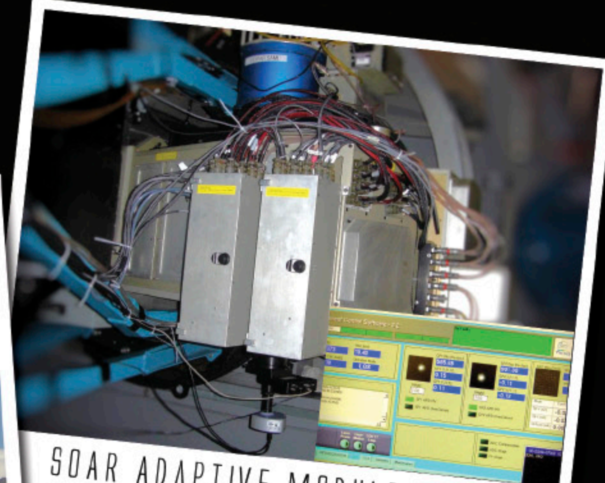
NOAO NEWSLETTER

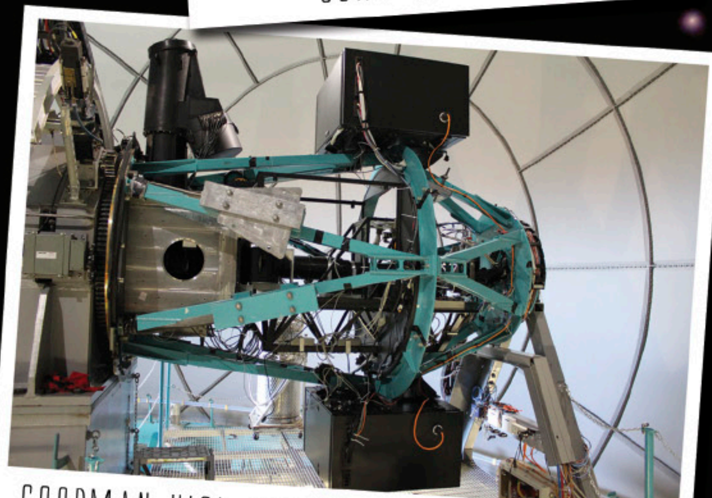
Issue 103, March 2011



SOAR ADAPTIVE MODULE (SAM)

SOAR TELESCOPE

SPARTAN INFRARED CAMERA



GOODMAN HIGH THROUGHPUT SPECTROGRAPH

NOAO

NOAO Newsletter

NATIONAL OPTICAL ASTRONOMY OBSERVATORY

ISSUE 103 — MARCH 2011

Science Highlights

System Science Capabilities

System Observing: Telescopes & Instruments

NOAO Operations & Staff

On the Cover

Against a background of Eta Carina, taken with the SOAR Adaptive Module in Natural Guide Star mode (clockwise from top left): The SOAR telescope on Cerro Pachón, the SOAR Adaptive Module (SAM), the Spartan Infrared Camera, and the Goodman High Throughput Spectrograph.

The background image is a color composite of B (blue), R (green), and I (red) images and was obtained during the commissioning of SAM and its integrated imager (SAMI) on a night with good stable seeing. The full width half-maximum of the adaptive-optics-corrected images was 0.19" in I. See "SAM Update: Working Toward a Laser Guide Star System on SOAR" on page 16 for the latest news of the status of SAM.

The Spartan Infrared Camera is a high-resolution, near-infrared imager built at Michigan State University. The camera has a focal plane consisting of four "Hawaii-II" 2048 × 2048 pixel HgCdTe detectors, which, when used with the *f*/12 optics, offers a field of view of 5.0 × 5.0 arcminutes at a scale of 0.073"/pixel. Broadband J, H, K filters and a variety of narrowband filters are available.

Built at the University of North Carolina, Chapel Hill, the Goodman spectrograph employs all transmissive optics and Volume Phase Holographic gratings to achieve the highest possible throughput for low-resolution spectroscopy over the range of 320–850 nm.

Image credit: Andrei Tokovinin, Jayadev Rajagopal, Luciano Fraga, and SAM Team/NOAO.

As a reminder to our readers, we have changed our format to make the *Newsletter* more useful and informative by making the sections subject-oriented. They are:

Science Highlights—This will remain, as it has been, a place for highlighting scientific accomplishments in astronomy/astrophysics.

System Science Capabilities—This includes articles about the telescopes and instruments under development and the plans for enhancing the US ground-based optical/infrared system of telescopes. These articles will pertain to the facilities provided to the US astronomical community by the Cerro Tololo Inter-American Observatory, Kitt Peak National Observatory, Gemini Observatory, SMARTS and SOAR consortiums, Telescope System Instrumentation Program, and Renewing Small Telescopes for Astronomical Research program.

System Observing: Instruments & Telescopes—This section contains everything readers will need to know to propose for observing time with the above-mentioned facilities.

NOAO Operations & Staff—This may include the NOAO director's article and articles about the operations/management of and the people involved with the National Observatory.

We continue to encourage our readers to view the *Newsletter* online (*www.noao.edu/noao/noaonews.html*). We send out an electronic notification when the *Newsletter* is posted online, generally several weeks before hard copies reach all our readers. We welcome comments on the *Newsletter*. If you are receiving a paper copy but would prefer not to, please let us know at *editor@noao.edu*.

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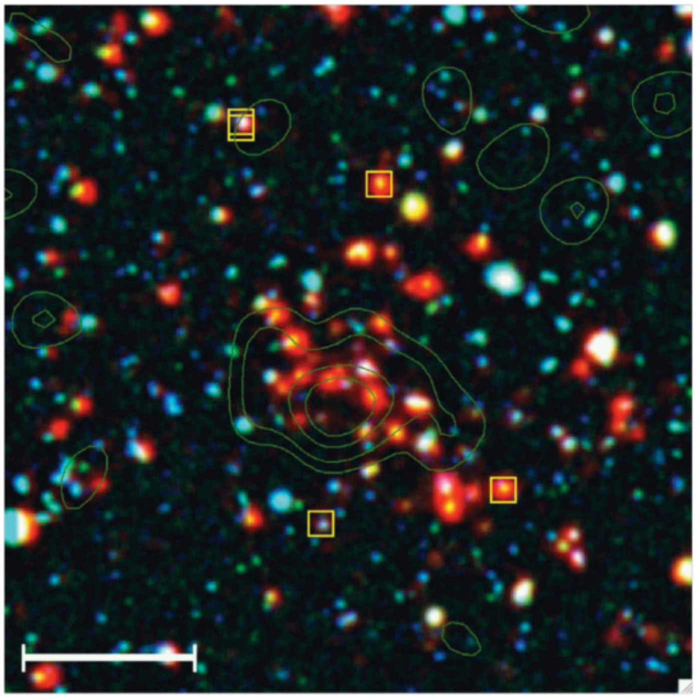
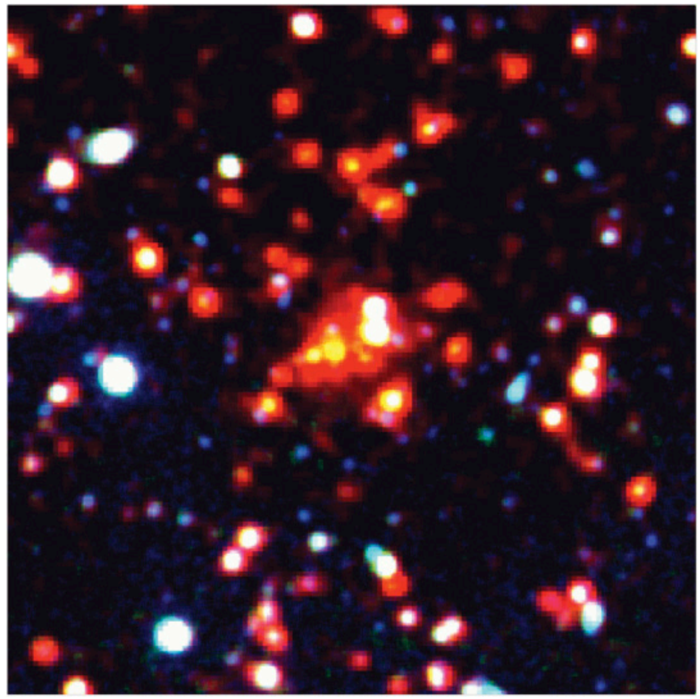
Finding Galaxy Clusters in Boötes

Anthony Gonzalez (University of Florida)





The left image is a B_W, I, 4.5-µm composite for the highest-redshift, spectroscopically confirmed cluster in the ISCS (z = 1.49). Contours for the X-ray detection of this cluster are shown in green, spectroscopic members that lie within the field are marked with yellow squares, and the scale bar corresponds to 30″. The image on the right (I, J, 4.5 µm) presents a new candidate at z ~ 1.8 detected using IBIS data in conjunction with NDWFS and SDWFS observations. Both clusters are detected at high significance in this new search. The field-of-view for each image is 2′.

The Infrared Boötes Imaging Survey (IBIS) is an infrared imaging program conducted with NEWFIRM on the Kitt Peak National Observatory Mayall 4-m telescope, surveying the entire NOAO/Spitzer Deep Wide-Field region in *J, H,* and K_S. This program is designed to facilitate diverse science programs by complementing existing optical (B_W, *R, I*) and Spitzer/Infrared Array Camera (IRAC) surveys in the field. Examples include characterization of low-mass, brown dwarf candidates (Eisenhardt et al. 2010), star formation histories of high redshift "dust-obscured" and "sub-millimeter" galaxies (Bussman et al. 2011), and UV-bright star-forming galaxies (Lee et al. 2010). The central scientific aim of IBIS, however, is detection of galaxy clusters and groups at $z > 1.5$ to enable direct studies of cluster galaxy evolution during an era of active star formation and cluster assembly. At this time, the survey has identified several hundred such galaxy clusters.

The survey employs a detection technique similar to the IRAC Shallow Cluster Survey (ISCS; Elston et al. 2006, Eisenhardt et al. 2008). A 4.5-µm-selected galaxy catalog with full photometric redshift probability distributions for the full sample serves as input for the over-density detection algorithm. For the ISCS, this approach yielded 116 cluster candidates at $z > 1$ with a less than 10% false positive rate for clusters with spectroscopic follow-up, but it is predominantly restricted to $z < 1.5$—the region where photometric redshifts were robust.

The combination of deep JHK_S imaging from IBIS with the existing optical (NOAO Deep Wide-Field Survey-NDWFS) and IRAC (Spitzer Deep Wide-Field Survey-SDWFS) data is designed to provide robust photometric redshifts for L_* galaxies out to $z \sim 3$, enabling detection of the relatively low-mass, high-redshift systems that are the progenitors of present day clusters like Coma. The full analysis of the cluster sample is still underway, but to highlight the potential of the survey, the figure shows images for two distant clusters for which Gonzalez and his team are obtaining Hubble Space Telescope/Wide Field Camera infrared grism observations. The system on the left is the highest redshift confirmed cluster from the ISCS ($z = 1.49$, $M_{200} \approx 2.5 \times 10^{14}\ M_\odot$; Brodwin et al. 2011) and detected at high significance in the IBIS. The system on the right is a candidate from the IBIS with estimated redshift $z \sim 1.8$, for which confirming grism observations will soon be available.

This survey is also intended to serve as a resource to the community. All processed images from the survey have been publicly released through the NOAO Science Archive, and the survey team also has provided *J*-selected matched catalogs for each of the 52 tiles spanning the survey region.

continued

Finding Galaxy Clusters in Boötes continued

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NEWFIRM and the Carnegie-Spitzer-IMACS Survey

Daniel Kelson (Carnegie Observatories), Rik Williams (CO), Alan Dressler (CO), Patrick McCarthy (CO), John Mulchaey (CO), August Oemler (CO) & Steve Shectman (CO)

Understanding the formation and evolution of galaxies and large scale structure is one of the outstanding challenges of astrophysics. However, significant gaps remain in our understanding of galaxy formation due in large part to the limited volumes, depths, and precision of current galaxy surveys. To remedy these issues, Kelson and his collaborators began an ambitious spectroscopic survey of distant galaxies that achieves unprecedented depth and area, the Carnegie-Spitzer-IMACS Survey (CSI). A key part of this survey is the use of the NEWFIRM wide-field infrared imager at the CTIO 4-m telescope to provide broadband infrared (IR) imagery over large areas.

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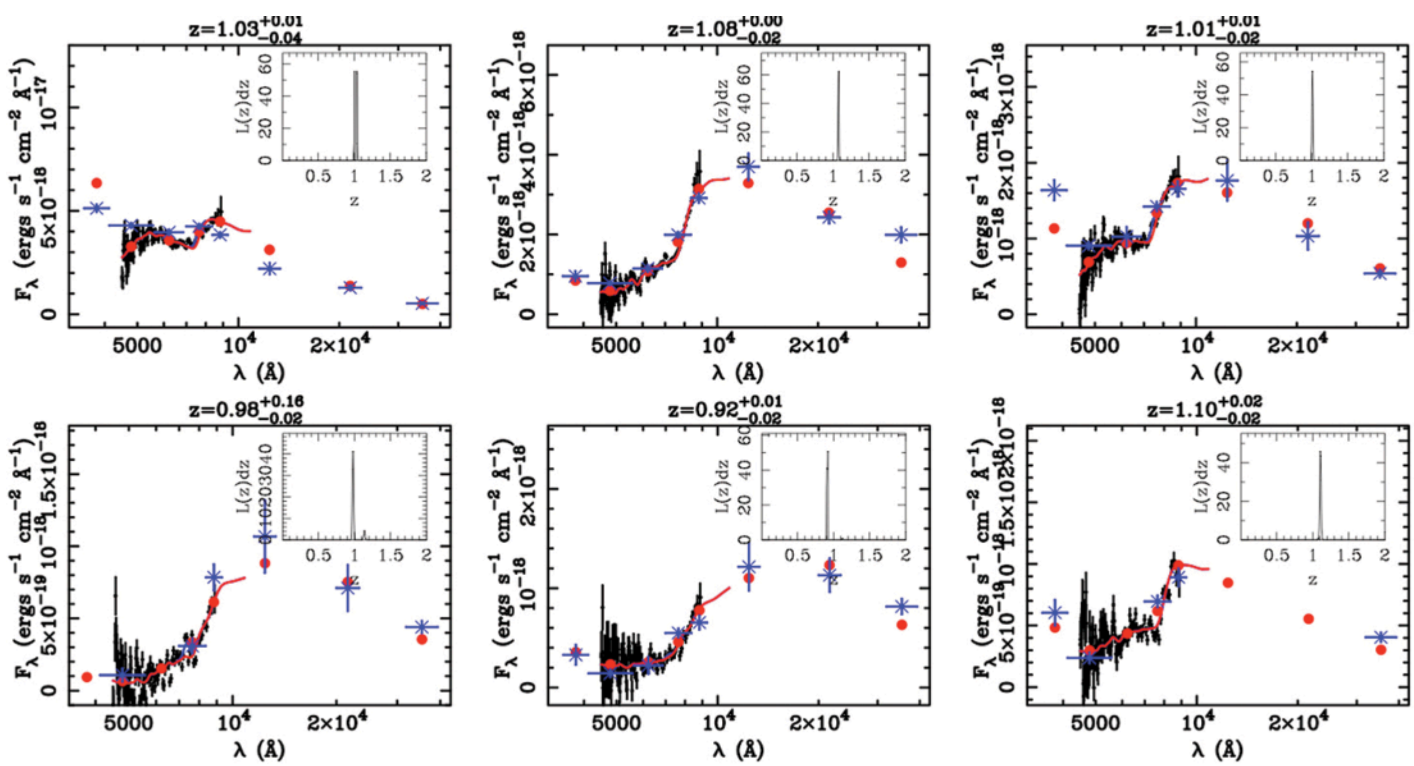

Figure 1: Random galaxies in CSI at z ~ 1 (Kelson et al. 2011, in preparation). (top) Three brighter than the Deep Extragalactic Evolutionary Probe (DEEP2) limit of r = 24.1 AB mag (Willmer et al. 2006). (bottom) Three fainter than r = 25.1 AB mag. These SEDs show IMACS low dispersion prism spectra (black) plus ugrizJK_s fluxes (blue). Template fits are shown in red and the resulting redshift likelihood functions are inset. The bright optical flux limits of DEEP2 or the Prism Multi-object Survey (PRIMUS) (Coil et al. 2010) skew samples at z = 1 more towards UV-bright, and potentially low-mass, galaxies than does a nearly stellar mass-limited survey like CSI.

NEWFIRM and the Carnegie-Spitzer-IMACS Survey continued

CSI targets three separate fields totaling 15 square degrees, selecting galaxies from the Spitzer Legacy Infrared Array Camera (IRAC) imaging at 3.6 mm (SWIRE, Lonsdale et al. 2003). Together these provide a sample that efficiently traces stellar mass over 2/3 the age of the universe and a volume comparable to the Sloan Digital Sky Survey. This unique methodology measures redshifts from multiwavelength spectral energy distributions (SEDs) (see Figure 1) constructed by combining low-dispersion spectroscopy from the Inamori-Magellan Areal Camera and Spectrograph (IMACS) (Dressler et al. 2011) on the 6.5-m Magellan telescope with broadband optical and near-IR photometry, achieving a redshift precision of $dz/(1+z) \leq 1\%$. CSI was granted NOAO Survey status in 2009 to obtain the necessary JHK_s imaging over the three fields.

The example CSI SEDs in Figure 1 show a handful of galaxies at $z \sim 1$ in the Spitzer Wide-Area Infrared Extragalactic Survey (SWIRE) XMM field. Kelson and his team are particularly focused on $0.8 \leq z \leq 1.5$, a range difficult to probe using traditional spectroscopy, and an epoch over which photometric redshifts are insufficiently accurate for characterizing local environments. With a typical source density of seven galaxies per square arcmin to the IRAC flux limits, and an expected completeness of ~2/3 based on the current success rates, the CSI Survey is expected to deliver SEDs like these for ~250,000 galaxies from $z = 0$ to $z = 1.5$.

The combination of multi-object slit spectroscopy with a low dispersion prism (LDP) gives an order-of-magnitude gain in multiplexing capability compared to other instruments on 8-m class telescopes. IMACS on the Baade 6.5-m telescope at Las Campanas Observatory delivers flux-calibrated, low-resolution spectra of 2,000 to 4,000 faint objects simultaneously over its D = 27' diameter field-of-view, depending on the source density. In 2007, IMACS was outfitted with the LDP by S. Burles for a large, optically-selected redshift survey (PRIMUS; Coil et al. 2010). Figure 2 shows the basic characteristics of such IMACS data.

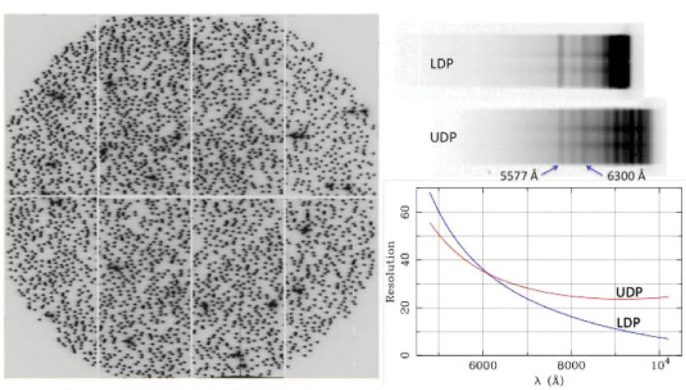

Figure 2: (left) IMACS multislit mask with very low dispersion prism spectra for 3,412 objects in the field of a rich cluster at z = 0.83, studied previously by Kelson (see Patel et al. 2009a, 2009b, 2011). (top right) Example LDP spectrum—the nod-and-shuffle observing mode produces doubled object and sky spectra. Night sky lines 5577 Å and 6300 Å are marked. Below the LDP spectrum is one taken with the newly deployed UDP, showing the more uniform dispersion of the uniform dispersion prism (UDP) compared to the LDP in the bottom right.

The left panel of Figure 2 shows a single IMACS LDP exposure with a multislit mask covering 3,412 galaxies in the field of a rich cluster at $z = 0.83$ studied previously by Kelson (see Patel et al. 2009a, 2009b, 2011). The high density of spectra, even within a single slit mask, allows one to sample overdensities very efficiently, yielding statistical samples of galaxies in a broad range of environments with few masks per pointing.

The upper right of Figure 2 shows a blow-up of a single nod-and-shuffle (Glazebrook and Bland-Hawthorn 2001) spectrum of a single object with the LDP. The poor resolution beyond ~8000 Å is evident in the blended OH lines; the run of the resolution with wavelength for this prism is shown as the blue line in the lower right. This poor resolution of the LDP in the far red limits the redshift precision for galaxies $z \geq 1$ and also greatly reduces one's ability to reliably estimate emission line fluxes. To mitigate these problems without sacrificing the benefits of extreme multiplexing, Kelson and his team have designed, constructed, and deployed a new "uniform dispersion prism" (UDP). An example nod-and-shuffle UDP spectrum is shown in the upper right of Figure 2, along with the run of its resolution with wavelength by the red line in the lower right. The new data have a factor of 2–3 greater information content beyond 8000 Å, with R ~ 25 out to the silicon cutoff. The difference is plainly visible in the night sky emission lines.

The IRAC flux limit of 21 AB mag allows for the definition of minimally biased samples down to masses as low as $M_*/2$, half the characteristic galaxy mass, at $z = 1.5$. With improved CCDs in IMACS that are a factor of ~2.5 times more sensitive at 9000 Å than the original detectors used by PRIMUS, CSI can reach two magnitudes fainter in the optical. In contrast to DEEP2's magnitude limit of $R = 24.1$ AB mag, CSI's near-IR flux limits and redshift success rates are equivalent to an optical limit of $R = 26.1$ AB mag. Such a depth allows the study samples of galaxies that are more complete below M_* to $z = 1.5$. Equally important is the increased resolution beyond 8000 Å, allowing measurement of the [O II] 3727 Å emission line to $z = 1.4$. Characterizing the simultaneous evolution of [O II] star formation rates and stellar mass as a function of environment and redshift are the chief goals of the survey.

The NEWFIRM near-IR imaging is a key component of the survey, providing fluxes in the long gap between the optical and IRAC data and greatly improving the reddening and stellar mass determinations from stellar population fitting. NEWFIRM, the only instrument in the US system that can provide the necessary combination of near-IR depth and sensitivity, is used to pare the three fields down to $J = 21.5$ mag, $H = 20.5$ mag, and $K_s = 20.0$ mag (Vega, D = 3", 10-σ). The survey has already completed the J and K_s imaging in both the SWIRE-XMM and Chandra Deep Field South (CDFS) fields, and has completed J and begun K_s in SWIRE-ES1. It should complete the southern fields while NEWFIRM is at CTIO, then wrap up with H in the XMM field when NEWFIRM returns to KPNO. The survey is reaching its targeted depths at the expected levels of efficiency. Only clouds and occasional minor technical hiccups have slowed its progress.

The first CSI paper is being prepared with the redshifts of the first 20,000 galaxies, in nearly five square degrees of the SWIRE-XMM field, obtained with the original low dispersion prism. Some additional data verification remains to be performed in order to characterize the quality of individual measurements for public consumption. This work proceeds in parallel with the assembly of the first paper. The survey team anticipates releasing the first batch of products when the first paper is released. An additional 40,000 galaxies have been observed in 2010 with the uniform dispersion prism in the same SWIRE-XMM fields, and their redshifts are being measured now. While the XMM field has been the highest priority, work is also being done to amass samples in SWIRE-ES1 and SWIRE-

continued

NEWFIRM and the Carnegie-Spitzer-IMACS Survey continued

CDFS. Redshifts for these fields will be computed as their NEWFIRM data are taken and reduced.

