

# NOAO NEWSLETTER

Issue 109, March 2014



NATIONAL  
OPTICAL  
ASTRONOMY  
OBSERVATORY

\$2.50 US  
AAS Meeting  
5-9  
January 2014



## *Tales of the Modern Astronomer* **ANTARES RISING**

I'M HOPING TO  
SEE A TIDAL  
DISRUPTION  
FLARE TONIGHT!





# NOAO Newsletter

NATIONAL OPTICAL ASTRONOMY OBSERVATORY

ISSUE 109 – MARCH 2014

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## On the Cover

### Tales of the Modern Astronomer

NOAO is embarking on a path to better serve the community in the use and analysis of big data. The cover image is the beginning panel of "Tales of the Modern Astronomer: ANTARES Rising," which tells the story of one young researcher in the near future benefiting from such development to exploit "open access to data and real-time astronomy tools" in the Large Synoptic Survey Telescope (LSST) Era (read the full story about ANTARES in the Science Highlights section of this *Newsletter*). Development is starting now to establish this expertise at NOAO on behalf of the community.

(Cover image credit: Pete Marenfeld/NOAO/AURA/NSF.)

# SAM Captures Gravitational Arcs in Abel 370



The science verification (SV) program for the SOAR Adaptive-optics Module (SAM) finished with the January 2014 run. SAM, built by CTIO/NOAO South, is mounted on the Southern Astrophysical Research (SOAR) 4.1-m telescope on Cerro Pachón in Chile. The accompanying picture shows several gravitational arcs in the galaxy cluster Abel 370 as seen by SAM (from SV proposal by D. Caminha et al.). In this amazing picture, almost every source is a distant galaxy, partially resolved by SAM, and only a few are stars. Elongation of galaxies caused by the weak lensing is also noticeable. The dark shadow on the left is produced by the SAM guide probe, which used a guide star at the periphery of the science field (this is a region of low star density). This picture is the result of combining five 5-minute exposures in the SDSS i' and r' filters. The images were taken on 29 September 2013 under non-optimal conditions and had a full width half-maximum (FWHM) resolution of 0.5 arcseconds. For more information about SAM, see the "SAM Makes It Sharp" article in this *Newsletter*. (Image credit: D. Caminha et al./SOAR/NOAO/AURA/NSF.)



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# Transforming NOAO

David Silva

With the start of 2014 NOAO began a period of transformation, driven by new financial and programmatic constraints from the NSF as well as new research aspirations by the community that NOAO serves. Looking out toward 2020, how will NOAO enable high impact research in the face of such changing circumstances?

NOAO has forged new, strong, and productive scientific and technical partnerships with the Dark Energy Survey (DES), Dark Energy Spectroscopic Instrument (DESI), and Large Synoptic Survey Telescope (LSST) projects over the last decade. Through those partnerships, NOAO has connected to key Federal centers such as Fermilab, Lawrence Berkeley National Laboratory, National Center for Supercomputing Applications, and SLAC. One tangible and significant result of these developments is the deployment of the Dark Energy Camera (DECam) at the CTIO Blanco 4-m telescope. Another result is reaching construction readiness for LSST, which is currently seeking final approval from NSF to begin construction. DESI, a 5000-fiber multi-object spectrometer to be integrated into the KPNO Mayall 4-m telescope, is still in the design and development phase. If all goes well, DESI will move into a construction phase in 2015 and start operations in 2018–2019. Each of these instruments enables a DOE-funded key project focused on dark energy characterization at various redshifts. But these instruments also enable many other exciting astronomical projects.

All of these instruments and the survey projects they enable will produce larger, richer object catalogs that will lead to numerous additional research applications. During 2015–2017, community-based DECam imaging surveys, as well as DES, will start delivering their public data products to NOAO. In preparation for the arrival of those catalogs, NOAO has begun a project to provide improved data services that are object (catalog) oriented, not just pixel (file) oriented. To do this, we will adopt systems and tools that exist or are under active development (e.g., by LSST) for catalog access and mining as well as analytic tools for large-sample research problems. Our overall goals are to enable high-impact, catalog-based research based on DES and other surveys, help train the next generation of data-oriented astronomers, and lay the foundation for providing similar services and user support in the LSST-open-access-to-data era. More details about these exciting developments will appear in future *Newsletter* issues.

Providing merit-based (“open”) access to highly capable telescopes and instruments will remain an NOAO hallmark for years to come, and will be focused on Gemini North, Gemini South, Blanco, and Southern Astrophysical Research (SOAR) telescopes. Each of these telescopes has recently commissioned (or will commission in the near future) exciting new instruments (e.g., Gemini Planet Finder at Gemini South, DECam at Blanco, Cerro Tololo Ohio State Multi-Object Spectrograph at Blanco, SOAR Adaptive-optics Module at SOAR). NOAO may also be able to offer access to non-federal facilities that offer such access in exchange for federal investment through programs like the NSF Mid-Scale Initia-

tive Program (MSIP) or through time trades (e.g., current arrangements between Blanco and Anglo-Australian Telescope or Gemini and Subaru).

One research activity that is growing in prominence at facilities operated by NOAO (or that provide time through NOAO) is follow-up observations of time-domain events detected by other facilities such as Palomar Transient Factory, Catalina Sky Survey, or SWIFT. Demand for time-domain event follow-up observations will only grow in the years ahead, culminating in the LSST era when several million events may be reported per night. How to select a manageable list of targets for follow-up observations, what telescopes and instruments will be desired, and how to distribute the observing load are topics of active discussion between NOAO and various community groups. A recent result from that discussion was the final report from the April 2013 “Spectroscopy in the Era of LSST” workshop. See the “ANTARES: A Tool for the LSST Transient Sky” article in this *Newsletter* for a discussion of a related development.

Consistent with federal funding decisions being imposed on NOAO, we will end open access to the Kitt Peak 2.1-m telescope after semester 2014A (30 August 2014) and the WIYN 3.5-m telescope after semester 2014B (31 January 2015). NOAO is working with the NSF to develop an announcement of opportunity for a new operator and hence new mission for the Kitt Peak 2.1-m telescope. Meanwhile, the WIYN partnership is actively seeking new partners. If you are interested in WIYN, please contact Dr. John Salzer (Indiana University).

What about the KPNO Mayall 4-m telescope? Through at least observing semester 2015A (inclusive), NOAO will continue to provide open access to the Mayall. What happens after 1 October 2015 is currently undecided by the NSF and depends greatly on the destiny of DESI.

If the DOE decides to proceed with DESI on terms acceptable to the NSF, NOAO expects to receive funding to operate the Mayall as an open access facility until at least 1 October 2017, albeit perhaps with a more limited instrument suite and fewer (open access) nights per month. There would then be a period of DESI installation, commissioning, and science verification. During 2019, DESI survey operations would begin, dominated by the DOE-sponsored dark energy experiment, but perhaps with opportunities for other teams to exploit bright time. The viability of this baseline plan will become clear during the second half of 2014. Stay tuned.

Yes, the number of actual nights provided by NOAO will contract over the next two years, mostly on Kitt Peak. But what nights are available will provide access to excellent, flexible instruments on 4-m and 8-m class telescopes, allowing forefront research across the entire range of astronomy and astrophysics. When coupled with the survey machines DECam and (hopefully) DESI as well as the arrival of new, rich data sets and improved data services, the NOAO user community will continue to have many opportunities for scientific leadership in the years ahead. Those opportunities will only increase when the LSST survey begins in the early 2020s.



# ANTARES: A Tool for the LSST Transient Sky

Tom Matheson & Abi Saha

NOAO scientists led by Tom Matheson and Abi Saha are collaborating with the University of Arizona Computer Science Department (Richard Snodgrass and John Kececioglu) to develop tools to annotate and filter alerts at the Large Synoptic Survey Telescope (LSST) scale. The collaborators have been awarded an NSF INSPIRE (Integrated NSF Support Promoting Interdisciplinary Research and Education) grant (CISE AST-1344024, PI: Snodgrass) to pursue this goal by developing a software infrastructure called the Arizona-NOAO Temporal Analysis and Response to Events System (ANTARES).

The rapid growth of time-domain surveys is producing discoveries at an ever-growing rate. Current surveys, such as the Catalina Real-Time Transient Survey [1], the Panoramic Survey Telescope & Rapid Response System [2], the Palomar Transient Factory (PTF and iPTF) [3], and the La Silla-Quest Variability Survey [4] generate transient alerts well beyond the capacity to follow up on them. These projects have developed tools to filter their discoveries to focus on events of interest. A good example of this is SkyAlert [5], a system that enables users to create filters on alerts, including ancillary information on these alerts, in order to find relevant events. The scale of time-domain alert generation, though, is increasing rapidly. The Zwicky Transient Facility [6] will have more than six times the field of view of PTF, while time domain surveys with the Dark Energy Camera (DECam) on the Blanco telescope benefit not only from the 3-square-degree field of view, but the depth attainable with a 4-m-class facility.

LSST [7] will boost the transient detection rates by orders of magnitude with its ~10-square-degree field of view and ~6 m collecting area. LSST will detect (with 5 $\sigma$  significance) 10<sup>3</sup>–10<sup>4</sup> alerts per image, or 10<sup>6</sup>–10<sup>7</sup> per night. A good fraction of these will be known variable stars or moving objects, but hidden among them will be rare and interesting objects that have relatively short lifetimes. Only with additional follow-up will these objects reveal their nature. These could range from short-lived phases of stellar evolution such as the final helium flash, to superluminous supernovae, to electromagnetic counterparts of the Laser Interferometer Gravitational-Wave Observatory (LIGO) gravity-wave sources. Without the ability to rapidly sort through these millions of alerts each night and winnow them down to a reasonable number that can be studied in detail, we will lose these rare and potentially extraordinarily interesting objects.

ANTARES is being developed to address this problem. The knowledge we have about an alert, such as magnitude, Galactic coordinates, ecliptic coordinates, distance to nearest galaxy, etc., constitute features that can probabilistically characterize alerts. We emphasize that this is a broad characterization, not a specific classification. Classification will have to come from software systems further downstream. ANTARES will then use multiple layers of filters to sort the alerts and find the rarest or most interesting among them (this is the focus of the prototype project). The other alerts are not discarded.

Rather, they are diverted from the main filtering stream but are still accessible to other filtering systems, including, potentially, copies of the ANTARES system itself that are tuned to specific goals. In this way, custom filters can be applied, allowing users to isolate exactly which of the alerts is of interest to them and thus address many different goals.

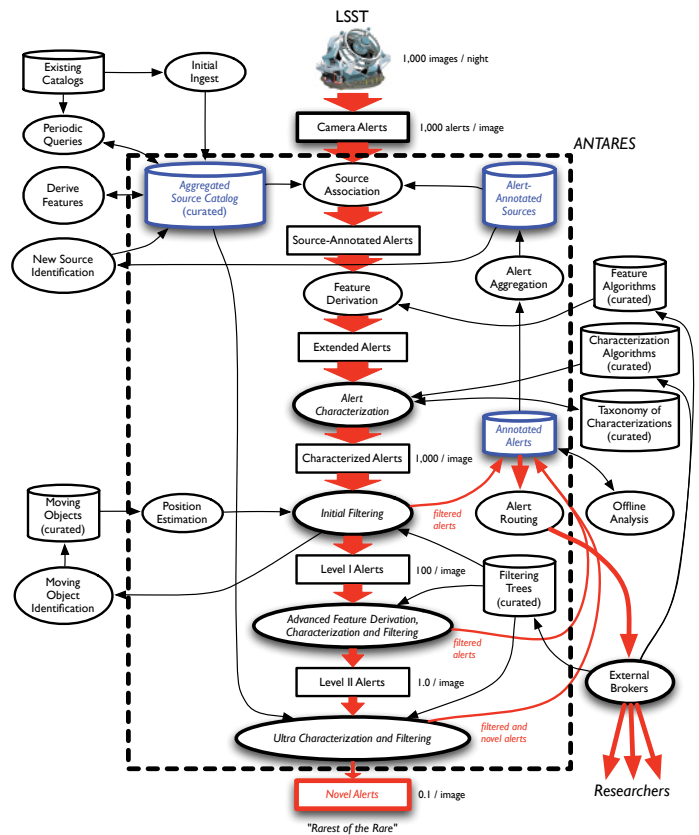


Figure 1: Main components of the Arizona-NOAO Temporal Analysis and Response to Events System (ANTARES) architecture.

Figure 1 illustrates the main components of the ANTARES architecture. The overall design principles are open source and open access. The software will be available for anyone to implement, and our implementation will be community driven. The alert stream can be tapped at many points throughout the system. Figure 2 presents some of the ways that ANTARES may work in practice.

Annotation adds value to the alerts. Source association is a critical step to incorporate relevant astronomical knowledge for each alert. An efficient database that can be updated regularly is an essential element of the system. This database will be a valuable astronomical resource on its own.

Filtering algorithms, derived from community input, will be applied in a multi-step process, allowing for better management of computational resources. By characterizing the alerts, the number of dimensions of feature space can be reduced. More complex filters can be applied to the smaller number of alerts after initial filtering stages. The goal for the prototype is to distinguish rare and unusual objects. Once it is operational, the next stage is to expand the scope to allow users to find any type of alert that is of interest to them.

*continued*

ANTARES continued



Figure 2: Possible ways that ANTARES may be put to use. (Image credit: Pete Marenfeld/NOAO/AURA/NSF.)

References:

- [1] [crts.caltech.edu/](http://crts.caltech.edu/)
- [2] [pan-stars.ifa.hawaii.edu/public/](http://pan-stars.ifa.hawaii.edu/public/)
- [3] [ptf.caltech.edu/iptf/](http://ptf.caltech.edu/iptf/)
- [4] [hep.yale.edu/lasillaquest](http://hep.yale.edu/lasillaquest)
- [5] [skyalert.org/](http://skyalert.org/)
- [6] Kulkarni, S. 2012 astro-ph/1202.2381
- [7] Krabbendam, V.L. & Sweeney, D. 2010, Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series, 7733

# A Laser Focus on Mutual Orbits of Kuiper Belt Binaries

Will Grundy (Lowell Observatory)

Will Grundy (Lowell Observatory) and collaborators are using NIRI (Near-Infrared Imager) plus the Altair Laser Guide Star (LGS) system at Gemini North to obtain precise mutual orbits of the components of binary Kuiper Belt objects. These observations, obtained through their NOAO survey program “Mutual Orbits and Masses of Kuiper Belt Binaries and Multiple Systems,” will be used to measure the masses and, in some cases, the densities of the objects to help understand the origin of this class of objects. Already, the orbital configuration of the binaries appears to reveal interesting diagnostics on the dynamical evolution of the Kuiper Belt.

Planetary systems are born from circumstellar disks of dust and gas, via accretion into planetesimals and ultimately planets. Crucial evidence of the processes involved is preserved in remnant debris disks seen around many stars. Our own such disk, the Kuiper Belt, hosts some  $10^5$  trans-Neptunian objects (TNOs) larger than 100 km, of which about 1600 have been discovered to date (many of them by the “Deep Ecliptic Survey,” an earlier NOAO survey program). TNOs occupy diverse dynamical niches indicative of dramatic events early in Solar System history. Photometry, spectroscopy, and polarimetry show they have varied surface properties in addition to their dynamical diversity. Efforts have been made to link these observable properties to formations in different regions of the protoplanetary nebula, but the bulk properties that would be most valuable for constraining conditions in distinct nebular environments are a lot harder to obtain.

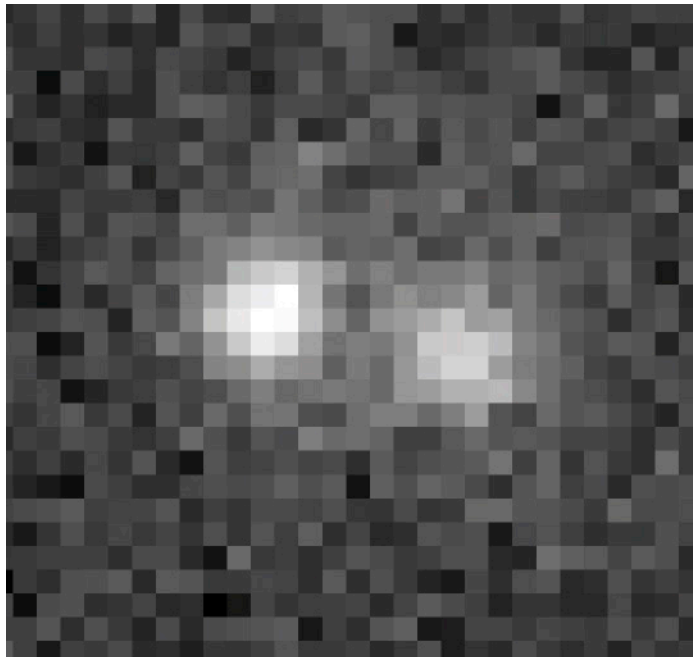


Figure 1: Laser guide star adaptive optics image of a binary trans-Neptunian object, well-resolved with a separation of 0.08 arcsec.

