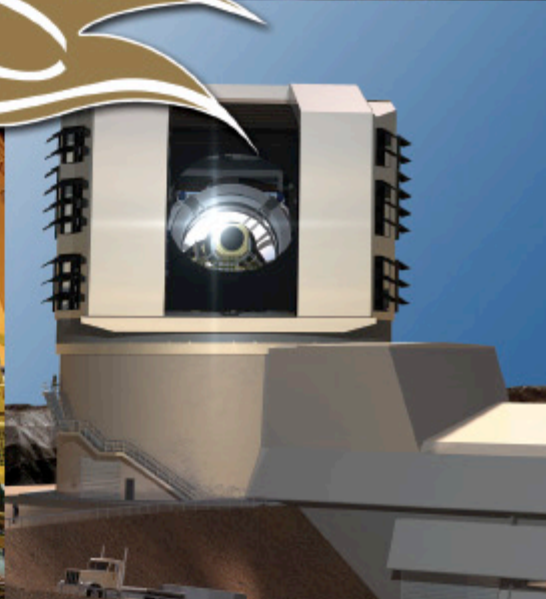
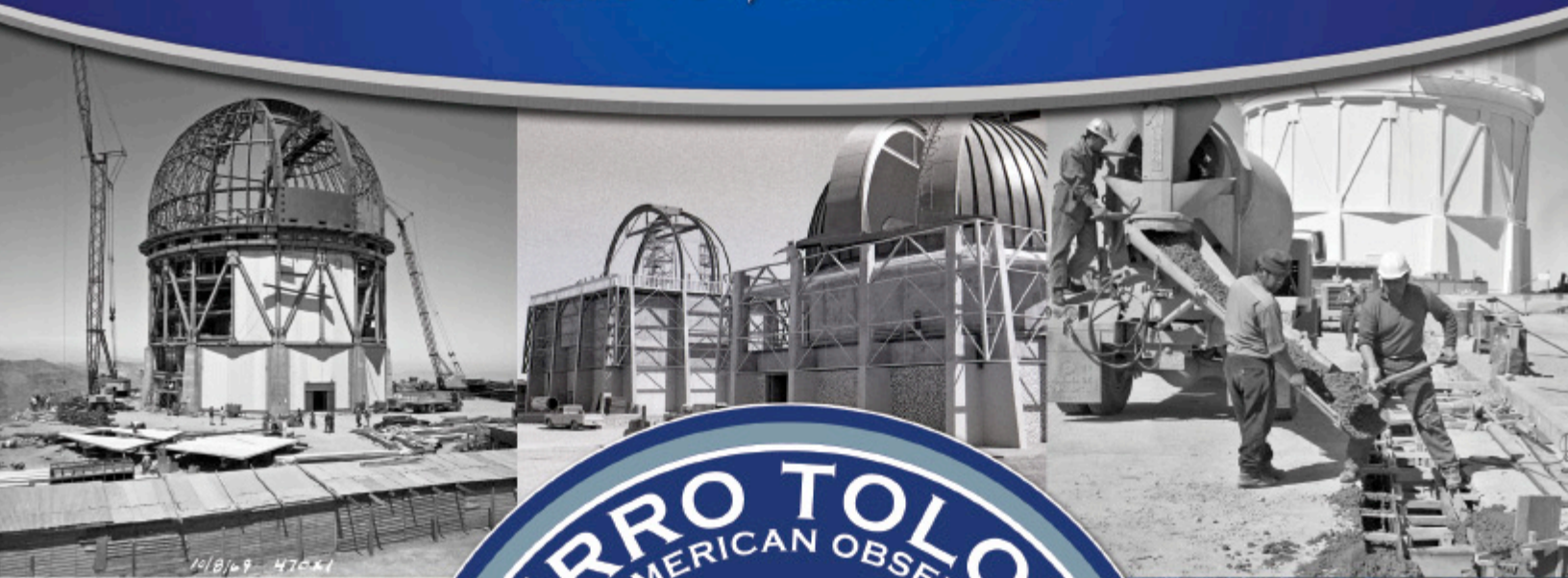


NOAO NEWSLETTER

Issue 107, March 2013



NOAO Newsletter

NATIONAL OPTICAL ASTRONOMY OBSERVATORY

ISSUE 107 – MARCH 2013

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On the Cover

CTIO: Past, Present, and Future

This cover presents a collage of the past, present, and future of the Cerro Tololo Inter-American Observatory in Chile in celebration of the observatory's 50th anniversary. Top left: 150-inch (Blanco 4-m) telescope building in progress, 8 October 1969. (Image credit: NOAO/AURA/NSF.) Top middle: Construction of the 60-inch (left) and 36-inch (right) telescopes on Cerro Tololo, 1967. (Image credit: NOAO/AURA/NSF.) Top right: CTIO construction progresses as workers create a utility trench, 9 September 1970. (Image credit: NOAO/AURA/NSF.) Middle left: Aerial view of CTIO, May 2009. (Image credit: NOAO/AURA/NSF.) Middle right: Star trails over the Blanco 4-m telescope on Cerro Tololo. (Image credit: T. Abbott/NOAO/AURA/NSF.) Bottom left: the Southern Astrophysical Research (SOAR) 4.1-m telescope on Cerro Pachón. (Image credit: NOAO/AURA/NSF.) Bottom middle: the newly-commissioned Dark Energy Camera installed on the Blanco 4-m telescope. (Image credit: R. Hahn/Femilab.) Bottom right: Computer rendering of the Large Synoptic Survey Telescope (LSST) to be constructed on El Peñón, which is part of the Cerro Pachón ridge. (Image credit: T. Mason/LSST Corporation.) For more information about the creation of CTIO and the building of its telescope facilities, see:

www.ctio.noao.edu/noao/content/CTIO-History.



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Looking Forward, not Back

Dave Silva

In the aftermath of the Portfolio Review, I believe it is important to look forward, to seek opportunities for excellence, and to lay the groundwork for a strong national optical/infrared (O/IR) center in 2020 and beyond. What opportunities do I see emerging?

The Large Synoptic Survey Telescope (LSST) Project remains the cornerstone of our future. NOAO already has a strong leadership role as one of four founding partners (with a permanent seat on the LSST Board of Directors) and the Lead Organization for the Telescope and Site Facilities design, development, construction, and commissioning activity. We also have helped foster the LSST Science Collaborations and their strong connections to the Project team. Looking forward, we expect to operate all LSST facilities in Chile on behalf of the partnership, including one of the top supercomputing centers in South America. Moreover, we have started developing an LSST Community Science Center, initially chartered to support LSST researchers during the LSST construction phase, but ultimately intended to act as the “go to” research support resource during the LSST survey era.

NOAO and the Thirty Meter Telescope (TMT) Project—at the invitation of TMT and with the approval of NSF—have started a collaboration to connect the broad US astronomy community more closely with TMT and to develop a federal partnership model for possible future NSF involvement in TMT. Both the Astro2010 decadal survey and Portfolio Review reports anticipated that NOAO would act as the federal partner on behalf of NSF, if such a partnership were cemented later in the decade. Ultimately, I believe that federal participation in one or more of the large aperture telescopes after 2020 at the 25% or greater level (each) is well justified scientifically and vital to the future of public astronomy in this country.

While Gemini and NOAO convergence is highly unlikely for the foreseeable future, closer collaboration would bring benefits to both organizations, especially as the US share in Gemini increases. My recent appointment to the Gemini Board of Directors, as well as the appointment of Tom Matheson to the Gemini Science and Technology Advisory Committee, is a significant step toward that closer collaboration. I also speak regularly with the new Gemini director. Gemini South will have an important role to play in LSST follow-up spectroscopic projects, within a US O/IR sub-system that also will include Blanco, Magellan, and the Southern Astrophysical Research (SOAR) telescope.

A strong NOAO data management development and operations program would bolster all three initiatives. Data management is an area where NOAO can contribute on behalf of the broad US community to activities and programs not easily handled at the individual institution level. In particular, NOAO looks forward to more extensive “big

data” expertise at the terabyte and petabyte scales, built on our current involvement in LSST, the Dark Energy Survey, and the Big Baryon Oscillation Spectroscopic Survey (BigBOSS). Gemini and NOAO are discussing how NOAO can become more involved in producing and supporting Gemini data products. Ultimately, as the federal partner in TMT, it is natural to imagine NOAO as the TMT US data and community science center, working closely with the NOAO LSST and Gemini community science center teams. Other facilities and projects (e.g., the Giant Magellan Telescope) could be served by such a center as desires and resources permit.

A strong national center should also have a vigorous focal plane instrumentation program. NOAO aspires to retain the expertise and resources to develop and deploy such instruments on 8-m-class telescopes, while looking forward to working within larger consortia of federal and non-federal partners to develop and deploy 30-m-class instruments.

What about our legacy 4-m telescopes? The Mayall and Blanco are world-leading wide-field imaging systems. To exploit that capability and enable world-class high-impact research projects, we have deployed the Dark Energy Camera (DECam) on the Blanco and continue to work vigorously toward deployment of the BigBOSS instrument on the Mayall circa 2018. Obviously, Blanco+DECam and Mayall+BigBOSS are optimized for large surveys. Over time, I expect such surveys to become the dominant mode of operation for those facilities, well into the 2020s. LSST follow-up alone is sound justification for continued involvement in SOAR in the 2020s. Recent imaging at the WIYN telescope (a partnership of the University of Wisconsin, Indiana University, Yale University, and NOAO) with the partially populated One Degree Imager (ODI) demonstrates that WIYN+ODI has the potential for being one of the most powerful wide-field imaging systems in the Northern Hemisphere, second only to SuprimeCam on Subaru.

This is not a vision that can be achieved instantly or even over a few years. Besides everything else, the NSF astronomy budget will likely remain constrained for several years into the future. But establishing a plausible strategic plan now has several obvious benefits: (1) it guides decisions about what activities to initiate, continue, or terminate; (2) it provides a framework for seeking funding from federal and non-federal sources; and (3) it establishes a list of topics for community discussion. All three things are required to reach a consensus in the short term and work toward an evolved but still strong O/IR national center in 2020 and beyond.

I look forward to vigorous discussions with you the community and our various funding agencies in the months ahead.



The Dark Energy Survey Fires Up

Josh Frieman, Fermilab and University of Chicago

The international Dark Energy Survey (DES) collaboration (130 senior scientists from 27 institutions) has been preparing for the start of the survey in observing semester 2013B, following First Light of the 570-megapixel Dark Energy Camera (DECam) on the CTIO Blanco telescope on 12 September 2012. After the initial DECam commissioning in September and October 2012, DES carried out extensive tests of the system during science verification (SV) observations from November 2012 through mid-February 2013. These observations were aimed to exercise and build up survey operational efficiency, to tune the instrument and associated systems, and to verify that the DES can meet its scientific goals. (See related article on page 13.)

The DES will image 5000 sq. deg. of southern extragalactic sky to ~24th magnitude in the *grizY* bands and carry out a time-domain survey (optimized to measure light curves for distant supernovae) over 30 sq. deg. The survey is allocated a total of 525 nights spread over five September-to-February seasons. The DES data will be used to probe the origin of cosmic acceleration through the study of galaxy clusters, weak gravitational lensing, the large-scale galaxy distribution, and supernovae.

During the SV period, DES imaged approximately 150 sq. deg. (in three fields centered approximately at 0.7h -55°, 2.4h 00°, and 4.7h -60°) to depths comparable to the full survey and exercised the time-domain survey by carrying out rapid difference-imaging and spectroscopic follow-up of supernova candidates at the Australian Astronomical Observatory (AAO), Hobby-Eberly Telescope, Southern African Large Telescope, and Keck. As of mid-

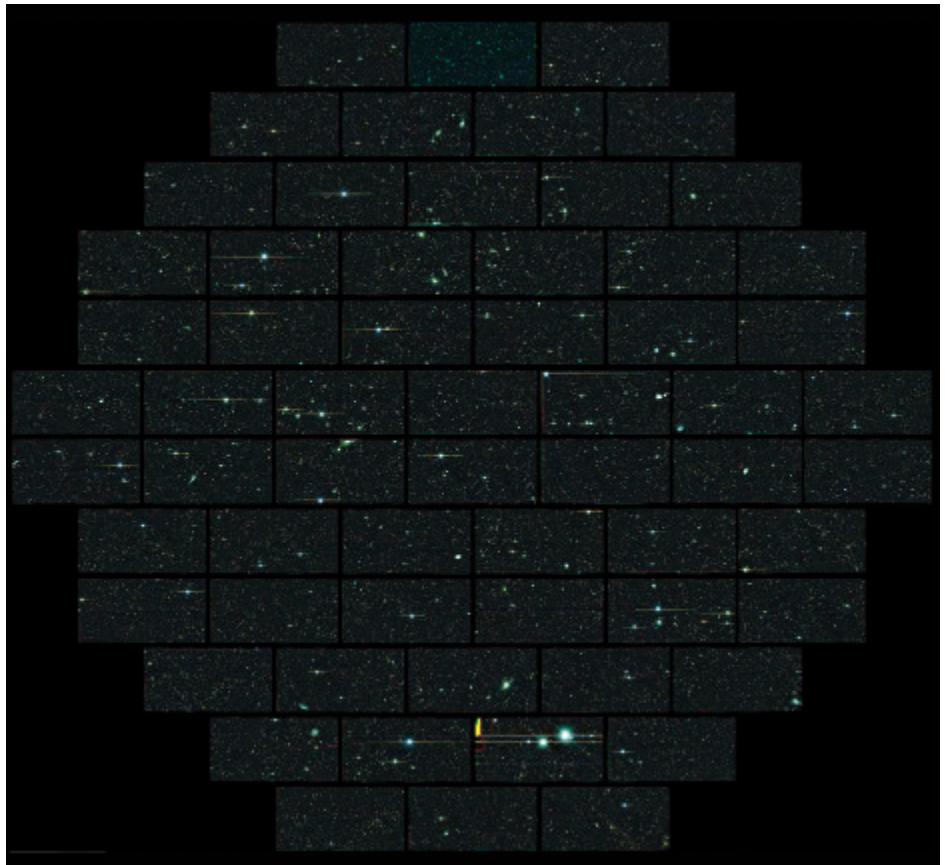


Figure 1: Composite *griz* DECam science verification image (December 2012) of one of the deep DES supernova fields. This image shows the mosaiced geometry of the 62 2048 × 4096 CCDs used to cover the DECam 2.2° field of view. The pixel scale is 0.27 arcsec/pixel.

January, these SV observations have led to the discovery of four spectroscopically confirmed supernovae and new high-redshift ($z \sim 0.8$) clusters, and have yielded weak lensing mass maps of several intermediate-redshift clusters.

The raw SV data are all available from the NOAO Science Archive. Highlights of these early developments were described in a well-attended DES Special Session at the January American Astronomical Society meeting in Long Beach, California.

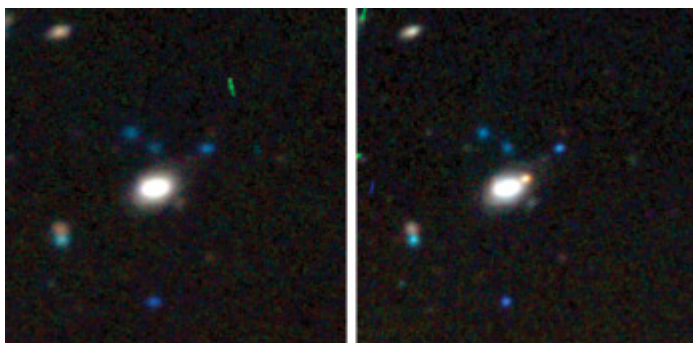


Figure 2: Two DES science verification images (November 7, left; December 15, right) bracket the explosion of a Type Ia supernova (SN) — the yellow source seen at the right end of the central galaxy in the December 15 image. AAO spectra obtained on December 17 showed the SN to be at redshift ~ 0.2 .

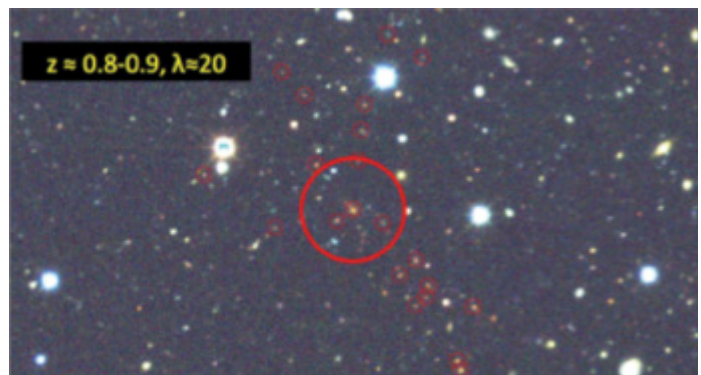


Figure 3: A redshift 0.8–0.9 galaxy cluster discovered in DES science verification data taken with the Dark Energy Camera on the CTIO Blanco 4-m telescope in November 2012.

A Survey of Stellar Population Ages in the Halo of Andromeda

Raja Guhathakurta (University of California Observatories/Lick Observatory, University of California Santa Cruz) & Rachael Beaton (University of Virginia)

Raja Guhathakurta (UCO/Lick Observatory, UC Santa Cruz) is leading an NOAO survey of the halo of M31. The survey is called M31AGES, which stands for M31 Asymptotic Giants Extended Survey. It was assigned 26 nights spread over two years on the KPNO Mayall 4-m telescope using the NEWFIRM wide-field infrared imager. The survey features deep, wide-field imaging in the *J* and *K* bands of about two dozen M31 dwarf satellites and more than a dozen fields in M31's halo: some targeting specific, previously discovered substructure (tidal debris from merged/merging satellites in the halo) and the rest targeting the smooth halo. These observations will be used to construct near-infrared (IR) color-magnitude diagrams (CMDs) of luminous, evolved stellar populations in M31's satellites and halo. Figure 1 displays the anticipated survey footprint and includes an inset that compares the *J*-band NEWFIRM image to the *V*-band Mosaic image. In addition to the principal investigator (PI), the survey team includes Rachael Beaton (co-PI, graduate student, University of Virginia), Martha Boyer (Space Telescope Science Institute), Arjun Dey (NOAO), Katherine Hamren (graduate student, UC Santa Cruz), Rob Swaters (NOAO/University of Maryland), Masashi Chiba (Tohoku University, Japan), Marla Geha (Yale University), Karoline Gilbert (University of Washington), Kathryn Johnston (Columbia University), Jason Kalirai (STScI), Evan Kirby (UC Irvine), Steve Majewski (U. of VA), Knut Olsen (NOAO), Richard Patterson (U. of VA), Mikito Tanaka (Tohoku U., Japan), Erik Tollerud (Yale U.), and Elisa Toloba (Observatories of the Carnegie Institution of Washington/UC Santa Cruz).