The most exciting results from the first batch of CSI data directly test the evolution of the correlation between star formation and environment (see Patel et al. 2009b, 2011; Cooper et al. 2010; and others). With 20,000 redshifts over nearly five square degrees, and the high spatial sampling afforded by the prism spectroscopy, the data statistically sample a few hundred group- and cluster-sized halos. Furthermore, because each galaxy has a detailed SED suited to stellar population and emission line modeling, constraints are possible on star formation rates, star formation histories, and stellar masses for large numbers of galaxies in both the field and in halos with a broad range of masses. Multiple indicators (UV flux and [O II] 3727 Å) provide estimates of star formation over different timescales. By combining these derived properties one can study the spatial distributions of active and passive galaxies as a function of group mass and redshift. Figure 3 shows the galaxies from $0.8 < z < 1.2$. Large scale structure in the distribution of galaxies and groups of galaxies is clearly visible.

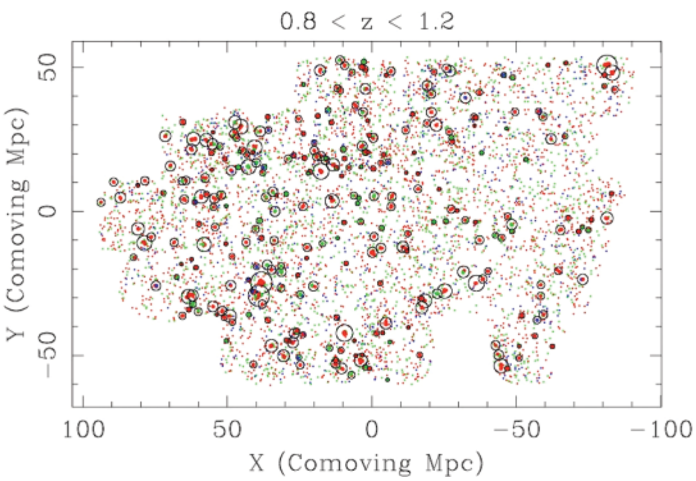

Figure 3: The spatial distribution of galaxies in a large fraction of the SWIRE-XMM field at redshifts $0.8 < z < 1.2$. Open circles mark the positions of groups identified through a friends-of-friends algorithm, where the diameters are proportional to the log of the stellar mass of the group (corrected for source-density-dependent incompleteness that is also a function of galaxy color and magnitude). Small points mark the positions of those galaxies outside of groups with stellar masses greater than log $M_* > 11.5$. Larger points mark the positions of galaxies inside the groups. Red points indicate galaxies with log SSFR(200 Myr) ≤ -11.5. Green and blue indicate galaxies with log SSFR > -11.5 dex, where green and blue mark galaxies with log SSFR([O II]3727Å) less than or greater than -9.7 dex.

Tallying the samples, and correcting for source-density+magnitude +color-dependent incompleteness, Kelson and his team have quantified the fraction of galaxies with on-going or recent star formation as a function of environment, with the results shown in Figure 4. The cyan symbols plot the fraction for those galaxies not identified as a member of any group (or pair); the orange symbols show the run of the star forming fraction with the group stellar mass. Even with the moderate uncertainties in the analysis to date, due to cosmic variance and the sampling statistics that come with a single slit mask per pointing (so far), very little evolution in the correlation between relative star formation activity and halo mass is seen in the data to $z \sim 1$, which is consistent with other studies of star formation rates, galaxy colors, and galaxy morphologies as functions of local galaxy density (van der Wel et al. 2007; Patel et al. 2009a, 2009b, 2011).

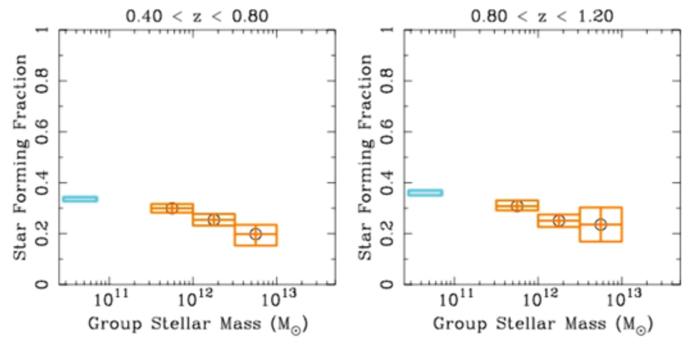

Figure 4: (Orange) The fraction of massive (log $M_* > 10.5$), star-forming (log SSFR > -11.5) galaxies as a function of group stellar mass. The cyan box marks the fraction for those galaxies outside of the detected groups. No significant evolution is seen in the correlation between star forming fraction with halo stellar mass. With the bulk of the stellar mass already in place by $z = 1$ (e.g., Cirasuolo et al. 2007), perhaps it is not surprising that little evolution is seen here to $z \sim 1$. When the CSI survey is completed, it will have more than 10 times as many galaxies, covering more than 3 times the area (and with more accurate UDP redshifts) used in this initial analysis. The volume and depth will be sufficient to trace such galaxy and halo properties back to $z = 1.5$.

By combining the precision of classical spectroscopy with the statistical power of large imaging surveys, CSI is in a unique position to produce an unbiased picture of the evolution of normal galaxies, including the growth of stellar mass, and the role of environment and feedback in regulating the timescales of galaxy evolution over the past nine billion years. The Carnegie-Spitzer-IMACS Survey team notes that the commitment made by NOAO to support this program, and their goal to create such a legacy data set for the community, has been critical for the survey's success to date and expresses gratitude for this support.

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The SMARTS Way to Discover Quick Stellar Cycles

Travis Metcalfe (High Altitude Observatory), Sarbani Basu (Yale University), Todd Henry (Georgia State University), Dave Soderblom (Space Telescope Science Institute) & Phil Judge (HAO)

Travis Metcalfe and collaborators have discovered the quickest stellar activity cycle yet for a Sun-like star—1.6 years for the F8V exoplanet host star iota (ι) Horologii. The discovery, which uses the CTIO 1.5-m telescope through NOAO and the SMARTS Consortium, is the first major result to emerge from a long-term program to monitor the Ca II H and K emission for about 60 bright solar-type stars in the Southern Hemisphere.

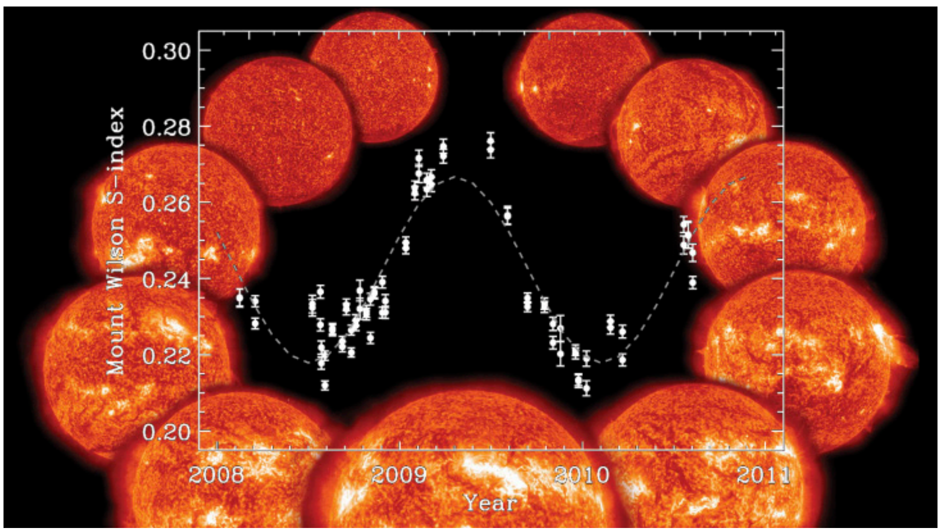

Figure 1: Chromospheric activity measurements of the F8V star ι Horologii from the southern HK survey, showing a clear variation with a cycle period of 1.6 years, the shortest cycle measured for a Sun-like star. The background image shows the Sun each year from 1996 to 2006 observed in the ultraviolet from NASA's Solar and Heliospheric Observatory satellite (assembled by Steele Hill, NASA GSFC).

The star sample was selected from a single-epoch survey of magnetic activity conducted by Henry and Soderblom at CTIO in the 1990s, with a focus on the best and brightest stars (V < 6) that will be the targets of future asteroseismic campaigns by the Stellar Observations Network Group (SONG). By combining observations of surface activity with information about the conditions in the stellar interior, the team hopes to probe the root causes of cyclic activity in stars.

Astronomers have been making telescopic observations of the Sun since the time of Galileo, gradually building a historical record showing a periodic rise and fall in the number of sunspots every 11 years. We now know that sunspots are regions with a sufficiently strong magnetic field to alter the local thermal structure, so this 11-year cycle actually traces a variation in surface magnetism. Although we cannot observe spots on other solar-type stars directly, these areas of concentrated magnetic field produce strong emission in the Ca II H (396.8 nm) and K (393.4 nm) spectral lines. Wilson (1978) was the first to demonstrate that many solar-type stars exhibit long-term cyclic variations in their Ca II H and K emission, analogous to the solar variations.

The idea for the project came to Metcalfe in 2005 while sitting in a seminar at High Altitude Observatory, the solar and space physics laboratory of the National Center for Atmospheric Research (NCAR). Postdoctoral fellow David Salabert was giving a presentation about helioseismic observations of the Sun observed as a star, without spatial resolution across the surface. The data spanned a complete solar cycle, and the oscillation frequencies showed a clear correlation with the number of sunspots—a traditional proxy for the strength of the global magnetic field. If the solar cycle had a measurable effect on the oscillation frequencies of the Sun observed as a star, then it should be possible to see similar effects from the magnetic cycles in other stars.

Stellar activity cycles had been well documented in many northern stars through the Mount Wilson HK survey (Baliunas et al. 1995), but some of the best targets for asteroseismology were located in the southern sky. One such star, β Hydri, had been the target of asteroseismic observations in 2000 and 2005, so Metcalfe and collaborators used archival International Ultraviolet Explorer (IUE) observations to measure its stellar activity cycle and predict the expected shifts in the global oscillation frequencies. In the process, they developed a simple model for the source of magnetic perturbations that can be tested using contemporaneous asteroseismic and HK observations. The precision of the asteroseismic data for β Hydri was not sufficient for a quantitative test, but the observations qualitatively agreed with the predictions (Metcalfe et al. 2007). The required precision for the asteroseismic data would eventually be addressed by the SONG project, expected to begin operations in 2012. The only missing ingredient was an HK survey for the southern sky.

After being hired as a scientist at NCAR in 2006, Metcalfe used some of his start-up funds to begin the monitoring project at the CTIO 1.5-m telescope through the SMARTS Consortium. During the second and third years, the project was supported as an NOAO long-term program with some additional time from Basu, Henry, and Soderblom through the SMARTS Consortium. The motivation was to begin measuring stellar cycle periods and phases for southern asteroseismic targets before the SONG network came online. The team would then be in a position to make recommendations on the timing of future asteroseismic observations to maximize the subtle signature of the stellar cycle.

The surprises began to emerge during the second year of monitoring, when it became clear that some targets were varying on timescales that were longer than what would be expected from rotation, but shorter than the activity cycles discovered by the northern surveys. Other targets showed no variations in activity at all—perfect flat-liners that demonstrated the precision of the measurements and ruled out an instrumental source for the short-term variations. With scheduling help from Fred Walter and service observations conducted by Manuel Hernandez and Jose Velasquez at CTIO, ι Horologii was the first star to show a complete stellar cycle in August 2010 (see Figure 1). A paper describing the discovery appeared in the

continued

The SMARTS Way to Discover Quick Stellar Cycles continued

Astrophysical Journal Letters in November 2010 (Metcalfe et al. 2010).

The implications of such a short activity cycle are profound. The shortest previously measured cycle periods were 2.52 years (HD 76151) and 2.60 years (HD 190406) from the Mount Wilson HK survey. Both of these appeared to be secondary cycles superimposed on a much longer primary cycle, suggesting two distinct dynamos that are driven in different regions of the star. There is currently no evidence for a longer cycle in ι Horologii, but continued monitoring will reveal whether it also shows the predicted six-year primary cycle. Asteroseismic observations of ι Horologii were obtained in late 2006, during the magnetic minimum one cycle before monitoring began for the southern HK project. A second set of asteroseismic data near the predicted magnetic maximum in late 2013 will have the best chance of probing the effects of the stellar cycle.

The southern HK project will continue this spring with Director's discretionary time from CTIO, and the team hopes to get continued support as an NOAO long-term program for two more years. With a modest allocation of five nights each semester, supplemented by time from other SMARTS partners, the project will continue to monitor this sample of Sun-like stars and reveal the diversity of stellar activity cycles. The success of the project so far is a testament to the unique capabilities of the queue-scheduled SMARTS telescopes at CTIO. All of the data are available to the community through the project Web site (*solar-stellar.org*), and the team is happy to collaborate with interested researchers.

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Ground-Based Observations of the NASA EPOXI Target Comet 103P/Hartley 2

Beatrice E. A. Mueller (Planetary Science Institute), Nalin H. Samarasinha (PSI), Michael F. A'Hearn (University of Maryland), Tony L. Farnham (UMD) & Alan Gersch (UMD)

Comet 103P/Hartley 2 came within only 0.12 AU of the Earth on 20 October 2010, shortly before it was encountered by NASA's Extrasolar Planet Observation and Deep Impact Extended Investigation (EPOXI) mission on 4 November 2010, about one week after perihelion. This rare occurrence was observable from the ground and presented a unique opportunity to characterize a Jupiter-family comet nucleus and its coma in unprecedented detail. Beatrice Mueller (Planetary Science Institute-PSI) and collaborators used the KPNO 2.1-m telescope to study the comet before, during, and after the encounter to characterize the dynamics of its nucleus and to provide a rich context for the interpretation of the data obtained by EPOXI.

Understanding cometary nuclei and their comae (which comprise the dust and gas escaping from the nucleus) in detail will give us an understanding of coma physics, activity, and evolution of comets as well as of nuclear bulk properties. These in turn will give clues to the conditions present in our solar nebula during the formation of the comets and the formation of our solar system.

In September 2010, Mueller and collaborators imaged the comet at the Kitt Peak 2.1-m telescope for three nights, in October for five nights, in November for seven nights (bracketing the encounter), and in December for five nights with the new STA2 chip, which has improved blue sensitivity and faster readout. They used a standard broadband R filter as well as HB narrowband comet filters, which isolate gas emissions due to the CN, C_3, C_2, OH, NH radicals, and the continuum emission, which is due to dust.

The R and CN filters provided images with the best signal-to-noise ratio for isolating discrete structures in the dust and gas comae. To bring out these structures above the background coma, the images were enhanced by dividing them by their azimuthal average (e.g., Samarasinha et al. 2006). An example of the same CN image, unenhanced and enhanced, is shown in Figure 1. It is clear even in the unenhanced image that the coma is asymmetric, i.e., shows structure. Figure 2 shows an enhanced

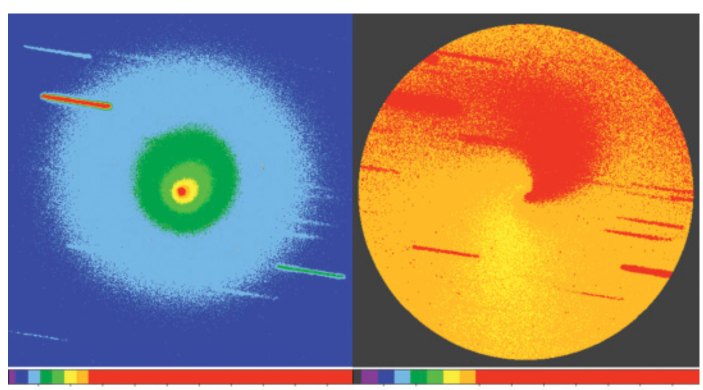

Figure 1: A CN image from October 4 is shown (left). Division by an azimuthally-averaged image produces the image on the right, which isolates a broad diffuse jet emerging from the nucleus. Red denotes higher flux. The streaks are trailed stars. North is up and east is to the left. Both images are ~5 arcmin across.

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NASA EPOXI Target Comet 103P/Hartley 2 continued

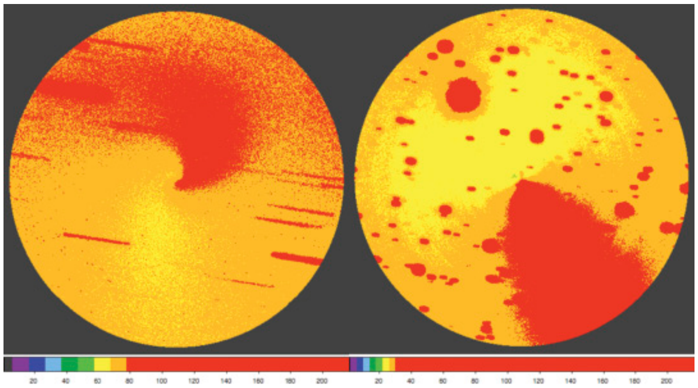

Figure 2: An enhanced CN image from October 4 is shown on the left, while an enhanced R image is shown on the right. The R filter is sensitive mostly to the dust. Red denotes higher flux. The streaks and elongated objects are trailed stars. North is up and east is to the left. Both images are ~5 arcmin across. The prominent feature to the SSW in the dust image (right) is the dust tail.

R image (dust) and an enhanced CN image showing the very different structure in the dust and CN. This is not unexpected as other comets have shown this as well. The enhanced CN images showed changes in one night, during one run, and between different observing runs. Figure 3 shows examples of enhanced CN images from each of the runs used to study the comet.

Mueller and collaborators were the first to notice that the periodicity derived from the repeatability of the CN morphology changed with time based on images from their first and second observing runs (Samarasinha et al. 2010). This change was confirmed with subsequent observations obtained by other observers. Furthermore, slight differences in their images at the same rotational phase for certain consecutive cycles indicated an excitation of the rotation state, i.e., a nonprincipal axis rotation (more commonly known as tumbling motion). Theoretically, most comets are expected to be in nonprincipal axis spin states due to the torques exerted by jets on the nucleus. However, observations indicate that only a few comets are in excited states.

Other comets showing changing rotation periods are 2P/Encke, 10P/Tempel 2, and 9P/Tempel 1. However, their observed changes in rotation periods are of the order of tens of seconds to tens of minutes per perihelion passage. The observed change for comet Hartley 2 is at least one hour over just a few months and is consistent with the high level of activity observed in this small, elongated nucleus. Together with the high-resolution images of the EPOXI mission (*epoxi.umd.edu*), the extensive KPNO observations, and other observers' data, a comprehensive and detailed picture will emerge of the nucleus and coma of comet 103P/Hartley 2.

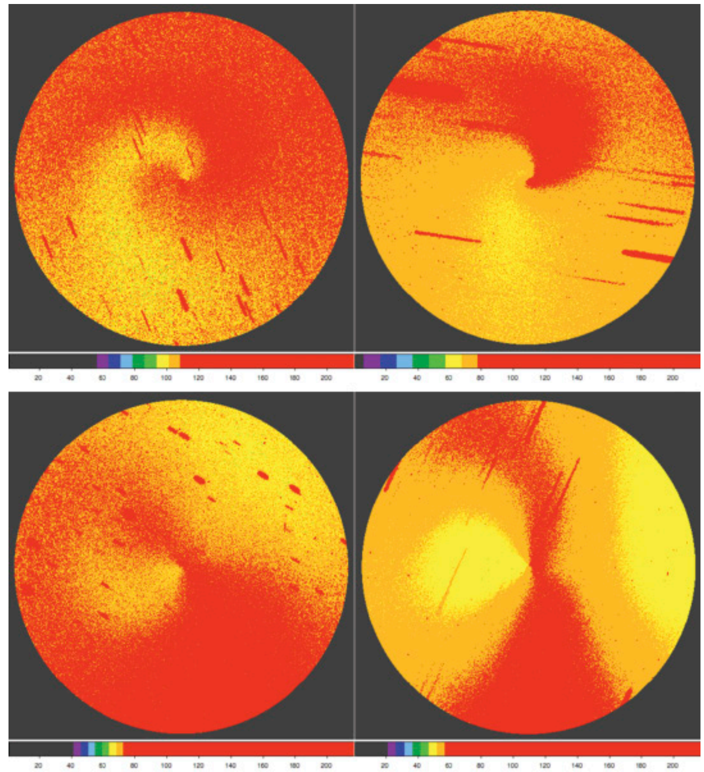

Figure 3: Enhanced CN images clockwise from top left for September 3, October 4, November 3, and December 11, showing changes in the pattern of nuclear emission. Red denotes higher flux. The streaks are trailed stars. North is up and east is to the left. All images are ~5 arcmin across. Due to the changing geocentric distances from run to run, the corresponding linear scales are different. The nucleus (opto-center) is at the center of each image.

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From the Director's Office

David Silva & Robert Blum

It's an exciting time at NOAO. We are deploying several new, major 4-m class instruments in the next 12 months and advancing several other major initiatives. As an ensemble, these activities support the goal of a stronger, more relevant national observatory within a strong optical/infrared system. This is consistent with the framework reiterated by the 2010 decadal survey report *New Worlds, New Horizons in Astronomy and Astrophysics* (NWNH). At a time when the federal budget process is even more volatile than usual, having such strategic guidance is more important than ever.

New Instruments

Timely deployment of modern, efficient, workhorse instrumentation creates the necessary foundation for scientific success at any observatory. I am happy to say that our multiyear, post-Senior Review effort to bring a new generation of 4-m class instruments into operation is coming to fruition.

In the north, 2010 closed with the arrival of the upgraded Mosaic 1.1 wide-field imager at the Mayall 4-m. By the end of 2011, a new optical, medium-resolution multi-object spectrograph, KOSMOS, will arrive and NEWFIRM will return to Kitt Peak. KOSMOS (Kitt Peak Ohio State Multi-Object Spectrograph) is being built in collaboration with The Ohio State University and is a near-clone of an instrument they already have commissioned successfully at the MDM 2.4-m telescope.

In the south, NOAO has begun to commission a high angular resolution imager behind a ground-layer adaptive-optics (GLAO) system. The GLAO system, also known as the SOAR Adaptive Module (SAM), is only the second such facility system in the world. While NOAO will deliver an imager to use with SAM, the SOAR Brazilian community will soon have a tunable filter imager (BTFI) to be deployed with SAM. On other fronts, the SOAR Goodman optical spectrograph (built by the University of North Carolina) is nearing its final acceptance testing in long-slit mode and will soon begin multi-object mode commissioning. The SOAR Integral Field Unit Spectrograph (SIFS) will be (re-)delivered in mid year to continue commissioning following the shipping-induced de-bonding of its lenslet array from the fiber bonding of late last year. Finally, the SOAR Telescope Echelle Spectrograph (STELES) will be delivered later in 2011. Both SIFS and STELES are major instrument contributions to SOAR from the Brazilian community through Laboratório Nacional de Astrofísica (LNA), while the BTFI project is led by Instituto de Astronomia, Geofísica e Ciênecias Atmosféricas.

Meanwhile, installation of the 2.2-deg field-of-view Dark Energy Camera (DECam) at the Blanco 4-m telescope will be well underway by the end of 2011. DECam should be available to the general user community during 2012A. And by semester 2012B, Blanco users also will have access to the Cerro Tololo Ohio State Multi-Object Spectrograph (COSMOS), the southern twin of KOSMOS.

