

# The LICK



# OBSERVER

## NEW UV-BRIGHT QUASARS USED TO STUDY THE HELIUM REIONIZATION EPOCH

by Gábor Worsack & J. Xavier Prochaska (UCO)



Hydrogen and helium are the only two elements produced in the Big Bang in significant amounts, accounting for more than 99 percent of the universe's primordial mass. After recombination, the universe was a highly neutral medium until the first galaxies ionized the hydrogen in their local surroundings. This phase transition from a predominantly neutral gas to a highly ionized intergalactic medium (IGM) is termed hydrogen reionization. A second and analogous phase transition in helium is believed to have occurred at later times when quasars were sufficiently abundant to supply the hard UV photons

required to fully ionize helium. Far-UV spectra of background quasars obtained with the *Hubble Space Telescope (HST)* probe the redshifted Lyman- $\alpha$  transition of singly-ionized helium, with strong absorption signaling that helium is not yet fully ionized. To date, very few quasars allow for such analysis due to the near-ubiquitous occurrence of strong Lyman continuum absorption by neutral hydrogen at longer wavelengths. Current quasar catalogs have been almost fully exploited, yielding high-quality helium absorption spectra of only 19 quasars.

During the past few years a team around UCO postdoc Gábor Worsack has been assembling the observational data required to obtain a detailed understanding of the epoch of helium reionization. Worsack and his team realized that optical color surveys, such as the Sloan Digital Sky Survey, are biased against UV-bright quasars at the redshifts of interest, due to their optical color similarities to stars. However, additional multi-wavelength photometry (Continued on next page)

## COME & PICNIC WITH THE ASTRONOMERS

Mark down Saturday, September 15th on your calendar to join many world-renowned UC astronomers for an end-of-summer picnic on Mt. Hamilton. The event begins at 5:00 pm with an outdoor BBQ catered by Bruno's of Scotts Valley, including ribs, chicken, vegetarian pasta, side dishes, watermelon, dessert, and live music from the Silicon Valley 70s band, Dr. West. Come mingle, chat and ask your cosmic questions of astronomers such as Alex Filippenko, Geoff Marcy and Sandra Faber, to name

current research. Each will present their talk twice so everyone will have an opportunity to hear them and also view the night sky through our 36-inch Great Lick Refractor and 40-inch Nickel Reflector.

Tickets to this special event are limited. Admission is \$60 (plus ticket service fee) and benefits Lick Observatory Public Programs. Tickets go on sale at 12 noon on Tuesday, July 10<sup>th</sup> and may be purchased by phoning (831) 459-2159 or by pointing your web browser to [www.SantaCruzTickets.com](http://www.SantaCruzTickets.com).



Alex Filippenko



Geoff Marcy



Sandra Faber



Yuri Liberzon received his master's degree from Yale School of Music and Bachelor's degree at the Peabody Conservatory of the Johns Hopkins University. Both universities awarded Mr. Liberzon full scholarships to study with two of the world leading guitar figures: Manuel Barrueco and Benjamin Verdery.

just a few.

At 7 o'clock the fun moves indoors as the classical guitar duo Equilibrium, featuring acclaimed artist Yuri Liberzon and his fellow San Francisco Guitar Quartet member Patrick O'Connell, fill the Main Building with ambient music.

From 7:30-10:30 pm, Filippenko, Marcy and Faber will offer astronomy talks based on their