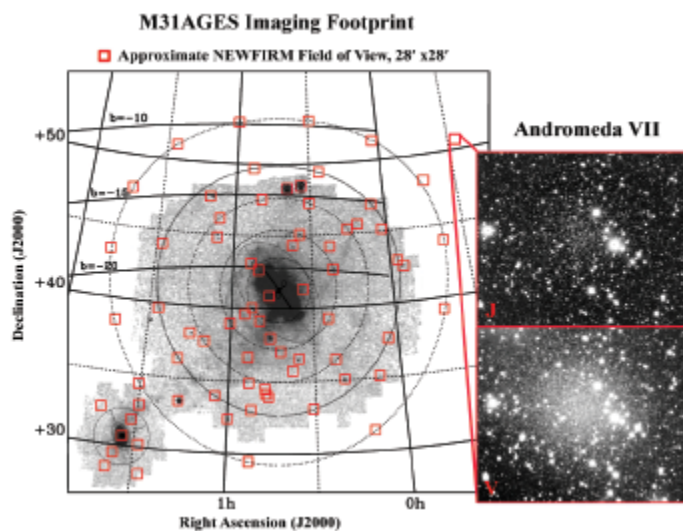


Figure 1: The red squares show the location of the M31AGES fields in the M31 halo. The inset shows how faint satellites are more visible in the near-infrared (lower) than the optical band-passes (upper).

The near-IR CMDs provide a census of intermediate-age Asymptotic Giant Branch (AGB) stars, thereby constraining the star-formation history of the known population of M31 satellites as well as a representative subset of its recently dissolved luminous satellites. These will be the first ever large-scale age constraints on the accreted population of a large disk galaxy like the Milky Way. It is already known that none of M31's satellites—and only two of the Milky Way satellites: the Large Magellanic

Cloud (LMC) and Small Magellanic Cloud (SMC)—contain young ($t \lesssim 1$ Gyr) stars. As shown in Figure 2 (M. Boyer, private communication), the LMC has a complex star-formation history and serves as a template to M31AGES for the identification of AGB stars in the M31 system. Indirect evidence suggests that the quenching of star formation in the M31 and Milky Way dwarf satellites, plausibly caused by the ram-pressure stripping of the satellites' gas by the parent galaxy's hot gaseous halo, occurs well before the satellites are tidally distorted by the parent galaxy.

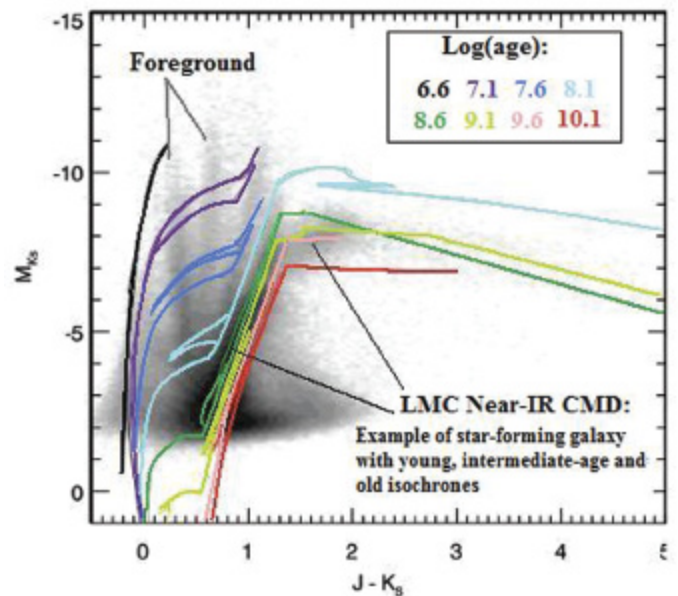


Figure 2: The LMC color magnitude diagram serves as a template for the identification of AGB stars in the M31 survey fields.

With its goal of identifying intermediate-age stellar populations, M31AGES will enable the determination of the epoch of the last major star-forming event in each of the M31 dwarf satellite galaxies, effectively age-dating the infall of the satellite into the parent halo. The observations will thus constrain the physical processes that regulate star formation in the smallest dark matter subhalos, improve our understanding of the low efficiency of star formation at these mass scales, and provide insight into the “missing satellites” problem. In addition to the dwarf galaxy science, the survey will use intermediate-age populations in the M31 halo as a means of discriminating among the three processes that are thought to contribute to the growth of stellar halos: (1) dwarf satellite accretion, (2) “kicking up” of stars from an early disk, and (3) in-situ star formation.

The survey has just started. Thirteen nights were completed in November 2012, and the pipeline-processed data observations were delivered in mid-January 2013. The NEWFIRM imaging data quality looks promising. Thirteen more nights are to be scheduled in the fall of 2013. Photometric catalogs will be made available a year after the last images have been processed through the data reduction pipeline, and the catalogs are anticipated in the spring of 2015. Processed images will be available after the conclusion of the proprietary period through the portal to the NOAO Archive.

Kepler Photometry Plus KPNO 4-m Spectroscopy to Get Stars Right

Andrej Prša (Villanova University)

Andrej Prša (Villanova University) and collaborators are using the KPNO 4-m telescope to obtain radial velocity curves of eclipsing binaries that have precise Kepler photometric curves. The goal of the program, operated as an NOAO survey, is to obtain accurate stellar radii of main sequence stars, thus improving fundamental knowledge of stellar structure.

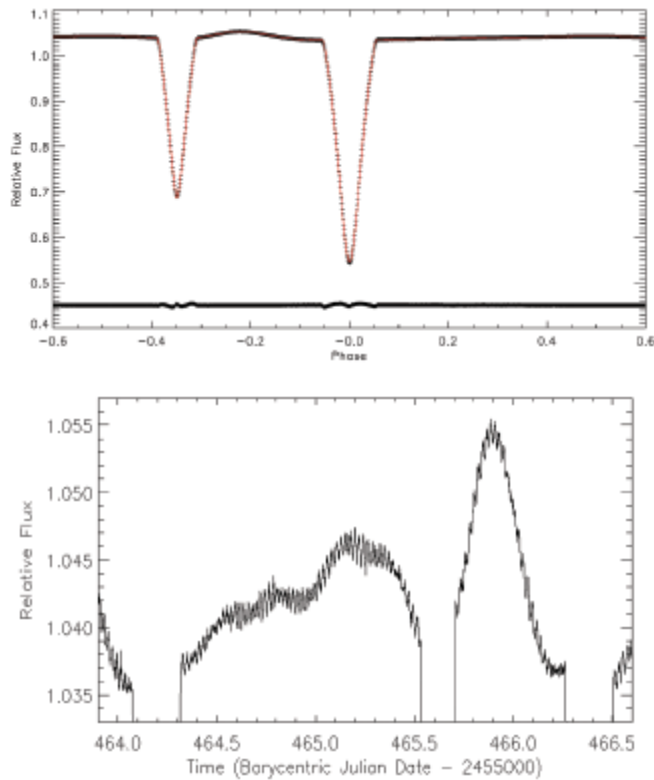


Figure 1: Kepler light curve of KIC 4544587, an eccentric eclipsing binary that exhibits intrinsically variable components (top; adapted from Hambleton et al. 2013). The black dots are observed data, and the red line is the best-fit model. The g-mode pulsations (~1-d period) and the p-mode pulsations (~30-min period) are clearly visible in the blown up light curve (bottom). From Kepler data alone, we can infer only the relative sizes of the stars. Their masses also are not attainable. Orbital properties such as eccentricity, inclination, and the argument of periastron, on the other hand, are attainable.

The Kepler mission hunts for extrasolar planets by acquiring nearly uninterrupted photometric data of an ~100-square-degree field in the constellations of Cygnus and Lyra. The data precision is unprecedented: the satellite can detect photometric variations of about 20 micro-magnitudes. This is analogous to detecting a single office light being turned off at the Empire State Building as seen from Philadelphia. Yet extrasolar planets are not the only celestial bodies caught in Kepler's web: the catch ranges from numerous variables, such as RR Lyrae, Delta Scuti and Cepheids, to binary stars. When the plane of rotation in binary stars coin-

cides with our line of sight, we see eclipses that repeat with the orbital period as stars pass in front of each other. These eclipsing binary stars are the scope of Prša's program. The goal is to acquire high-resolution ($R \sim 20,000$) spectroscopy using the KPNO Mayall 4-m telescope to obtain radial velocity curves to complement the photometric profiles.

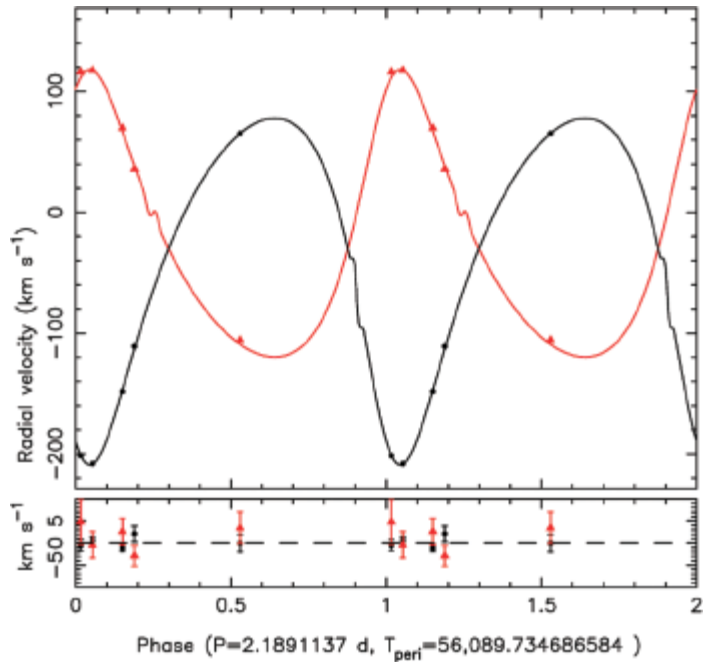


Figure 2: Radial Velocity (RV) curve of KIC 4544587, computed from the spectra acquired with the KPNO Mayall 4-m telescope within the survey program. Because the orbital parameters are essentially set in stone with Kepler photometry, the only remaining parameters left to fit are the semimajor axis, determining the absolute scale of the system and the mass ratio, and determining the masses of individual stars. That is why the survey needs only a handful of exposures per star to derive the masses and radii with uncertainties less than ~3%.

Eclipsing binary stars have been one of the best astrophysical laboratories to date for probing stellar structure—their unique geometry allows us to derive fundamental parameters: temperatures, radii, masses, and luminosities—of the binary system components. This unique property, contrasted to other means of determining stellar radii that either apply to only a handful of objects (such as resolving the disk of a star) or are encumbered by a larger uncertainty (i.e., period-luminosity relationships), promoted eclipsing binaries as calibrators of stellar properties and distance gauges. Binarity allows us to determine the masses of individual components, and the alignment of the system's orbit with the line of sight and consequent eclipses allow us to determine their radii to better than a few percent. To perform such accurate modeling, we need to acquire both photometric and spectroscopic observations. From single-band photometry (such as Kepler data), we can obtain only the relative sizes of both components and their temperature ratio. For individual tem-

continued

Kepler Photometry Plus KPNO 4-m Spectroscopy continued

peratures, we require multiband photometry; and for the masses and an absolute scale of the system, we require spectroscopy. Having these data available, modeling yields fundamental parameters of the components in the system that are used to calibrate stars across the H-R diagram, determine accurate distances, and study a range of intrinsic phenomena such as pulsations, spots, accretion disks, etc.

The NOAO survey program draws its targets from over 2600 objects in the Kepler Eclipsing Binary Catalog (Prša et al. 2011, Slawson et al. 2011, Kirk et al. 2013; submitted). The follow-up priority is assigned to: (1) well-detached binaries in near-circular orbits, which are the prime sources for calibrating the M - L - R - T relationships across the H-R diagram; (2) low-mass main sequence binaries—these reside in the under-sampled region of the H-R diagram with known anomalies, such as the notably larger observed radii to those predicted by the evolution theory; (3) binaries exhibiting eclipse timing variations—the deviations from linear ephemerides typically indicate the dynamical interaction with third bodies (stellar and substellar); and (4) binaries with intrinsically variable components, in order to measure their masses and radii. The role of spectroscopy is to determine the masses and the absolute scale of the system; without spectroscopy, this is not attainable. Most Kepler tar-

gets are faint: their typical magnitudes range from $K_p = 12$ –15. Thus, the program stars require a 4-m-class telescope for follow-up observations.

After the first year of the survey, Prša and collaborators acquired and reduced a total of 196 spectra of 38 unique targets (excluding comparison stars): 123 observations of 30 targets in 2011A (eight nights), and 73 observations of 24 targets in 2011B (five nights). They extracted radial velocities with an ~ 1 km/s accuracy using 2-D cross-correlation and broadening functions; for that, they needed to observe and use suitable RV standards in place of the tentatively planned use of synthetic model spectra because of the uncertainties of flux normalization. The program is strong and healthy and will produce a catalog of ~ 150 binaries in the course of three years with all fundamental physical parameters determined to better than $\sim 3\%$.

References:

- Prša, A., et al. 2011, AJ, 141, 83
- Slawson, R.W., et al. 2011, AJ, 142, 160
- Kirk, B., et al. 2013, submitted to AJ
- Hambleton, K., et al. 2013, submitted to MNRAS

Examining a Twin of SN 1987A before It Explodes

Nathan Smith (University of Arizona)

Nathan Smith and Dave Arnett (U. of Arizona), John Bally, Adam Ginsburg (University of Colorado), and Alex Filippenko (University of California, Berkeley) used Thermal-Region Camera Spectrograph (T-ReCS) observations obtained at Gemini South to study the surprising distribution of circumstellar dust around the Galactic blue supergiant SBW1 (Smith et al. 2013). SBW1 is thought to be the closest analog of the progenitor of SN1987A, although unlike SN1987A's progenitor, this B1.5 Iab supergiant has yet to explode. The observations were intended to investigate the type of circumstellar material into which the blast wave of SN1987A has been expanding during the past 25 years. Combining the T-ReCS images with data from the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) has revealed interesting and unexpected details about the structure of the nebula. These new clues solve some debates about the circumstellar structure around SN1987A and suggest a possible explanation for the formation of its bizarre triple-ring nebula.

SBW1 was discovered relatively recently by Smith, Bally, & Walawender (2007), who used the Mosaic camera on the CTIO Blanco 4-m telescope to conduct a narrowband imaging study of the Carina Nebula star-forming region. Radial velocities of SBW1 and the luminosity class of its central star suggest that SBW1 is not actually in the Carina Nebula (home to Eta Carinae and about 70 O-type stars) at a distance of 2.3 kpc, but is instead located at a much greater distance of 6–7 kpc *behind* Carina. At that greater distance, the luminosity of the blue supergiant at the center of SBW1 matches that of SN 1987A's progenitor, indicating an initial mass of the B1.5 supergiant of about 18–20 M_{\odot} . Moreover, at this distance, the

radius of SBW1's ring nebula is 0.2 pc, nearly identical to the size of the ring around SN1987A.

Figure 1 shows a color composite image of SBW1 in the left panel, with the blue/green tint showing Ha emission as seen with HST/WFC3, and the red/orange tint showing the distribution of 11.7 mm dust emission seen with T-ReCS. The HST image reveals details about the structure of the ionized (blue) ring in SBW1, which cannot be discerned in HST images of the ring around SN1987A because it is so much farther away. The fine details seen in SBW1 do not resemble the elongated type of structures that have been hypothesized to exist in the ring of SN1987A, based on predictions from standard models for its formation. The structures in SBW1, therefore, have important implications for alternative ways in which the ring may have been ejected and shaped, as is discussed in detail in the new paper by Smith et al. (2013).

The most interesting and surprising aspect of the new observations is provided by the distribution of warm dust traced by the T-ReCS 11.7 mm image (the red/orange emission inside of the blue ring in Figure 1, left). This image shows two bright peaks of dust emission residing in the interior of the ring. The double-peaked structure implies limb-brightening of a toroidal dust distribution. The fact that the dust resides inside the ionization front in the ring is a bit puzzling—and important. To the extent that SBW1 is representative of the progenitor of SN1987A, the dust residing interior to the dense equatorial ring (seen in Ha) immediately rules out some popular models for the formation of the bipolar nebula around SN1987A, which attempted to explain the origin of the bipolar

continued

Examining a Twin of SN 1987A continued

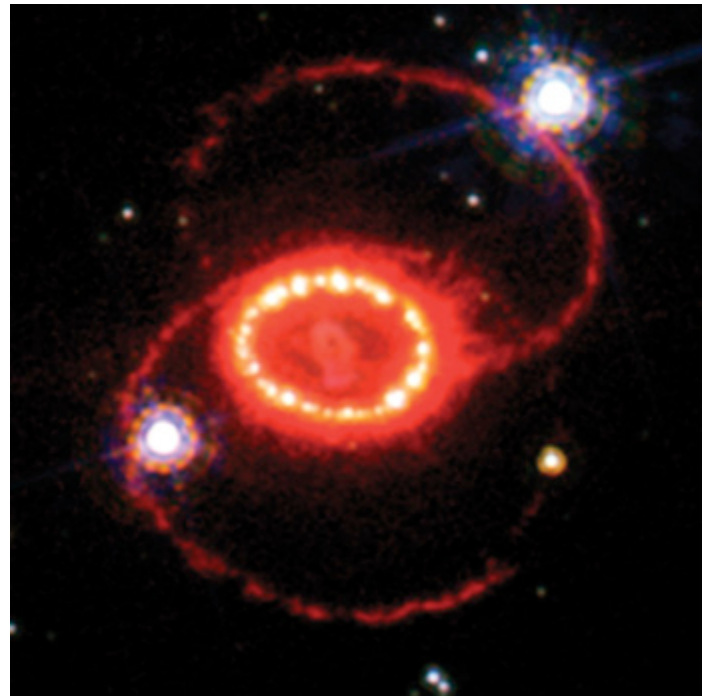


Figure 1: (Left) A color composite image of SBW1, showing the Ha emission observed with HST/WFC3 in blue, and the mid-IR dust emission seen with T-ReCS in red/orange. (Image credit: N. Smith, U. of Arizona, NASA/NOAO.) (Right) A color image of the triple ring nebula around SN 1987A taken with HST. (Image credit: P. Challis, Center for Astrophysics.)

nebula by the hydrodynamic interaction of the fast blue-supergiant wind crashing into a red-supergiant wind that was denser at the equator than at the poles (Blondin & Lundqvist 1993; Martin & Arnett 1995). The reason the location of this dust is so critical is that in these models, the entire interior of the ring must be filled with the wind of the blue supergiant in order for that wind to reach and shape the ring. The winds of normal blue supergiants are too fast, hot, and rarefied to form dust on their own, however, so some alternative model is needed.