Although not scheduled to arrive until 2014, a new medium-resolution near-infrared spectrometer is also coming to the Blanco. The spectrometer is a fourth copy of TripleSpec; this instrument will be built in collaboration with Cornell University.

The combination of larger field-of-view, higher end-to-end flux throughput, and/or higher spatial resolution in these new instruments will dramatically extend the science grasp of existing facilities and maintain or restore world leadership in core capabilities for the astronomical community.

While SAM and its imager were funded from the NOAO base budget, the other new instruments have been funded through the NSF Renewing Small Telescopes for Astronomical Research (ReSTAR) Phase 1 supplementary grant (Mosaic 1.1, COSMOS, KOSMOS, TripleSpec) and the SOAR partners. DECam was mostly funded by the Department of Energy Office of Science through Fermilab but with significant NSF funding for the DECam data management system. Preparations and upgrades to the Blanco telescope to support the Dark Energy Survey and DECam are funded through NSF allocations to the NOAO base budget. These projects are excellent examples of NOAO reaching across traditional boundaries to build new collaborations and raise new funding to bring exciting new capabilities to the community-at-large.

On-going Major Initiatives

During the next year, NOAO will continue its major participation in the Large Synoptic Survey Telescope (LSST) project, the highest-priority ground-based project of this decade in the judgment of the NWNH report. Our collaboration with the BigBOSS (BOSS stands for Baryon Oscillation Spectroscopic Survey) project will deepen as we advance through the conceptual design phase. Hopefully, both projects will receive construction funding in the fiscal year (FY) 2014 federal budget.

NOAO will submit a final proposal to NSF for the completion of ReSTAR Phase 1 activities, and the process already is underway to build new collaborations for a second three-year ReSTAR phase (ReSTAR Phase 2). I have seen some exciting ideas, and I foresee a strong proposal to NSF for FY 2012–2014 funding. Our goal is to submit such a proposal in October or November of this year.

Naturally, given the pertinent NWNH recommendations, possibly closer relationships in the near future between NOAO and Gemini, as well as between NOAO and an Extremely Large Telescope/Giant Segmented Mirror Telescope project, are never far from my mind. NSF Astronomy has taken responsibility to sort out these relationships, and I know they are taking that responsibility very seriously. Although NOAO is not directly involved in on-going discussions, we are being consulted on a regular basis.

continued

From the Director's Office continued

Budget Volatility
This year, the federal budget process is even more exciting than usual. As of mid-February 2011, the White House, House of Representatives, and Senate were locked in a major multi-way confrontation over federal spending. Consequently, the official operating budgets for NOAO in FY 2011 and FY 2012 remain both unknown and highly uncertain. While it is unproductive to dwell on worst-case scenarios, it is also unwise to assume the best.

For now, we are making decisions and planning activities under the assumption that our FY 2011 base budget will be level with FY 2010, while our FY 2012 base budget will be marginally larger. While this assumption is likely to cause some internal pain during FY 2011, this level of funding will allow us to complete the instrument deployment plan described above.

As the year unfolds, I will use our e-newsletter *Currents* to update you on developments. Until then, clear skies!

LSST Activities at NOAO—the Excitement Continues

Victor L. Krabbendam & William J. Gressler

NOAO engineers and scientists continue to support the Large Synoptic Survey Telescope (LSST) Project with exciting activities in design, prototyping, analysis, science verification and community interaction. At the summit of Cerro Pachón (Figure 1) where private funds are being used for site preparation, dynamite is moving rock. In Tucson both science and designs are discussed, and down in the basement labs prototype hardware is being tested. All of these activities at NOAO are helping move LSST forward.

Figure 1: Solid model of the LSST summit facility shown on Cerro Pachón.

LSST's top ground-based ranking by the Astro2010 committee was a boost to the entire LSST team. Fortuitously timed with the fifth "All Hands" meeting in northwest Tucson, 200 friends and colleagues were gathered together to hear the committee's Friday-the-13th public announcement.

LSST is now working with staff in the Astronomy Division at NSF and in the High Energy Physics office at the Department of Energy (DOE) to complete the steps before LSST can receive construction funding. The Project is planning for three more years of design and development before a proposed 2014 new start.

A key item to support the Major Research Equipment and Facility Construction (MREFC) request was a new, revised construction proposal, which was submitted to NSF in January. This one replaced the original 2007 version with updated designs, costs, and schedules. While the detailed plans have evolved with the maturing design, the project costs primarily have escalated just with inflation since the 2009 report to Astro2010.

NOAO has been involved in the development of the LSST since its inception more than a decade ago. After contributing to the early ideas for a large survey telescope in the 2000 decadal survey, NOAO partnered with the University of Arizona, the University of Washington, and the Research Corporation in founding the LSST Corporation in 2003. Since then, there has been a steady initiative in the community and at NOAO to support the project. Efforts have focused on the Telescope and Site design, but NOAO also contributes with Board level stewardship and directly in the Project Office: Victor Krabbendam is the Deputy Project Manager and Chuck Claver has been temporarily assigned to LSST to be the Systems Engineer. There has also been significant work in operations simulation, code that Abi Saha started and is now Michelle Miller's responsibility.

This article focuses on the telescope technical activities pursued at NOAO. Other articles in this issue discuss ways NOAO is involved in LSST scientific support, the simulated survey results from the NOAO-based operations simulation group, and early simulated LSST data products from the data management group.

Summit Activities at NOAO South
In the year since moving to Chile, Jeff Barr has been busy with the detailed design of the summit facility and the civil design layout for the roads and building platforms. The architect, ARCADIS Chile, and its design consortium in Santiago, have completed the 50% design package, and the Telescope team has diligently reviewed it. The image of the facility in Figure 1 shows the exterior result of the effective collaboration between the Tucson-based telescope engineering team, Jeff and AURA administrators in La Serena, and the ARCADIS team in Santiago.

Civil engineering recently accelerated with an LSST Corporation allocation of $1.3M to perform the initial rough leveling of the site. This early investment by LSST was made possible by the generous gifts of Charles Simonyi and Bill Gates. It will allow the summit design work to move forward with accurate knowledge of the final geotechnical conditions. It will also enable swift progress on critical-path building construction when that phase of the Project begins.

The completion of the environmental declaration and the NSF acceptance of that process was a critical accomplishment. The formal interaction with the Chilean equivalent of the Environmental Protection Agency concluded with a declaration of "no significant impact" in

continued

LSST Activities at NOAO continued

December 2008 and the subsequent authorization of building and use permits for LSST.

The excavation effort is now underway as a team from Rocterra Ingeniería y Servicios Ltda carefully, but explosively, removes nine meters from the top of El Peñón for the main LSST telescope and eight meters from the neighboring peak for the calibration telescope. The work is done slowly, with very controlled blasts designed to leave no damage to the rock below final grade. This way, the telescope can take full advantage of the solid, load-bearing conditions of Cerro Pachón. Figure 2 shows the start of the effort. Progress can be viewed online through a webcam linked from *www.lsst.org/lsst/gallery/*.

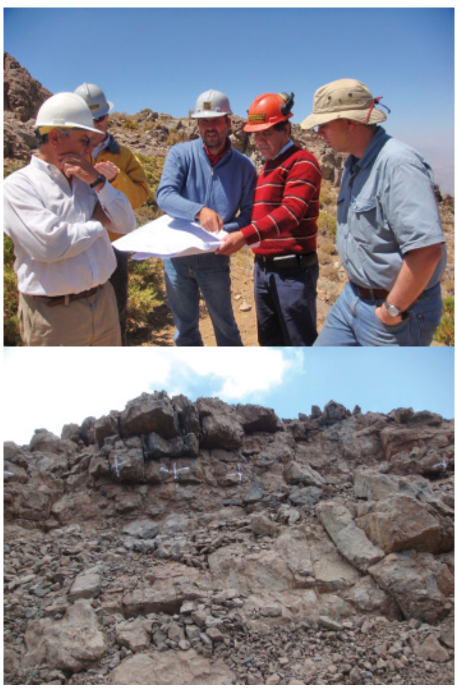

Figure 2: (top panel) Rocterra engineers discuss excavation design with AURA and LSST representatives, Enrique Figueroa (far left) and Dan Phillips (far right). (bottom panel) The cut line survey marks are visible for the excavation.

Telescope Mount System

NOAO engineers and designers have invested significant effort in the development of the telescope mount preliminary design. The structure, its drive system, and ancillary subsystems are the backbone of the whole telescope system. Doug Neill and Bill Schoening have made it a priority to design details, develop the model using SolidWorks software, and analyze highly refined finite element models. Figure 3 shows the latest model of the 340-ton system, which achieves the high slew and settle time with advanced control of the 350 hp in the drive system and the 8 Hz lowest natural frequency of the system (including the pier).

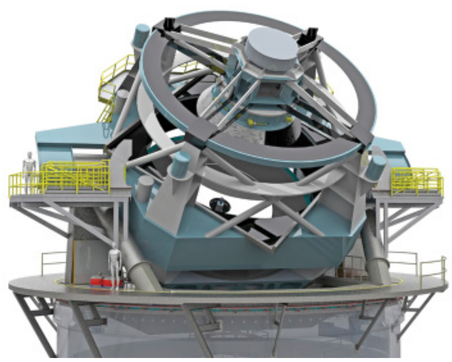

Figure 3: SolidWorks model of the LSST telescope mount preliminary design.

Mirror Support Design and Prototype

The Telescope and Site team has completed the preliminary design of the primary mirror support system. This is a vast ensemble of pneumatic actuators for uniform support, hardpoint actuators for mirror positioning, cooling fans for thermal equilibration, sensors and software for delicate control, and cold hard steel to carry it all. Several critical details of the system, including the pneumatic cylinders, valves, and a fully functional hardpoint actuator with load-limiting break-away mechanism, have been prototyped at NOAO and are undergoing functional and performance testing. The equipment and hovering engineers taking measurements—Oliver Wiecha, Ed Hileman, and Joe DeVries—can be found in the NOAO optics shop and laboratories. The team members in Tucson and Chile have collaborated to assemble test fixtures and analyze the hardware. Figure 4 shows Joe with the primary mirror hardpoint strut, designed, built, and tested under his supervision.

Also in the optics shop, in final testing, is the LSST Optical Beam Simulator. The five-element imaging system, built by Gary Muller, Ron Harris, and Gary Poczlup, simulates the $f/1.23$ beam and central obscuration of the LSST providing five-micron spots for prototype sensor evaluation.

Wavefront and Reconstruction

The Telescope team continues to develop the wavefront sensing and optical alignment reconstruction algorithms for LSST. Efforts in the past with Lawrence Livermore National Laboratory personnel and other contractors have determined that the optical feedback from corner sensors in the huge focal plane will work well in the LSST design. Ming Liang and Srini Chandrasekharan are now working, along with Purdue University, to build the "curvature sensing" algorithms and reconstruction code into full prototype pipelines to support rigorous testing.

Instrument Calibration

Stringent performance requirements dictate the need for precise calibration of the LSST survey data. This will be accomplished via two telescope-based systems: a dome calibration screen and an auxiliary calibration telescope.

A team led by Bill Gressler and Chris Stubbs (Harvard) has been investigating novel optical projection systems that will be the heart of an instrument calibrating dome screen. Instead of a simple reflective dome flat, this technique will use a tunable laser to feed discrete projectors to flood the LSST pupil (all 8.4 m) with monochromatic or broad spectrum light and uniform angular illumination at the detector pixel level.

Figure 4: Joe DeVries with the LSST primary mirror hardpoint strut.

The Calypso telescope, acquired by LSST Corporation in 2008, will provide atmospheric calibration by acquiring images simultaneously with the survey data. The entire Calypso telescope assembly will be refurbished with modern drives and updated controls for eventual shipment and installation at the LSST site.

continued

LSST Activities at NOAO continued

John Andrew and Elaine Halbedel have worked hard to operate Calypso for the last two years to do LSST on-sky experimentation. The facility is currently in long-term shutdown awaiting other experiments or the start of refurbishment.

Software and Controls

The Observatory and Telescope control software for LSST are developing from the heritage of software developed at NOAO South over the last 10 years. German Schumacher and Francisco Delgado are deeply involved in the LSST effort adapting the successful Southern Astrophysical Research Telescope Control System (TCS) model and forming it around DDS open source communication middleware. The recent Blanco TCS upgrade serves as a prototype for the LSST system. Additional prototypes of the middleware system can also be found on the many CPUs running in Dave Mills' office in Tucson, and many electronic parts are running in Mike Warner's office in La Serena. The joint North and South effort that taps the collective experience of many existing systems is proving an effective approach for LSST.

NOAO's Group Effort

The design and development of the LSST telescope and site system is a significant enterprise supported by many others at NOAO. The systems engineering effort from Jacques Sebag is critical to keeping the designs on track. Chuck Gessner is supporting safety analysis, Iain Goodenow is keeping the computers and data systems running, Emily Acosta is a daily help in the Photo Imaging Lab, and Melissa Bowersock is providing the administrative support to the whole group. Development support from Enrique Figueroa and many others in NOAO South has been a critical effort for recent successes with environmental permitting, site testing, software, and diplomatic relations. The vast expertise available in nearly every corner of NOAO North and South is providing the Telescope and Site team with valuable contributions. NL

NOAO Support for LSST Science

Tom Matheson, Knut Olsen & the NOAO LSST Science Working Group

Members of the NOAO scientific staff have been involved in the Large Synoptic Survey Telescope (LSST) Project since near its inception. A significant portion of that involvement has been in the form of contributing to the development of the science case for the project, but also in addressing other scientific issues related to operational strategies. NOAO has formed an LSST Science Working Group (SWG) to confront some of the scientific challenges facing the LSST Project. Two areas of significant focus are the LSST Operations Simulator and the problem of the transient and variable sky. Here, we describe some of our progress on these issues.

The LSST Operations Simulator is being developed to study the effects of different observing strategies on the scientific productivity of LSST data. Our group has aided in the development of preliminary scheduling requirements as well as suggested improvements to the reports generated by the Operations Simulator. We are currently working with the Project and the LSST Science Collaborations to generate merit functions that can be used with the simulator to assess the direct effects of observing strategies on particular science programs. (See "Making Sense of an LSST Simulated Schedule" in this section.) Our group will assist with the creation and testing of these metric functions. In addition, we will aid the Project in devising cadence requirements.

One of the four main scientific goals of the LSST project is the study of optical transients. The nature of the variable sky in terms of types, numbers, and distributions is generally poorly constrained. For any given pointing of LSST, it is still not clear exactly how many or what types of variables will appear. The NOAO LSST SWG is engaged in a project to provide a characterization of the variable sky. This will be a comprehensive description of variable objects, including color and magnitude ranges as well as distribution. With a basic framework of these objects, we will flesh out details in our areas of expertise and then look to the Science Collaborations to provide expertise for other types of variables. The goal is to predict more accurately the range of variable objects that will arise in any particular LSST image, and use that knowledge to support the Project's nightly pipeline algorithms.

Another issue with science involving transient objects found by LSST is the vast number of them that are expected to be found. Although exact numbers are still uncertain, there is no doubt that there will be an enormous number of transients found each night. How best to sort these in a sensible way and how to decide which deserve follow-up observations are still open questions. The NOAO LSST SWG is working to develop a software tool that would take the transient event alerts from LSST and provide additional information aggregated from external sources. This combined information could then be used to define various filters that would allow users to select specific types of events for notification and possible follow-up. We intend to test these tools with on-sky experiments.

Once a reliable estimate for the number of discoveries is available, and we have a robust way to identify interesting objects, then we can predict the scale of follow-up resources that will be required. NOAO recognizes that an important role for the national observatory will be to provide telescopes and instrumentation for studying LSST discoveries. Planning for these facilities has to begin in the near future in order to meet the needs of the community once LSST is in full operational mode.

Making Sense of an LSST Simulated Schedule

Steve Ridgway

The core requirement for the Large Synoptic Survey Telescope (LSST) is to accomplish the Wide-Fast-Deep (WFD) survey to specified limits in the area observed, number of images acquired, and stacked depth. Due to its emphasis on time-domain phenomena, LSST cannot pursue the survey according to a simple scanning rule. The ~2.5 million visits (pairs of 15-second images) recorded over the nominal 10-year mission must be made with cadences that serve a wide variety of science, beginning with the LSST key science and extending to programs described in the LSST Science Book, not to mention providing a rich database for science topics that have not been explicitly considered yet.

The LSST Operations Simulator group, based at NOAO, has developed an approach to scheduling WFD. The approach is based on sequentially observing the currently highest-priority field, with a relatively complex set of parameters (including current conditions) feeding into the prioritization. The problem of optimizing a schedule for 2.5×10^6 events begs the question of how to measure the effectiveness of such a schedule once it has been computed.

The Simulator group has developed a standard report that provides extensive statistics on a simulated schedule, well suited for optimizing open-shutter time, sky coverage, depth, and other basic parameters. Eventually, sophisticated (possibly time-consuming) science analysis of simulated data will provide a high degree of confidence in the effectiveness of a schedule for particular science problems. Such analysis may be possible for only a few simulations, and perhaps not for all science goals. In the meantime, procedures are needed for extracting from a simulated schedule parameters that are sufficiently close to science needs that they can be used to compare the effectiveness of scheduling algorithms, and yet sufficiently simple and efficient that they can be applied to dozens or hundreds of simulations.

For this purpose, the NOAO Science Working Group is working with the LSST Operations Simulator group to develop merit functions and metrics. As used here, a merit function is a (preferably simple) algorithm for describing the value of observations in a simulated schedule, and a metric is a single (or few) value characterization of a merit function that can be conveniently used in a head-to-head comparison of two or more simulations, showing the relative effectiveness in the characteristic described. The following two examples, based on the current baseline simulation, 3.61, will illustrate this approach.

In the course of the LSST survey, there will be an early need for a high-resolution image of each field (in practical terms, an image with good seeing). A high-resolution image is needed of course to identify sources in crowded fields. A high-resolution image also is needed for matching (by convolution, if necessary) to later images for differencing and identification of transient sources. For this reason, it is interesting to know how early in the program high-resolution images will be available for a large fraction of the fields. Having such images early is not presently a formal requirement. Nevertheless, a scheduler that did not perform well in this area would deserve further scrutiny. Figure 1 shows a very simple merit function, defined as the best delivered image quality (DIQ) during the first year of the simulated schedule. DIQ is described here by the point spread function (PSF) width achieved for each field in the r or i filters. This merit funtion shows that a large fraction of the fields are observed with good image quality during the first year. If future simulations were to show a substantial reduction in this metric, it would be an indication that some change in the scheduling algorithm had prejudiced the schedule against it.

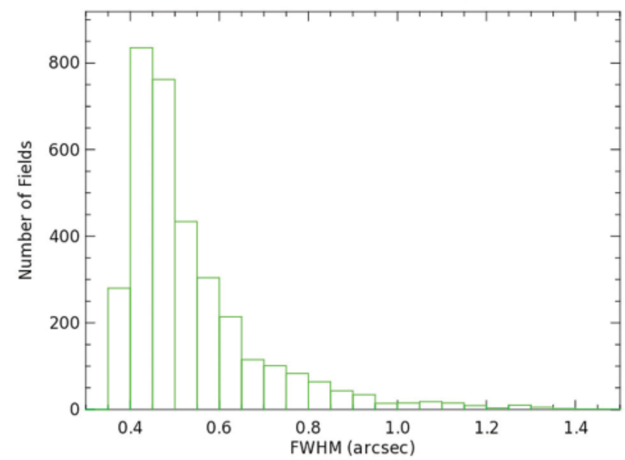

Figure 1: Histogram of the number of fields for which the best single image obtained in r or i filters is in the range of the histogram bins, by the end of year one. The associated metric is the median, 0.59 arcsec. (For comparison, the values after 3 and 10 years are 0.53 and 0.50 arcsec.) Note that these numbers are based on all fields observed, including some that transit at a relatively large zenith distance—performance for the main WFD survey will be somewhat better.

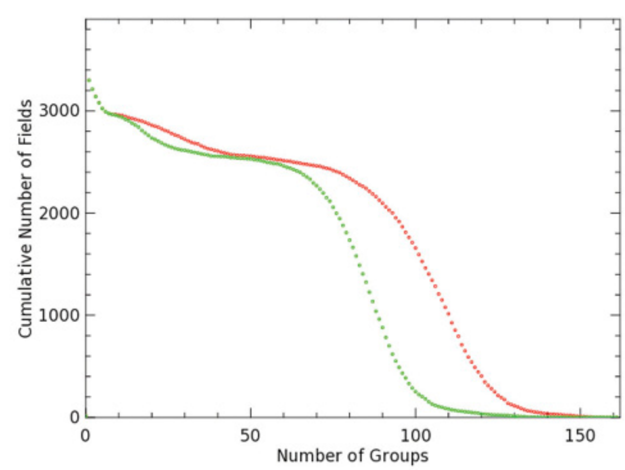

Figure 2: Cumulative histogram of the number of fields vs. number of qualifying groups—all groups (red), and groups with at least one three-visit-night (green). The associated metrics are the values of the histogram at the 50% point—106 for all groups and 85 for groups with at least one triple visit.

continued

Making Sense of an LSST Simulated Schedule continued

A second example is chosen from the area of asteroid detection and tracking. Asteroids are expected to be both interesting in their own right and an important contaminant of transient searches. Asteroids will be initially identified from spaced image pairs. To obtain useful motion but to avoid confusion with other asteroids, the interval between visits should be in the range of 15–60 minutes. In addition, pairs must be available for at least three nights within two weeks in order to link one-night "tracklets." Let's call a sequence of visits satisfying these requirements a group. On-going exercises with simulated data show that even with qualified groups, the association of tracklets can be problematic. This difficulty may be alleviated by acquiring image triples (allowing inference of an apparent acceleration in addition to a motion). An experimental merit function under evaluation finds, for each field, the number of groups obtained and also the number of groups for which at least one data set has a triple. This is illustrated in Figure 2, based on visits in filters g,r,i,z, which are expected to contribute most strongly to asteroid identification. It is promising to see a relative abundance of data sets for most fields—typically 100 groups per field. At present, there is no target value for this function. Continuing work with simulated data can show whether or not the performance achieved in this illustration is sufficient for LSST key science.

LSST merit function studies will be useful in optimizing automated scheduling and will perhaps continue at some level throughout the life of the project, providing insight into the relation of the observing program to the science requirements.

Additional information on the LSST schedule simulator and its implementation can be found in Delgado et al. 2006 (SPIE 6270E, 45), Ridgway et al. 2010 (SPIE 7737E, 22), and at *www.noao.edu/lsst/opsim/*.

Early Delivery of LSST Simulation Data Products

Richard A. Shaw

The Large Synoptic Survey Telescope (LSST) Project reached a major milestone in early January by delivering to the LSST Science Collaborations (SC) a large quantity of processed data from the Data Management (DM) production system. The effort is part of a series of data challenges, which are ever more sophisticated realizations of the LSST data, the pipelines, the computational infrastructure, and the tools needed to assess them. This data challenge, termed DC3b, when completed, will have processed large quantities of raw data from both the Canada-France-Hawaii Telescope (CFHT) Legacy Survey and sophisticated simulations of LSST images. The goal is to prototype the majority of the pipelines of the full Data Release Production system, which will generate calibrated images, deep stacks, and catalogs of all detected objects in multiple visits to large areas of sky. DC3b is being carried out in a series of performance tests (PTs), which exercise the software on massively parallel computer clusters via the TeraGrid in order to demonstrate scientific fidelity, computational throughput, and system scalability.

Figure 1: Members of the LSST Science Collaborations at a Splinter meeting held on the University of Washington campus prior to the 217th AAS meeting.