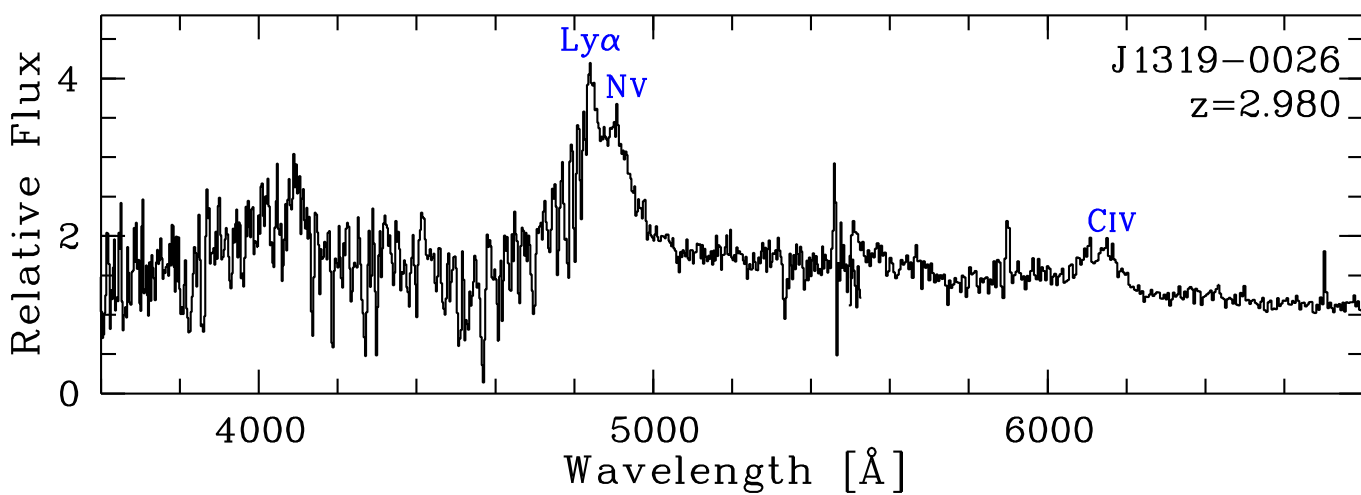
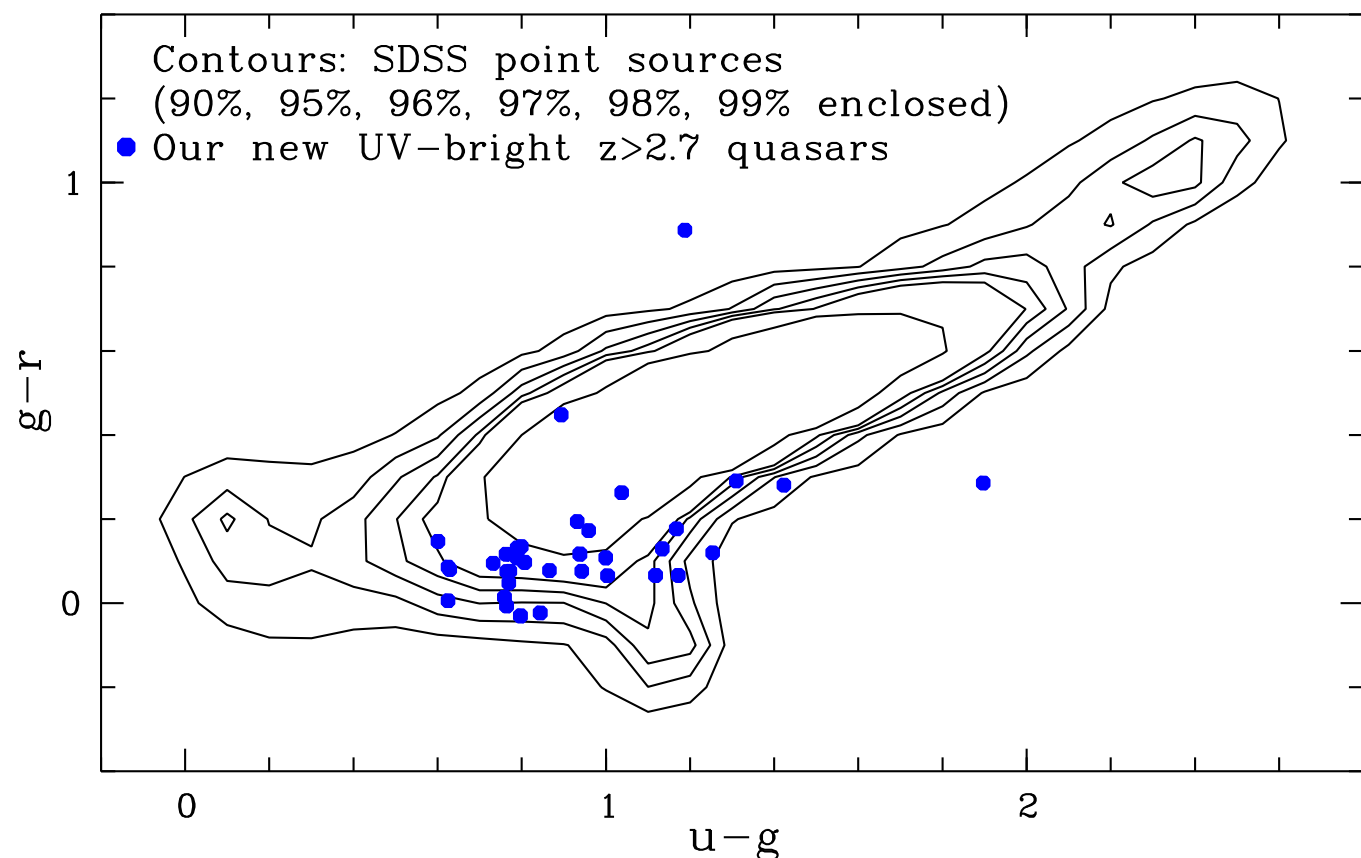
## HUNDREDS @ MT. HAMILTON WATCH TRANSIT OF VENUS