Figure 2 illustrates a sketch from Smith et al. (2013) that shows an alternative scenario. Here, ultraviolet (UV) radiation from the star photo-evaporates a thin and dense equatorial ring (ejected earlier: perhaps during a mass-transfer event in a binary system or in a merger). Because the ring is expanding away from the star at only 10 km/s, the ionized gas expands into the interior of the ring. This expanding gas from the dense ring entrains dust with it and expands inward until it collides in the shock with the expanding blue-supergiant wind. This collision is where the dust piles up and gives rise to the structures seen with T-ReCS. A similar ionized gas structure was hypothesized to exist around SN1987A as well, suggested by Chevalier & Dwarkadas (1995) in order to account for the expansion of the spatially resolved radio emission from SN1987A. This structure never was directly observed around SN1987A, however, and if it had dust like SBW1, that dust in the interior of the ring may have been vaporized by the UV flash from the supernova. The structures seen around SBW1 before it explodes suggest that ionization and photo-evaporative flows play a dominant role in shaping the nebula, rather than a fast wind colliding directly with a slower wind. Moreover, the photo-evaporated material keeps the fast blue-supergiant wind at bay, and the material that piles up in the shock interface and flows downstream might play a role in producing the mysterious polar rings around SN1987A. This scenario awaits a test from numerical simulations.

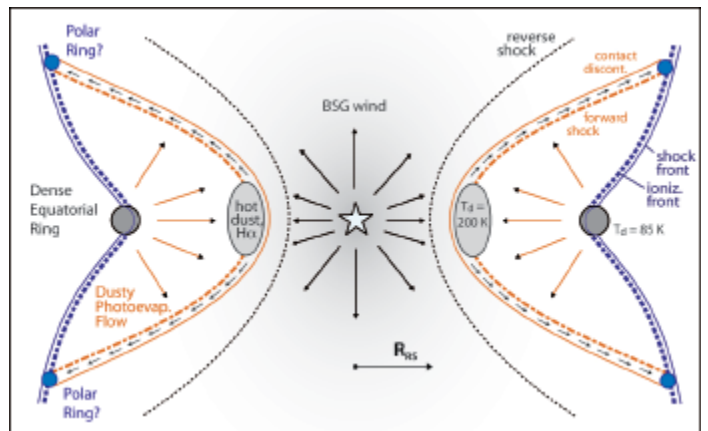


Figure 2: The likely geometry of the nebula around SBW1 (Smith et al., 2013). This is a cross section as seen from the side in the equatorial plane. The hypothesis is that $\sim 10,000$ yrs ago the central star ejected a thin, dense ring composed mostly of cool neutral gas and dust. The ring expands slowly and its inner edge is then ionized by UV radiation from the central star. This forms an ionized skin on the inner edge of the ring, which is over-pressured and must expand into the interior of the ring, dragging dust along with it (this is called a dusty photo-evaporative flow, or DPF). The DPF expands in toward the star until it collides with the stellar wind of the blue supergiant, forming a curved shock front that shepherds material down the walls of the shock front, with most of the compressed material confined to a thin range of latitudes between the equator and pole.

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Preparing for the Future: The NOAO LSST Community Science Center

Knut Olsen

Have you thought about how you will use the Large Synoptic Survey Telescope (LSST) for your future research? Even though the start of LSST operations is still ~10 years away, now is the time to start positioning yourself to be ready for the massive data flow.

Why should you start thinking about this now? One reason is that once the data begin to arrive, they will come very quickly with 15 terabytes of new data each night—the equivalent of the entire Sloan Digital Sky Survey (SDSS) every week. Making sense of the data, be it the images themselves, the object catalog (~20 billion objects, each with hundreds of measurements over the 10-year survey), or the transient alerts (~ 10^5 to 10^7 per night, depending on location on the sky), will require you to think carefully about how to select the types of objects to collect and the measurements to make on them.

Another reason is that for many scientific problems you will discover exciting objects in LSST that you will want to follow up with other types of observations, e.g., spectroscopy to characterize them, imaging in bands outside the *ugrizY* filter set of LSST, or those taken on a more rapid timescale than is provided by the LSST cadence. Making sure that the kinds of facilities needed for your follow-up observations are available when LSST begins operations is the collective responsibility of all of us and will require many years of advanced planning.

Perhaps the *best* reason to start getting ready for LSST now is that it will give you immediate scientific benefit. You could find yourself making exciting discoveries in precursor surveys relevant to future LSST research. Learning new data analysis or modeling techniques that you will

need for LSST data also will help you tackle the scientific problems that concern you now. Building and advancing a scientific career depends on making sound decisions on how to invest your time. Why not link that investment to the bright future of LSST?

NOAO believes that having you, the community, invest in LSST now is an excellent way to help ensure the long-term health of the US Ground-Based Optical/Infrared System. To encourage and increase the impact of that investment, we, in collaboration with the LSST Project, propose to establish an LSST Community Science Center (LCSC) at NOAO.

The LCSC will serve several purposes. First, it will provide an interface between the LSST research community and the LSST Project during the 10-year LSST construction phase—a time when the Project must dedicate itself almost exclusively to working on LSST development, leaving few resources for community user support. Second, it will stimulate LSST pathfinder scientific research in advance of the survey; the LCSC will be a center of expertise that would provide user support on using LSST-developed software and tools and serve up test beds in the form of existing precursor surveys (such as SDSS Stripe 82 and ongoing Dark Energy Camera surveys) or provide planning for new surveys. Third, it will help the LSST science community organize itself to meet the challenges of LSST-based research through workshops, collaboration meetings, and development of roadmaps to LSST. If you would like to learn more, read our LSST Community Science white paper at ast.noao.edu/facilities/future/lst, where you can also learn about the activities of the NOAO LSST Science Working Group. Send us your thoughts. Let's get started on preparing for the future today!

BigBOSS Status Update

Timothy Beers, Arjun Dey, Joan Najita & David Sprayberry

The Big Baryon Oscillation Spectroscopic Survey (BigBOSS) project, led by the Lawrence Berkeley National Laboratory, aims to create a powerful new spectroscopic capability for the KPNO 4-m Mayall Telescope. The BigBOSS instrument, a 5000-fiber optical spectrograph with a 3-degree field of view, will undertake an unprecedented galaxy redshift survey to constrain various cosmological parameters. It also will be available for community science programs (see bigboss.lbl.gov/ and Schlegel et al. 2011, arXiv 1106.1706).

The Gordon and Betty Moore foundation has awarded a \$2.1 Million grant to the Berkeley Center for Cosmological Physics to support the development of technologies required for the BigBOSS project. This in-

cludes development of the prototype for ten advanced spectrographs that will be used by BigBOSS and purchase of the large glass blanks for two of the four lenses in the corrector optics that will be used on the Mayall 4-m telescope to achieve the 3-degree-wide field of view planned for this project.

NOAO has organized a Community Science Committee to ensure that the broader community's scientific interests in BigBOSS are represented. The committee is co-chaired by Constance Rockosi (University of California, Santa Cruz) and Joan Najita (head of the NOAO Office of Science). Other members of the committee are Carles Badenes (University of Pittsburgh), Jennifer Johnson (The Ohio State University), Casey

continued

BigBOSS Status Update continued

Papovich (Texas A&M University), Caty Pilachowski (Indiana University), Greg Rudnick (University of Kansas), and Verne Smith (director of the NOAO System Science Center, *ex officio*). The committee is charged with articulating the community needs (e.g., time and resource require-

ments) for, and the scientific impact of, community access to the BigBOSS instrument and BigBOSS archival data. These recommendations will, in turn, inform NOAO's discussions with the BigBOSS project (and the NSF) on how best to satisfy the community's scientific aspirations. **11**

System Development Workshop: "Spectroscopy in the Era of LSST"

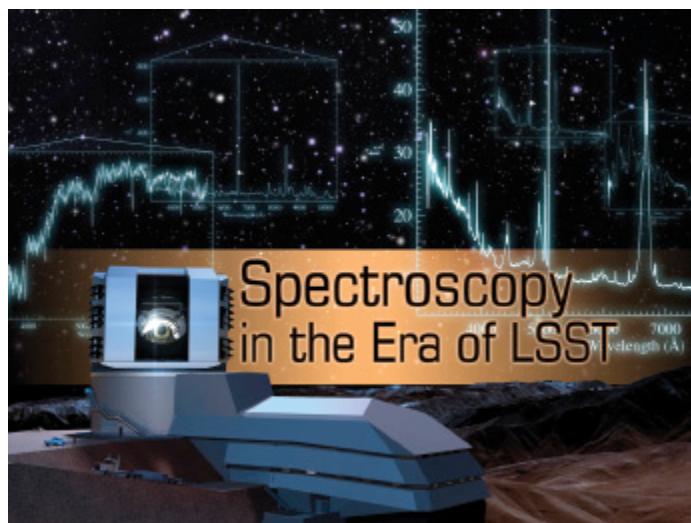
Tom Matheson

The Large Synoptic Survey Telescope (LSST) is the primary ground-based optical/infrared (O/IR) recommendation of the 2010 decadal survey. LSST and its data products will become primary resources for the US O/IR community. Many scientific questions can be answered wholly within the context of the LSST project itself, but others will require further observations, either at other wavelengths or with other optical facilities.

Spectroscopic follow-up observations of LSST discoveries will play an important, often critical, role in fulfilling the scientific promise of LSST. To prepare for science with LSST, NOAO will host a workshop on "Spectroscopy in the Era of LSST" on 11–12 April 2013 in Tucson. The workshop will bring together astronomers working on a wide array of LSST science topics to discuss the needs for follow-up spectroscopic facilities, instruments, and observing modes.

The goal of the workshop is to produce a responsive and prioritized development plan for the coming decade, for NOAO, and for the Ground-Based O/IR System, so that the community will be ready to take advantage of all that LSST will offer.

For more information, please see the meeting website (www.noao.edu/meetings/lsst-spec/) or contact Tom Matheson (matheson@noao.edu).



KOSMOS and COSMOS Updates

Jay Elias & David Sprayberry

The Kitt Peak Ohio State Multi-Object Spectrograph (KOSMOS) and the Cerro Tololo Ohio State Multi-Object Spectrograph (COSMOS) are nearly identical spectrographs being developed simultaneously for use in the Northern and Southern Hemispheres, on the Mayall and Blanco telescopes, respectively. The development is by a partnership between NOAO and The Ohio State University (OSU) and is funded through the NSF's Renewing Small Telescopes for Astronomical Research (ReSTAR) Program.

We are modifying the spectrograph camera design as a result of problems experienced by a third party optics vendor, which have continued to delay delivery. We anticipate beginning to commission KOSMOS during the coming summer, with plans to make it available in semester 2013B. Because KOSMOS will not have been commissioned by the time proposals are due, prospective users should propose for the R-C Spectrograph and indicate their interest in using KOSMOS instead, fol-

continued

KOSMOS and COSMOS Updates continued

lowing the rules described below. Dark Energy Survey operations and recommissioning of the Blanco $f/8$ secondary mirror will affect when COSMOS is commissioned; we do not expect it to be available for science use in semester 2013B.

Capabilities

The “KOSMOS and COSMOS Updates” article in the September 2011 *Newsletter* includes information on the instrument capabilities (www.noao.edu/noao/noaonews/sep11/pdf/104syssci.pdf). The most current information on the KOSMOS/COSMOS capabilities as well as relevant technical documentation can be found at www.noao.edu/nstc/kosmos/.

Status

The September 2011 *Newsletter* article and follow-up articles in the March and September 2012 *Newsletter* reported that we were waiting for final delivery of the optics, which had been figured but not cemented or assembled at the vendor. Since then, a continuing series of issues with the cemented lens assemblies have further delayed final delivery of the completed camera and collimator assemblies.

The collimator assemblies for both instruments were completed by the end of July 2012, but there were continuing problems with the glued triplets and doublets in the camera assemblies. We have concluded that the cemented interfaces will not work over the required temperature range. OSU has negotiated with the vendor to deliver the collimator assemblies and the camera lenses. OSU is completing the design of a camera barrel that will use fluid coupling between the triplet and doublet elements instead, and acceptance testing of those assemblies will take place when the cameras are also completed. A prototype has been built and is being extensively tested (as of January 2013; testing should be complete in the next few weeks); the final design will be independently reviewed. Similar designs have been implemented in, among others, the Baryon Oscillation Spectroscopic Survey (BOSS) spectrograph on the Sloan Digital Sky Survey Telescope at Apache Point (Smee et al. 2012, AJ, submitted: astro-ph: arXiv 1208.2233) and the Goodman spectrograph on SOAR (Clemens, Crain and Anderson 2004, Proc. SPIE, 5492, 331).

The optics have all been delivered to OSU, inspected, and accepted. Once the camera mechanical design is final and passes review, mechanical fab-

rication will take place in the NOAO instrument shop in Tucson. Integration with the optics and subsequent integration of the camera and collimator assemblies into the instruments will take place in Tucson as well, for both instruments.

We expect the instruments to be “telescope ready” toward the start of the summer, which means that KOSMOS commissioning at the Mayall should be carried out as part of the Kitt Peak summer shutdown. In general, there is enough clear time, even during the height of the monsoon season, to ensure that KOSMOS is adequately exercised and its performance verified.

Proposal Policy

We are adopting the following policy for requesting KOSMOS, because the first telescope run will occur after the deadline for proposal submission, and commissioning will be incomplete when the Telescope Allocation Committee meets. (Please see the 2013B Call for Proposals for the definitive rules; this is the same policy as was set for 2012B in the March 2012 *Newsletter*):

- Proposers should only write proposals that can be carried out with the R-C Spectrograph.
- Proposers who would be interested in using KOSMOS if it becomes available should indicate this in their technical section and describe how their proposal would be adapted to the KOSMOS capabilities found at www.noao.edu/nstc/kosmos/ for the same amount of observing time.
- If KOSMOS is ready for shared-risk use during 2013B, we will contact scheduled observers and confirm their continued interest. We may end up making only a subset of capabilities available during the semester (e.g., long slit but not multi-object spectroscopy mode).

Because the two instruments are nearly identical mechanically, COSMOS integration has been proceeding largely in parallel with KOSMOS; performance of the two should be nearly identical as well. COSMOS commissioning will take place following recommissioning of the repaired $f/8$ secondary mirror, probably very late in semester 2013B, due to time pressure from the Dark Energy Survey. ■

SAM Update

David Sprayberry & Andrei Tokovinin

The SOAR Adaptive Module (SAM) is a ground-layer adaptive optics (AO) system with a laser guide star that improves natural seeing at the Southern Astrophysical Research (SOAR) 4.1-m telescope. It is equipped with a dedicated charge-coupled device (CCD) imager that has a pixel scale of 0.045 arcsec/pixel and a field of view of 3 arcmin. The system was built at NOAO South under the direction of Andrei Tokovinin, instrument principal investigator. SAM commissioning on the SOAR telescope is now well along. The SOAR Observatory has recently announced the availability of up to six nights in semester 2013A

for science verification projects that will test the capabilities of SAM in real science projects. SOAR and the Cerro Tololo Inter-American Observatory (CTIO) also have agreed to offer SAM to the general community on a shared-risk basis during semester 2013B.

Capabilities

The most complete information about SAM’s capabilities and performance can be found at www.ctio.noao.edu/new/Telescopes/SOAR/Instruments/SAM/. The performance of SAM depends on the turbulence

continued

SAM Update continued

profile: seeing improvements are larger when the majority of the natural seeing results from low-altitude (“ground layer”) turbulence, for which SAM is designed to compensate. Under median conditions, the full width half-maximum (FWHM) resolution is typically 0.4, 0.45, 0.5, and 0.55 arcsec in the *I*, *R*, *V*, and *B* filters, respectively. The best resolution achieved so far is 0.25 arcsec in the *R* and *I* bands. The point spread function (PSF) can be modeled by a Moffat function with $\beta = 1.5$. In addition to the laser guide star, SAM requires two natural guide stars brighter than $R = 18$ for tip-tilt correction; these stars must be located within a 5×5 square arcmin field around the science target. The SAM imager is equipped with standard *B*, *V*, *R*, *I* filters, an H α filter (656/64 nm) and can also use other 3" and 4" filters available at CTIO and the SOAR Optical Imager (SOI) 4" filters. Note, however, that observations with filters such as *U* or *u'*, which transmit at 355 nm (the wavelength of the laser guide star), are not possible.


