

# PRIMEFOCUS

Tri-Valley Stargazers

September 2002



## Meeting Info:

### What

*So you want to test a mirror...*

### Who

John Swenson

### When

September 20, 2002  
Conversation at 7:00 p.m.  
Lecture at 7:30 p.m.

### Where

Unitarian Universalist  
Church in Livermore  
1893 N. Vasco Road

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## September Meeting

Mirror testing: An overview of amateur mirror testing techniques with an in depth look at the new lateral wire test

OR

So you want to test a mirror...

*John Swenson*

Amateur mirror testing is a bit of a black art. Many books describe it, but no matter how many books you read, actually performing the test is a surprise. This talk will actually perform several of the common mirror tests with what you see projected on a TV screen so you can get a “feel” for what it’s like to squint at fleeting shadows.

I will go into detail on the new “lateral wire test”, a very simple test that is MUCH easier to perform than the others, and is valid for a much broader range of mirrors. I’ll run a mirror or two through the process and come up with a surface error chart for them.

Hopefully this presentation will demystify the art of mirror testing enough so that some of you will dive in and make your own mirror.

### Figures 1-3

The images on the right show three different types of mirror testing. Note that these test images are *not* from the same mirror. Figure 1 is the ronchi test, Figure 2 is the foucault test, and Figure 3 is the new lateral wire test.

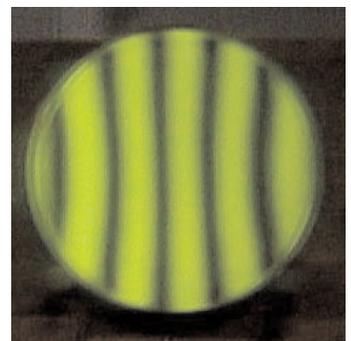


Figure 1

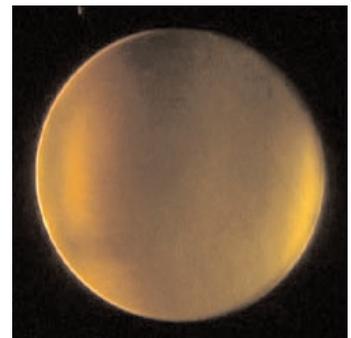


Figure 2

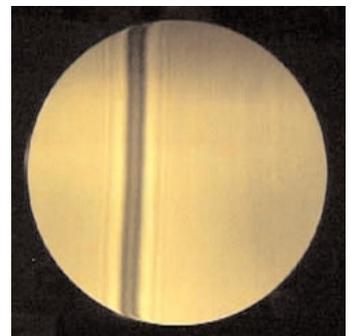


Figure 3

# News & Notes

## New Members

Next time you see them at the meeting, say hello to our two new members, **Stan Isakson** and **Tom Kozon**.

## 2002 TVS Meeting Dates

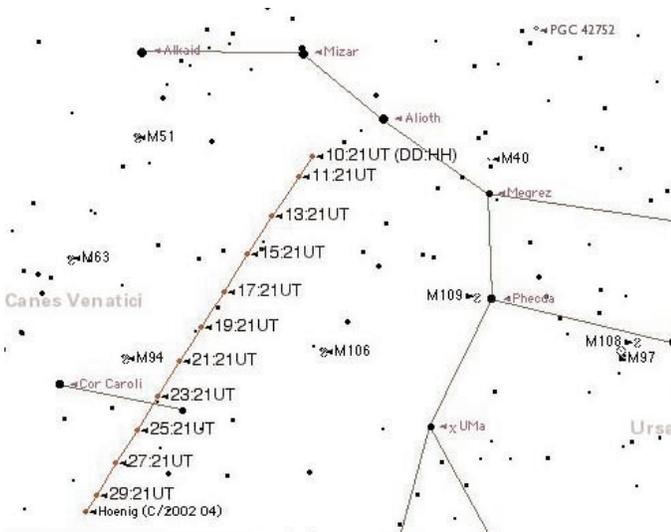
Below are the remaining meeting dates for 2002. The lecture meetings are held on the third Friday of the month, with the Board meeting on the Monday following the lecture meeting. The *Prime Focus* deadline applies to that month's issue (e.g., the October 6th deadline is for the October issue).

Lecture Meeting	Board Meeting	Prime Focus Deadline
Sep. 20	Sep. 23	Sep. 8
Oct. 18	Oct. 21	Oct. 6
Nov. 15	Nov. 18	Nov. 3
Dec. 20	Dec. 16	Dec. 8

We do not have a speaker lined up for October just yet, but our November speaker is Deanna Pennington who will speak on the Keck wave front correction systems. Our December meeting will be our Winter Solstice Potluck.

## Comet Hoenig

Comet Hoenig is now around 7.5 magnitude in the north circumpolar sky. It will reach perihelion (its closest point to the Sun) around October 1st. The map below shows its path from now through September 30th. The first number is the date in September, the second number is the time in UT. So the first number you see—10:21 UT—means September 10th at 21:00 UT (9:00 PDT). All plot positions are for 21:00 UT/9:00 PDT.



