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University of California Observatories

The LICK OBSERVER

Lick Observatory
Est. 1888

SN 1A HUBBLE DIAGRAM ACCURACY GAINS: THE LOSS AND BSNIP SURVEYS

by
JEFFREY SILVERMAN, MOHAN GANESHALINGAM & ALEX FILIPPENKO (UC BERKELEY)



Standardizing (calibrating) the luminosity of Type Ia supernovae (SNe Ia) at peak brightness has led to their use as accurate distance indicators. Two teams of which Alex Filippenko was a member made observations of nearby and distant SNe Ia that led to the conclusion, in 1998, that the Universe's expansion is accelerating—a result honored with the 2011 Nobel Prize in Physics. To build upon this incredible finding, astronomers are trying to improve SN Ia distance measurements by compiling huge datasets of these exploding stars, and searching for correlations that might decrease the scatter in the SN Ia Hubble diagram.

Since 1998, Filippenko's research group at UC Berkeley has conducted the Lick Observatory Supernova Search (LOSS) using the 0.76-m Katzman Automatic Imaging Telescope (KAIT). LOSS was the world's most successful search for nearby SNe until wide-field surveys such as the Palomar Transient Factory started operating a few years ago. LOSS discovered or detected more than 1000 SNe, and used an optimal subsample of 726 SNe to derive the most accurate SN rates for the nearby Universe.

The team has collected over 16,000 photometric observations with KAIT and the Lick 1-m Nickel telescope to produce multi-filter light curves for 165 SNe Ia. One interesting and unexpected discovery: both smaller-mass *and* smaller-luminosity galaxies have a larger SN Ia rate per unit mass than is the case for core-collapse SNe—even in passive

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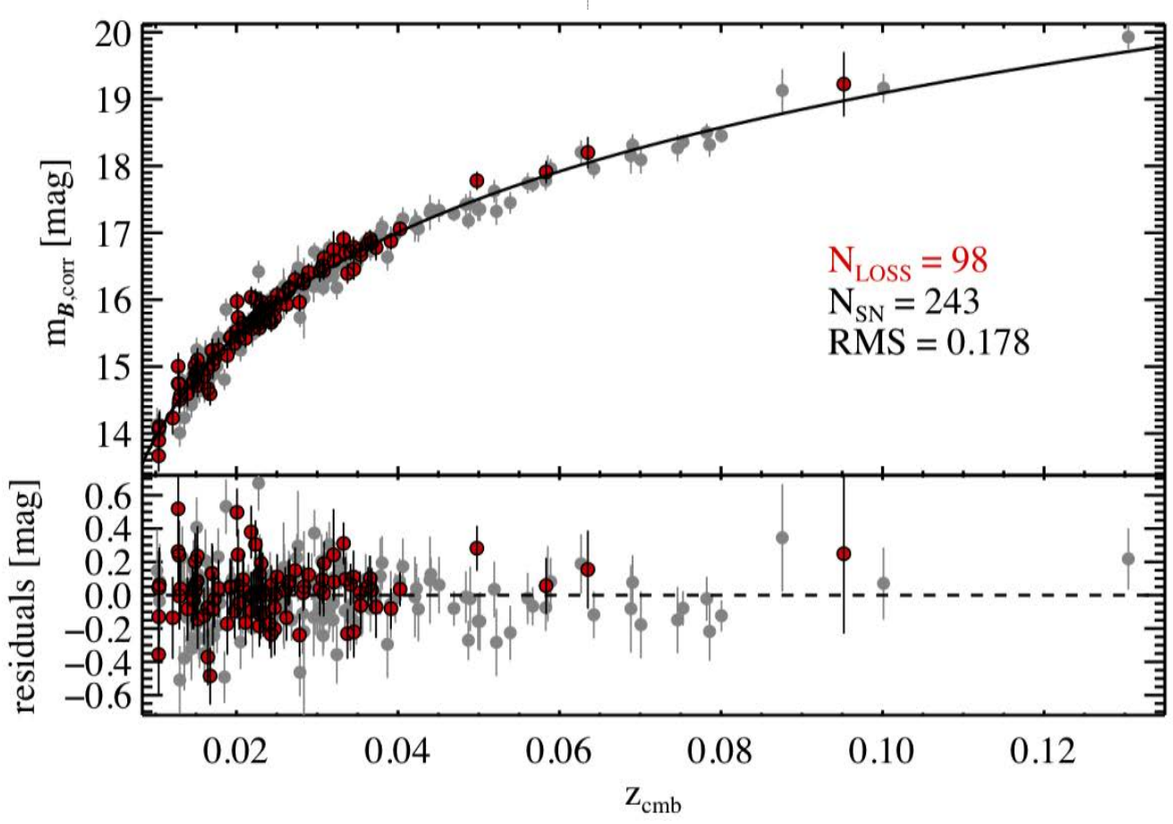

