to install a differential receiver into the circuit to further reduce noise pickup. A new circuit card has been designed, built, and tested, and all new waveplate hardware will be updated with the new design.

The Mauna Loa PM was more routine and allowed for upgrades to numerous system components. In particular, a CCD camera with improved temperature control and a Lyot filter (which was rebuilt with a more stable optical coupling compound) were installed. Subsequent to the Udaipur PM, problems with the uninterruptible power supply (UPS) began following installation of new, higher-capacity air conditioners. The higher load now causes the input voltage to drop to the point that the UPS switches to battery power, and although the switch-over is brief, it occurs frequently enough that the batteries eventually loose their charge, and the UPS shuts down completely. Some interim actions have been taken to prevent further unexpected shutdowns, and additional adjustments to the UPS control parameters are being tried in order to determine a long-term solution.

Meanwhile, upgrades to cameras, Lyot filters, electronics, clean-air systems, and turrets have been underway in preparation for the next round of PM trips scheduled to begin in March 2008. Long-term testing (now at eight-plus months) of the prototype, clean-air system upgrade continues at Tucson's engineering site. We hope to get at least one year of use out of the pump before it needs to be rebuilt, which would allow pump servicing to be done by our staff during the annual maintenance trips.

The replacement candidate for the GONG++ camera has been set up in the lab and is collecting preliminary images. A replacement candidate for the GONG workstation has been received and configuration and testing is progressing as time permits.

Data Processing, Software Development, & Analysis

Two new Linux servers have been ordered. These servers will support routine pipeline operations and facilitate the eventual retirement of GONGXX and Tarat. Additional disk space is being added to the archive to support the increasing demand for online data products.

Recent detailed analysis of the GONG synoptic maps shows an apparent motion of the polar field with a one-year periodicity. This is an artifact arising from a problem in our data processing pipeline. We are currently reviewing the software to identify and correct the problem.

continued

GONG++ continued

Work continues on the pipeline to process fully calibrated, full-resolution, merged magnetograms. The pipeline will also include modifications to process SOLIS magnetograms. The programming team continues to port GONG's production software to Linux. The calibration pipeline is the latest module to be approved for routine processing on the Linux platform.

Processing to date includes time series, frequencies, merged velocity, and rings for GONG Month 123 (centered at 6 July 2007), with a fill factor of 0.90. Last quarter, 750 GB of data were distributed through the FTP site.

Program

In addition to the successful NASA SOHO Guest Investigator award mentioned earlier, we have submitted a joint SOLIS/GONG++ proposal to NASA to develop new synchronic maps of the global solar magnetic field. These new data products would be constructed with a background/quiet-Sun field from the GONG++ high-cadence magnetograms and the radial field inside active regions derived from the SOLIS vector magnetograms.

The proceedings from the 24th NSO/Sacramento Peak Summer Workshop, "Subsurface and Atmospheric Influences on Solar Activity," are in press and should be distributed shortly. Congratulations to Rachel Howe and her co-editors Rudi Komm, Gordon Petrie, and K.S. Balasubramaniam for completing the job! NSO/GONG++ hosted a NASA Target Research and Technology team meeting on emerging active regions on January 28, followed by a two-day Local Helioseismology Comparison Group (LoHCo) workshop on January 29–30, the 11th meeting of this group.

We are now inviting speakers for the GONG 2008/SOHO 21 meeting to be held in Boulder, CO, 11–15 August 2008 (*www.hao.ucar.edu/gong-soho/*). We are also gearing up for the second International Research Experience for Students program this summer. Funded by the NSF Office for International Science and Engineering, this program will send four US graduate students, studying any field of astronomy, to work with scientists at the India Institute for Astrophysics in Bangalore, India, for eight weeks this summer. Last year's program was extremely successful, and we are happy to report that we have substantial oversubscription for the student slots this year.

Third Quarter Deadline for NSO Observing Proposals

The current deadline for submitting observing proposals to the National Solar Observatory for the third quarter of 2008 **is 15 May 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 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 at *nsokp.nso.edu/* for the Kitt Peak facilities. An observing-run evaluation form can be obtained at *ftp://ftp.nso.edu/observing_templates/evaluation.form.txt*.

Promoting Inquiry in Science Education: Project PRISE in Piñon

Robert Sparks & the NOAO PRISE Team

Left: NOAO scientist Katy Garmany shows teachers how to use a Sunspotter solar-projection telescope. Center: Teachers in the Piñon PRISE workshop built spectroscopes in their exploration of light. Right: Master teacher Karina Leppik assists teachers with liquid explorations.

Staff members from the NOAO educational outreach group have been instrumental in presenting a series of professional development workshops for teachers at schools on the Navajo and Hopi Nations. These workshops were held in Piñon, Arizona, in the far northeast corner of the state as part of a creative project called Promoting Inquiry in Science Education (PRISE).