Fortunately, some 80 TNOs have been discovered to be binaries or multiple systems. These systems provide a path to learning about the bulk properties of TNOs and relating those properties to their dynamical classes, observable surface characteristics, and ultimately to their origins in the protoplanetary nebula. The first step is to determine the mutual orbits and masses, something Grundy’s team has been working on for more than a decade. At first, only the Hubble Space Telescope could resolve these faint, tight systems. But more recently, the team has been using ground-based LGS adaptive-optics systems at Keck successfully and, thanks to their NOAO survey program, at Gemini North (see Figure 1). The periods, semi-major axes, and eccentricities have now been determined for half of the known systems, yielding their system masses and, where sizes have been constrained by other observations, their bulk densities (see Figure 2).

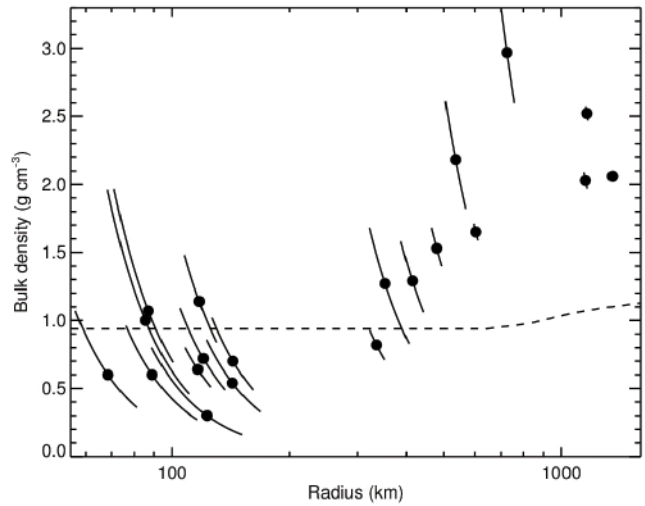


Figure 2: Bulk densities of trans-Neptunian objects as a function of object size. The dashed curve indicates the density of a pure water ice sphere, rising slightly at large sizes due to gravitational self-compression.

The bulk densities show an intriguing dichotomy. Most smaller objects have densities below  $1 \text{ g cm}^{-3}$ , indicating high porosity and relatively ice-rich compositions. In contrast, larger TNOs tend to have much higher bulk densities, requiring appreciable rocky material in addition to ice. These different density classes could not have been assembled from the same mix of solid ingredients, pointing to formation on different time scales and/or in different parts of the nebula from solids with distinct compositions.

Interesting patterns have begun to emerge from other binary orbital characteristics, as well. For instance, the tightness of binaries, as measured by their mean separation relative to the size of their Hill sphere, shows a curious relation to the heliocentric orbits of the systems. Loosely bound binaries are only found on the least excited heliocentric orbits, providing

*continued*



## A Laser Focus on Mutual Orbits of Kuiper Belt Binaries continued

an important constraint on the scattering process that excited the heliocentric orbits of many TNOs. The orientations of the mutual orbits are also interesting. Orbit poles of the loose binaries seem to be randomly distributed, but among the tighter binaries, prograde orbits outnumber retrograde ones by a large margin, contrary to the predictions of several proposed binary formation mechanisms.

Eccentricities of the mutual orbits are clearly non-random, too. Many are circular, but others are eccentric, clustering around  $e = 0.5$ . No proposed formation mechanism predicted the observed distribution of orbital eccentricities. But dynamical models of the perturbing effect of solar tides in conjunction with perturbations from non-spherical object shapes and tidal dissipation are able to explain the observed eccentricity distribution.

Some noteworthy systems have been identified. For instance, Salacia and Varda were found to be the sixth and seventh highest mass TNOs among those with known masses. The orbit solution for the Sila-Nunam system predicted that the two equal-sized bodies should be eclipsing one another every 6.25 days during 2009–2017, much as Pluto and Charon did during 1984–1989. These “mutual events” offer a wealth of additional characterization opportunities, including accurate size measurements. Already, several Sila-Nunam events have been successfully observed. Very recently, we found that another system, still identified by its provisional designation of 2003 QW<sub>111</sub>, will be doing mutual events during 2015–2018 (see Figure 3). Interpretation of Pluto-Charon

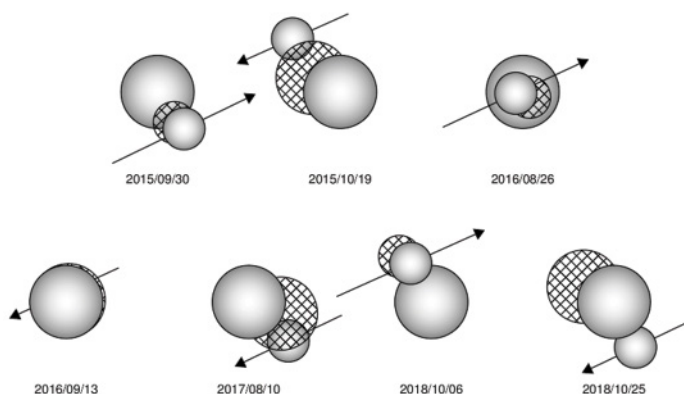

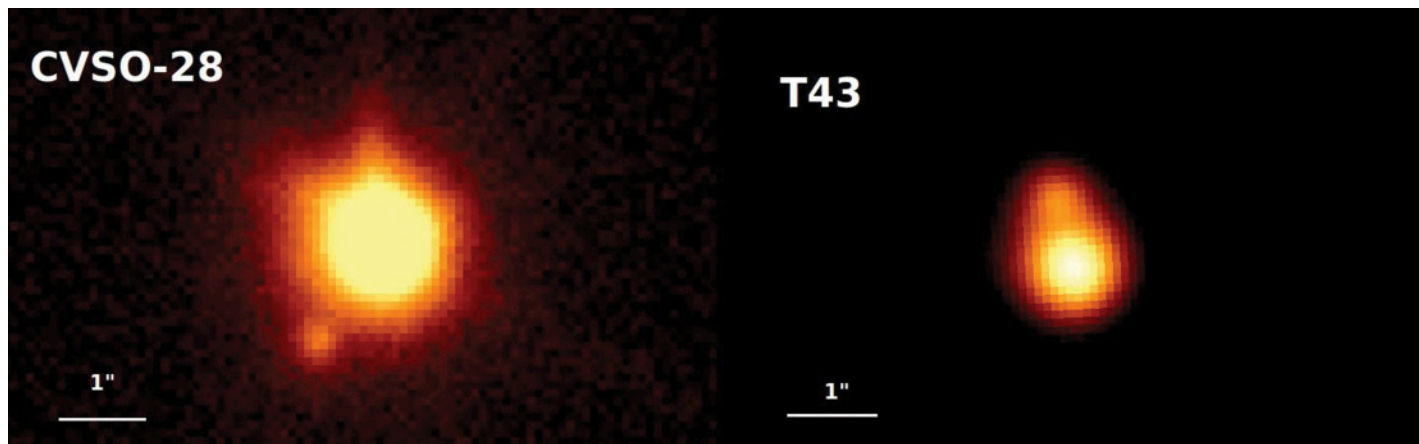


Figure 3: Predicted 2003 QW<sub>111</sub> mutual events projected to the instantaneous sky plane with north up and east to the left. Motion of the secondary relative to the primary over a 16-hour period is indicated by arrows. The shadow of the foreground object at the distance of the background object is indicated by the hatched area. For simplicity, the object shapes are assumed here to be spherical, but in reality, the secondary is expected to be somewhat elongated and chaotically tumbling.

and Sila-Nunam mutual events benefited from the fact that both systems are fully tidally locked. Our integrations of the QW<sub>111</sub> system suggest that the secondary should be chaotically tumbling, presenting an interesting new challenge for mutual event modelers. 

## SAM Makes It Sharp

Andrei Tokovinin & César Briceño



Images from the SOAR Adaptive Module (SAM) of a newly discovered probably binary system CVSO-28 in the 25 Ori cluster (left) and the known T Tauri binary T43 in the Chamaeleon I association (right). (Image credit: César Briceño and Andrei Tokovinin, NOAO/AURA/NSF.)

The SOAR Adaptive Module (SAM) is now officially commissioned (see report at: [www.ctio.noao.edu/new/Telescopes/SOAR/Instruments/SAM/archive/samrep.pdf](http://www.ctio.noao.edu/new/Telescopes/SOAR/Instruments/SAM/archive/samrep.pdf)). The SAM science verification (SV) program was executed in the 2013A and 2013B observing semesters. In addition, valid data were obtained for two regular proposals

(both extragalactic) through the Brazilian and Chilean Time Allocation Committees. The instrument is offered in 2014B with a CCD imager. SAM delivers a typical full width half-maximum (FWHM) resolution of 0.5" in the visible and 0.4" in the *i* and *z* bands.


*continued*



### SAM Makes it Sharp continued

During the SAM SV program, we have observed a number of pre-main sequence low-mass stars in the nearby Orion OB1 association to detect its binary or multiple members. Among the newly discovered probable binary systems is CVSO-28, an M1-type T Tauri star located in the young (~8 Myr) 25 Ori cluster (Briceño et al. 2005, AJ, 129, 907; Briceño et al. 2007, ApJ, 661, 1119). The SAM SV image in the SDSS-z band, with a FWHM = 0.36", reveals an object at a separation of 1.2", roughly 4

magnitudes fainter than the primary. If this is a physical companion, its feeble brightness would imply it is a young brown dwarf at a projected separation of ~400 AU.

As a test, we also observed a known T Tauri binary in the Chamaeleon I association, the M2-type star T43, with a separation of 0.8". The image in the SDSS-z band (FWHM = 0.4") clearly resolves the pair of stars. 

## Finding the End of the Hydrogen-Burning Main Sequence

Sergio Dieterich (Georgia State University)

**S**ergio Dieterich and Todd Henry (Georgia State University) combined optical photometry, infrared photometry, and trigonometric parallaxes to construct a true Hertzsprung-Russell (HR) diagram for 62 objects ranging in spectral types from M6V to L4 to search for diagnostics indicative of the boundary between the lower hydrogen-burning main sequence and brown dwarfs. They used the SMARTS 0.9-m telescope to obtain optical (*V*-, *R*-, and *I*-bands) photometry of M dwarfs and to obtain trigonometric parallaxes for 37 objects that were lacking parallaxes. The SOAR 4.1-m telescope provided optical photometry of the optically much fainter L dwarfs. Near infrared photometry was obtained at what is now the SMARTS 1.3-m telescope during the time it was operated by the 2-Micron All-Sky Survey (2MASS). Finally, the optical and near infrared photometry was combined with mid-infrared photometry from the Wide-field Infrared Survey Explorer (WISE). This broad photometric coverage covers about 97% of the energy emitted by these cool objects, allowing the bolometric flux to be estimated. The trigono-

metric parallaxes were then used to transform bolometric flux into bolometric luminosity. Effective temperatures were obtained by comparing photometric colors to the new BT-Settl atmospheric models.

The issue of establishing the dividing line between normal stars and brown dwarfs has been explored extensively from a theoretical perspective but not from an empirical observational perspective. The fact that very low mass stellar objects reach thermostatic equilibrium and enter the main sequence whereas brown dwarfs are always cooling means that these two categories of objects have different evolutionary histories and internal structures, but these differences are not readily apparent from observations. The problem lies with translating readily observable quantities such as spectra and photometry to fundamental parameters of stellar structure such as luminosity, effective temperature, and radius.

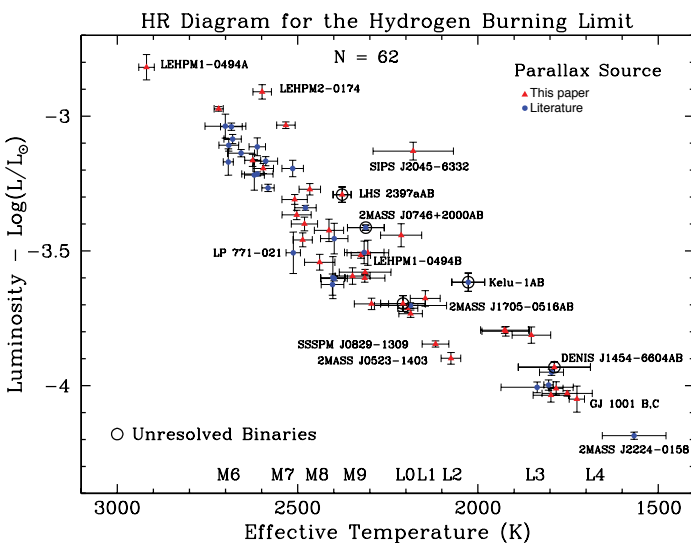


Figure 1: Hertzsprung-Russell diagram for objects close to the stellar/substellar boundary. The luminosities were determined based on nine bands of photometry ranging from optical to mid-infrared and trigonometric parallaxes. The effective temperatures were determined by comparing photometric colors to the latest atmospheric models. Several well-known nearby objects are indicated. (Image credit: Dieterich et al. 2014, in press.)

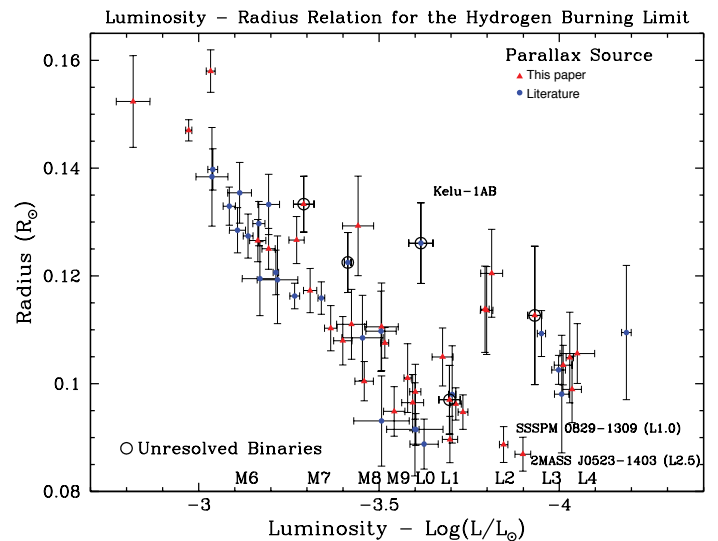



Figure 2: Luminosity-Radius diagram plotting the same data as in Figure 1. The stellar main sequence is visible on the left, with radius decreasing as a function of luminosity until the proximity of 2MASS 0523-1403. The sudden jump in radius and reversal of the radius-luminosity trend for fainter objects indicates the onset of the brown dwarf cooling sequence. A sequence of elevated objects consisting of very young brown dwarfs and unresolved multiple objects is visible above the main sequence. (Dieterich et al. 2014 shows this same figure super-imposed with evolutionary tracks from several evolutionary models.) (Image credit: Dieterich et al. 2014, in press.)

continued

## Finding the End of the Hydrogen-Burning Main Sequence continued

If the parameters of stellar structure can be derived empirically, it then becomes possible to differentiate between stars and brown dwarfs based on trends that are directly correlated to internal structure. The analysis of trends related to stellar radii is particularly useful for determining the end of the stellar main sequence, as a star's radius decreases with decreasing mass (and luminosity and temperature), but the opposite is true for brown dwarfs. Because brown dwarfs are supported by electron degeneracy pressure, the most massive brown dwarfs actually have smaller radii. The combination of these two trends produces a minimum in radius for objects at the stellar/substellar boundary.

To place an object in an HR diagram, (1) the object's distance must be known through an accurate trigonometric parallax, (2) wide photometric coverage of the spectral energy distribution must be available to calibrate the bolometric flux, and (3) the object's effective temperature must be determined by comparing observed colors to the predictions of atmospheric models. The resulting HR diagram is shown in Figure 1. Figure 2 re-arranges the HR diagram to make radius an explicit function

of luminosity. The luminosity-radius trend shows a clear minimum at  $\log(L/L_{\odot}) \sim -3.9$ , corresponding to an effective temperature of 2075 K. The data can be interpreted as the stellar main sequence coming to an end close to that point. Because main sequence stars do not cool down, the objects hotter than 2075 K can have any range of age corresponding to the galactic disk population (anywhere from 0.5 to 13 Gyr). The cooler brown dwarfs, on the other hand, must still be young in order to shine like early L dwarfs (0.5 to 1 Gyr). These brown dwarfs have not yet finished contracting, thus there is a jump in radius at temperatures cooler than 2075 K. The luminosity-radius trend also changes slope at that point due to the onset of core electron degeneracy for brown dwarfs. Interestingly, the stellar/substellar boundary indicated by this study is about 400 K hotter than originally predicted by stellar structure models. Several factors may explain the discrepancy between observations and theory. Among the most probable reasons are the recent revisions in the solar abundances used to calculate the zero point of the metallicity scale used by atmospheric models and updated opacity tables for the simple molecules present in these cool atmospheres. 