Status

Integration and commissioning efforts during the last few months have succeeded in resolving the last major performance issues with SAM (see the September 2012 *Newsletter* article on page 11 at, www.noao.edu/noao/noaonews/sep12/pdf/106syssci.pdf). Tests in mid 2012 revealed that the control electronics for the Laser Launch Telescope (located above or “behind” the SOAR secondary mirror assembly) were producing significant heat, which was degrading the image quality of the output laser beam. As a result, the image size of the return laser spots was too large to sup-

port successful AO operation except in excellent natural seeing. These electronic components were relocated to the outer part of the telescope top ring during semester 2012B, and the size of the return laser spots improved significantly. Also, problems of poor performance and intermittent failure of one quadrant of the wavefront sensor (WFS) CCD were resolved in the same timeframe, allowing more reliable operation with reduced down time. Finally, some software improvements were made that improve the efficiency of setup and operations, though there is still more work underway in this area.

Availability

SOAR announced in January 2013 that a limited amount—up to six nights—of engineering time would be made available during semester 2013A for science verification observations. Proposals for use of this time should be made directly to SOAR through a special process described at www.ctio.noao.edu/new/Telescopes/SOAR/Instruments/SAM/science/sv.html. The deadline for these applications is 15 March 2013.

SAM will be offered to the general US community for shared-risk observing in semester 2013B, through the normal NOAO Time Allocation Committee process. Please see the 2013B Call for Proposals in the System Observing: Telescopes & Instruments section of this issue for more information on how to propose. Information about SAM and its performance can be found on the SAM web page, www.ctio.noao.edu/new/Telescopes/SOAR/Instruments/SAM/. 

Las Cumbres Observatory Gains First Light for Entire 1-m CTIO Node

Oscar Saa

On 10 October 2012, the Las Cumbres Observatory Global Telescope Network (LCOGTN) team successfully completed the assembly of two of the three 1-m telescopes in the CTIO node of the network. That same night, immediately following the assembly, first light was obtained with these two telescopes.

The third telescope was completed the next day and saw first light that night. The entire CTIO node of 1-m telescopes was up and running!

For more information and images taken by those telescopes, see: lcogt.net/press/las-cumbres-observatory-gains-first-light-entire-1-meter-node-ctio.



The LCOGT 1-m telescopes at the CTIO Node.

2013B NOAO Call for Proposals Due 28 March 2013

Verne V. Smith & Dave Bell

Standard proposals for NOAO-coordinated observing time for semester 2013B (August 2013–January 2014) are **due by the evening of Thursday, 28 March 2013, 11:59 pm 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), as well as community-access time on the 10-m Keck telescopes, the 8-m Subaru telescope (via time exchange with Gemini), and the 4-m Anglo-Australian Telescope (AAT) through a time exchange with CTIO.

A formal Call for Proposals is available at ast.noao.edu/sites/default/files/cfp2013b.pdf as 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.

All of the information within the Call for Proposals document also is available using links 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/.

Email 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 email. Please carefully follow the instructions in the LaTeX template for submitting proposals and figures. Please use file upload instead of email 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. The PIT can be downloaded from www.gemini.edu/sciops/observing-gemini/proposal-submission/phase-i-tool-pit. PIT-submitted proposals will be printed using the PIT’s “NOAO” style format and are subject to the same page limits as other NOAO proposals. Please see the guidelines at www.noao.edu/noaoprop/help/pit.html.

Note, however, that proposals requesting time on Gemini *plus other NOAO facilities* **MUST** use the standard NOAO form. Proposals for Gemini time alone may also be submitted using the standard NOAO form.

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 observing run	keck@noao.edu

DECam Is Operational

Alistair Walker

Commissioning & Science Verification

Dara Norman and I wrote in the September 2012 *NOAO Newsletter* about the commissioning and scientific verification phases of the Dark Energy Camera (DECam), which we noted was predicted to start on September 28. Actually, the installation of DECam and subsequent tests to verify it was working went really fast, and first light took place on September 12. It was established almost immediately that the image quality was excellent, with constant focus over the whole three-square-degree field. Over the subsequent eight weeks, a battery of tests was conducted to evaluate the performance and debug the acquisition software and all the interfaces.

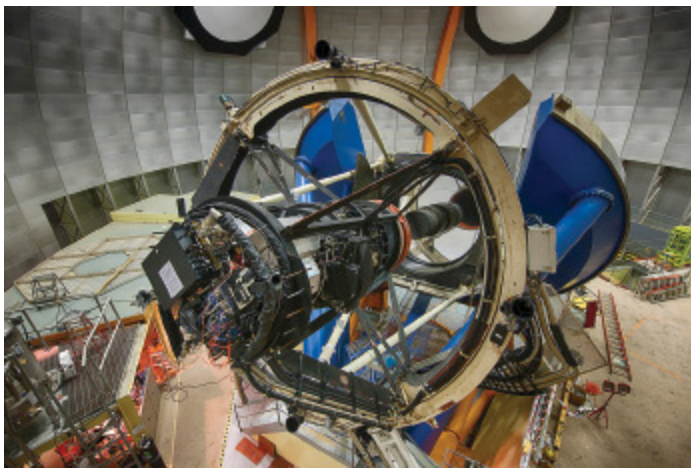


Figure 1: DECam on the Blanco 4-m telescope. The cage end cap and side covers are not installed to show that DECam completely fills the prime focus cage. (Image credit: Reidar Hahn, Fermilab.)

Commissioning DECam really required characterizing the behavior of a brand new system. The telescope had been heavily modified: the tube weight was increased by 10 tons; heavy lines including liquid nitrogen, cooling water, and air and electrical conduits were run up to the prime-focus cage; and a new Telescope Control System was installed.

Sufficient progress had been made by the end of October to move to science verification (SV), despite there still being difficulties with pointing, tracking, and guiding, particularly when pointing north of zenith. NOAO community observers, via a service observing team led by Dara Norman (NOAO), and Dark Energy Survey (DES) collaboration members led by Gary Bernstein (University of Pennsylvania) and Klaus Honscheid (The Ohio State University) shared 23 nights of SV time (see related articles on pages 14 and 3, respectively) to fully test DECam's capability, including exercising the reduction pipelines.

Community 2012A proposals awarded time by the regular NOAO Time Allocation Committee process were started on December 1 in shared-risk mode, while DES continued with extended science verification. By the end of the year, over 31 TB of DECam images had entered the NOAO Science Archive. All of the commissioning and SV data is nonproprietary and can be accessed and downloaded by anyone.

DECam will most likely be the only instrument scheduled on the Blanco telescope in 2013B, via the normal Call for Proposals (which are due 28 March 2013). DECam is available for NOAO Surveys under the present call for survey proposals (also due on 28 March 2013). The DES starts in September 2013 and, during a period of five years, it will take 105 nights per year from September through February, so community time will be limited to approximately one week per month during that period.

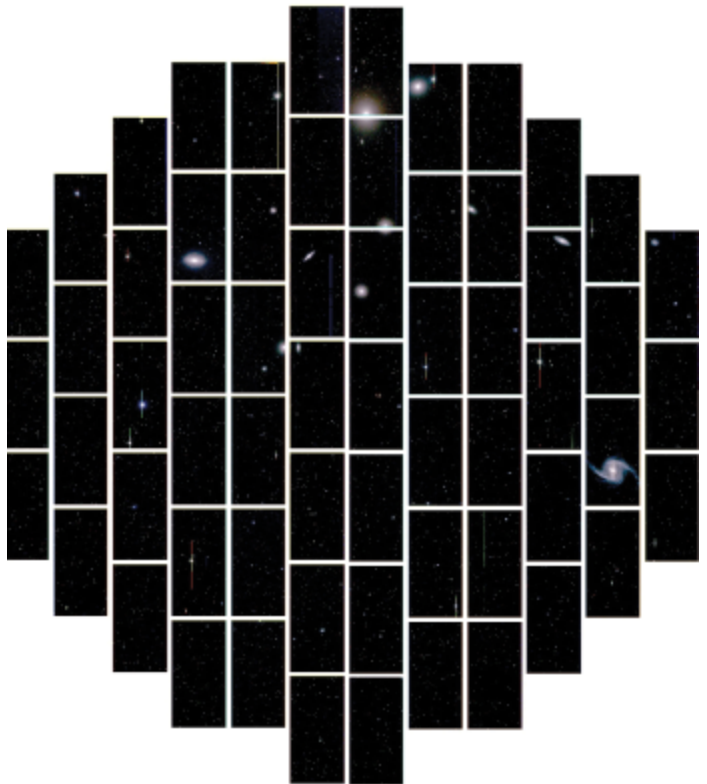


Figure 2: The Fornax cluster was chosen as the main "first light" image, as it well matches DECam's 3 square degrees of view. This 300-second *r*-band exposure is from 12 September 2012. By mid-February 2013, more than 46,000 images had been taken and transferred to NCSA and the NOAO Science Archive. (Image credit: DES Collaboration.)

DECam and Telescope Status

DECam is performing well. Images as good as 0.6 arcsec full width half-maximum in the *z* and *Y* bands have been recorded. A single CCD (N30) at the edge of the focal plane is not working at present, and approximately 10 (of the 124) CCD amplifiers display non-linear behavior at low light levels (less than 1000 counts), although normally the sky level is well above this. The DECam Community Pipeline used to process all the DECam community data runs at NOAO Tucson. Good quality reduced images including stacks can be produced, although there are still some issues with masking, and more subtle effects at the few percent level such as pupil ghosts are not yet perfectly understood. Frank Valdes (fvaldes@noao.edu) is the DECam pipeline scientist and works closely with the National Center for Supercomputing Applications (NCSA) team led by Don

continued




DECam Is Operational continued

Petravick (University of Illinois) that developed both the Community and the DES pipelines.

The latest DECcam information, instructions for observing with DECcam, and a scripts editor for download can be found at www.ctio.noao.edu/noao/content/dark-energy-camera-decam/. Or, consult with the CTIO DECcam support team of Alistair Walker (lead), Andrea Kunder, David James, Tim Abbott, and Catherine Kaleida via email at decam-help@ctio.noao.edu.

Substantial progress has been made recently in improving the telescope tracking performance, following the identification of excessive friction

on the Right Ascension (RA) bearing, and by the reduction of stiction due to the DECcam cable wraps. The RA damping system has been modernized and re-implemented. Optimization work on the telescope drive servo system continues, and improvements to the pointing model are expected. We will keep working to improve the instrument, telescope, and environment over the next few months.

The very aggressive schedule for moving DECcam from installation to operations in just a few months has been successful. The majority of the data now being produced is of high quality, and we are working on improving performance and efficiency and understanding subtleties. DECcam is now a very useable instrument. 

Availability of the Blanco 4-m Telescope during the Dark Energy Survey

Nicole van der Blik

The Dark Energy Survey (DES) collaboration has been granted a total of 105 nights per year for a period of five years to conduct the survey. The survey observations will be concentrated in September through January, with half nights in February, of each year. The community will have access to roughly one week per month in September through January during the five years of DES observations. Community access in the A semesters should be normal for the most part.

Even though community access is limited in the survey period, the DES will be providing imaging data in all available filters over 5000 square degrees, which is much of the sky available in the B semester. This data will have a one-year proprietary period. So if your observation involves

imaging of selected fields during the B semester, it is possible that the data you need will be taken by the DES and will be available after the one-year proprietary period.

We expect to recommission the Blanco $f/8$ secondary mirror by 2 September 2013, i.e., prior to the DES observing season. The $f/8$ will be commissioned using the Infrared Side Port Imager (ISPI), so ISPI may be ready in 2013B. Commissioning of the $f/8$ instrument Hydra (and ISPI as needed) will follow and is expected to occur over a two- to three-month period, during bright time. An update on the availability of $f/8$ instruments will be in the 2013B Call for Proposals, issued at the beginning of March 2013.

DECam Community SV Update

Dara Norman

The science verification (SV) period for the Dark Energy Camera (DECcam) was 1–24 November 2012. The SV nights were generally split into half nights, with the Dark Energy Survey (DES) team observing on the first half and the community program observing during the second half of each night. The community program was completed through service observing done by NOAO South and North staff.

The community SV program included 13 scientific programs selected from the 24 proposed via a modified time allocation process. The regular Time Allocation Committee selection criteria were modified to take into account the technical usefulness and uniqueness of the science case in testing the DECcam systems and capabilities as well as scientific merit.

The SV programs awarded time fell into two broad categories of deep observations and detection of transient objects. Selected programs were diverse in their scientific scope and included topics of weak gravitational lensing, galaxy evolution, stellar populations, variable stars, near-earth objects, Kuiper belt objects. All of the SV data taken for these projects are publically available through the NOAO Science Archive. Titles of the projects and their proposal identification numbers can be found at www.ctio.noao.edu/noao/content/SV-Programs.

The weather during SV was exceptional; nearly all the nights were photometric nights and there was only one half-night where thick clouds were a problem. Most telescope systems worked well on most nights, however,

continued

DECam Community SV Update continued

there were some notable and significant exceptions that continue to be addressed by engineering staff after the completion of SV. All but two programs (obsids = 2012B-3006, 2012B-3016) received at least part or all of the minimal data set requested by the principal investigator (PI) before SV start. The image quality for SV data varies significantly between (and within) programs primarily because of guiding/tracking problems that sometimes resulted in elongated images when pointing to declinations farther north than about -30 degrees. This problem is the reason for the absence of a minimal data set for the two programs noted above. For more southern declinations, the image quality was very good, with point spread functions on most nights of better than or about $1.0''$ and a few nights with seeing at $0.8''$.


Pointing of the telescope between slews was accurate to only about $10'$ at the SV start; however, that was improved to about $1'$ by the middle of SV and could be improved to $\sim 20''$, as reported by Chris Klein (2012B-3002), with pointing "tweak-ups" before programs that required greater accuracy, most notably many of the transient science fields.

Community PIs also reported that the quality of the calibrations has been good, with stable flat-field and bias frames. So far, PIs have reported no problems with the focus of images, suggesting that the Donuts (focus control system) and Hexapod systems are working well. We continue to assess image sensitivity in all filters. PI Ian Dell'Antonio (2012B-3004) reports that for the u band, preliminary extrapolation from standard stars shows comparable sensitivity to the expectation in the Exposure Time

Calculator spreadsheet, available online at www.ctio.noao.edu/noao/content/dark-energy-camera-decam.

There were almost no problems with the data transfer system and archive during the SV period. So far, all PIs have reported easy access to their raw and reduced (when available) data through the NOAO Science Archive.

An initial version of the DECam Community Pipeline (CP) began processing data about a week after the start of SV to remove instrument signature. These calibrations include overscan, bias, and flat-field removal; pupil ghost, crosstalk, and illumination corrections; and astrometric solution. Note that universal illumination correction and fringe images (for Y band) have not yet been built. As the pipeline currently uses only data from a single program to compute these frames, if an individual data set is small, these calibration images can have problems. CP improvements are still being assessed and corrections are being made and implemented. Image stacks are being built through the CP and are available in the Archive. A number of SV PIs plan to or have processed their data through their own custom pipelines. Efforts will be made to compare these data to the CP output to identify and inform improvements to the CP as appropriate.

Community users with questions or comments about the DECam SV raw or reduced data are encouraged to contact Dara Norman via email (dnorman@noao.edu). 

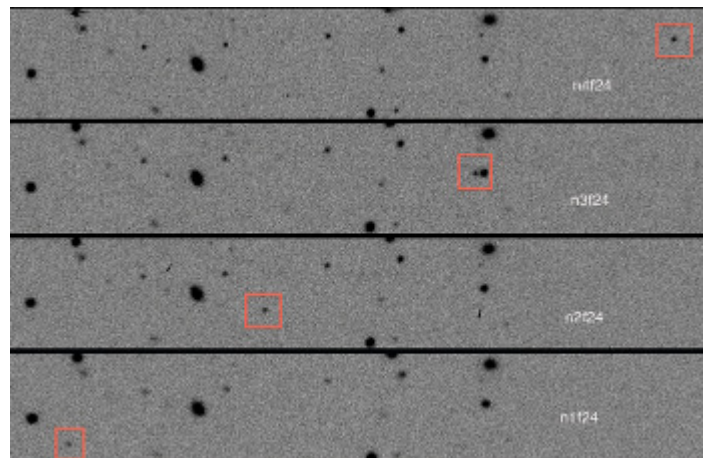
Confessions of a Noncosmologist DECam Observer

Lori Allen

"It's a new instrument," I said, "just barely commissioned, and we have half-nights, and it's mid-summer. How much data can we possibly expect to get under these circumstances?"

A lot. I found the operation of the Dark Energy Camera (DECam) at the CTIO Blanco 4-m telescope to be smooth and efficient while observing half-nights, January 3–6. I, César Fuentes (Northern Arizona University), and David James (CTIO) were obtaining data through a 2013A shared-risk program to test our observing strategy for a planned survey of near-earth objects (NEOs). The objective was to cover as much area on the sky as possible, a minimum of four times per night, for four consecutive nights. With only 3.5 hours of darkness, I was surprised by the area we ended up surveying each night, ~ 144 square degrees. Integrations were 60 seconds, and the camera read-out time was less than 30 seconds. The DECam operating system was easy to use and (did I mention?) very efficient, owing in part to the clever queue design that allows observers to insert, remove, or re-order commands with a minimum of fuss.

Keeping up with the DECam data stream can be challenging, but the Dark Energy Survey (DES) team has provided useful tools for tracking image quality, sky background, and detector performance in near-real time. Our data were processed by the DECam Community Pipeline (see "The DECam Community Pipeline" article in this section), then analyzed



Kuiper Belt Object detected on four successive nights during our DECam NEO pilot project. (Image credit: Frank Valdes/NOAO/AURA/NSF.)

for moving objects. We detected thousands of main belt asteroids, several faster moving NEOs, and at least one more distant, slower-moving Kuiper Belt Object (see figure).



