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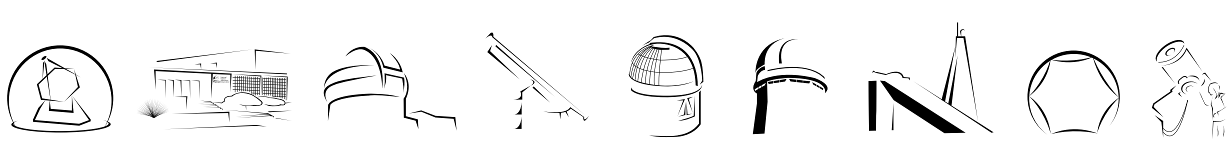

Third Workshop on the Ground-Based Optical/Infrared System

A community workshop aimed at developing, identifying and prioritizing new instrument capabilities for medium and large ground-based telescopes (3.5–10 meters in aperture), both public and private, is being planned for November 16–17 in the Phoenix, AZ, area.

The workshop will be limited to about 75 participants. There will be some openings available for general applicants — watch the main NOAO Web page for an announcement and further details.

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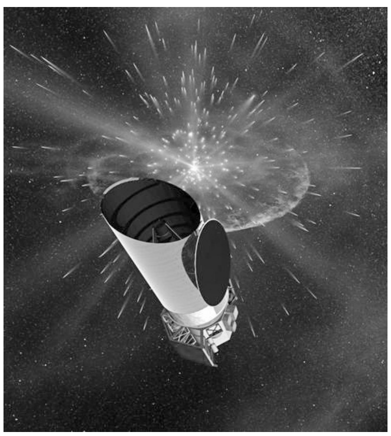
NASA Funds Development of Destiny: The Dark Energy Space Telescope



A team led by Principal Investigator Tod Lauer of the National Optical Astronomy Observatory has been selected by NASA to further develop a concept for a space mission to characterize the mysterious "Dark Energy" that permeates the Universe and causes the expansion to accelerate.

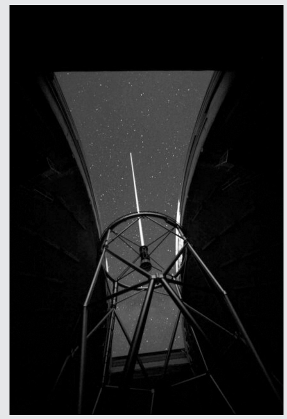
Known as the Dark Energy Space Telescope (Destiny), this small spacecraft would be launched as early as 2013 to detect and observe more than 3,000 supernovae over its two-year primary mission to measure the expansion history of the Universe. This mission would be followed by a year-long survey of 1,000 square-degrees of sky at near-infrared wavelengths to measure how the large-scale distribution of matter in the Universe has evolved since the Big Bang. Used together, the data from these two surveys will have 10 times the sensitivity of current ground-based projects to explore the properties of Dark Energy.

Dominic J. Benford of NASA's Goddard Space Flight Center is the Deputy Principal Investigator for Destiny. The Destiny team has strong connections to the state of Arizona, with members in Tucson at NOAO, the University of Arizona's astronomy department and Lunar and Planetary Laboratory, and several astronomers and space scientists from Arizona State University. Other team members (including several that were part of the original discovery of Dark Energy) are based at the Space Telescope Science Institute, Harvard University, Texas A&M, the University of California at Davis, Michigan State University, the University of Chicago, and the Carnegie Observatories.

On the Cover

This fisheye-lens view shows the adaptive optics laser guide star system at Gemini North, partly illuminated by the rising Moon, during testing on 13 July 2006.

Credit: P. Michaud/Gemini Observatory



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A Large Population of 1 < z < 2 Galaxy Clusters in the IRAC Shallow Survey of the NDWFS Bootes Field

Mark Brodwin (JPL), Peter Eisenhardt (JPL), Anthony Gonzalez (University of Florida), Adam Stanford (University of California-Davis) & Daniel Stern (JPL)

With their large numbers of galaxies at a common look-back time in the most massive gravitationally bound systems, galaxy clusters provide key insights into both galaxy evolution and cosmology. Redshift 1 < z < 2 clusters are particularly ideal laboratories in which to directly observe the assembly of massive galaxies as it occurs, allowing us to determine the relative importance of early-collapse and late-time hierarchical assembly mechanisms. High-redshift clusters also allow us to study the properties of the dark matter halos in which they reside (via weak lensing methods), and are sensitive to cosmological parameters, such as Ω_M, σ_8, Ω_Λ, and to both the equation of state of the dark energy and its derivative.

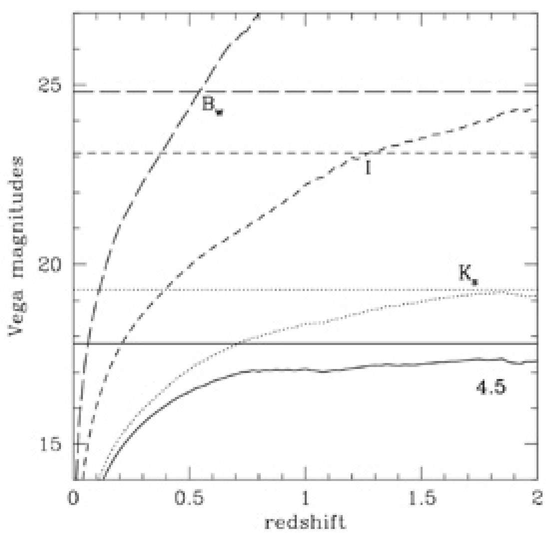


Figure 1. Apparent magnitudes for passively evolving L cluster galaxies in B_W, I, K_S, and 4.5μm for a Bruzual & Charlot model where the stars form in a 0.1 Gyr burst beginning at $z_f = 3$ in a {Ω_Λ= 0.7, Ω_M = 0.3, h = 0.7} cosmology. This model fits the observed L* in galaxy clusters to at least z ~ 1 (De Propris et al. 1999). The horizontal lines indicate the 5σ limits of these bands in 5″ diameter apertures in the IRAC Shallow Survey and NDWFS, and at the 50% completeness limit in a 6″ diameter aperture in K_S in FLAMEX. Note that a 5″ aperture is larger than optimal for detection at B_W and I; the 50% completeness limits in these bands are about 2 mag fainter. The selection function at 4.5 μm is flat between 1 < z < 2, demonstrating that 90-second IRAC exposures allow unbiased cluster detection out to z = 2 (Eisenhardt et al. in preparation).*

Previous surveys at X-ray and optical wavelengths have found large samples of galaxy clusters at z < 1, but have largely failed at z > 1. This failure is due to both the lack of sensitivity in the X-ray for all but the most massive clusters, and to the loss of the primary observational signal of early type galaxies in the optical as the 4000Å break shifts out of the optical window. One of the primary goals of the Spitzer/IRAC Shallow Survey (Eisenhardt et al. 2004, *ApJS*, 154, 48) was to take advantage of the beneficial k-correction in the mid-IR, illustrated in figure 1, whereby passively evolving cluster elliptical galaxies have an approximately flat selection function at 1 < z < 2.

Our methodology consists of calculating accurate photometric redshift probability distributions (Brodwin et al. 2006, ApJ, in press, astro-ph/0607450) for a 4.5 μm flux-limited sample of 200,000 galaxies across the 8 deg^2 common to the IRAC Shallow survey and the NOAO Deep Wide-Field Survey (NDWFS; Jannuzi & Dey 1999) in Boötes. It is therefore the *combination* of the infrared Spitzer data and the optical NDWFS photometry that make this survey possible.

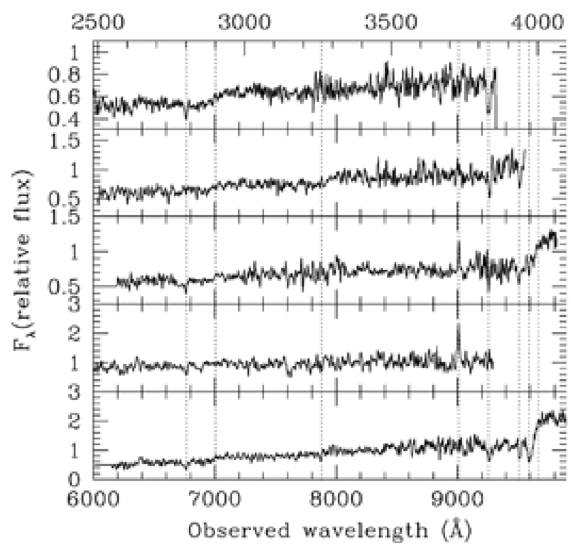


Figure 2. Optical spectra of the five member galaxies after being smoothed by a five pixel boxcar. The following spectral features (not present in every object) are marked in increasing wavelength by the dotted lines: Mg II λ2800, B2900, B3260, [O II] λ3727, Mg I λ3830, Ca II K and H, and D4000. The rest-frame wavelength at z = 1.4166 is shown along the top (Stanford et al. 2005, ApJ, 634, L129).

continued

IRAC Shallow Survey of the NDWFS Bootes Field continued

A wavelet search algorithm uses the photometric redshift probability distributions to identify structures on cluster scales in narrow redshift slices from 0 < z < 2. Detailed simulations allow us to assess the significance of candidate clusters relative to the likelihood of random associations (Gonzalez et al. in prep). Near-IR data from the FLAMINGOS Extragalactic Survey (FLAMEX; Elston, Gonzalez et al. 2006, ApJ, 639, 816) were used, post-discovery, to improve the photometric redshifts in the ~4 deg^2 common area in Boötes.

Follow-up Keck spectroscopy has confirmed seven clusters at z > 1, with mean redshifts of 1.11 (Elston, Gonzalez et al. 2006, ApJ, 639, 816); 1.24 (Brodwin et al. 2006, ApJ, in press, astro-ph/0607450); 1.06, 1.16, 1.26, and 1.37 (Eisenhardt et al. in prep); and 1.41 (Stanford et al. 2005, ApJ, 634, L129). Spectra for five members of the latter cluster, which was, until recently, the highest redshift cluster known, are shown in figure 2 (an image of this cluster is shown in figure 3, upper right panel).

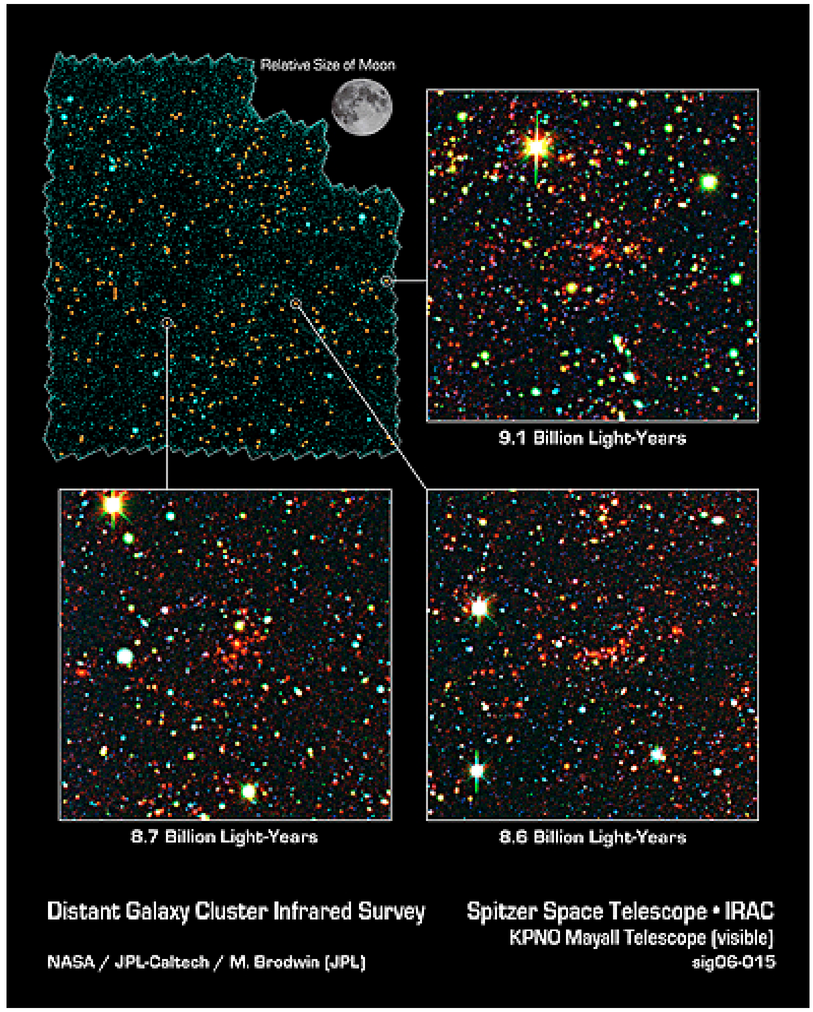


Figure 3. The IRAC Shallow Cluster Survey in the NDWFS Boötes field contains 292 clusters and groups (upper left). Three spectroscopically-confirmed z > 1 clusters are shown in fan-outs, at <z> = 1.41, 1.24, and 1.26 (clockwise from upper right). These images combine the BW (blue), I (green) and 4.5 μm (red) band images. The full moon illustrates the extent of survey's large 8 deg^2 area.

Seven of our z > 1 clusters were targeted with HST/ACS in Cycle 14 by S. Perlmutter to search for Type-Ia SNe in high-redshift cluster elliptical host galaxies. Because the dust correction is the primary uncertainty in the supernova cosmology field, each such supernova is statistically worth nine times as many as those found in late-type hosts. Several good candidates were discovered and then followed up with NICMOS and Keck/Subaru/VLT. The cosmological analysis is ongoing.

The full IRAC Shallow Cluster Survey (ISCS) contains 292 cluster candidates and groups from 0 < z < 2, illustrated in figure 3, including 93 at z > 1. This represents a six-fold increase in the number of known high-redshift clusters, and provides the ideal laboratory for studies of galaxy formation and evolution. Deep follow-up, multi-wavelength data, including HST/ACS, Palomar/WIRC, Spitzer/IRAC and Spitzer/MIPS, is currently being acquired for 18 of these z > 1 clusters, along with HST/NIC3 for those at the highest redshifts.

The next phase of the project is to extend our cluster sample to z = 2. Although the Spitzer/IRAC data are already sensitive enough to detect clusters at these redshifts, the algorithm is limited by the photometric redshifts, which are currently only reliable to z~1.5. Detailed simulations have demonstrated that adding deep near-IR data over the full survey area will produce accurate photometric redshifts to z = 2 and beyond. With the imminent commissioning of NEWFIRM on the KPNO Mayall 4-m telescope, the capability to efficiently acquire these data is at hand.

Filling in the Gaps: WIYN + Hydra Explores Changing Carbon Abundances in Globular Clusters

Michael Briley (University of Wisconsin-Oshkosh/NSF[1]), Judy Cohen (California Institute of Technology) & Daniel Harbeck (University of Wisconsin-Madison)

Contrary to what we are taught in graduate school, individual Galactic globular clusters are not chemically homogeneous populations. Every cluster studied to date has revealed significant star-to-star variations in the elements C, N, and often O (by as much as a factor of 10), as well as other light elements such as Na, Al, and Mg, am ong otherwise indistinguishable stars. The underlying nature of these anomalies, i.e., their characteristics and their origins, are still uncertain due in no small part to the limited parameter space sampled to date.

However, it appears likely that two separate processes are active at different times in cluster histories. The first process, occurring early in the cluster histories, modifies the light-element compositions of the stars (a "primordial" process). The second process, taking place during red giant branch ascent, brings CN and possibly ON-cycle exposed material to the surface (a form of "extra-mixing" beyond that expected from first dredge-up). Clearly, it is important to understand these variations not only for their clues to the physics/evolution of low-mass stars and cluster formation, but also to properly interpret the integrated spectra of GCs in external galaxies (e.g. the N-rich globulars of M31).