A plot of redshift vs. observed B-band magnitude (top) for 243 nearby SNe Ia, 98 of which are from the LOSS photometry sample (red points). The solid line is the best fit to the entire sample assuming a universe dominated by dark energy. The LOSS data act as an anchor to improve the accuracy of the fits to the high-redshift SNe Ia. The BSNIP data show that the residuals to the best fit (bottom) can be decreased by incorporating spectral observations into the analysis.

E/PO Workshop at Lick Observatory, March 23, 2012. Lick Observatory's Associate Director Xavier Prochaska points the way forward. UCO Director Mike Bolte and CfAO Director of Education and Workforce Development Lisa Hunter attend via videocon.

EDUCATION & PUBLIC OUTREACH WORKSHOP

by J. XAVIER PROCHASKA (UCO)

On March 23rd, a one-day workshop held at Lick Observatory (LO) focused on future education and public outreach (E/PO) efforts at Lick. Members of the Center for Science Education (CSE) of the Space Sciences Laboratory (SSL) at UC Berkeley were invited to explore a University of California Observatories (UCO)–CSE partnership and to help develop the future vision for E/PO. The participants concluded that it was a very successful meeting and UCO and CSE are moving to establish a formal relationship. Future E/PO activities at Lick may include teacher training workshops, partnerships with Bay area museums, high school science 'camps,' and more. Anyone interested in participating or developing E/PO programs at Lick should contact the observatory's Associate Director Xavier Prochaska.

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The Center for SCIENCE EDUCATION at the UC Berkeley Space Sciences Laboratory

In attendance were UCO Director Mike Bolte, UCO Assistant Director Maureen McLean, LO Deputy Director for Operations John Wareham, LO Associate Director Professor J. Xavier Prochaska, UCO Research Astronomer Bob Kibrick, Center for Adaptive Optics Director of Education and Workforce Development Lisa Hunter, LO Support Astronomers Elinor Gates, Bryant Grigsby and Paul Lynam, UC Berkeley Professor Geoff Marcy, SSL/CSE Director Laura Peticolas, CSE Senior Public Education Specialist Dan Zevin, CSE Coordinator of Public Programs & *Eye on the Sky* Director Ruth Paglierani, CSE Coordinator of Public Programs Kyle Frick, SSL E/PO Specialist Dr. Bryan Mendez, 'Imiloa Astronomy Center at the University of Hawai'i Executive Director Ka'iu Kimura, NOAO/Kit Peak Observatory Director Steve Pompea. The workshop was facilitated by Kathy Dunne, Director of Professional Development for *WestEd*.

NEWS FROM MT. HAMILTON

by Deputy Director John Wareham

Generous Donation from Rust-Oleum

Kudos to David Perrin of our maintenance staff for facilitating a donation of nearly $2,000 worth of top-of-the-line protective paint products from Rust-Oleum. These special coatings are being used to repaint fire hydrants, fire-alarm pull boxes, bollards and parking-lot stripes throughout the observatory grounds. We could not afford to purchase these expensive specialty paints, and wish to extend our gratitude to Mr. Steve Gillman and the Rust-Oleum Corporation for their generosity. Pictured below with about a third of Lick Observatory's new collection of anti-rust and other paints is David Perrin.