The DECam Community Pipeline

Francisco Valdes

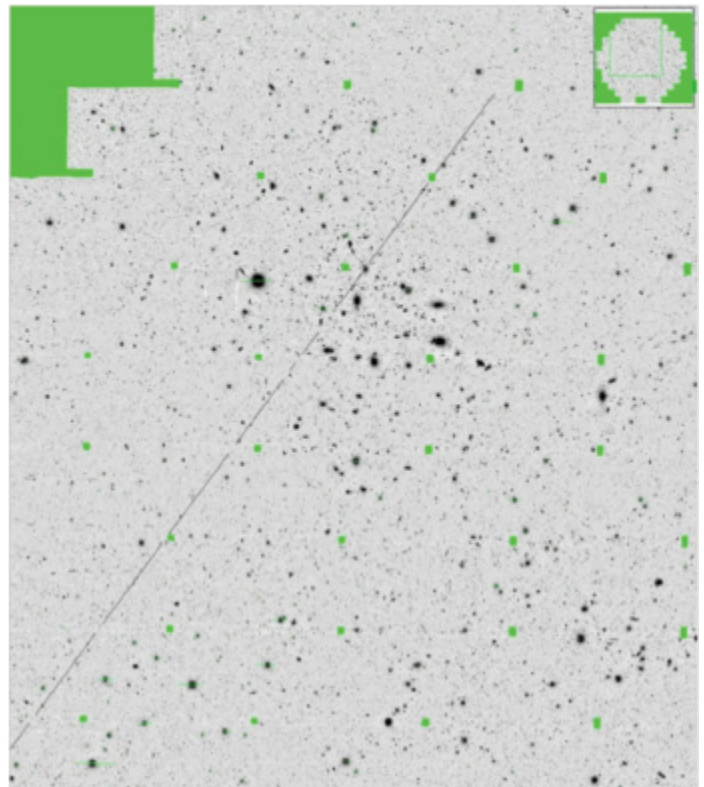
The Dark Energy Survey (DES) project included delivery of a pipeline along with the Dark Energy Camera (DECam). This “Community Pipeline” provides standard calibrated data products to principle investigators (PIs) and to the community (for nonproprietary data). Given the large data volume typically produced during a night of observing, this is a valuable capability. The pipeline is a product of the DES Data Management group in collaboration with NOAO, which operates the pipeline with NOAO and Science Data Management resources.

The first release of the Community Pipeline went into production in November. In this initial version, the baseline functions include cross-talk removal, application of standard dome calibrations (e.g., biases and dome flats), saturation and bleed trail masking, dark sky fringe and illumination corrections, astrometric calibration to the 2-Micron All-Sky Survey (2MASS) catalog, remapping to remove distortions, and co-added images for dithered or repeat visits. The accompanying figure shows something of the quality achieved in an early co-add from the science verification (SV) program. Cosmic rays are the main thing one would notice at smaller scales.

Follow-up releases to improve algorithms and to address other instrumental features are being planned. The important areas on which we are working are removal of cosmic rays (particularly when cosmic ray splits or dithering is done); rejection of poor data in fringe, illumination, and co-add stacking; and eliminating edge artifacts in stacks. There are two instrumental effects that still require research and development before good corrective algorithms can be identified: (1) correcting CCD non-linearities (most prominent at low-light levels) and (2) large-scale patterns visible in dark sky stacks. These patterns are currently treated as illumination flat fielding patterns but are more likely to have a scattered light or reflection origin. Understanding this latter instrumental characteristic is important because it affects the uniformity of photometry across the wide-field of DECam. We hope many of these will be implemented by March with the rest following by the middle of the year.

The data products include master dome, fringe, and illumination calibrations; instrumentally calibrated CCD images; and co-added fields. Associated with these images are weight, data quality, and exposure maps. Note that all master calibrations are nonproprietary.

The production pipeline processed much of the SV observations but, due to early bug fixes, a reprocessing is underway. Priority is being given to providing calibrated data for the post-SV schedule and the soon-to-start 2013A semester. NOAO’s nominal commitment is to provide the data



Co-add of Abell 3128 dithered exposures in g' from 13 November 2012 SV observations (PI: Dell’Antonio) produced by the DECam Community Pipeline. The green overlay indicates no data, and the inset shows the full field. The streak is an unfortunate occurrence of a satellite trail. These trails will be largely removed by the cosmic ray masking and removal algorithm noted in this article.

products within a week of the end of the program run. The SV data already in the Archive or being added in time are nonproprietary and available for those interested in sample data or archival science.

We hope that observers and archival researchers will find these pipeline data products useful. The documentation to help understand the data products is still in progress. We ask for feedback and patience as additional features are added to the pipeline to improve the quality of the DECam data products.

Instruments Offered at KPNO in 2013B and Beyond

Lori Allen

There are some upcoming changes in the instrument suite offered by NOAO on Kitt Peak. We look forward to the anticipated spring arrival of KOSMOS at the Mayall 4-m telescope. As before, those proposing to use the R-C Spectrograph should indicate whether they prefer KOSMOS, should it be available.

Semester 2013B will be the last semester that the Florida Multi-Object Imaging Near-Infrared Grism Observational Spectrometer (FLAMINGOS) is offered at KPNO. FLAMINGOS has had a long and productive run as a facility instrument. It was built by the late Richard Elston at the University of Florida and has been in continuous use on Kitt Peak at both the 4-m and 2.1-m telescopes since 2003. We will be sad to see it go, but given the shrinking of our technical staff due to budget cuts, we must retire it and other instruments that are no longer in high demand. FLAMINGOS' recent usage is only

~5% of the scheduled science time on the Mayall 4-m telescope and ~10% on the 2.1-m telescope.

Phoenix will no longer be available at the 2.1-m telescope after 2013B. Our plan is to make it available only at the 4-m telescope in 2014A. Its future beyond 2014A is undetermined at present.

Users of the 2.1-m telescope are advised that the future availability of the telescope is uncertain, pending implementation of the recent Astronomy Portfolio Review recommendations and the federal budget for fiscal year 2014.

Observers are reminded to check the "Telescopes and Instruments" web page at ast.nao.edu/observing/current-telescopes-instruments to get current information before submitting proposals.

WIYN Instrumentation in 2013B

Patricia Knezek

Because various commissioning activities at both the WIYN 3.5-m and 0.9-m telescopes will be happening when this Newsletter issue is published, we strongly recommend that you visit the WIYN status web page, www.wiyn.org/observe/status.html, prior to proposing to get the latest updates and for links to current information.

WIYN 3.5-m

Commissioning of the partially populated One Degree Imager (pODI) in static mode is essentially complete, and commissioning of the coherent guiding mode is underway. We are on track to begin shared-risk operations of pODI in March. Note that pODI is actually a system—we will be providing not only the instrument and the raw data, but also pipeline-processed data products to remove instrument trends, tools to access the data and data products, and access to the archived data. This part of the system, known as the Pipeline, Portal, and Archive (PPA), is hosted at Indiana University. As commissioning is not yet completed for pODI, observations in 2013B will again be shared-risk. We should have several months of normal operations under our belt before the 2013B semester starts, but we cannot currently guarantee that all aspects of the instrument, including the PPA, will be fully tested and optimized. Therefore, (1) observers should be prepared to confirm the measurements they make (surprising results, especially), (2) some things may not yet have been implemented, and (3) some things may be inefficient. Information about proposing for pODI as well as its capabilities and performance can be found at www.wiyn.org/ODI/Observe/wiynodiobserve.html.

There are several key things to note about the availability of the other 3.5-m instruments in 2013B:

- In anticipation of the use of pODI for optical imaging, we are not offering MiniMo.
- All other WIYN instruments now share the second Nasmyth port, known as the Hydra port. Thus, SparsePak+WHIRC, WHIRC+Visitor Instruments, and Hydra will be block scheduled. The switch between Hydra and the Instrument Adapter System (IAS) that supports the WIYN High-Resolution Infrared Camera (WHIRC), SparsePak, and visitor instruments takes two to five days to complete. We are currently discussing the optimal cadence for the switch. Therefore, there will be a minimum of two months between changes of Hydra to other instruments on the Hydra port. Check the WIYN status page, www.wiyn.org/observe/status.html, for updates.
- Remote observing at WIYN is now available to all qualified observers for all instruments except pODI. Please see www.wiyn.org/Observe/wiynremote.html for more information.
- Repair work on the tip-tilt stage of the WIYN Tip-Tilt Module (WTTM) has been completed. The instrument will be re-commissioned on-sky in the spring. Principal investigators with programs that would benefit from actively using WTTM for improving delivered image quality should contact the support scientists for WHIRC and visit the WIYN status web page, www.wiyn.org/observe/status.html, prior to proposing.
- The delivered sensitivity of WHIRC has decreased significantly since it was commissioned in 2008, likely due to the degradation of the WTTM mirror coatings. (Please see www.nao.edu/kpno/manuals/whirc/hotnews.html for the latest measurements.) We are developing a plan to recoat these mirrors and intend for this to be completed prior to the 2013B semester. Successful proposers are encouraged to contact the support scientists for WHIRC and visit the WIYN status web page, www.wiyn.org/observe/status.html, prior to their observing run(s).

continued



WIYN Instrumentation in 2013B continued

WIYN 0.9-m

WIYN is anticipating the delivery and commissioning of the Half Degree Imager (HDI) camera on the WIYN 0.9-m telescope in February 2013. Through the NSF Program for Research and Education with Small Telescopes (PREST), the 0.9-m Consortium will be offering nights to the community through proposals to NOAO. In semester 2013B, these nights will be offered as shared-risk, and the total number of nights available is currently under negotiation. Because of this and that the commissioning will be happening when this Newsletter issue is published, we strongly recommend that you visit the WIYN status web page, www.wiyn.org/observe/status.html, to get the latest updates and links to

current information prior to proposing. Assuming delivery is as scheduled, the instrument will have been commissioned prior to the March 28 proposal deadline, and updated information will be provided on that website. If some issues arise after the March 28 deadline that seriously impact the delivery or performance of HDI, we will work with successful proposers to see if their program can be accomplished using our current imager(s), S2KB and/or Mosaic. (Key characteristics of S2KB and HDI are given in the table below. For information about filters available with HDI, etc., see www.noao.edu/0.9m/observe/s2kb.html. For information on Mosaic, see www.noao.edu/kpno/mosaic/.)

Comparison of S2KB and HDI

	S2KB	HDI
Pixel size	21×21 μm	15×15 μm
	0.6×0.6 arcsec	0.43×0.43 arcsec
Number of pixels	2048×2048	4096×4096
Area on sky	20.5×20.5 arcmin	29.2×29.2 arcmin
Readnoise (various modes)	9, 14, 20	4, 5, 7, 10
Readout time (1×1 bin)	180 sec	111 sec/N amplifiers
Well depth (e ⁻)	240,000	300,000
Coolant	LN2	Closed system
Quantum efficiency (%)		
300 nm	10	35
350 nm	35	50
400 nm	70	75
450 nm	75	80
500 nm	77	80
650 nm	90	75
750 nm	80	70
850 nm	50	55
950 nm	25	25

NL



Remote Observing Opportunities on Kitt Peak

Heidi Schweiker (WIYN) and Lori Allen (NOAO)

KPNO will offer remote observing for selected programs in 2013B. If you are interested in this opportunity, please see the requirements for observing remotely at www.noao.edu/kpno/remote.html.

Instructions for indicating a preference for remote observing in your proposal can be found on the NOAO Observing Proposal Form website, www.noao.edu/noaoprop/noaoprop.html.



SMARTS Consortium Enters New Era as “SMARTS III”

Victoria Misenti (Yale University), Charles Bailyn (Yale), Todd Henry (Georgia State University) & Nicole van der Blik

The SMARTS Consortium has been operating the 1-m-class telescopes at the Cerro Tololo Inter-American Observatory for ten years. With the current agreement expiring and budgets at most places getting tighter, a new agreement, including a financial plan to run telescopes for another three years, will have to be in place this year. At the beginning of February 2013, this agreement and financial plan were being prepared, and we expect to be able to operate the small telescopes on Cerro Tololo for at least three more years in their new incarnation as “SMARTS III.” For the latest information, see the 2013B Call for Proposals and the SMARTS and CTIO web pages.

SMARTS offers its members telescope access, which includes a variety of observing modes and instruments, for a relatively low cost. Current instrumentation includes a CCD (0.9-m); ANDICAM, a dual-channel optical and near-infrared imager (1.3-m); CHIRON, an Echelle spectrometer

(1.5-m); and SIMON, an IR spectrograph (1.5-m). The low-resolution, optical R-C Spectrograph on the 1.5-m telescope has been retired after many long years of service.

The 1.5-m and 1.3-m telescopes, which are managed by Yale University, offer service observing and queue-scheduled observing. Queue scheduling is especially efficient for monitoring projects, targets of opportunity, and large surveys. The 0.9-m telescope, which is managed by Georgia State University, offers classical observing.

For more information about SMARTS and the opportunities it offers for science programs, please see our website at www.astro.yale.edu/smarts/. See also our SMARTS YouTube interview from the January 2013 AAS at www.youtube.com/watch?v=GdB-CN7TLYo&list=UUQkLvACGWo8IYY1-WKfPp6g&index=2 (begin at 3:00).

System-Wide Observing Opportunities for Semester 2013B: Gemini, Keck, Subaru, and AAT

Letizia Stanghellini, Dave Bell & Verne V. Smith

Semester 2013B runs from 1 August 2013 to 31 January 2014. 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. Observing opportunities on telescopes other than those of KPNO, CTIO, WIYN, and SOAR are summarized below.

The Gemini Telescopes

The US user community has about 75 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.

NOAO encourages US proposers to consider classical programs, which can be as short as one night, on the Gemini telescopes in an effort to increase interactions between US users and the Gemini staff and to increase observing directly with the telescopes and instruments. We also encourage queue observers to visit Gemini to see the operation firsthand. NOAO will cover the travel costs for thesis student observers to observe at or visit Gemini.

US Gemini observing proposals are submitted to and evaluated by the NOAO Time Allocation Committee (TAC). The formal Gemini “Call for Proposals” for 2013B will be released in early March 2013 (close to the

publication date of this *Newsletter* issue), with a US proposal deadline of Thursday, 28 March 2013. As this article is prepared well before the release of the Gemini Call for Proposals, the following lists of instruments and capabilities are only our expectations of what will be offered in semester 2013B. Please watch the Gemini Science Operations web page (www.gemini.edu/sciops) 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 2013B:

Gemini North:

- NIFS: Near-infrared Integral Field Spectrometer.
- NIRI: Near Infrared Imager.
- GMOS-North: Gemini Multi-Object Spectrograph and imager. Science modes are multi-object spectroscopy (MOS), long-slit spectroscopy, integral field unit (IFU) spectroscopy and imaging. Nod-and-Shuffle mode is also available. GMOS-North currently features red-sensitive e2v CCDs. Gemini does not expect to replace them with the higher efficiency Hamamatsu CCDs in 2013B.
- 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.
- ALTAIR adaptive optics (AO) system in natural guide star (NGS) mode, as well as in laser guide star (LGS) mode, with sky coverage limited by

continued





System-Wide Observing Opportunities for Semester 2013B continued

the need for natural AO or tip/tilt guide stars. A mode that uses LGS along with fast guiding from the peripheral wavefront sensor yields improved image quality with 100% sky coverage. ALTAIR can be used with NIRI imaging, NIFS IFU spectroscopy, NIFS IFU spectral coronagraphy, and GNIRS.

- Michelle, a mid-infrared (7–26 μm) imager and spectrometer that includes an imaging polarimetry mode, will likely *not* be available in 2013B.
- All of the available instruments and modes are offered for both queue and classical observing, except for LGS, which is available as queue only. Classical runs are offered to programs that are one night or longer and consist of integer nights.
- Details on the use of the LGS system can be found at www.gemini.edu/sciops/instruments/altair/?q-node/11, 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.
- Visitor Instruments: Gemini is expected to offer TEXES (a mid-IR echelle spectrograph) and DSSI (a two-channel speckle imager), pending sufficient demand from the community.

Gemini South:

- 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. At this time, the instrument is offered with EEV CCDs; a plan is set but not scheduled to replace these with the Hamamatsu CCDs. If the replacement occurs during 2013B, the time available on GMOS-South might be reduced.
- GeMS+GSAOI: Gemini Multi-Conjugate Adaptive Optics System with the Gemini South Adaptive Optics Imager. GeMS continues to undergo commissioning and system verification at the time of this writing (January), and it is expected to be offered regularly in 2013B.
- FLAMINGOS-2: Florida Multi-Object Imaging Near-Infrared Grism Observational Spectrometer version 2. FLAMINGOS-2 is under repair, and it is expected to return to the telescope by mid-March 2013, when it will resume commissioning. FLAMINGOS-2 is expected to be available throughout 2013B on a shared-risk basis, in imaging and long-slit modes only.
- All modes for GMOS-South are offered for both queue and classical observing. As with Gemini North, classical runs are 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.

Gemini proposals can be submitted jointly with collaborators from other Gemini partners. An observing team requests time from each relevant partner. All multipartner proposals must be submitted using the Gemini Phase I Tool (PIT). We encourage proposers for US-only time to consider using the PIT, as it reduces the effort needed behind the scenes to process Gemini proposals, although the NOAO Web-based form continues to be available.

Efficient operation of the Gemini queue requires that it be populated with programs that can effectively use the full range of observing conditions. Gemini proposers and users have become increasingly experienced at specifying the conditions required to carry out their observations using the online Gemini Integration Time Calculators 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.**

NOAO accepts Gemini proposals via either the standard NOAO Web proposal form or the Gemini PIT software. For additional instructions and guidelines, please see www.noao.edu/noaoprop/help/pit.html.

Subaru Access through Gemini Exchange Program

We expect classical observing time to be available on Subaru through an exchange program with Gemini, but at this time we do not have a specific commitment on the time or instrument that will be available. Observers interested in the Subaru time exchange should check the status of these capabilities closer to the deadline.

TSIP Open-Access Time on Keck

As a result of awards made through the National Science Foundation Telescope System Instrumentation Program (TSIP), telescope time is available to the general astronomical community at the Keck Telescopes. A total of 10 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 are available. For the latest details, see www.noao.edu/gateway/keck/.

AAT Access through CTIO Exchange Program


In 2012B, CTIO and the Australian Astronomical Observatory (AAO) started a program to exchange time between the CTIO 4-m telescope and the 4-m Anglo-Australian Telescope (AAT). This program is expected to continue through 2013B, with up to 10 classically scheduled nights on the AAT available to the NOAO community. All AAT instruments are available to this program. NOAO users may also apply directly for AAT time through the AAO's open call.