The present project is primarily focused on improving our understanding of the red giant branch extra-mixing mechanism (currently missing in standard models) that takes place within cluster giants of lower metallicity during the RGB ascent. Models which include various candidate mechanisms (meridional circulation, turbulent diffusion, etc.) predict a noticeable change in CN(O) surface abundances following the "red bump" in the red giant branch luminosity function. The red bump (an over-density in the luminosity function of the red giant branch) corresponds to the destruction of the molecular gradient by the outward-moving H-burning shell.

Mixing is inhibited by the gradient before this point. Indeed, our previous Keck and Palomar study of M13 stars (Briley, Cohen, & Stetson 2003) has demonstrated that extra-mixing occurs in M13 giants on top of pre-existing "primordial" inhomogeneities (figure 1). The observation that extra-mixing takes place in M13 is not a new result, however, the extent of the primordial variations was very surprising. However (and unfortunately), even when combined with data from previous investigations, the region immediately preceding the bump was woefully under-sampled, leaving the onset of the carbon depletions uncertain.

This was rectified during a two-night run in July 2005 with Hydra, the wide-field multi-object spectrograph on the WIYN 3.5-m telescope at Kitt Peak, where two fields of 30–40 stars each in M13 were observed. We used the 400 g/mm grating, blue fiber bundle, and bench spectrograph camera for a resolution of about 7.1 Å/spectral resolution element. The setup was adjusted so the region of interest, 4000–4400 Å, was best focused.

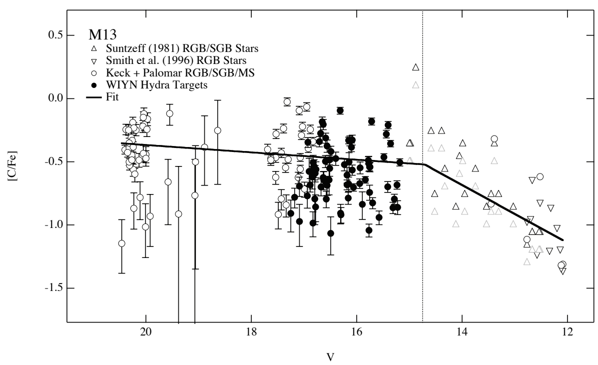


Figure 1. Carbon abundance distribution of red giant branch stars in the globular cluster M13. The dotted vertical line indicates the luminosity of the red bump. Note how the mean C abundance starts dropping at the red bump, while a substantial primordial variation in the Carbon is evident at all luminosities.

From these spectra, the strengths of the G-bands (a CH feature) were measured and compared with model spectra following techniques in our earlier papers (Marcs models from isochrones, and spectra from SSG). The resulting carbon abundances are plotted as filled circles in figure 1. Immediately obvious in figure 1 is the trend of rapidly decreasing carbon abundances with evolutionary state for cluster giants having passed through the luminosity function bump (indicated by the dashed vertical line). Also present is a significant star-to-star scatter at every evolutionary phase, which we attribute to the result of "primordial" contamination (see above).

To help interpret figure 1, we fit the observations to a simple model in which carbon abundances are allowed to linearly change with luminosity at two independent rates: one to represent possible changes before extra-mixing sets in (i.e., on the sub-giant branch), and one after extra-mixing is in operation. We also allow the point at which the extra-

continued

Filling in the Gaps: WIYN + Hydra *continued*

mixing sets in to be freely chosen in the fitting process. A chi-squared fit of the C abundances in figure 1 results in an initial -0.03±0.01 dex/mag rate of decrease in [C/Fe], followed by a drop to -0.23±0.02 dex/mag after the onset of extra-mixing (to the right). Moreover, the onset of extra-mixing is best fit by a change in slope at V = 14.71±0.20 mag. This is remarkably close to the V = 14.75 location of the luminosity function bump found by Paltrinieri et al. (1998) and the behavior expected (anticipated) by theory.

In an upcoming paper, we will be presenting similar results for the more metal-poor globular cluster M15. However, in this case, the rate of carbon depletion during extra-mixing is significantly steeper following the bump. While enhanced mixing with lower metallicity is again predicted by theory, we are now able to build upon the pioneering works of Suntzeff, Kraft, Carbon, Bell, Hesser, Norris, Smith, and others to measure definitive changes in composition with luminosity in globular clusters of different metallicities, over the entire color-magnitude diagram. It is our hope that observational constraints such as these can provide the inputs needed by the theory community to identify the underlying process.

Any opinions, findings, conclusions, and recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

A 6100-Gauss Sunspot Emerges

Bill Livingston & Jack Harvey

It was there in the Mount Wilson archives, awaiting us since 28 February 1942, when Joe Hickox first observed it at the 150-foot tower. On the sunspot drawing for that day, it was marked not as 6100 Gauss (G), but as 52°. The 52° angle was the inclination of the Nicholson tipping plate that was required to bring the two Zeeman sigma components of the Fe 617.33 nm spectrum line into coincidence. The nominal calibration was 1° per 100 G.

Prompted by a Russian article (Lozitsky, V. G., 1993, *Kinematika i Fizika Nebesnykh Tel.)* on the possibility of strong fields in excess of 5000 G in connection with flares, Jack Harvey and I decided to find out what the strongest measured fields actually were. Few people appreciate the fact that modern synoptic magnetographs do not work well in sunspots: they are good for plage and network fields, but fail in sunspot umbrae because of scattered light. The Kitt Peak Vacuum Telescope seldom recorded fields over 2400 G. The sure way to measure sunspot fields is by spectral photography, or visually, with the Hale-Nicholson parallel-plate micrometer. This latter device (figure 1) was employed at Mt. Wilson from 1914 through 2004. Few instruments in astronomy can boast a 90+ year record of regular use.

The displacement of a ray through a tilted glass plate is linear for small angles, but larger angles produce underestimates. Seth Nicholson, who worked with George Ellery Hale at Mt. Wilson, recognized this effect, and implemented a procedure to add 1° above about 32°. Perhaps strong fields were too rare to require further elaboration. This could hardly suffice at 52°. Jack Harvey decided to investigate properly and, with help from Larry

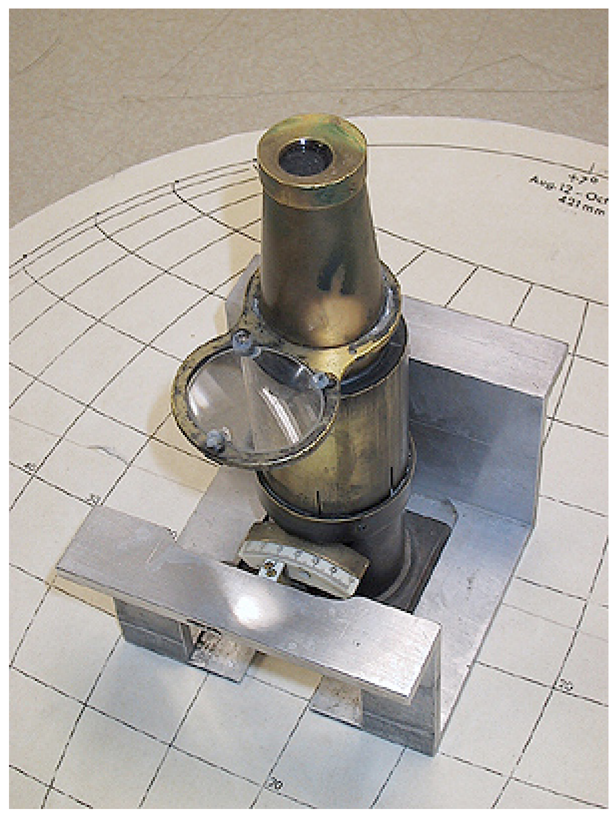


Figure 1. The Hale-Nicholson parallel-plate micrometer, used for 91 years to measure the strength of the magnetic field of sunspots at Mt. Wilson Observatory (photo courtesy of Larry Webster).

continued

6100-Gauss Sunspot Emerges continued

Webster at Mt. Wilson, searched for the original equipment even though it was modified in 1962. It was still there! Jack and Larry recalibrated it to find the 52° implied a 6100 G field strength.

What about other strong field spots? What was their frequency, for example? In order to search for these, we went through the Mt. Wilson publications of Nicholson, together with the microfilm copies of the daily sunspot drawings. The early work was very complete, but with the onset of photoelectric magnetograms around 1960, the visual measurements were deemed less important and their quality became variable. Fortunately, other observatories initiated similar visual or photographic programs, so we went through the archives of Potsdam, Rome, and the Crimea. We had read of Nikolai Steshenko's Crimean photographic observation of a 5300 G field, and Elena Malanushenko (formerly of NSO, now at Apache Point Observatory) had obtained the original plates for our study. We readily verified the 5300 G value. From records of 30,000 spot groups, we found 57 spots with fields in excess of 4000 G, and five of at least 5000 G.

What kinds of spots have such strong fields? From the US Naval Observatory collection of white-light full-disk images (1898–1970), which reside at the Kitt Peak solar facility, we found many examples on our list (see figure 2). Often the spots are complex, with light bridges across the umbra. But in some instances the spots are simple in form.

Jack Harvey performed a statistical study of the distribution of strong fields, and found no particular location for them within the solar cycle. The distribution of fields above 3000 G is continuous and follows a power law. One notable feature is that odd-numbered cycles contain 30% more sunspot groups, but 60% fewer 3000 G or greater field-strength sunspot groups, compared to the preceding even-numbered cycles.

Given such interesting results, we are concerned that, at present, no systematic (synoptic) observations are being made of sunspot fields.

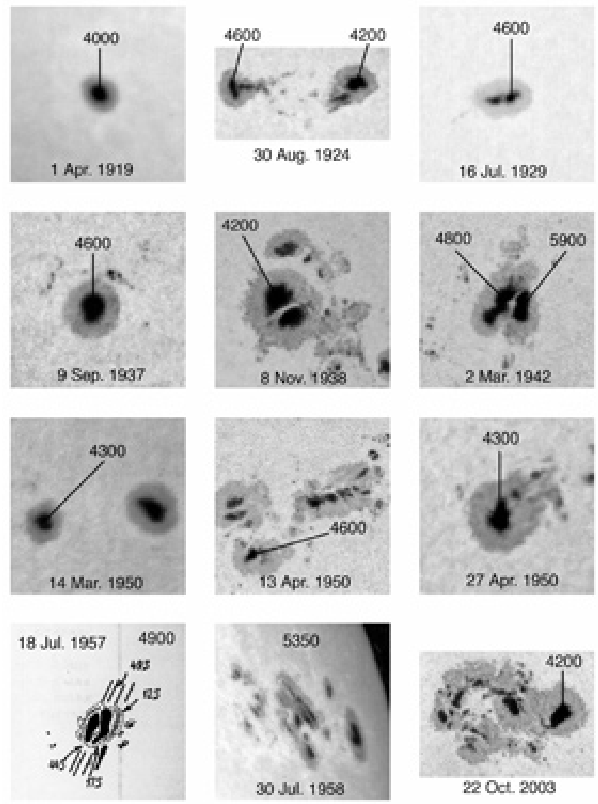


Figure 2. A sampling of photographs (and one drawing) of sunspot groups with strong magnetic fields.

An Active Chromosphere on a 55 Jupiter-Mass Object

Steve Howell

The study of low-mass stars and brown dwarfs is generally limited to the study of single objects, or those present in binaries paired with a more massive main sequence star. Our group has entered into the study of both low-mass, brown dwarf-like objects and active chromospheres in a most unexpected way.

Theoretical models of the formation and evolution of close binaries containing a white dwarf primary and a low-mass secondary star in the Galaxy today predict that the vast majority of these systems will be in very tight orbits, encircling each other every 70–90 minutes. These systems are interacting binaries, i.e. they have mass transfer via Roche lobe overflow from the low-mass secondary to the higher-mass, but smaller, primary star. These systems, termed cataclysmic variables (CVs), are primarily classified by the strength of the magnetic field that is present in the white dwarf. For white dwarfs with no discernible magnetic field, thought to have magnetic fields of ~5 MG or less, the transferred mass forms an accretion disk around the white dwarf. This disk heats up by both irradiation from the white dwarf and self-frictional heating due to the material viscosity, often outshining both stellar components in the optical bandpass.

Intermediate polars are CVs in which the white dwarf has a measurable magnetic field (5–10 MG) that disrupts the inner part of the accretion disk, and material there is confined to roughly follow the magnetic field lines accreting onto the white dwarf at its two magnetic poles. Polars, or AM Herculis stars, contain white dwarfs of high magnetic field strength from 10 MG up to 250 MG. These systems do not contain any accretion disks, because the Roche Lobe overflow material from the secondary star is captured, pulled out of the orbital plane, and funneled in a tight stream along the strong field lines directly onto one of both of the white dwarf magnetic poles.

Fred Walter (Stony Brook University), Thomas Harrison (New Mexico State University), Mark Huber (Lawrence Livermore National Laboratory), and myself have recently studied one of the shortest orbital period polars, EF Eri (Nov. 2006 *ApJ*, astro/ph 0607140). With an orbital period of only 81 minutes, the two component stars in EF Eri are about a solar radius apart and the secondary object can be no larger than about the planet Jupiter. EF Eri's white dwarf is at the weak end for a polar (13 MG), but strong enough to greatly affect the mass transfer and the behavior of the secondary.

We have studied this binary during its long-lived low-accretion state; that is, the time when essentially no mass is flowing through the inner Lagrangian point, and when no substantial accretion onto the white dwarf occurs. Using the SMARTS telescopes on Cerro Tololo in Chile, the long-term photometric and spectroscopic behavior of EF Eri has been followed. Hα emission, as detected after the binary had been in deep quiescence for over five years, and Keck spectroscopy revealed complete Balmer emission, as well as He and other activity sensitive species. The emission lines are shown to emanate from the secondary object and are consistent in strength and ratio to that of a typical active chromosphere in a solar-like star.

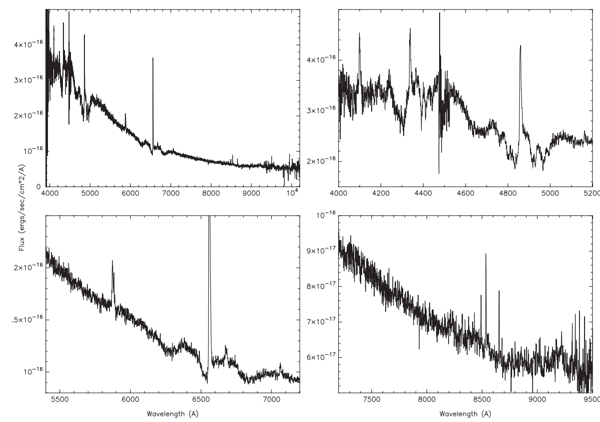


Figure 1. EF Eri as observed by Keck II in January 2006. The spectrum covers the majority of the optical band pass at quite good S/N (full range shown at top left) and reveals the set of emission lines from the secondary (see expanded views). The underlying white dwarf Balmer absorption lines are Zeeman split, and reveal the surface magnetic field strength. See text for details.

Using over two years of SMARTS observations, radial velocities of the Hα emission line were combined with previous estimates of the white dwarf mass to yield a measurement of the secondary object. The estimated mass of the secondary is 55 Jupiter masses, securely in the range of brown dwarfs. But how did such an object come to be in EF Eri? Did the secondary start out as a more-or-less normal main sequence star and has simply suffered Giga-years of mass loss to end up as a brown dwarf-like object? Did the binary start out with a brown dwarf companion, or is the secondary object a remnant helium core covered with a thin hydrogen atmosphere? We do not know the answer to this question yet, but we do have some clues.