Members of the LSST SC gathered at a AAS Splinter meeting, on the University of Washington campus, the Sunday prior to the 217th AAS meeting (see Figure 1), to learn about the details of the image simulations (ImSims), the processing algorithms, and output data products. In the latest performance test (dubbed PT1.1) the DM Team processed 444 "visits" of ImSim data, which were distributed over seven adjacent fields in all six photometric passbands (u, g, r, i, z, y). Each visit consists of paired exposures (2×15 s duration), with a full focal plane containing 189 science CCDs, covering 9.6 deg^2. The total coverage of this dataset, roughly 60 deg^2 (see Figure 2), generated 12.4 TB of calibrated images, from which catalogs of 165 million source detections and 4 million unique objects were generated.

The SC members who attended the Splinter meeting in person or online were presented with a great deal of information about the cur-

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Early Delivery of LSST Simulation Data Products continued

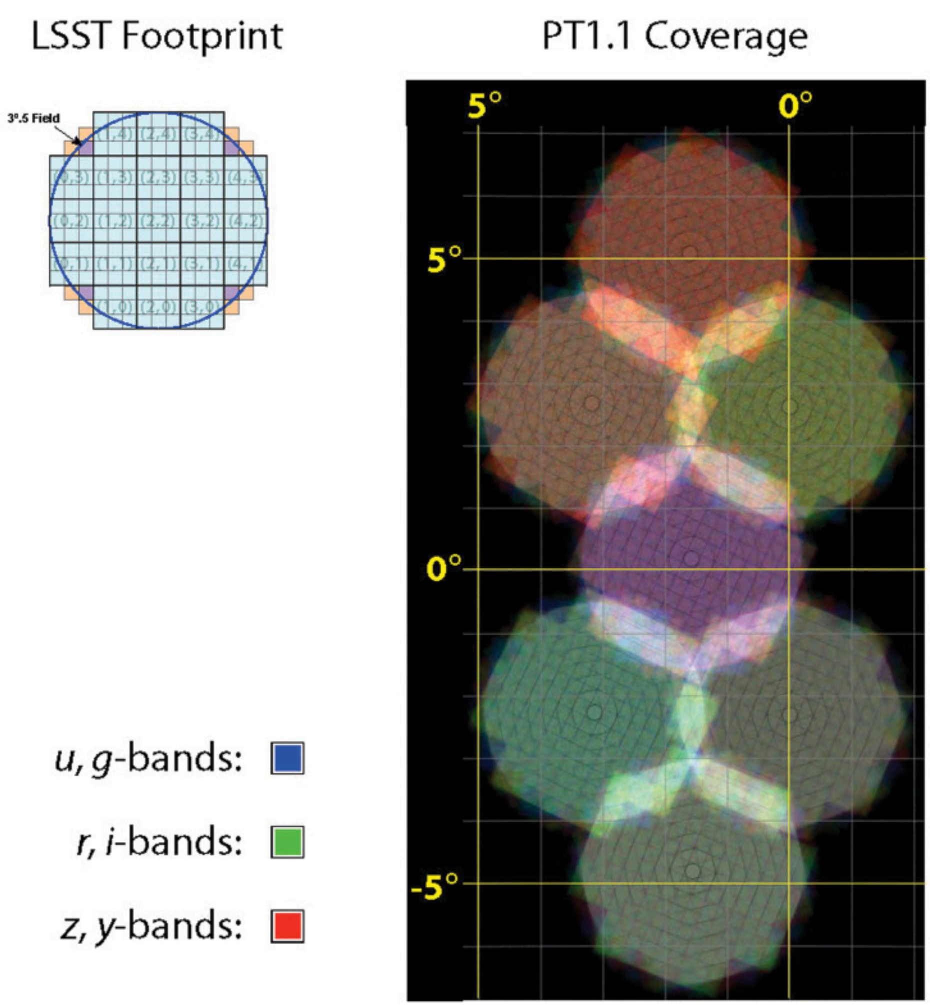


Figure 2: The exposure times of the LSST single-image footprint (left), which covers 9.6 deg^2, were summed over all processed images for PT1.1 (right) to show the coverage in color and depth.

rent level of maturity of the image simulations, the data production system, the details of the data products, and of some important, if preliminary, assessments of the quality of the released data products. This information is described in detail in the *LSST Data Challenge Handbook* (see Figure 3). The SC members are now well positioned to engage in the analysis of the released images and catalogs. Through their participation, the SC members can help DM Team members analyze a number of specific science and technical questions that were posed in the presentations on a variety of topics, including the completeness and fidelity of the image simulations, the accuracy of the photometry, and the fidelity of the source detection and object identification algorithms. The SC members also have been asked to help plan and prioritize the additional capabilities that will be developed for subsequent stages of DC3b and to provide input in the longer-term development of the science archive and supporting tools. The new capabilities will include difference image analysis to detect moving, variable, and transient sources and the creation of deep stacks to detect faint objects. This partnership will help ensure that the DM processing system will enable the full science potential of LSST once operations begin.

Community scientists in the US will have another opportunity to join an LSST Science Collaboration in the coming year; see *www.lsst.org/lsst/science/participate* for details. NL

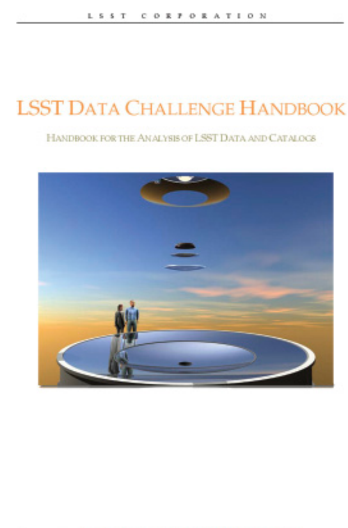


Figure 3: The *LSST Data Challenge Handbook* provides the SC with information for data products, their processing, and their scientific quality.

SAM Update: Working Toward a Laser Guide Star System on SOAR

Nicole van der Bliek & Steve Heathcote

The SOAR Adaptive-optics Module (SAM) project has passed two major milestones in recent months: commissioning of SAM in Natural Guide Star (NGS) mode was completed in December 2010, while in January 2011, the components for the Laser Guide Star (LGS) system were integrated on the telescope and the laser was launched for the first time, inside the SOAR dome.

NGS Commissioning Complete

The basic functionality of SAM in NGS mode was tested during a first round of tests at the telescope in August and September 2009. In particular, the adaptive optics (AO) loop was closed for the first time.

The SAM main module then returned to the laboratory in La Serena to allow installation of the Tip-Tilt guiders and Atmospheric Dispersion Compensator. The main module also was configured for the LGS mode, so that the LGS Wave Front Sensor and the LGS Turbulence Simulator could be tested. During the Chilean winter, extensive testing of the LGS system took place in the laboratory, which included closing the loop on a simulated "laser star."

With laboratory testing in LGS mode completed, the SAM main module was re-configured for NGS mode and taken back to SOAR at the end of November 2010 to complete commissioning in NGS mode. This time around, the focus was on testing the Tip-Tilt guiders of SAM, as well as commissioning the SAM Imager (SAMI).

The Tip-Tilt guiders are used in LGS mode to track one or two natural guide stars in order to correct atmospheric tip-tilt which cannot be measured with the laser. High frequency tip-tilt correction is performed using SAM's deformable mirror, with the accumulated error being off-loaded, at lower frequency, to the SOAR M3 and eventually the telescope mount.

SAMI is a simple direct imager, consisting of a clone of the SOAR Optical Imager (SOI) dewar containing a red optimized e2v CCD, plus a filter wheel. It will be permanently mounted on one of SAM's two ports, while the other output port will be available for a visitor instrument, such as the SOAR Integral Field Unit Spectrograph (SIFS).

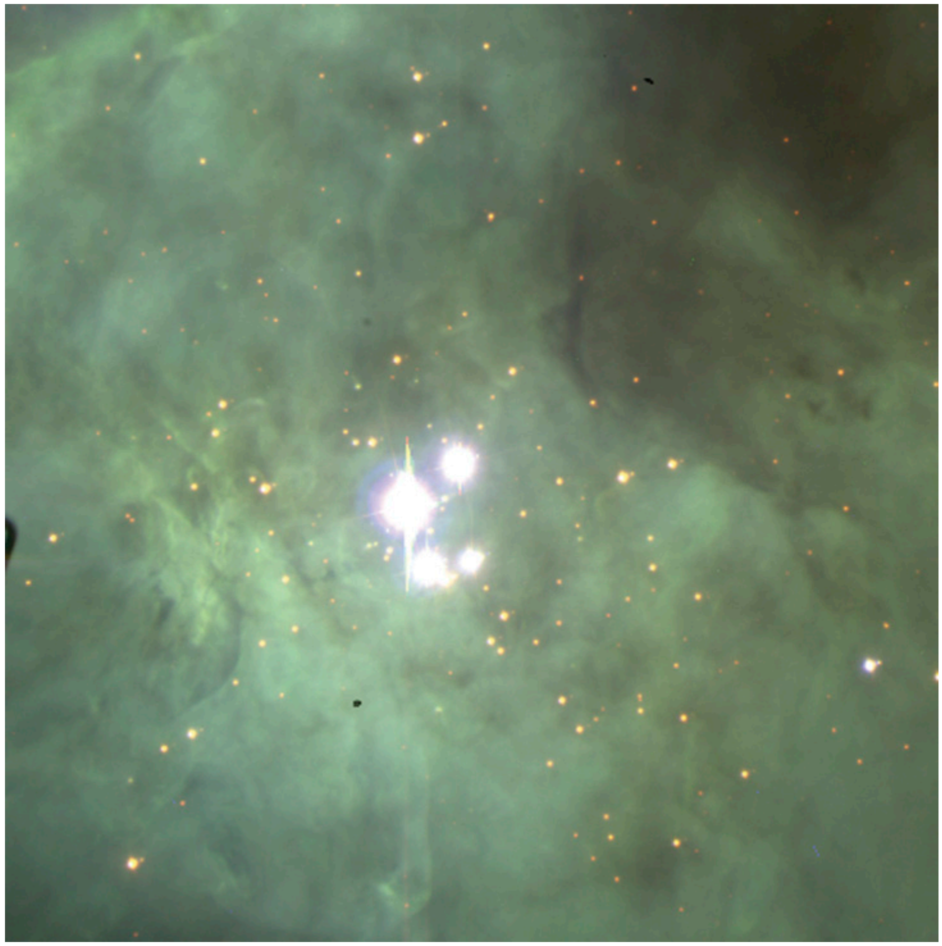


Figure 1: Results with SAM in NGS mode. BVR color composite of the Orion Nebula: B = blue, V = green, R = red. The full width half-maximum (FWHM) of the AO-corrected images in I is 0.26" and 0.3" in R. This image was taken on a night when the seeing was good, and stable (~0.5–0.6" at 500 µ), with the strongest contribution coming from the ground layer (the free atmosphere seeing, excluding that layer, was ~0.2"). Consequently, even using a natural guide star, good AO correction was achieved over the full field of view of SAMI. This image thus foreshadows what should be achieved with SAM in LGS mode (which only corrects the lower layers) on nights with good free atmosphere seeing. The 25 percentile free atmosphere seeing for Cerro Pachón is 0.29", with nights as good as the one in question occurring regularly (Tokovinin & Travouillon 2006, MNRAS, 365,1235). (Image credit: Andrei Tokovinin, Jayadev Rajagopal, Luciano Fraga, and SAM Team/NOAO.)

In addition to testing the Tip-Tilt guiders and SAMI, images (see Figure 1 and this *Newsletter* cover) were obtained to fully characterize SAM's functionality in NGS mode, which serves as the foundation for subsequent work on LGS mode. These images also give a taste of the quality of the AO-corrected images to be obtained once SAM is fully operational.

Preparing the Laser Guide Star System

In parallel with the work on the SAM main module for the second round of commissioning, the components of the SAM LGS system were integrated, aligned, and tested in the optics lab (see Figure 2).

continued

SAM Update continued

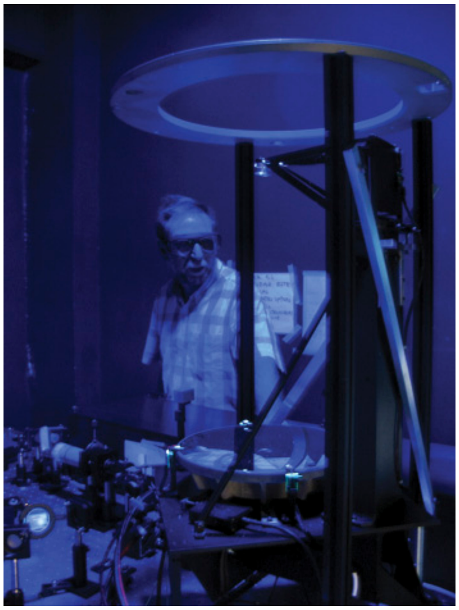


Figure 2: The LGS test setup in the CTIO Optical Laboratory in La Serena. The LLT points at a piece of white paper at the ceiling, which, when illuminated by the UV laser, fluoresces in violet. Roberto Tighe, optical engineer, stands behind the LLT. (Image credit: Nicole van der Bliek/NOAO.)

The complete LGS system—the Laser Box, the Beam Transfer Optics (BTO) and the Laser Launch Telescope (LLT)—were mounted at the telescope in January 2011 (see Figure 3). Testing of the system is now well underway, including, for example, alignment of the BTO, and alignment of the LLT with respect to SOAR. This effort culminated on January 28, when we were able to launch the laser for the first time inside the dome (see Figure 4).

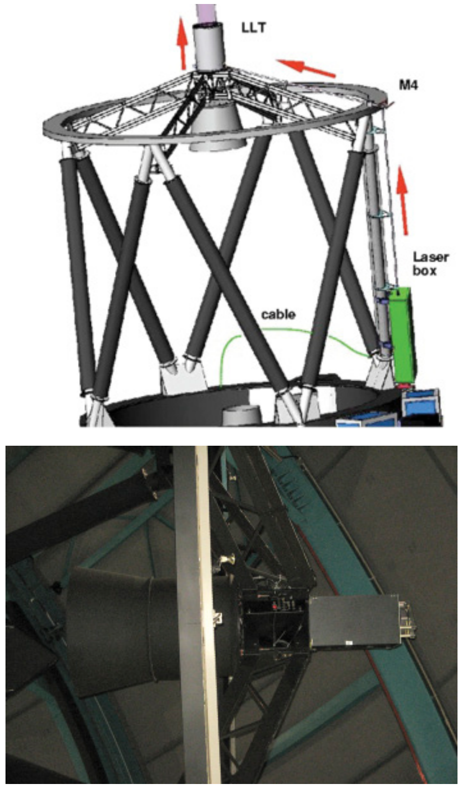


Figure 3: The Laser Guide Star system. The LGS system consists of: a Laser Box, containing the laser and optics for beam forming and diagnostics; the Beam Transfer Optics, bringing the laser light from the Laser Box up to the secondary of SOAR; and a Laser Launch Telescope (LLT), mounted behind the SOAR secondary, which expands and focuses the beam and sends it skyward. (a) Location of the SAM LGS components at the SOAR Telescope (Image credit: SAM Team/SOAR. (b) The LLT (right) mounted behind the SOAR secondary (left). (Image credit: Nicole van der Bliek/NOAO.)

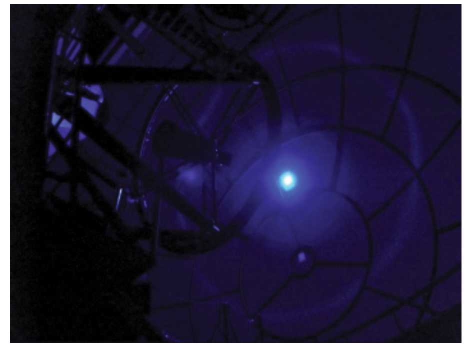


Figure 4: SAM UV Laser launched inside the SOAR dome for the first time on 28 January 2011 at 00:30 am. The laser is pointed at a piece of paper attached to the dome, to produce the fluorescent violet light that is lighting the dome. This is another important step forward in getting the SAM LGS system online. (Image credit: Daniel Maturana/SOAR/NOAO.)

Over the coming months we will carry out the many tasks required to fully test and commission the LGS system and SAM in LGS mode, which will lead up to science verification testing later in the year. NL

Dark Energy Camera Update

Alistair Walker, Tim Abbott & Chris Smith

The new, large-format Dark Energy Camera (DECam) was described in detail in the March 2010 *NOAO Newsletter* (page 10), and the filter complement was discussed in the September 2010 issue (page 11). Here we highlight a few features of DECam, provide a progress report, and outline the schedule for installation and commissioning. The latter topic is treated in detail in the "Availability of the CTIO Blanco 4-m Telescope in 2011B and Beyond" article in the System Observing section of this issue.

DECam is a 520-Mpixel CCD camera being built by the Dark Energy Survey (DES) Collaboration for the prime focus of the CTIO Blanco 4-m telescope. The DES Collaboration consists of 120 faculty-level scientists and ~80 postdocs and students from 12 US institutions plus international consortia located in Brazil, Germany, Spain, and the UK. The DES covers 5,000 square degrees of the South Galactic Cap, for which it will use 30% of the telescope time for five years. DECam and DES are described at *www.darkenergysurvey.org*.

continued

Dark Energy Camera Update continued

DECam will also be available as a facility instrument for general users, providing a substantial gain in efficiency compared to the present Mosaic II camera. For example, from the data in Table 1, which compares some of the critical parameters for the two cameras, it can be readily calculated that in "survey mode" DECam covers the sky some 10 (long exposures, g band) to 50 (moderate exposures, i and z bands) times faster than Mosaic II, the precise figure depending on wavelength and exposure time. Even for a fixed-position (deep drilling) program, the gains provided by the short read time and the expected lack of fringing in the red passbands will make DECam the faster camera.

Table 1

Parameter	Mosaic II	DECam
No. of CCDs	8	62
CCD Format	2K×4K, 15μ pixels	2K×4K, 15μ pixels
CCD Type	standard, broadband AR	Fully depleted, red optimized
Full well	60K	130K
Image size	128 MB	1040 MB
Relative QE 400 nm	1	0.9
Relative QE 700 nm	1	1.1
Relative QE 850 nm	1	1.8
Relative QE 1000 nm	1	6.0
Read noise	6–12 e- rms	<15 e- rms
Read time	100s	17s
Atmospheric Disp. Corr.	yes	no
Guiding	separate	Focal plane
Filters	many	g r i z Y

The project includes the construction of a new prime focus cage, a new corrector, and the provision of a set of Sloan Digital Sky Survey (SDSS) g, r, i, z, and Y filters. The large dewar containing the 62 science and additional CCDs dedicated to focus/alignment and guiding, together with the filters, shutter, and optics, are supported within the prime focus cage via a hexapod mechanism that allows compensation for displacements and tilts. The prime focus cage also contains cooled cabinets that house all the electronics needed for operating the instrument and detectors, plus a network of pumps, valves, cryogen lines, cooling lines, and electrical connections. The control software runs on multiple computers, which will be housed in a rebuilt and enlarged computer room, and we are rebuilding and reorganizing the telescope control room. Very importantly, a Community Pipeline, which removes instrument signature and provides astrometry and approximate photometry, is a project deliverable that is being developed at the National Center for Supercomputing Applications (NCSA) at the University of Illinois. The Community Pipeline will be operated by the Science Data Management (SDM) group at NOAO Tucson, who will also archive and serve DECam (and DES) data via the NOAO Science Archive.

In the age of DECam, we still will be scheduling Cassegrain focus instruments, initially the Infrared Side Port Imager (ISPI) and Hydra, and later the Cerro Tololo Ohio State Multi-Object Spectrograph (COSMOS). However, changing from prime to Cassegrain will become rather more involved. The prime focus cage will no longer flip end-to-end to allow selection of the $f/8$ mirror that feeds the Cassegrain instruments. Instead, the cage will always be in the same orientation for both foci, and the $f/8$ mirror will be mounted in front of the prime focus corrector when needed, i.e., no longer permanently installed at the other end of the cage, which will be overflowing with DECam! Since the $f/8$ mirror is large (1.5 m in diameter) and heavy, a new handling fixture has been constructed as part of the DECam Project to allow safe and precise handling of the $f/8$ mirror and the counterweight that replaces the mirror when it is not in use. This $f/8$ handler was shipped to CTIO in October 2010 and installed in January 2011 by CTIO and Fermilab technical staff (see Figure 1) adjacent to the N-W platform that is used to access the prime focus cage. The $f/8$ handler was designed and built at the Argonne National Laboratory, a DES partner.

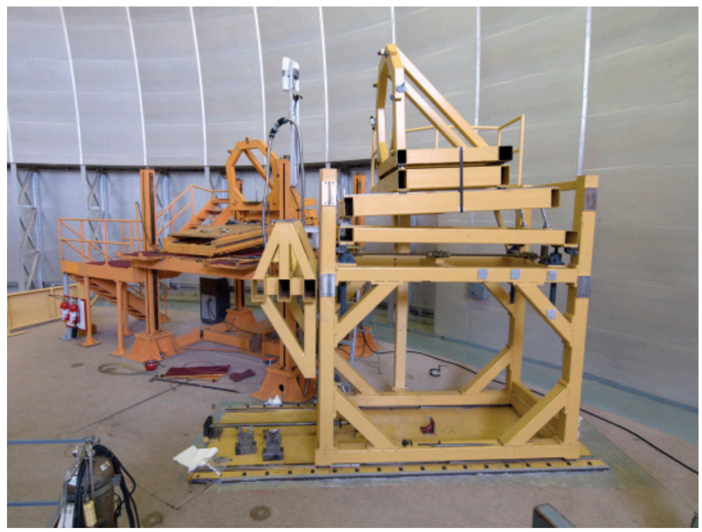


Figure 1: The new Blanco telescope $f/8$ mirror handler. (Image credit: Tim Abbott/NOAO.)

DECam is at present installed on the telescope simulator at Fermilab (Figure 2). The telescope simulator allows positioning the instrument in different orientations thus mimicking its behavior on the Blanco telescope. The instrument is complete with the exception of the five-element optical corrector, the filters, and the installation of engineering rather than science-grade detectors on the focal plane, and some minor items such as cage covers and doors are lacking. A full suite of tests is underway of the hardware and the data acquisition software. These tests, lasting several months, are designed to exercise and debug all the camera systems, and, notably, they include a week of simulated observing in mid-February where astronomers will ascertain convenience of use and gauge reliability and efficiency by exercising the hardware and software in modes as close to observing as is possible without actually being connected to a telescope.

Tests will continue until mid-March, at which stage DECam will be dismounted from the simulator and all the hardware with the exception of the Imager and the DECam electronics will be packed up and sent to CTIO. The science CCDs will then be installed in the Imager and thoroughly tested before being shipped by air to CTIO, arriving in July. At about the same time, the mounting and alignment of the optical

continued

Dark Energy Camera Update continued

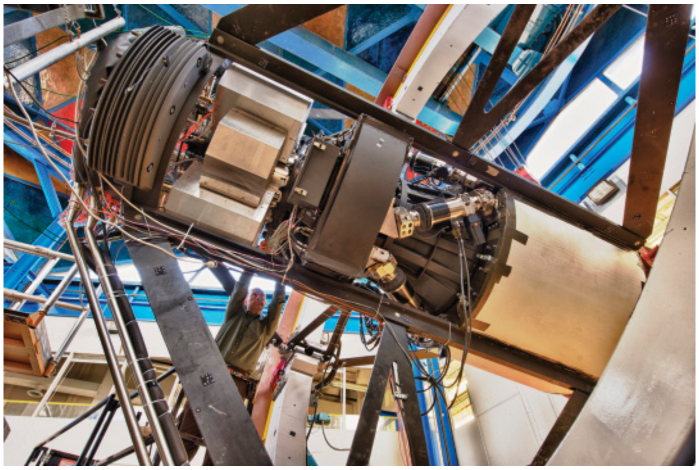


Figure 2: DECam mounted on the telescope simulator at Fermilab. (Image credit: Reider Hahn/Fermilab.)