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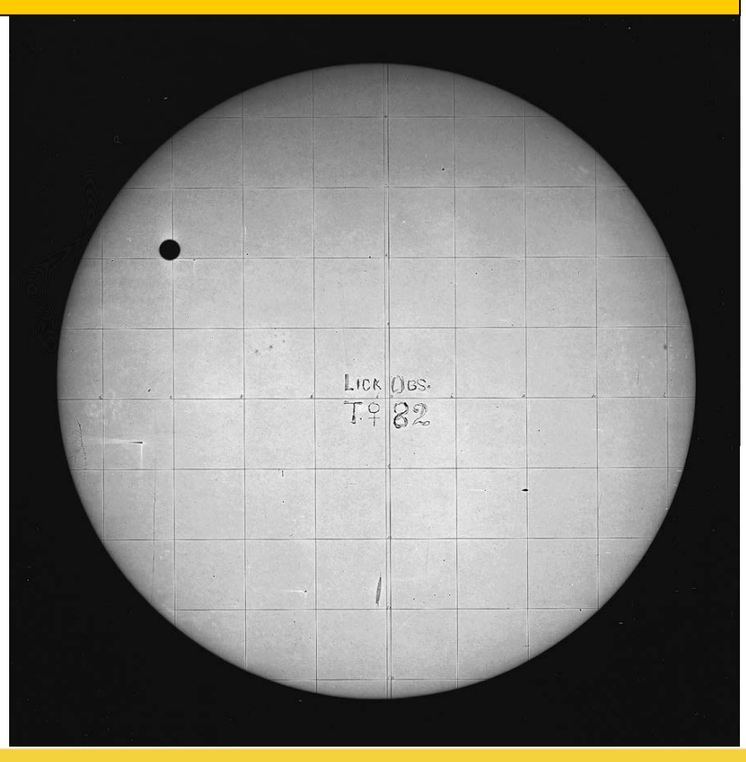
THE JUNE 5, 2012 *TRANSIT OF VENUS*

When Venus makes its last 21st century transit of the Sun, you may enjoy a unique opportunity at Lick Observatory on Mt. Hamilton. On June 5th between 2:00 pm and 8:30 pm guests may take part in a celebration of this rare, celestial phenomenon. You'll be able to view the sun through the historic 36-inch Great Lick Refractor, and you'll receive your own pair of solar-viewing glasses to use during the event—yours to keep. In addition, a variety of smaller telescopes will be available for safely viewing the solar disc. You may bring your own telescope, but it must be approved for safety, in advance, by Lick staff astronomers, and you must sign a release.

Once an hour former Lick support astronomer Tony Misch will give a talk on the history of Venus transits, with special reference to the 1882 event, the first observed from Mt. Hamilton. During that transit of Venus Lick astronomers photographed an extraordinary sequence of 147 glass-plate images that survive in Lick's archive, constituting the most complete photographic record of any transit of Venus prior to the 2004 event. The image at right was made from one of those photographs taken at Mt. Hamilton during the 1882 transit. Misch's talk will feature a time-lapse movie that he and William Sheehan made from this series of glass plates.

The **250 tickets for this event will go fast**. Admission is $12.00 ($9.50 plus a service fee), **in advance**. All tickets must be purchased—in advance—either by pointing your web browser to www.SantaCruzTickets.com or by 'phoning (831) 459–2159. Please note that there will be no public access to the observatory's Main Building before 2 pm on the day of the event.

A 'transit' occurs whenever a planet passes in front of the Sun, as viewed from Earth. Transits of Venus are among the rarest of predictable astronomical phenomena. They happen in pairs, eight years apart, at intervals of more than a century. The last transit of Venus was in 2004; the next will be seen in 2117 and 2125.