## Rapid Response Observations of NEOs, Using the SOAR Telescope Goodman Spectrograph

Nicholas Moskovitz (Lowell Observatory) & MANOS Team

The Mission Accessible Near-Earth Object Survey (MANOS) is a three-year NOAO Survey program (PI, Moskovitz) designed to catalog physical properties of newly discovered near-Earth objects (NEOs) with astrometric, photometric, and spectroscopic observations. Survey targets are selected based on their accessibility with current spacecraft technology and are typically an order of magnitude smaller than previously studied NEOs. MANOS obtains data from nearly the full suite of telescopes available through NOAO: GNIRS and GMOS at Gemini North and South, Mosaic at KPNO Mayall 4-m, ANDICAM at the SMARTS 1.3-m, and the Goodman Spectrograph at SOAR. Ultimately, MANOS will help to inform understanding of the origin and evolution of NEOs, including those with the potential to impact Earth and the parent bodies of meteorites.

An example of these targets and one for which we took data is the asteroid 2013 TG6. It is an object only 30 m in size with an orbit more easily accessible than 95% of all other NEOs. We took these data at the Southern Astrophysical Research (SOAR) Telescope with the Goodman Spectrograph on 10 October 2013, just five days after the asteroid's discovery, at a time when the object had an apparent magnitude of  $V \sim 20$  and was moving at non-sidereal rates of  $\sim 5''/\text{min}$ . The Goodman Spectrograph is always on-line; and with its combined imaging and spectroscopic capabilities, we were able to capitalize on a narrow observing window dictated by the rapid fading of the asteroid as its geocentric distance increased post-discovery.

Preliminary results of these observations are presented here. These data produced high-quality astrometry for orbit refinement with root mean square (RMS) residuals of  $0.075''$  (Figure 1). This figure highlights the asteroid (red), reference stars for automatic field recognition (blue),

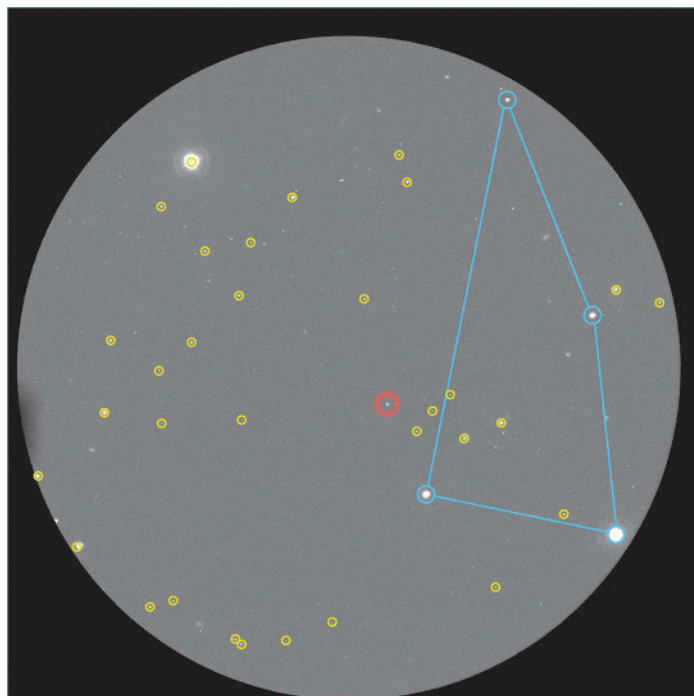


Figure 1: Image from SOAR/Goodman Spectrograph used for measuring astrometry. The red circle is asteroid 2013 TG6, blue circles are reference stars used for automatic field recognition, and yellow circles are field stars used in the astrometric solution.

*continued*

## Rapid Response Observations of NEOs continued

and field stars used in the astrometric solution (yellow). In addition, a 1.5-hour time series of images was obtained to constrain the rotational properties of the asteroid (Figure 2). Fourier analysis reveals no periodic photometric variability, suggesting a roughly spherical morphology and/or a rotation period much longer than 1 hour. Finally, a reflectance

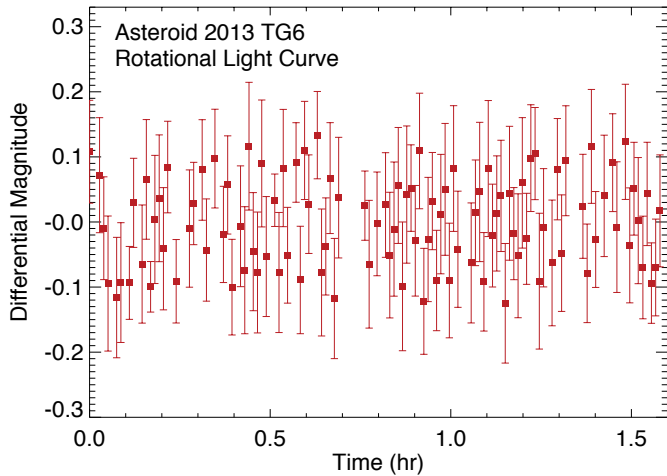


Figure 2: Times series photometry of asteroid 2013 TG6 showing errors of  $\sim 0.1$  magnitude per image. The lack of detected periodicity in this light curve indicates a spherical morphology and/or a rotation period much longer than 1 hour.

spectrum was obtained (Figure 3). This largely featureless spectrum is taxonomically classified as a Cb-type, a group that makes up less than 10% of the NEO population and whose members are thought to have compositions associated with primitive, low albedo, carbonaceous chondrite meteorites.  $\oplus$

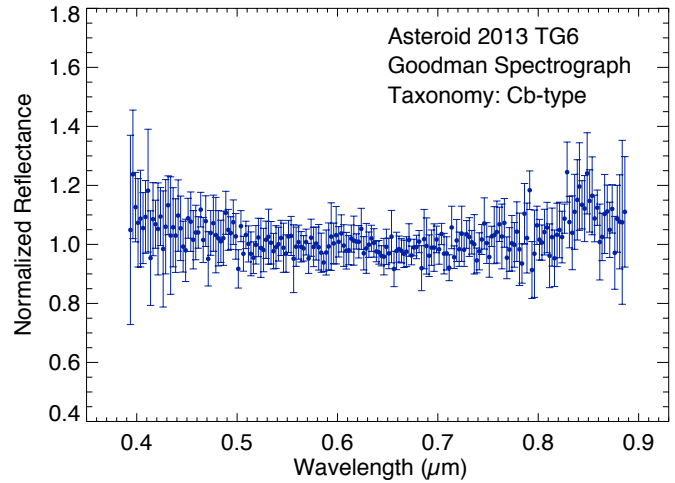
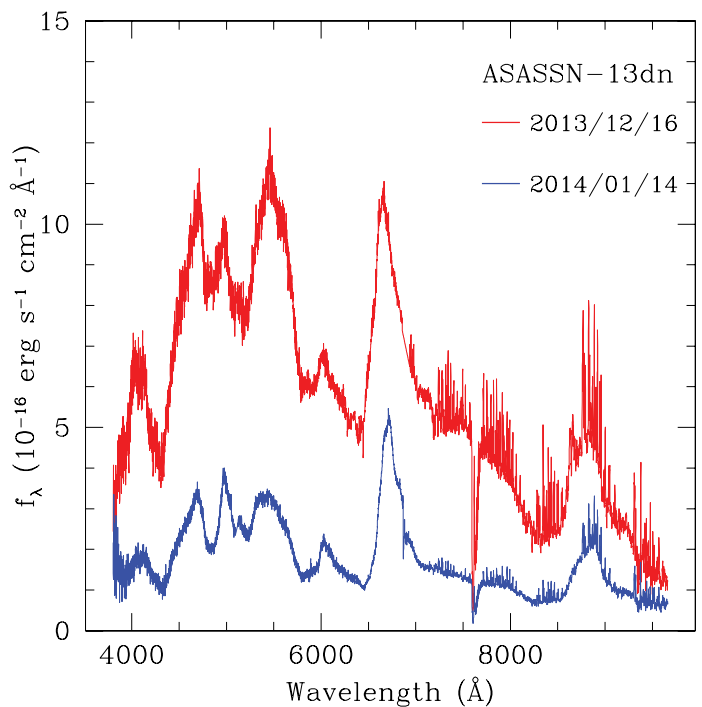


Figure 3: Reflectance spectrum for asteroid 2013 TG6. This spectral type is most commonly associated with carbonaceous chondrite meteorites.

## KOSMOS Begins Science with a Bang

Paul Martini (The Ohio State University),  
Jay Elias (NOAO) & Sean Points (CTIO)

The first science result from the Kitt Peak Ohio State Multi-Object Spectrograph (KOSMOS) was the photometric confirmation and spectroscopic classification of the supernova ASASSN-13dn. This supernova was identified as a candidate by the All-Sky Automated Survey for Supernovae (ASAS-SN; [www.astronomy.ohio-state.edu/~assassin/index.shtml](http://www.astronomy.ohio-state.edu/~assassin/index.shtml)), which presently has four robotic 14-cm telescopes in Hawaii that survey 10,000 square degrees down to  $V \sim 17$  mag every clear night. KOSMOS spectra obtained during the December 2013 commissioning run revealed that ASASSN-13dn was a very luminous Type II supernova at  $z = 0.023$  ( $D \sim 100$  Mpc) with an absolute  $V$  magnitude of  $-19.3$ . A second spectrum about a month later during the January 2014 commissioning run showed similar spectral features, but a fading continuum, consistent with an aging supernova. In both cases, the supernova was observed with the blue and red Volume-Phase Holographic (VPH) grisms through a slit 0.9 arcsec (3 pixels) wide. Spectra at the two epochs are shown in the figure. These results were reported in The Astronomer's Telegram #5665 and #5667 ([www.astronomerstelegam.org/?read=5665](http://www.astronomerstelegam.org/?read=5665) and [www.astronomerstelegam.org/?read=5667](http://www.astronomerstelegam.org/?read=5667), respectively).



Spectra of the Type II supernova ASASSN-13dn obtained with KOSMOS during the December 2013 (red) and January 2014 (blue) commissioning runs. (Image credit: José Luis Prieto, Princeton.)

## The Thirty Meter Telescope and the US Astronomical Community

Mark Dickinson

A new generation of giant, optical/infrared (O/IR) ground-based telescopes is being born: observatories that will achieve revolutionary new limits of sensitivity and angular resolution, thanks to their huge collecting areas and to the capabilities of advanced adaptive optics. The Thirty Meter Telescope (TMT), Giant Magellan Telescope (GMT), and European Extremely Large Telescope (E-ELT) are moving forward with multiple-mirror architectures and diameters of 20 to 40 meters, which will enable new breakthroughs in subjects ranging from extrasolar planets to the formation of the earliest galaxies during the epoch of re-ionization. Each of these projects is an international consortium; and the national astronomy communities of Australia, Canada, Chile, China, India, Japan, Korea, and the European Southern Observatory member states will have access to one or more of these telescopes. At present the US community, outside of the universities that are members of TMT or GMT, is not yet formally a partner in any of these observatories. The last two decadal surveys of US astronomy gave national participation in a giant telescope high priority: ranked first among large, ground-based O/IR projects in Astro2000 and by the Astro2010 ground-based O/IR panel and third overall in the final Astro2010 report.

In 2013, the NSF and TMT entered into a cooperative agreement to formulate a plan for a potential NSF partnership in TMT. As a result of that agreement, several activities were initiated. NOAO established a US TMT Liaison office to develop this relationship. The US-at-large community now has equal representation on the TMT Collaboration Board and its Science Advisory Committee. A US TMT Science Working Group (SWG) was formed consisting of a dozen astronomers from institutions across the country who represent the US community's interests, surveying its priorities and wishes, and developing a partnership concept for the NSF.

The current TMT partners each have subscribed shares of 10–20% of the telescope. The NSF could potentially join the project with a share comparable to that of the other international and US university partners. The US SWG has begun work on this participation plan. Throughout 2014 expect to hear from your SWG representatives, who will be asking about your scientific priorities, your interest in TMT instrumentation (as potential users, or as part of the teams that will build them), and your thoughts about observatory operations. What science programs would you carry out with TMT, and what instrumental capabilities would you need? How can TMT best complement the suite of other observatory facilities that will be operating post 2020? Should US observing time on TMT be classically or queue-scheduled, or some mix thereof? Should the US organize large science projects with some fraction of its time, or participate in internationally coordinated “TMT key programs”? What share of the TMT does the US need to be globally competitive in astronomical research?

At a TMT Town Hall meeting at the 223<sup>rd</sup> American Astronomical Society meeting in January, Michael Bolte (University of California, Santa Cruz) described the status of TMT: the state of the partnership and



## Attend the Second TMT Science Forum

The TMT Science Forum is an annual gathering of astronomers, educators, and observatory staff for the purpose of exploring TMT science, instrumentation, observatory operations, archiving and data processing, astronomy education, and STEM (science, technology, engineering, and mathematics) issues. It is an opportunity for astronomers from the international TMT partners and from the US-at-large community to learn about the observatory status, discuss and plan cutting-edge science, establish collaborations, and help shape the future of TMT.

NOAO will host the second TMT Science Forum:

When: **17–19 July 2014**

Where: Loews Ventana Canyon Resort in Tucson, Arizona

Website: [conference.ipac.caltech.edu/tmfsf2014/](http://conference.ipac.caltech.edu/tmfsf2014/)

One important theme for the Forum will be the synergy between TMT and other facilities in the post-2020 astronomical landscape. There will be plenary sessions, an instrumentation workshop geared toward US scientists who may wish to participate in developing and building TMT instruments, and breakout sessions for the TMT International Science Development Teams (ISDTs).

The NSF-TMT cooperative agreement can support members of the US community who would like to attend the TMT Science Forum. Write to [tmt@noao.edu](mailto:tmt@noao.edu) for more information about the Forum (or anything related to TMT). Watch the Forum website (above), the NOAO *Currents* electronic newsletter, and the US TMT SWG Facebook page at: <https://www.facebook.com/USTMTSWG> for more information.




plans to start construction in the next few months of 2014, with first light planned for 2022. Mark Dickinson (NOAO) discussed the NSF-TMT cooperative agreement, introduced the US SWG, and described opportunities for US astronomers to become involved in TMT. You can view the Town Hall presentation at [ast.noao.edu/system/us-tmt-liaison](http://ast.noao.edu/system/us-tmt-liaison) and follow

*continued*

## The TMT and the US Astronomical Community continued

the US SWG and its community engagement activities on Facebook at <https://www.facebook.com/USTMTSWG>.

This summer, NOAO will host the second TMT Science Forum (see accompanying box for details) for astronomers, educators, and observatory staff to explore TMT science, instrumentation, observatory operations, archiving and data processing, astronomy education, and STEM (science, technology, engineering, and mathematics) issues. Last year's TMT Forum was a great success, with more than 50 astronomers attending

from the US community at large, outside the University of California and Caltech partners. We will continue that conversation in Tucson. The Science Forum will include breakout sessions for the new TMT International Science Development Teams (ISDTs). The ISDTs are organized around eight themes, from exoplanets to cosmology, and advise TMT on science that guides the observatory development. They are open to participation from all PhD astronomers and will have annual calls for membership. For more information, watch the *NOAO Newsletter*, the *NOAO Currents* electronic newsletter, and the US TMT SWG Facebook page. 

# The LSST Project Prepares for Construction

Bill Gressler

The Large Synoptic Survey Telescope (LSST) Project has taken significant steps recently toward a federal construction start. LSST is the top-ranked, large-scale ground-based project for the next decade as recommended by the Astro2010 decadal survey report. The LSST Project passed its National Science Foundation (NSF) Final Design Review (FDR) in early December 2013. In addition, the omnibus spending bill signed by President Obama in January included language within the Major Research Equipment and Facilities Construction budget line that specifically allocated funds for the initiation of LSST construction in fiscal year 2014. Readers interested in the latest information about LSST should visit [www.lsst.org](http://www.lsst.org) and subscribe to the quarterly LSST E-News at [www.lsst.org/lsst/news/enews](http://www.lsst.org/lsst/news/enews).

The NSF convened a panel of 15 members to conduct the FDR for the LSST. The week-long review took place in Tucson, Arizona. The panel concluded that the project team is very strong, with well-developed plans, schedules, and cost estimates and declared that the project to be ready for start of construction on 1 July 2014. This crucial step moved the project closer to National Science Board approval of a construction start.

Also crucial to an LSST construction start is the identification of funding. The Consolidated Appropriations Act, 2014 includes \$200,000,000 for Major Research Equipment and Facilities Construction (MREFC), the line in the Federal budget from which large projects like LSST are funded. The omnibus bill was accompanied by an NSF-provided Explanatory Statement in the MREFC section that stipulated: "Funds are provided at the request level for all projects for which construction has already begun, and remaining funds are for the initiation of the Large Synoptic Survey Telescope (LSST) project. If NSF determines that LSST requires additional funding in fiscal year 2014, NSF may submit a transfer proposal to provide such funds."

The LSST **Telescope and Site** team has completed several early procurements of major telescope subsystems and made awards to vendors. Current awards include the M2 (the secondary mirror) Cell Assembly (ITT Exelis) and the M2 Hexapod and Camera Hexapod/Rotator systems (Moog/CSA Engineering). These early efforts support vendor-specific final design and risk reduction activities and will enable a swift transition into construction once authorization is received.