Funded by the Arizona Department of Education, Project PRISE is a partnership between the University of Arizona; the National Optical Astronomy Observatory; the Navajo Nation Office of Diné Science, Math and Technology; and the Piñon Unified School District. Oliver Monti (University of Arizona Chemistry Department) is the Principal Investigator, and Selina Johnson at the University of Arizona's Science and Math Education Center provides logistical support for the project. The NOAO team led the professional development effort in the physical sciences for these elementary and middle-school teachers, while the University of Arizona will lead the biology teaching efforts in the second half of the project.

The NOAO team conducted two-day teacher workshops monthly for six months starting in August 2007. Teachers participated in an online component of the workshop using the University of Arizona's D2L Web site. Over 45 teachers from Navajo and Hopi schools attended. Participating schools included Piñon Elementary School, Piñon Advanced Middle School, Hopi Day School, Black Mesa Elementary School, First Mesa Elementary School, Jeehdeez'A Academy, and Cottonwood Elementary School.

The materials selected for the workshops focused on content knowledge in the physical sciences. Each workshop used a teaching guide in the exemplary *Great Explorations in Math and Science* (GEMS) series developed at the Lawrence Hall of Science at theUniversity of California, Berkeley. The GEMS guides were supplemented with activities on other important topics in the physical sciences.

Each workshop was taught by a combination of master teachers and educational outreach scientists. Master teachers focused on teaching the GEMS guides, showing how the material applies to the classroom. They also provided links from the materials to national and state science standards. The scientists provided more in-depth content knowledge by giving talks and leading activities that build upon the basic activities in the GEMS guides.

The NOAO team consisted of master teachers Karriaunna Scotti and Karina Leppik, and NOAO staff members Stephen Pompea, Connie Walker, Robert Sparks, Steven Croft, Katy Garmany, and John Glaspey.

A unique aspect of Project PRISE was the use of Navajo and Hopi cultural experts to review the instructional materials and activities to ensure that the instruction was sensitive to their cultural beliefs. Navajo and Hopi cultural experts attended two of the physical sciences workshops and also gave presentations on traditional Navajo and Hopi beliefs about the natural world.

The workshop presenters left Tucson early on Friday mornings to drive to Piñon. A late afternoon arrival left just enough time to set up before the teachers arrived for the start of the workshop at 5:00 pm. The workshop lasted until 10:00 pm on Friday night and sometimes continued later with star parties. The second day (Saturday) workshop started at 8:00 am and ended at 5:00 pm.

Activities were chosen from the GEMS guides *Secret Formulas, Sifting Through Science, Bubbleology, Liquid Explorations, Color Analyzers,* and *More Than Magnifiers.* Karina and Karriaunna reinforced both the teachers' content knowledge as well as the pedagogy needed to effectively use these units in the classroom. The teachers were actively engaged doing the activities.

The scientists gave talks on a wide variety of topics, including astronomical images, the nature of light, water in the Solar System, convection, auroras, lightning, and science experiments you can do at the dinner table.

continued

Promoting Inquiry in Science Education continued

At the final physical sciences workshop in January, the teachers from the various schools presented lessons based on what they had learned throughout the PRISE project. These lessons frequently blended science-content knowledge with Native American stories in entertaining and creative ways.

Although the physical sciences portion of the workshop is now complete, with very favorable evaluations, we are still providing support to the PRISE teachers through the D2L distance-learning Web site. We look forward to seeing their progress this spring as the teachers implement these physical sciences units. We hope to apply some of the experience gained from Project PRISE to our expanding outreach activities with the Tohono O'odham Nation in the region around Kitt Peak.

An Informal Visit to CADIAS

Katy Garmany & John Glaspey

On an observing trip to Chile in early January, we had an opportunity to visit the site of the Centro de Apoyo a la Didáctica de la Astronomía (CADIAS), the astronomy outreach center funded by NOAO and Gemini Observatory in Altovalsol, just outside of La Serena, Chile.

We were fortunate to be there on a night when a group of students and their parents were present for a workshop as part of the Universidad de los Niños program. CADIAS occupies an older, ranch-style building, but it has sufficient interior space for an inflatable Starlab planetarium (shown in figure 1) as well as a small, Internet-connected library and a computer lab, which give it the feel of a community science center. An additional room is being equipped with monitors and panels to have the look and feel of the Gemini control room.

Figure 1: CADIAS Director David Orellana (NOAO and Universidad de La Serena) introduces a group of students to some familiar constellations after they made star wheels. Katy Garmany of the NOAO educational outreach group also helped the students get their bearings.

