

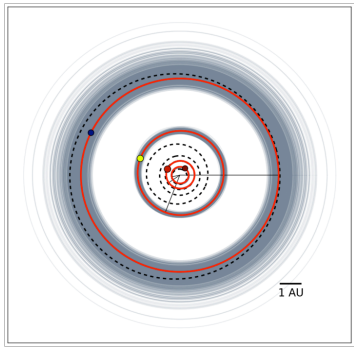
# The LICK OBSERVER

## AUTOMATED PLANET FINDER (APF) BAGS FIRST PLANETS

By Steven S. Vogt • UCSC Astronomer



The first planets discovered using data from the Automated Planet Finder (APF) Telescope are described in a paper, recently accepted for publication, that was authored by the Lick-Carnegie Exoplanet Team, co-led



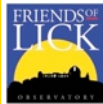
by Steve Vogt of UCSC and R. Paul Butler of Carnegie.

The first catch was a 4-planet system orbiting the slightly evolved K-type star HD 141399, about 118 light-years away. This system features four gas giant planets in orbits with periods of 94d, 202d, 2.9y, and 10.1y, as shown in top view (red lines) in the figure. This figure also shows (dashed lines) the orbits of our own Mercury, Venus,

Earth, Mars, and Jupiter overlaid for reference.

With its three gas giant planets orbiting at distances similar to the terrestrial planets of our own solar system, and an outer 4th gas giant in an orbit similar to our own Jupiter, this system is fundamentally alien. Yet, it is also typical of the sorts of planetary systems found around ~10% of F, G, and K stars. HD 141399 was long suspected of hosting planets from data gathered by HIRES on Keck, but there was insufficient cadence and precision to characterize the multiple orbits securely. APF's ability to get high precision with high cadence quickly clinched all the orbits, characterizing each with high accuracy. Indeed, the quality of the APF measurements shows that APF is functioning fully as expected, and has, since July 2013, been delivering state-of-the-art radial velocity precision.★

### HELP SAVE LICK



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## A GLIMMER OF LIGHT FROM POLARIZED WORLDS

By Sloane Wiktorowicz • Sagan Fellow at UCO

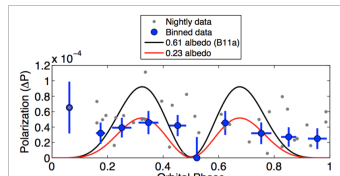


Sloane with his POLISH2 instrument at the Shane 3-meter Telescope.

Forty years ago, the detection of polarized, scattered light from Venus revealed the presence of sulfuric acid droplets in the atmosphere. A 100-fold improvement in instrument sensitivity, required to obtain similar results on distant exoplanets, is now possible. Ground-based polarimetry now rivals the sensitivity of the recently defunct Kepler Mission (Wiktorowicz, 2009, ApJ, 696, 1116) at a fraction of the cost (\$40k). Since 2011, the POLISH2 instrument (Wiktorowicz & Matthews, 2008, PASP, 120, 1282) has monitored a handful of known exoplanets with the Lick 3-m Shane Telescope to search for polarized scattering in blue light (B band).

A reported detection of scattered light from the transiting hot Jupiter HD 189733b (Berdyugina et al., 2011, ApJ, 728, L6 [B11a]) requires nearly the maximum possible reflectivity (albedo)

of 0.61 in UV and blue light. However, HST photometry during stellar occultation of the planet allowed Evans et al. (2013, ApJ, 772, L16) to measure a blue albedo of only 0.23. POLISH2 data are inconsistent with the 0.61 albedo model but are possibly

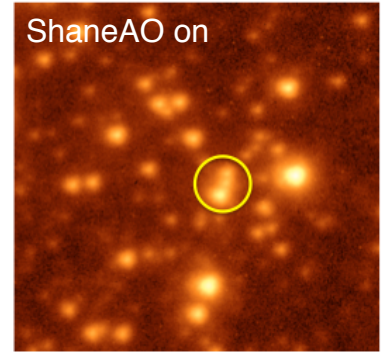
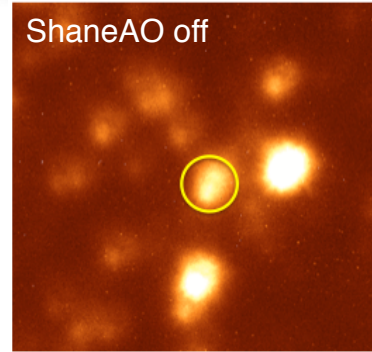


POLISH2 linear polarimetry of the HD 189733 star+planet vs. the planet's orbit, where 0 is during mid-transit and 0.5 is during occultation of the exoplanet by the host star. Blue POLISH2 data are inconsistent with the black 0.61 albedo curve (original claim) but possibly match the red 0.23 one (from HST).

consistent with the 0.23 one. Ongoing efforts with POLISH2 are soon to be finished that will significantly improve the accuracy of nightly measurements. Therefore, the first, reliable isolation of scattered light from a distant exoplanet will soon be another scientific triumph from the historic Lick 3-m telescope.★

## SUCCESSFUL FIRST LIGHT FOR SHANE ADAPTIVE OPTICS!

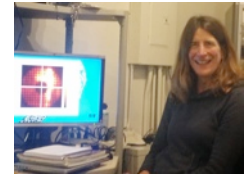
By Don Gavel (PI) and the ShaneAO Team • UCO



After years of hard work from the ShaneAO team (including 3 PhD graduate students and one undergrad), high-performance AO correction was achieved within the first hour of on-sky commissioning on April 12, 2014. Special thanks are due for the intensive and expert help from the entire staff on Mt. Hamilton.