Figure 1: Victor Krabbendam (left) and Bill Gressler (right) stand behind the LSST M2 substrate, which is in its shipping/turnover fixture.



Figure 2: The M2 Cell Assembly for LSST. For scale, the diameter of the cell is 3.5 m.

The M2 substrate is shown in Figure 1. The M2 Cell Assembly, shown in exploded view in Figure 2, includes an efficient steel mirror cell and active electromechanical support system.

The M2 Hexapod (see Figure 3) consists of a ring of six actuators that attaches the M2 Cell Assembly to the Telescope Mount to provide precise positioning about the telescope optical axis. The Camera Hexapod/

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**LSST Project Prepares for Construction continued**

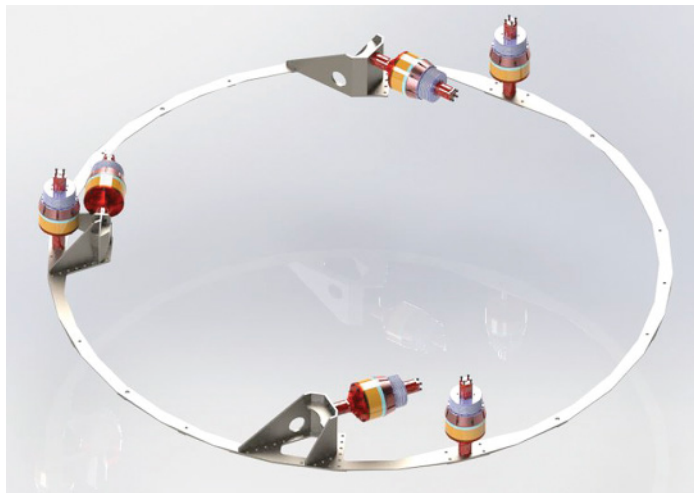


Figure 3: M2 Hexapod for LSST. The diameter of the ring is 3.5 m.

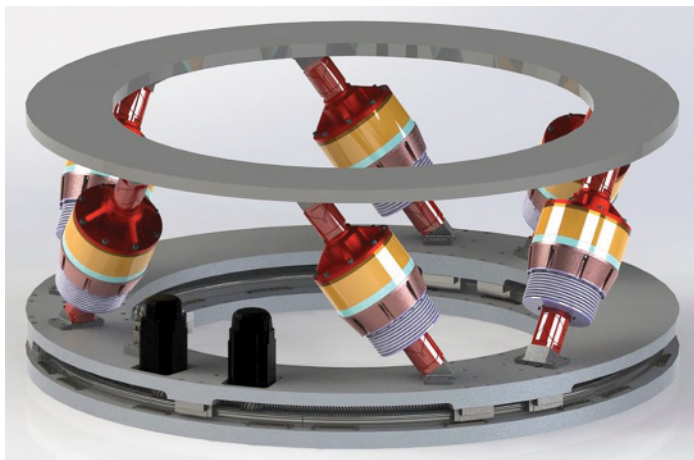


Figure 4: Camera Hexapod/Rotator for the LSST. The diameter of each ring is 1.65 m.

Rotator (see Figure 4) system likewise connects the LSST instrument to the Telescope Mount and provides for rigid body positioning and field rotation.

Additional procurements of the Telescope Mount Assembly (TMA) and the Summit Facility are planned for early 2014. The TMA is the largest single contracted effort of the Telescope and Site group and is depicted in Figure 5, integrated efficiently to the summit facility pier. This effort includes the mount structure, azimuth and elevation drives, a capacitor bank system to support the rapid settle and slew requirements, access platforms, and the camera cable wrap.

The Summit Facility procurement is being coordinated from Chile and will utilize the 100% facility design package (see Figure 6), which was completed in late 2013 by ARCADIS, an architecture firm based in Santiago, Chile. Initial construction activities will include final excavation to support road completion and structural design elements (see Figure 7).

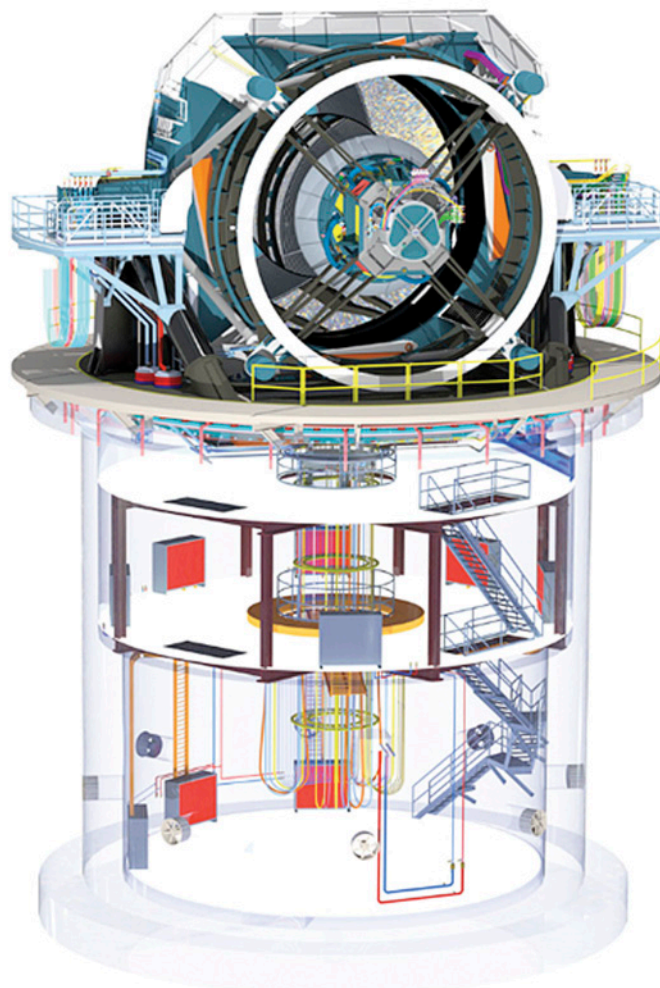


Figure 5: Telescope Mount Assembly integrated with the LSST summit facility pier.

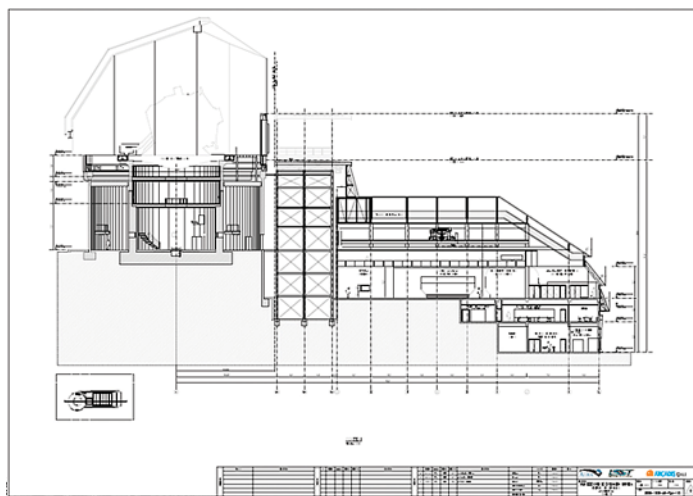


Figure 6: Design of the Summit Facility for LSST.

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## LSST Project Prepares for Construction continued



Figure 7: LSST site (El Peñón) on Cerro Pachón in Chile.



Figure 9: The delivered shipping/storage container for the LSST M1/M3 mirror.

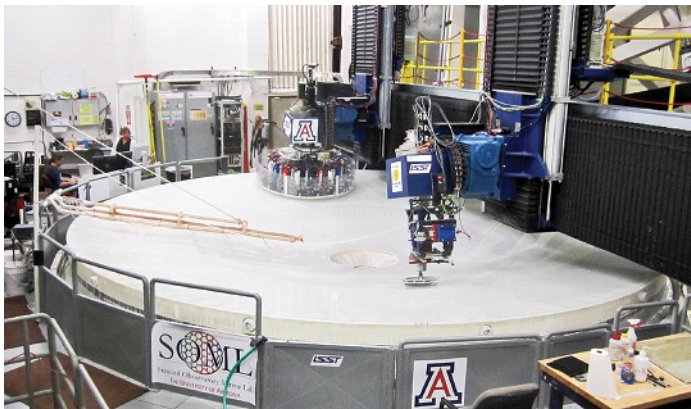


Figure 8: Polishing of the LSST M1/M3 mirror at the Steward Observatory Mirror Lab in Tucson.

The M1/M3 (primary/tertiary mirror) polishing effort is also nearing completion (see Figure 8), with final acceptance testing scheduled for mid 2014 at the University of Arizona Steward Observatory Mirror Lab. The mirror shipping/storage container has been fabricated and delivered (see Figure 9). The polished mirror will be stored locally in Tucson, awaiting completion of the active mirror cell system, which will be procured once construction is authorized. The M1M3 mirror will be integrated to its cell and retested optically prior to shipment to the summit for integration on the TMA.

The LSST **Camera** team has recently issued two large Requests for Proposals (RFPs): one for the sensor elements and the other for the L1/L2 lenses. The evaluation of proposals submitted in response to the RFPs will be completed and awards for both of these major procurements are expected to be made within the first quarter of 2014.

The **Data Management (DM)** team has prototyped approximately 60% of the software functional capability. Over 350,000 lines of open source C++ and Python have been coded, unit tested, integrated, run in production mode on LSST simulated data and data from precursor surveys. The team has released three terabyte-scale data sets, including single-frame measurements, point source, and galaxy photometry. A significant portion of this software has been executed in parallel on up to 10 K cores—TeraGrid/Extreme Science and Engineering Discovery Environment (XSEDE) and the National Center for Supercomputing Applications (NCSA) Blue Waters hardware—with highly scalable results demonstrating that the DM System will scale to the data volumes necessary to provide annual LSST data releases during operations. In the area of giga-scale network design, the team is currently testing data transfers between Chile and the US at up to 1 Gbps, a 10-Gbps link shared with Dark Energy Survey and CTIO. Agreements in principle are in hand with key network and processing center infrastructure providers (NCSA, Florida International University/AMPATH, REUNA).

The **LSST Project** continues to grow to support the upcoming construction effort. In Tucson there were a number of personnel changes recently, including the addition of Bo Xin as Systems Analysis Scientist and Chuck Gessner as Head of Safety. Recruitment for several additional positions is planned for early 2014, including the Telescope and Site Scientist and Deputy Director. The month of December marked the inclusion of the 40<sup>th</sup> Institutional Member to the LSST Corporation as both Northwestern University and Oxford University gained official organizational membership. Finally, the Project anticipates another All Hands Meeting in August 2014, to bring together scientists and technical teams for a week of intense interaction, including a workshop on survey cadences. ■

# Constructing TripleSpec 4: A New Infrared Spectrograph for NOAO South

David Sprayberry & Ron Probst

**T**ripleSpec 4 will be the last new instrument built under the ReSTAR process for NOAO. Its construction is a partnership between Cornell University (Dr. Terry Herter, PI) and NOAO; Cornell has engaged the University of Virginia (Dr. John Wilson) to support the project. TripleSpec 4 will be a moderate-resolution, single-object infrared spectrograph designed to support a broad range of science with a simple format, operational robustness, and the following principal features:

- Simultaneous wavelength coverage of 0.8–2.4 microns
- Reimaging fore-optics to match the telescope  $f/\#$  to the instrument
- Single, fixed collimator-disperser-camera unit (no moving parts)
- Resolution of  $R \sim 3000$
- Slit width of 1 arcsec, slit length of 37 arcsec
- Pixel sampling of 1 arcsec = 2.4 pixels
- Integrated infrared slit viewer/guider with an approximately  $4 \times 4$  arcmin field of view

The name of the instrument comes from the fact that three versions were planned originally. Two are in use: on the Palomar Observatory 200-inch Hale Telescope and on the Astronomy Research Consortium (ARC) 3.5-m telescope. The third is under construction at the California Institute of Technology (PI, Keith Matthews) for the Keck II telescope. The one for NOAO will be the fourth version, and it will be installed at the Cassegrain focus on the Blanco 4-m telescope at CTIO (Figure 1).

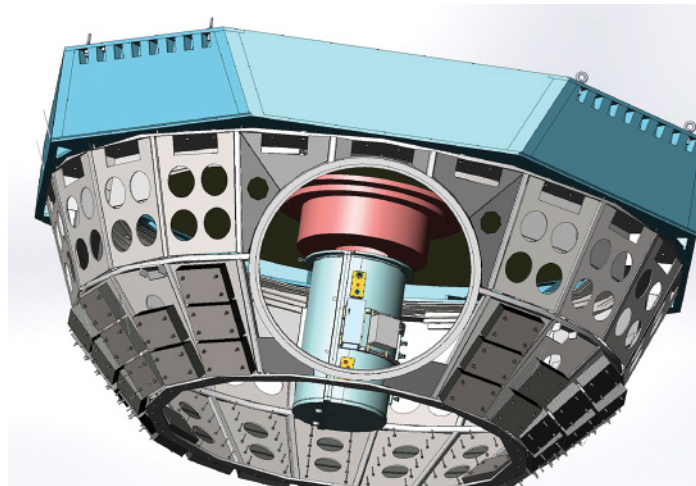


Figure 1: Engineering model showing TripleSpec 4 in the new Cassegrain cage at the Blanco 4-m telescope. TripleSpec 4 is shown at its correct focal position below the rotator, without the required mechanical spacer, which makes it look as if the instrument is “floating.”

The TripleSpec 4 team is making good progress in the construction of the instrument. Cornell and the University of Virginia are sharing responsibility for the opto-mechanical assembly. Major subsystems being fabricated by vendors are well underway, and some are nearly complete. As of mid-January, Cornell expected to oversee acceptance testing of the instrument cryostat and the spectrograph camera in late January or early February. The grating (Figure 2), the cross-dispersing prisms (Figure 3), the collimator, and the lenses for the slit-viewing camera have already been received. The off-axis paraboloidal mirrors for the entrance relay are expected around April of 2014. Several machine shops, predominantly the on-campus facil-

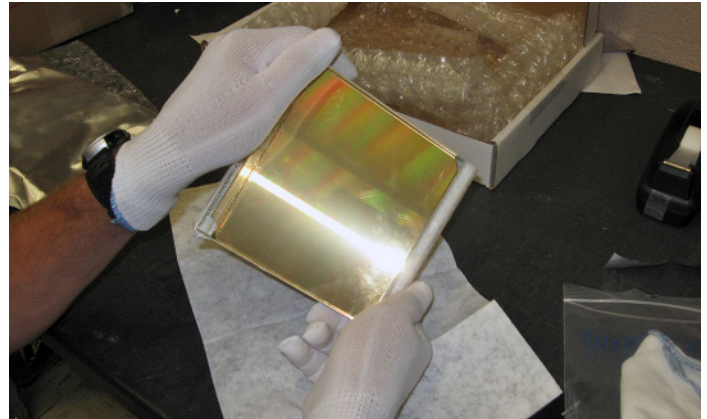


Figure 2: The echelle grating for TripleSpec 4 undergoing post-shipment inspection at Cornell.

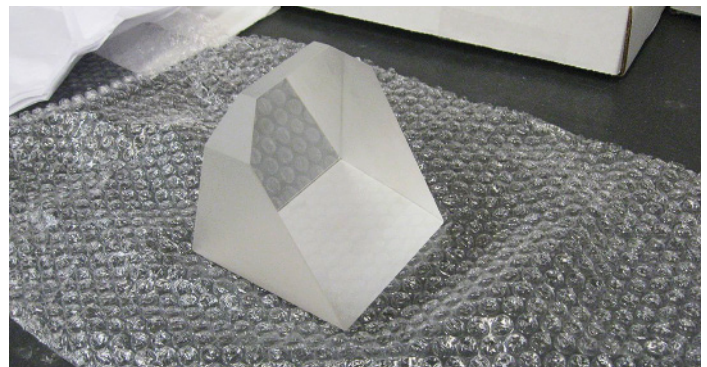


Figure 3: One of the three cross-dispersing prisms for TripleSpec 4, unpacked for inspection at Cornell.

ity at University of Virginia, are making good progress on the myriad of small parts that are needed for initial assembly of the instrument.

NOAO is responsible for the detectors, electronics, and the software to control and operate them. NOAO has completed the low-level control software and most of the higher-level user interface items. The H2RG detectors were received by NOAO along with a bare multiplexer (MUX) from Teledyne and the controller electronics from Astronomical Research Cameras. NOAO has operated the bare MUX at room temperature and achieved nominal performance as specified by Teledyne, thus verifying the design and execution of the software, cabling, and controller setup. NOAO has constructed a small test Dewar for cold testing and optimization of the detectors and is awaiting the receipt of the vacuum/cryo-qualified detector cables from a vendor. Cold-testing and optimizing the first detector should be completed by late April with delivery of this first detector-controller system to Cornell in May for their use in instrument integration.

Overall, some schedule time has been lost due to minor contracting issues, which led to a delayed start to the work at Cornell. Some of that lost time has been recovered, and Cornell and NOAO are cautiously optimistic that TripleSpec 4 will be delivered to CTIO in January 2015.