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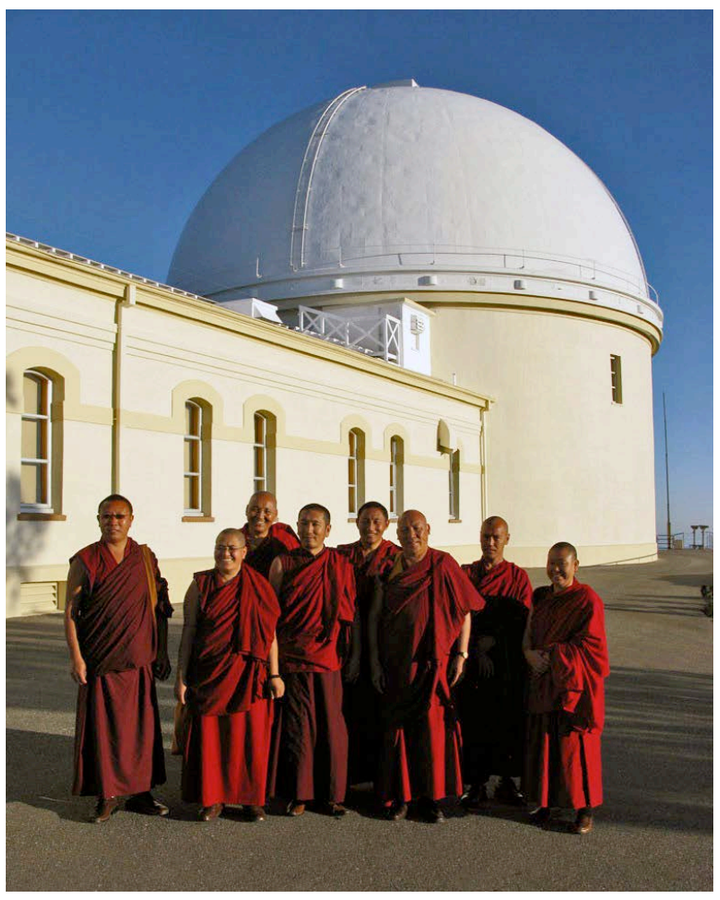
More NEWS FROM MOUNT HAMILTON

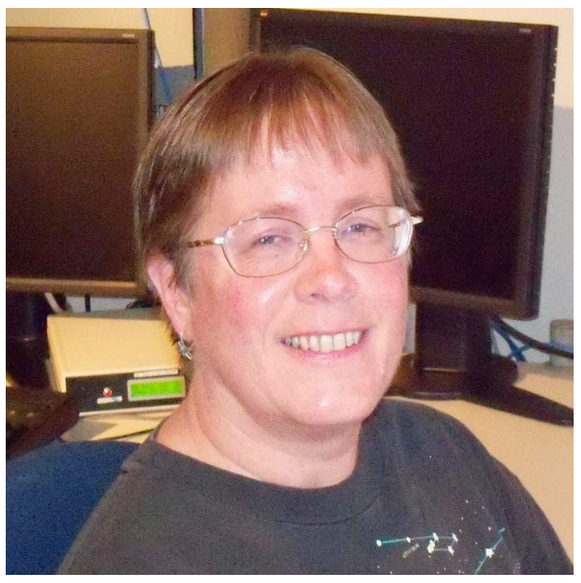
Monks And Nuns Visit Lick Observatory

> "I wanted to understand science because it gave me a new area to explore in my personal quest to understand the nature of reality. I also wanted to learn about it because I recognized in it a compelling way to communicate insights gleaned from my own spiritual tradition."
> ~*His Holiness the Dalai Lama*

On April 21st a group of Buddhist nuns and monks (pictured at right) toured Lick Observatory and observed through the 36-inch Great Lick Refractor. Their interest was purely scientific. Since 2000, at the behest of their spiritual leader, more than 200 Buddhist monks have taken part in "Science for Monks," a program to introduce science education to the monastic curriculum. One offshoot is the presentation that will be seen in May at San Francisco's Exploratorium. "The World of Your Senses Exhibition" runs from the 1st through the 10th and shares parallel perspectives on sensory perception from Buddhism and western science.