Figure 3: The largest element (1 m in diameter) of the prime focus corrector, pictured at SESO at the time of acceptance in January 2011. (Image credit: Société Européenne de Systèmes Optiques.)

corrector elements in their barrel will have been completed at University College London and will be flown from the UK to Chile directly, and the filters should be delivered by Asahi Spectra (Japan) and also flown directly to Chile. Polishing of the five optical corrector elements (Figure 3) has just been completed at Société Européenne de Systèmes Optiques (SESO) in France.

The telescope shutdown for the DECam installation is nominally scheduled to begin on 1 September 2011 and to last for two months. The subsequent two months will be devoted to commissioning both the new *f*/8 handling system and DECam. Commissioning will be followed by science verification for the DES Project and the community and then shared-risk community observing for the remainder of 2012A (see details elsewhere in this *Newsletter* and up-to-date information at *www.noao.edu/noaoprop/help/facilities.html).*

Presentations on the DES and on DECam use by the community were made at the January 2011 Seattle AAS meeting in a Special Session and a Splinter Meeting, and some of these can be viewed at *www.ctio.noao.edu/decam/*. Also, we would like to draw your attention to a two-day DECam Community Workshop being planned for 18–19 August 2011 in Tucson. The purpose of this workshop is three-fold: (1) to convey the details of DECam and allow for extensive discussions between interested astronomers and the DECam team; (2) to provide an opportunity for prospective users to meet and form collaborations based upon common or complementary interests in DECam data and capabilities; and (3) to give the DECam team an overview of the interest in DECam, thus allowing us to optimize commissioning, operations, and data reductions. The workshop details can be viewed at *www.noao.edu/meetings/decam.*

Be sure to visit the above Web pages, and, please, email if you have any questions about DECam or the DES. NL

BigBOSS: Mapping the Universe with the Mayall

Abhijit Saha, Arjun Dey, Mark Dickinson, David Sprayberry & Buell Jannuzi

In December 2009, NOAO issued an Announcement of Opportunity (*www.noao.edu/kpno/largescience.html*) for institutions to partner with NOAO and the NSF to pursue a Large Science Program (LSP) with the Mayall telescope on Kitt Peak and to develop a major, new, observing capability on the Mayall. The dual goals of the Large Science Program are to enable high-impact, frontier science and improve the capabilities offered within the US system of ground-based optical/infrared facilities. In response to this call, in October 2010, NOAO received a proposal from the BigBOSS Collaboration (BOSS stands for Baryon Oscillation Spectroscopic Survey), a partnership of 16 US institutions (universities and national laboratories) and international partners. The Lawrence Berkeley National Laboratory is the lead institution and Dr. David Schlegel is the principal investigator on the proposal. The collaboration (see *bigboss.lbl.gov/*) proposes to construct a wide-field (three degrees in diameter), 5,000-fiber multi-object spectrograph for the prime focus of the Mayall telescope. The collaboration will then undertake a survey of roughly 20 million galaxies over 14,000 square degrees of the sky with the goal of constraining the equation of state of dark energy by measuring the imprint of the baryon acoustic oscillations on the large-scale structure of galaxies.

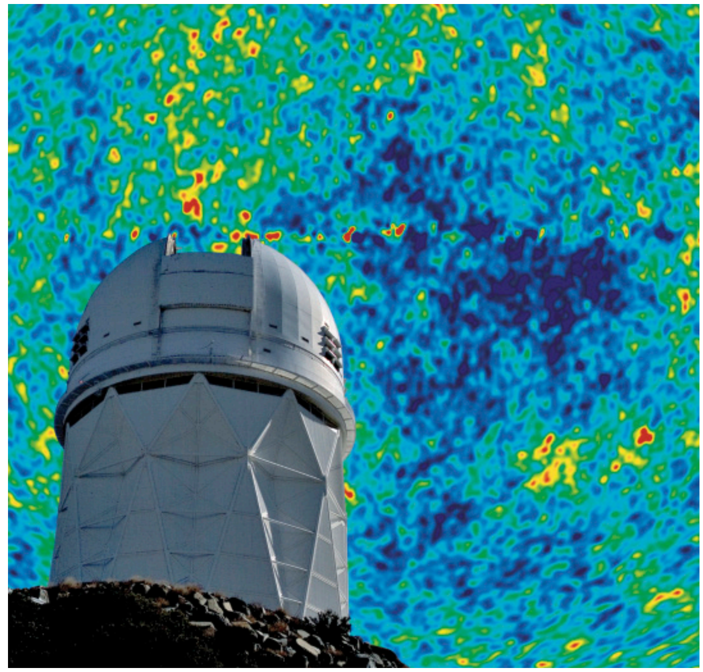
continued

BigBOSS continued

In November 2010, NOAO convened an external, non-advocate committee of 11 experts to review the proposal and advise the director on the project. The reviews of the proposal were very positive. The committee report asserted that "if BigBOSS achieves its stated science goals, it will be a highly effective use of the Mayall Telescope in the period of 2016–2020, and the resulting survey would be one of the telescope's major scientific contributions during its lifetime." They went on to say that BigBOSS "potentially provides a compelling new capability, enabling a wide range of front-line scientific investigations for the general user community."

Following the recommendation of the review committee, NOAO is conditionally accepting the proposal—subject to the satisfactory mitigation of identified risks and the successful conclusion of a Memorandum of Understanding with the project team—and is partnering in the BigBOSS project to further develop the proposal toward a Conceptual Design. In particular, NOAO will work closely with the BigBOSS team in order to better understand the scientific, technical, and management risks identified by the review, to articulate the public role for science with the instrument, and to help ready the project for a Conceptual Design Review. Dr. Arjun Dey will serve as the NOAO project scientist for the BigBOSS project.

BigBOSS potentially provides an unprecedented capability for the US astronomical community. It will enable astrophysical investigations into a vast range of topics including observational cosmology, Galactic Archaeology, and galaxy evolution. Along with the soon-to-be-offered Dark Energy Camera on the Blanco Telescope, BigBOSS showcases the ability of the 4-m telescopes to undertake groundbreaking scientific investigations in a very cost-effective manner on our existing facilities. NL



The BigBOSS project proposes to equip the Mayall telescope with a new, wide-field spectrograph covering a 3-degree-diameter field of view with 5,000 fibers. This instrument will have unprecedented astrophysical grasp and, in addition to mapping the geometry and expansion history of the universe, will be available for use by the community.
(Image credit: Pete Marenfeld/NOAO.)

ReSTAR Phase 1 Update

David Sprayberry

The Renewing Small Telescopes for Astronomical Research (ReSTAR) committee report (see *www.noao.edu/system/restar/files/ReSTAR_final_14jan08.pdf*) described a 10-year program for enhancing the scientific capabilities of the 2-m to 4-m telescopes within the US ground-based optical/infrared system and enlarging the amount of open-access time available on those telescopes. NOAO began the process of implementing this program with an initial, unsolicited proposal to the NSF requesting funding for activities in the first three years of this overall 10-year program. NOAO calls this first proposal, and the activities funded through it, "Phase 1" of the ReSTAR program.

The NSF responded favorably to NOAO's Phase 1 proposal, but because of constraints within its own budget, the NSF could not commit up front to funding the full three years of Phase 1. So far, the NSF has released funding one year at a time for Year 1 and Year 2 of Phase 1, each time explicitly cautioning that funding for future years could not be guaranteed. NOAO responded to this constraint by launching in each year only those projects that could be completed with the funding awarded in that year. The priorities of the ReSTAR report were carefully reviewed with the ReSTAR committee and other community representatives (e.g., the NOAO Users Committee) before selecting projects.

Projects Funded in the First Year

Palomar Time Purchase: NOAO agreed with Caltech Optical Observatories to acquire a modest share of the time for three years on the Hale 200-inch telescope (Figure 1) at Mount Palomar, mainly to provide open access to the Hale Double Spectrograph (optical) and TripleSpec (near-infrared). We are now in the third semester of observing under this agreement. The open-access time has been well received, and it is typically over-subscribed by a factor of 2–3.

Mosaic 1 Prime Focus Imager Upgrade: In December 2009 (immediately after receiving the first year of ReSTAR funding), NOAO launched an internal project to upgrade the CCDs and controllers on the heavily-used Mosaic 1 prime focus imager for the KPNO 4-m Mayall telescope. This upgrade was completed in October 2010 with the recommissioning of the Mosaic 1 camera on the Mayall. The upgraded camera was returned to scheduled science use in November 2010. For more details about the

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ReStAR Phase 1 Update continued

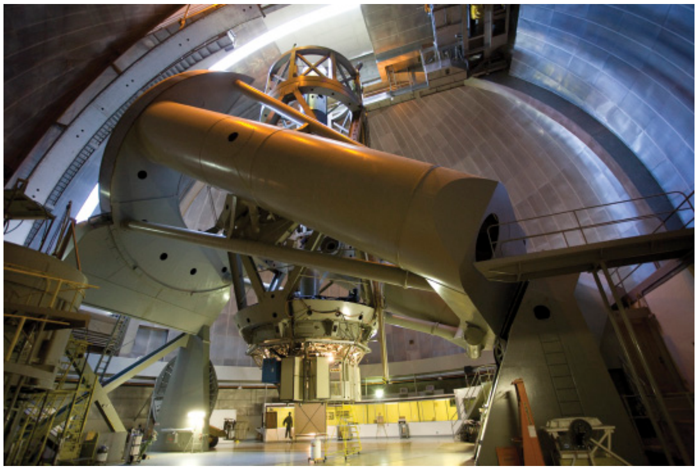


Figure 1: Hale 200-inch telescope. (Image credit: Scott Kardel/Caltech Optical Observatories.)

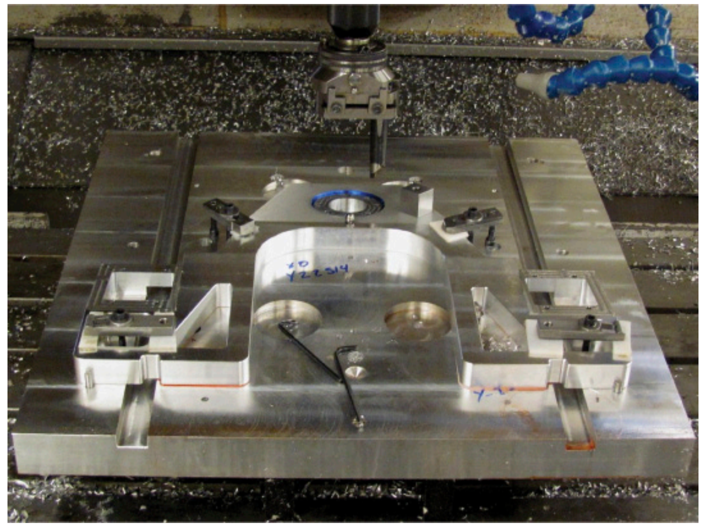


Figure 3: KOSMOS part in fabrication in an NOAO CNC milling machine. (Image credit: NOAO.)

upgraded Mosaic camera and a recent image obtained with it, see "A New and Improved Mosaic 1.1 Returns to Science Operations" in the System Observing: Telescope & Instruments section.

KOSMOS Optical Spectrograph: Immediately upon receiving the first year of ReSTAR funding, NOAO launched a project in partnership with the astronomy instrumentation group at The Ohio State University (OSU) to construct a high-throughput, medium-resolution optical spectrograph for KPNO's Mayall 4-m telescope (see Figure 2 & 3). The project is based on the recent successful Ohio State Multi-Object Spectrograph (OSMOS) that OSU built for the 2.5-m Hiltner telescope at the MDM Observatory on Kitt Peak; the partnership with OSU allows for substantial savings in time and money by re-using much of the OSMOS design. For full details about the status of KOSMOS, see the next article, "KOSMOS Updates: COSMOS for CTIO and Other News."

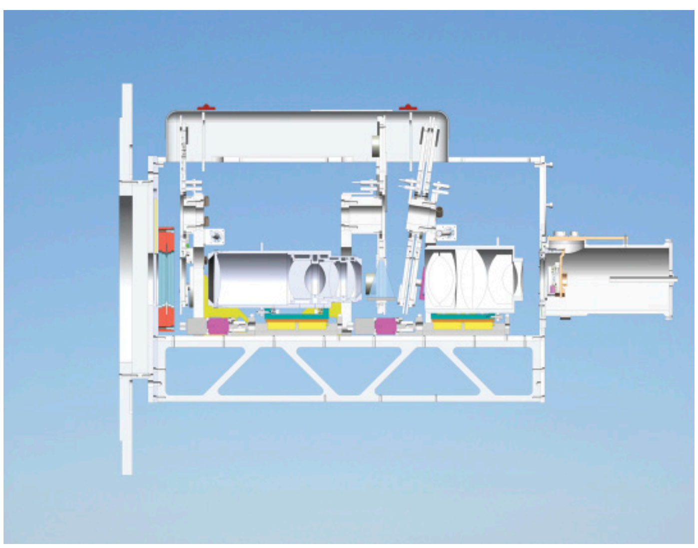


Figure 2: Cutaway of KOSMOS mechanical design. (Image credit: Mark Derwent/Ohio State University.)

Hydra-South Spectrograph Upgrade: NOAO also plans to upgrade the Hydra-South multi-object fiber spectrograph on the CTIO Blanco 4-m telescope, using ReSTAR funds to purchase a new, red-sensitive CCD and a new controller. During the planning for this project, it became clear that the CTIO engineering and technical staff was already fully committed with large, high-priority projects—primarily completion of the SOAR Adaptive Module, a ground-layer adaptive optics system, and preparation for the delivery of the Dark Energy Camera—and could not begin work on this upgrade until at least early 2012. With NSF approval, NOAO elected to purchase the CCD and other hardware during 2011 but defer all work to implement the upgrade until 2012.

Projects Funded in the Second Year

COSMOS Optical Spectrograph: Shortly after the KOSMOS design review (see the next article), NOAO learned that NSF would provide ReSTAR

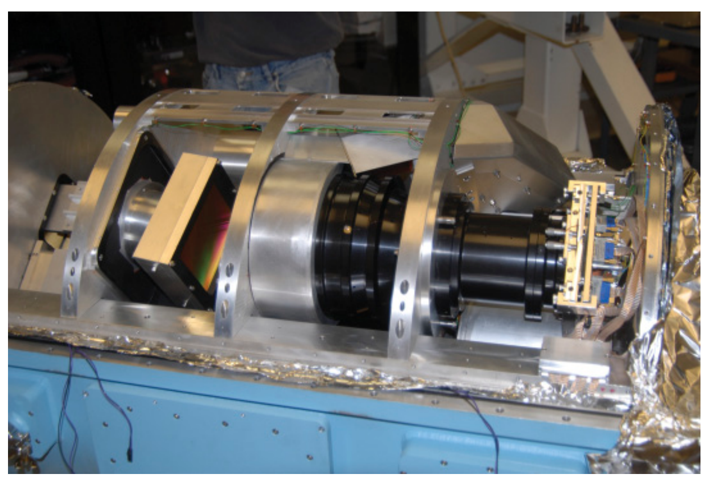


Figure 4: Interior view of TripleSpec, showing (L-R) diffraction grating, camera lens barrel, and detector head with wiring. (Image Credit: Chuck Henderson/Cornell University.)

continued

ReSTAR Phase 1 Update continued

funding in the second year, in part to support construction of a similar spectrograph for the CTIO Blanco 4-m telescope. NOAO and OSU planned the fabrication and assembly phases of the two projects to maximize the savings from making two nearly identical copies at once. As a result, the incremental cost of making COSMOS for CTIO is only about 60% of the cost of making KOSMOS for KPNO alone. For more information about COSMOS and its expected delivery date, see the next article.

TripleSpec 4 Near-Infrared Spectrograph: The second year of funding from NSF also is designated to support construction of a near-infrared, high-throughput spectrograph for the CTIO Blanco 4-m telescope. In order to deliver the instrument as quickly and cost-effectively as possible, NOAO will form a partnership with the astronomical instrumentation group at Cornell University to build a fourth copy of the spectrograph known as "TripleSpec" (Figure 4). The Cornell group built the first copy, which is now deployed on the Hale 200-in telescope at Mount Palomar. Because both the Cornell group and the CTIO technical staff are heavily committed to other things during most of fiscal year (FY) 2011, the project will begin during the second half of FY 2011 with a quick review of the minor modifications needed to adapt TripleSpec to the Blanco telescope; actual construction work will begin late in FY 2011 or early in FY 2012, with delivery expected in mid-FY 2014.

KOSMOS Updates: COSMOS for CTIO and Other News

Jay Elias

Since the last ReSTAR update was written for the March 2010 *Newsletter,* there have been several important developments related to the Kitt Peak Ohio State Multi-Object Spectrograph (KOSMOS) project.

Additional funding for the Renewing Small Telescopes for Astronomical Research (ReSTAR) project has been received (see previous article, "ReSTAR Phase 1 Update"), which allows for construction of a duplicate of KOSMOS, appropriately named Cerro Tololo Ohio State Multi-Object Spectrograph (COSMOS) for the Blanco telescope. The two instruments will be duplicates of one another, except for differences related to telescope and dewar interfaces. As much as possible, we intend for these differences to be transparent to observers, who ideally should find observing with one instrument to be the same as observing with the other. In practice, there are differences between the telescopes that must be overcome (in particular, the absence of a wide-field cassegrain atmospheric dispersion compensator and calibration system on the Mayall); this may take a while due to the constraints on observatory resources.

In the meantime, the availability of funding has allowed us to proceed with the mechanical and electronic fabrication and the optics and detector procurement in parallel, resulting in significant cost and schedule savings. The two instruments will be assembled, tested, and commissioned sequentially, with KOSMOS commissioning due for semester 2011B and COSMOS commissioning due for semester 2012A. General availability should occur in the following semester for each instrument. This ought to include the multi-object mode for both instruments.

The decision to proceed to construction was taken following a design review held in Columbus, Ohio, with an external panel chaired by Dr. Andrew Sheinis (University of Wisconsin). The panel was generally very supportive, but identified a number of concerns, which the project has subsequently responded to or addressed. One consequence of both the addition of COSMOS and the design review has been the designation of Sean Points (CTIO and SOAR) as the project scientist.

As part of the effort leading up to the design review, a detailed construction schedule and budget were prepared. The baseline plan includes two CCD dewars for each instrument: one will contain a 2K × 4K e2v CCD similar to those used in the Mosaic upgrade, while the second will contain a 4K × 2K Lawrence Berkeley National Laboratory thick CCD, which will provide very good response in the red and far-red. Users will be able to request either CCD, but any dewar exchanges will have to be scheduled in advance, not at the last minute. The initial disperser complement will likely consist only of moderate-resolution blue and red Volume-Phase Holographic grisms, but our hope is to add to the set as funding permits. The instruments will use the standard KPNO and CTIO 4-inch filters. Some additional information can be found on the KOSMOS Web page (accessed through the Instrumentation link on the NOAO Astronomers home page).

As noted above, KOSMOS is expected to become available for general use in semester 2012A. We expect to post detailed information on instrument performance in late August, with updates possible after the first commissioning run (nominally September). This schedule depends, of course, on timely delivery of all optics and on a relatively problem-free instrument integration.

NOAO Assumes Leadership of ODI Development

At the request of the WIYN Board, NOAO has taken over leadership of the development of the One Degree Imager (ODI) for the WIYN telescope. Although the opto-mechanical fabrication of ODI is nearly complete, the project has been impeded by the difficulty of producing the necessary detectors for the focal plane of the instrument. The current phase, which will include continued work on the development of the detectors, exploration of remaining risks, and creation of a reliable budget and schedule for completion, will last through the rest of fiscal year 2011. WIYN operations, meanwhile, will continue with its currently available complement of instruments.

The Decadal Survey's Effect on NOAO and GSMT

Jay Elias

As most readers of the *Newsletter* are aware, the recent Astro2010 decadal survey report, *New Worlds, New Horizons in Astronomy and Astrophysics (www.nap.edu/catalog.php?record_id=12951)*, recommended that federal participation in an extremely large telescope (ELT) or giant segmented-mirror telescope (GSMT) should be the third highest priority for major ground-based projects in the next decade. The survey panel also recommended that the NSF act promptly to select an ELT project for federal investment. The two US-based candidate projects are the Giant Magellan Telescope (GMT—*www.gmto.org/*) and the Thirty Meter Telescope (TMT—*www.tmt.org/*).

Up until this time, AURA had been exercising oversight of the two projects on behalf of the NSF, which had provided some development funding for both. The NSF has now assumed a direct oversight role, appointing Dr. Donald Terndrup as its GSMT program officer. The NSF is expected to issue a formal solicitation near the middle of 2011 as part of the process for deciding on its investment strategy, with an initial decision possible around year-end.

The solicitation or its outcome may redefine AURA's role once again; in the meantime, NOAO staff (and those at other AURA-run observatories) may participate in GMT and TMT activities such as design review panels or science collaborations. The NSF's decision was explicitly intended to preserve the option of a future role for NOAO in managing the federal interest in GSMT. NOAO also continues to perform a limited amount of GSMT-related technical work under contract.

In view of this altered role for NOAO, the GSMT Program Office (GSMTPO) will cease to exist as a separate (already very small) piece of the NOAO System Technology Center (NSTC). The GSMTPO personnel will remain within NSTC as part of a more integrated development program.

2011B NOAO Call for Proposals Due 31 March 2011

Verne V. Smith & Dave Bell

Standard proposals for NOAO-coordinated observing time for semester 2011B (August 2011–January 2012) are **due by the evening of Thursday, 31 March 2011, midnight MST.**

The facilities available this semester include the Gemini North and South telescopes, Cerro Tololo Inter-American Observatory (including SOAR), Kitt Peak National Observatory (including WIYN), and community-access time with the 10-m Keck I and Keck II telescopes at the W. M. Keck Observatory, the 6.5-m MMT telescope, the 200-in (5-m) Hale telescope at Palomar Observatory.

New to this semester is a formal Call for Proposals at *ast.noao.edu/observing/cfp*, which is a self-contained, downloadable pdf document that contains all information necessary to submit an observing proposal to NOAO. Included in this document are:

- How to prepare and submit a proposal for an observing program.
- Deadlines.
- Descriptions of classes of programs, such as normal, survey, or long-term, as well as the criteria of evaluation for each class.
- Who may apply, including special guidelines for thesis student proposals, or travel support for classical observing on the Gemini telescopes.
- Changes and news or updates since the last Call for Proposals.
- Links to Systems facilities Web pages.
- How to acknowledge use of NOAO facilities in your papers.

Previous information on various Web pages that contain all of the information within the Call for Proposals document also remains available at *www.noao.edu/noaoprop*.

There are four 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.

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

E-mail submission – 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 e-mail. Please carefully follow the instructions in the LaTeX template for submitting proposals and figures. Please use file upload instead of e-mail if possible.