# 2014B NOAO Call for Proposals Due 31 March 2014

Verne Smith & Dave Bell

Proposals for NOAO-coordinated observing time for semester 2014B (August 2014–January 2015) are **due by the evening of Monday, 31 March 2014, midnight MST**.

The facilities available this semester include the Gemini North and South telescopes, Cerro Tololo Inter-American Observatory (including SOAR), Kitt Peak National Observatory (including WIYN), as well as the Subaru 8.2-m telescope and the 4-m Anglo-Australian Telescope (AAT) through exchange programs.

The Call for Proposals is available at [ast.noao.edu/observing/proposal-info](http://ast.noao.edu/observing/proposal-info) as a self-contained, downloadable PDF document that contains all information necessary to submit an observing proposal to NOAO. Included in this document are the following:

- 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 and travel support for classical observing on the Gemini telescopes
- Changes and news or updates since the last Call for Proposals
- Links to System facilities' web pages
- How to acknowledge use of NOAO facilities in your papers

Previous information on various web pages that contain all of the information within the Call for Proposals document also remains available at [www.noao.edu/noaoprop](http://www.noao.edu/noaoprop).

There are three options for submission:

**Web Submission** – The Web form may be used to complete and submit all proposals. The information provided on the Web form is formatted and submitted as a LaTeX file, including figures that are “attached” to the Web proposal as encapsulated PostScript files.

**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/](http://www.noao.edu/noaoprop/submit/).

**Gemini Phase I Tool (PIT)** – Investigators proposing for Gemini time **only** are encouraged to use Gemini’s tool, which runs on Solaris, RedHat Linux, Windows, and Mac platforms and can be downloaded from [www.gemini.edu/sciops/observing-gemini/proposal-submission/phase-i-tool-pit](http://www.gemini.edu/sciops/observing-gemini/proposal-submission/phase-i-tool-pit).

Proposals for Gemini time may also be submitted using the standard NOAO form, and proposals that request time on Gemini plus other NOAO facilities must do so using the standard NOAO form. PIT-submitted proposals use a PDF attachment for the proposal text sections that closely mimics the standard NOAO form—be sure to use the correct PDF template. To ensure a smooth import of your proposal, follow the guidelines at [www.noao.edu/noaoprop/help/pit.html](http://www.noao.edu/noaoprop/help/pit.html).

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



## Proposal Preparation and Submission Help

Web proposal materials and information

[www.noao.edu/noaoprop/](http://www.noao.edu/noaoprop/)

TAC information and proposal request statistics

[www.noao.edu/gateway/tac/](http://www.noao.edu/gateway/tac/)

Web submission form for thesis student information

[www.noao.edu/noaoprop/thesis/](http://www.noao.edu/noaoprop/thesis/)

Request help for proposal preparation

[noaoprop-help@noao.edu](mailto:noaoprop-help@noao.edu)

Gemini-related questions about operations or instruments

[gemini-help@noao.edu](mailto:gemini-help@noao.edu)

[www.noao.edu/ngsc/noaosupport.html](http://www.noao.edu/ngsc/noaosupport.html)

CTIO-specific questions related to an observing run

[ctio@noao.edu](mailto:ctio@noao.edu)

KPNO-specific questions related to an observing run

[kpno@noao.edu](mailto:kpno@noao.edu)



# CTIO and KPNO Telescope and Instrument Combinations for 2014B

Nicole van der Bliek (CTIO) & Lori Allen (KPNO)

## Blanco 4-m Telescope

In 2014B, CTIO will be offering three instruments on the Blanco 4-m telescope: the Dark Energy Camera (DECam), the Infrared Side-Port Imager (ISPI), and the CTIO Ohio State Multi-Object Spectrograph (COSMOS). The multi-object spectrograph Hydra is not being offered in 2014B; similar observing capabilities are available through the time trade with the Anglo-Australian Telescope (AAT). Commissioning of the CTIO Ohio State Multi-Object Spectrograph (COSMOS) will start during semester 2014A, and in 2014B, COSMOS will be offered for the community in long-slit mode on a shared-risk basis. Details of the telescope and instruments can be found on the CTIO website, [www.ctio.noao.edu/](http://www.ctio.noao.edu/).

For the duration of the Dark Energy Survey (DES), 105 nights per year will be allocated to DES. DES started on 31 August 2013 and will run through 2017. In the B semesters, DES will take up a large part of the time in the months of September to January, while the community will have access to no less than 25% of the time (roughly one week per month). In the A semesters, community access will be largely normal, although there may be up to 20 half-nights scheduled for DES in February.

DES will be providing imaging data in all available filters over 5000 square degrees, which is much of the sky available in that semester. This data will have only a one-year proprietary period. If your observation involves imaging of selected fields during the B semester, it is possible that the data you need will be taken by DES and will be available after one year.

## SOAR 4.1-m Telescope

For semester 2014B, the following instruments will be offered: the SOAR Optical Imager (SOI), the Ohio State Infrared Imager/Spectrometer (OSIRIS), the Spartan IR imager, the Goodman Spectrograph, and the SOAR Adaptive Module (SAM). The Goodman Spectrograph is available in single-slit mode. Multi-slit mode may be offered on a shared-risk basis depending on the successful outcome of science verification observations in February; confirmation and further information will be posted on the website in advance of the proposal deadline.

Approximately 85% of the 2014B time on SOAR will be scheduled for science, with the remainder being used mostly for instrument commissioning. NOAO users get 30% (almost 46 nights) of the available science time.

Remote observing is being offered for proposals requesting time through the NOAO Time Allocation Committee (TAC) and the Chile National TAC with SOI, OSIRIS, Spartan, or the Goodman Spectrograph, provided: (a) *the person who will carry out the observations has previously observed at SOAR using the instrument(s) requested in the proposal*, and (b) our review of the proposal does not reveal any special technical requirements that would make it preferable to have an observer on site.

Details of these and future instruments can be found at [www.soartelescope.org](http://www.soartelescope.org).

## Small Telescopes

The SMARTS Consortium continues to operate the CTIO small telescopes under the SMARTS 3 agreement.

In semester 2014B, 15% of the time on the 1.5-m, 1.3-m, and 0.9-m telescopes is available through the NOAO Time Allocation Committee. The 1.5-m and 1.3-m telescopes are offered in service mode, while the 0.9-m telescope is only offered in user mode. The 1.0-m telescope is currently closed. Please consult the SMARTS web pages for the latest information: [www.astro.yale.edu/smarts](http://www.astro.yale.edu/smarts). In addition, please check the Call for Proposals for the availability and observing modes on the SMARTS telescopes.

New SMARTS partners are always welcome, see the SMARTS website at [www.astro.yale.edu/smarts/about.htm](http://www.astro.yale.edu/smarts/about.htm) for information on membership. SMARTS 3 also allows principal investigators to purchase smaller amounts of time by the night (0.9-m) or by the hour (1.5-m and 1.3-m). Please contact Victoria Misenti at Yale ([victoria.misenti@yale.edu](mailto:victoria.misenti@yale.edu)) for information on the 1.5-m and 1.3-m telescopes and Todd Henry at Georgia State University ([thenry@chara.gsu.edu](mailto:thenry@chara.gsu.edu)) for information on the 0.9-m telescope.

## Mayall 4-m Telescope

The instruments available on the Mayall 4-m telescope in the 2014B observing semester will be the Ritchey-Chrétien Spectrograph (R-C Spec), Kitt Peak Ohio State Multi-Object Spectrograph (KOSMOS), Echelle, Phoenix, Mosaic, and the NEWFIRM wide-field infrared imager. Following the successful commissioning of KOSMOS in semester 2013B, some R-C Spec programs may be migrated to KOSMOS. Proposals to use KOSMOS or R-C Spec should indicate clearly whether either instrument can be used. Phoenix is offered again, however its future beyond the 2014B semester is highly uncertain. The Echelle may soon be retired, too. The instrument complement at the 4-m telescope will be further restricted in coming semesters. By the end of observing semester 2015A, the Mayall instrument complement likely will consist of only three instruments: Mosaic, NEWFIRM, and KOSMOS.

Observing semester 2014A was the last semester of open access for the KPNO 2.1-m telescope (see the article on page 16 of the September 2013 *Newsletter*). At this writing, a request for proposals from the community for the operation of the 2.1-m is in preparation.

## WIYN 3.5-m Telescope

Two new integral field units (IFUs), GradPak and HexPak are available at the WIYN 3.5-m telescope on a shared-risk basis, subject to approval by the PI (Matt Bershady, University of Wisconsin). SparsePak continues to be available as a facility instrument. Also available are Hydra and WHIRC. Note that Hydra and the instrument package that supports WHIRC and the IFUs are scheduled in campaign mode. The availability of pODI depends on when the imager is removed from the telescope for the focal plane upgrade; it may be available early in semester 2014B,

*continued*

## CTIO and KPNO Telescope and Instrument Combinations for 2014B continued

but it may be unavailable for most (if not all) of that semester. Proposers should visit the WIYN status web page, [www.wiyn.org/Observe/wiynstatus.html](http://www.wiyn.org/Observe/wiynstatus.html), prior to proposing.

The Half Degree Imager at the WIYN 0.9-m telescope was successfully commissioned in October 2013. It takes the place of Mosaic, which now remains at the Mayall 4-m telescope. Check the “Telescopes and

Instruments” web page at [ast.noao.edu/observing/current-telescopes-instruments](http://ast.noao.edu/observing/current-telescopes-instruments) for current information before submitting proposals.

All NOAO proposers are reminded that requests for remote observing on Kitt Peak are considered on an individual basis, and that certain criteria must be met in order for a proposal to be considered. These criteria can be found at [www.noao.edu/kpno/remote.html](http://www.noao.edu/kpno/remote.html).

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# System-Wide Observing Opportunities for Semester 2014B: Gemini, Subaru, and AAT

Letizia Stanghellini, Dave Bell & Verne V. Smith

Observing semester 2014B runs from 1 August 2014 to 31 January 2015. 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 is allocated about 85 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 investigators to propose for 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 first-hand. 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 Telescope Time Allocation Committee (TAC). The formal Gemini “Call for Proposals” for 2014B will be released in early March 2014 (close to the publication date of this *Newsletter* issue), with a US proposal deadline of Monday, 31 March 2014. As this article is written 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 2014B. Please watch the Gemini Science Operations web page ([www.gemini.edu/sciops](http://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 2014B:

#### 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 higher efficiency Hamamatsu CCDs in 2014B.
- GNIRS: Gemini Near Infrared Spectrograph offers a wide variety of spectroscopic capabilities including long-slit (single order) spectroscopy within the 1.0–5.4  $\mu\text{m}$  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 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.
- 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](http://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.

*continued*



## System-Wide Observing Opportunities continued

### 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. Hamamatsu CCDs should be available in 2014B.
- GeMS+GSAOI: Gemini Multi-Conjugate Adaptive Optics System with the Gemini South Adaptive Optics Imager.
- FLAMINGOS-2: Florida Multi-Object Imaging Near-Infrared Grism Observational Spectrometer version 2. FLAMINGOS-2 is expected to be available in imaging and long-slit modes for regular proposals in 2014B.
- GPI: Gemini Planet Imager. GPI is expected to be offered on a shared-risk basis in 2014B.
- GMOS-South and FLAMINGOS-2 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](http://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 multi-partner 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 includes additional tools for target optimization and verification and produces proposals that can be smoothly migrated into Phase II. The NOAO Web-based form continues to be available and should be used for proposals that wish to request other NOAO resources besides Gemini.

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 programs that can obtain useful science when the conditions are less-than-ideal are also needed.

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](http://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. Typically, up to 5 nights are available through this exchange. Observers interested in the Subaru time exchange should check the status of these capabilities closer to the deadline.

### 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 2014B, 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. For additional information, see [www.noao.edu/gateway/aat/](http://www.noao.edu/gateway/aat/).

### Summary of Instruments Available

Lists of instruments that we expect to be available in 2014B 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](mailto:lstanghellini@noao.edu)), Dave Bell ([dbell@noao.edu](mailto:dbell@noao.edu)), or Verne Smith ([vsmith@noao.edu](mailto:vsmith@noao.edu)). 

# KPNO Instruments Available for 2014B

Spectroscopy	Detector	Resolution	Slit Length	Multi-object
<b>Mayall 4-m</b>				
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
Phoenix [3]	InSb (512×1024, 1–5μm)	50,000–70,000	30"	single
<b>WIYN 3.5-m</b>				
Hydra + Bench Spectrograph [4]	STA1 CCD	700–22,000	NA	~85 fibers
SparsePak [5]	STA1 CCD	400–13,000	IFU	~82 fibers
GradPak [6]	STA1 CCD	~400–13,000	IFU	90 fibers
HexPak [6]	STA1 CCD	~400–13,000	IFU	102 fibers

Imaging	Detector	Spectral Range	Scale ("/pixel)	Field
<b>Mayall 4-m</b>				
CCD MOSAIC 1.1	8K×8K	3500–9700Å	0.26	35.4'
NEWFIRM [7]	InSb (mosaic, 4, 2048×2048)	1–2.3μm	0.4	28.0'
<b>WIYN 3.5-m</b>				
pODI [8]	12K×12K central + 4 (4K×4K) distributed	3600–9500Å	0.11	24'×24' central
WHIRC [9]	VIRGO HgCdTe (2048×2048)	0.9–2.5μm	0.10	3.3'

## 2.1-m

Not offered in 2014B

## WIYN 0.9-m

Half-Degree Imager [10]	8K×8K	3300–9700Å	0.43	59'
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[1] PIs can propose for RC Spec in 2014B, but projects that can be moved to KOSMOS will be. T2KA is the default CCD for RC Spec and Echelle. T2KB now serves as T2KA's backup. LB1A may be requested for RC Spec if appropriate.

[2] KOSMOS is offered in both single-slit and multi-object mode. See [www.noao.edu/nstc/kosmos/](http://www.noao.edu/nstc/kosmos/) for more information.

[3] See [www.noao.edu/kpno/phoenix](http://www.noao.edu/kpno/phoenix) before preparing the proposal.

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

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

[6] Gradpak and HexPak are new IFUs containing multiple fiber diameters in the same head, designed to sample different spatial scales within the same observation. They are offered in 2014B on a shared-risk basis, subject to approval of the PI. Proposers should check the WIYN status web page, [www.wiyn.org/observe/status.html](http://www.wiyn.org/observe/status.html), for contact information before proposing.

[7] Permanently installed filters include J, H, Ks. See [www.noao.edu/ets/newfirm](http://www.noao.edu/ets/newfirm) for further information, filter availability, and the policy on filter changes.

[8] pODI may be available at the beginning of the 2014B semester, before removal for focal plane upgrade. Check the WIYN status web page, [www.wiyn.org/Observe/wiynstatus.html](http://www.wiyn.org/Observe/wiynstatus.html), before proposing.

[9] WHIRC was built by Dr. Margaret Meixner (STScI) and collaborators. Potential users requiring WTTM are advised to contact KPNO support staff for details on its current status before making a proposal and [www.wiyn.org/Observe/wiynstatus.html](http://www.wiyn.org/Observe/wiynstatus.html) for any updates.

[10] HDI was successfully commissioned in 2013B.



# CTIO Instruments Available for 2014B

Spectroscopy	Detector	Resolution	Slit
<b>CTIO BLANCO 4-m</b>			
COSMOS [1]	e2v CCD 2K×4K CCD	2100	10'
<b>SOAR 4.1-m</b>			
OSIRIS IR Imaging Spectrograph [2,5]	HgCdTe 1K×1K, JHK windows	1200, 1200, 3000	3.2', 0.5', 1.2'
Goodman Spectrograph [3,5]	Fairchild 4K×4K CCD, 3100–8500Å	1800, 2800, 4300, 5900, 10,100	3.5'
<b>CTIO/SMARTS 1.5-m [4]</b>			
CHIRON	e2v CCD 4K×4K, 420–870 nm	80,000 (with image slicer)	2.7" fiber

Imaging	Detector	Scale ("/pixel)	Field
<b>CTIO BLANCO 4-m</b>			
DECam Optical Imager	LBL 62-CCD mosaic, 2K×4K	0.27	2.0 degrees diameter
ISPI IR Imager	HgCdTe (2K×2K 1.0–2.4µm)	0.3	10.25'
COSMOS [1]	e2v CCD 2K×4K CCD	0.29	12' diam cropped to 100 sq arcmin
<b>SOAR 4.1-m</b>			
SOAR Optical Imager (SOI) [5]	e2v 4K×4K Mosaic	0.08 (1×1 binning)	5.25'
OSIRIS IR Imaging Spectrograph [5]	HgCdTe 1K×1K	0.33 ( <i>f</i> /3 camera), 0.14 ( <i>f</i> /7 camera)	3.2' ( <i>f</i> /3 camera), 1.3' ( <i>f</i> /7 camera)
Spartan IR Imager [5,6]	HgCdTe (mosaic 4-2K×2K)	0.0661, 0.0400	5.04', 3.05'
Goodman Spectrograph [3,5]	Fairchild 4K×4K CCD	0.15	7.2' diameter
SOAR Adaptive Module (SAM)	4K×4K CCD (e2v)	0.045	~3'×3'
<b>CTIO/SMARTS 1.3-m [7]</b>			
ANDICAM Optical/IR Camera	Fairchild 2K×2K CCD	0.17	5.8'
<b>CTIO/SMARTS 0.9-m [8]</b>			
Direct Imaging	SiTe 2K×2K CCD	0.4	13.6'

[1] COSMOS will be offered on a shared-risk basis in 2014B in long-slit and imaging modes, pending successful commissioning in 2014A. The spectral resolution is given for a 3-pixel (~0.9") slit for the central wavelength of the blue and red VPH gratings. A 2-pixel (0.6") slit is also available. In imaging mode, COSMOS uses 4×4 inch square filters. Performance of COSMOS at Blanco is expected to be similar to KOSMOS at Mayall.