Theoretical models suggest that the formation of such a close binary, as seen at present, from a precursor binary of a main sequence star (the present day white dwarf) and a brown

continued

Active Chromosphere on a 55 Jupiter-Mass Object continued

dwarf is difficult. If the binary starts out well separated, it will never come into contact within a Hubble time. If it starts out too close, the brown dwarf will coalesce with the pre-white dwarf during the common envelope stage. Thus, the primordial brown dwarf scenario seems unlikely.

The presence of substantial stellar activity seems to argue against a helium core-type object, leaving us with a secondary that is probably a degenerate low-mass, remnant object, the result of aeons of mass transfer onto the white dwarf primary. The driving force for the stellar activity (starspots, flares, etc.) is also unknown, but the rapid rotation of the synchronously locked secondary, and the fact that the entire low-mass object is fully permeated by the white dwarf's strong magnetic field are likely catalysts.

Three other polars have since been studied in detail during low-accretion states, and they all seem to show a similar result: the low-mass secondary stars have high chromospheric activity, which is probably also driven by the fact that the secondary is continually bathed in the strong magnetic field of the white dwarf.

Further work will continue to expand the sample of polars observed in low states, and observations of EF Eri and the like are being started to detail the atmospheric structure and inner workings of the "dynamo-like" mechanism responsible for the chromospheric activity seen in these low-mass stars.

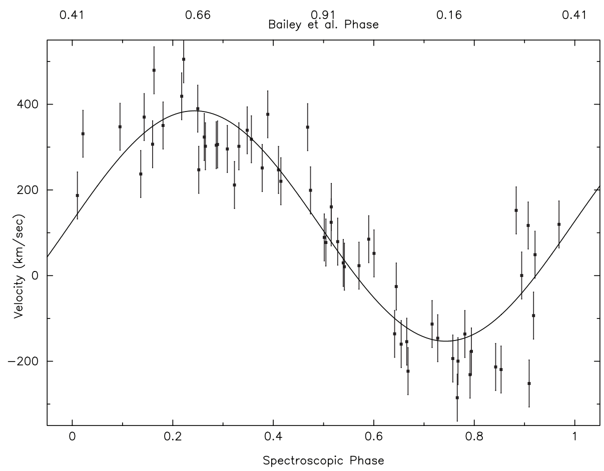


Figure 2. The Hα radial velocity curve for EF Eri based on SMARTS spectroscopy. The solid line is our best fit, as described in the text. The top axis shows the photometric phase as determined by Bailey et al. (1982) and the bottom axis show our new spectroscopic orbital phase.

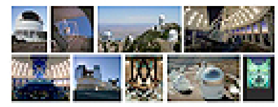
CATCH Web Site Publicizes Availability of Telescope Time

Todd Boroson & Letizia Stanghellini

One of the practical difficulties of using the diverse set of facilities that make up the ground-based optical/infrared (O/IR) system is just being familiar with all of the capabilities that are available.

This becomes obvious twice a year at NOAO, when we receive proposals for time on 18 telescopes. Only three of these telescopes are operated by NOAO independent of partners. Of the other 15, nine are run by partnerships that include NOAO, and six are private telescopes for which community observing time is distributed by NOAO. For a user, this array of possibilities must seem just as daunting as it is to the members of the Time Allocation Committee, especially when the additional facilities supported by the NSF Program for Research and Education with Small Telescopes (PREST) are added to the mix.

We have just launched the Community Access Telescope Clearing House (CATCH) Web site to address this problem (see *www.noao.edu/system/catch/)*. This site aims to organize the information on all publicly available facilities and to present that information in a uniform way.



CATCH presents two views of the O/IR system: one organized by capability, and the other by site and program. The capability view allows the user to specify what type of observation is desired, then query the CATCH database. CATCH provides a table with all the potentially usable instruments, together with links to more detailed information. The site/program view lists each observatory, providing pull-down menus for links to specific information, including how to obtain time. The listings include all NOAO and NOAO-partner facilities, all TSIP-funded facilities, and all PREST-funded facilities. We intend to offer the option of being included on this listing to other private observatories that make time available to the broader community.

Please send comments on CATCH and ideas for improving its usefulness to Letizia Stanghellini (*lstanghellini@noao.edu*).

Users Committee Meets October 5–6

James Lowenthal (Smith College) & Jeremy Mould

The NOAO Users Committee is seeking input from the astronomical community this month. The committee provides the national observatory with feedback and advice on all aspects of operations that might impact you as a user of NOAO facilities and services.

In its upcoming October meeting, the Users Committee will address current, near-term and medium-term issues relating to instrumentation, user access, Gemini, program efficiency, small and medium telescopes, the TSIP and SMARTS programs, and public/private cost-sharing. The committee's input to NOAO will be much richer if users take a few minutes to send an email to one of the committee members providing positive or negative comments on the NOAO facilities that you currently use, or that you would like to see us offer.

There will be two important special topics of the Users Committee meeting this year. The first is a discussion about the next new instrument for the 4-meter telescopes, following the commissioning of NEWFIRM at the end of this year. New instrumentation is a long lead-time item, essential to keeping a science facility on the frontier, and must be a strategic addition to the optical/infrared system.

Of further importance, the Users Committee and NOAO will discuss what we currently know about implementation plans in response to the outcome of the NSF Senior Review. Whatever facilities or programs the Senior Review Committee may recommend phasing out (unknown at this writing), NOAO's goal remains to provide cutting-edge public access observing facilities for the foreseeable future.

Your input, combined with these meetings and discussions, will be the start of a vitally important dialogue with the community, which we hope will be in a mature state at the time of the January 2007 AAS meeting in Seattle.

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Gemini Observing Opportunities for Semester 2007A

Verne V. Smith

The NOAO Gemini Science Center (NGSC) encourages the US community to take advantage of Gemini observing opportunities for semester 2007A (1 February 2007–31 July 2007). US Gemini observing proposals are submitted to and evaluated by the NOAO Time Allocation Committee (TAC). The formal Gemini "Call for Proposals" for 2007A will be released on or about 1 September 2006, with a US proposal deadline of 2 October 2006. As this article was prepared well before the release of the Call for Proposals, the following list of instruments and capabilities represents only our expectations of what will be offered in semester 2007A. Watch the NGSC Web page (*www.noao.edu/usgp*) for the Gemini Call for Proposals, which will list in clear detail the instruments and capabilities that will be offered.

NGSC anticipates the following instruments and modes on Gemini telescopes in 2007A:

Gemini North:

- Near-infrared Integral Field Spectrometer (NIFS).
- The Near Infra-Red Imager/spectrograph (NIRI) will be offered 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. LGS commissioning and system verification (SV) runs are taking place in 2006A/B. LGS full science mode will be offered in 2007A, contingent on the success of these runs. Altair is available with NIRI imaging and spectroscopy, with NIFS IFU imaging and spectroscopy, and with NIFS IFU spectral coronagraphy.
- Michelle, mid-infrared (7–26 micron) imager and spectrometer including 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 instruments and modes are offered for both queue and classical observing. Classical runs are offered only to programs with a length of three nights or longer.
- Time trades will allow community access to the Keck Telescope high-resolution optical spectrograph, HIRES, and to the Subaru Telescope Suprime-Cam wide-field imager and the infrared imager and spectrograph (MOIRCS).

Gemini South:

- Gemini Near Infra-Red Spectrograph (GNIRS).
- Thermal-Region Camera Spectrograph (T-ReCS) mid-infrared (2–26 micron) 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.
- Bench-mounted High-Resolution Optical Spectrograph (bHROS).
- Acquisition Camera for time-series photometry.
- Phoenix high-resolution infrared spectrograph, for a limited time during the first part of 2007A (see following article). Phoenix is available only in classical mode (in whole nights with no three-night minimum). NGSC Staff will provide training and start-up assistance to Phoenix classical observers.
- All modes for GMOS-South, bHROS, GNIRS, and T-ReCS are offered for both queue and classical observing. Classical runs are offered only to programs with a length of three nights or longer (except in the case of Phoenix).

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 2007A is planned to be greater than 85 percent at Gemini North and greater than 70 percent at Gemini South.

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

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

NOAO accepts Gemini proposals via the standard NOAO Web proposal form and the Gemini PIT software. We remind proposers that they can save their proposals as a PDF file to view the version that will be used by the NOAO TAC (please see *www.noao.edu/noaoprop/help/pit.html*).

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

Limited Phoenix Availability for 2007A

Ken Hinkle & Verne V. Smith

The NOAO high-resolution infrared spectrograph, Phoenix, has been offered on Gemini South since semester 2002A. The NOAO/Gemini agreement for shared use of Phoenix expired this year. Gemini operations strive to minimize instrument changes, with typically a single instrument assigned to each instrument port. On its arrival at Pachón, the Multi-Conjugate Adaptive Optics (MCAO) system will displace Phoenix from the telescope. MCAO is expected at Pachón in 2007A, so Phoenix's time as a dedicated Gemini South instrument is limited. The current Gemini timeline shows possible Phoenix availability for a part of semester 2007A (February–mid-March).

Proposers planning to request Phoenix in 2007A should keep this limited availability in mind. If Phoenix is offered, the final range of available dates will be announced in the 2007A Call for Proposals to be posted about 1 September 2006. The NGSC Web page (*www.noao.edu/usgp/*) or the Gemini Web site (*www.gemini.edu*) will keep you current on Phoenix availability dates.

Phoenix has had substantial use on Gemini South with at least 16 nights scheduled each semester for the last 10 semesters. Phoenix is the only high-resolution infrared spectrograph available to the US and Gemini community in the southern hemisphere. NOAO would like to see Phoenix offered again at some future date. Future use of Phoenix may involve the SOAR telescope.

To aid in this effort, we strongly encourage previous users of Phoenix to send us copies of refereed Phoenix publications as they become available. NGSC and NOAO will keep the US community informed of Phoenix's future.

An Update on bHROS for 2007A

Katia Cunha & Verne V. Smith

The bench-mounted High Resolution Optical Spectrograph (bHROS) at Gemini South was first offered as a facility instrument in semester 2006A. During its first two semesters of availability, the US community submitted seven proposals for 2006A and six proposals for 2006B: two were awarded time for 2006A and two for 2006B. Requests from other Gemini partners were also minimal.

As a result of the small number of submitted proposals, bHROS did not meet the 16-night minimum criterion to be used on the telescope over the two semesters it has been offered, although the 16-night rule was waived for these two semesters. As noted in the Gemini Semester Overview and Call for Proposals (*www.gemini.edu/sciops/ObsProcess/ObsProcIndex.html*), it is possible that bHROS will not go on the telescope in 2007A if there is not an increase in demand such that it meets the 16-night rule.

With its very high spectral resolution (R=150,000), bHROS presents a powerful and nearly unique capability for an 8-meter class telescope. If you have observing programs that could benefit from the superior spectral resolution and relatively high throughput of bHROS, semester 2007A is the time to consider them.

The December 2005 *NOAO/NSO Newsletter* contains an article summarizing the capabilities of bHROS (page 19). Detailed information on bHROS can be found on the Gemini Web page (*www.gemini.edu/sciops/instruments/hros*) or by contacting Katia Cunha (*kcunha@noao.edu*).

NGSC Staff Arrivals and Relocations

Verne V. Smith

We are pleased to announce the following two additions to the scientific staff of the NOAO Gemini Science Center (NGSC). Please join us in welcoming them.

Susan Ridgway joined the NGSC Staff in La Serena, Chile, on 1 July 2006, arriving from her previous position at The Johns Hopkins University in Baltimore, MD. She is expert on Active Galactic Nuclei, radio galaxies, and quasars. Susan will support US users of Gemini's increasingly powerful adaptive optics (AO) capabilities, such as the Laser Guide Star system on Gemini North with NIFS and NIRI, and AO on Gemini South with the arrival of MCAO. She will also help support the heavily used Gemini Multi-Object Spectrographs (GMOS).

Jayadev Rajagopal arrived as an NGSC Staff member in La Serena on the same date. Previously a Michaelson Fellow at NASA's Goddard Space Flight Center in Greenbelt, MD, Jayadev brings research expertise in interferometry, and he will split his observatory support duties between NGSC and the New Initiatives Office.

In mid-June 2006, Bob Blum relocated from NOAO South in La Serena to NOAO North in Tucson. Bob continues his work with NGSC in support of AO programs, as well as Phoenix; he is also working on the Thirty Meter Telescope project.

Plans for Gemini Science 2007 in Iguazú Falls, Brazil

Verne V. Smith & Sally Adams

Building upon the first Gemini Science meeting in May 2004, the next meeting in the series will be held in the second half of May 2007 at Iguazú Falls (Foz do Iguaçú), Brazil. Hosted by the Brazilian National Gemini Office, the three-day meeting will highlight and discuss science results from the Gemini South and North telescopes. The meeting will consist of oral and poster presentations, as well as a users' session including talks about future Gemini instruments and software development, with plenty of time for discussion and feedback.

Foz do Iguaçú is located in southeastern Brazil near its borders with Paraguay and Argentina. The spectacular Iguazú Falls are wider than Victoria Falls and higher than Niagara Falls, and surrounded by the virgin jungle of Iguazú National Park, home to an estimated 2,000 species of flora and 400 species of birds.

The main points of entry for travel to Brazil are Sao Paulo (airport code GRU) and Rio de Janeiro (airport code GIG). Domestic airline service from these airports to Foz do Iguaçú is readily available.

Iguazú Falls, Brazil

Keep an eye on the NGSC (*www.noao.edu/usgp*) and Gemini Observatory (*www.gemini.edu*) Web pages for information on Gemini Science 2007.

NGSC Instrumentation Program Update

Verne V. Smith & Mark Trueblood

The NGSC Instrumentation Program continues its mission to provide innovative and capable instrumentation for the Gemini telescopes in support of frontline science programs. This article gives a status update on Gemini instrumentation being developed in the US, with progress since the June 2006 *NOAO/NSO Newsletter*.

NICI

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

NICI is in the final assembly and testing phase of the project, with pre-ship acceptance testing expected to begin by the end of summer. The NICI adaptive optics (AO) system has been tested. As of July, the static AO performance has been characterized and the dynamic performance tested but not yet fully characterized, with initial results encouraging.

Progress was made in reducing the elevated background signal on the NICI arrays. Furthermore, the electronic noise in the array/controller combination has been reduced from previous levels. Final software fixes are being made in preparation for acceptance testing.

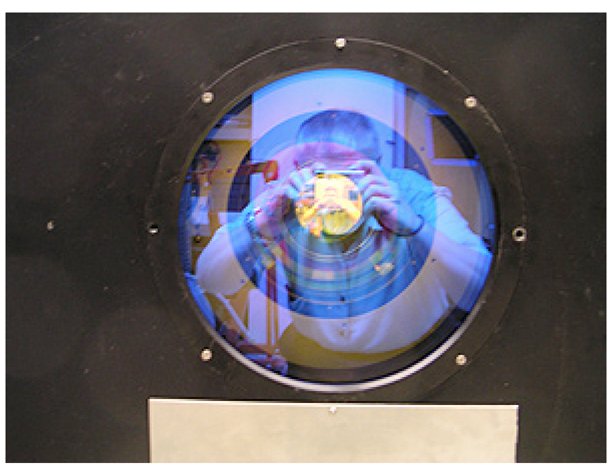
As of the end of June, MKIR reported that 99 percent of the work to NICI final acceptance by Gemini is complete.