As noted on their Web site (*www.ctio.noao.edu/AURA/CADIAS/*), multiple organizations support CADIAS, and not just financially. To encourage the students to learn more about astronomy and to investigate further, Cerro Tololo Inter-American Observatory donated a complete set of the ESO Sky Survey. The NOAO Public Affairs and Educational Outreach group has also contributed a variety of books, posters, handouts, computers, and telescope equipment.

Figure 2: NOAO South outreach coordinator Hugo Ochoa (middle) and Katy Garmany (right) show one of the transparencies of the ESO Sky Survey to a parent attending the event.

Our visit was a pleasure for us and, we hope, added something to the workshop experience for the children.

We would strongly urge anyone passing through La Serena as part of an observing run to inquire about visiting CADIAS. You will get to see a small but extremely important educational resource for the children of an area where astronomy has become an important part of the local economy and culture. You may even be able to help out with some of the activities for the kids!

Spitzer-NOAO Research Program for Teachers Makes News at AAS

Douglas Isbell

A team consisting of astronomers from NOAO and Spitzer Science Center, high school teachers, and their students presented their discovery of dark matter in accretion disks—and its potentially large implications for several branches of astronomy—during a press conference at the AAS meeting in Austin on January 9.

As part of a continuing, joint, outreach project called the Spitzer-NOAO Observing Program for Teachers and Students, the research team observed the interacting binary star WZ Sagittae (WZ Sge) using the 2.1-meter and WIYN 0.9-meter telescopes at Kitt Peak National Observatory and the Infrared Array Camera (IRAC) on NASA's Spitzer Space Telescope.

WZ Sge is an interacting binary star located in the constellation Sagitta, the arrow of the archer Sagittarius. The pair consists of a white dwarf star (a compact star about the size of the Earth, but with a mass near that of the Sun) and a larger, but less massive and much cooler, companion star. The companion, a brown dwarf in this case, has material ripped off its surface by the stronger gravity of the white dwarf. This material flows toward the more massive star and, in the process, forms a disk surrounding the white dwarf, known as an accretion disk.

"We were very surprised to see the contrasting results obtained with the optical telescopes on the ground and the infrared telescope in space," said Steve B. Howell, an NOAO astronomer and leader of the Spitzer-NOAO research team (figure 1). "The much larger size of the infrared-emitting portion of the accretion disk around WZ Sge was immediately obvious in the data. Our observations strongly imply the presence of dark matter in these structures, which are ubiquitous throughout the Universe."

Whether they form in cataclysmic variable systems or they surround the massive black hole hearts of active galaxies, accretion disks have been well observed and modeled using measurements obtained across much of the electromagnetic spectrum, from X-rays to the near infrared. The derived picture of the "standard accretion disk" model is a geometrically thin disk of gaseous material surrounding the white dwarf or black hole. Accretion disk models, bolstered by observation, are generally composed of hot gas having a temperature distribution within them, being hottest near the center and falling off in temperature toward the outer edge.

Figure 1: NOAO astronomer Steve B. Howell presents the team's results during the "black hole press briefing" at the January 2008 AAS meeting.

In order to confirm the general accretion disk models and extend them into the mid-infrared portion of the spectrum, Howell's team obtained the first time-series observations of an accretion disk system at 4.5 and 8 microns with the Spitzer Space Telescope. At nearly the same time, they obtained optical observations of WZ Sge at Kitt Peak. The optical observations confirmed the standard view of the accretion disk size and temperature, values known for over a decade.

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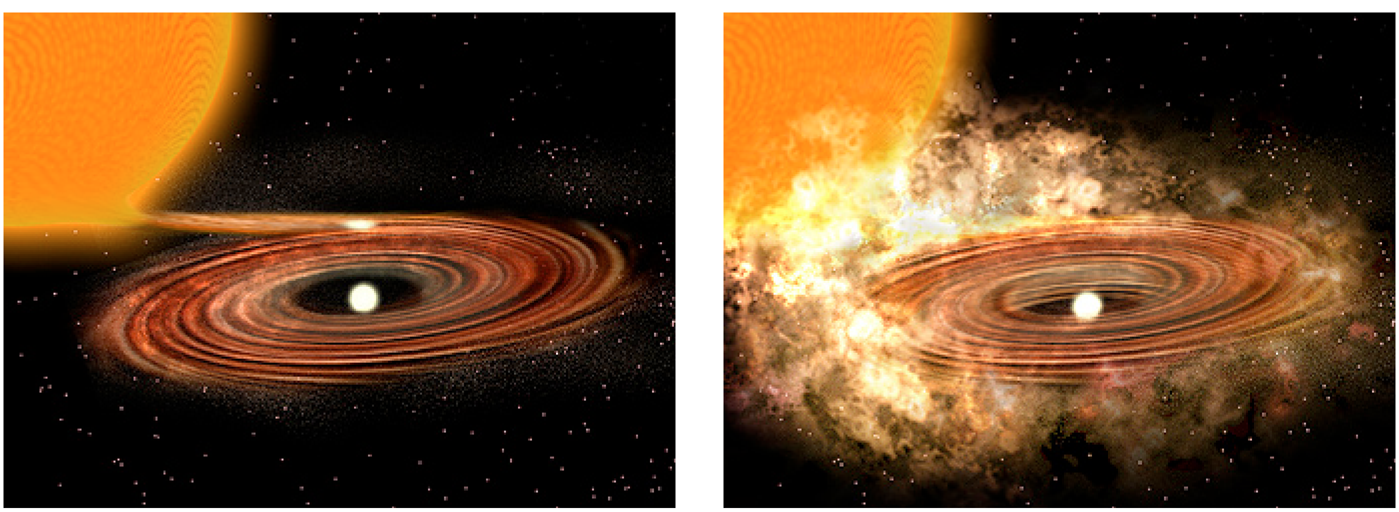