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

[3] The Goodman Spectrograph is available in single-slit mode. Multi-slit mode may be offered on a shared-risk basis depending on the successful outcome of science verification observations in February; confirmation and further information will be posted on the website in advance of the proposal deadline. The resolutions given are the maximum achievable with the 400, 600, 930, 1200, and 2100 l/mm gratings using the narrowest (0.46") slit and measured at 5500 Å. Imaging mode is also available. The instrument has its own set of U, B, V, and Rc filters, but it is also possible to install any SOI 4×4 inch square filters.

[4] Service observing only.

[5] Remote observing is possible with this instrument. Please see [www.soartelescope.org/observing/remote-observing-at-soar](http://www.soartelescope.org/observing/remote-observing-at-soar) for details.

[6] 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.

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

[8] Classical only.



# Gemini Instruments Available for 2014B \*

GEMINI NORTH	Detector	Spectral Range	Scale ("/pixel)	Field
NIRI	1024×1024 Aladdin Array	1–5 $\mu$ m Broad and narrow filters	0.022, 0.050, 0.116	22.5", 51", 119"
NIRI + Altair	1024×1024 Aladdin Array	1–2.5 $\mu$ m + L Band Broad and narrow filters	0.022, 0.050	22.5", 51"
GMOS-N	3×2048×4608 e2v deep depletion CCDs	0.36–1.0 $\mu$ m R~670–4400	0.072	5.5' 5" IFU
NIFS	2048×2048 HAWAII-2RG	1–2.5 $\mu$ m R~5000	0.04×0.10	3"×3"
NIFS + Altair	2048×2048 HAWAII-2RG	1–2.5 $\mu$ m R~5000	0.04×0.10	3"×3"
GNIRS	1024×1024 Aladdin Array	0.9–2.5 $\mu$ m 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	0.36–1.0 $\mu$ m R~670–4400	0.072	5.5' 5" IFU
FLAMINGOS-2	2048×2048 HAWAII-2	0.9–2.4 $\mu$ m R~1200, 3000	0.18	6.1' (circular)
GSAOI + GeMS	4×2048×2048 HAWAII-2RG	0.9–2.4 $\mu$ m Broad and narrow filters	0.02	85"×85"
GPI	2048×2048 HAWAII-2RG	0.9–2.4 $\mu$ m R~40–90	0.0141"/lenslet	2.8"×2.8"
EXCHANGE	Detector	Spectral Range	Scale ("/pixel)	Field
MOIRCS (Subaru)	2×2048×2048 HAWAII-2	0.9–2.5 $\mu$ m R~500–3000	0.117	4'×7'
Suprime-Cam (Subaru)	10×2048×4096 CCDs	0.36–1.0 $\mu$ m	0.2	34'×27'
HDS (Subaru)	2×2048×4096 CCDs	0.3–1.0 $\mu$ m R<90,000	0.138	60" slit
FOCAS (Subaru)	2×2048×4096 CCDs	0.33–1.0 $\mu$ m R~250–7500	0.104	6' (circular)
FMOS (Subaru)	2048×2048 HAWAII-w	0.9–1.8 $\mu$ m R~250–7500	0.216	30' diameter
COMICS (Subaru)	6×320×240 Si:As	8–25 $\mu$ m R~250, 2500, 8500	0.13	42"×32"
IRCS (Subaru)	1024×1024 InSb	1–5 $\mu$ m R~100–20,000	0.02, 0.05	21"×21", 54"×54"
IRCS+AO188 (Subaru)	1024×1024 InSb	1–5 $\mu$ m R~100–20,000	0.01, 0.02, 0.05	12"×12", 21"×21", 54"×54"

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



## AAT Instruments Available for 2014B

	Detector	Resolution	Spectral Range	Scale ("/pixel)	Field
AAOmega + 2dF (392-fiber MOS)	2x e2v 2024×4096	R~1300–8000	0.37–0.95μm	R~1.3K–8K	120'
AAOmega + KOALA (1000-element IFU)	2x e2v 2024×4096	R~1500–10,000	0.4–0.95μm	0.7" or 1.25"	24"×18" or 43"×32"
HERMES + 2dF (392-fiber MOS)	4x e2v 4096×4112	R~28K, 45K	0.47–0.79μm	R~28K or 45K	120'
IRIS2 (near-IR img/spec/mos)	1024×1024 HgCdTe	R~2400	0.9–2.5μm	0.45	7.7'×7.7'
UCLES (cross-dispersed echelle)	2K×4K EEV2 or MITLL3	R~40K–120K	0.38–1.1μm	0.16, 0.18	
UCLES + CYCLOPS2 (16-element IFU)	2K×4K EEV2 or MITLL3	R~70K	0.45–0.74μm	0.6"/fiber	2.45"
UHRF (ultra-high resolution echelle)	2K×4K EEV2	R~300K, 600K, 940K	0.3–1.1μm	0.03, 0.05, 0.10	

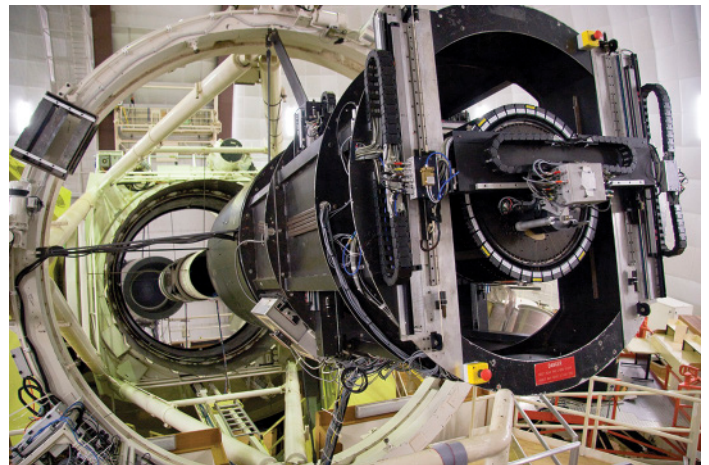
## Multi-Object Spectroscopy Options in the Southern Hemisphere

David James

The time-exchange agreement between NOAO and the Australian Astronomical Observatory (AAO) provides the US astronomical community with wide-field, multi-object spectroscopy on a Southern Hemisphere 4-m-class telescope with two instruments. The two active multi-object instruments on the 3.9-m Anglo-Australian Telescope (AAT) are superior to the Blanco's Hydra spectrograph in two distinct ways: on-sky field of view and number of fibers available.

The first instrument, the AAOmega Spectrograph, is a dual-beam instrument with an atmospheric dispersion corrector (ADC), feeding red (3700–8500 Å) and blue arms (4700–9500 Å), which receive input from either the Two Degree Field (2dF) multi-object unit or the SPIRAL integral field unit (IFU). There are approximately ten Volume-Phase Holographic (VPH) transmission gratings available for use, which yield one-pixel resolving powers in the range of  $1000 < R < 10,000$ . In 2dF mode, there are 392 fibers available, 2.1 arcsec in diameter with a minimum separation of 30 arcsec, which may be placed over a two-degree-diameter circular field of view. Located at prime focus, 2dF has a second fiber assembly and "tumbler" system available that allows users to configure their next field during their current set of observations. In SPIRAL mode, a Cassegrain-focus IFU contains a 512-element fiber-lenslet array, which yields 2-D spectra over a field of view of  $22.4 \times 11.2$  arcsec<sup>2</sup>, with a spatial resolution of 0.7 arcsec. In addition, 2dF images are pipeline processed: with extracted, wavelength-calibrated spectra as deliverables.

The second instrument, HERMES (High Efficiency and Resolution Multi-Element Spectrograph), is a recently commissioned high-resolution spectrograph that is fed using the 392-fiber 2dF multi-object unit. HERMES can provide  $R \sim 28,000$  spectra simultaneously over four



A bird's-eye view of the AAO/2dF instrument at the prime focus of the 3.9-m Anglo-Australian Telescope, located at Siding Spring in New South Wales, Australia. (Image credit: Barnaby Norris, AAO.)

wavelength bands: Blue at 4718–4903 Å, Green at 5649–5873 Å, Red at 6481–6739 Å, and Infrared at 7590–7890 Å. An even higher resolution mask, which provides  $R \sim 50,000$ , is available albeit with light losses approaching 50%.

These facilities are now available to the entire US-based astronomical community for 10 nights in each of the A and B observing semesters, with some service observing modes allowable (typically, for programs requiring less than six hours).





# DECam Update and the Dark Energy Survey First Season

Alistair Walker

The Dark Energy Camera (DECam) has been the only instrument scheduled on the Blanco telescope, apart from a small amount of time scheduled in 2013B and 2014A for the Infrared Side Port Imager (ISPI) and for commissioning the Cerro Tololo Ohio State Multi-Object Spectrograph (COSMOS).

Scientifically, the most exciting news is that the Dark Energy Survey (DES) began on 31 August 2013 and, by the end of December, had taken 16,902 science images, with a combination of full and half nights in January and a few half nights in February still to come. The September and October weather at Tololo was quite variable, with large temperature swings and often poor image quality. Thus, the survey progress was initially rather slow with only 60% of images declared “survey quality” in September. The weather improved after that, and there were some technical changes made that probably helped too (described below), so that 92% of the November and December images were declared “survey quality.” Indeed, in his talk at the AAS DES session, Aaron Roodman (SLAC) declared, “The Dark Energy Camera and the Blanco 4-meter are delivering images at the required Image Quality for the Dark Energy Survey.” Tom Diehl (Fermilab) presents in an internal DES report a table that shows through the end of December the DES had observed for 82.1% of the available DES observing time, with 12.2% lost due to weather and the remaining 5.7% being unscheduled technical down time that was shared approximately equally between DECam and the telescope. So, we conclude that the DES is off to a great start! In addition, we recently made improvements to the facility and anticipate making more changes that will help make the subsequent seasons even better.

Turning now to the technical aspects, we have continued to make upgrades to the DECam system, particularly those concerned with the telescope environment. In mid-November, the dome floor system was found to be working at low efficiency and was repaired; plus, we altered the daytime primary mirror air-cooling algorithm, with the result that during subsequent observations the primary mirror more often was as cool or cooler than the average ambient air temperature. This condition inhibits the formation of a thin highly-turbulent layer of air that occurs above a too-hot primary, and although the Chilean weather stabilized at about the same time as the change, it is impressive that since then the mean nightly delivered image quality (DIQ) has been very close to that expected from adding in the DECam, optical error budget in quadrature to the site seeing reported by the differential image motion monitor (DIMM). Another improvement made to the dome environment was bringing back into use the rebuilt Right Ascension (RA) bearing hydraulic oil cooler. The hydraulic oil is pressurized to more than 1000 psi and would reach temperatures over 30 °C at the bearing pads without cooling. The hydraulic oil is now kept at the same temperature as the ambient air. Anticipated in the next few months are installation of new prime-focus cage covers and commissioning of the new air-conditioning system for the dome.

DECam has performed reliably, with little scheduled time lost due to technical problems. An exception was the three nights lost when hexapod actuator #6 could not be controlled due to an apparently failed encoder. Hexapod problems are potentially very serious, and although we have a spare actuator, replacement would involve major disassembly and could take many weeks. However in this case, ADS (the hexapod manufacturer) quickly came up with a work-around that got us back on-sky, and a couple of weeks later the CTIO Telescope Operations group found that the actual fault was in wiring external to the actuator, so we are now back in the happy situation of all actuators working nominally. We continue to lose small amounts of time regularly due to the shutter failing and requiring a reset; we plan to dismount and clean the shutter in March. We have lost a little time due to miscellaneous computer-related problems, but, in general, the instrument has been operationally very reliable.

The worst news is that we lost a second CCD, so now we have 60 science CCDs functional. CCD S30 (exactly opposite N30 that failed in November 2012, thus at the edge of the focal plane) failed on November 28 with a fault either associated with the output amplifiers of the CCD or with associated wiring inside the Imager vacuum. We do not plan to replace these two CCDs in the near future, as the process is complicated and risky, although we will certainly review this question if we lose more CCDs. Other on-going issues are not affecting observing at present; these include thermal shorts, associated vacuum leaks in the liquid nitrogen supply and return lines near the prime-focus cage that are a serious concern, and the need to replace and rebuild the submersed liquid nitrogen pump at intervals of approximately seven to eight months.

A significant telescope improvement was made after finding that some DECam exposures were compromised by the telescope dome not being in the correct position, thus the mirror was partially vignetted. A rush project was started to replace the old electromechanical encoder system with a tape encoder and bar reader. Following installation and tests in early December, the switchover took place on December 16, and poor dome positioning became a thing of the past.

We expect to install a new DECam filter in March. This is a very broad-band “VR” design with pass-band of 500–760 nm, presently under construction at Asahi Spectra. The science drivers for this filter are deep photometry of solar system moving objects and very deep photometry of transients and variables.

In summary, DECam is producing great data for community observers and DES alike, with the community data flowing through the Community Pipeline and into the NOAO Science Archive. DES raw data will be available to the community via the Archive portal following a 12-month proprietary period. DECam is scheduled for 144 nights in 2014A, and we expect to see science papers from the first year of operations very soon.



## SMARTS Is Poised for K2

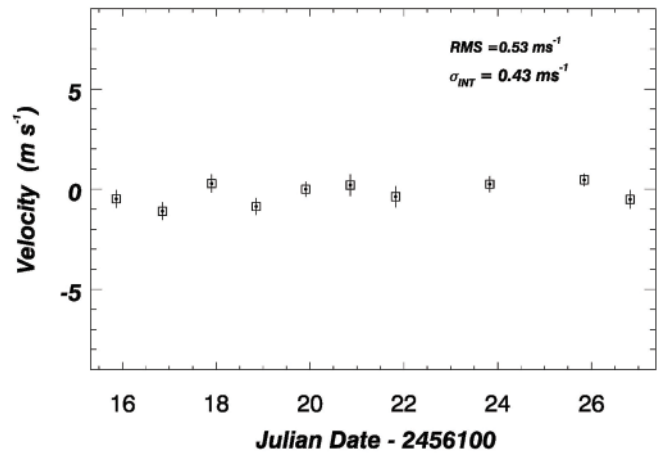
Imran Hasan (Yale), SMARTS Data Manager

The Kepler mission has greatly enhanced our understanding of the local cosmos. Kepler's proposed K2 mission (Kepler's Second Light) will continue to do so in a new capacity, and SMARTS is ready to enable principal investigators to enhance our knowledge further with follow up observations.

SMARTS (Small and Moderate Aperture Research Telescope System) employs a family of 1-m-class telescopes. Located at CTIO in Chile, the telescopes can observe targets as north as +20 and as south as -80 degrees in declination, granting coverage of the K2 field of view along the ecliptic.

The spectrometer mounted on the SMARTS 1.5-m, CHIRON, is particularly well suited for continuing observations of possible planet-hosting stars. CHIRON is a high-precision fiber-fed spectrometer capable of measuring radial velocities at the sub meter-per-second level. Covering a wavelength range of 415–880 nm, the temperature- and pressure-stabilized instrument can achieve a resolution of  $R = 136,000$ . The SMARTS 1.5-m telescope and CHIRON together operate in queue and service mode, enabling flexible scheduling for continuous observations.

For more information on how to get access to CHIRON for Kepler follow-ups, please see the SMARTS website at [www.astro.yale.edu/smarts](http://www.astro.yale.edu/smarts).



HD 10700 (Tau Ceti) was observed using CHIRON for a period of two months to produce a nightly radial velocity precision of 0.42 m/s with a root mean square scatter of 0.96 m/s (Tokovinin et al. 2013, PASP, 123, 1336). (Image credit: D. Fischer.)

## SOAR Dome Waxing Completed

Steve Heathcote

The bi-annual process of wax-polishing the SOAR dome was successfully completed in January. The composite fiberglass panels that make up the SOAR dome exude titanium oxide due to exposure to ultra-violet light. As a result, the panels become porous so that ice and snow adhere to them, increasing the time lost following winter storms and risking long-term damage to the panels. To prevent this, the accumulated oxide is removed every two years, and the dome is wax-polished until it shines. Accomplishing this safely, while working up to 25 m above the ground, requires the help of two teams of specialist contractors. The first team works on the lower two thirds of the dome from a man-lift, while the second team rappels from the top of the dome to access the upper third. The work of the contractors was supervised by Gerardo Gómez. Eduardo Serrano developed the overall plan for this activity, which was executed under the able supervision of Gerardo Gómez, while Mariela Silva, NOAO South Safety and Environmental Engineer, kept a sharp eye on the safety aspects. The work was completed in three weeks, exactly as scheduled.



