

The LICK OBSERVER

UC OBSERVATORIES DIRECTOR'S REMARKS

by Sandra Faber • Interim Director



The stars still shine brightly over Lick Observatory! Despite UC's announced cutoff of operating funds for Lick by 2018, observers still use the telescopes nightly from all corners of the UC system and inspiring new technology is, as usual, being developed. The second-generation Shane adaptive optics (AO) system began commissioning on the Shane 3-meter reflector in November. By next summer, this advanced AO system will be taking pictures that rival the Hubble Telescope's in sharpness. ShaneAO is debuting a much brighter laser guide star, a faster deformable mirror, and software that actually anticipates the next AO correction based on wind measurements. The first adaptive optics system in astronomy began on the Shane in the 1990's, and its advances are, and will continue to be, the foundations of AO on much larger telescopes, such as UC's Keck and Thirty-Meter Telescopes.

The Automated Planet Finder Telescope, smaller cousin to the Shane, began regularly taking data last summer. APF is a 2.4 meter telescope that is dedicated to finding exoplanets via the tiny tugs of planet gravity on parent stars. As I write this, APF had its first night of *fully robotic* operations last night...like Google Car, it drives itself! Best of all, after a year of

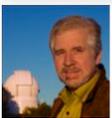
careful tuning, APF's precision Doppler spectrograph works exactly as planned and can measure planetary tugs slower than the *speed of a human walk*. We foresee that APF will be the premier telescope for exoplanet discovery in the next decade.

While dedicated Lick mountain staff are tending to these dazzling new machines, other staff and friends are seeing to the future of Lick. This issue of the Newsletter announces the formation of the Lick Observatory Council. Comprised of distinguished scientists and citizens, many in the Bay Area, and led by indefatigable Professor Alex Filippenko of UC Berkeley, the Council has dedicated itself to finding new resources for Lick for both near-term and long-term projects. Soon, you'll be noticing new signage for an "Astro-History Trail" that explains epochal events in the history of astronomy that have happened at Lick. You'll also be hearing about a program to preserve the historic Lick artifacts collection. And you will be reading about efforts to identify more significant resources to support long term operations. These are just a few of the Council's initiatives.

You can help. See below right and tell the President of UC how much Lick means to you personally as a historic, cultural, and scientific icon for California.★

AUTOMATED PLANET FINDER (APF) AT LICK IS OPERATIONAL

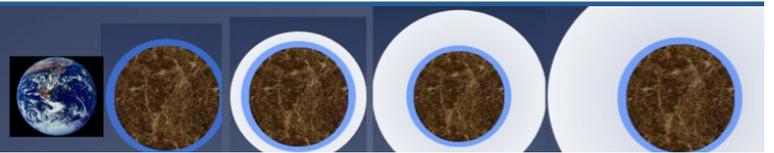
By Steven S. Vogt • UCSC Astronomer



APF, a new 2.4-meter telescope on Mt. Hamilton, has moved from commissioning into routine science-quality operations. Equipped with an optical echelle spectrometer (the Levy spectrometer), APF is optimized for high-precision radial velocities. The APF project was launched almost 10 years ago by the California-Carnegie Exoplanet team, expressly to find potentially-habitable rocky planets around nearby low-mass stars. Such planets are detectable through the Doppler velocity variations they exert on their host stars. These planets have 20-60 day periods, a range that is close to the lunar cycle and thus hard to capture from conventionally-shared telescopes scheduled around lunar phases. APF, however, will provide exoplanet hunting teams at Santa Cruz and Berkeley nightly telescope access throughout the lunar month. APF also

provides exoplanet hunters with more repeat data than possible on a shared large telescope (such as Keck), thereby enabling enough data points on a given star to tease out the extremely weak signals of any rocky planets orbiting in the liquid-water habitable zone. APF operates every clear night of the year, and hence requires a high degree of automation. For safety reasons, nightly observing is still overseen by human attendants, but as of the first of the year, APF has moved into an autonomous, fully-robotic mode.