Access to the CHARA Optical Interferometer Array

About 50 hours will be available during calendar year 2013, and they have been allocated by the 2013A TAC. No CHARA proposals will be accepted this semester.

Summary of Instruments Available

Lists of instruments that we expect to be available in 2013B can be found following this article. As always, investigators are encouraged to check the NOAO website for any last-minute changes before starting a proposal.

If you have any questions about proposing for US observing time, feel free to contact Letizia Stanghellini (lstanghellini@noao.edu), Dave Bell (dbell@noao.edu), or Verne Smith (vsmith@noao.edu). 



KPNO Instruments Available for 2013B

Spectroscopy	Detector	Resolution	Slit Length	Multi-object
Mayall 4-m				
R-C CCD Spectrograph [1]	T2KA/LB1A CCD	300–5000	5.4'	single/multi
KOSMOS [2]	e2v CCD	2400	up to 10'	single/multi
Echelle Spectrograph [1]	T2KA CCD	18,000–65,000	2.0'	single
FLAMINGOS [3]	HgCdTe (2048×2048, 0.9–2.5 μ m)	1000–1800	10.3'	single/multi
Phoenix [4]	InSb (512×1024, 1–5 μ m)	50,000–70,000	30"	single
WIYN 3.5-m [5]				
Hydra + Bench Spectrograph [6]	STA1 CCD	700–22,000	NA	~85 fibers
SparsePak [7]	STA1 CCD	400–13,000	IFU	~82 fibers
2.1-m				
FLAMINGOS [3]	HgCdTe (2048×2048, 0.9–2.5 μ m)	1000–1900	20.0'	single
Phoenix [4]	InSb (512×1024, 1–5 μ m)	50,000–70,000	60"	single
Imaging	Detector	Spectral Range	Scale ("/pixel)	Field
Mayall 4-m				
CCD MOSAIC 1.1	8K×8K	3500–9700Å	0.26	35.4'
NEWFIRM [8]	InSb (mosaic, 4, 2048×2048)	1–2.3 μ m	0.4	28.0'
WIYN 3.5-m [5]				
pODI [9]	12K×12K central + 4 (4K×4K) distributed	3600–9500Å	0.11	24'×24' central
WHIRC [10]	VIRGO HgCdTe (2048×2048)	0.9–2.5 μ m	0.10	3.3'
2.1-m				
CCD Imager [11]	STA CCD	3300–9700Å	0.305	10.2'(RA)×6.6'(DEC)
FLAMINGOS [3]	HgCdTe (2048×2048)	JHKs	0.61	20.0'
WIYN 0.9-m				
HDI [12]	4K×4K	3000–9700Å	0.43	29.2'

[1] T2KA is the default CCD for RCSP and ECH. T2KB now serves as T2KA's backup. LB1A may be requested for RCSP if appropriate.

[2] PIs should write proposals using the capabilities offered by RCSP. If the science requirements could be met by the initial capabilities of KOSMOS, PIs should specifically indicate an interest in adapting the proposal for KOSMOS when writing the Technical Description section. See page 16 of the March 2012 *NOAO Newsletter* for more details.

[3] 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 instrument PI.

[4] See www.noao.edu/kpno/phoenix before preparing the proposal.

[5] See article in this *NOAO Newsletter* referring to block scheduling of all instruments except pODI.

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

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

[8] Permanently installed filters include J, H, Ks. See www.noao.edu/ets/newfirm for further information about the filters.

[9] pODI will be available for shared-risk science observing in both static and coherent guiding mode. Information about proposing and the instrument capabilities and performance can be found at www.wiyn.org/ODI/Observe/wiynodiobserve.html.

[10] WHIRC was built by Dr. Margaret Meixner (STScI) and collaborators. WTTM was repaired; recommissioning will be in the spring. Proposers interested in its tip-tilt guiding should contact KPNO Support staff before proposing and check www.wiyn.org/observe/status.html for updates.

[11] An STA CCD with MONSOON controller will become the default CCD for the 2.1-m; T2KB may be available as backup. Lab performance will be made available as soon as possible; meanwhile, contact KPNO Support for further information.

[12] HDI is scheduled to be delivered and commissioned in February 2013. Assuming a successful commission, HDI will be offered to the general user community through NOAO as shared-risk in 2013B, and Mosaic may not be offered at the 0.9-m. See article in this *NOAO Newsletter* referring to the expected characteristics and capabilities of HDI vs. S2KB, and check www.wiyn.org/observe/status.html for updates before submitting proposals.



CTIO Instruments Available for 2013B

Spectroscopy	Detector	Resolution	Slit
SOAR 4.1-m			
OSIRIS IR Imaging Spectrograph [3]	HgCdTe 1K×1K, JHK windows	1200, 1200, 3000	3.2', 0.5', 1.2'
Goodman Spectrograph [4]	Fairchild 4K×4K CCD, 3100–8500Å	1800, 2800, 4300, 5900, 10,100	3.5'
CTIO/SMARTS 1.5-m [5,6]			
CHIRON	e2v CCD 4K×4K, 420–870nm	80,000 (with image slicer)	2.7" fiber
Imaging	Detector	Scale ("/pixel)	Field
CTIO BLANCO 4-m [1]			
DECam Optical Imager	LBL 62-CCD mosaic, 2K×4K	0.27	2.0 degrees diameter
ISPI IR Imager [2]	HgCdTe (2K×2K 1.0–2.4µm)	0.3	10.25'
SOAR 4.1-m			
SOAR Optical Imager (SOI) [7]	e2v 4K×4K Mosaic	0.08 (1×1 binning)	5.25'
OSIRIS IR Imaging Spectrograph [7]	HgCdTe 1K×1K	0.33 (<i>f</i> /7 camera), 0.14 (<i>f</i> /3 camera)	3.2' (<i>f</i> /7 camera), 1.3' (<i>f</i> /3 camera)
Spartan IR Imager [7,8]	HgCdTe (mosaic 4-2K×2K)	0.068, 0.041	5.2', 3.1'
Goodman Spectrograph [4,7]	Fairchild 4K×4K CCD	0.15	7.2' diameter
SOAR Adaptive Module (SAM) [9]	4K×4K CCD (e2v)	0.045	~3'×3'
CTIO/SMARTS 1.3-m [5,10]			
ANDICAM Optical/IR Camera	Fairchild 2K×2K CCD	0.17	5.8'
	HgCdTe 1K×1K IR	0.11	2.0'
CTIO/SMARTS 0.9-m [5,11]			
Direct Imaging	SITe 2K×2K CCD	0.4	13.6'

[1] In 2013B, the Blanco 4-m telescope will be available to users for less time than usual because of the Dark Energy Survey and *f*/8 repairs.

[2] Pending Blanco *f*/8 secondary mirror repairs and recommissioning, ISPI may be available during the 2nd half of the semester.

[3] 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.

[4] The Goodman Spectrograph is available in single-slit mode. The resolutions given are the maximum resolution achievable with the 400, 600, 930, 1200, and 2100 l/mm gratings using the narrowest (0.46") slit and measured at 5500Å. Imaging mode is also available. The instrument has its own set of *U*, *B*, *V*, and *R_c* filters, but it is also possible to install any of the SOI 4×4 inch square filters.

[5] Availability of the CTIO/SMARTS 1.5-m, 1.3-m and 0.9-m telescopes is pending future funding. Definitive information for 2013B and 2014A will be announced in the Call for Proposals and on the NOAO and CTIO web pages.

[6] Service observing only.

[7] Remote observing is possible with this instrument. Please see www.soartlescope.org/observing/remote-observing-at-soar for details.

[8] 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 NIR imaging observations.

[9] The SOAR Adaptive Module (SAM) will be available in shared-risk mode during the 2013B semester.

[10] Service observing only. Proposers who need the optical only will be considered for the 0.9-m unless they request otherwise. Note that data from both ANDICAM imagers are binned 2×2.

[11] Classical only.



Gemini Instruments Available for 2013B¹

GEMINI NORTH ²	Detector	Spectral Range	Scale ("/pixel)	Field
NIRI	1024×1024 Aladdin Array	1–5μm Broad and narrow filters	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 Broad and narrow filters	0.022, 0.050	22.5", 51"
GMOS-N	3×2048×4608 e2v deep depletion CCDs	0.36–1.0μm R~670–4400	0.072	5.5' 5" IFU
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 EEV CCDs	0.36–1.0μm R~670–4400	0.072	5.5' 5" IFU
GSAOI + GeMS	4×2048×2048 HAWAII-2RG	0.9–2.4μm Broad and narrow filters	0.02	85"×85"
FLAMINGOS-2	2048×2048 HAWAII-2	0.9–2.4μm R~1200, 3000	0.18	6.1' (circular)
EXCHANGE	Detector	Spectral Range	Scale ("/pixel)	Field
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)
FMOS (Subaru)	2048×2048 HAWAII-2	0.9–1.8μm R=600, 2200	0.216	30' diameter
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"

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

2) Gemini is expected to offer TEXES (a mid-IR echelle spectrograph) and DSSI (a two-channel speckle imager) as visitor instruments at Gemini North in 2013B, pending sufficient demand from the community.



Keck Instruments Available for 2013B

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
Keck-I					
HIRESb/r (optical echelle)	3x MM-LL 2K×4K	R~30K–80K	0.35–1.0 μ m	0.19	70" slit
LRIS (img/lslit/mslit)	Tek 2K×4K, 2x e2v 2K×4K	R~300–5000	0.31–1.0 μ m	0.22	6'×8'
OSIRIS (near-IR AO img/spec)	2048×2048 HAWAII2	R~3900	0.9–2.5 μ m	0.02–0.1	0.32"–6.4"
MOSFIRE (near-IR img/mos)	2048×2048 HgCdTe	R~4000	0.97–2.4 μ m	0.18	6.1', 46 slits
Keck-II					
DEIMOS (img/lslit/mslit)	8192×8192 mosaic	R~1200–10,000	0.41–1.1 μ m	0.12	16.7'×5'
ESI (img/low-disp/optical echelle/IFU)	MIT-LL 2048×4096	R~1000–6000	0.39–1.1 μ m	0.15	2'×8', 4.0"×5.7" (IFU)
NIRSPEC (near-IR echelle)	1024×1024 InSb	R~2000, 25,000	1–5 μ m	0.14, 0.19	42", 12" & 24" slit lengths
NIRSPA0 (NIRSPEC w/AO)	1024×1024 InSb	R~2000, 25,000	1–5 μ m	0.014, 0.018	3.96", 1.13" & 2.26"
NIRC2 (near-IR AO img)	1024×1024 InSb	R~5000	1–5 μ m	0.01–0.04	10"–40"

AAT Instruments Available for 2013B

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
AAOmega + 2dF (392-fiber MOS)	2x e2v 2024×4096	R~1300–8000	0.37–0.95 μ m	R~1.3K–8K	120'
AAOmega + SPIRAL (512-element IFU)	2x e2v 2024×4096	R~1500–10,000	0.4–0.95 μ m	0.7"/fiber	22.4"×11.2"
HERMES + 2dF (392-fiber MOS)	4x e2v 4096×4112	R~28K, 45K	0.47–0.79 μ m	R~28K or 45K	120'
IRIS2 (near-IR img/spec/mos)	1024×1024 HgCdTe	R~2400	0.9–2.5 μ m	0.45	7.7'×7.7'
UCLES (cross-dispersed echelle)	2K×4K EEV2 or MITLL3	R~45K–100K	0.38–1.1 μ m	0.16, 0.18	
UCLES + CYCLOPS2 (16-element IFU)	2K×4K EEV2 or MITLL3	R~70K	0.45–0.74 μ m	0.6"/fiber	2.45"
UHRF (ultra-high resolution echelle)	2K×4K EEV2	R~300K, 600K, 940K	0.3–1.1 μ m	0.03, 0.05, 0.10	

Blanco $f/8$ Secondary Return to Service: January 2013 Update

Jay H. Elias

Articles by Eric Mamajek and Jay Elias in the last issues of the *NOAO Newsletter* reported on the unfortunate accident to the Blanco $f/8$ secondary that occurred in February 2012 and on the recovery progress through late July 2012. This article reports on the progress in the subsequent six months and outlines the remaining steps required to return the mirror to service.

Mirror Testing and Repair

All the required mounting fixtures for the optical tests were completed in late August, and the initial optical tests were completed by late September (see Figures 1 and 2). The optical tests strongly indicate that the mirror figure was not measurably distorted by the damage to the center section (Figure 3). The dominant optical error is astigmatism, which has always been present and which is removed using the adjustments in the primary mirror support system.

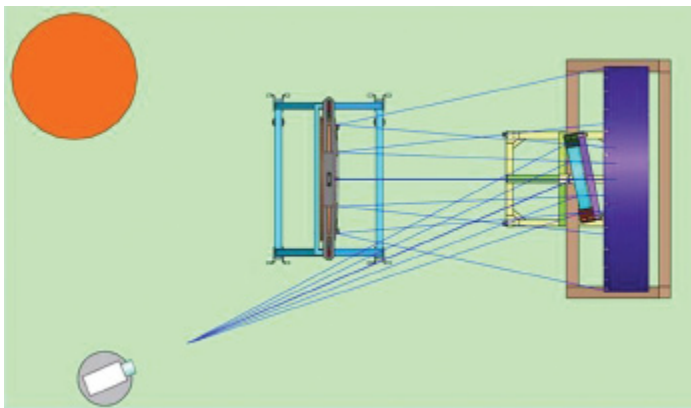


Figure 1: Test setup for secondary mirror, viewed from above. The secondary is mounted in the center of the image. The large Hindle sphere is on the right with a fold flat directly in front of it. The interferometer used for testing is on the lower left. The test needed to be repeated with the secondary rotated by ~ 45 -degree increments about its optical axis in order to separate figure errors in the secondary from figure errors in the other two mirrors.

This suggests that the mirror can be returned to service as soon as the repair of the center section is completed; however, there are two reasons to be a little cautious. First, until the center section repair is complete, we cannot be certain that there are not additional stresses that may be produced or relieved. Of lesser importance, the coating used for the tests was a “spray-on” silver coating that was less than uniform, and the non-uniformity produced some uncertainty in the test results.

Repair of the central damage is to be done using an optical generating engine to cut away the damaged portions and produce a hole into which a Cervit plug will be glued. The plug is being fabricated by a vendor in Tucson (Figure 4). Cutting the hole in the center of the mirror began toward the end of January 2013 (Figure 5); care is required because of the damage to the material in this area.

Once the cutting is complete, the plug will be carefully fitted and glued. Then the mirror will be aluminized, and the optics tests repeated. At that point, we will know definitively whether the mirror needs refiguring or not; if it does not, it will be returned to Chile.



Figure 2: Preparing for optical tests. The mirror is lifted off its handling cart (top) by Ron Harris (left) and Gary Poczulp (behind the mirror) and installed on its test fixture in the basement of the NOAO optics shop (bottom). In this bottom photo, Gary is on the left (and twice in reflection) and Joe De Vries is seen behind him in reflection.

Mirror Cell Repair and Integration Schedule

As personnel became available from the final stages of the Dark Energy Camera installation, work on the mirror cell recovery intensified. The cell itself was carefully inspected (Figure 6) and was determined to be undamaged. The mechanisms and supports do require replacement, and in some cases, replacement with more modern hardware will be made. The underlying objective is to return the mirror assembly to its original level of performance, not to make improvements that might be marginally beneficial, but which would undoubtedly delay the overall recovery schedule.

The date that the secondary will be returned to service depends primarily on whether it needs to be refigured or not. If it does not require refiguring, the end date is set by the work on the mirror cell, and this could be as early as August 2013. If refiguring is required, the refiguring determines the end date. Initial discussions with potential vendors suggested that a delay of approximately three months is likely.

We should have information on the need to refigure around the end of February, or soon thereafter. If the mirror requires refiguring, we will start the process of letting a contract for that work at that time. Periodic updates are posted to the CTIO website (www.ctio.noao.edu/noao/), and interested potential users should check there from time to time.

continued



Blanco f/8 Secondary Return to Service continued

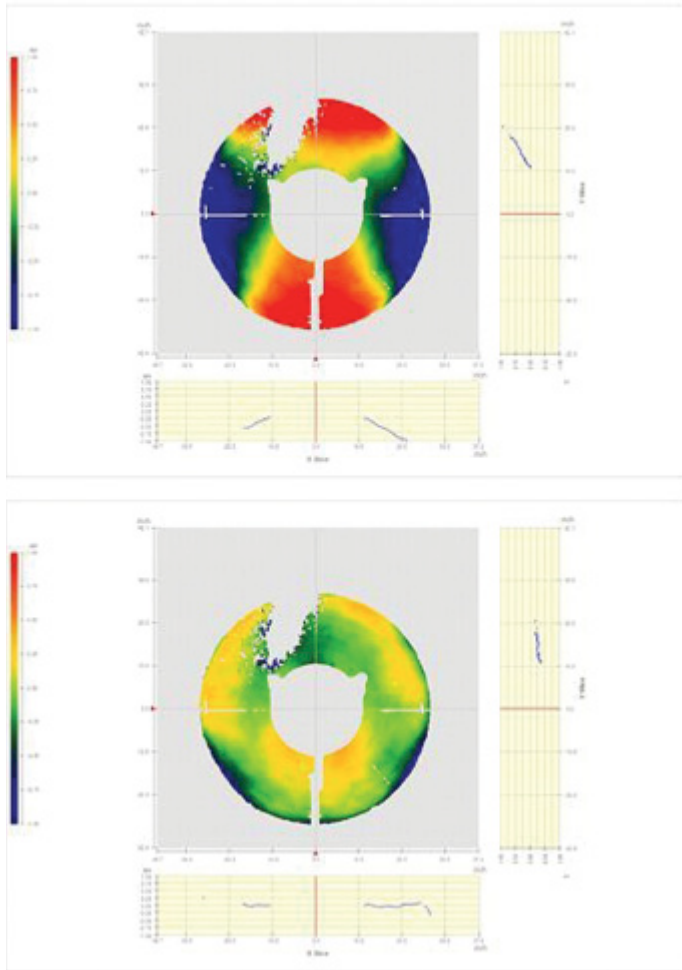


Figure 3: Results of optics tests. The top panel shows the mirror figure after the test optics errors are subtracted. The bottom panel shows the figure with astigmatism removed as well. The measured figure is consistent with the figure of the mirror prior to the accident.