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

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

Help with proposal preparation and submission is available via the addresses below:

Web proposal materials and information	www.noao.edu/noaoprop/
TAC information and proposal request statistics	www.noao.edu/gateway/tac/
Web submission form for thesis student information	www.noao.edu/noaoprop/thesis/
Request help for proposal preparation	noaoprop-help@noao.edu
Address for submitting LaTeX proposals by email	noaoprop-submit@noao.edu
Gemini-related questions about operations or instruments	gemini-help@noao.edu www.noao.edu/usgp/noaosupport.html
CTIO-specific questions related to an observing run	ctio@noao.edu
KPNO-specific questions related to an observing run	kpno@noao.edu
Keck-specific questions related to an obvserving run	keck@noao.edu
MMT-specific questions related to an observing run	mmt@noao.edu
Hale-specific questions related to an observing run	hale@noao.edu

System-Wide Observing Opportunities for Semester 2011B: Gemini, Keck, MMT, and Hale

Knut Olsen, Dave Bell & Verne V. Smith

Semester 2011B runs from 1 August 2011 to 31 January 2012, and the NOAO System Science Center (NSSC) encourages the US community to propose for observing time using all of the ground-based, open-access, system-wide facilities available during this semester. This article summarizes observing opportunities on telescopes other than those from KPNO, CTIO, WIYN, and SOAR.

The Gemini Telescopes

The US user community has about 50 nights per telescope per semester on the Gemini North and Gemini South telescopes, which represents the largest piece of open-access observing time on 8-m-class telescopes. The Gemini Observatory provides unique opportunities in observational and operational capabilities, such as the ability to support both classically- and queue-scheduled programs.

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

US Gemini observing proposals are submitted to and evaluated by the NOAO Time Allocation Committee (TAC). The formal Gemini "Call for Proposals" for 2011B will be released in early March 2011 (close to the publication date of this *Newsletter* issue), with a US proposal deadline of Thursday, 31 March 2011. As this article is prepared well before the release of the Call for Proposals, the following list of instruments and capabilities are only our expectations of what will be offered in semester 2011B. Please watch the NSSC Web page (*www.noao.edu/nssc*) for the Gemini Call for Proposals, which will list clearly and in detail the instruments and capabilities that will be offered.

NSSC anticipates the following instruments and modes on Gemini telescopes in 2011B:

***Gemini North*:**

- NIFS: Near-infrared Integral Field Spectrometer.
- NIRI: Near Infrared Imager and spectrograph with both imaging and grism spectroscopy modes.
- ALTAIR adaptive optics (AO) system in natural guide star (NGS) mode, as well as in laser guide star (LGS) mode. ALTAIR can be used with NIRI imaging and spectroscopy and with NIFS integral field unit (IFU) spectroscopy, as well as NIFS IFU spectral coronagraphy.
- Michelle: mid-infrared (7–26 μm) imager and spectrometer, which includes an imaging polarimetry mode.
- GMOS-North: Gemini Multi-Object Spectrograph and imager. Science modes are multi-object spectroscopy (MOS), long-slit spectroscopy, IFU spectroscopy and imaging. Nod-and-Shuffle mode is also available.
- GNIRS: Gemini Near Infrared Spectrograph offers a wide variety of spectroscopic capabilities including long-slit (single order) spectroscopy within the 1.0–5.4 μm range. The instrument can be used with adaptive optics over most of its wavelength range.
- All of the above instruments and modes are offered for both queue and classical observing, except for LGS, which is available as queue only. **Classical runs are now offered to programs that are one night or longer and consist of integer nights.**
- Details on use of the LGS system can be found at *www.gemini.edu/sciops/instruments/altair/?q-node/10121*, but a few points are emphasized here. Target elevations must be >40 degrees and proposers must request good weather conditions (Cloud Cover = 50%, or better, and Image Quality = 70%, or better, in the parlance of Gemini observing conditions). Proposals should specify "Laser guide star" in the Resources section of the Observing Proposal. Because of the need for good weather, LGS programs must be ranked in Bands 1 or 2 to be scheduled on the telescope.
- Time trades will allow community access to:
  Keck I: up to 5 nights (HIRES only)
  Subaru: up to 10 nights (all instruments offered).

Gemini South:

- T-ReCS: Thermal-Region Camera Spectrograph mid-infrared (2–26 μm) imager and spectrograph.
- GMOS-South: Gemini Multi-Object Spectrograph and imager. Science modes are MOS, long-slit spectroscopy, IFU spectroscopy and imaging. Nod-and-Shuffle mode is also available.
- NICI: Near-Infrared Coronagraphic Imager. NICI is available for general user proposals, although its use is restricted to good seeing conditions.
- FLAMINGOS-2 is being refurbished at the La Serena base facility prior to being taken back to the telescope to finish its commissioning and is not expected to be available for general scientific use in 2011B.
- All modes for GMOS-South, T-ReCS, and NICI are offered for both queue and classical observing. **As with Gemini North, classical runs are now offered to programs with a length of at least one or more integer nights.**

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

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. All multi-partner proposals must be submitted using the Gemini Phase I Tool (PIT).

Note that queue-proposers have the option to fill in a so-called "Band 3" box, in which they can reconfigure their program execution if it is scheduled on the telescope in Band 3. Historically, it has been found

continued

System-Wide Observing Opportunities for Semester 2011B continued

that somewhat smaller than average queue programs have a higher probability of completion if they are in Band 3, as well as if they use weather conditions whose occurrences are more probable. Users might want to think about this option when they are preparing their proposals.

Efficient operation of the Gemini queue requires that it be populated with programs that can effectively use the full range of observing conditions. Gemini proposers and users have become increasingly experienced at specifying the conditions required to carry out their observations using the on-line Gemini Integration Time Calculators for each instrument. NSSC reminds you that a program has a higher probability of being awarded time and of being executed if ideal observing conditions are not requested. **The two conditions that are in greatest demand are excellent image quality and no cloud cover. We understand the natural high demand for these excellent conditions, but wish to remind proposers that programs that make use of less than ideal conditions are also needed for the queue.** Potential users of the RC spectrograph on the CTIO 4-m Blanco telescope might consider GMOS on Gemini South in 90% cloud cover conditions as a possible alternative, or back-up, if their proposal cannot be scheduled on the Blanco.

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

TSIP Open-Access Time on Keck and MMT

As a result of awards made through the National Science Foundation's Telescope System Instrumentation Program (TSIP), telescope time is available to the general astronomical community at the following facilities in 2011B:

- **Keck Telescopes**
  A total of 12 nights of classically scheduled observing time will be available with the 10-m telescopes at the W. M. Keck Observatory on Mauna Kea. All facility instruments and modes are available. For the latest details, see *www.noao.edu/gateway/keck/*.
- **MMT Observatory**
  Up to 10 nights of classically-scheduled observing time are expected to be available with the 6.5-meter telescope of the MMT Observatory. We have a total of 28 nights on MMT that we expect to take at up to ~10 nights per semester over three semesters starting with 2011B. MMT will use the TSIP funds to finish development of the Binospec optical multi-object spectrograph. For further information, see *www.noao.edu/gateway/mmt/*.

ReSTAR Observing Time on the Hale Telescope

Funding for the Renewing Small Telescopes for Astronomical Research (ReSTAR) proposal was provided by the NSF for FY10, and one part of this award was used to procure 23 nights per year, over three years, on the Hale 200-in telescope at Palomar. The 2011B allocation is as follows:

- **Hale Telescope**
  Ten nights of classically-scheduled observing time will be available with the 200-in Hale Telescope at Palomar Observatory. For more information, see *www.noao.edu/gateway/hale/*.

Lists of instruments that we expect to be available in 2011B can be found immediately following this article. As always, investigators are encouraged to check the NOAO Web site for any last-minute changes before starting a proposal.

If you have any questions about proposing for US observing time, feel free to contact us:

vsmith@noao.edu
kolsen@noao.edu
dbell@noao.edu.

Moving Forward with Gemini Instrumentation

Knut Olsen and Verne Smith

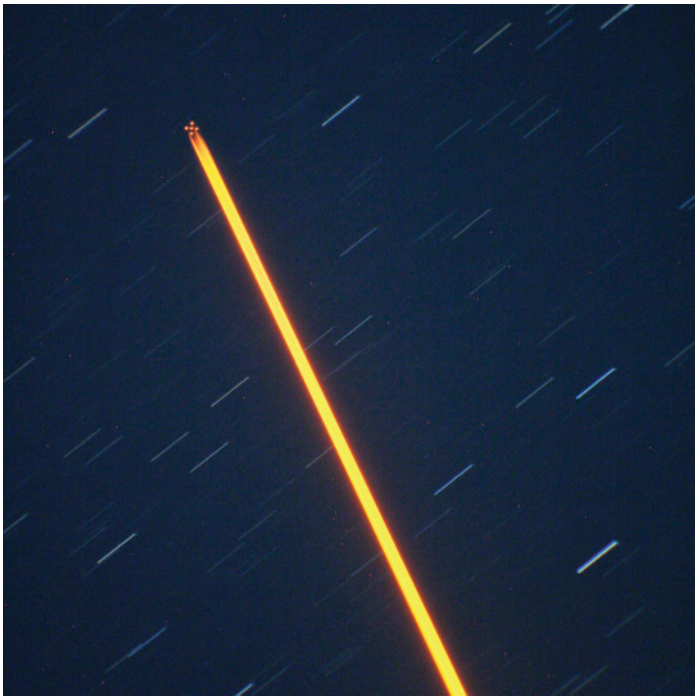
Within the next few years, NOAO proposers will have access to three new, exciting instruments on the Gemini South telescope, while other instruments will be retired to accommodate the new capabilities within a limited operational budget. Here is a quick update on the current outlook.

The Gemini Multi-Conjugate Adaptive Optics System (GeMS) is being commissioned in 2011A along with its associated near-infrared imager, the Gemini South Adaptive Optics Imager (GSAOI). GeMS features a 50-W sodium laser, which is used to create a constellation of five laser guide stars. Coupled with wavefront information from three natural guide stars, GeMS will monitor and correct for the three-dimensional atmospheric turbulence along the line of sight to an astronomical target, providing excellent, spatially uniform adaptive optics (AO) correction over a significant field. Indeed, GeMS + GSAOI should provide diffraction-limited resolution in JHK with uniform performance over a 1-arcmin field and useful performance over a 2-arcmin field. GeMS passed a major milestone on the night of January 21-22 when light from the 50-W laser first shined on the sky, forming the first ever laser guide star constellation (see figure, reproduced from the Gemini press release at *www.gemini.edu/node/11603*).

The Gemini Planet Imager (GPI) is expected to be delivered to Gemini South sometime in 2011, with possible availability for science in late 2012. As its name suggests, GPI is designed for direct detection of planets around nearby stars. It is an extreme AO coronagraphic imaging polarimeter/integral-field spectrometer, and it will be used with bright natural guide stars to provide detections of faint companions with contrast

continued

Moving Forward with Gemini Instrumentation continued



In this image, the split beam from a 50-W laser is seen shining on the sky. The light, which is tuned to a resonant frequency of sodium, excites emission in sodium atoms at ~90 km altitude in the Earth's atmosphere, yielding a constellation of five artificial guide stars. (Image credit: Maxime Boccas and Benoit Michel/Gemini Observatory.)

ratios nearing 1 part in 10^8 (see *www.gemini.edu/sciops/instruments/gpi* for GPI's full range of capabilities). GPI will host Campaign projects requiring hundreds of hours, or more, of queue telescope time, as well as be available for proposals submitted to the regular NOAO Time Allocation Committee. An invitation to submit Letters of Intent to the Gemini Observatory for prospective Campaign projects was issued in December 2010, with letters due on 20 January 2011. These letters were intended to gauge the level of interest in GPI Campaign science; failure to submit a letter does not exclude anyone from applying for Campaign time. A Call for Proposals for Campaign science was issued in February 2011, with proposals due 31 March 2011.

The Florida Multi-Object Imaging Near-Infrared Grism Observational Spectrometer (FLAMINGOS-2) was delivered to Gemini South in July 2009. Following its acceptance and initial commissioning, a number of problems were identified that need to be addressed before the instrument sees regular use. A detailed description of the issues, as well as the progress that is being made to address them, is available at *www.gemini.edu/sciops/instruments/flamingos2/status-and-availability*. The work includes replacement of a faulty detector, improvement of the instrument's thermal stability, and improvement of the mechanical reliability of some key components. Recommissioning of FLAMINGOS-2 may occur in the second half of 2011. Once ready, the instrument will provide near-infrared imaging over a 6.1-arcmin diameter field as well as multi-object spectroscopy with resolution R = 1200–3000 at near-IR wavelengths. FLAMINGOS-2 is also designed to be fed by the GeMS AO system, providing imaging and spectroscopy with excellent spatial resolution and sensitivity.

The Near-Infrared Coronagraphic Imager (NICI) has been in use at Gemini South since 2009A. While it has been available to all queue and classical observers, its primary purpose has been an observing Campaign to image Jupiter-like planets around nearby stars, the first results from which are described in Liu et al. (2010) and Biller et al. (2010). NICI features its own natural guide star AO system, dual-channel imaging, and several pupil and focal plane masks, all of which contribute to its ability to suppress speckle noise. The result is that with NICI faint companions at arcsecond separations from bright stars can be detected at contrast ratios of $\sim 2 \times 10^{-6}$. The NICI Planet-Finding Campaign is currently ~75% complete; once the Campaign finishes, NICI will be retired, to be replaced by GPI.

The high-resolution, near-infrared echelle spectrometer Phoenix has been in use at Gemini South since 2002A. It was removed from the telescope in January 2011 in order to relieve operational burden, and there is currently no plan to offer it in future semesters. Phoenix was built by NOAO and provided to Gemini on loan. With long-slit, single-order spectroscopy at resolution R ~ 50,000–80,000 at wavelengths 1–5 µm, Phoenix provided the only high-resolution spectroscopic capability available to the US community in the Southern Hemisphere for much of its tenure at Gemini South. Phoenix has been productive, yielding 51 papers by US users so far, with many more from Gemini's other international partners. Phoenix provided an excellent bright-time complement to Gemini South's Gemini Multi-Object Spectrograph, which is primarily used during dark time. We would like to thank the Gemini Observatory for making it available. We would particularly like to thank the many individuals who made Phoenix a resounding success on Gemini South: Ken Hinkle, who built Phoenix and provided excellent support on Gemini; Bob Blum, Katia Cunha, Nicole van der Bliek, and Verne Smith for their extensive support of classical observers; Claudia Winge and German Gimeno for excellent instrument support; and, of course, all of the Phoenix observers! NL

CTIO Instruments Available for 2011B

Spectroscopy	Detector	Resolution	Slit
CTIO BLANCO 4-m [1]			
Hydra + Fiber Spectrograph	SITe 2K×4K CCD, 3300–11,000Å	700–18,000, 45,000	138 fibers, 2" aperture
SOAR 4.1-m			
OSIRIS IR Imaging Spectrograph [2]	HgCdTe 1K×1K, JHK windows	1200, 1200, 3000	3.2', 0.5', 1.2'
Goodman Spectrograph [3]	Fairchild 4K×4K CCD, 3100–8500Å	1400, 2800, 6000	5.0'
CTIO/SMARTS 1.5-m [4]			
Cass Spectrograph	Loral 1200×800 CCD, 3100–11,000Å	<1300	7.7'
CHIRON [5]	e2v CCD 4K×4K, 420-870 nm	80,000 (with image slicer)	2.7" fiber

Imaging	Detector	Scale ("/pixel)	Field
CTIO BLANCO 4-m [1]			
Mosaic II Imager [6]	8K×8K CCD Mosaic	0.27	36'
NEWFIRM [7]	InSb (mosaic, 4-2K×2K, 1–2.3μm)	0.4	28.0'
ISPI IR Imager [8]	HgCdTe (2K×2K 1.0–2.4μm)	0.3	10.25'
SOAR 4.1-m			
SOAR Optical Imager (SOI)	e2v 4K×4K Mosaic	0.08	5.25'
OSIRIS IR Imaging Spectrograph	HgCdTe 1K×1K	0.33, 0.14	3.2', 1.3'
Spartan IR Imager [9]	HgCdTe (mosaic 4-2K×2K)	0.068, 0.041	5.2', 3.1'
Goodman Spectrograph [3]	Fairchild 4K×4K CCD	0.15	7.2' diameter
CTIO/SMARTS 1.3-m [10]			
ANDICAM Optical/IR Camera	Fairchild 2K×2K CCD	0.17	5.8'
	HgCdTe 1K×1K IR	0.11	2.0'
CTIO/SMARTS 1.0-m [11]			
Direct Imaging	Fairchild 4K×4K CCD	0.29	20'
CTIO/SMARTS 0.9-m [12]			
Direct Imaging	SITe 2K×2K CCD	0.4	13.6'

[1] In 2011B, the Blanco 4-m telescope will be available to users for a limited amount of time only. Please see the article by Chris Smith, "Availability of the CTIO Blanco 4-m Telescope in 2011B and Beyond" in this section of the *Newsletter*.

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

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

[4] Service observing only.

[5] If CHIRON is available for 2011B, it probably will be offered on a shared-risk basis.

[6] MOSAIC II will be offered during the first few months of 2011B only. Please see the article by Chris Smith, "Availability of the CTIO Blanco 4-m Telescope in 2011B and Beyond" in this section of the *Newsletter*.

[7] NEWFIRM will be offered at the Blanco 4-m only during the first few months of 2011B. There will be no filter change during the remainder of NEWFIRM's stay at CTIO. For more information about filters currently installed in NEWFIRM please refer to *www.noao.edu/ets/newfirm/*.

[8] ISPI will be offered during the second half of semester 2011B only.

[9] Spartan is available in the low resolution mode. The high resolution mode is commissioned, but has seen very little use. Spartan should be preferred to OSIRIS for most imaging applications.

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

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

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

Gemini Instruments Available for 2011B*

GEMINI NORTH	Detector	Spectral Range	Scale ("/pixel)	Field
NIRI	1024×1024 Aladdin Array	1–5µm R~500–1600	0.022, 0.050, 0.116	22.5", 51", 119"
NIRI + Altair (AO- Natural or Laser)	1024×1024 Aladdin Array	1–2.5µm + L Band R~500–1600	0.022	22.5"
GMOS-N	3×2048×4608 CCDs	0.36–1.0µm R~670–4400	0.072	5.5' 5" IFU
Michelle	320×240 Si:As IBC	8–26µm R~100–30,000	0.10 img, 0.20 spec	32"×24" 43" slit length
NIFS	2048×2048 HAWAII-2RG	1–2.5µm R~5000	0.04×0.10	3"×3"
NIFS + Altair (AO- Natural or Laser)	2048×2048 HAWAII-2RG	1–2.5µm R~5000	0.04×0.10	3"×3"
GNIRS	1024×1024 Aladdin Array	0.9–2.5µm R~1700, 5000, 18,000	0.05, 0.15	50", 100" slit (long) 5"–7" slit (cross-d)

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

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

* Availability is subject to change. Check the NOAO and Gemini Calls for Proposals and/or the Gemini Web pages for up-to-date information.

KPNO Instruments Available for 2011B

Spectroscopy	Detector	Resolution	Slit Length	Multi-object
Mayall 4-m				
R-C CCD Spectrograph	T2KB/LB1A/T2KA CCD	300–5000	5.4'	single/multi
MARS Spectrograph	LB CCD (1980×800)	300–1500	5.4'	single/multi
Echelle Spectrograph	T2KB/T2KA CCD	18,000–65,000	2.0'	
FLAMINGOS [1]	HgCdTe (2048×2048, 0.9–2.5μm)	1000–1900	10.3'	single/multi
WIYN 3.5-m [2]				
Hydra + Bench Spectrograph [3]	STA1 CCD	700–22,000	NA	~85 fibers
SparsePak [4]	STA1 CCD	700–22,000	IFU	~82 fibers
2.1-m				
GoldCam CCD Spectrograph	F3KA CCD	300–4500	5.2'	
FLAMINGOS [1]	HgCdTe (2048×2048, 0.9–2.5μm)	1000–1900	20.0'	

Imaging	Detector	Spectral Range	Scale ("/pixel)	Field
Mayall 4-m [5]				
CCD MOSAIC 1.1 [6]	8K×8K	3500–9700 Å	0.26	35.4'
SQIID	InSb (3-512×512 illuminated)	JHKs	0.39	3.3'
FLAMINGOS [1]	HgCdTe (2048×2048)	JHK	0.32	10.3'
WIYN 3.5-m [2]				
Mini-Mosaic	4K×4K CCD	3300–9700 Å	0.14	9.3'
WHIRC [7]	VIRGO HgCdTe (2048×2048)	0.9–2.5μm	0.10	3.3'
2.1-m				
CCD Imager [8]	T2KB/STA2 CCD	3300–9700 Å	0.305	10.4'
SQIID	InSb (3-512×512 illuminated)	JHKs	0.68	5.8'
FLAMINGOS [1]	HgCdTe (2048×2048)	JHK	0.61	20.0'
WIYN 0.9-m				
CCD MOSAIC 1.1 [6], [9]	8K×8K	3500–9700 Å	0.43	59'

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

[2] Owing to delay in the One Degree Imager (ODI), we expect 2011B to be a normal semester with the instrument complement as listed in the table.

[3] One degree field with two fiber bundles of ~ 85 fibers each. "Blue" (3") and "Red" (2") fibers.

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

[5] NEWFIRM will be available in 2012A

[6] This is the Mosaic camera that has been upgraded with new e2v CCDs and MONSOON-based controllers and is now offered for routine observing.

[7] WHIRC was built by Dr. Margaret Meixner (STScI) and collaborators. Proposals requiring use with WTTM should explicitly state this; new users of WTTM are advised to consult KPNO support staff for details.

[8] While T2KB is the default CCD for CFIM, CFIM may be offered with T2KA (scale 0.305"/pix, 10.4' field). A new CCD, STA2, with MONSOON-based controllers has been used for some special applications and will undergo laboratory development followed by on-sky commissioning during 2011A. Its main advantages will include better DQE than T2KB, especially in U and B, and faster readout. Observers may be offered this CCD or they can specifically request it to exploit these particular properties. Potential users should consult KPNO support staff for details.

[9] Availability at WIYN 0.9-m is strongly dependent on Mayall 4m scheduled use.