After major on-sky commissioning in the spring and summer of 2013, science-quality operations started in July. Tests with standard stars show that the fraction of photons detected is double to triple (cont. on page 2)



Planets near Earth-size come with various amounts of gas (white), on top of a rocky core and thin layer of water (blue). The APF can distinguish the purely rocky planets from those with large amounts of gas.

APF AND KEPLER: IN TANDEM TOWARD EARTH-LIKE PLANETS

By Geoffrey Marcy • UCB Astronomer



Among the 100 billion stars in our Milky Way, how many contain habitable planets, and how many contain intelligent life? Faculty and students in the University of California are using Lick Observatory's new Automated Planet Finder (APF) telescope to answer these questions. They are using the APF in tandem with the greatest planet-hunting machine in history, NASA's Kepler space-borne telescope, to determine which of the thousands of Earth-size planets are habitable.

By watching the dimming of stars as their planets cross in front, Kepler detects the planets, and it also measures both their diameters (from the amount of dimming) and the clock-like timing of their orbits. A key question looms. Which of them is rocky, like Earth, and which are simply surrounded by a thick

layer of hydrogen and helium gas, like Jupiter and Neptune, suffocating any chances for life?

The APF telescope and its Levy Spectrometer are perfectly suited to determine which of the planets are rocky and which are fluffed-up by gas. The APF can make Doppler measurements of the host star, timed precisely when the planets are "rounding the turn" in their orbit. At that instant, the star has a maximum velocity toward us or away from us, giving us an easily detectable measure of the gravitational pull by the planet, and hence its mass.

The masses of the planets, measured by the APF, along with the planet diameters measured by Kepler, establish the density of each of the planets. Those planets as dense as Earth are rocky, while those less dense have thick layers of gas.★



Help Save Lick Observatory

Lick is a vibrant center that conducts cutting-edge research, hands-on training of top graduate students, public outreach and education. It is a rich source of knowledge and it needs your help to continue and to grow its mission. Here are a couple of ways you can make a difference.



Make a Tax-Deductible Gift

Gifts to the Friends of Lick Observatory provide flexible support that can be used where the needs are most pressing. Some of our current projects include:

- A revolutionary new red detector for the **Kast Double-Beam Spectrometer**, the most requested instrument at Lick Observatory.
- Support for the **Automated Planet Finder**, the first telescope capable of robotically detecting rocky planets that might support life in other planetary systems.
- Next-generation **Shane Adaptive Optics** system, enabling ground-based telescopes to capture images much clearer than even space-based telescopes.
- The **Life at Lick** program, combining the excitement of astronomy and the explorations of people who live and work at Lick Observatory to engage middle school students in Santa Clara County.

If you would prefer to send a check, please mail it to: UCO/Lick Observatory
1156 High Street Santa Cruz, CA 95064

Checks should be made out to the **UC Santa Cruz Foundation** with Lick Observatory written in the memo line or on another sheet of paper. Please note that the UC Observatories (includes Lick) are headquartered at UC Santa Cruz and operate on behalf of the entire University of California System.

Become a Friend

Initiate a closer relationship with Lick and at the same time receive valuable benefits by joining **Friends of Lick Observatory**.



If you would like to speak with someone in more detail about the specific needs at Lick Observatory, please contact [Rebecca Zeilon](#), Sr. Director of Development at 831-459-4240 or Professor [Raja Guha Thakurta](#) at 831-459-5169.



FRIENDS OF LICK OBSERVATORY

In the past year and a half, Friends of Lick Observatory (FoLO) has moved forward with its mission of supporting Lick by reaching out to the community and raising funds to help sustain the Observatory's facilities and underwrite some of its research and educational programs.

With help from FoLO, Lick Observatory:

- Provided hands-on observing workshops for astronomy graduate students throughout the UC system
- Began to refurbish the historic 36-inch Great Lick Refractor
- Started upgrades to improve the sensitivity of the Kast spectrograph
- Expanded the 2013 season of the Music of the Spheres concert series and the always popular Summer Visitors Program
- Launched the new Saturday Stars program which provided small groups direct viewing through the Great 36-inch Lick Refractor of targets the group selected. Participants also chose targets to be observed with the direct imaging CCD camera on the Nickel 1-Meter telescope and received copies of the digital images.