## Money Matters

At the August Board meeting, Treasurer Mike Anderson reported the balances (as of August 19, 2002) of the following TVS accounts:

Checking	\$1,149.16	
CD #1	\$3,882.06	matures 11/17/02
CD #3	\$2,395.77	matures 11/27/02
CD #4	\$2,039.04	matures 10/16/02

*continued page 7*

# Calendar of Events

## Classic Sci-Fi Film Series Chabot Space & Science Center

The movies are shown at the Tien MegaDome Theater. Tickets are \$5 per person and are available at the door, at TicketWeb.com, or the Chabot Box Office, 510-336-7373.

### Movies:

*Indiana Jones and the Temple of Doom*, October 4 – 6

*Indiana Jones and the Last Crusade*, November 1 – 3

*2001: A Space Odyssey*, December 6 – 8

### Showtimes:

Friday – Sunday on the first weekend of each month.

Fridays – 7:30 p.m.

Saturdays – 4:00 & 7:30 p.m.

Sundays – 4:00 p.m.

## Ends September 15

**What:** *The Lost Spacecraft: Liberty Bell 7 Recovered*

**Where:** Chabot Space & Science Center

**Cost:** General Admission price

**Newsletter header image:** Semeis 147: Supernova Remnant. Seen towards the constellation Taurus it covers nearly 3° (six full moons) of the sky corresponding to a width of 150 light-years at the stellar debris cloud's estimated distance of 3,000 light-years. On three separate nights in December 2001 and January 2002 astronomer Steve Mandel accumulated a total of over eight hours of exposure time to compose this image. He used an astronomical CCD camera, telephoto lens, and his specially designed adapter to allow such wide-field digital imaging. He also used a narrow H-alpha filter to transmit only the light from recombining hydrogen atoms in the expanding nebulosity, defining the regions of shocked, glowing gas. This supernova remnant has an apparent age of about 100,000 years (light from the original explosion first reached Earth 100,000 years ago) but it is not the only aftermath of the massive stellar explosion. The cosmic catastrophe also left behind a spinning neutron star or pulsar, all that remains of the star's dense core.

*Credit & Copyright: Steve Mandel*

## Calendar of Events *continued*

The *Liberty Bell 7* exhibit is quickly coming to an end. If you want to see the actual spacecraft that had sunk to the bottom of the ocean in 1961 and was retrieved 38 years later, you'll need to get over to Chabot by Sunday the 15th of this month, as the exhibit will be gone the next day. This is a really neat (and large) exhibit, so if you haven't already made the trip I highly recommend a visit.

### September 17, 7:30 p.m.

**What:** *The Substellar Zoo*

**Who:** Dr. Gibor Basri (UC Berkeley)

**Where:** Morrison Planetarium, San Francisco

**Cost:** \$3

The Fall Dean Lecture Series at the Morrison Planetarium starts off with Dr. Gibor Basri, who will be talking about the surprising picture of brown dwarfs and giant planets based on their observed numbers, masses and orbits. Advance ticket purchase is recommended. You can send a self addressed stamped envelope (SASE) and check payable to Morrison Planetarium to:

Dean Lecture Series, Morrison Planetarium  
California Academy of Sciences  
Golden Gate Park  
San Francisco, CA 94118

For more information you can reach the Dean Lecture Info line at 415-750-7141.

### September 19, 7:30-9:00 p.m.

**What:** *The Art & Science of Interstellar Message Making*

**Who:** Dr. Doug Vakoch (Interstellar Message Group, SETI Institute)

**Where:** Chabot Space & Science Center

**Cost:** \$5

Dr. Vakoch researches ways that different civilizations might create messages that could be transmitted across interstellar space, allowing communication between humans and extraterrestrials even without face-to-face contact. He is particularly interested in how we might compose reply messages that would begin to express what it's like to be human. His current project in interstellar message composition focuses on communicating concepts about the evolution of altruism, as seen from sociobiological, evolutionary psychological, and philosophical perspectives. Dr. Vakoch is a clinical psychologist with a training in comparative religion.

### September 22, 3:00 p.m.

**What:** *COSMOS I: Attempts to Fly the First Solar Sail Spacecraft*

**Who:** Louis D. Friedman (Executive Director, The Planetary Society)

**Where:** Morrison Auditorium, Cal. Academy of Sciences Golden Gate Park, San Francisco

**Cost:** \$3 advanced, \$5 at the door.

The Planetary Society Bay Area Volunteer Network and the Morrison Planetarium of the California Academy of Sciences present this talk by Louis Friedman.

To order your tickets in advance, send a check payable to The Planetary Society, and a SASE to:

X-Environs  
c/o Barbara Raskin  
1530 Bay Laurel Dr.  
Menlo Park, CA, 94025.