Contractors wax-polish the SOAR dome. (Image credit: Gerardo Gómez, SOAR.)



## Retirement of Hydra from Blanco

Nicole van der Bliek & Steve Heathcote

In the near future, two new spectroscopic capabilities will be offered at the Blanco: the CTIO Ohio State Multi-Object Spectrograph (COSMOS) and TripleSpec 4. Currently, access to multi-fiber spectrograph capability is available through the time trade with the Anglo-Australian Telescope (AAT), which is described in this *Newsletter* in the “Multi-Object Spectroscopy Options in the Southern Hemisphere” article by David James. In light of this, NOAO will be retiring Hydra from the Blanco 4-m telescope.

If you were conducting a long-term program using Hydra, and/or if you are uncertain about the multi-fiber opportunity at the AAT, please contact us ([nvdbleik@ctio.noao.edu](mailto:nvdbleik@ctio.noao.edu) and [sheathcote@ctio.noao.edu](mailto:sheathcote@ctio.noao.edu), respectively)

## Recovery Status of the $f/8$ Secondary Mirror

Timothy Abbott

Progress has continued since the last *Newsletter* report on the return of the  $f/8$  secondary mirror to the Blanco telescope and recommissioning the Cassegrain focus. We completed two additional engineering runs in August and October of 2013. During these, we repeatedly installed the mirror on the telescope using the  $f/8$  handler mechanism, checked and tweaked its alignment with the primary mirror, tested the baseline active optics lookup table, and established a pointing map with the new Telescope Control System (TCS). In October, the mirror was used to obtain scientific observations with the Infrared Side Port Imager (ISPI). At this point, the Cassegrain focus appears to be performing at a level comparable to that obtained before the mirror was damaged in February 2012.

Inevitably, some issues were exposed that will need to be addressed. In particular, we will modify the handling mechanism to permit quick and safe exchanges of the  $f/8$  mirror with the counterweight that takes its place during observations with DECam. We are investigating these issues, and, in the meantime, the telescope with  $f/8$  instruments is offered to the community for observations. For now, we must write more contingency time into the schedule than we would normally expect to do once the focus exchange procedure has been properly commissioned.

The Blanco prime focus unit, with the  $f/8$  secondary mirror installed, partway through the rotation between the position at which the mirror is installed and its orientation when pointed at the primary mirror for observations. The DECam nitrogen recondensation facility can be seen reflected in the mirror. (Image credit: Timothy Abbott/NOAO/AURA/NSF.)



# NOAO at the 2014 Winter AAS Meeting

Ken Hinkle



Figure 1: NOAO booth at the 2014 winter American Astronomical Society meeting in Washington, D.C. The booth backdrop was designed by NOAO Graphical Designer Pete Marenfeld with input from NOAO staff Bob Blum, Tom Matheson, and Abi Saha. (Image credit: Stephen Pompea/NOAO/AURA/NSF.)



Figure 2: NOAO astronomers Tom Matheson (left) and Knut Olsen (right) mimic their likenesses shown on the NOAO booth backdrop at the January 2014 AAS meeting. (Image credit: Stephen Pompea/NOAO/AURA/NSF.)

NOAO takes advantage of the large, winter American Astronomical Society (AAS) meetings to meet and talk with you, the users and potential users of our facilities and services. A focal point of this activity is the NOAO booth. For the 2014 NOAO booth, the NOAO Graphical Designer Pete Marenfeld produced a comic themed backdrop (see Figure 1), with input from Bob Blum, Tom Matheson, and Abi Saha. The backdrop presented the story of an astronomer searching a night's LSST data aided by software currently under development in a University of Arizona and NOAO collaboration (see "ANTARES: A Tool for the LSST Transient Sky" in the Science Highlights section of this *Newsletter*). NOAO scientific staff members were illustrated as characters, including Tom, Abi, Hanae Inami, Gautham Narayam, Knut Olsen, and Colette Salyk, with student intern Rebecca Levy as the astronomer searching the LSST data (see Figure 2). The appeal of comics was apparent, as many people came by to read the strip.

NOAO scientific staff members were present at the booth throughout the meeting (see Figure 3). The staff had varied goals for the meeting, which included providing assistance with Gemini Phase II preparation, discussing the NOAO Research Experiences for Undergraduates program with undergraduates, talking to prospective candidates for open positions, interacting with students and teachers, discussing new NOAO projects, as well as answering questions about the ongoing NOAO mission. NOAO Director Dave Silva was available to talk with users as were CTIO and KPNO Associate Directors Nicole van der Blik and Lori Allen, respectively. A high point was an Education and Public Outreach teaching event held by Connie Walker at the booth with middle school students making telescopes from lenses.

NOAO also hosted a town hall meeting during the AAS meeting. Dave Silva presented the forward look for NOAO in this time of fiscal austerity and transformation of priorities by the NSF. About half of the hour-long town hall was used for discussion, with Dave fielding questions from a number of NOAO telescope users.

Look for NOAO in Seattle in January 2015.



Figure 3: NOAO staff manning and visiting the NOAO Booth during the January 2014 AAS meeting: (Left to right) Alistair Walker, David Sprayberry, Bob Blum (NOAO deputy director), Dave Silva (NOAO director), Tom Matheson, and Knut Olsen talking to a visitor. (Image credit: John Glaspey.)



# Kitt Peak Visitor Center Milestone: 50 Years of Providing Public Outreach

Rich Fedele



Kitt Peak Visitor Center circa 1960s



For over 50 years, the Kitt Peak Visitor Center (KPVC) has functioned as part-museum, part-interpretive center, an auditorium, gift shop, classroom and media center. Well over 2 million people have come through the KPVC to learn about the science, history, and mission of the Kitt Peak National Observatory, National Solar Observatory, NOAO, AURA, and NSF.

The KPVC was built in 1964 with funding provided by the NSF. The facility has enabled outreach opportunities to the general community, and the Tohono O’odham Nation in particular, ever since. The visitor center has educated young and old, local residents and international visitors, ardent lovers of science, and casual tourists alike from all walks of life and backgrounds. For our visitors, the KPVC has served as the “face” of not only Kitt Peak National Observatory (KPNO), but of ground-based optical astronomy. It is one of the main ways for KPNO to engage the public with our mission and educationally based activities.

The KPVC is considered to be one of the major niche markets for astronomy tourism in Arizona and is a unique experience for even seasoned

world travelers. The KPVC now receives an estimated 45,000 to 50,000 guests annually.

KPNO receives national and international attention for not only the science that occurs at its facilities, but also through its outreach efforts and the world-class informal science education programs that are open to all. The KPVC mission is simple: “To engage, inform, and inspire a sense of wonder and discovery about the science of astronomy to a diverse audience through exhibits, tours, and public programs.”

A lot has changed over the years. New programs and learning opportunities have been added and continue to increase. New facilities have been taken over and run by the visitor center to expand program offerings. Opportunities exist with other mountain tenants to create one-of-a-kind experiences found nowhere else. All of these programs, dedicated staff, and volunteers make Kitt Peak a true experience like no other.

You have an open invitation to pay us a visit the next time you are on the mountain. Visiting astronomers receive a 10% discount on items in the visitor center store.



Kitt Peak Visitor Center circa 1970s



*continued*



Kitt Peak Visitor Center Milestone continued



Kitt Peak Visitor Center circa 1980-1990s



Kitt Peak Visitor Center circa 2000s



## The 2014 La Serena School for Data Science

Chris Smith (CTIO) & Chris Miller (University of Michigan)

In August 2014, CTIO, AURA, the Large Synoptic Survey Telescope Project Office (LSST), and several collaborating Chilean institutions are hosting the second annual “La Serena School for Data Science.” The school aims to introduce advanced undergraduates and beginning graduate students in the fields of astronomy, computer science, statistics, and mathematics to the tools and techniques currently available to explore the large data sets of today and the extremely large data sets of tomorrow. These young scientists will be finishing their studies just in time to lead the exploration of the data coming from LSST and other

large surveys in 2020 and beyond. With the foundation and experience gained from this school, students will be equipped with the knowledge to better exploit currently accessible astronomical databases. They will also be able to quickly learn to use, and possibly participate in the development of, the new tools that are needed for the next generation of petabyte data sets.

The school is being held for one week each August in 2013, 2014, and 2015 in La Serena, Chile. In August 2013, 35 eager students from the

*continued*

## The 2014 La Serena School for Data Science continued

US and Chile participated in the first program, which included introductory lectures, a variety of hands-on activities, and several group projects in which the students applied the tools and methods they recently had learned.

The 2014 program will be held the week of August 15–23. Applications are due April 15, and scholarships for US and Chilean students are

available to cover travel and most living expenses for the week, thanks to support from the NSF, AURA, NOAO, LSST, and Chilean institutions. Please visit the school's website ([www.aura-o.aura-astronomy.org/winter\\_school/](http://www.aura-o.aura-astronomy.org/winter_school/)) for more information on the 2014 school as well as the program and presentations from the 2013 school. CTIO looks forward to hosting the best and brightest future data scientists for the 2014 program in La Serena!

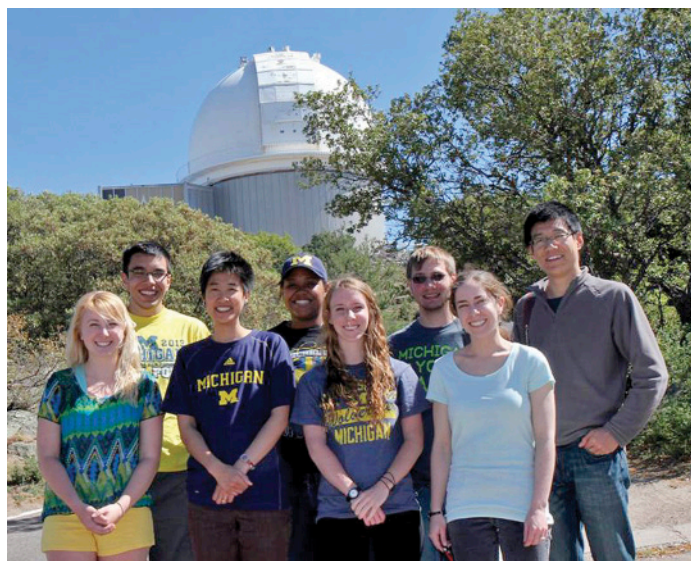
## A Month of Personal Transformation at Kitt Peak

Sierra Grant (University of Michigan, class of 2014)

The bright, sunny afternoon of 5 May 2013 found my five classmates and me walking out of the Tucson airport doors and into the fierce Arizona heat. Following a little grocery shopping to pick up last-minute items, our two rental cars drove along Ajo Way toward the mountains. As we wound our way around Kitt Peak on that narrow ribbon of blacktop, I couldn't help but crane my neck to look out the window and up to the gleaming white domes that stood waiting at the peak. It was clear from the butterflies in my stomach that calling Kitt Peak National Observatory home for the next four weeks was an experience I would never forget.

Early in the 2012–2013 school year, word began traveling around the University of Michigan Astronomy Department that Professor Sally Oey was trying to organize a class that would bring students to the national observatory for an extended amount of time. Her goal in forming this class was to draw students out of the Michigan classroom and expose them to real astronomy work, teach them about the community to which they will belong should they continue their careers in astronomy, and give them an experience not many astronomy students anywhere in the world are afforded. As time went on, the class was finalized, Anne Jaskot was chosen as the graduate student teaching assistant, and students planned their summers. Six astronomy and astrophysics majors applied and were accepted into the class: Talor Henderson, Keith Johnson, Evan Kasal, Hui Li, Jill Moreau, and I were those lucky six.

The six of us were to live at the observatory for four weeks, taking tours of the facilities at Kitt Peak and other neighboring observatories, attending lectures on everything from CCDs to the politics of light pollution in nearby Tucson, and having an observing run of our own at the McGraw-Hill and Hiltner MDM telescopes. Our first week was a busy one; we spent it preparing observing proposals to be judged by our peers for our observing run, getting to know our way around the mountain, and attending our first lectures. Our third night on the mountain, May 7, my roommate Jill and I were lying in our beds and talking. Half an hour had gone by despite our heavy eyelids when Jill stopped me, saying, “Sierra, did we just talk about telescopes for half an hour straight and not even realize it?” I had not noticed, but she was right, we had discussed nothing else! I wrote about the incident in my journal the next day with the words, “We’re becoming astronomers.”



University of Michigan Astronomy Department students, professor, and teaching assistant during their visit to Kitt Peak National Observatory. Front row: Jill Moreau, Sally Oey (professor), Sierra Grant, Anne Jaskot (teaching assistant); Back row: Evan Kasal, Talor Henderson, Keith Johnson, Hui Li. (Image credit: John Glaspey.)

It was a common theme I found, that astronomy was all I could think about. Not more than a few minutes would go by that I would not think about this telescope or that, some observing team and their project, or the data reductions to be done. I was not alone; not one single time in my four weeks on Kitt Peak did I hear any person outside of our group discuss anything unrelated to astronomy. The dinner discussions at neighboring tables in the cafeteria, the conversations between astronomers as they walked through the hallway of the Administration Building, the exchanges between observers as their exposures were being taken: every dialogue I heard contained the words “field of view,” “dark current,” or “flat field.” People were continually discussing this galaxy, that cluster, this H II region. It seemed strange to me, and at first I thought to myself, “Don’t they realize there are other things in the world besides astronomy?” But it did not take me long to discover for myself that these people are simply passionate.

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## A Month of Personal Transformation at Kitt Peak continued

The word “passionate” is played out, or overexposed as one might say as one’s mind drifts to the two saturated CCD exposures taken the night before. Every visiting astronomer I met at Kitt Peak—every telescope engineer, every staff support person, every docent—was passionate. Their hands would become animated as they talked about getting the partially populated One Degree Imager of WIYN up to a full degree; their eyes would light up as they carefully threw the Burrell Schmidt around its dome; their words would speed up as they told us about unique, new questions from the public on a tour they had given that day. But these people are not just passionate—they are fervent, dedicated, and excited, and their enthusiasm quickly rubbed off on me in a way I know I will never forget.

In our time at Kitt Peak, I learned things I will never learn in a classroom, got behind-the-scenes views of the telescopes most visiting astronomers will never see, and discovered the astronomy community I will spend the rest of my life striving to be a part of. To every single person who was associated with our stay at Kitt Peak in some way, I offer my thanks. Saying “Thank You” feels so small, in return for all you have given me and my fellow students. Every one of you walked that extra mile to make sure we got the absolute most out of our time, and it was not in vain. You are extraordinary people doing extraordinary things, and I will forever be grateful for the passion and excitement you have passed on. I think I may speak on behalf of the rest of the Michigan Astro 461 class when I say your lessons will be ones we remember all our lives. “Thank You” may seem so small, but we mean it so big. 🎧

## Astronomy 101 at Tohono O’odham Community College

Katy Garmany & Colette Salyk



Figure 1: Tohono O’odham Community College campus. Note the Mayall on the mountain ridge in the far background.

**K**itt Peak National Observatory is located on the reservation of the Tohono O’odham Nation. Recent years have seen increasing, positive interactions between the tribe and NOAO, particularly in the areas of education and outreach. Thus, last spring when the administrators of Tohono O’odham Community College expressed interest in offering an astronomy course, NOAO welcomed the opportunity to be involved.

Tohono O’odham Community College (TOCC) is a young, tribal college, only in existence since 1998. It serves a reservation that is about the size of Connecticut in area, with a population of about 30,000. For the first few years of its existence, the college operated from existing buildings in Sells, a town 20 miles west of the turnoff to Kitt Peak (Iolkam Duag is the Tohono O’odham name for Kitt Peak). In 2013, the college moved to a new campus located just 10 miles west of the turnoff. Figure 1 shows the Mayall 4-m telescope on Kitt Peak, as seen from the TOCC campus.

Colette Salyk, the NOAO Goldberg postdoc, and Katy Garmany, NOAO Associate Scientist, jointly taught the Astronomy 101 (Astro 101) class at TOCC this fall. Astro 101, which carries transfer credit to Arizona State colleges, is a four-credit class that met Mondays and Wednesdays from 4–6:30 pm. Garmany, a member of the NOAO Education and Public Outreach (EPO) staff, had taught Astro 101 at TOCC from 2004–2006, but astronomy had not been offered by the college since that time. There was quite a bit of interest in the class, and 12 students enrolled—a large class by TOCC standards. Three Tohono O’odham employees of NOAO/KPNO were among those enrolled in the class.