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 spectroscopy 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 FLAMINGOS-2 Team is continuing with the integration and testing phase of the project. Previous issues in obtaining the R ~ 3000 grism have been resolved. The science-grade detector was installed following a sudden catastrophic delamination of the engineering-grade detector. A software/hardware incompatibility in the programmable logic array devices used in the detector array controller that was severely restricting the range of integration times was corrected. Instrument and detector control software is complete and is in use to control the hardware. Integration with the Gemini software was begun by Gemini software engineer Roberto Rojas during a June visit to Gainesville. As of July, there are no major technical issues preventing the team from completing the integration work and proceeding to pre-ship acceptance testing.

As of June, the University of Florida team reports that 93 percent of work to FLAMINGOS-2 final acceptance by Gemini is complete.



FLAMINGOS-2 from the entrance window of the MOS Dewar with the imaging port in place on the slit wheel.

2007A Observing Proposals Due 2 October 2006

Todd Boroson

Standard proposals for NOAO-coordinated observing time for semester 2007A (February—July 2007) are **due by Monday evening, 2 October 2006, midnight MST.** 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, HET, Magellan, and MMT.

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

- **Web submission:** 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.

- **E-mail submission:** 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 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 which 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 of your proposal, 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*
HET-specific questions related to an observing run	*het@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*

Two New NOAO Survey Projects

Tod R. Lauer

Two new NOAO survey projects have been approved, with observations beginning in the second semester of 2006. The projects were selected from ten proposals submitted in response to an announcement of opportunity for new surveys.

The NOAO Survey Program is designed to foster observing proposals that require the generation of a large, coherent data set in order to address the proposers' scientific research goals. Survey projects 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 (NSA) for follow-on investigations by other interested astronomers.

continued

Two New NOAO Survey Projects continued

A key part of the evaluation of the survey proposals is determining the likelihood that interesting follow-on investigations can be done with the data products that will not be conducted as part of the primary scientific goals of the survey team itself. 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.

Two new surveys were selected: "The Outer Limits Survey: Stellar Populations at the Extremities of the Magellanic Clouds," Principal Investigator Abhijit Saha (NOAO); and "ChaMPlane II: Optical Spectra and IR Imaging Identification of ChaMPlane X-Ray Sources," Principal Investigator Jonathan E. Grindlay (Harvard/CfA).

The Saha et al. survey will use the CTIO Blanco 4-meter telescope and Mosaic imager to obtain deep stellar photometry in selected areas in the extreme out-lying regions of both the Large and Small Magellanic Clouds. The observations are designed to reach 1.5 magnitudes below the oldest main-sequence turnoff stars, using Washington band-passes to determine ages and abundances.

The scientific goals of this survey are to use the stellar properties as a probe of the very earliest phases in the formation of the clouds, as well as diagnostics of past mergers of smaller stellar systems that gave rise to the clouds or of interactions with the Milky Way. The observations will also elucidate the structural composition of the clouds, and will identify stellar tracers that may be subsequently used to probe the dark matter distribution in the outskirts of the clouds.

The Grindlay et al. survey is a spectroscopic and infrared follow-up to their earlier NOAO ChaMPlane survey, which provided optical identifications of Chandra X-ray sources in the plane of the Milky Way. The new survey will use the CTIO 4-meter with the Hydra multi-object spectrograph to obtain spectra for source classification, and the ISPI infrared camera to obtain J-, H-, and K-band imagery of highly reddened fields that could not be probed with the Mosaic imagery of the initial survey.

This survey's scientific goals are to understand the space density of cataclysmic variables as a function of galactic radius and longitude, as well as to identify quiescent low-mass X-ray binaries and Be-high mass X-ray binaries to constrain the accretion source content of the Galaxy.

Community Access Time Available in 2007A with Keck, HET, Magellan, and MMT

Todd Boroson & 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 2007A:

• Keck Telescopes
A total of eight nights of classically scheduled observing time will be available with the 10-meter telescopes at the W.M. Keck Observatory on Mauna Kea. All facility instruments and modes are available, including the Interferometer. For the latest details, see *www.noao.edu/gateway/keck/*.

• Hobby-Eberly Telescope
About 76 hours of queue observations are expected to be available at the 9.1-meter effective aperture Hobby-Eberly Telescope at McDonald Observatory. Available instruments include the High, Medium-, and Low-Resolution Spectrographs. For the latest information on HET instrumentation and instructions for writing observing proposals, see *www.noao.edu/gateway/het/*.

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

• MMT Observatory
Twelve nights of classically-scheduled observing time will be available with the 6.5-meter telescope of the MMT Observatory. For further information, see *www.noao.edu/gateway/mmt/*.

A list of instruments we expect to be available in 2007A can be found at the end of this section. As always, investigators are encouraged to check the NOAO Web site for any last-minute changes before starting a proposal.

Observing Request Statistics for 2006B 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	170	206.88	1.22	55.14	0.23	0	55.14	3.75
GEM-S	113	175.82	1.56	47.42	0.77	4	43.42	4.05
CTIO								
CT-4m	56	196.9	3.52	86.5	0	0	86.5	2.28
SOAR	11	25.1	2.28	21.5	0	0	21.5	1.17
CT-1.5m	10	36.4	3.64	8.7	0	0	8.7	4.18
CT-1.3m	13	58.3	4.48	9.6	0	1.9	7.7	7.57
CT-1.0m	8	63	7.88	37	0	0	37	1.7
CT-0.9m	20	85	4.25	45.5	0	0.6	44.9	1.89
KPNO								
KP-4m	57	203.6	3.57	112	0	0	112	1.82
WIYN	28	79.8	2.85	40	0	0	40	1.99
KP-2.1m	23	123.2	5.36	93	0	0	93	1.32
KP-0.9m	8	45	5.62	17.5	0	0	17.5	2.57
Community Access								
Keck I	14	20	1.43	7	0	0	7	2.86
Keck II	18	25.5	1.42	6	0	0	6	4.25
HET	12	18.08	1.51	7.45	0	0	7.45	2.43
Magellan-I	5	12	2.4	2	0	0	2	6
Magellan-II	5	10	2	2	0	0	2	5
MMT	20	49.5	2.48	13.5	0	0	13.5	3.67

*Nights allocated by NOAO Director

KPNO Instruments Available for 2007A

Spectroscopy	Detector	Resolution	Slit	Multi-object
Mayall 4m				
R-C CCD Spectrograph	T2KB/LB1A/F3KB CCD	300-5000	5.4'	single/multi
MARS Spectrograph	LB CCD (1980x800)	300-1500	5.4'	single/multi
Echelle Spectrograph	T2KB/F3KB CCD	18000-65000	2.0'	
FLAMINGOS[1]	HgCdTe (2048x2048, 0.9-2.5μm)	1000-1900	10.3'	single/multi
IRMOS[2]	HgCdTe (1024x1024, 0.9-2.5μm)	300,1000,3000	3.4'	single/multi
WIYN 3.5m				
Hydra + Bench Spectrograph	T2KA CCD	700-22000	NA	~100 fibers
DensePak[3]	T2KA CCD	700-22000	IFU	~90 fibers
SparsePak[4]	T2KA CCD	700-22000	IFU	~82 fibers
2.1m				
GoldCam CCD Spectrograph	F3KA CCD	300-4500	5.2'	
FLAMINGOS[1]	HgCdTe (2048x2048, 0.9-2.5μm)	1000-1900	20.0 '	
Exoplanet Tracker (ET)[5]	CCD (4kx4k, 5000-5640 Å)	See Note	Fiber (2.5")	

Imaging	Detector	Spectral Range	Scale ("/pixel)	Field
Mayall 4m				
CCD Mosaic	8Kx8K	3500-9700Å	0.26	35.4'
SQIID	InSb (4-512x512)	JHK + L (NB)	0.39	3.3'
FLAMINGOS	HgCdTe (2048x2048)	JHK	0.32	10.3'
WIYN 3.5m				
Mini-Mosaic[6]	4Kx4K CCD	3300-9700Å	0.14	9.3'
OPTIC[7]	4Kx4K CCD	3500-11000 Å	0.11	9.3'
WTTM	4Kx2K CCD	3700-9700Å	0.11	4.6'x3.8'
2.1m				
CCD Imager	T2KB/F3KB CCD	3300-9700Å	0.305	10.4'
SQIID	InSb (4-512x512)	JHK +L (NB)	0.68	5.8'
FLAMINGOS[8]	HgCdTe (2048x2048)	JHK	0.61	20.0'
WIYN 0.9m				
CCD Mosaic	8Kx8K	3500-9700Å	0.43	59'

[1] Resolution for 2-pixel slit. Not all slits cover full field; check instrument manual
[2] IRMOS, built by John MacKenty and collaborators. Availability will depend on proposal demand and block scheduling constraints.
[3] Integral Field Unit: 30"x45" field, 3" fibers, 4" fiber spacing @ f/6.5; also available at Cass at f/13.
[4] Integral Field Unit, 80"x80" field, 5" fibers, graduated spacing
[5] Exoplanet Tracker (ET) is an instrument provided by 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] OPTIC Camera from U of Hawaii may be assigned as alternative if it meets proposed imaging needs and making such an assignment would further observatory support scheduling needs. Fast guiding mode of operation of OPTIC is now a supported mode for NOAO users of the instrument.
[7] We anticipate that OPTIC will again be available through an agreement with John Tonry of the University of Hawaii. The instrument should be available for scheduling February 1 through April 15, 2007.
[8] FLAMINGOS is an instrument built by Richard Elston and his collaborators at the University of Florida. Steve Eikenberry is currently the PI of the instrument.

Gemini Instruments Possibly Available for 2007A*

GEMINI NORTH	Detector	Spectral Range	Scale ("/pixel)	Field
NIRI	1024x1024 Aladdin Array	1-5µm R~500-1600	0.022, 0.050, 0.116	22.5", 51", 119"
NIRI + Altair (AO)	1024x1024 Aladdin Array	1-2.5µm R~500-1600	0.022	22.5"
GMOS-N	3x2048x4608 CCDs	0.36-1.0µm R~670-4400	0.072	5.5' 5" IFU
Michelle	320x240 Si:As IBC	8-26µm R~100-30,000	0.10 img, 0.20 spec	32"x24" 43" slit length
NIFS	2048x2048 HAWAII-2RG	1-2.5µm R~5000	0.04 x 0.10	3" x 3"
NIFS + Altair (AO)	2048x2048 HAWAII-2RG	1-2.5µm R~5000	0.04 x 0.10	3" x 3"

GEMINI SOUTH	Detector	Spectral Range	Scale ("/pixel)	Field
GNIRS	1Kx1K Aladdin Array	1-5.5µm R~1700, 6000, 18000	0.05, 0.15	3"-99" slit length 5" IFU
GMOS-S	3x2048x4608 CCDs	0.36-1.0µm R~670-4400	0.072	5.5' 5" IFU
T-ReCS	320x240 Si:As IBC	8-26µm R~100,1000	0.09	28" x 21"
Phoenix	512x1024 Aladdin Array	1-5µm R ≤70,000	0.085	14" slit length
bHROS	2048x4608 CCD	0.4-1.0µm R~150000		0.7" or 1" fiber
Acquisition Camera	1Kx1K frame-transfer CCD	BVRI	0.12	2' x 2'

* Please refer to the NOAO Proposal Web pages in September 2006 for confirmation of available instruments.
* Due to time trades, Gemini time is also available with HIRES on Keck and with Suprime-Cam and MOIRCS on Subaru.

CTIO Instruments Available for 2007A

Spectroscopy	Detector	Resolution	Slit
4-m Blanco			
Hydra + Fiber Spectrograph	SITe 2Kx4K CCD, 3300-11,000Å	300-2000	138 fibers, 2" aperture
R-C CCD Spectrograph	Loral 3Kx1K CCD, 3100-11,000Å	300-5000	5.5'
4-m SOAR[1]			
OSIRIS IR Imaging spectrograph	HgCdTe 1Kx1K, JHK windows	1200, 3000	1.3', 3.3'
1.5-m[2]			
Cass Spectrograph	Loral 1200x800 CCD, 3100-11,000Å	<1300	7.7'

Imaging	Detector	Scale ("/pixel)	Field
4-m BLANCO			
Mosaic II Imager	8Kx8K CCD Mosaic	0.27	36'
ISPI IR Imager	HgCdTe (2Kx2K 1.0-2.4μm)	0.3	11'
4-m SOAR[1]			
Optical Imager	E2V 4Kx4K Mosaic	0.08	5.5'
OSIRIS IR Imaging spectrograph	HgCdTe 1Kx1K	0.14, 0.35	1.3', 3.3'
1.5-m[2]			
CPAPIR IR Imager	HgCdTe 2Kx2K	0.9	30'
1.3-m[2 3]			
ANDICAM Optical/IR Camera	Fairchild 2Kx2K CCD	0.17	5.8'
	HgCdTe 1Kx1K IR	0.11	2.0'
1.0m[4]			
Direct Imaging	Fairchild 4Kx4K CCD	0.29	20'
0.9-m[5]			
Direct Imaging	SITe 2Kx2K CCD	0.40	13.6'

[1]The amount of science time available on SOAR in 2007A will be between 40-60%. Classical (i.e. visitor) observing is the only observing mode offered for NOAO proposals.
[2]Service observing only.
[3]Proposers who need the optical only will be considered for the 1.0m unless they request otherwise. Note that data from both ANDICAM imagers is binned 2x2.
[4]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 1.3m. In this case, there will be a corresponding increase in the scheduled time. No specialty filters, no region of interest.
[5]Classical or service, alternating 7-night runs. If proposing for classical observing, requests for 7 nights are strongly preferred.

Keck Instruments Available for 2007A

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
Keck I					
HIRESb/r (optical echelle)	Tek 2048 × 2048	30k-80k	0.35-1.0µm	0.19	70" slit
NIRC (near-IR img/spec)	256 × 256 InSb	60-120	1-5µm	0.15	38"
LRIS (img/lslit/mslit)	Tek 2048 × 2048	300-5000	0.31-1.0µm	0.22	6×7.8'
Keck II					
ESI (optical echelle)	MIT-LL 2048 × 4096	1000-6000	0.39-1.1µm	0.15	2×8'
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"
DEIMOS (img/lslit/mslit)	8192 × 8192 mosaic	1200-10000	0.41-1.1µm	0.12	16.7×5'
OSIRIS (IR IFU w/AO)	2048 × 2048	3800	1-2.4µm	0.02-0.10	0.32x1.28"-3.2x6.4"
Interferometer					
IF (See http://msc.caltech.edu/software/KISupport/)					

HET Instruments Available for 2007A

	Detector	Resolution	Slit	Multi-object
LRS (Marcario low-res spec)	Ford 3072 × 1024			
	4100-10,000Å	600	1.0"-10"×4'	13 slitlets, 15" × 1.3" in 4' × 3' field
	4300-7400Å	1,300	1.0"-10"×4'	13 slitlets, 15" × 1.3" in 4' × 3' field
	6250-9100 Å	1,900	1.0"-10"×4'	13 slitlets, 15" × 1.3" in 4' × 3' field
MRS (med-res spectrograph)	(2) 2K × 4K, 4200-9000 Å	7,000	2.0" fiber	single
		9,000	1.5" fiber	single
HRS (high-res spectrograph)	(2) 2K × 4K 4200-11,000Å	15,000-120,000	2"or 3" fiber	single

MMT Instruments Available for 2007A

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
BCHAN (spec, blue-channel)	Loral 3072 × 1024 CCD	800-11,000	0.32-0.8µm	0.3	150"
RCHAN (spec, red-channel)	Loral 1200 × 800 CCD	200-3,000	0.5-1.0µm	0.3	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	R ~1K	0.38-1.1µm	0.9	60'
Hectochelle (240-fiber MOS, PI)	2 2048 × 4608 CCDs	R ~ 32K	0.38-1.1µm	0.9	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	1.1, 2.1	20", 40"
CLIO (med near-IR imager, PI)	320 × 256 InSb		3-5µm	0.05	15.5" × 12.4"

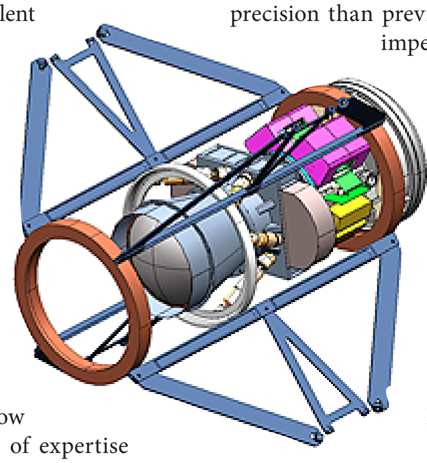
Magellan Instruments Available for 2007A

	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'
Magellan II (Clay)					
MagIC (optical imager)	2048 × 2048 CCD		BVRI, u'g'r'i'z'	0.07	2.36'
LDSS2 (mslit spec/img)	SITe#1 CCD	R~200-1000	0.4-0.8 µm	0.38	6.4'
MIKE (echelle/multi spec)	2K × 4K CCD	R~19000-65000	0.32-1.0µm	0.14	30' (~200 fibers)

Dark Energy Survey Passes Fermilab Review

Timothy Abbott

The Fermilab Director's CD-1 Review of the Dark Energy Survey/Camera project (equivalent to a Conceptual Design Review) was held 25–27 July 2006 at Fermilab in Batavia, IL. Project staff gave a range of presentations on survey science and design, camera design, cost, schedule, and management to a committee of physicists and astronomers with a wide range of expertise in the development of instrumentation projects. The committee close-out report states that the project is in good health, and should move on to the US Department of Energy CD-1 approval stage immediately, and to the CD-2 review next year.