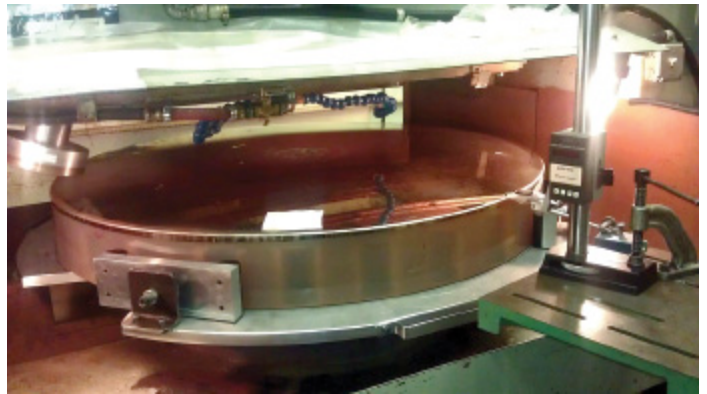


Figure 5: Secondary mirror during alignment on the generating engine (top) and with cutting under way (bottom).

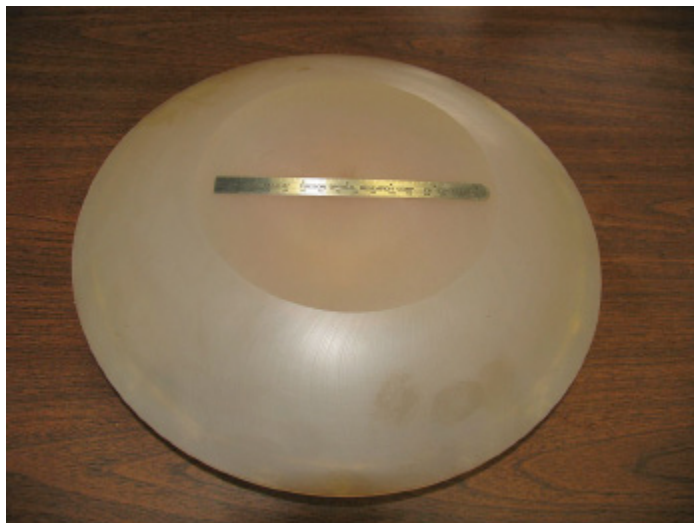


Figure 4: Cervit plug partway through fabrication. The general dimensions and shape can be seen.



Figure 6: Checking the mirror cell for distortions and other damage; none were found.

KPNO Director's News

Timothy C. Beers

These are challenging times for Kitt Peak and NOAO. However, NOAO is committed to working with (and on behalf of) the entire community to plan for a productive present and a scientifically rich future. Kitt Peak National Observatory (KPNO) continues to provide the astronomical community with open access to over 700 nights per year at an excellent site, on the Mayall 4-m telescope, KPNO 2.1-m telescope, and 40% of the time assigned on the WIYN 3.5-m telescope. These telescopes, along with the numerous others hosted by the tenant observatories on Kitt Peak, produce a wide variety of high-impact science year in and year out. The future of astronomy at KPNO is now being re-evaluated, as the National Science Foundation (NSF) decides how to implement the recommendations of its Portfolio Review Committee (www.nsf.gov/mps/ast/porfolioreview/reports/ast_portfolio_review_report.pdf), which called for divestment of NSF funding for the Mayall 4-m, KPNO 2.1-m, and the NOAO portion of WIYN. NOAO does not believe that divestment means an end to high-impact science at Kitt Peak.

This uncertain funding environment is the landscape in which we now find ourselves, yet new and compelling opportunities still exist. The most exciting of these is the execution of the Big Baryon Oscillation Spectroscopic Survey (BigBOSS) project, led by the Lawrence Berkeley National Laboratory, which aims to create a powerful new spectroscopic capability for the KPNO 4-m Mayall telescope (see "BigBOSS Status Update" in

the System Science Capabilities section) to be used for a dedicated dark energy experiment. This survey, scheduled to begin as early as 2018, provides the basis for the current planning at Kitt Peak. NOAO is committed to finding ways to enable the survey on the Mayall and to execute other high-impact and community science using the Big BOSS capability, consistent with the NSF implementation of the Portfolio Review. We are considering how best to make use of the Mayall 4-m time between now and the execution of this survey and to understand the level to which the community will be involved in the BigBOSS survey. We also are considering other science projects that could be done during the BigBOSS survey and the modes of operation in the years after the BigBOSS survey has completed.

NOAO management is in the process of developing a set of concrete plans to enable the execution of scientifically compelling public/private operational modes of the NSF-funded telescopes on Kitt Peak and expects to hold discussions with possible partners to refine and extend these ideas in the near future. Now is the time for creative and constructive thinking on the part of our large user community as we endeavor to achieve the best possible future for astronomy on Kitt Peak. Please do not hesitate to contact me; I look forward to speaking with many of you in the coming months as these plans are refined.

Dedication of the Dark Energy Camera The Start of the 50th Anniversary Celebration of CTIO

Nicole van der Blik & Andrea Kunder

Ceremonies on 9 November 2012 on the summit of Cerro Tololo, Chile, marked the dedication of the Dark Energy Camera (DECam) and the beginning of the 50th anniversary celebration of Cerro Tololo Inter-American Observatory (CTIO). Bringing DECam online and making it available for the astronomical community through NOAO's open-access telescope allocation is a milestone in the history of Cerro Tololo. We are very proud that we could start the celebration of 50 years of service by CTIO to US astronomers with the dedication of this new capability.

DECam, installed on the 4-m Victor M. Blanco Telescope at CTIO will conduct a powerful survey collecting light in each snapshot from 100,000 galaxies located up to 8 billion light years away. The camera has 62 charge-coupled devices (570 megapixels) with an unprecedented sensitivity to very red light, creating the most powerful sky-mapping machine ever available. The Dark Energy Survey (DES) will attempt to answer one of cosmology's greatest mysteries: why the expansion of the universe is speeding up rather than slowing down due to gravity.



Figure 1: Blanco, DECam, and the DECam dedication attendees.

continued

Dedication of the Dark Energy Camera continued

More than 100 people participated in the celebration, including representatives of the DES collaboration: Young-Kee Kim, deputy director of Fermilab; Kathy Turner, program manager in the Office of Science of the Department of Energy; all of the members of the DES council; and many others. There were also several representatives from neighboring observatories and astronomy departments throughout Chile, as well as several Chilean dignitaries.

Upon arrival on the summit, the participants were received in the beautifully decorated dining room, where they were served a tasty lunch. The group toured the facilities after lunch. Much time was spent of course at the Blanco 4-m admiring DECam, its shiny hexapod and sleek cable wraps, all kept in balance by a new sparkling Cass cage. The official part of the celebration consisted of a series of presentations on CTIO, DECam, and DES. Speakers included David Silva (NOAO director), R. Christopher Smith (director of AURA Observatories in Chile), Nicole van der Blik (interim CTIO director), Joshua Frieman (director of the Dark Energy Survey), Timothy Abbott and Alistair Walker (CTIO), and Brenna Flaugher (Fermilab). These presentations told the story of Cerro Tololo and DECam and covered the history of CTIO, the start of the DES collaboration, the concept of DECam, the challenges and successes during the construction and installation of DECam, and some of the first results with DECam. Young-Kee Kim presented CTIO



Figure 2: Young-Kee Kim presenting the picture from Fermilab to Nicole van der Blik.

with a beautiful picture composite of Fermilab and a blow-up of the night sky. This picture is now featured prominently in the hallway of the CTIO office in La Serena. After the ceremony, the crowd had leisure time to wander around and admire the view of the summit, and by the time the sun set, several small telescopes were set up to watch the night sky. It was well past 10 pm when people boarded the buses for the trip back to La Serena. 🎧

CTIO's 50th Anniversary Celebrations

Andrea Kunder



Cerro Tololo was chosen on 23 November 1962 as the site for a US observatory in the Southern Hemisphere. The official name for the new observatory also was adopted that day. And so, following a few years of talks, tests, and agreements, Cerro Tololo Inter-American Observatory was founded 50 years ago.

A historic milestone was the construction of what was then the largest telescope in that hemisphere, the 4-m Blanco telescope. The Blanco mirror arrived on Cerro Tololo in September 1974, and on November 8 of that year, an informal prime focus “first-light” ceremony was held. Visiting astronomers first started observing with this telescope in January 1976. The principal telescopes now at the AURA sites on Cerro Tololo and nearby Cerro Pachón are the 4-m Victor M. Blanco Telescope, the 4.1-m SOAR (Southern Astrophysical Research) telescope, and one of the 8-m telescopes of the

Gemini Observatory. More than 10 other telescopes and astronomical projects share the Cerro Tololo site.

A fun and friendly schedule of events has been released to celebrate the 50-year milestone. The kick-off event, the Dark Energy Camera (DECam) dedication (see the “Dedication of the Dark Energy Camera” article in this *Newsletter*), set off the excitement. Since then, the festivities continue to impress, with the opening of the CTIO Historical Public Exhibition and additional tours to Cerro Tololo. I feel almost like a celebrity when grocery shopping at the local supermarket in La Serena (the JUMBO, for those who have visited here) and I see CTIO's history and scientific impact on display. Staff and family visits, as well as a scientific symposium, are scheduled to take place in the following months. An especially festive atmosphere is present in the CTIO building over these celebrations!

50 Years of CTIO – an Exposition

Leonor Opazo, Arturo Gomez, Oscar Saa, Nicole van der Blik

Cerro Tololo Inter-American Observatory is celebrating its 50th anniversary. The decision was made on 23 November 1962 to locate a new observatory on Cerro Tololo in Chile and to call it the “Cerro Tololo Inter-American Observatory.” On 25 November 1962, the Association of Universities for Research in Astronomy (AURA) bought the property “El Totoral,” which includes close to 30,000 hectares with Cerro Tololo near its center.

As part of CTIO’s anniversary celebrations, we created an exposition on the history of the Observatory, including photographs, instruments, and telescopes used at CTIO. The exposition was on display in January in the La Serena library area for the staff, family, and friends (Figure 1). In February and March, the exposition will go downtown, to allow access to the general public. The exposition will be on display in the foyer of the city’s largest supermarket (Jumbo) starting February 6. From there the exposition will be moved to various cultural centers of the Region of Coquimbo, such as the Centro Cultural Palace in Coquimbo, the Centro de Extensión de la Universidad de La Serena in La Serena, and



Figure 1: (Left to right) CTIO staff Freddy Muñoz, Ximena Herreros, Leonor Opazo and Hernán Bustos in front of the CTIO 50th Anniversary Exposition panel of photographs illustrating the beginning of the Cerro Tololo Inter-American Observatory.



Figure 2: The Cerro Tololo construction site in 1963.

the Museo del Limarí in Ovalle. Eventually, we will set up a permanent display on AURA premises, most likely on Cerro Tololo itself.

The exposition contains on one panel photographs about the beginning of the Cerro Tololo Inter-American Observatory, introducing the public to the history of CTIO. This panel has pictures of the construction, which began in 1963 (Figure 2), and of the inauguration on 6 November 1967 following first light with the 1.5-m telescope.



Figure 3: The CTIO 50th Anniversary Exposition panels set up in the library area of the CTIO La Serena offices.

continued

50 Years of CTIO continued

A second panel shows how the observatory grew into a lively mountaintop with several smaller telescopes and, eventually, the construction of the Blanco 4-m telescope. The third panel (Figure 3) includes a series of astronomical images taken with instruments and telescopes at CTIO, showing the improvement of the capabilities and ending with the first-light image of the Dark Energy Camera (DECam) taken on 12 September 2012.

In addition to the panels, a selection of more than thirty different instruments, telescopes, and gadgets are on display in the exposition, sampling the technology used on Cerro Tololo from the 1960s onward. There are astronomical instruments, such as a Bifilar Micrometer (Figure 4), the Big Throughput Camera (BTC) (Figure 5), and the two-channel infrared photometer (Figure 6). Other instruments on display are a spectrograph and a “plaque blinker” whose mechanical system still works. Plexiglas covers were installed in various instruments to let the public admire their interiors and learn about the delicate optical and mechanical systems.

While putting together the exposition, Arturo Gomez and Oscar Saa, who selected the instruments and brought them from the mountaintop to La Serena, spent many hours fondly remembering the past and exchanging memories of how it used to be and of the “astrónomos visitantes” during all these years.

The exposition is a nice sample of instruments used at CTIO, which, in their time, were state-of-the-art. It gives an excellent overview of how fast technology has changed, from photographic plates, to small digital detectors, to the very

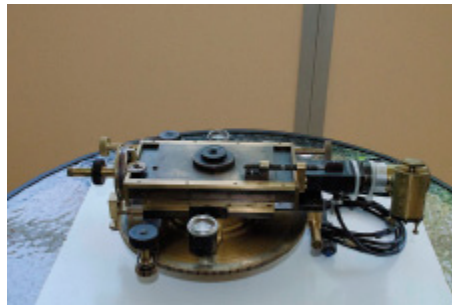


Figure 4: A Bifilar Micrometer, used to measure the separation and angle of double stars. This brass instrument was made in 1924 and first used in South Africa. It was used on Cerro Tololo in the 1970s.



Figure 5: The Big Throughput Camera (BTC), the first optical imager with a detector mosaic of four CCDs. The BTC was installed on the Blanco 4-m telescope in 1996.


large focal plane array that is possessed by the current state-of-the-art instrument, DECam. The exposition shows the impact of technological advances on the science and clearly illustrates how Tololo was founded and still remains at the cutting edge of astronomy. 



Figure 6: A two-channel infrared photometer used on Cerro Tololo in the 1980s.

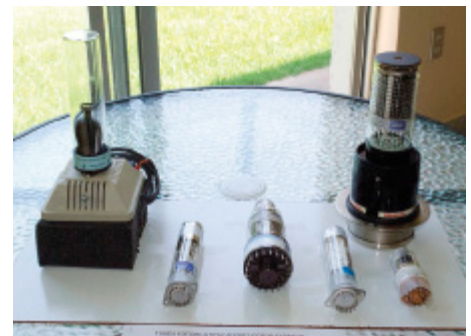


Figure 7: Photomultiplier photoelectric tubes used on Cerro Tololo in the 1970s.





Fifty Years of Wide Field Studies in the Southern Hemisphere

La Serena, Chile | 06-09 May 2013

www.ctio.noao.edu/noao/conference/CTIO-50-years

Image credit: Ann Elliott

Sean Points & Andrea Kunder

The advent of wide-field CCD cameras on 4-m-class telescopes has provided the opportunity to survey vast parts of the sky to significant depths, leading to new perspectives on the formation of our Galaxy. In particular, the selection of the Cerro Tololo site in November 1962, enabled a mapping of the then relatively inaccessible Southern Hemisphere skies. As we celebrate the 50th anniversary of our National Optical Astronomy Observatory in the South, there is cause to come together for stimulating scientific discussions and a little reverie. The topics of this conference include the resolved stellar populations of the bulge of the Milky Way, the Galactic Halo, and the Magellanic Clouds. We will discuss existing observations from large-scale surveys, new surveys in the works, and different strategies that allow for innovative approaches to constrain Galaxy formation models. This meeting will be a starting point to highlight the capabilities provided by wide-field cameras such as the Dark Energy Camera and how to use them efficiently in a new era of “big data” science.

CTIO was founded and remains at the cutting edge of astronomy. Indeed, CTIO’s impact on astronomy has far surpassed its original mission to provide world-class facilities to observe the southern sky. On the occasion of CTIO’s 50th birthday, it is therefore appropriate to share stories and memories of the many events (some unconventional) and

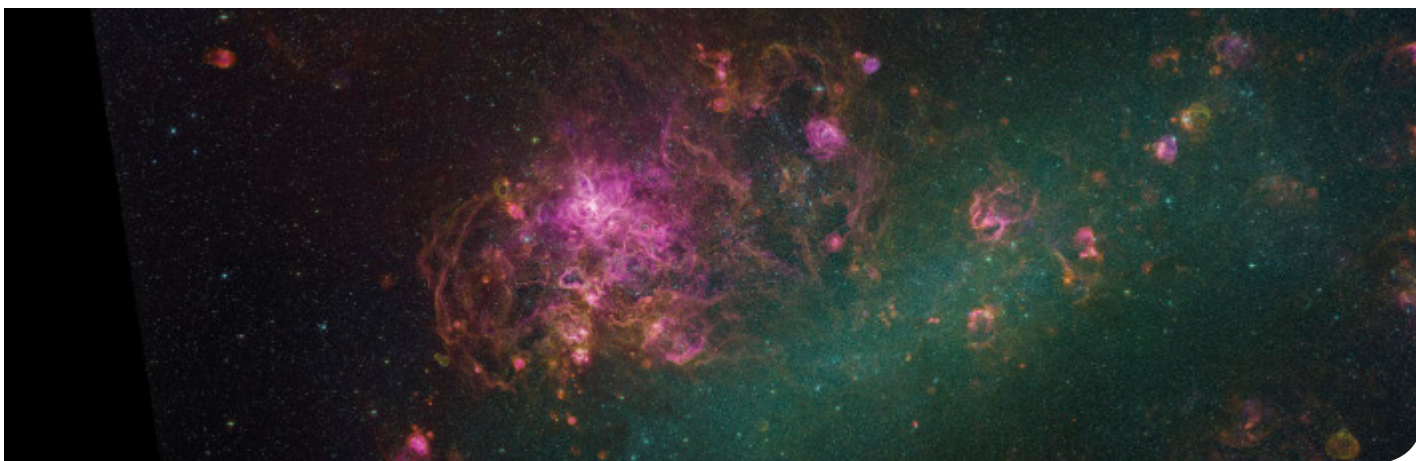
exceptional characters that have helped shape CTIO. Thus, the conference will include a program of invited talks on the scientific and cultural history of CTIO.