The left frame shows the new data of M92, a famous and well-studied cluster of stars, with no AO correction. The right shows the same field with the new AO system turned on. The three stars in the circle are 0.42 and 0.58 arcseconds apart. ShaneAO represents a leap forward for UC astronomical instrumentation, with its advanced

capability for Lick astronomers and by providing technology proof for the next generation of Keck AO instruments.



Renate Kupke in the control room during ShaneAO first light.

ShaneAO is made possible through an NSF Major Research Instrumentation grant, #0923585.★

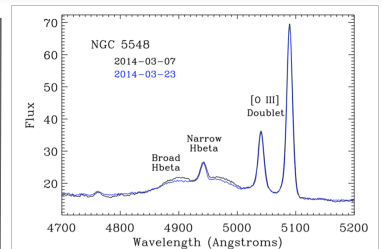
## LICK'S STORM PROVIDES NEW MAPS OF GAS SWIRLING AROUND SUPER-MASSIVE BLACK HOLES

By Liuyi Pei • PhD Student at UC Irvine



The Space Telescope and Optical Reverberation Mapping (STORM) program is an international campaign to obtain the first-ever detailed map of the broad-line region (BLR) of a nearby active galactic nucleus (AGN). Doppler-broadened emission lines of the BLR are emitted by gas orbiting within several light-days around a black hole. The BLR is irradiated by the central black hole accretion disk seen as the spectral continuum. Reverberation mapping uses the time lags between the changes in the continuum and emission lines to characterize the size, structure, and dynamics of the BLR.

STORM's target is the Seyfert 1 galaxy NGC 5548, which will be monitored photometrically and spectroscopically for six months. UV spectra from an 180-orbit HST program will monitor carbon IV lines from the inner BLR. Over the same six-month span, Lick will monitor the changes in the hydrogen-beta line which comes from the outer BLR by



This plot shows the spectral region around the H-beta emission line in NGC 5548 on two different nights. The broad H-beta emission comes from ionized gas in rapid rotation around the black hole, while the narrow [O III] (doubly ionized oxygen) emission lines come from a much larger region in the host galaxy.

securing optical spectra from the Kast Spectrograph on the 3-m Shane telescope. For each dark run from February to July of 2014, each group of regularly-scheduled Kast observers is taking two observations of NGC 5548 each night. This interrupt-mode of observing gives Lick Observatory the unique ability to provide observations for a long monitoring (Continued on page 2)



Special times at Lick Observatory's public programs. (Image Credit: E. Gates)

## 2014 PUBLIC PROGRAMS AT LICK OBSERVATORY

In the 126 years since its inauguration, Lick Observatory has continued to offer the public opportunities to visit, observe through its telescopes, and share an understanding of our wondrous Universe. Thus, in addition to its pedigree as an active centre of forefront research and development, Lick is a pioneer of science outreach.

This summer will see those traditions continue as the public programs of this iconic San Francisco Bay sentinel welcome thousands of participants to its beautiful mountaintop setting.

### Summer Visitors Program

Every second weekend between Memorial Day and Labor Day, renowned astronomers will speak about astronomical discoveries, ancient, modern and those yet to be made. Experienced and informative volunteers and staff offer myriad views of interesting objects through a range of telescopes, tours of the night sky and indispensable advice. Among the many highlights are views through the research-class Nickel Reflector telescope and the world-famous Great Lick Refractor telescope.

Additionally, on Friday and some Saturday nights, the Summer Visitors Program includes an additional speaker, telling the entertaining story of how James Lick circuitously became California's wealthiest man and why his observatory has always enjoyed global recognition. Tickets (starting at \$9.50 plus service fee) and information for the 2014 Summer Visitors Program can be acquired via the following URL: <http://www.ucolick.org/public/sumvispro.html>

### Music Of The Spheres Program

Alternatively, on selected Saturday nights, attendees of the Music Of The Spheres can enjoy either a Jazz, World Fusion, Celtic or Guitar concert within the magnificent halls of the original building. Tickets (starting at \$40.00 plus service fee) and information for the 2014 Music Of The Spheres concerts can be acquired via the following URL: <http://www.ucolick.org/public/music.html>

### Saturday Stars Program

For groups of 20 to 30 people with a deeper interest in observing, the Saturday Stars Program sets aside a limited number of Saturday nights to observe with both the Great Lick Refractor using its eyepiece and the Nickel Reflector equipped with a CCD direct imaging camera. Further information for the 2014 Saturday Stars Program can be acquired via the following URL: <http://mtham.ucolick.org/public/programs/SaturdayStars.html>