Current and future projects include:

- Repairing the historic movable floor of the 36-inch Great Lick Refractor
- Implementing a new self-guided tour brochure and signage for the various points of interest, emphasizing the rich history and important scientific accomplishments of Lick Observatory
- Organizing the archives and cataloguing and preserving historical instruments on Mt. Hamilton
- Continuing to make possible the annual Shane Observational Astronomy Workshop for UC graduate students.

Besides playing an integral part in supporting this vibrant institution and historic gem of our community, members of the FoLO receive benefits for joining, including ordering tickets for the Summer Visitors Program a full two weeks before the general public, a 10% discount at the Observatory Gift Shop, and an early opportunity for members and their friends to sign up for a Saturday Stars Night. If you are not already a member, now is a great time to join. Check out the Friends web page by going to www.ucolick.org/public/friends. ★

LICK OBSERVATORY COUNCIL

The Lick Observatory Council, also serving as the governing board for FoLO, plays an important role in reaching out to the community on behalf of Lick and raising funds to support scientific research, educational programs, and facilities on Mt. Hamilton. Its membership includes scientists, Silicon Valley entrepreneurs, and long-time supporters of the Observatory. Additional information about the Council, including bios for all of its members, can be found at: www.ucolick.org/SaveLick/council.html ★



Photo credit: Bob Kibrick



Watsonville Day in the Sky - Elinor Gates helps a youngster view through the SolarMaxII telescope, while Kurt Kuhlmann explains the features on the Sun to the gentleman viewing through his telescope.
Photo credit: Steve Elstad

DAY IN THE SKY STEM EVENT AND SOUTH BAY BIRD FEST

Lick Observatory Astronomer Elinor Gates, LO Council member Robert Kibrick, and volunteers Steve Elstad and Kurt Kuhlmann headed to the Watsonville airport on May 4, 2013 to share solar viewing with the public at the Day in the Sky - Science, Technology, Engineering, and Math event. Not only was Lick Observatory's solar scope used for showing the features of the Sun, our closest star,

but Kurt Kuhlmann shared his own telescope equipped with special solar filters, so that twice as many people could view the prominences, filaments, and sunspots visible on the solar disk that day. We also had make-your-own sundial projects for the children and handed out brochures about our summer events and visitors center on Mount Hamilton.

Lick's solar telescope's next appearance was at the South Bay Bird Fest, Don Edwards National Wildlife Refuge, on May 11th. Patricia Madison operated the telescope and shared, with the public, information about the education and research we do at Lick Observatory.

The week of solar viewing events began with Elinor Gates taking the solar scope to Silver Oak Elementary School on May 2nd to share solar astronomy with three fifth-grade classes, with the help of volunteer Karen Hokanson. We now have many volunteers trained in the use of our solar telescope, so that we hope to expand our ability to visit classrooms in the South Bay area. Contact publicprograms@ucolick.org for more information on scheduling a classroom visit. ~ Elinor Gates ★

(APF Operational from page 1) that of competing planet-hunting facilities around the world. Other tests indicated that APF is delivering sub-meter/second precision, superior to that obtainable with Keck/HIRES. The APF facility offers spectral coverage of 374-970 nm, with spectral resolving powers up to 150,000. Though primarily intended for objects brighter than $V=13$, objects as faint as $V=15$ are easily acquired and tracked, with

$V=18.5$ possible when using the charge multiplication mode. Besides exoplanet detection, APF will also be a powerful workhorse for other high-resolution spectroscopic projects, since a significant fraction of APF time will be available to users across the UC community. Go to www.ucolick.org/public/telescopes/apf.html for more details on APF and its science. ★