Figure 2: An artist's concept comparing the previous view (left) and the new view (right) of the accretion disk around WZ Sge. Credit: P. Marenfeld and NOAO/AURA/NSF

Spitzer-NOAO Research Program continued

The results from the mid-infrared observations, however, were completely unexpected and revealed that a larger, thicker disk of cool, dusty material surrounds much of the gaseous accretion disk (see figure 2). This outer dust disk likely contains as much mass as a medium-size asteroid. The newly discovered outer disk extends about 20 times the radius of the gaseous disk.

"This discovery suggests that our current model for accretion disks of all kinds is wrong," said team member Donald Hoard of the Spitzer Science Center. "We will need to rethink and recast these models for accretion disks, not only in interacting binary stars, but also in distant, highly luminous active galaxies."

The implications from such a discovery are far reaching, affecting not only the theoretical models (since the formation and evolution of the disks are modeled based on their size, temperature, and composition—all quantities that may now need to be revised), but also nearly all previous observations of systems containing accretion disks, from binary stars to supermassive black holes.

For example, the dust disk (which is thicker than the known gaseous disk) blocks infrared light emitted by the compact central object and the inner hot regions of the gaseous disk. Not knowing that some mid- to far-infrared light is blocked by the newly discovered outer dust ring can lead observers to significantly underestimate the total luminosity of the central object. "The amount of this underestimation is not yet accurately known from our initial discovery, but may be as large as 50 percent," Howell said.

The observational program making this discovery was a joint effort between research scientists Howell, Hoard, and Carolyn Brinkworth of Spitzer Science Center, and high school teacher Beth Thomas and student Kimmerlee Johnson (Great Falls Public Schools, Great Falls, MT), teacher Jeff Adkins and student John Michael Santiago (Deer Valley High School, Antioch, CA), and teacher Tim Spuck and student Matt Walentosky (Oil City High School, Oil City, PA). See figure 3 for a photo of most members of the Spitzer-NOAO program who attended the Austin AAS.

Figure 3: Members of Spitzer-NOAO Observing Program for Teachers and Students in attendance at the January 2008 AAS meeting in Austin.
Credit: M. Newhouse and NOAO/AURA/NSF

The work was funded by Spitzer Science Center as part of a joint project with NOAO to expand the national observatory's Research Based Science Education (RBSE) program to include observations with the Spitzer Space Telescope. RBSE, a professional development program for teachers, has been training groups of 20 teachers in the research process (including regular observations at Kitt Peak National Observatory) every year for more than a decade, using funding support from NSF.

This discovery was covered by a variety of news media, including BBC News, National Geographic News, and Astronomy.com, several astronomy blogs, and local newspapers and radio programs in the teachers' hometowns of Great Falls, MT, Brentwood, CA, and Pittsburgh, PA.

REU 2008 Begins at CTIO

Styliani Kafka

On Tuesday, 15 January 2008, a new Research Experiences for Undergraduates (REU) program started at CTIO. Six US students joined two Chilean students, participants of the parallel Practica de Investigación en Astronomía (PIA) program, in La Serena (Chile), where they will spend the southern summer working on research projects with CTIO and Gemini staff members.

During their 10-week internship at CTIO, the REU and PIA students have the chance to visit the Tololo, Gemini, and Las Campanas facilities; observe at Cerro Tololo; attend seminars and colloquia; and sample the rich social and cultural life of the CTIO compound and Chile. At the end of their tenure, the students will present their research in a two-day workshop held in La Serena.

The 2008 REU students are Adele Plunkett (Middlebury College), Matt Schenker (Dartmouth College), Emma Crow-Willard (Occidental College), Emily Lynch (Dartmouth College), Peter Mares (Cornell University), and Amit Misra (Case Western Reserve University). The 2008 PIA students are Macarena Campos (Universidad de Concepción) and Regis Cartier (Universidad de Chile).

We all wish them an enjoyable stay in La Serena.