The Tibetan Buddhists, who live exiled in India have created this exhibit, which explores sensory perception (sight, sound, smell, taste, and touch) from both a Buddhist and a western science perspective. The nine monks and nuns travel with the exhibition and serve as its interpreters. They're part of a larger group that the Dalai Lama charged with teaching science to the next monastic generation. The two nuns are among the first ever to be trained as science education leaders for their communities. For more information, visit scienceformonks.org. (Photo by The Exploratorium's Ron Hipschman).





Patricia Madison Steps In

Pat is our new Public Programs Coordinator, providing volunteer coordination and event support for our public programs. Pat has served as a volunteer coordinator, guide and Gift Shop clerk for the past 13 years. She has already proven herself to be an exceptional resource in our event-planning activities. Welcome aboard, Pat!

New Mt. Hamilton Resident

Pictured above is Rylen Cooper Perrin, whose arrival on the planet at 9:12 pm, Friday, February 3, created a mini population boom at Mt. Hamilton. The newest and youngest member of Lick Observatory's resident community is son to David and Sarah Perrin. In fact, the little tyke was in such a hurry to see his new home that he surprised everyone and showed up a week early! At 6 lbs–7 oz and 20 inches long, it'll no doubt be some time before Rylen is unseated as (by far) the cutest member of our family!

Greetings To A New Employee

We are pleased to welcome Connie Villicana to the Mt. Hamilton community. For the past year she's provided us with contract custodial and housekeeping services, and she recently accepted our offer of a staff position. Connie is a diligent worker and always seems to wear a smile. We're very happy to have her on staff at Lick Observatory.

CHARTER MEMBERSHIP DRIVE BEGINS JUNE 5TH DURING TRANSIT OF VENUS

Earlier this year UCSC Chancellor George Blumenthal approved formation and initial bylaws of the *Friends of Lick Observatory* (*FoLO*), a not-for-profit group formed to provide financial and other support for various programs at Lick Observatory, including development and maintenance of educational programs, exhibits, facilities and volunteer programs. *FoLO* will launch its Charter Membership Drive on June 5, 2012 during the *Transit of Venus* celebration on Mt. Hamilton. Provisional membership levels can be found in the box at right, beginning with the Celestial Circle, our basic membership.

FRIENDS OF LICK OBSERVATORY MEMBERSHIPS

THE CELESTIAL CIRCLE
INDIVIDUAL $50
SENIOR/STUDENT $30
FAMILY (CHILDREN UNDER 18) $75

Those who join the Celestial Circle will receive a *Friends* membership card, a quarterly newsletter, electronic notification of programs and events, a 10%-off coupon for the Mt. Hamilton Gift Shop, and a Lick Observatory insignia.

THE NEBULA CIRCLE
$150

In addition to Celestial Circle benefits, Nebulae may purchase tickets to summer public program events in advance of the general public, and will be given a Laurie Hatch print commemorating the *Friends of Lick Observatory* inauguration on June 5, 2012.

THE GALAXY CIRCLE
$500

As well as the Nebula benefits, Galaxies receive two general-admission tickets to a *Music of the Spheres* concert, and priority viewing at summer public programs.

THE SUPERNOVA CIRCLE
$1,000

In addition to the Galaxy benefits, Supernovae are invited to an exclusive member event.