Detector packaging and testing facilities are now well established at Fermilab, and a solid base of expertise has been developed. Monsoon detector controller development is well in hand, and the optical design for the Dark Energy Camera (DECam) is now mature and ready to move into vendor selection. The instrument design explores new territory for the opto-mechanical system, using a hexapod to drive a large mass to higher precision than previously attempted in astronomy, but no major impediments have been identified.

Significant work remains in the areas of instrument control and integration with CTIO facilities, although CTIO has done much to improve the performance of the Blanco 4-meter telescope. While the Dark Energy Survey has been predicated on the current performance of the Blanco + Mosaic II imager, DECam is expected to improve significantly on this combination. The committee urged that a high priority be placed on DECam commissioning at the Blanco in 2010.

Further details on the instrument design can be found in the proceedings of the May 2006 SPIE meeting in Florida, where the instrument team presented several papers.

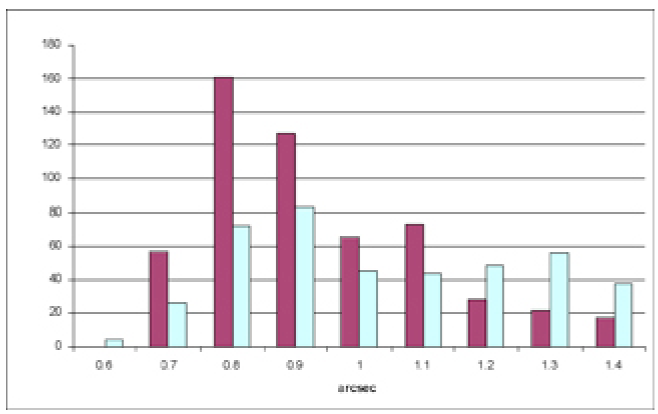
(Image Credit: R. French Leger/Fermilab)

Blanco Update

Timothy Abbott

After suffering an extended shutdown in October-November 2005, the V. M. Blanco 4-meter telescope has shown considerable improvement in performance. Initial efforts to repair and retune the broken radial supports were frustrated when the telescope was reassembled at the end of October, and four additional supports failed within a short period. CTIO staff quickly identified the problem and resolved it. A single radial support did fail again immediately after the second reassembly, but the cause is known and no others have failed since.

Tests have shown that the primary mirror is no longer moving around in its cell, and coma has been relegated to third place (after spherical and astigmatic aberration, not including defocus) from its previous number one position. The measured coma is also stable, and the majority of the remaining measurable translations between the primary mirror and prime focus appear to be the result of flexure of the telescope structure. The improvement in performance is reflected in the figure, showing the change in seeing distribution before and after the shutdown, as found in data from the SuperMacho program, which is obtained under similar conditions throughout.



Improvment in image quality obtained at the Blanco 4-meter telescope by the SuperMacho program, semester 2005B, air-mass corrected, VR filter. Dates: 5 September 2005–31 December 2005. Light color: pre-shutdown, darker color: post-shutdown, with approximately equal number of exposures (~580) each.

SOAR Update

Steve Heathcote

As of July 2006, the SOAR team is busy making the final preparations for the start of regular science operations, with the first NOAO users scheduled to observe at the telescope in mid-August. In all, 42 percent of semester 2006B time is scheduled for science use, with the rest of the time scheduled for ongoing commissioning work.

Looking ahead to the 2007A semester, we anticipate scheduling 50 percent of the time for science (with a goal of 60 percent) so that approximately 27 nights will be available through the NOAO Time Allocation Committee. Again, the instruments available will be the SOAR Optical Imager and the OSIRIS near-infrared imaging spectrometer (see *www.soartelescope.org* for further information on these instruments).

Progress on commissioning the Goodman spectrograph suffered a major set back when it was found that the CCDs were unsuitable for science use. A crash program is currently under way to procure a new detector package, consisting of a custom version of a camera manufactured by Spectral Instruments containing a 4K x 4K Fairchild CCD 486. Work on commissioning the spectrograph itself, using the current detector package, will continue in parallel in order to minimize the time required to bring the instrument into service, once the new camera is delivered.

Meanwhile integration and testing of the Spartan infrared camera continues at Michigan State University, with delivery to Chile and the start of commissioning now expected to take place toward the end of this calendar year.

An update on the status of these two new instruments, and in particular a decision on whether or not they will be offered for the 2007B semester, will be provided in the March 2007 *NOAO/NSO Newsletter*.

Credit: M. Urzúa Zuñiga/Gemini Observatory

CTIO Supports Award-Winning Science

Chris Smith & Nicholas Suntzeff (Texas A&M)

The Shaw Prize Foundation announced its laureates for 2006 on June 21, awarding the Shaw Prize in Astronomy to Saul Perlmutter, Adam Riess, and Brian Schmidt "in recognition of their leadership roles on the two teams that made the remarkable discovery of an acceleration in the rate of the expansion of the Universe."

The discovery of the accelerating universe was made contemporaneously in 1998 by the High-z Supernova Search (High-z SN) team led by Schmidt, and the Supernova Cosmology Project (SCP) led by Perlmutter. Both teams used the CTIO Blanco 4-meter telescope to discover the Type-Ia supernovae (SNe) that were used to measure cosmological distances and derive the evidence for acceleration and the mysterious "Dark Energy." High-z SN team member Adam Riess was also recognized for his leadership in the study of even higher redshift SNe with the Hubble Space Telescope, which provided confirmatory measurements of the acceleration.

The pioneering work that forms the basis of using Type-Ia SNe as precise distance indicators was also done with CTIO telescopes. The Calan/Tololo survey (1990–1995), led by CTIO astronomers Mario Hamuy, Mark Phillips, and Nicholas Suntzeff, provided the first uniform, high-quality sample of low-redshift SNe light curves. This sample was used to discover a method of measuring distances to these supernovae to an accuracy of six percent, making them the most accurate "standard candles" in cosmology.

Based upon these findings, Suntzeff and Schmidt started the High-z SN team in 1994 to pursue the use of these candles in the study of cosmology. The SCP, using a similar distance calibration based on the Calan/Tololo data, began an independent campaign to measure cosmological parameters.

Both teams relied on the wide-field imaging capabilities of the Blanco telescope to identify the significant numbers of high-redshift SNe needed to trace the expansion history of the Universe. They both derived the surprising result that, instead of decelerating due to the mutual gravitation of all galaxies, the expansion is actually accelerating.

The Blanco 4-meter continues to be at the forefront of Dark Energy studies. The ongoing NOAO Survey project named ESSENCE (Principal Investigator Nicholas Suntzeff: see *www.ctio.noao.edu/essence*) is attempting to constrain the equation-of-state parameter of Dark Energy through further studies of Type-Ia SNe. In addition, the recently initiated Blanco Cosmology Survey (PI Joe Mohr: see *www.cosmology.uiuc.edu/BCS/*) has begun observations aimed at probing Dark Energy through its effects on clusters of galaxies.

In the future, the Blanco will host one of the major next-generation probes of Dark Energy, known as the Dark Energy Survey (DES: *www.darkenergysurvey.org/*). The DES will bring a major new facility instrument, the 500-megapixel Dark Energy Camera, to the Blanco to support all NOAO community science in the southern hemisphere.

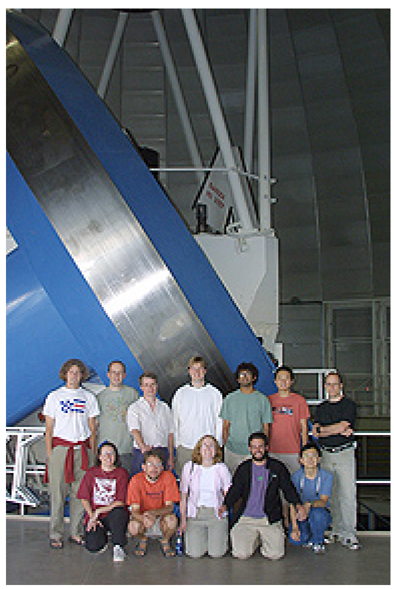
The Shaw Prize honors individuals, regardless of race, nationality and religious belief, who have achieved significant breakthrough in academic and scientific research or its application, and whose work has resulted in a positive and profound impact on humankind. It is an international award managed and administered by The Shaw Prize Foundation in Hong Kong. Previous winners of its astronomy prize have been Geoffrey Marcy and Michel Mayor (2005) and James Peebles (2004). For more information, visit *www.shawprize.org*.

Collaborations Improve Capabilities of KPNO and Our Partners

Buell T. Jannuzi, Sylvain Veilleux (University of Maryland) & Jeremy King (Clemson University)

With the encouragement and advice of the NSF, the AURA Board of Directors, and the Observatory Council, Kitt Peak National Observatory (KPNO) has been working to continue support of its operations and improve its capabilities by forming collaborations that further the scientific and educational missions of the National Optical Astronomy Observatory. We are happy to report the renewal of a successful partnership and the formation of a new collaboration, both of which further the ability of NOAO to provide first-class observing capabilities to the community and our partners. Several smaller instrumentation collaborations are also continuing into FY 2007.

Early in 2006, an external committee was impaneled to review proposals for the formation of collaborations in support of NOAO 4-meter telescope operations, and one proposal for the renewal of an existing partnership to develop instrumentation for KPNO. We thank the committee for their careful and thorough review of the proposals. Following the committee's recommendations, and past guidance from the Observatory Council, NOAO has finalized agreements with the University of Maryland and Clemson University.



University of Maryland faculty and undergraduate summer school students at Kitt Peak in 2004.

Renewal of the KPNO-University of Maryland Collaborative Agreement

A partnership was established between KPNO and the Astronomy Department at the University of Maryland in 2003, following an Announcement of Opportunity in the March 2002 *NOAO/NSO Newsletter* and a series of reviews (see the August 2004 *Newsletter*). This partnership, judged to be beneficial to both parties, has served as an example for developing other new collaborations.

The initial focus of the KPNO-Maryland partnership has been the production of the NOAO Extremely Wide-Field Infrared Imager (NEWFIRM) as a complete scientific system. This instrument is scheduled to see first light in 2007. Maryland has provided financial and in-kind support to this project in exchange for guaranteed access to 20 percent of science nights on the Mayall 4-meter telescope (with possibility of trading for equivalent WIYN or 2.1-meter telescope time).

Maryland's resources have supported the purchase of large optics for the NEWFIRM camera and helped in the procurement of some key NEWFIRM components through competitive bidding to outside contractors. Maryland resources enabled the acquisition of a suite of narrow-band filters not otherwise in the baseline budget, which will be available for use by the astronomical community. Maryland personnel Rob Swaters, Brian Thomas, and Ping Huang are fully integrated into the NOAO pipeline and archive development teams, and their participation has been essential to meeting the delivery schedule for the NEWFIRM system.

The guaranteed access to the Kitt Peak telescopes provided to Maryland has had a strong positive impact on the scientific productivity of the university's department. The high level of interest in these facilities necessitated the formation of an internal review committee to prioritize the requests for telescope time. The Maryland users of the KPNO facilities cover a broad cross-section of the department: nine professorial faculty, seven postdocs and research scientists, and 11 graduate students have used these facilities since semester 2003B. Of the 11 students, nine are using the telescopes in support of their PhD research.

Science highlights include successful searches for and studies of comets and asteroids (e.g., the NASA Deep Impact Mission), detailed ground-based follow-ups of star-forming molecular clouds in our Galaxy mapped by the Spitzer Space Telescope, and analyses of the mass distribution, star formation history, and impact of nuclear activity in nearby and distant galaxies. Science results have already appeared in more than a half-dozen publications, and several other papers are in preparation. The smaller KPNO telescopes have also served as excellent training tools for beginning students. A Kitt Peak summer school has been organized in 2004 (see photo) and 2005 to provide pre-thesis astronomy graduate students with some hands-on experience at the facilities of KPNO.

A proposal to extend the collaborative agreement for an additional three years was submitted by Maryland in late 2005. The extension proposal was reviewed as described above, and accepted in

continued

Collaborations of KPNO and Our Partners continued

June 2006. The terms of this new agreement follow the recommendations of the Observatory Council. The commissioning of NEWFIRM on the Mayall telescope, the advent of the QUad Orthogonal Transfer Arrary (QUOTA), followed by the One-Degree Imager (ODI) on WIYN, and the release of expanded versions of the NOAO Science Archive (NSA), represent major milestones planned for this renewal period. Maryland will contribute both financially and in-kind to these projects through its collaboration with KPNO.

The top software priority will be to finalize the Mosaic and NEWFIRM data reduction pipelines. Much of the effort will focus on streamlining the installation procedure for both pipelines, adding to the documentation, and fine-tuning the user interface to control the pipeline and monitor the data processing and data quality. The WIYN consortium has welcomed the participation of NOAO Data Products Program (DPP) staff in the development and implementation of the QUOTA and ODI data reduction pipeline, so another important component of the collaborative effort will be to adapt the highly flexible and scalable framework of the Mosaic/NEWFIRM pipelines to the higher demands of QUOTA, and eventually ODI, with Maryland playing a role in this effort.

Finally, Maryland will continue to contribute to the development of the NSA. The most exciting areas of potential development include the construction of pipelines to create higher-level data products from NSA holdings of Mosaic and NEWFIRM images, continuation of work on generic catalog query capability to enable queries across multiple heterogeneous catalogs in the NSA holdings, and construction of new Web services for analysis of images and catalogs.

A New KPNO-Clemson Partnership

The new partnership for KPNO recommended by our review panel (beyond those pending with CTIO) is with Clemson University. With a growing astrophysics presence in the university's Department of Physics and Astronomy, the new three-year agreement provides Clemson researchers and students with guaranteed access to 10 percent of Mayall telescope observing time each year, while providing KPNO with needed operating funds. Signed in June, the agreement also allows Clemson astronomers to exchange half of their KPNO 4-meter time for nights on other optical telescopes in the US national system.

This partnership was made possible by an extremely generous $100,000 grant from the Seneca-based Charles Curry Foundation. The agreement demonstrates Clemson's commitment to world-class basic inquiry, graduate education and training, and frontier research resources. Clemson greatly appreciates the continuing generous support of the Curry Foundation in strengthening graduate astrophysics research opportunities at the university.