Members of the public took advantage of a once-in-a-lifetime opportunity on June 5th when they viewed the historic transit of Venus at Lick Observatory. Our sister planet will not make another transit of the sun until 2117. Visitors were able to view this rare phenomenon through the 36-inch Great Lick Refractor and a variety of other telescopes assembled outside of the Main Building. Guests were also treated to Tony Misch's time-lapse film, which he created from the original photographic plates that captured the 1882 Transit of Venus at Mount Hamilton.

The day of the transit also saw the kick-off of the Charter Membership Drive of the Friends of Lick Observatory, a nonprofit organization charged with preserving and advancing science and public programs on Mount Hamilton.



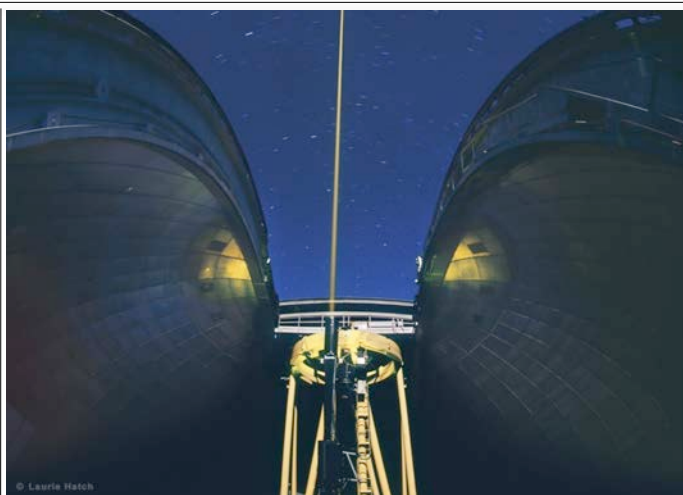
Lick Observatory's Main Building parking lot was reserved for amateur astronomers and professionals alike for the transit of Venus. A visitor smiles to the right of UCO's Bob Kibrick (in the hat), while LO Associate Director J. Xavier Prochaska looks skyward. UC Santa Cruz Astronomy & Astrophysics Department Chair Greg Laughlin looks on (arms crossed behind X.). The 1881 Twelve-inch Equatorial Telescope dome is in the background (Mike Bolte photo).



Upper panel: SDSS g-r vs. u-g color diagram of the newly discovered 35 UV-bright  $z > 2.7$  quasars (blue points) and SDSS point sources (contours). At  $u-g > 0.6$  stars constitute the vast majority of  $i < 19$  SDSS point sources. Quasars hidden in this so-called stellar locus are revealed by complementary UV and mid-IR photometry. Lower panel: Lick/Kast discovery spectrum of a UV-bright quasar with indicated emission lines.