Keck Instruments Available for 2011B

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
Keck-I					
HIRESb/r (optical echelle)	3x MM-LL 2K×4K	R~30k–80k	0.35–1.0μm	0.19	70" slit
LRIS (img/lslit/mslit)	Tek 2K×4K, 2×e2v 2K×4K	R~300–5000	0.31–1.0μm	0.22	6'×8'
Keck-II					
ESI (optical echelle)	MIT-LL 2048×4096	R~1000–6000	0.39–1.1μm	0.15	2'×8'
ESIi (optical echelle, IFU)	MIT-LL 2048×4096	R~1000–6000	0.39–1.1μm	0.15	2'×8'
NIRSPEC (near-IR echelle)	1024×1024 InSb	R~2000, 25,000	1–5μm	0.18 (slitcam)	46"
NIRSPAO (NIRSPEC w/AO)	1024×1024 InSb	R~2000, 25,000	1–5μm	0.18 (slitcam)	46"
NIRC2 (near-IR AO img)	1024×1024 InSb	R~5000	1–5μm	0.01–0.04	10"–40"
OSIRIS (near-IR AO img/spec)	2048×2048 HAWAII2	R~3900	0.9–2.5μm	0.02–0.1	0.32"–6.4"
DEIMOS (img/lslit/mslit)	8192×8192 mosaic	R~1200–10,000	0.41–1.1μm	0.12	16.7'×5'
Interferometer					
IF (See *http://msc.caltech.edu/software/KISupport/*)					

MMT Instruments Available for 2011B

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
BCHAN (spec, blue-channel)	Loral 3072×1024	R~800–11,000	0.32–0.8μm	0.3	150" slit
RCHAN (spec, red-channel)	Loral 1200×800	R~300–4000	0.5–1.0μm	0.3	150" slit
MIRAC-BLINC (mid-IR img, PI inst)	256×256 DRS MF/HF		2–25μm	0.054–0.10	13.8"–25.6"
Hectospec (300-fiber MOS, PI)	2 2048×4608	R~1000–2500	0.37–0.92μm	R~1K	60'
Hectochelle (240-fiber MOS, PI)	2 2048×4608	R~34,000	0.38–0.9μm	R~32K	60'
SPOL (img/spec polarimeter, PI)	Loral 1200×800	R~300–2000	0.38–0.9μm	0.19	19"
ARIES (near-IR imager, PI)	1024×1024 HgCdTe	R~3000-60,000	1.1–2.5μm	0.02–0.10	20"–100"
SWIRC (wide n-IR imager, PI)	2048×2048 HAWAII-2		0.9–1.8μm	0.15	5'
CLIO (thermal-IR AI camera, PI)	512×1024 HAWAII-1		3–5μm	0.03	15"×30"
MAESTRO (optical echelle, PI)	4096×4096	R~28,000-93,000	0.32–1.0μm	0.15	
PISCES (wide n-IR imager, PI)	1024×1024 HgCdTe		1–2.5μm	0.026–0.185	1.9"–3.2"

Hale Instruments Available for 2011B

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

Availability of the CTIO Blanco 4-m Telescope in 2011B and Beyond

Chris Smith

Availability of the Blanco in 2011B

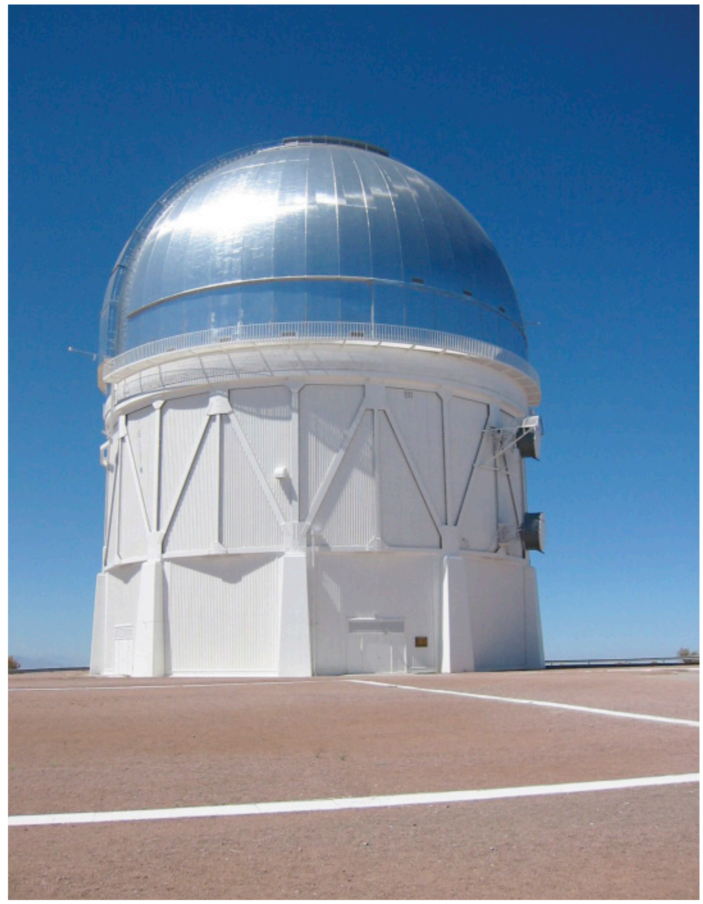
In semester 2011B, CTIO will install and commission the Dark Energy Camera (DECam) on the Blanco 4-m telescope. Due to the complexity of this installation, involving significant work to the telescope structure, the telescope will be unavailable for most of the semester.

The Blanco will be available for four to eight weeks at the beginning of the semester, definitely through all of August and possibly well into September. During this time, Mosaic, the NEWFIRM wide-field infrared imager, and Hydra will be offered. The RC Spectrograph will not be offered because an equivalent capability, the Goodman Spectrograph, is offered at SOAR.

NOTE: As mentioned in the previous *Newsletter*, this 4- to 8-week time frame will be the last time Mosaic II on the Blanco will be available. At the end of this short period in 2011B, Mosaic II will be retired from the Blanco.

ALSO NOTE: The August/September 2011 period is also the last run of NEWFIRM on the Blanco for the near future. At the end of this period, NEWFIRM will be removed from the Blanco and shipped back to the US to be returned to operation on the Mayall 4-m telescope as quickly as possible. The schedule for the possible return of NEWFIRM to the Blanco is currently unknown.

In the second half of semester 2011B, approximately two to four weeks will be available on the Blanco for science, once DECam installation is complete and commissioning is underway. This time will be distributed most likely in two runs. During this period, only Hydra and the Infrared Side Port Imager (ISPI) will be offered. We plan to schedule this time flexibly, probably as remote observing, so that the observation schedule can be adjusted to adapt to changes in the DECam installation and commissioning plan.



The Blanco 4-m Telescope. (Image credit: NOAO.)

Availability of DECam and the Blanco in 2012A

We anticipate community access to the Blanco to return to normal during the 2012A semester. We plan to offer Hydra and ISPI for normal observing. During much of this period, we will be performing DECam science verification programs. DECam science verification will include a significant amount of community science. Depending on how the commissioning proceeds, we also may offer some shared-risk standard proposal observations with DECam. Watch for more information about both science verification and shared-risk observing opportunities with DECam in subsequent *Newsletters* and the 2012A Call for Proposals.

During 2012A, we plan to commission the new Cerro Tololo Ohio State Multi-Object Spectrograph (COSMOS), a result of the ReSTAR program, on the Blanco. COSMOS will replace the RC Spectrograph. The RC Spectrograph will not be offered in 2012A and will be retired after the successful commissioning of COSMOS.

Community Access to the Blanco in 2012B and Beyond

In exchange for delivering DECam as a new facility instrument on the Blanco, the Dark Energy Survey (DES) will be scheduled for approximately 105 nights per year in the B semesters for the next five years, starting in September 2012 (semester 2012B). Due to this commitment, the community time available in the B semesters will be limited for the duration of the DES. In August, community access will be normal, as there will be no DES time then. In the September through January period, the community will have access to no less than 25% of the time (roughly one week per month). Although there may be a few DES nights scheduled in February, we anticipate largely normal community access in the A semesters during the duration of the DES survey (2012 to 2016).

Please note that although community access is limited, the DES will be providing imaging data in all available filters over 5,000 square degrees, which is much of the sky available in the B semester. This data will have

continued

Availability of the CTIO Blanco 4-m Telescope continued

only a one-year proprietary period. So if your observation involves imaging of selected fields during the B semester, it is likely that the data you need will be taken by the DES and will be available after one year.

Survey Proposals on the Blanco

Due to the limited time available for community access as described above, as well as the extremely broad scientific impact of the Dark Energy Survey data set, we anticipate that no survey proposals will be accepted in the first four semesters following the commissioning of DECam, specifically semesters 2012A through 2013B inclusive. We will re-evaluate this proposed policy as we see the demand evolve over the 2012 and 2013 period. We will make the official announcement in the next call for NOAO Survey proposals. Meanwhile, we encourage groups to collaborate on standard proposals using the DECam. Even a 3- to 5-night run with DECam will generate survey-sized data sets (up to 2 Terabytes of raw data)!

A New and Improved Mosaic 1.1 Returns to Science Operations

Dave Sawyer (NOAO), Steve Howell (NOAO) & Heidi Schweiker (WIYN)

On 29 August 2009, NOAO received a supplemental funding award from the NSF for year one of the Renewing Small Telescopes for Astronomical Research (ReSTAR) project. One of the projects funded by that award was an upgrade to the Mosaic 1 imager. At the end of October 2010, a little more than one year later, the new and improved Mosaic 1.1 imager was successfully commissioned on the 4-m Mayall telescope and released for shared-risk science operations for the remainder of semester 2010B. The goals of the upgrade, which were to replace the detectors and controllers to achieve better efficiency and performance, were achieved as the readout time is significantly reduced to 22 seconds and the CCD performance characteristics are greatly improved (see the properties of the e2v CCDs at *www.noao.edu/kpno/mosaic/e2v_V2.html*). The thicker "deep depletion" variant of the e2v CCDs used in the upgrade offers better red sensitivity and reduced fringing levels in I and z bands, and a multi-layer AR coating provides better quantum efficiency in the U and B bands.

This image shows off the impressive imaging capabilities of the new CCD detectors in the Mosaic 1.1 camera on the Mayall 4-m telescope at Kitt Peak National Observatory. The image is of Sharpless 2-188 (Sh2-188), an unusual planetary nebula located in the constellation Cassiopeia. The image was generated with deep observations in the Hydrogen alpha filter (red) and the Oxygen [O III] filter (cyan). In this image, north is up and east is to the left. (Image credit: Heidi Schweiker/WIYN and Travis Rector/University of Alaska.)

From a physical perspective, the Mosaic 1.1 imager is very similar to its predecessor with the focal plane consisting of eight 2048 × 4096, 15-micron-pixel CCDs that produce an 8192 × 8192 pixel array covering a 36' × 36' field of view on the Mayall telescope. By keeping the physical configuration the same, many of the original components of the instrument could be reused, and all existing Mosaic filters are still available. The CCDs were assembled on a new focal plate with very high mechanical precision to produce a very flat focal surface that yields very consistent image quality across the entire field.

One change that users will notice with the Mosaic 1.1 upgrade is the data format. The CCDs are now read out through 16 amplifiers and the final multi-extension Flexible Image Transport System (FITS) files have 16 extensions, instead of eight as with the previous Mosaic. The Mosaic 1.1 images now require 32-bit pixels to accommodate a much greater dynamic range (typically 210,000 e- per pixel) and thus the file size is increased to 282 MB per image. There are two modes available: a "normal gain" mode optimized for readout speed and a "low gain" mode optimized for read noise. Two binning options, 1 × 1 and 2 × 2, are also available.

Another significant change that users will see is the new instrument control interface, NOAO Observing Control Software (NOCS), which was adapted from the interface for the NEWFIRM wide-field infrared imager and incorporates a script-driven observing paradigm. The NOCS interface offers a user-friendly environment that is very reliable and provides many new capabilities for observers. The associated data handling system provides users with a quick-look display for full-field images and is integrated with the NOAO data archive to automatically save backup images for retrieval by a program's principal investigator. The data pipeline has been updated as well to allow data reduction of the new Mosaic 1.1 data format. The image above is a processed image of the planetary nebula Sharpless 2-188 (Sh 2-188) taken during commissioning of Mosaic 1.1.

Additionally, the instrument was commissioned at the WIYN 0.9-m telescope in January 2011 and is available there for shared-risk observing as well. Starting in semester 2011A, Mosaic 1.1 is expected to be available for normal science use at both telescopes.

More information on the Mosaic 1.1 instrument, including a newly revised user manual, is available at:
www.noao.edu/kpno/mosaic/mosaic.html.

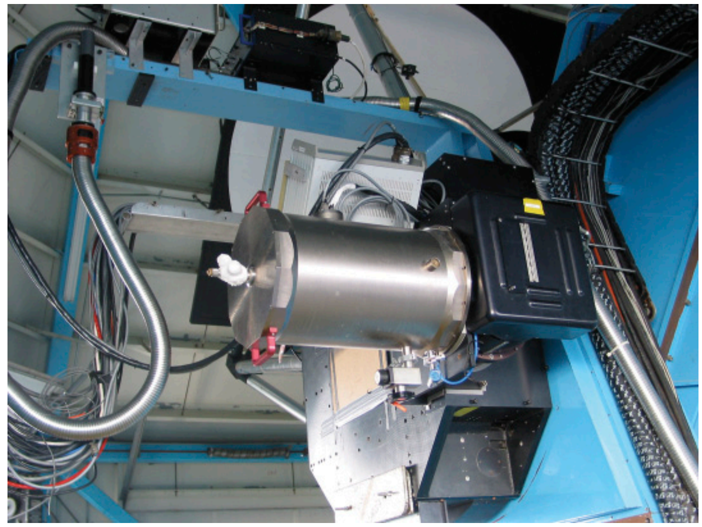
Infrared Instrumentation Update

Dick Joyce

The FLAMINGOS observers at both the KPNO 4-m and 2.1-m telescopes will note new observing environments as a result of upgrades to the console rooms at both telescopes. The instrument is now run through a MacMini with two large monitor screens that have ample room for all of the necessary windows. At the 2.1-m telescope, both the telescope and instrument may be controlled from different workspaces on the MacMini, eliminating the need for a single observer to scoot back and forth between two workstations. FLAMINGOS data can be ported directly to the MacMini for transfer to the observer's laptop or to an external USB drive, or for inspection and analysis using the Image Reduction and Analysis Facility (IRAF) application installed on the MacMini. Several of the commonly used FLAMINGOS commands also may be executed now from a graphical menu as well as the command line.

As a reminder, multi-object spectroscopy (MOS) with FLAMINGOS is supported only at the Mayall 4-m telescope, although long-slit spectroscopy may be carried out at both the 2.1-m and 4-m telescopes. Because the fabrication of MOS masks involves an outside vendor, we require the coordinate files for the masks at least four weeks prior to the observing run.

The WIYN High-Resolution Infrared Camera (WHIRC) observers are asked to consider the WIYN Tip-Tilt Module (WTTM) for active tip/tilt correction if it is consistent with their science requirements. Heroic efforts by WIYN and mountain support now seem to have WTTM operating reliably, and frequent use will help accustom the observer community to its advantages (particularly in reducing the effects of wind shake) and maintain operator proficiency in its use.



WHIRC installed on WIYN. (Image credit: Jennifer Power/NOAO.)

Observers are encouraged to check the FLAMINGOS and WHIRC Web sites for the current versions of the user's manuals as well as recent updates on the "Hot News" link.

New NOAO Survey Programs Selected

Tod R. Lauer

Four new NOAO survey programs have been initiated, with observations beginning in the first semester of 2011. Thirteen proposals were submitted in response to an announcement of opportunity for new survey programs.

NOAO surveys are observing proposals that require the generation of a large, coherent data set in order to address their scientific research goals. Surveys may run for up to three years and can receive larger blocks of time than are usually awarded in the standard observing-time allocation process. In return for the large allocation of resources, the survey teams are required to deliver their reduced survey data products to the NOAO Science Archive (NSA) for follow-on investigations by other interested astronomers. A key part of the evaluation of the survey proposals is understanding the likelihood that interesting follow-on investigations can be done with the data products that will not be conducted as part of the primary scientific goals of the survey team, itself.

Overall, the Survey Telescope Allocation Committee graded the proposals in three categories, with the final grades comprising a weighted sum of 50% for quality of the primary scientific goals, 25% for the archival research value of the data products, and 25% for the credibility of the survey management plan.

William Grundy (Lowell) and four co-investigators will use 10 Gemini North NIRI+Altair nights to study "Mutual Orbits and Masses of Kuiper Belt Binaries and Multiple Systems." The goal is to use the distribution of orbital properties of the binaries, as well as the information that they provide on the masses, densities, and albedos of the Kuiper Belt objects, to provide information about the formation of these objects and, in turn, the conditions in the forming solar system in the outer regions of the solar nebula. The Gemini observations will augment time they are using at Keck and Hubble Space Telescope and will make use of Gemini's queue scheduling to observe the longer-period systems in their sample.

continued

NEW NOAO Survey Programs Selected continued

Andrej Prsa (Villanova) and 11 co-investigators will use 30 nights of echelle time at the KPNO 4-m telescope for their survey, "Towards Unprecedented Accuracy of Fundamental Parameters for Kepler Eclipsing Binary Systems." This survey uses the new sample of eclipsing binary stars discovered by Kepler to serve as probes of basic stellar astrophysics. The survey will acquire spectra for about 150 systems selected from 1,879 eclipsing binaries in the Kepler catalog. The selection criteria are designed to identify probes throughout the H-R diagram where high-precision measures of stellar temperatures, radii, and luminosities as a function of mass can provide interesting tests of the underlying astrophysics.

John Salzer (Indiana) and four co-investigators will conduct their survey, "Making Hay with ALFALFA: The Star-Formation Properties of an HI-Selected Galaxy Sample," using 50 nights of imaging time with the KPNO 2.1-m telescope. They have constructed a volume-limited sample of 553 HI-detected galaxies from a blind HI survey using the Arecibo 305-m radio telescope. The goal is to use H-alpha imaging of the target galaxies to derive a highly accurate measure of the ongoing star-formation rate of the Universe at the present epoch.

Christopher Stubbs (Harvard) and 34 co-investigators will conduct "Spectroscopy of Galaxies in Massive Clusters: Galaxy Properties and Dynamical Cluster Mass Calibration" using 23 nights of Gemini South time. They will use the Gemini Multi-Object Spectrograph to obtain spectra of 85 galaxy clusters selected via the Sunyaev-Zel'dovich effect from the South Pole Telescope microwave background survey. They are targeting $0.3 < z < 0.8$ clusters to tighten constraints on cosmological parameters, including the nature of dark energy.

SMARTS News

John Subasavage

The SMARTS telescopes continue to operate smoothly at CTIO. Perhaps the most exciting news pertaining to SMARTS is the addition of the new CHIRON spectrometer, a high-resolution, fiber-fed echelle spectrograph on the 1.5-m telescope, built at CTIO. Commissioning began in late January of this year and CHIRON will be available to the community in 2011B. More information will be published on the CTIO and SMARTS Web sites.

From left to right: Christian Schwab, Andrei Tokovinin, Julien Spronck with CHIRON. (Image credit: Patricio Schurter/NOAO)

For 2011B, proposals for the 1.5-m telescope will be accepted as usual. The temporary "freeze" experienced in 2011A—to accommodate for a shutdown, commissioning of CHIRON, and because of the fairly large proposal pressure on the 1.5-m telescope in the A semesters—has been lifted.

The SMARTS consortium will be hosting a meeting-in-a-meeting at the 2011 summer American Astronomical Society meeting in Boston. (See "SMARTS Meeting-in-a-Meeting at Upcoming AAS" announcement in the NOAO Operations & Staff section.). Please stop in to hear more about the latest news from consortium members if you plan to attend the AAS meeting.

Finally, as always, the SMARTS consortium is excited to discuss new partnership opportunities. Interested parties should contact Charles Bailyn (*charles.bailyn@yale.edu*) for more information. Additional SMARTS-related information and a list of the consortium members can be found at *www.astro.yale.edu/smarts*.

Archiving a Rich Collection of 4-m Telescope Mosaic Images

Mark Dickinson, Derec Scott & Frank Valdes

Since 1997, astronomers have gathered a treasure trove of images using the Mosaic prime focus cameras at KPNO and CTIO. Principal investigators (PIs) and their collaborators have used these data for their own research programs, but this horde of wide-field images would undoubtedly be valuable for many other scientific investigations—if only one could get at them! The NOAO Science Archive has been ingesting and serving Mosaic (and other) data since the 2008A semester, but the long "backlog" of earlier observations has been unavailable until now.

From 2004B through 2007B, data from NOAO telescopes were captured by the Data Cache Initiative (DCI) and stored on hard drives, where they were safe but could not be searched or accessed by outside users. (Still earlier data were captured by the Save-The-Bits system and are stored on exabyte tapes; observers who lost or accidentally deleted data can attest to the value of that service!) NOAO has now ingested this DCI backlog of Mosaic data into the NOAO Science Archive, where any astronomer can query and retrieve them. These "new old data" consist of approximately 72,000 Mosaic exposures (including both science and calibration data) taken at the KPNO and CTIO 4-m telescopes from semesters 2004B through 2007B. This represents a 62% increase in the archived holdings of Mosaic data, and a still-larger increment for nonproprietary data, since all of the backlog data sets are fully public. (The default proprietary period is normally 18 months.)

Better still, this backlog is now being processed through the NOAO Mosaic Imager Pipeline. The pipeline calibrates on-sky science images through standard processing steps such as bias subtraction, flat fielding (generally with both dome and sky flats), fringe and pupil ghost removal where needed, and astrometric calibration. The pipeline will combine dithered sequences of exposures to produce deep, stacked images, removing artifacts such as cosmic rays and satellite trails. (For more information on the Mosaic Pipeline, see the *NOAO Data Handbook* at *www.noao.edu/sdm/help.php*.) Pipeline reductions of Mosaic data from 2008A to the present are already available in the Archive; the new backlog processing has started for the 2007B semester and will proceed backward in time to 2004B. The pipeline effort is expected to take about six months.

You can search the newly expanded archive of Mosaic data in the NOAO Science Archive at *www.noao.edu/sdm/archives.php*. From the query form, you can search for data by object name, coordinates, observing program ID, date, and other parameters. To restrict the search to just the Mosaic data holdings, select the KPNO or CTIO 4m + Mosaic imager (or both) from the Telescope + Instrument pull-down menu. You can search for raw or reduced data products—all raw data since 2004B and reduced data since 2008A are available now, and pipeline reductions of the older data will be added gradually as they are processed. You do not even need to register with the Archive to retrieve public data sets: just search, stage the images that you want, and download them using ftp.

In other, related news, the Mosaic Pipeline has been updated to process data from the new and improved Mosaic 1.1 imager at the Mayall 4-m telescope (see the article "Mosaic 1.1—Bringing Better Imaging to Kitt Peak" in the September 2010 *NOAO Newsletter*). The quality of the new Mosaic 1.1 data is excellent, and PIs from 2010B have been notified that their processed data are now available from the Archive.

So, next time you are looking for imaging of a particular object or field, check the NOAO Science Archive; what you need may be there waiting for you now!

Preserving the History of the National Observatory

John Glaspey & Jessica Moy

Although the National Observatory has existed for more than half a century, most of the records that define the history of what is now NOAO have never been organized or indexed. Materials are spread throughout NOAO and in the care of multiple departments. With each office move, retirement, or clean out, irreplaceable items are at risk of being lost. For this reason, we have started an archive project to first identify historically significant materials at NOAO and then work to ensure their preservation.

The 50th anniversary celebration of the National Observatory brought to light many interesting items. For example, people who attended Dr. Aden Meinel's talk on "Why Kitt Peak?" on 22 March 2010 were treated to a viewing of a short color movie showing the first ascent of Kitt Peak by Meinel and Harold Thompson in 1956. That footage had languished unknown in the basement of NOAO Headquarters for decades and could easily have been discarded (the same is true for a collection of slides and negatives). Instead, the film was able to be restored, giving viewers the chance to relive history. Another item of significance is Helmut Abt's 1955 log book, which records his first aerial impression of Kitt Peak when it was being considered as a potential site for the National Observatory: "Looks better—more trees. Investigate."

It is easy to understand why we want to preserve these examples. Equally important, but perhaps less obvious, are things like:

- The files and records of someone who was intimately involved in an instrumentation project. Gary Poczulp has files that belonged to John Richardson of the Optics Shop detailing his involvement in the polishing of numerous mirrors for major telescopes, such as the WIYN primary. Figure 1 is an example, showing Gary carefully transferring to the mirror surface the map of areas needing hand figuring to remove high spots.

continued

Preserving the History of the National Observatory continued

Figure 1: Gary Poczulp marking areas on the WIYN mirror that need high spots removed.

Figure 2: Kitt Peak lease signing (in black and white).

- Records that document the early development of a major project, e.g., the early Gemini project. Items could include schematics, proposals, and correspondence.
- Missing items! Do you recognize the picture of the lease signing meeting (Figure 2) that is in the NOAO Image Gallery? Nicely done, but in black and white. The originals of that meeting were color slides, e.g., Figure 3, but we cannot find the original of the nicely posed one shown in Figure 2. If anyone knows where it is, please let us know!