Clemson astronomers will use their guaranteed telescope access to investigate the origin of hyper-energetic gamma-ray bursts, track the evolution of supernovae explosions, determine the composition of high-redshift gas in the intergalactic medium, search for the formation of planets in circumstellar disks around other stars, and probe the physics of the atmospheres and interiors of stars in the Milky Way. For more information on astrophysics at Clemson, see *www.astro.clemson.edu*.

Instrumentation Collaborations with the University of Florida, STScI, and Goddard Continue

KPNO continues to form smaller but vitally important collaborations to further the development of new instrumentation technology. These agreements bring new capabilities to the community and provide instrument developers with opportunities to test new ideas and technology.

Through these kinds of agreements, we are currently providing observing time with the Exoplanet Tracker (ET, Jian Ge and the University of Florida, see *www.noao.edu/noaoprop/help/etmemo.html* and *www.astroufl.edu/et/*) on the KPNO 2.1-meter telescope; FLAMINGOS (Steve Eikenberry and the University of Florida, see *www.noao.edu/manuals/flmn* and *flamingos.astro.ufl.edu/*); and, the Infrared Multi-Object Spectrograph (IRMOS, John MacKenty of the Space Telescope Science Institute (STScI), with the instrument being a collaboration between NASA's Goddard Space Flight Center, STScI, and KPNO; see *www.noao.edu/manuals/irmos_perf.pdf*).

We are open to forming additional collaborations with teams interested in bringing their instruments to KPNO telescopes. Please contact Buell Jannuzi (*bjannuzi@noao.edu*) with expressions of interest.

NSF Grant Helps Fund Development of New Imager for WIYN 0.9-meter Telescope

Buell T. Jannuzi and Heidi Schweiker

The NSF has awarded a Program for Research and Education with Small Telescopes (PREST) grant to Con Deliyannis and the University of Indiana to support the development of a new wide-field imager for the WIYN 0.9-meter telescope on Kitt Peak, plus observatory upgrades and some new outreach activities.

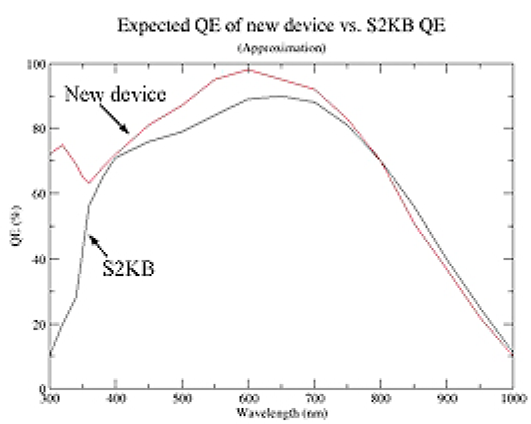
While the KPNO Mosaic-I imager is already available for use at the 0.9-meter telescope for a portion of each observing semester, Mosaic is predominantly scheduled on the Mayall 4-meter telescope, leaving the 0.9-meter without a wide-field imager for most available nights. The NSF funds will enable the construction of the Half-Degree Imager (HDI).

HDI will use monolithic four-amp 4K x 4K CCDs with 15 micron pixels providing a 29 arcminute field of view sampled with 0.43-arcsecond pixels. HDI will be available to members of the WIYN 0.9-meter consortium (see *www.noao.edu/0.9m/general.html*) and the general astronomical community. Approximately 10 percent of the telescope nights that HDI is scheduled will be available to the general community. There will also be public access to the WIYN 0.9-meter special observing queues (the long-term synoptic and "opportunity" queues).

Together with Mosaic, HDI will provide a competitive imaging capability in support of the scientific and education missions of the WIYN 0.9-meter.

On 27 June 2006, the WIYN 0.9-meter telescope was struck by lightning. Portions of the recently awarded PREST grant will be used to improve the lightning protection of this observatory.

The KPNO Mosaic camera is available for use with the WIYN 0.9-meter telescope (above), but is primarily used with the Mayall 4-meter telescope. With the 0.9-meter, Mosaic provides a one-degree field of view with approximately 0.6-arcsecond pixels. The new Half-Degree Imager, while providing only a 0.5-degree field of view, will have smaller pixels (0.43 arcseconds), a better match to the good image quality provided by the telescope and the site.



When Mosaic is not scheduled on the 0.9-meter, the available imager is the KPNO CCD S2KB, which is not competitive with the characteristics of the detectors planned for the Half-Degree Imager. HDI will provide a wider field of view than S2KB and a more sensitive system.

From the Director's Office

Steve Keil

The NSO Long Range Plan, covering FY 2006 through FY 2010, is now available on the NSO Web site (*/www.nso.edu/general/docs/*). Upcoming major milestones in the plan include commissioning of SOLIS in 2007, with the long awaited release of the SOLIS full-disk vector magnetograms. More time than expected has been spent on calibrating the vector data, but great care has been taken to ensure that reliable data are released. A VSM vector working group has recently been formed to finalize the vector data processing pipeline.

The Advanced Technology Solar Telescope (ATST) project approaches a major milestone this fall, when the NSF conducts a Preliminary Design Review with the aim of understanding all cost and management issues associated with construction of the ATST. A successful review should result in the ATST project being forwarded to the Major Research Equipment and Facilities Construction (MREFC) Panel for approval, and followed by submission to the National Science Board (NSB) early next spring. The NSB will then decide if and when ATST should enter the MREFC queue, and its ranking with respect to other projects in the queue. This could then lead to funding in the 2009–2010 period. The ATST project will hold its next Science Working Group meeting this October, with a meeting of members of the newly forming ATST International Organization occurring shortly after.

Will Rogers with granddaughter Kyaa Gilliam during the farewell gathering at Sunspot.

Other milestones that will greatly enhance observing capabilities at NSO include commissioning of the Diffraction-Limited Spectro-Polarimeter (DLSP) as a user instrument at the Dunn Solar Telescope (DST) in 2007. NSO and the High Altitude Observatory are jointly purchasing a new infrared camera for the Spectro-Polarimeter for Infrared and Optical Regions (SPINOR). The DST observing crew is quickly learning the ins and outs of SPINOR, which should become a user instrument (no longer shared-risk) within the 2007–2008 time frame. At the McMath-Pierce, we are rapidly gaining experience in the near-infrared with the NSO Array Camera (NAC). The combination of the NAC with the infrared adaptive optics system (IRAO) is a powerful tool for studying solar magnetic fields, as demonstrated by high-resolution sunspot granulation videos collected in May. The NAC, with IRAO, remains a shared-risk user instrument, as filter and modulator tests continue this fall.

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The NSO Users Committee met in Durham, NH, during the June AAS Solar Physics Division meeting. The combined report from that meeting and from the December 2005 meeting is available at *www.nso.edu/general/committees/*. The committee highlighted the importance of releasing SOLIS vector field data, given the imminent launches of STEREO and Solar-B, and the expected synergism of these missions with the SOLIS project.

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The current cooperative agreement between the National Science Foundation and AURA to operate NSO and NOAO is mid-way through its five-year term. The NSF conducted a review of AURA management in July to determine whether the agreement should be renewed or reopened for competition. This review is one of several factors that would enter into such a decision. NSO prepared a self-evaluation for the review and has participated in the panel review. Meanwhile, we await the report of the NSF Senior Review on all its ground-based facilities. This review could have broad impact on future NSO long-range planning.

Kathy Plum with her farewell gift, a painting by artist Wesley Keil.

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This summer, NSO bid farewell to two long-term staff at Sac Peak. William A. "Will" Rogers retired from the facility crew at Sunspot, where he operated heavy equipment, ran the "one man" motor pool, and generally assisted with facility projects. Will has been with the observatory since 1982, and he will be deeply missed. We wish him well in his retirement. Kathy Plum, who has served as cook at Sunspot for the past 11 years, had to leave her position due to health issues exacerbated by the high altitude. Kathy's excellent lunches and outstanding catering of meetings and workshops are well known throughout the solar community. Just as an army does, an observatory advances on its stomach, and Kathy will be missed by all of us who have enjoyed her cooking. We hope that moving to a lower altitude will quickly restore her health, and we wish her all the best for the future.

ATST Update: Preliminary Design Review Scheduled; Refinements Made to Optical Design

The ATST Team

The NSF Division of Astronomical Sciences and Office of the Deputy Director for Large Facility Projects will conduct the Preliminary Design Review (PDR) for the Advanced Technology Solar Telescope (ATST) in Tucson, Arizona in October. The review committee will assess the progress of planning for the ATST project. The proposed ATST, a four-meter aperture, off-axis Gregorian telescope with integrated adaptive optics and coronal capability, will be used for high-resolution studies of the solar atmosphere — the photosphere, chromosphere, and corona — with emphasis on the generation and evolution of magnetic fields that are key to our understanding of solar activity.

Construction funds for the ATST would come from the NSF's Major Research Equipment and Facilities Construction (MREFC) account. The construction of the ATST is a specific recommendation of a number of National Research Council-level studies, including the most recent astronomy and astrophysics decadal survey. The NSF has supported the design and development of the ATST facility and instrumentation since FY 2001 with funds from the divisions of Astronomical Sciences and Atmospheric Sciences. Both internal and external panels, including the MREFC panel and the Mathematics and Physical Sciences Advisory Committee, have scrutinized the project with respect to its scientific relevancy, broader impacts, preliminary management plans, and preliminary bottom-up cost estimate. NSF Director Arden Bement promoted the project to "Readiness" stage in September 2004.

ATST design and planning have been reviewed by several external committees. Systems Design Reviews (SDR) were conducted by the project in late 2005 and early 2006, covering the telescope mount assembly, M1 assembly, enclosure, support facilities and building, and site infrastructure. Instrument-focused SDRs have also been conducted.

The MREFC process defined in November 2005 stipulates that a requirement for a project's exit from the Readiness phase is the successful completion of an NSF conducted PDR. The PDR committee will consider our site-specific design, major subsystems and their interconnections, cost estimates, and risk analysis, including contingency estimates. Upon successful completion of the NSF conducted PDR, the project will be considered for submission to the National Science Board (NSB) as early as March 2007, as a candidate for inclusion in a future NSF budget. Following positive NSB consideration, Congress and the Office of Management and Budget will then determine when and if funding for ATST construction will begin. Under reasonable current assumptions, the earliest start date for ATST construction is FY 2009. Given the federal budget and appropriations processes, this would imply an initiation of construction funds early in calendar year 2009.

A near-term milestone for ATST is the release of the Draft Environmental Impact Statement, scheduled for late August, to be followed by public hearings in late September. The next Science Working Group meeting will be held October 16–19 on Maui.

Meanwhile, the project has initiated several industry contracts to further define aspects of the telescope design, including work on the site-specific foundations, aspects of the heat stop, the M2 and M5 (tip/tilt) mirrors, and the deformable mirror (DM) for the high-order adaptive optics.

The wavefront correction system encompasses several systems designed to "iron out the wrinkles" in the incoming solar image. At the heart of the system is the high-order adaptive optics (HOAO), with a DM that is reshaped so it is the reverse of the constantly changing, distorted lens formed by Earth's atmosphere. A tip/tilt mirror compensates for gross image motions caused by atmospheric turbulence and telescope vibration.

The optical arrangement of the ATST has been refined in recent months to improve performance and incorporate recommendations from instrument partners and the Science Working Group. In the refined design, the DM has been moved from the M5 position inside the elevation axis for the Optical Support Structure, down to M9 inside the support tower in the coudé laboratory, with the tip/tilt mirror shifted to the M5 position. This shift was an early recommendation of the Conceptual Design Review committee in its report.

There are several advantages to the refined design, both from performance and functional aspects. If the deformable mirror was at the top, which rotates with the telescope, then the wavefront correction system would have to translate. With the DM in the coudé lab, compensation for pupil rotation is no longer necessary.

As part of the shift, the tip/tilt mirror was moved from M6 to M5. Because this mirror has a much smaller angle of incidence, the beam footprint, and therefore the mirror dimension, can be significantly smaller. This reduces

continued

ATST Update continued

the weight of the optic, which in turn improves tip-tilt performance.

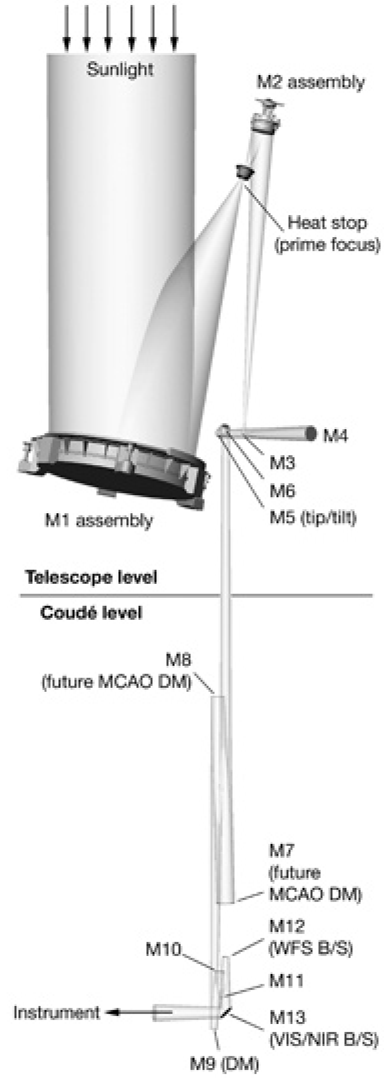
A contract with Physik Instrumente (Waldbromm, Germany) is now underway to perform risk analyses on the M5 tip/tilt and M2 secondary mirrors. Project engineers are concerned about meeting the bandwidth requirements because M5 is still a relatively large mirror, about 230 millimeters in diameter, as compared to 35 millimeters for the tip/tilt mirror on the Dunn Solar Telescope. The mirror must move rapidly, ±40 arcseconds, up to 200 times per second , to stabilize the image. Optical performance must be maintained while pushing and pulling on the mirror at these high rates. In addition, air jets on the back must keep the temperature at 0 to –2 degrees Centigrade of ambient.

Using the project's performance-based specifications, Physik Instrumente will develop models that predict how the mirror will react to loads. The company will perform a similar analysis for the M2 mirror, which will be used to help stabilize the image when ATST uses the all-reflective Nasmyth focus for observations of the corona.

The project is also evaluating proposals for mechanical design of the M9 deformable mirror, including thermal control, which may include both air and liquid systems, and performance analysis. Risk mitigation is essential for thermal control of the mirror, which also is 0 to –2 degrees Centigrade.

The M7 and M8 mirror positions were adjusted several months ago so they could potentially be replaced with deformable mirrors to form a multi-conjugate adaptive optics (MCAO) system providing diffraction-limited observations over a wider field of view. To that end, Project Scientist Thomas Rimmele has been leading experiments with two DMs at the Dunn: one conjugated (i.e., focused on) atmospheric turbulence just outside the telescope, the other at altitudes from two to nine kilometers. Significant progress with the development of solar MCAO has been made, with the experiments clearly demonstrating the capability of substantially increasing the corrected field of view.

On the instrument side, the Visible Broadband Imager (VBI) is also scheduled for a systems design review this summer. The VBI design was recently switched from a zoom lens system, which proved to be too slow and expensive, to a two-in-one blue and red/near-infrared imaging system. Sizing and uniform coating will be a challenge, as most of the narrow band filters used at the Dunn have diameters of 2.5 to 5 centimeters, with bandpasses of about 10 angstroms. The VBI will require 7.5 centimeter-diameter filters, some of which will have bandpasses of just 0.2 angstroms, requiring greater precision (over four to nine times as much area as the smaller filters).