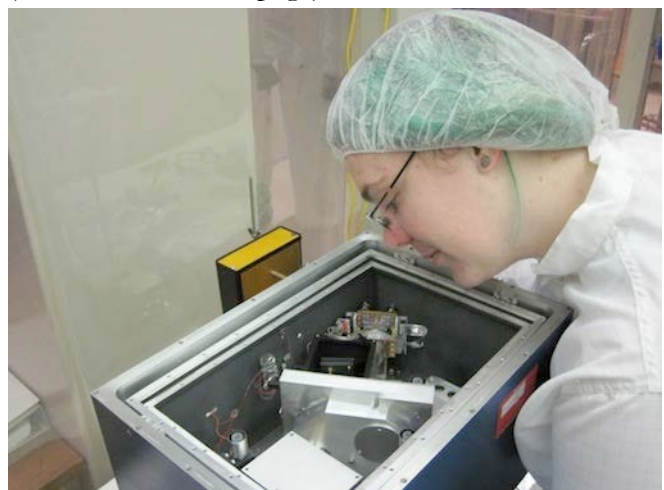
## IRCAL UPGRADE

IRCAL is the near-infrared camera used with the Lick Adaptive Optics (AO) instrument on the 3-m Shane Telescope. This camera has been the workhorse instrument with AO doing imaging and polarimetry since 2000. In conjunction with the NSF/MRI-funded Shane AO project (led by Don Gavel of UCO's Laboratory for Adaptive Optics), IRCAL is getting an upgrade to take advantage of the improved Strehl and capabilities provided by the new AO system. Led by UCO Associate Director Connie (Continued on next page)



## UNDERGRADUATE EDUCATION @ LICK

Lick Observatory Astronomer and Associate Director J. Xavier Prochaska has integrated several of the observatory's telescopes within the upper division undergraduate Advanced Astronomy Laboratory that he teaches at UC Santa Cruz. The program includes remote observing with the Nickel 1-m telescope and an overnight field trip to Mt. Hamilton to observe (on his time) using the Shane 3-m and the Kast Double Spectrograph. We encourage faculty around the UC system to pursue similar activities at the Observatory.



Graduate Student Rosalie McGurk examines IRCAL's interior.



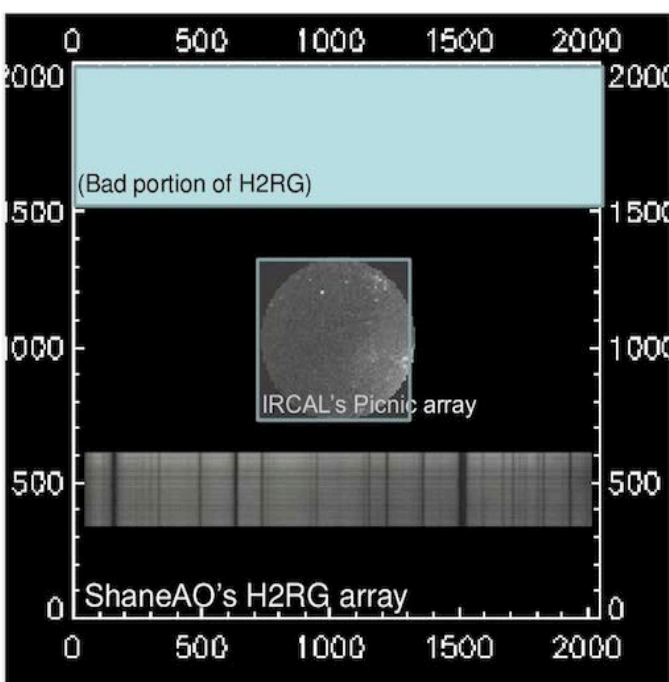
Our smiling Staff Astronomer Elinor Gates aimed the historic 36-inch Great Lick Refractor at Venus for all to see (Paul Bricmont photo).