2013 MT. HAMILTON EVENTS

SUMMER VISITOR'S PROGRAM AND MUSIC OF THE SPHERES



Outside viewing during the 2013 Music of the Spheres event. Lick Observatory volunteers share their telescopes with the public after the concert. Photo credit: Mike Bolte

Eight weekends of Friday night viewing programs and Saturday Night Music of the Spheres concerts pleased the public who attended and kept our staff and volunteers very busy during the summer. Visitors attended wonderful concerts by artists in genres ranging from Jazz to Classical to Celtic music and lectures by prominent astronomers, such as Drs. Sandra Faber and Alex Filippenko. Visitors also viewed through the Lick Refractor and Nickel 1-meter telescopes and through smaller

telescopes provided by our volunteers. 2014 will continue the series with seven weekends of events between Memorial Day and Labor Day. More information to come in future issues of the *Lick Observer* and [online](http://www.ucolick.org). ★

LICK OBSERVATORY TEACHER'S INSTITUTE

Lick Observatory teamed up with the Center for Science Education at UC Berkeley Space Sciences Laboratory to conduct a science teacher training workshop during August, developed and taught by Bryan Mendez (CSE-SSL) and Elinor Gates (Lick Observatory). A dozen middle and high school science teachers spent two days on Mount Hamilton learning about astronomy, how to acquire data using the Nickel 1-meter Telescope, how to reduce data both from Lick's telescopes as well as on-line archives, and, finally, how to use these activities in their classrooms. This was the first of what we hope will be a series of workshops where teachers from previous workshops will return to act as mentors for the new attendees.



Workshop participant Rachel Freed (Harker School, San Jose) proudly displays the data she's taken of a spiral galaxy with the Nickel 1-meter telescope.

Photo credit: Elinor Gates

Funding is being sought from the National Science Foundation and other sources so that we can continue the program. ★

SATURDAY STARS

The first of the Saturday Stars programs was a resounding success, as a group of about 20 amateur astronomers enjoyed a night looking through the historic Lick 36-inch refractor and then using the Nickel 1-meter Telescope to obtain CCD images of objects they selected. The ability to choose the objects observed and the personal attention from our expert telescope operators made this a special evening for those who attended. The Saturday Stars program will continue in 2014, so refer to <http://mtham.ucolick.org/public/programs/SaturdayStars.html> in the Spring for the 2014 available dates for booking the telescopes for your group.

RENOVATION OF THE FLOOR OF THE GREAT LICK REFRACTOR

The construction of the Lick 36-in refractor employed a number of engineering innovations. With a telescope as long as the refractor (58 ft), access to the eyepiece is not always easy, particularly when pointed at an object low in the sky. To this end, the design of the refractor building included something new to astronomy: a floor that could be raised or lowered in height, depending on where the eyepiece was situated. This novel approach was formulated by Howard Grubb of Dublin, Ireland. Although the contracts for building the telescope and its dome were, instead, awarded to U.S. companies, Grubb's pioneering concept of an elevating floor has since become incorporated into many telescope domes.

(Continued on page 3)

2013 MT. HAMILTON EVENTS

RENOVATION OF THE FLOOR OF THE GREAT LICK ... CONT.

The movable floor has contributed greatly to the public outreach programs of Lick Observatory, but after 126 years of continuous service, the floor is now in need of major maintenance and restoration:

1) Seismic activity has created a discrepancy between the now out-of-round enclosure and the round floor, resulting in abrasions and reduced performance of guide rails.

2) Many cast-bronze racks and pinions are original. Inclusions are common and internal corrosion possible in castings of this vintage.

3) Originally, under-floor hydraulics were powered via water pressure. Following electrification, the plumbing was retained. Decades on, the integrity of this plumbing needs verification.

4) Cables bearing the load of the floor and counterweights have aged.

Recovery from mechanical failure would be more demanding than in-situ renovation. Thus, in November 2013, floor operation was confined to maintenance tasks only, pending an engineering study to advise on how the floor may be renovated, conserved, and returned to service, while complying with today's standards.