The current optical layout of the ATST. Positions of M7 and M8 were adjusted to be conjugate with atmospheric turbulence at 6 and 11 kilometers, respectively. This will allow easy replacement with deformable mirrors when the anticipated future upgrade to high-order multi-conjugate adaptive optics (MCAO) is performed. Two mirrors act as beamsplitters: M12 to pass five percent of the light to the wavefront correction system, and M13 to divide the visible and near-infrared light beams, as well as to steer the beam to selected instruments. Alternatively, the beam can be focused at the Nasmyth position, which forms a smaller image with a minimum number of reflections.

SOLIS

The SOLIS Team

Interest remains high in the SOLIS vector spectromagnetograph (VSM) magnetograms. With the return to nominal operation of the VSM instrument following modulator replacement, work has resumed in earnest on the vector algorithms. In addition to finalizing the vector calibration procedures for the new modulators, the Milne-Eddington inversion code is in the process of being updated to work with full-disk data. The original inversion code was not designed to treat the full-disk, so development time is needed to create and apply position dependent "quiet-Sun" line profiles.

Figure 1. SOLIS data processing aides Nathan Hadder, Jessica Goodman and Alex Toussaint pause a moment from their work in the SOLIS area. All three are supplementing their studies at the University of Arizona with projects related to VSM magnetogram data.

Three data processing aides — Jessica Goodman, Nathan Hadder and Brittany Shaw — joined the SOLIS team in early February 2006 to help reprocess and reorganize VSM longitudinal 630.2 and 854.2 nanometer data, and to remove instrumentation artifacts and outliers from flat-field and continuum images.

Jessica Goodman graduated in May from the University of Arizona with a double major in physics and mathematics, and is taking this year to prepare for graduate school. Jessica has made great progress de-trending and removing instrumental artifacts from VSM continuum images, and has improved limb-profile fitting and modified overall radial fits to compensate for imperfect tracking across the disk. Nathan Hadder will be working to complete a third major in mathematics at the University of Arizona this fall, in addition to already completed degrees in physics and astronomy. He has reprocessed longitudinal 630.2 nanometer photospheric magnetograms from 2004 to include improvements in dark subtraction and camera cross-talk elimination, and he streamlined the offline data reduction process. Nathan is currently revising the browser interface to allow quick search and display of VSM data based on user queries, and translating code between programming languages. Brittany Shaw graduated from the University of Arizona in May with a double major in physics and astronomy. She applied her experience with open cluster CCD imagery to improve the treatment of VSM flat fields. Brittany left Tucson following graduation, but her work was a good start toward more robust flat-field reduction.

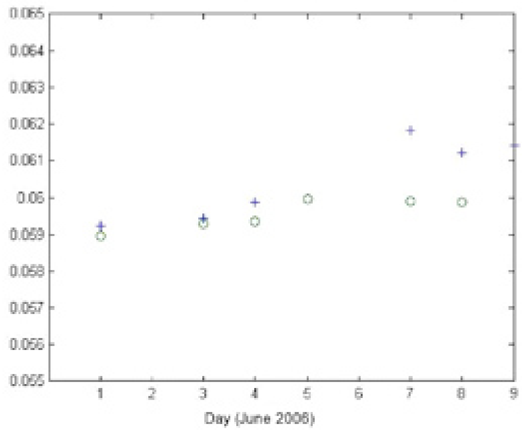
Our most recent data processing assistant, Alex Toussaint, was hired in June. Alex graduated in May with a major in mathematics, and was drawn to this position by the opportunity to compress calibrated vector data using Hermite functions. Thus far, he has been exploring windowing techniques to properly select lines and the surrounding continuum.

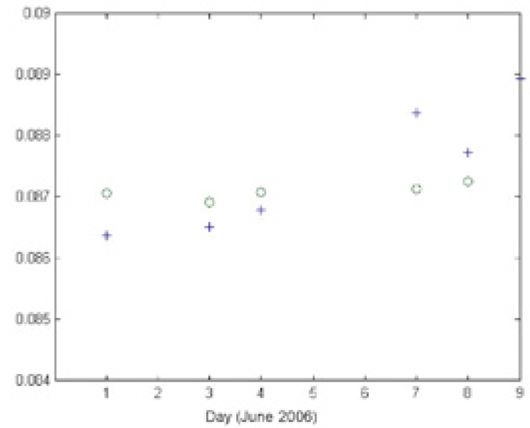
Correlation between solar disk-integrated spectra from the Integrated Sunlight Spectrometer (ISS) and the McMath-Pierce Solar Telescope began this summer, with the help of NSO Research Experiences for Undergraduates student Tiffany Hayes (University of New Mexico). This initial investigation compares the parameters pertaining to width, intensity, integrated area, and position of absorption features within the Ca II K line. ISS resolution is approximately 50 percent higher than resolution at the McMath-Pierce spectrograph, but interpolation of both datasets enables spectral features to be measured identically. Figures 2 and 3 show comparisons of K3 core intensity and the 1Å K-index from spectra acquired during the first week of June at the ISS and McMath-Pierce.

Integrated sunlight Ca II K-line spectra have been acquired at the McMath-Pierce scanning spectrometer for the past three decades. Correlation between spectra at the McMath-Pierce telescope and ISS provides an important benchmark for ISS calibration, and achieves continuity with the invaluable dataset obtained by Bill Livingston (NSO) at the McMath-Pierce in the multi-decadal program he began in 1974.

continued

SOLIS continued





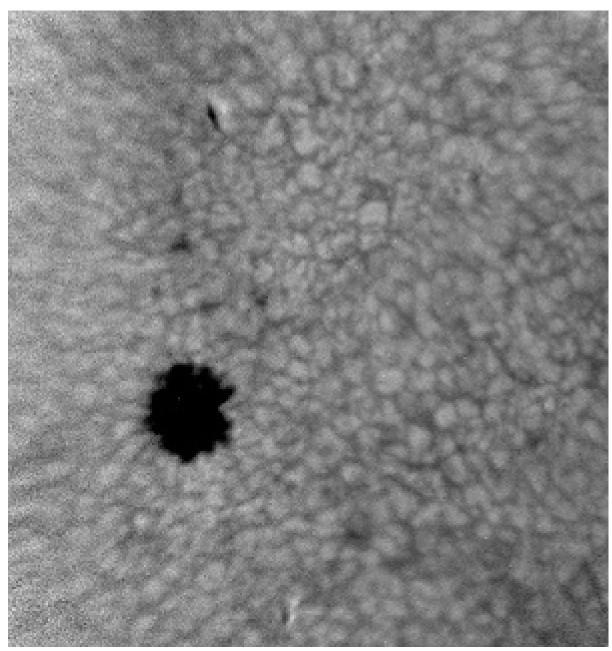
Figures 2 (left) and 3 (right). Initial comparison of K3 core intensity and 1 Å K-index for Ca II K λ 3933 from spectra acquired with the SOLIS ISS (crosses) and McMath-Pierce photoelectric scanning spectrometer (open circles) during the time period 1–8 June 2006. Dark subtraction and flat correction were applied to ISS spectra previous to measurement of features, and the intensity normalization point for both spectra was taken at 3935.046 Å in the red wing of the K line. The intensity reference at this point was 0.1756.

Granulation Imaging in the K-band with the NSO Array Camera

Matt Penn

In May 2006, imaging tests were done with the NSO Array Camera (NAC) system on the main telescope at the McMath-Pierce facility. The infrared (IR) adaptive optics system was used in conjunction with the main spectrograph; the diffraction grating was used in zeroth-order, and the slit removed from the system to relay an image to the camera for these initial tests. Several nighttime objects were observed in the K-band, including stars, Jupiter, Saturn and the Moon.

During the day, a two-hour granulation time sequence was collected in the K-band around the small sunspot in NOAA region number 10880. The IR adaptive optics system used the small sunspot to compute the wavefront correction for the entire field of view. A frame from the time sequence is shown in the accompanying figure, in which the field of view is only about 40 arcseconds across. The image contrast is highly enhanced to show the granulation. During the two-hour time sequence, evolution of granulation is seen clearly, as are flows that move the granules in the region surrounding the small sunspot.



Granulation at 2.2 microns imaged with the NAC system at the McMath-Pierce facility in May 2006. The field of view is about 40 arcseconds across, and the small sunspot in region NOAA 10880 is visible.

Successful First Summer School in Solar Physics

Dave Dooling

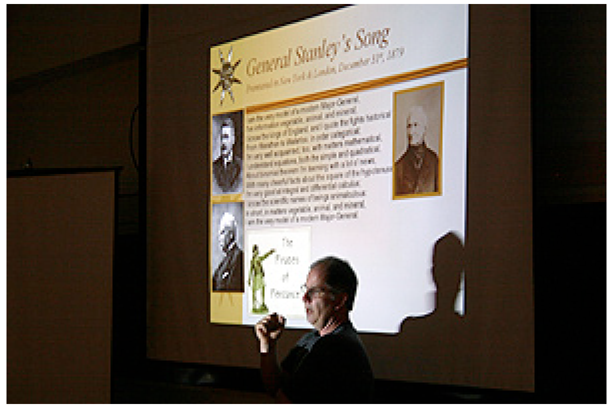
More than 30 students and faculty attended the first of five, week-long Summer Solar Physics Schools held by the National Solar Observatory (NSO) and the University of Arizona's Lunar and Planetary Laboratory (LPL). The school was held June 11–16 at the NSO Sacramento Peak (Sac Peak) site in Sunspot, NM.

"This was a highly successful first session," said LPL conference organizer Joe Giacalone. "We were fully subscribed and we were pleasantly surprised to find some faculty interested in attending so they could enhance how they teach solar physics." The latter included two representatives from the Space Studies Department at the University of North Dakota, which is expanding its astronomy offerings.

The workshop was designed for advanced undergraduate and beginning graduate students interested in the physics of the Sun and possible careers in solar physics, space physics, or related fields. Lectures were given by Giacalone on solar energetic particles, Rachel Howe and Rudi Komm (NSO) on helioseismology, Randy Jokipii (University of Arizona) on solar magnetohydrodynamics, Gordon Petrie (NSO/Tucson) on the solar interior, Han Uitenbroek (NSO) on radiative transfer, K. S. Balasubramaniam (NSO) on photospheric and chromospheric fields, and by Tom Bogdan (Director, Space Environment Center, Boulder, CO) on solar-terrestrial history.

Social activities included a pizza/stargazing party, a barbecue, a trip to White Sands National Monument, and a visit from a brown bear attracted to the breakfast foods available at one of the morning lectures.

The summer school was supported in part by a grant from the National Science Foundation.



"I am the very model of a modern solar scientist."
Thomas Bogdan, director of the Space Environment Center in Boulder, responded to a challenge from the audience by reciting these words from General Stanley's song in the Pirates of Penzance. Bogdan described Major General Edward Sabine as a modern major general for his 1859 prediction that "In our present ignorance of the physical agency by which periodical magnetic variations are produced, the possibility of discovery of some cosmic connection which may throw light on a subject yet so obscure, should not be altogether overlooked."

Summer 2006 Solar Physics School participants at Sunspot, NM.

GONG

Frank Hill & the GONG Team

It has been a very busy quarter, with the GONG team engaged in a variety of projects. The scientific staff has been preparing for our major biennial meeting in Sheffield, UK. The network operations staff successfully completed the shelter swap at Learmonth. In anticipation of the new and improved magnetograms and the upcoming STEREO launch, the data processing group has been busy constructing a magnetogram pipeline. On top of all this, GONG team members have been crisscrossing the globe, participating in a number of international meetings.

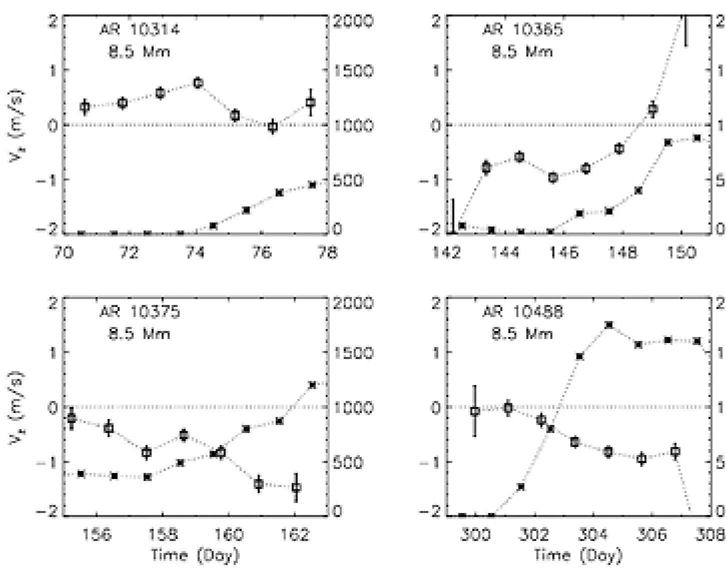


Figure 1. One of the current goals of helioseismology is to detect active regions before they emerge on the surface of the Sun. Because emerging magnetic flux is typically accompanied by upflows, one approach is to search for pre-emergence signatures of active regions in subsurface flows. In addition, previous studies have shown that established active regions exhibit downflows near the surface at depths less than about 10 megameters. Thus we expect to see a variety of flow characteristics depending on the state of evolution of the active region. The figure compares the evolution of four active regions, indicated by the region's area (stars) with the temporal variation of the vertical velocity (squares) measured at 8.5 megameters below the surface. The location of AR10314 (top left) shows an upflow (positive values) before the region emerges (days 70–74). The location of AR10488 (bottom right) shows no pronounced up- or downflow while the region emerges, but shortly after the region is visible on the surface (days 302–308) the characteristic downflow (negative values) is present. The other two regions, AR10365 (top right) and AR10375 (bottom left), are aging regions characterized by downflow where new flux emerges during their disk passage. After new flux emerges, the flows change to upflows in the case of AR10365, and to even stronger downflows in the case of AR10375. From this very small sample of four active regions, we confirm that the relationship between the flows and the temporal evolution of the regions is indeed complex. A large statistical sample is currently being analyzed in a search of a reliable indicator for active region emergence.

Science Highlights

One of the goals of modern helioseismology is to develop tools for space weather prediction, and local helioseismic techniques can certainly contribute to this goal. For example, farside holography can detect large active regions up to two weeks before solar rotation brings them onto the Sun's front side. However, there is no way as yet to use the farside signal to predict the activity level of approaching sunspots. Irene González Hernández is working on an empirical calibration of the farside signal by comparing the signal to the properties of the active regions when they are directly visible. Preliminary results suggest that the area of the sunspot is an important factor in determining the magnitude of the farside signal.

Another local helioseismology technique, ring-diagram analysis, recently revealed that active regions producing a large number of strong flares are almost always associated with a particular pattern of subsurface velocity. With this in mind, the ring diagrams are now being further developed as space weather predictors. This summer, Sushant Tripathy and Kiran Jain worked with Research Experiences for Undergraduates (REU) student Stephanie de Wet (Rice University) on a study of ring-diagram parameters and Coronal Mass Ejections (CMEs). They have found that distinctive changes in the amplitudes and widths of the rings occur prior to the onset of a CME. Rudi Komm and Rachel Howe, along with Satoshi Morita (Japan Aerospace Exploration Agency), analyzed the subsurface vertical flow field to search for signs of active region emergence. Figure 1 shows encouraging results for one case, where an increasing upflow was detected approximately two days before the magnetic flux appeared on the surface.

continued

GONG continued

GONG staff mentored two participants in the Research Experiences for Teachers (RET) program this summer. Charlene Olson, a physical science, integrated chemistry and physics teacher from Central Middle School in Kansas City, MO, worked with Cliff Toner on temporal variations in the solar limb darkening to determine if the shape of the Sun changes with the solar cycle. Dalfra Lynn Fleming, a physics, chemistry, and computer science programming teacher at Walker High School in Walker, LA, worked with Gordon Petrie on solar wind predictions using coronal hole maps derived from SOLIS synoptic spectroheliograms and magnetograms.