## IRCAL UPGRADE

(Continued from page one)

Rockosi, electronics engineer Michael Peck and graduate student Rosalie McGurk are replacing the PICNIC array with a HAWAII-2RG detector. Currently IRCAL has a pixel scale of 76 milliarcseconds, enabling Nyquist sampling of the diffraction limited point spread function (PSF) only at K band. While the 20 arcsecond field of view will remain unchanged, the new detector will have a pixel scale of 35 milliarcseconds, so observers will have Nyquist sampled or better PSFs at J, H, and K bands, as well as the ability to observe in the optical. The significantly greater quantum efficiency and lower read noise of the H2RG detector will improve the sensitivity of the camera by an order of magnitude with Shane AO. Additionally, the optics in IRCAL have been redesigned for better performance, including moving the cold stop before the filter wheels, Wollaston prism, and grisms. The aperture wheel positioning accuracy and repeatability will be improved so that spectroscopy will be a feasible and efficient observation mode. The H2RG detector has been placed in a test dewar and initial tests have been done, showing the detector is functional and sensitive to light. Testing continues along with software development and the H2RG will be moved from the test dewar to IRCAL during late 2012 with first light with Shane AO in 2013.



H2RG detector is much larger (even with the inoperative portion of the engineering grade detector) than the 256 x 256 PICNIC array currently installed in IRCAL. While the 20 arcsecond field of view will be unchanged, a 600 x 600 pixel section of the H2RG will be used for direct imaging, while the full width of the H2RG could be used for spectroscopy, enabling higher resolution or broader wavelength coverage than with the PICNIC device.

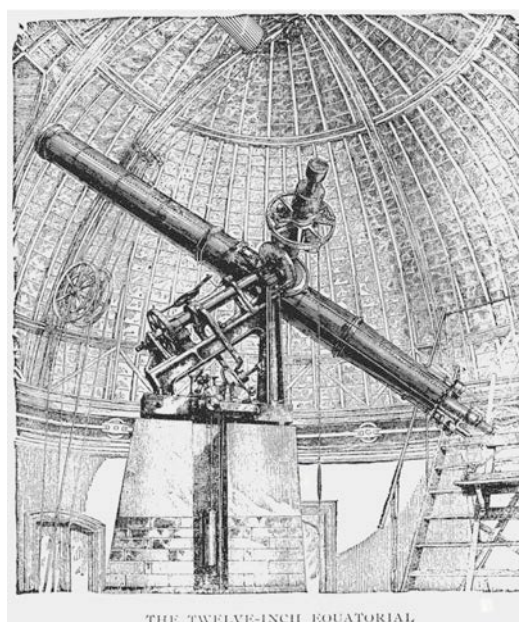
## OBSERVATIONAL ASTRONOMY WORKSHOP

In early November 2012 Lick Observatory will once again host what has become an annual fixture: an Observational Astronomy Workshop, intended as an introduction for first-year graduate students in the UC system. Feedback from previous years' participants has been invariably positive. In response to multiple requests, the Workshop has been moved to November from its former September/October schedule, which coincided with the commencement of UCSC's graduate studies academic year.

The workshop will be run by Lick Support Astronomers, featuring hands-on experience with the Kast spectrograph on the Shane telescope, the Hamilton spectrograph on the Coudé Auxiliary Telescope (CAT), and direct imaging with the Nickel 1-m reflector.

Participants will be accommodated in the New and Old Dormitories on Mount Hamilton. Rooms are doubles or triples with shared baths. UCO Davidson Funds will help defray the costs of registration, travel and food. Participants may be asked to help prepare meals. Further details, including timing and duration, will be posted as they become available, on the web at [www.ucolick.org/astro\\_workshop/](http://www.ucolick.org/astro_workshop/).

Please direct your questions to Xavier Prochaska ([xavier@ucolick.org](mailto:xavier@ucolick.org)) or one of the Support Astronomers: Elinor Gates ([egates@ucolick.org](mailto:egates@ucolick.org)) or Paul Lynam ([plynam@ucolick.org](mailto:plynam@ucolick.org)).



The 40-inch Nickel Reflector now resides where the 1881 Twelve-Inch Equatorial telescope once operated.