We are hoping that NOAO staff and astronomers will discover that they hold part of NOAO history and add it to the archive. This will ensure that important items will be around for the next fifty years! There may even be people in the community who have things to contribute—please feel free to contact either of the authors (*glaspey@noao.edu* or *jmoy@noao.edu*) to discuss what you have!

Figure 3: Color slide of the Kitt Peak lease signing.

Are you interested in using the Dark Energy Camera?

Then mark your calendars for 18–19 August 2011!

Join us in a community workshop then to learn about the Dark Energy Camera (DECam). Be part of extensive discussions with the DECam team. This is a unique opportunity for prospective users to meet and form collaborations based upon their common or complementary interests in DECam data and capabilities, to optimize commissioning, operations, and data reductions. For workshop details and to register, go to *www.noao.edu/meetings/decam*.

For more information, please contact Alistair Walker at NOAO South (*awalker@ctio.noao.edu*).

CTIO Summer Student Program for 2011

David James & Nicole van der Bliek

Summer in the Southern Hemisphere is in full swing and so are the CTIO Summer Student Programs. During the 10-week CTIO Summer Student Programs, US and Chilean students work and live at the CTIO compound in La Serena. All students carry out research projects with CTIO, SOAR, and Gemini staff. Further, the students participate in field trips to Cerro Tololo and Cerro Pachón, observe at Cerro Tololo, and attend seminars catered to the undergraduate level. Of course, they sample the social and cultural life of the CTIO compound and Chile as well.

This year's students are funded through a variety of sources. Three US students participate in the CTIO Summer Student Program through the NSF-funded CTIO Research Experiences for Undergraduates (REU) program. The 2011 REU students are Julia O'Connel (Tennessee State University), Derrick Rohl (Illinois Wesleyan) and Brett Basarab (Middlebury College). Two Chilean students, Gustavo Morales (Pontificia Universidad Católica de Chile) and César Muñoz (Universidad de Concepción), participate through Prácticas de Investigación en Astronomía (PIA), funded by CTIO. Two Fulbright students, Owen Boberg (New Mexico State University) and Ryan Keenan (University of Wisconsin), who started their internships at CTIO in January, participate in all Summer Student Program activities. In addition to the REU, PIA, and Fulbright students, Ana Mikler (Union College) and Scott Stubbs (Cal Poly) are participating in the CTIO Summer Student Program through independent internships.

We wish them an enjoyable stay in La Serena "y buena suerte en todo."

Mentors for the students are an integral part of the program. As such, we would like to thank CTIO staff Roberto De Propris, Andrea Kunder, Alistair Walker, and Gemini staff Peter Pessev, Percy Gomez, Bryan Miller, and Gelys Trancho, who, in addition to David James and Nicole van der Bliek, are the mentors for this year's CTIO Summer Student Program.

National Observatory's Connection with Tohono O'odham Nation More Visible

John Dunlop & Abi Saha

On 8 June 2010, the Tohono O'odham Nation's Legislative Council passed resolution No. 10-197, "Approving Design and Placement of New Sign for Kitt Peak National Observatory and the Flying of the Tohono O'odham Nation and Schuk Toak District Flags." This culminated a multi-year consultation between then KPNO Director Buell Jannuzi and the Schuk Toak District Council, the Tohono O'odham Legislative Council, Schuk Toak District Chairwoman Phyllis Juan, and the office of the Tohono O'odham Nation's Chairman, Ned Norris, Jr., on how to improve the communication to the general public that the national observatory is located inside the Schuk Toak District of the Tohono O'odham Nation.

With approval from both the Schuk Toak District and the Nation's Legislative Council, the observatory has prepared and installed a new sign (see photo) for the turn off from State Route 86, State Route 386, which takes a visitor to the observatory. The words and the flag of the Tohono O'odham Nation on the sign communicate where KPNO is located. In addition, a new flagpole has been installed on the mountain near the dining hall, and KPNO looks forward to flying the flags of both the Tohono O'odham Nation and the Schuk Toak District next to the flags of the United States of America and the state of Arizona. NOAO hopes this, along with an existing exhibit inside the visitor center, helps visitors recognize that the National Observatory is hosted courtesy of the people and governments of the Tohono O'odham Nation. NOAO greatly appreciates the opportunity to study the Universe from land that is sacred to the people of the Tohono O'odham Nation.

New sign at turnoff to Kitt Peak National Observatory in recognition of the observatory's hosts, the Tohono O'odham Nation and Schuk Toak District.
(Image credit: John Dunlop/NOAO.)

A Day at the Fair

Sally Oey (University of Michigan)

One of the best things about being on sabbatical is having the time and opportunity to experience things I cannot do ordinarily. One such memorable event was the 73rd annual Tohono O'odham Nation Rodeo and Fair, which took place 3–6 February 2011 at the Tohono O'odham (Desert People) Nation's fairgrounds near Sells, Arizona. Katy Garmany, who directs NOAO's outreach to the tribe, told me that although Kitt Peak National Observatory is on tribal land, there are many members who are not too sure about what is going on "up there." So following on former KPNO Director Buell Jannuzi's new initiatives to improve relationships with the tribe, Katy kicked off the Observatory's second half-century on the "Rez" by organizing the first KPNO booth at the Fair.

Figure 1: Kathie Zelaya demonstrates solar telescope to Miss Tohono O'odham candidate. (Image credit: John Glaspey/NOAO.)

I tagged along on this adventure for the big day, Saturday, which started at 9 am with a colorful parade in downtown Sells. This was very much a Native community event, with the ethnically affiliated tribes, like the Gila River community, represented, along with several unaffiliated regional tribes, like the White Mountain Apache, also present. On the other hand, I could count on one hand the number of other non "Desert People" I saw there. While the floats and groups had similar themes to those at other community parades around the country, they were completely different, being so deeply rooted in essentially a separate culture. On display were ceremonial dance groups, a Waila band and other music groups, military veterans, traditional games, public service organizations, political candidates, school groups, and various beauty queens with exquisite O'odham woven headdresses (Figure 1).

The Rodeo and Fair itself was a much bigger event, situated on the desert floor beneath a scenic knoll. The Fair hosted a variety of booths, vendors, and activities, and the Kitt Peak booth was perfectly situated in a central location near the food stalls. Along with Katy, the booth was hosted by Irene Barg, Nanette Bird, Bob Blum, John Glaspey, Steve Pompea, Rob Sparks, Kathie Zelaya, and Education and Public Outreach student workers Carmen Austin, David Montgomery, and Pye Pye Zaw. My occasional presence at the booth represented the intermittent visits from the visiting astronomers and tenant institutions—including the University of Michigan.

Most of the visitors to the booth were families with young children, who enjoyed looking through the C-8 telescope pointed at the nearby peak, the small H-alpha solar telescope, and a small Sunspotter solar projection telescope. Pye Pye is an inspiring University of Arizona student planning a career in science education, and she was in her element, enthusiastically explaining astronomy and telescope functions to the children and parents. The booth also featured "Ask an Astronomer," where children were encouraged to examine the astronomical images on display and to ask us about them. The children then received a Kitt Peak rainbow slinky as a gift. How gratifying that the children ask many of the exact same things about celestial phenomena that we astronomers do: "Why does it have that shape?" "Why does it have that color?" Although most kids asked only one question and then ran off with slinky in hand, there were certainly some who asked multiple questions and seemed genuinely curious. And it was also a pleasure to meet tribal members who were old friends or employees of the Observatory (Figure 2). Katy found the event to be an excellent networking opportunity, since many of the local leaders were at the Fair at some point.

Figure 2: Don Mendez (left), former telescope operator at Kitt Peak, visits with Katy Garmany. (Image credit: John Glaspey/NOAO.)

The entire day was filled with concurrent activities: the all-Indian rodeo, powwow, carnival with rides, traditional games, and live music and dancing, plus plenty of edible offerings including lots of fry bread, menudo, taco options, hot dogs, curly fries, cotton candy, and more. There was so much to see and do that I was only able to sample various events (e.g., the Gourd Dance and women's team calf roping), even after being there all day. We packed up around 5 pm, but it seemed the real partying was only just beginning, and was to last until at least 10 pm. It was an exhilarating and exhausting day, and I highly recommend it. Many in our science community are not too sure of what goes on "down there" below Kitt Peak, and this annual event is a great way to get in touch.

Kitt Peak National Observatory on Facebook

Katy Garmany & Jerry Scott

If you are a Facebook user, you might have noticed that you can "friend" Kitt Peak. Since the page was established about a year ago by Kitt Peak Docent Jerry Scott, almost 1,000 people have done just that. Jerry updates the page every few days with information on the observers at Kitt Peak at the Mayall 4-m, the 2.1-m and WIYN (community time) telescopes. The proposal title links to its abstract, which is publically available to all. Jerry also posts notices about other events at the mountain that are of interest to the public. Based on the statistics that he has collected, most "friends" are between 25 and 55 years of age, about 40% of the Kitt Peak friends are women, and although over 70% are from the US, there are friends in almost 20 other countries.

One issue that we plan to address concerns the proposal titles that Jerry currently posts. While understandable to the NOAO Time Allocation Committee, many among the general public probably find titles such as "The Striking Li Dispersions in Pleiades G & K Dwarfs: Real or Illusory?" a bit opaque. (Our thanks to Simon Schuler, who offered the following more user friendly title: "Understanding the Anomalous Li Abundances of Cool Stars in the Pleiades Open Cluster.") So, observers will soon be receiving an invitation to send us a title that may be more understandable. This should be of the 25 words or less variety; interested Facebook readers will still be able to link to the proposal abstract as they can now. We also will suggest that observers, perhaps during long integrations, might log in and add a comment about what they are doing. You could be surprised to find you have a fan club!

ATST Independent Safety Review

Chuck Gessner

An Independent Safety Review for the National Solar Observatory Advanced Technology Solar Telescope (ATST) project was conducted from 25–27 January 2011 at the NOAO Tucson facilities. With administrative help from the ATST project team, NOAO Safety Manager Chuck Gessner coordinated, presented, and participated in the review. The review committee consisted of a diverse group of safety professionals with extensive experience in large construction projects, scientific projects, operations, and compliance. The committee was led by Richard D. Hislop, loss prevention and safety management consultant for Hislop & Associates, Inc.; Mark J. Grushka, University of Arizona Manager of Biosafety and Biosecurity; Joseph J. Kane, safety and risk management consultant for Thunder Road Consulting, LLC; and Stephan Shimko, W. M. Keck Observatory Safety, Health, and Environmental Affairs Officer.

Right to left: Gessner, Grushka, Shimko, Hislop (standing), Kane, and some of the ATST project team at the Independent Safety Review for ATST.

The review committee's charge was to assess whether Risk Management considerations are properly addressed given the project's current stage of development. More specifically, the committee was to determine whether the project:

• has well-defined, prioritized, and appropriate risk management objectives;

continued

ATST Safety Review continued

• is properly coordinated and is in compliance with relevant regulatory agencies; and
• has allocated appropriate risk management resources.

ATST project management presented an overview of the project, site, and safety specifications followed by the project lead engineer's detailing progress of current contracts with focused discussions on the scope of work, design, risk assessments, and mitigations strategies. The committee provided feedback directly to presenters during each presentation.

On the last day during the debriefing to the project team, the committee noted the following observations:
• "The Safety, Health and Environmental Plan (SHE) is comprehensive, containing core elements to implement the strong systems safety foundation.
• Safety by Design—the emphasis placed on hazard analysis extends to the contractor selection process. It is clear that ATST management and project personnel are committed to framing project success around integration of project and risk management processes.
• Safety requirements and safety processes in place within the ATST Project are more evolved and better integrated into the project at this stage than the review team has seen on any other federally funded project.
• The familiarity of the project team with the safety processes as demonstrated by their presentations, the nature of the examples of their engagement with the safety processes and their responses to questions was exceptional."

Chuck Gessner noted: "It is evident that the ATST project team is managing and designing for safety, brought about by a strong commitment from senior management. Much of the success to date can be attributed to the establishment of the hazard analysis process early in the project schedule by ATST's systems engineer. The engineering team supported and took ownership of this methodology to reduce risks during the design, construction, and future operation of ATST." NL

CTIO Welcomes New Staff Astronomer David James

Nicole van der Bliek

Just before Christmas, Dr. David James, his wife Katy, and their son Benjamin arrived in La Serena. Before officially joining the NOAO staff as an astronomer on 15 December 2010, David was an assistant professor at the University of Hawai'i at Hilo. He also was Director of the Hoku Ke`a Observatory on top of Mauna Kea, and as such oversaw the construction and instrumentation of the Hoku Ke`a telescope, a new 0.9-m telescope on Mauna Kea replacing the original 0.6-m one (which was the first astronomical telescope on the mountain). David has been a frequent observer at CTIO and KPNO, pursuing an active research program in the fundamental properties of solar-type stars and nearby star-forming regions. Before going to Hawai'i, he spent four years at Vanderbilt University, where in addition to his lecturing duties and research, he served as the director of the Fisk/Vanderbilt outreach program, presenting over 600 portable planetarium shows to school-aged children in the area.

Tilferd Cachora Retires after 37 Years with KPNO

John Dunlop & Mike Hawes

On 30 December 2010, Tilferd Cachora retired from the Kitt Peak National Observatory facilities staff after approximately 37 years of service to Kitt Peak. He is a member of the Tohono O'odham Nation and began working at the observatory in 1973 after leaving the Marines. His initial position was as a custodian on the mountain, and, over the years, he had the opportunity to train as a painter and general craftsperson in support of numerous mountain projects. In the early 1990s, with the retirement of several individuals, he was elevated to a craftsperson painter position. Tilferd helped paint the exterior of several smaller domes such as those of the 2-m and 0.9-m telescopes and was involved in numerous building renovation projects. Throughout his long service to the National Observatory, Tilferd continuously worked to improve the appearance of the facility and public areas as he helped refurbish the visitor center several times and was instrumental in keeping the observatory grounds, dormitories, control rooms, and building interiors looking good. We will miss him and his dedication to Kitt Peak and wish him well in this new phase of his journey.

Don Hunten: Early Times in Tucson

Michael J.S. Belton

Joe Chamberlain, one of the founding members of the AAS Division for Planetary Sciences, was reported to have once said that Don Hunten was the closest to a genius than any man he knew. Joe brought Don to Tucson in the early 1960s to help form the nucleus of a new Space Division at the Kitt Peak National Observatory.

Don was a "hands on" Canadian physicist who had just published a book on electronics, knew how to design and build experimental equipment, and whose research focused on processes in the Earth's upper atmosphere, particularly its sodium layer. Joe was already famous for his remarkable book on Aurora and Airglow. Together with Russell Nidey, Lloyd Wallace, and Don's former student, Lyle Broadfoot, they started a program of exploration of the upper atmosphere using Aerobee rockets with unique instrumentation, designed and built within the division, and launched out of White Sands, New Mexico. Ultimately, the goal was to develop pointable payloads that could observe stars and objects in the solar system.

Simultaneously, NASA's Mariner program to explore the terrestrial planets was getting underway with the first attempts to explore Venus and Mars, and research groups focusing on planetary astronomy were springing up around the country. It was a time of unexpected discovery and intense scientific competition.

Determined to achieve the highest standards, Don, Joe, and Lloyd rose to the occasion. They enticed younger scientists from major universities to join the group including Mike McElroy, Jack Brandt, Dick Michie, and myself; they started a highly successful series of symposia in Planetary Atmospheres that attracted international attention; they even competed in the race to build the first satellite designed to observe stars spectroscopically. Their proposal for an Orbiting Astronomical Observatory eventually lost out to a Goddard proposal that became the famous IUE (International Ultraviolet Explorer).

In those days, the halls of the Kitt Peak Space Division flowed with the very best in the field, most of them good and intimate friends of Don. As a result, we got to meet and learn from such icons as Alex Dalgarno, Richard Goody, Ray Hide, Charlie Barth, Tom Donohue, Jacques Blamont, Hank v.d.Hulst, Guido Münch, Pierre Connes, Bob Danielson, and Lew Kaplan to name a few. All of this activity ultimately led to a change in emphasis in the group, and Don was at the very center of it. The triggering event was the publication of the paper by Kaplan, Münch, and Sprinrad (KMS) in 1964 that indicated, through high resolution spectroscopic observations of a few weak CO_2 lines, that the surface pressure of the Mars atmosphere at ~25 mb was some three to five times less than what more classical astronomical observations were suggesting. This was at a time when NASA was designing its Mars-Voyager project that was intended to land an instrument package of the planet's surface and needed precise knowledge of this parameter. Don seized the opportunity, realizing that Kitt Peak had a unique instrument in the McMath Solar Telescope and its 13.4-m vertical spectrograph to tackle this problem.

Donald Mount Hunten, 1 March 1925–14 December 2010. (Image credit: Maria Schuchardt.)

Don and Joe quickly persuaded Keith Pierce, the director of Kitt Peak's Solar Division, to let Don use the telescope for planetary observations. He designed and built an image guider out of loud-speaker coils to feed one of Pierce's image slicers; he built what must have been the world's largest eyepiece out of a half-meter plastic Fresnel lens just to find Mars in the telescope's large field; he designed and built a photon-counting photomultiplier head for the spectrometer, which still was used largely in the photographic mode. He enlisted me to help make and reduce the observations and program the computer. It was at that point that he became my mentor. From him, I learned how the curve of growth of a spectral line really worked, the essential elements of optical systems, of molecular spectroscopy, and of radiative transfer.

The results, published in 1966, showed that the surface pressure was even lower than what KMS had suspected and ranged between 5–13 mb. This was a substantial contribution to the spectacular success of the Viking missions that were to land on Mars a decade later. Growing out of this investigation came a new direction in the Space Division. The McMath telescope was used to make the first topographic map of the surface of Mars; it became a workhorse for studies of O_2 and H_2O in Mars and Venus, a search for an atmosphere on Mercury, H_2 column densities on Jupiter (with Uwe Fink), and Raman lines in the spectrum of Uranus that showed the clarity of that planet's atmosphere.

While all of this was transpiring, Don also found himself near the center of efforts to develop a special group within the American Astronomical Society to hold annual meetings on Planetary Astronomy. Although he was not on the initial organizing committee that included Joe Chamberlain, Mike McElroy, Harlan Smith, Richard Goody, Ed Anders, Carl Sagan, Toby Owen, and probably several others of whom I am unaware, a concept was developed that was the genesis of today's AAS Division for Planetary Sciences. Don became totally committed to the organization, becoming its chair in 1977 and winning its most prestigious award, the Kuiper Prize, in 1987. Others have written about Don's achievements later in his career, and those will not be repeated here. Suffice it to say that Don Hunten was a complex man of high technical and intellectual achievement. He was formidable in discourse; he overflowed with ideas for creative techniques and solutions to difficult problems; and he had an encyclopedic memory, unquestionable integrity, and a profound, yet intuitive, awareness of how nature works. He was also a superb musician. This man has left an indelible mark on our understanding of Planetary Physics.

SMARTS Meeting-in-a-Meeting at Upcoming AAS

What: **SMARTS: Current and Future Capabilities**
Where: **AAS 218, Meeting-in-a-Meeting**
When: **Tuesday, 24 May 2011, 2:00 PM–3:30 PM**

Organizer: Charles Bailyn

This meeting-in-a-meeting will discuss the organization, science results, and future of the Small and Moderate Aperture Research Telescope System (SMARTS). This second session will start with presentations from the SMARTS principal scientist and CTIO deputy director on the organization of the consortium and its current capabilities, followed by brief presentations on possible new instruments and capabilities. Much of the session will consist of a general discussion of future directions for the consortium.

First International Symposium of Science with the SOAR Telescope

The Southern Astrophysical Research (SOAR) Telescope is a 4.1-m aperture telescope designed to produce the best quality images of any observatory in its class in the world. It was funded by a partnership between the US National Optical Astronomy Observatory (NOAO), the Ministério da Ciência e Tecnologia do Brasil, Michigan State University (MSU) and the University of North Carolina at Chapel Hill (UNC).

After five years of continuing science operations with the SOAR telescope, the First International Symposium of Science with SOAR will bring together specialists, graduate students, and postdocs from the different partners with expertise in a wide variety of scientific areas, who will highlight key results gathered from observations with SOAR and/or outline promising science programs for the future.

The Symposium is also an opportunity to discuss current instrument performance and future instrumentation to SOAR as well as to share common experience in the reduction and analysis of data with SOAR.

The Symposium will take place at the resort area of Maresias Beach, on the Atlantic coast of São Paulo, Brazil, on 15–19 May 2011. There will be a number of invited speakers, together with ample time for contributed (oral) papers, posters, and discussion.

Please see *www.lna.br/FISSS2011/* for more details.

Staff Changes at NOAO North and South

(14 August 2010–1 February 2011)

New Hires

Adams, Sally	Administrative Assistant II (re-hire)	NOAO North
Basarab, Brett	CTIO REU summer student	NOAO South
Best, Tanya	Cook, Kitt Peak	NOAO North
Bippert-Plymate, Teresa	Administrative Assistant II, LSST	NOAO North
Childs, Capri	Cashier, Kitt Peak (Seasonal)	NOAO North
Culver, Amanda	Environmental Health & Safety Technician, Kitt Peak	NOAO North
Delp, Britny	Special Projects Assistant	NOAO North
Dunlop, Christopher	Special Projects Assistant	NOAO North
Everett, Mark	Research Associate, Interim	NOAO North
Fraga, Luciano	SOAR Postdoctoral Fellow	NOAO South
Fullwood, Keana	Cashier, Kitt Peak (Seasonal)	NOAO North
Glaspey, John	Archive Project Specialist	NOAO North
Hernandez, Rodrigo	SMARTS Assistant Observer	NOAO South
James, David John	Associate Astronomer	NOAO South
Ketelsen, Dean	Public Program Specialist II, Kitt Peak (re-hire)	NOAO North
Obreque, Gillermo	A&F Air Conditioner Technician	NOAO South
O'Connell, Julia	CTIO REU summer student	NOAO South
Peterman, Carol	Accountant	NOAO North
Rohl, Derrick	CTIO REU summer student	NOAO South
See, Mark	Craftsperson I, Kitt Peak	NOAO North
Weintraub, Shelley	Administrative Coordinator II, Office of Science	NOAO North

Promotions

Fraps, Barbara	From Administrative Coordinator I to Publications Coordinator	NOAO North
Garcia, Sharmain	From Assistant Visitor Center Supervisor to Visitor Center Supervisor	NOAO North
Gomez, Gerardo	From Telescope Mechanic 2 to Telescope Mechanic I	NOAO South
Mayne, Monica	From Part-time Office Assistant to Administrative Assistant I	NOAO North

Transfer

Guajardo, Dario	CTIO Telescope Mechanic (formerly Garage Mechanic)	NOAO South

Retirements/Departures

Berdja, Amokrane	Research Associate	NOAO South
Cachora, Tilferd	Craftsperson, Kitt Peak	NOAO North
Campbell, Ryan	Research Associate	NOAO South
Ditsler, William	Engineering Associate	NOAO North
Don, Kenneth	Technical Associate II	NOAO North
Falgout, Sheryl	Administrative Coordinator I	NOAO North
Halbedel, Elaine	Observing Associate, Kitt Peak	NOAO North
Hicks, Judith	Electronic Document Specialist	NOAO North
Lotz, Jennifer	Research Associate (Leo Goldberg Fellow)	NOAO North
Nuñez, Clay	Cook, Kitt Peak	NOAO North
Pope, Alexandra	Research Associate (Spitzer Fellow)	NOAO North
Ramon, Frederick	Cook, Kitt Peak	NOAO North
Rosin, David	Technical Associate II	NOAO North
Whitehouse, Matthew	Public Program Specialist I	NOAO North

Deaths

Hunten, Don	Former KPNO employee	NOAO North