Invited speakers will cover the following topics:

- The Stellar Population of the Galactic Bulge
- Chemical Abundances in the Galactic Bulge
- Galactic Clusters in the Galactic Bulge
- Modeling the Formation of the Galactic Bulge
- The Old Stellar Populations of the Magellanic Clouds
- Young Stellar Objects in the Large Magellanic Cloud
- Variable Stars in the Magellanic Clouds and Galactic Center
- Star Formation and the IMF in the Magellanic Clouds
- CTIO Science Highlights

For more information on the conference, check the website: www.ctio.noao.edu/noao/conference/CTIO-50-years.

Please feel free to email Andrea Kunder and Sean Points, Chair, at ctio50soc@ctio.noao.edu.





Got Data?

Frossie Economou

NOAO's Science Data Management (SDM) group operates the NOAO Archive, serving raw and pipeline data from a variety of NOAO North and South instruments. While each instrument's data set presents its own challenges, at the Archive back end, we are trying to solve the same problems as other astronomical data centers. How do we reliably store increasing volumes of data? How do we process massive data sets in parallel? How do we enforce proprietary restrictions, while also facilitating scientific collaboration? How do we scale up our databases? And, can we efficiently manage hundreds of machines?

NOAO SDM is hosting a workshop aimed at infrastructure staff from astronomical data centers that are grappling with these issues every day. The workshop, titled "Astronomical Data Center Technologies," will be in Tucson, 18–19 April 2013. The aim is for attendees to share their experiences, positive or negative, with various technologies that they employ and to foster closer links with their colleagues at other institutions. If you think that describes your interest, visit the workshop website at www.astdatcentech.org/. Registration is now open; for the workshop format to function well, space is limited, so register soon.

NOAO at the 2013 Winter AAS Meeting

Ken Hinkle & Stephen Pompea

American Astronomical Society (AAS) meetings are an opportunity for NOAO staff to meet with you, our users and potential users. NOAO had a booth at the 221st AAS meeting in Long Beach, California, in January 2013 that was well attended, with many discussions going on each day. The booth backdrop emphasized NOAO's future and its new projects: the Dark Energy Camera (DECam), the Large Synoptic Survey Telescope (LSST), and the Big Baryon Oscillation Spectroscopic Survey (BigBOSS). The 50th anniversary of CTIO also was highlighted at the booth.

NOAO scientific staff members were present at the booth throughout the meeting. The staff had varied goals for the meeting, included providing information on LSST simulations, assisting with Gemini

Phase II preparation, discussing the NOAO Research Experiences for Undergraduates (REU) program with students, talking to prospective candidates for open positions, interacting with students and teachers, discussing new NOAO projects, and answering questions about the ongoing NOAO mission (Figure 1). NOAO Director Dave Silva was available to talk with users as were a number of NOAO's associate directors and managers (Figure 2).

During the AAS meeting, NOAO hosted a town hall meeting, which was well attended by the community. Dave Silva presented the long-range plan for NOAO and the US Ground-Based Optical/Infrared System in this time of fiscal austerity. The plan was well received. Look for NOAO at the January 2014 AAS meeting in Washington, D.C.



Figure 1: The NOAO booth at the January 2013 Long Beach AAS meeting. At the far right, Dave Silva talks with Eric Smith (NASA). (Image credit: John Glaspey/NOAO.)

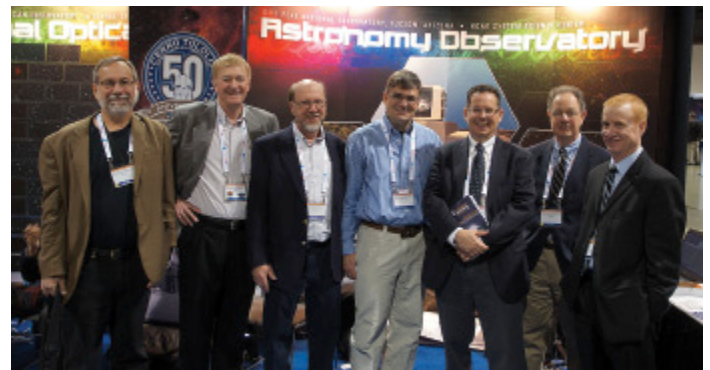


Figure 2: Some of the NOAO management and staff who attended the 221st AAS meeting and spent time at the NOAO booth. Left to right: Stephen Pompea (Education and Public Outreach program head), Stephen Ridgway, Ken Hinkle, Tom Matheson, Dave Silva (NOAO director), David Sprayberry (NOAO System Technology Center program head), and Bob Blum (NOAO deputy director). (Image credit: Michael Bolte, University of California Observatories.)

CTIO Summer Student Program for 2013

Catherine Kaleida



It is summer in the Southern Hemisphere, and the CTIO Summer Students (above) have arrived eager to learn! 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, or Gemini staff, as well as observing at Cerro Tololo and attending seminars geared toward the undergraduate level. The students will participate in field trips to various observatories while sampling the social and cultural life in Chile during their time here.

Six US students participate in the CTIO Summer Student Program through the NSF-funded CTIO Research Experiences for Undergraduates (REU). The REU students for 2013 are Brian Chinn (University of Florida), Alexander Deich (Humboldt State University), Emily Finney (Scripps College), Briana Indahl (University of Wisconsin-Madison), Lois Smith (University of Colorado at Boulder), and Molly Williams (Eastern Kentucky University). Two Chilean students, Gonzalo Briones Zerené (Universidad de Valparaíso) and Diego Calderón Espinoza (Universidad de Concepción/Pontifical Catholic University of Chile), participate through the *Práctica en Investigación en Astronomía (PIA)* program funded by CTIO.

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

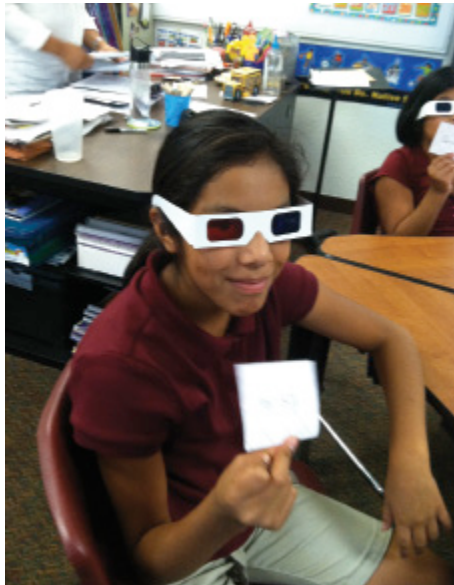
Mentors for the students are an integral part of the program. As such, we would like to thank CTIO staff Andrea Kunder, Sean Points, Chris Smith, and Catherine Kaleida; SOAR staff Steve Heathcote, Karianne Holhjem, and Tiago Ribeiro; Gemini staff Percy Gomez and Peter Pessev; and Alexandre Roman and Mario Soto from the University of La Serena.

EPO Participation in the Sells Elementary Extended-Day Program

Robert Sparks

The Baboquivari Unified School District’s (BUSD) Indian Oasis Elementary School contacted NOAO’s Education and Public Outreach (EPO) group in the fall of 2011 to ask for assistance in running after-school sessions as part of their School Improvement Program. The school is located in Sells, the capital and main town on the Tohono O’odham Nation in southern Arizona. The School Improvement Program is a three-year program funded by a grant from the Arizona Department of Education and is designed to improve test scores and the academic performance of BUSD students. The after-school program targets the bottom 25% of the students in the Indian Oasis Elementary School, which has high turnover rates among its teachers and school administrators.

NOAO staff began visiting the elementary school on Monday afternoons in January of 2012 to lead a variety of hands-on science-based activities for third- to fifth-grade students over the last year. The activities cover a wide



Kristi Segundo participates in a School Improvement Program activity provided by the NOAO EPO at the Indian Oasis Elementary School. (Image credit: Katy Garmany, NOAO/AURA/NSF.)

array of topics in science including light and color, dark skies awareness, the solar system, electricity, magnetism, and the states of matter.

A typical day in the program begins at 3:00 pm. The students receive snacks (provided by NOAO) and have time to get help with their homework. At 3:30 pm, the students begin the activities provided by NOAO and other community organizations. Other organizations providing activities include Tohono O’odham Community Action, the local fire department, the Desert Rain Café, and Tohono O’odham Community College. The activities last for approximately an hour. Each student has a journal, and at the end of each session, they write about what they did. The students end their day with physical activity on the playground.

The science activities led by NOAO have been well received by the students. They always look forward to Mondays, when we visit. One of the most popular activities last semester was building fruit batteries. Students experi-

continued

EPO & Sells Elementary Extended-Day Program continued


mented using different types of nails and different fruits and attempted to light up a light-emitting diode (LED). After a couple of failed attempts, the students let out a cheer when they successfully created a circuit to light the LED. Another popular activity was making a flashlight. Students used a battery pack, plastic cup, light bulb, and switch to make a flashlight. The students took home their completed flashlights at the end of the day.

NOAO hosted a star party at Indian Oasis Elementary School on 29 November 2012, and

many students from the after-school program attended and participated in several hands-on astronomy activities. NOAO's EPO students set up telescopes to show the school's students and their parents a variety of objects in the night sky.

The NOAO staff involved in the project include Katy Garmany, Robert Sparks, Connie Walker, and Steve Pompea. The EPO's student outreach cadre of Will Roddy, Calvin Ortega, Johnathan Siqueros, and Cameron Capara also have been involved in the project. Calvin

and Johnathan are both graduates of BUSD's Baboquivari High School. Several aides at the Indian Oasis Elementary School are involved with the School Improvement Program and help with EPO's efforts as well.

The program is already underway for the spring semester of 2013. Our first set of activities for the spring has focused on the GLOBE at Night program and air pressure. We will continue by exploring the states of matter with the students for the next several weeks. 

Kitt Peak at the 2013 Tohono O'odham Rodeo and Fair

Katy Garmany

The Tohono O'odham Nation held their rodeo and fair on the first weekend of February. NOAO has had a booth there for the past three years. The rodeo celebrated its 75th anniversary this year, making it the longest-running all-Native American rodeo in the United States. The three day fair brings together enormous crowds; they come for the rodeo, the Pow Wow featuring dancing by many different tribes, the midway and carnival, and, of course, the food!

NOAO Education and Public Outreach (EPO) staff set up telescopes for fair attendees to observe solar prominences and sunspots. This year they distributed a balsa-wood airplane with the logo of the Mayall 4-m telescope to the kids. The booth provided an important opportunity

for members of the Tohono O'odham Nation to chat with staff and scientists from NOAO and to view images taken with the telescopes at Kitt Peak. It also gave NOAO the chance to share information about Kitt Peak events and to remind visitors to the booth about the public programs and that they are free to members of the Nation.

The EPO group was in charge of setting up the tent every day and relied heavily on the NOAO EPO student outreach workers. As a result of interactions at past fairs, there are two student workers in the EPO group who grew up and attended school on the Nation, Calvin Ortega and Johnathan Siqueros.



Figure 1: Colette Salyk (right, background) oversees the construction of balsa-wood airplanes as Katy Garmany (left) and Calvin Ortega (right, foreground) help budding aerospace engineers. (Image credit: John Glaspey.)



Figure 2: Hundreds of people stopped by the NOAO/KPNO tent over the three day fair. Despite some clouds, many were able to see solar prominences and sunspots. Rob Sparks (left, facing camera) and Colette Salyk (right in striped shirt) answered questions about the Sun and Kitt Peak. (Image credit: John Glaspey.)



Welcome Mariela Silva Olivares, Safety and Environmental Engineer

Nicole van der Blik & Chuck Gessner

Mariela Silva has joined NOAO South as our Safety and Environmental Engineer. Mariela has a professional degree in health and safety, and a masters in environmental engineering. She is a seasoned safety and environmental professional who has worked in refinery construction, academia, and government. We would like to welcome Mariela Silva, the new NOAO South Safety and Environmental Engineer.

Tenure Track Position at CTIO

The National Optical Astronomy Observatory (NOAO) invites applications for a tenure track staff position based at NOAO South, the site of the Cerro Tololo Inter-American Observatory (CTIO), in La Serena, Chile. The ideal candidate will be an observational astronomer who brings scientific presence and a science-driven interest in pushing the performance of the Blanco and SOAR telescopes and their instruments, all of which are expected to be relevant in the era of the Large Synoptic Survey Telescope. The preferred candidate will have significant hands-on experience with modern instruments and telescopes.

The main focus of CTIO in the coming years will be the Blanco 4-m telescope and the recently installed wide-field optical imager, Dark Energy Camera (DECam). DECam was built at Fermilab under the

auspices of the Dark Energy Survey and installed and commissioned by CTIO. Other instruments expected to come online in 2013–2014 are the SOAR Adaptive Module (SAM), a ground layer adaptive optics module built at CTIO for the SOAR 4.1-m telescope; the Cerro Tololo Ohio State Multi-Object Spectrograph (COSMOS), an optical spectrograph; and TripleSpec4, an infrared spectrograph. These two spectrographs were built in collaboration with university partners, following the recommendations from the ReSTAR (Renewing Small Telescopes for Astronomical Research) committee.

Applications received prior to 15 February 2013 are assured of full consideration; however, the position will remain open until filled. See www.ctio.noao.edu/noao/content/Employment-Opportunities.

Staff Changes at NOAO North and South (16 August 2012–15 February 2013)

New Hires

Briones, Gonzalo	CTIO PIA Summer Student	South
Calderon, Diego	CTIO PIA Summer Student	South
Chinn, Brian	Summer Research Assistant (REU)	South
Conrad, Jason	Logistics Specialist	North
Deich, Alexander	Summer Research Assistant (REU)	South
Finney, Emily	Summer Research Assistant (REU)	South
Godoy, Luis	Mechanic Technician	South

continued

**Staff Changes continued**

Gomez, Luis Arturo	Administrative Specialist	South
Hatfield, George	AOP Imager Guide	North
Ibacache Velasquez, Gilmar	AC, Plumbing, Water Pump System Technician	South
Indahl, Brianna	Summer Research Assistant (REU)	South
Latuff, Carlos	Buyer II	North
Loftin, Sheri	Public Program Specialist	North
Moreno, Victor	Craftsperson II	North
Pinochet, Carlos J.A.	Driver Heavy Equipment	South
Rojas Vega, Jose	Electrician	South
Semple, Travis	Student Intern	North
Silva Olivares, Mariela	Safety & Environmental Engineer	South
Smith, Denise	Cashier, KPNO	North
Smith, Lois	Summer Research Assistant (REU)	South
Watson, David	Public Program Specialist	North
Williams, Molly	Summer Research Assistant (REU)	South
Winskly, James "Jim"	AOP Imager Guide	North

Promotions

Abbott, Timothy	To Scientist	South
Chandrasekharan, Srinivasan	To Senior Software Engineer	North
Dunlop, Christopher	To Special Projects Assistant III	North
Harris, Ronald	To Technical Associate II	North
Loftin, Sheri	To Education Specialist	North
Mathis, Hillary	To KPNO Manager of Telescope Operations	North
Norman, Dara	To Associate Scientist	North
Pizarro, Sergio	To Assistant Observer 1	South
Points, Sean	To Associate Scientist	South
Power, Jennifer	To Observing Associate	North
Reetz, Kristin	To Observing Associate	North
Riabokin, Melania	To Observing Associate	North
St. Paul-Butler, Karen	To Observing Associate	North
Stanghellini, Letizia	To Head of Program, SUS	North
Summers, David	To Observing Associate	North
Taghon, Stacy	To General Maintenance Person I	North
van der Bliet, Nicole	To Interim Associate Director for NOAO South	South
Williams, Douglas	To Senior Observing Associate	North
Zelaya, Kathie	To Technical Associate II	North

New Positions

Bird, Nanette	From Administrative Assistant III to Administrative Coordinator III	North
Ortega, Calvin	From KPNO REU Summer Student to EPO Education Outreach Assistant	North
Seaman, Robert	From Software Systems Engineer to Data Engineer	North

continued


**Staff Changes continued****Transfers**

Acosta, Emily	From NOAO to LSSTC as Graphic/Web Design Assistant	North
Angeli, George	From TMT to LSSTC as Systems Engineering Manager	North
Blaine, Keith	From Helper to Craftsperson I	North
CAS and HR Teams	From NOAO to AURA Corporate	North & South
Claver, Charles	From NOAO to LSSTC as System Scientist	North
Haase, Flynn	From NOAO to WIYN as WIYN 0.9-M Site Manager	North
Montijo, Guillermo	From NOAO to NSO-ATST as Engineering Associate	North

Retirements/Departures

Aldrich, Cliff	Logistics Supervisor	North
Andree, Vitold (Skip)	Mtn. Telescope Operations Manager	North
Austin, Carmen	Special Projects Assistant	North
Brehmer, Gale	Telescope Operation Manager	South
Brown, Jonathan	KPNO REU Summer Student	North
Buchholz, Nick	Sr. Software Engineer	North
Collao, Fabián	Head Instrument Maker	South
Conrad, Jason	Logistics Specialist	North
Cunha, Katia	Associate Astronomer	North
Figuerola, Enrique	Strategic Development Manager	South
Foster, Kathryn	Facilities Engineer	North
Gomez, Luis Arturo	Observer Support Specialist	South
Hunten, Mark	Sr. Systems Engineer	North
Johnson, Linsey	KPNO REU Summer Student	North
O'Leary, Erin	KPNO REU Summer Student	North
Orrego, Juan	Instrument Maker	South
Ortega, Calvin	KPNO REU Summer Student	North
Phillips, James (Jim)	Crafts Leader	North
Romero, Paige	KPNO REU Summer Student	North
Schmidt, Ricardo	Electronic Engineer, Manager	South
Shirtz, Amelia	KPNO REU Summer Student	North
Smart, Brianna	KPNO REU Summer Student	North
Whitehouse, Matthew	Education Specialist, KPNO	North

Deaths

Clemons, Dawn	Lead Custodian and Water Treatment Plant Operator (Kitt Peak)	North
Scott, John	Former Facility Supervisor (Kitt Peak)	North
Simmons, Jorge	Former Senior Engineering Physicist	North 



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