Network Operations & Engineering
Installation of the new magnetogram modulator hardware continued with a visit to Cerro Tololo in April. While on site, preventive maintenance tasks were performed for the first time in almost two years. One significant improvement was the replacement of a malfunctioning CCD camera.

The major undertaking for this quarter was the replacement of the Learmonth shelter. The first group arrived on site during the second week of May. People came and went as the work progressed, in response to the quantity of work and skills needed, until the instrument became operational in the third week of June.

continued

2006-07-20 22:58 UTC [Thu Jul 20 15:58:02 2006 MST]
Monitor View: All Gong Sites

	Instrument and Workstation Status									Software Status			
GONG Site	Local Time	Reporting Time (UTC)	Min. Ago	Instrument Mode	CPU Load	# Users	/ (root)	/home	/gong1	Reporting Time (UTC)	Min. Ago	Good Obs.	Bad Obs.
LE	06:58	07/20 22:50	8	STOW	0.53, 0.27, 0.25	2	1%	15%	59%	07/20 22:53	5	0	0
UD	04:28	07/20 22:35	23	STOW	0.43, 0.22, 0.25	2	1%	12%	3%	07/20 22:51	7	0	0
TD	22:58	07/20 22:50	8	STOW	0.13, 0.17, 0.22	1	1%	19%	50%	07/20 22:53	5	0	0
CT	18:58	07/20 22:50	8	STOW	0.55, 0.29, 0.25	2	1%	16%	59%	07/20 22:53	5	0	0
BB	14:58	07/20 22:35	23	OBSERVE	0.76, 0.95, 0.99	1	47%	27%	44%	07/20 22:51	7	148	389
ML	12:58	07/20 22:50	8	OBSERVE	1.22, 1.50, 1.52	2	40%	51%	74%	07/20 22:53	5	360	5

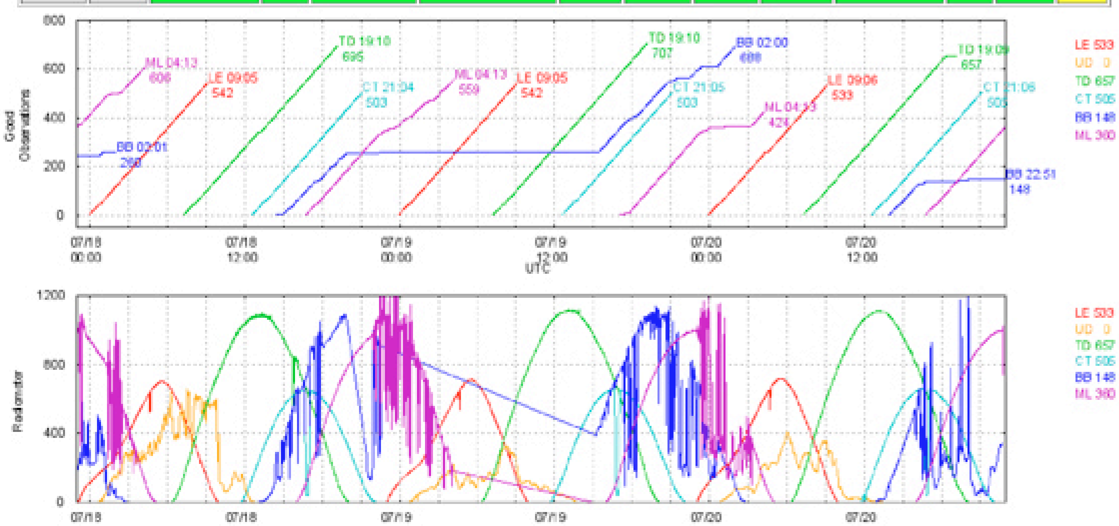


Figure 2. This figure shows a portion of the new GONG monitor Web page, available at http://gong.nso.edu/monitor/monitor.html, allowing a real-time assessment of instrument health network-wide. The page shows information about the operation of all of the sites in the GONG network at a particular time. The "monitor" shows the progress of data collection for each station over the previous three days and the information is updated every five minutes. The top panel shows the status of the sites including instrument mode, instrument computer load and disk usage, and the number of good and bad images collected during the current observing day. The lines in the middle panel represent the number of good images, as a function of time, for each site. The bottom panel shows the sky brightness as a function of time at each site. Clear days are visible as smooth curves, where cloudy days have a jagged appearance. Simultaneous coverage and duty cycle can also be inferred from the plots.

GONG continued

Work on the Hot Spare is in progress, with most of the work being done in the Instrument Shop. Wiring of the system electronics rack and chassis began in August.

The new modulator hardware was installed at Learmonth when the instrument was reassembled after the shelter swap, completing the installation of the upgrade at all GONG sites. Data from the sites are being monitored, and results indicate that poor weather during the installation at Mauna Loa prevented proper alignment, requiring a follow-up trip to realign that modulator.

Data Processing & Analysis

Software Maintenance and Development

The majority of the software team is working on various parts of the magnetogram pipeline, which is the group's top priority. The driver for the pipeline development is the NASA STEREO launch, now scheduled for 31 August 2006. GONG will be providing near-real-time magnetograms and synoptic maps to the STEREO science team, thus playing an active role in the mission's coronal science.

Figure 3. On 9 May 2006, the first team of Tucson-based GONG operations personnel arrived in Australia to initiate the installation of a new GONG shelter. The largest team to be together, as teams one and two overlap, is pictured above, with (from left to right) George Luis, Guillermo Montijo, Dave Dryden, Bert Villegas, Sang Nguyen, Dave Hauth, Gary Poczulp, and Ron Kroll.

Steady progress is being made in the porting of our Solaris-based calibration pipeline to the Linux platform. The Linux port runs several times faster than our current Solaris code, and consequently, we expect a significant reduction in our processing backlog.

A new "GONG Network monitoring tool" has been developed and implemented. This tool allows a quick real-time assessment of instrument health network-wide, which is essential for near-real-time pipeline development. The tool may also prove to be helpful in diagnosing problems at the remote stations. A view of the monitor for 20 July 2006 is shown in figure 2. The tool is accessible through the "Network Status" link on the main GONG Web page.

Data Operations

Processing to date includes month-long (36-day) velocity time series and power spectra through GONG Month 107 (centered at 03 November 2005), with a fill factor of 0.93. 108-day Mode Frequency Tables and Ring Diagrams are available through Month 106. Last quarter, the Data Storage and Distribution System (DSDS) distributed 1.5 terabytes in response to 21 data requests.

The Dwarf Moves to a New Home

Hugo Ochoa & Dara Norman

Long-time visitors to Cerro Tololo will notice that one of the smallest domes has left the summit. This three-meter diameter dome housed "El Enano" or "The Dwarf," as it was affectionately nicknamed: a commercial Cannon 50-millimeter camera lens (operated at *f*/1.6) mounted in front of a 1025 x 1025 Texas Instruments CCD with 12 micron pixels, for a field of view of 13 x 13 degrees.

The robotic telescope first appeared on Tololo in 1997 to begin observations for the Southern H-Alpha Sky Survey Atlas (SHASSA). The resulting atlas covers the entire southern sky south of +15 degrees declination to a brightness level of two Rayleighs (*PASP*, 113, 1326, 2001). For comparison, the faintest nebulosities visible on the Palomar Sky survey (POSS I) are about 100 Rayleighs. The atlas has also been used to confirm that the WMAP spacecraft survey of microwave background anisotropies was not being confused by foreground emission from Galactic hydrogen.

In 2002, a second phase of the project was begun to obtain images at the wavelength of [SII] emission lines for all those regions showing H-alpha emission. The brightness ratio of [SII]/H-alpha will differentiate between HII regions heated by ultraviolet light from stars and those heated by shock waves from supernovae.

In June of this year, El Enano was donated by John Gaustad (Swarthmore College) and Wayne Rosing (Las Cumbres Observatory Inc.) to the Centro de Apoyo a la Didáctica de la Astronomía (CADIAS, Center for the Support of Astronomy Education) and Colegio Seminario Conciliar (Conciliar Seminary School) in La Serena. CADIAS receives funding from NOAO and Gemini to conduct local astronomy outreach, and this group works closely with the seminary school.

The telescope currently resides at CADIAS in Altovalsol, a 15-minute drive from downtown La Serena, but it will eventually be moved to Cerro Mayu, 25 kilometers east of La Serena, where Colegio Seminario Conciliar is building their new observatory. With additional support from the University of La Serena, El Enano will be used by local educational institutions for several purposes: 1) to promote astronomical education and involve students in astronomical activities, 2) to develop high-level astronomy projects for Chilean students and amateur astronomers, and 3) to enhance awareness and protection of Chilean dark skies.

While El Enano begins new life as an educational tool, Tololo looks forward to its sequel, El Enano II, for which there are plans to begin a third phase of the survey by gathering images of [OIII], which should aid in temperature determinations.

Hands-On Optics Engages Local Boys & Girls Clubs

Stephen Pompea

This summer, the NOAO Hands-On Optics (HOO) program went on the road to the Boys & Girls Clubs in the city of South Tucson and in the town of Sells, on the Tohono O'odham Nation. The program introduced the science of optics to the kids through entertaining activities using lasers, mirrors, telescopes, infrared and ultraviolet light, and laser communications.

Figure 1. Focusing a telescope built using an activity from HOO Module 3.

Establishing the program at these Boys & Girls Clubs provided an ideal opportunity for effective local outreach, as well as a chance to further develop our materials in different informal education settings, and to aid us in adapting these materials for use with younger audiences. The HOO-based programs will continue through the next year at both locations. The project is also looking to expand in the next year to other Boys & Girls Club in Tucson, as well as to other southwestern clubs serving Native American students.

At the South Tucson Boys and Girls Club 73 children participated in some aspect of the program classes, which met twice a week with an average of 22 students participating each day. There were approximately equal numbers of boys and girls, and about twice as many seven-to-ten year olds as 11-14 year olds (the usual target audience for the program). On July 6, the 18 children who had the highest attendance record for the program over the first three weeks traveled to Kitt Peak National Observatory to participate in the Visitor Center's Nightly Observing Program.

The program at the Sells Boys & Girls Club was also well received. On the last day, the club program director asked for a show of hands among the three dozen children in attendance of how many kids had participated in the HOO program—about 90 percent of the children raised their hands. She then asked how many would be interested in having the program continue—likewise, 90 percent of the children raised their hands. In addition to conducting activities at the Boys & Girls Club in Sells, the NOAO HOO team participated in a special optics event at Pisinemo, in association with the "Tohono O'odham Truck of Love" summer day camp.

The Boys & Girls Club program team at NOAO consisted of four undergraduate students working in the outreach group at NOAO; University of Arizona science education Ph.D. candidate and NSF GK-12 Fellow Erin Dokter; and NOAO HOO project staff members Rob Sparks, Katy Garmany, and Connie Walker, who managed the team effort.

Figure 2. An HOO demonstration of how a polarization filter works.

Hands-On Optics is an NSF-sponsored informal education program for middle school students created by NOAO, the Optical Society of America, and SPIE–The International Society for Optical Engineering. HOO is being used in museums and science centers across the country, and in after-school classes in seven states. Hands-On Optics workshops for educators were offered this summer in Los Angeles and Livermore, CA, and will also be conducted this fall by the NOAO team in Tucson, Albuquerque, Longmont (CO), Baltimore, and Boston.

For more information about the project, go to *www.hands-on-optics.org* or contact Hands-On Optics project director Stephen Pompea (*spompea@noao.edu*).

The Gemini Virtual Tour - Version 4.0

Peter Michaud (Gemini Observatory)

The Gemini Observatory Public Information and Outreach (PIO) office recently completed a new version of its popular Virtual Tour CD-ROM. This new incarnation has several important additions, particularly the inclusion of Spanish language text and audio to make the tour entirely bilingual.

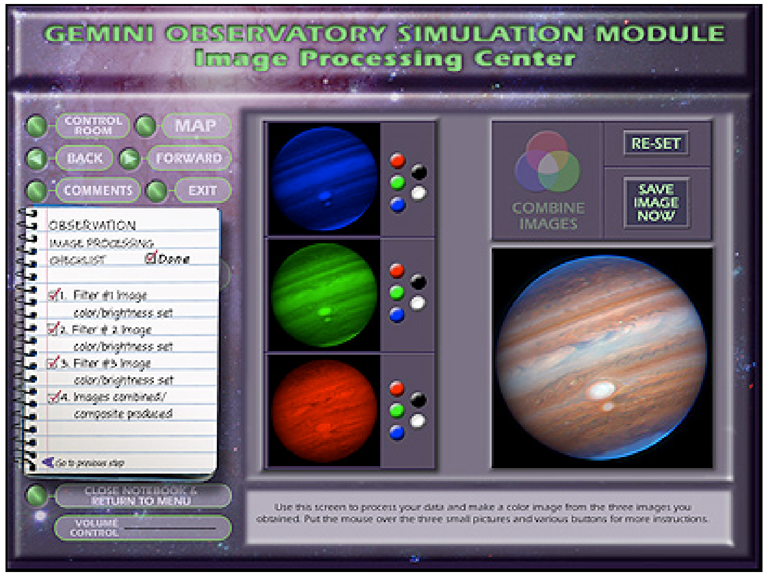
The new release (scheduled for duplication in September 2006) builds on the diverse educational content of the Virtual Tour, from simulated observations using actual Gemini data, to a Screen-Saver Maker that allows users to make a custom computer screen-saver from an assortment of spectacular Gemini images.

All of the elements of the previous tour have remained in this version. These include an interactive walking tour of a Gemini observatory (with hidden surprises), "news reports" updated from the Web, several games, and the Electromagnetic Radiation Explorer. As always, the tour can be installed on Mac or Windows computers, and is available in an entirely mouse-driven mode for bulletproof use in a public kiosk.

The addition of the Spanish translations was completed by Antonieta Garcia of the Gemini South PIO office, assisted by Guillermo Bosch of the Argentina Gemini Office, and Gemini Staff Astronomer Eleazar Rodrigo Carrasco Damele.

Plans are currently underway to produce a complete French translation of the program, in an effort led by Stephanie Coté of the Herzberg Institute of Astrophysics/National Research Council, Victoria, Canada.

To request a copy of the tour on CD-ROM, please send an email (including your postal mailing address) to *geminivt@gemini.edu*.



CTIO REU Program 2007

Cerro Tololo Inter-American Observatory (CTIO) anticipates offering six undergraduate research assistant positions from January to March 2007 under the Research Experiences for Undergraduates (REU) program funded by the National Science Foundation.

The CTIO REU program provides an exceptional opportunity for undergraduates considering a career in science to engage in substantive research activities with scientists working at the forefront of contemporary astrophysics. This research takes place in the stimulating environment of three major international observatories (CTIO, Gemini South, and SOAR). These REU students work alongside Chilean undergraduates participating in a parallel program.

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

Participants must be enrolled as full-time undergraduate students during the REU program, and must be citizens or permanent residents of the United States. The program will run for 10 weeks approximately January 15 to March 24, 2007. The positions are full-time, with roundtrip travel costs to La Serena covered, and furnished housing provided at the AURA/CTIO compound for an added cost. Complete applications, including all necessary applicant information, official transcripts, and two to three letters of recommendation, should be submitted no later than 2 October 2006.

Applications are online at *www.ctio.noao.edu/REU/ctioreu_2007/reuad2007.html*. For additional information, contact *ctioreu@noao.edu*.

REU students are not the only wildlife known to appear occasionally on Cerro Tololo!

Credit: M. Urzúa Zuñiga/Gemini Observatory