## UCO/Lick Archive Search

A screen grab of the Lick Archive web interface (Courtesy of B. Holden)

## PUBLIC RELEASE OF THE LICK OBSERVATORY DATA ARCHIVE ROLLS OUT IN AUGUST

UCO has long maintained an archive of all data acquired from each telescope at Lick Observatory. Recently, UCO's Scientific Programming Group has made a number of improvements that will become available to the UC community starting in August of 2012. The contents of the data headers are now in a database, which will allow astronomers to search based on position on the sky, instrument, telescope or other parameters. The Principal Investigator (PI) and all collaborators listed on a proposal are automatically granted access to the data acquired under that proposal, but each PI will be able to modify access permissions on a file by file basis. The PI can also grant access for groups of collaborators, and

group membership can be updated whenever the Principal Investigator needs.

The new policy, as approved by the UCAOC, is that newly acquired data will become publicly available after a 24-month proprietary period (data acquired prior to August 2012 will be treated as if it was acquired on August 1, 2012). Any PI may reduce the proprietary period on any of his or her data, or may request that the Director extend the proprietary period of some data. One of the purposes of this archive project is to provide data access for the public at large. This archive, and its search tools, can be used as part of a data-management plan for an NSF program.



The new Board of Directors-approved Friends logo. Graphic design by John Simon of Santa Cruz.

## FLO CHARTER MEMBERSHIP DRIVE

The much anticipated launch of our new community organization took place in conjunction with the Transit of Venus event at Mt. Hamilton on June 5. Friends of Lick Observatory (FLO) volunteers were stationed in the Main Building foyer, where they interacted with event-goers, handed out informational brochures, and accepted new members in the kick-off of the Charter Membership Drive.

The newly installed Board of Directors was well represented. Mike Bolte, Michele Kibrick, Patricia Madison, Ron Bricmont, J. Xavier Prochaska, John Wareham, and Rebecca Zeilon were in attendance, as were Staff Liaison Maureen McLean and Membership Coordinator Raychel Sky. The Board is charged with overseeing all aspects of FLO, especially maintaining and growing the membership, strategic planning, and funds allocation.

We're on the web at [www.ucolick.org/friends](http://www.ucolick.org/friends), and there's a secure, online way to become a member. The response so far has been encouraging. Kudos to all of the planners for making sure everything was in place for the launch. And thanks to UCSC's office of University Relations for enabling us to offer memberships online—a first for the campus.

## MASTHEAD CHANGES

After helping to guide *The Lick Observer* through its gestation and first two numbers, Lick Observatory's Associate Director J. Xavier Prochaska has passed his co-editorial oversight of science content over to his UCO colleague Jean Brodie, who's been at work on this issue. Please direct any questions, comments, or suggestions for science articles to Brodie at [ucolick dot org](mailto:ucolick dot org).

## UV-BRIGHT QUASARS

(Continued from page one)

from the recently completed all-sky surveys by the *Galaxy Evolution Explorer* and the *Wide Field Infrared Survey Explorer*, promised to break these color degeneracies. In 2011, the team embarked on a dedicated survey for these elusive UV-bright high-redshift quasars, using the Lick 3-m telescope and the Calar Alto 2.2-m telescope. To date, they have discovered 35 sources, almost doubling the number of known UV-bright quasars. Having solved this needle-in-a-haystack problem, Worseck's team seeks to maximize the number of quasars suitable for helium reionization studies before the end of *HST*'s mission. Recently, their efforts were rewarded with 21 *HST* orbits in Cycle 20 aimed at obtaining UV spectra of the seven most distant quasars from their sample.

Worseck, G., & Prochaska, J.X., 2011, *ApJ*, 728, 23.  
Worseck, G., et al. 2011, *ApJ*, 733, L24.