The class includes laboratory work, so we naturally made great use of Kitt Peak, located only 30 minutes away. We spent an evening with the KPNO Visitor Center Nightly Observing Program; this gave our students an opportunity to use planispheres (star wheels), binoculars, and do visual observing with a 20-inch telescope. Although many of our students



## Astronomy 101 at Tohono O'odham Community College continued



Figure 2: Image of M74 taken by a Tohono O'odham Community College Astronomy 101 student at the WIYN 0.9-m telescope with the new Half Degree Imager camera.

live nearby, none had ever attended the evening program at Kitt Peak, which is free to all members of the Tohono O'odham Nation. We also arranged an evening at the WIYN 0.9-m telescope with its new Half Degree Imager camera, courtesy of Flynn Haas (WIYN). As true observers, our students began the evening with dinner in the astronomers' dining hall, before proceeding up to the 0.9-m telescope where each student got to choose, and take, their own observation of a Messier object. Figure 2 shows M74, as imaged by one of our students. (Processing help was provided by Travis Rector, University of Alaska!)

The class was not without its challenges. Our students sometimes faced obstacles to learning in their personal lives. This is not surprising, given some of the issues facing this community. For example, according to statistics from the Tohono O'odham Community Action website ([www.tocaonline.org](http://www.tocaonline.org)), 46% of the community is below the poverty level (compared to 13% overall in Arizona), unemployment may be as high as 75%, and 60% of adults are diabetic. In addition, there are many problems associated with the community's co-location with the international border. TOCC is also primarily a commuter college, and so transportation to class was at times an issue for some students. The students also entered the class with a wide range of math/science experience.



Figure 3: Tohono O'odham Community College Astronomy 101 students and instructors at their class potluck.

Nevertheless, we strove for (and believe we achieved) a highly interactive and positive classroom experience. We made extensive use of lecture-tutorial exercises, in-class labs, and as many interactive projects as possible. In addition, students did a final project and class presentation. Among the final projects, Bellina interviewed Arlo Landolt about his observing at Kitt Peak, Amy learned the O'odham names for the lunar phases from her grandmother, and Steven painted a realistic impression of the surface of Titan (and donated the painting to NOAO).

While there were certainly challenges, we both felt very good about the impact of the class. After the first week, no students dropped the course, and attendance was generally very good. Informal Facebook posts attested to student interest and excitement about the class. Connections between EPO staff and AISES (American Indian Science and Engineering Society) students were made, and a star party for the entire community is being planned. In the course of a discussion about the history of Kitt Peak, there were frank, open conversations with younger members of the Tohono O'odham Nation. Students found that there are indeed shared concerns, such as light pollution, between Kitt Peak and the Nation. The final anonymous evaluation submitted by the students confirmed that the class was well-received (although considered harder than expected by some!). And all of the comments singled out the visits to Kitt Peak as a highlight of the course. NOAO has been approached by TOCC administrators about teaching another astronomy course next fall.

We ended the class with a potluck dinner (see Figure 3). How many of us have students who can make frybread from scratch for 12 (although the O'odham prefer to call them popovers)? ●●●

## CTIO Summer Student Program for 2014

Catherine Kaleida

It is summer in the Southern Hemisphere and the CTIO Summer Students 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 will 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. In the first weeks of the program, we already have toured the CTIO La Serena facilities, the telescopes on Cerro Tololo and Cerro Pachón (see the “Students Take ‘Grand Tour’ of Telescopes” article in this *Newsletter*), and participated with the NOAO South Education and Public Outreach team in a public outreach event in Punta de Choros, a small village north of La Serena. The program is off to an exciting start!



The 2014 CTIO Summer Students on Cerro Pachón with Cerro Tololo in the background: (Left to right) John Farmer, Alexander Contreras Quijada, Piera Soto King, Shane Loeffler, Margot Paez, Joshua Frechem, Sarah Burkhart, Blake Pantoja, and Vaishali Parkash. (Image credit: Catherine Kaleida/NOAO/AURA/NSF.)

Six US students participate in the CTIO Summer Student Program through the NSF-funded CTIO Research Experiences for Undergraduates (REU) program. The 2014 REU students are Sarah Burkhart (Arizona State University), John Farmer (Clemson University), Joshua Frechem (Old Dominion University), Shane Loeffler (University of Minnesota), Margot Paez (University of California Los Angeles), and Blake Pantoja (University of Louisville). Two Chilean students, Piera Soto King (Universidad de La Serena) and Alexander Contreras Quijada (Universidad de Valparaíso), participate through the *Práctica en Investigación en Astronomía* (PIA) program, funded by CTIO. We also have an additional student intern this year, Vaishali Parkash, who is continuing the work she began as a Union College Term Abroad student at CTIO last year. 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 David James, Kathy Vivas, and César Briceño; CTIO visiting astronomer Djazia Ladjal; and Gemini staff Percy Gomez, Peter Pessev, and Blair Conn for contributing their time to mentor students in the 2014 program.

## Students Take “Grand Tour” of Telescopes

Chris Smith & Catherine Kaleida

CTIO, Gemini, and AURA hosted a large group of students on the “Grand Tour” of AURA facilities in Chile, 17 January 2014. The group was composed of the six CTIO Research Experiences for Undergraduates students, the two CTIO *Práctica en Investigación en Astronomía* (a Chilean internship) students, two Gemini interns from Australia, a Union College/CTIO Term Abroad student, and twelve students participating in a two-week data science program co-sponsored by AURA, Harvard, the University of Chile’s Center for Mathematical Modeling, and the Millennium Center for Supernova Studies (MCSS).

The day started on Cerro Tololo with a brief history of the site together with a visit to the Blanco 4-m telescope to see the largest camera in the Southern Hemisphere, the Dark Energy Camera. The group then moved over to Cerro Pachón to see the SOAR and Gemini South telescopes. After watching the sun set slowly over the site for the Large Synoptic Survey Telescope, the tour culminated with a view of the Gemini Multi-Conjugate Adaptive Optics System firing its five-laser constellation skyward.



Some of the 2014 students touring the CTIO Blanco 4-m telescope. Back row (l-r): Piera Soto, Blake Pantoja, Shane Loeffler, Joshua Frechem, John Farmer, Sarah Burkhart, Alexander Contreras, and Margot Paez; front row (l-r): Vaishali Parkash, Rebecca Davies, and Marcus Wong. (Image credit: Catherine Kaleida/NOAO/AURA/NSF.)



# Update on NOAO Associate Directors

David Silva

NOAO has Associate Directors (ADs) for the NOAO System Science Center (NSSC), Kitt Peak National Observatory (KPNO), and NOAO South (NS). Between them, these three ADs have day-to-day operational responsibility for the majority of NOAO activities. Naturally, all three ADs are also deeply involved in reshaping their groups to adapt to new financial and programmatic realities (see the “Director’s Corner” article in this *Newsletter*). Who are these people that are so critical to NOAO’s success?

Since 2006, Dr. Verne Smith has been the AD for NSSC. Verne has overall responsibility for the US National Gemini Office, operations and maintenance of all science data archiving and processing systems, and various community services development projects related to the Large Synoptic Survey Telescope, Thirty Meter Telescope, and optical interferometry. More and more, NSSC is turning its focus toward how to enable high impact research with the rich catalogs and processed data being produced by NOAO Survey programs, especially the Dark Energy Survey. By developing improved services in this area now, NSSC is preparing for a future where the exploitation of LSST data products will be a key area of focus for our community.

As of 1 September 2013, Dr. Lori Allen is the AD for KPNO. Before that, she was the KPNO Deputy Director for two years. As AD, Lori has overall responsibility for all administrative, scientific, and technical activities needed to operate and maintain NOAO facilities on Kitt Peak as well as the common infrastructure shared by NOAO and other tenants on Kitt Peak. Specific activities include providing the main interface between NOAO and leaders of the Tohono O’odham Nation, as well as collabo-

rating with observatory leaders and government authorities throughout Arizona on site protection, especially controlling light pollution. Lori is also engaged in the development work needed to lay the foundation for bringing the Dark Energy Spectroscopic Instrument (DESI) to the Mayall.

As of 1 February 2014, Dr. Stephen (Steve) Heathcote has become AD for NOAO South. As described in the “Changes at the SOAR Directorship” article in this *Newsletter*, Steve comes back to NOAO after a long tenure as SOAR Director. As AD, Steve has overall responsibility for all administrative, scientific, and technical activities needed to operate and maintain NOAO facilities on Cerro Tololo and Cerro Pachón as well as the common infrastructure shared by NOAO, Gemini, LSST, and other tenants on those mountains and within the common area in La Serena. In the next two years, Steve’s team will be commissioning major new instruments for both Blanco and SOAR. Steve will also be busy over the next years overseeing NOAO’s support for LSST construction activities on Cerro Pachón and in La Serena.

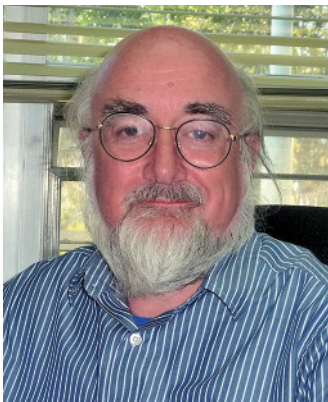
While I’m talking about our ADs, I will take this opportunity to thank Dr. Nicole van der Blik for her service as acting AD for NOAO South during the period of October 2012 through January 2014. Nicole had an exceptionally busy and productive 16 months, building a solid foundation for continued NOAO South success through such activities as ensuring a successful first year of DECam operations, guiding the repaired Blanco *f*/8 secondary mirror back into service, and working to place NOAO South shared infrastructure support on a more transparent and robust basis for all tenants. Nicole will act as the Deputy Director for NOAO South for at least the next six months. Thank you, Nicole!



Dr. Verne Smith



Dr. Lori Allen



Dr. Stephen Heathcote



Dr. Nicole van der Blik

## Changes at the SOAR Directorship

Stephen Zepf (Chair, SOAR Board)

As of February 1, Steve Heathcote will move from being Director of the SOAR Telescope to being Director of CTIO (NOAO Associate Director for NOAO South). While Steve is only moving offices by several meters,

this is a major change for SOAR, as he has been the SOAR director since 2000. As director—and the first director, that is—Steve has led the SOAR Telescope with a very steady hand and a clear focus on making it run as

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## Changes at the SOAR Directorship continued


efficiently and effectively as possible. This has been true from the start with SOAR's first light and telescope commissioning through its current regular science operations.

Steve's dedication and calm demeanor in the face of inevitable challenges will be greatly missed. The SOAR partners appreciate his tireless efforts and gratefully acknowledge his key role in making SOAR into a scientifically productive facility. Fortunately, Steve will still be very nearby, and a search for the next SOAR Director is underway.

With Steve Heathcote stepping down as SOAR Director and the search process for a new director still underway, an interim solution was called for. Dr. Horacio Dottori (Universidade Federal de Rio Grande do Sul,

Brazil) kindly accepted the SOAR Board's request to serve as Interim SOAR Director for a period of six months, which began 16 January 2014.

Horacio was an associate professor at the Astronomy Department at the Universidade Federal de Rio Grande do Sul, with several years of managerial and administrative experience at the department. Most recently, he has been a consultant to the Brazilian Conselho Nacional de Desenvolvimento Científico e Tecnológico (National Council for Scientific and Technological Development).

Horacio, originally from Argentina, moved to La Serena with his wife, Isa, for the duration of his interim directorship. 



## In Memoriam: Oscar Saa 1942–2013

R. Chris Smith

It is with a heavy heart, but a wealth of respect and admiration, that we report the passing of Oscar Saa, a cornerstone of the CTIO staff. Oscar's leadership of the telescope operations group over more than 30 years helped establish CTIO's long-lasting reputation as a world-leading platform for astronomical observations, both for the primary telescopes he himself helped commission (like the Blanco 4-m) and smaller projects like GONG and PROMPT, which he looked after almost as a father. Oscar set an example for all of the staff, from technical to scientific, not only with his dedication but even more so with the positive, can-do attitude that he always brought to the task at hand or the challenges being faced.

Oscar joined the staff at CTIO on 5 January 1970 after serving his country for several years in the Chilean Air Force. He was hired as an assistant observer for the Lowell telescope and was soon recognized for his contributions. By 1978 he was leading the Observer Support group on Cerro Tololo, setting the example of high quality support of visiting astronomers for which Tololo has long been known. From 1982 until he stepped down in 2010, Oscar managed the operations of all of the telescopes on Cerro Tololo, keeping some of the decades-old instruments running while leading the commissioning of instruments at the cutting-edge of technology. With his 43 years of experience on Tololo, his knowledge of every corner of every building was unparalleled and often critical when it came to performing tasks that only happened once every decade! Even after he retired in 2011, he answered the call to come back and help with the new challenges of both the installation of the Dark Energy Camera on the Blanco 4-m telescope and the installation and commissioning of the three 1-m telescopes of the Las Cumbres Observatory Global Telescope Network on Cerro Tololo.



Oscar's contributions and lasting impact go well beyond the realm of managing the operations of all of the telescopes on Cerro Tololo. He was a mentor to many generations of staff at CTIO, from telescope operators to scientists, and even several directors. His experience and wisdom was matched with a humble and gentle demeanor, which made his advice all the easier to request and valuable to receive. Furthermore, Oscar touched generations of visiting astronomers at CTIO, teaching many students, postdocs, and professors not just the science, but the art, of observing.

Oscar carried his passion for astronomy beyond the CTIO staff and visiting astronomers. He was always willing to guide visiting guests around the CTIO telescopes and proudly introduce them to the sights of the stunning skies of northern Chile. His enthusiasm extended beyond the boundaries of the observatory through participation in public events and a wide range of amateur astronomy activities. He helped establish Chile's first municipal observatory, Mamalluca, in his hometown of Vicuña. His work there planted a seed that has grown into a full-blown industry of astro-tourism, now recognized not only locally in the "Region of the Stars" (as the region of Coquimbo, Chile is now known) but also at national and international levels.

Above all, Oscar was a friend and pillar of the Tololino family. His most lasting contribution is the spirit of enthusiastic service mixed with a sense of wonder for astronomy that he brought to CTIO, a spirit that has shaped so many of the staff and visitors who have passed through CTIO over the past four decades. For those who would like to share their memories, a memorial page is available at [www.noao.edu/news/saa-memorial.php](http://www.noao.edu/news/saa-memorial.php).



# NOAO Staff Changes at NOAO North and South

(16 August 2013–15 February 2014)

## New Hires

Agresti, Michele	Office Assistant, KPNO	North
Austin, Carmen	NOP Public Program Specialist, Kitt Peak	North
Berkson, Emily	Public Program Specialist, Kitt Peak	North
Brehmer, Gale	Construction Administrator	South
Briceño, César	Associate Scientist SOAR	South
Burkhart, Sarah Marie	Summer Research Assistant (REU)	South
Contreras, Alexander	CTIO PIA Summer Student	South
Cortes, Fernando	Observer Assistant	South
Evatt, Matthew	Mechanical Engineering Group Manager	North
Farmer, John Michael	Summer Research Assistant (REU)	South
Frechem, Joshua Carl	Summer Research Assistant (REU)	South
Gary, Orlando	Seasonal Craftsperson, CFO	North
Gualillen, Solvello	Maintenance Man 4	South
Harris, Jessica	Drafting Office Assistant	North
Juan, Amy	Cashier, KPNO	North
Jutras, Matthew	Craftsperson I, CFO	North
Loeffler, Shane Matthew	Summer Research Assistant (REU)	South
Lotz, Paul	Senior Software Engineer	North
Margot Paez, Veronica D.	Summer Research Assistant (REU)	South
Pantoja, Blake M.	Summer Research Assistant (REU)	South
Pinto, Victor	Instrument Maker 3	South
Rivera, Monica	Secretary 3	South
Serón, Jacqueline	SMARTS Operator	South
Soto, Piera	CTIO PIA Summer Student	South
Vivas, Anna Katherina (Kathy)	Assistant Astronomer	South
Xin, Bo	Systems Analysis Scientist	North
Zenteno, Alfredo	Research Associate (postdoc)	South

## Promotions

Allen, Lori	To Associate Director for KPNO	North
Heathcote, Steve	To Associate Director for NOAO South	South
Lauer, Tod	To Interim Head of Science	North
Tighe, Roberto	To NS ETS Head of Program	South

## Transfers

Diaz, Cristian	To Telescope Mechanics on Cerro Tololo	South
Hernández, Manuel	To Observer Support	South

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**NOAO Staff Changes continued****Retirements/Departures**

Auza, Nicole	Administrative Specialist	South
Blancato, Kirsten	KPNO Summer REU	North
Bowersock, Melissa	Administrative Assistant	North
Capara, Cameron	Special Projects Assistant	North
Chmielewski, Jeanine	KPNO Summer REU	North
Figueroa, Enrique	Strategic Development Manager	South
Goble, William	Engineering Manager	North
Holck, Daniel	Optic Instrument Specialist	South
Kunder, Andrea	Research Associate (postdoc)	South
Nydegger, Rachel	KPNO Summer REU	North
Phillips, Daniel	Housing Oversight Advisor	South
Power, Jennifer	Observing Associate	North
Saa, Oscar	Telescope Operations Manager	South
Schmidt, Ricardo	Senior Engineer	South
Torres, Simon	Assistant Observer 3	South

**Deaths**

Saa, Oscar	Telescope Operations Manager	South	
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