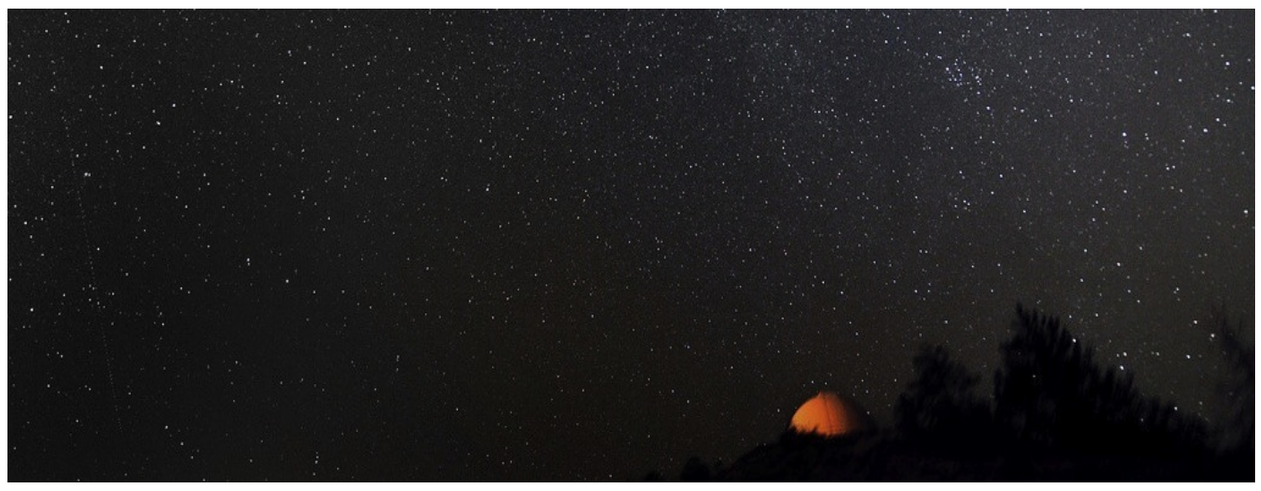
THE QUASAR CIRCLE
$2,500

In addition to the Supernova benefits, Quasars are granted a private tour of Lick Observatory, given by an astronomer.

THE JAMES LICK SOCIETY
$5,000

Society members receive all of the benefits of Quasars, as well as a private viewing session at the Great Lick Refractor, and an invitation to the Director's Reception.

LICK OBSERVATORY'S PUBLIC SUMMER PROGRAMS



Summer Visitors Program

On six Friday evenings each summer, the public is invited to enjoy this view of the sky, observe it through the Great Lick Refractor and the 40-inch Nickel Reflector, attend a lecture by a UC astronomer, and hear a talk about the history of Lick Observatory. Dates, and astronomers: **June 15**, Graeme Smith (UCO); **June 29**, Brian Siana (UC Riverside); **July 13**, Jonathan Fortney (UC Santa Cruz); **July 27**, Adam Burgasser (UC San Diego); **August 10**, Tommasso Treu (UC Santa Barbara); **August 24**, Alice Shapley (UCLA). **Tickets go on sale May 15**. Call (831) 459–2159 or go to SantaCruzTickets.com (photo by peter-lundqvist.smugmug.com).

Music of the Spheres

Lick Observatory resounds with an eclectic line-up of contemporary musicians on six summer Saturday nights during our benefit concert series. Attendees 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 reflector. Dates, artists, and astronomers: **June 16**, *Singing Strings Trio*, Richard Kron (University of Chicago); **June 30**, *Ramon Romero and Strings of Fire*, Raja GuhaThakurta (UC Observatories); **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. **Tickets go on sale May 8**. Call (831) 459–2159 or go to SantaCruzTickets.com.

THE LOSS & BSNIP SURVEYS

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galaxies. The reason for this is unclear, given that SNe Ia result from the thermonuclear runaway of a carbon–oxygen white dwarf.

The Berkeley Supernova Ia Program (BSNIP) represents complementary spectroscopic work, comprising 1298 spectra of 582 SNe Ia observed from 1989 through 2008, using primarily the Lick 3-m Shane telescope equipped with the Kast spectrograph. Together, LOSS and BSNIP represent two of the largest samples of SN Ia observations ever published.

Selected Publications:

1. Ganeshalingam, M., *et al.* 2010, *ApJS*, **190**, 418.
2. Li, W., *et al.* 2011, *MNRAS*, **412**, 1473.
3. Silverman, J.M., *et al.* 2012, *MNRAS*, **in press** (arXiv:1202.2128).

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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 wareham@ucolick.org or xavier@ucolick.org