## LO BANDWIDTH UPGRADE COMPLETE

On June 12th Lick Observatory's Internet bandwidth increased by more than a factor of 20, when network traffic was rerouted onto the recently installed 11 GHz microwave radio link. That link provides a minimum bandwidth of 100 Mbps and can achieve 200 Mbps under optimal conditions. This marks the successful completion of a multi-year collaborative effort between UC Observatories, Lick Observatory, UCSC Information and Technology Services, UCSC Extension, UC Natural Reserve System, and the Blue Oak Ranch Reserve.



## MUSIC OF THE SPHERES TICKETS

Good seats are still available for this summer's remaining Music of the Spheres concerts. Concertgoers also hear a talk by a renowned UC astronomer and view the night sky through the 36-inch Great Lick Refractor and the 40-inch Nickel reflecting telescope.

Dates, artists, and astronomers:

**July 14**, *Tingstad & Rumbel*, Chris Fassnacht (UC Davis); **July 28**, *Highland Way, the Music of Scotland*, Peter Jenniskens (SETI Institute); **August 11**, *Kurt Ribak Jazz*, Aaron Barth (UC Irvine); **August 25**, *Great Guitars featuring Alex de Grassi and Daniel Roest*, Mariska Kriek (UC Berkeley). Net proceeds help to fund the observatory's public programs. For tickets call (831) 459-2159 or go to [SantaCruzTickets.com](http://SantaCruzTickets.com).



## Emergency Operations Plan

We are making strides to improve our security, safety and resilience on Mt. Hamilton. Our newly completed Emergency Operations Plan (EOP) is a vital resource for staff and residents. The plan adheres to FEMA-standardized protocols and nomenclature that are used at federal, state and local levels. It was developed in collaboration with Cal Fire, Santa Clara County Sheriff and a number of other regional agencies.



In addition to emergency response procedures, the EOP provides specific guidelines on how to handle medical emergencies, power failure, water main closure and other critical operational information.

## Street Addresses at Last!

Santa Clara County recently approved our plan to designate each structure on observatory property with its own unique and numerically-consecutive street address. These new addresses will take effect on September 1st. Until now, each structure was identified only by a UC building asset number. These numbers were assigned decades ago, generally by age of the structure and not based on its geographic location.

On September 1st, the official street address for Lick Observatory will become 29955 Mt. Hamilton Road.



This address should be used for ground shipping (UPS, FedEx, Freight) and for locating the observatory in online directories, [mapquest.com](http://mapquest.com) and [maps.google.com](http://maps.google.com). Our post office mailing address will remain P.O. Box 85. New street address signage will be installed over the coming months.



Perhaps the greatest benefit of our new addressing system is that it will enable 9-1-1 dispatchers to identify the specific origin of emergency telephone calls. It will also enable dispatchers to simultaneously call all fifty-one telephones on Mt. Hamilton. This capability could be critical should there ever be a need to issue an evacuation order or other important advisory. Please continue to use our current address through August 31st, but make a note on your calendar to begin using the new addresses on September 1st. In late August I'll send out an email reminder (with a complete list of new Mt. Hamilton addresses attached) to UCO staff and faculty.

## New LO Emergency Number For Urgent & Emergent Situations on Mt. Hamilton

We've developed a new way for staff, residents and visitors to reach Lick Observatory management or emergency operations in a timely manner during urgent or emergent situations. Just call 9-5955 from any campus phone. From non-campus phones use 1 (831) 459 5955. Calls to this line will ring simultaneously on a dedicated



'Red' phone in our administrative & facilities office, the Deputy Director's and Telescope Operations Manager's residences, and the Telescope Technician's 3-m readout room. We have a well-trained Community Emergency Response Team (CERT) that includes several certified first responders to provide critical assistance before the public safety agencies arrive.



Published quarterly in Winter, Spring, Summer & Fall

### Editors

Jean Brodie & John Wareham

### Contributors

Rob Gargett, Elinor Gates, Bradford Holden, Bob Kibrick, Paul Lynam, J. Xavier Prochaska & John Wareham

### Design & Production

Rob Gargett

If you have an idea for something you'd like to see included in *The LICK OBSERVER*, please email your suggestion to [brodie@ucolick.org](mailto:brodie@ucolick.org) or [wareham@ucolick.org](mailto:wareham@ucolick.org)