Sunset, twilight, and stargazing atop Mount Hamilton are special experiences. Discover them and more through Lick Observatory's public programs. ~ Ellie Gates ✨

## LICK OBSERVATORY NEWS

### IRISH MINISTER OF STATE VISITS LICK OBSERVATORY

For St Patrick's day, world landmarks turn green, Irish Ministers of state disperse across the globe, and while presenting a bowl of shamrock, the Taoiseach (Irish Prime Minister) has the ear of the US President. This year, Minister of Arts, Culture and the Gaeltacht (Gaelic Affairs) James Deenihan toured the Bay Area, which has links with Ireland through the twinning of San Jose with Dublin and San Francisco with Cork. On March 18, the Minister was



UCO Director Sandy Faber with Bob Kibrick present James Deenihan with a souvenir of his visit to Lick. (Image Credit: M. Bolte.)

welcomed (in Gaelic) to Mount Hamilton, and learned of Lick's history, Irish connections, and the TARA project (<http://www.bco.ic/tara/>), an initiative of Blackrock Castle Observatory in Cork. TARA seeks to stimulate interest in science, technology, engineering, math, culture, and cooperation among thousands of students in Ireland, California, and elsewhere by exploiting time differences to access remotely operated telescopes. Facilitated by Multiverse (formerly known as UC Berkeley's Center for Science Education), TARA's first California-based telescope operates at Portola Valley's Ormondale elementary school. It is hoped to expand TARA to involve Lick's Nickel 1-m Telescope, which Mr. Deenihan visited, and where he witnessed Ormondale students participate in a trans-Atlantic video link with their Irish counterparts. The Minister declared himself impressed with Lick, the beautiful setting, and the commitment and dedication of those involved. The visit was reported to be the highlight of his tour. ~Paul Lynam ✨



### Eugene A. Harlan 1921-2014 AN ICON OF LICK OBSERVATORY LEAVES A LEGACY OF SCIENCE AND STORIES

Several generations of astronomers who used Lick Observatory from 1960 to 1991 would have encountered one of Mt. Hamilton's most colorful characters - "Gene" Harlan. We are sad to report that Gene passed away March 29, 2014 at the age of 92 years. Another "old-timer" and now-retired staff of Lick Observatory, Rem Stone, [shares](#) his personal account of some of Gene's many contributions to astronomy, his life, and distinctive character. Gene's obituary can be found [here](#).

Those of us who knew Gene will undoubtedly recall some of his famous and usually hilarious stories and remember him with a smile.

~Rem Stone ✨

(Black Holes from page 1)

period with only minimal interruptions to the observing time of other research groups using Shane. Meanwhile, Lick's robotic KAIT telescope contributes regular photometry from optical images.

My thesis contribution to STORM is analyzing optical spectra of NGC 5548 from the Lick 3-m as well the MDM 1.3-m and APO 3.5-m telescopes. My job is to construct light curves to track the time lags between the changing broad-lines (see Figure) and continuum. Combining data into standardized parameters and quality from different telescopes is challenging and requires communication and coordination across multiple campuses and observatories, as well as the willing cooperation of fellow observers.

The results from this collaboration will be the first of its kind, and Lick Observatory's participation in STORM has brought together observers across multiple UC campuses in a combined effort to further our understanding of the structure of AGNs and their role in the co-evolution of galaxies and super-massive black holes through cosmic time. ✨

## REPORT FROM LICK OBSERVATORY COUNCIL

In March, Mr. Adam Kablanian became the newest member of the Lick Observatory Council (LOC). Mr. Kablanian is currently the Executive Chairman of PlasmaSi, a startup company focused on becoming the leader in thin film barrier technology for OLED displays, and a board member of Cortex MCP, a startup company developing a new foundational platform for the future of Mobile Commerce. Mr. Kablanian has numerous inventions, 14 patents granted in the area of micro-chip design, and he is the author and co-author of over 15 technical publications in leading trade journals. A more extensive bio for Mr. Kablanian and other members of the LOC can be found at [here](#).

At its March 19 Council meeting, Ms. Debbie Shen, a project manager in the Office of Research and Graduate Studies at the UC Office of the President (UCOP), briefed the Council on the current status of UCOP's transition study for Lick Observatory. According to Ms. Shen, that study will investigate and "report on the current state of Lick Observatory in order to inform decision-makers in the development and selection of a successful transition path for Lick." The study has compiled over 30 transition options so far. LOC member Jim Katzman, who is the Council's liaison to the transition study, had a follow-up meeting with Ms. Shen later in March. The Council looks forward to working with Ms. Shen and others at UCOP to secure sources of funding that will ensure that Lick is able to continue supporting UC astronomy research, education, and public outreach functions. ~Robert Kibrick ✨

### A New Monster Roams Mt. Hamilton



A 45-foot articulating lift.  
Image Credit: M. Redel

University of California Observatories

Lick Observatory Est. 1888

## The LICK OBSERVER

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