The Friends of Lick Observatory has pledged funds for the engineering study. In the interim, visitors can look at objects limited to the Northern Celestial hemisphere, with observers reaching the eyepiece using a ladder. Unfortunately, for those unable to negotiate a ladder, observing may prove impractical.
~ Paul Lynam & Graeme Smith ✨



Photo credit: Keith Wandry

2013 SHANE OBSERVATIONAL ASTRONOMY WORKSHOP

Outstanding... Inspirational... Awesome... Amazing. Those were comments from graduate students attending the C. Donald and Mary Lea Shane Observational Astronomy Workshop from 24 to 28 October, 2013.

With twenty participants, a mix of first and second year students from all eight UC campuses with astronomy departments and engaged in research astronomy, the workshop exploited Lick Observatory as an educational nexus for UC astronomy. Participants listed interactions with UC colleagues as a highlight of the workshop.



Photo credit: Elinor Gates

No other observatory features a comparable variety of telescopes and instruments of differing designs and vintages. Augmenting CCD, IR and AO lectures were interactive sessions in experimental design, data acquisition and reduction, as well as hands-on experience with primary instruments. Participants unanimously found the curriculum relevant and the majority reported the material covered as being new to them.

UC Irvine professor Virginia Trimble provided a donation to secure the workshop as an annual event from 2013 onwards and proposed that the workshop be named to honor the Shanes.

Academic support was provided by Lick's resident astronomers assisted by Kelsey Clubb (UC Berkeley) and Patrick Maloney (Santa Clara University). However, the workshop could not have succeeded without the combined contributions of the entire Observatory staff.

Applicants unable to attend the oversubscribed 2013 workshop are encouraged to apply for the 2014 workshop. ~Paul Lynam & Elinor Gates ✨



LICK OBSERVATORY HISTORICAL COLLECTIONS

The Lick Observatory Historical Collections comprise scientific objects, manuscript notebooks, photographic plates, publications, and ephemera representing the observatory's long history of scientific achievement. A project to preserve, organize, catalog, and provide access to the collections was begun in 2008 under the direction of retired Lick support astronomer, Tony Misch, with the help of a small group of volunteers.

Limited resources and the large scope of the collections present many challenges, but an important milestone was reached in January 2014 with receipt of a collections assessment report by the historical consulting firm, History Associates Incorporated.

The report follows an intensive two-day site visit in December 2013 by a team from HAI. Their findings include a host of recommendations—from cataloging methods to best storage practices to database strategies—that will provide vital guidance for the ongoing work of caring for Lick's precious legacy. The collections assessment was made possible, in part, by a generous contribution from FoLO. Thank you! ~Tony Misch ✨



Erica Williams and Renny Bergeron from HAI at work on the Lick collections assessment.

A MESSAGE FROM FORMER DEPUTY DIRECTOR JOHN WAREHAM



It was my honor to help lead Lick Observatory through a most difficult three and a half year period that ended last September 2013. Nearly everyone on Mt. Hamilton took on additional responsibilities in order to get the job done in an environment of shrinking financial support. Throughout the downsizing effort, I continued to receive extremely positive feedback on our team's performance from observers and the general public.

I am deeply saddened by the decision of the UC Office of the President to pull funding from such an efficient and iconic research and educational institution. I hope UCOP will feel enough political pressure from the citizens of California to reconsider its decision.

In the meantime, this mountaintop jewel is in excellent hands. Kostas Chloros and his team are dedicated, resourceful, and resilient. Anyone who has ever visited Lick Observatory would know, as we do, it is a one-of-a-kind treasure because of Lick's tremendous value for new science discoveries, UC education, and UC's regular and positive visibility to the public. Clear skies, John ✨

GREG SULGER MEMORIAL GARDEN



Photo credit: Bob Kibrick



University of California Observatories

Lick Observatory Est. 1888

The LICK OBSERVER

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If you have an idea for something you'd like to see included in *The LICK OBSERVER*, please email your suggestion to koo@ucolick.org