Orders received after September 15, or without a SASE, will be held at Morrison Auditorium. Tickets are limited and non-refundable.

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#### **Officers**

##### **President:**

Chuck Grant  
cg@fx4m.com  
925-422-7278

##### **Vice-President:**

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steinhour1@juno.com

##### **Treasurer:**

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##### **Secretary:**

Maggie Halberg  
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##### **Board of Directors**

Alane Alchorn, Jim Alves, Dave Anderson, Dennis Beckley, Paul Caswell, Rich Combs, Debbie Dyke, Gert Gottschalk, Kathleen

Kelley, Signe McIntire, Dave Rodrigues, Frank Rogue, Mike Rushford, Debbie Scherrer, John Swenson, Norm Thomas, Phil Waide

##### **Volunteer Positions**

##### **Librarian:**

Jim Alves  
jim\_alves\_engr@yahoo.com  
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##### **Newsletter Editor:**

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925-461-3003

##### **Program Director:** unfilled

##### **Loaner Scope Manager:**

John Swenson  
johnswenson1@attbi.com

##### **Webmaster:**

Chuck Grant

##### **Observatory Director/**

**Key Master:**

Chuck Grant

##### **School Star Party Chair:**

Rich Green (unofficially)  
richgreen@pacbell.net  
925-449-2190

##### **Public Star Party Chair:**

Roger Gathers  
925-455-6039

##### **Historians:**

Paul Caswell & Debbie Dyke

##### **Addresses**

*Mailing:*  
Tri-Valley Stargazers  
P.O. Box 2476  
Livermore, CA 94551

##### *Lecture Meeting:*

Unitarian Universalist Church  
1893 N. Vasco Road, Livermore

##### *Board Meeting:*

Round Table Pizza  
1024 E. Stanley Blvd., Livermore

##### **Web & E-mail**

www.trivalleystargazers.org

tvst@trivalleystargazers.org

##### **Eyes on the Skies**

Eyes on the Skies is a robotic solar telescope run by Mike Rushford (rushford@eyes-on-the-skies.org). You may access it by visiting [www.eyes-on-the-skies.org](http://www.eyes-on-the-skies.org).

## Calendar of Events *continued*

On the web, visit The Planetary Society at <http://planetary.org> and The Bay Area Volunteer Network at [www.tpsbavn.org](http://www.tpsbavn.org). For directions to the California Academy of Sciences, call 415-750-7144.

### September 28–29

**What:** *The ASP's 2002 Annual Meeting*

**Where:** Various Bay Area locations

**Cost:** \$35 adults, \$30 ASP members, \$25 students

Is life widespread through the cosmos, or is Earth a lonely oasis? The Astronomical Society of the Pacific cordially invites you to learn more about this fascinating topic by attending its 114th Annual Meeting. The theme of this year's meeting is "The Cosmic Thread: From Stars to Life."

On Saturday, September 28, the Society will be sponsoring a free public astronomy lecture by renowned comet discoverer and author **David H. Levy**. The lecture will be held at 7:30 p.m. in the amphitheater near the summit of Mt. Tamalpais in Marin County. Levy's talk is entitled "From Stars to Life: Suppose You Had to Design a Universe?" A free public star party, sponsored by the San Francisco Amateur Astronomers (SFAA), follows Levy's talk. Don't worry about bringing a telescope; SFAA members will be out in force!

Mt. Tamalpais State Park, which is co-sponsoring the event, is charging \$5.00 for parking permits for all visitors that evening. People can order pre-paid parking permits to guarantee they will have a parking space near the theater.

To purchase a pre-paid parking permit, send a SASE and a check for \$5.00 (payable to MTIA) to:

MTIA Astronomy Programs  
c/o Tinka Ross  
89 Dominican Drive  
San Rafael, CA 94901.

Parking is limited, so car pooling is encouraged. If MTIA does not sell all the parking passes before September 28, it will sell the remaining passes on a first-come, first-serve basis at the entrance gate to Mt. Tamalpais State Park.

On Sunday, September 29, the Society will host a full day of lectures by some of the world's leading astronomers. The lectures will run from 9:00 a.m. to 5:35 p.m. at Pimentel Hall on the U.C. Berkeley campus. Scheduled speakers include **Alex Filippenko** (ASP President, U.C. Berkeley), **Geoff Marcy** (U.C. Berkeley), **Chris McKay** (NASA's Ames Research Center), **David Morrison** (NASA's Ames Research Center), **Jill Tarter** (SETI Institute), **Chris Impey** (University of Arizona), **Ben Zuckerman** (U.C.L.A.), and **Seth Shostak** (SETI Institute).

From 7:00 to 10:00 p.m. the ASP will be hosting a reception at the U.C. Berkeley Faculty Club, followed by a dinner banquet in the Heyns Room. Award-winning author and journalist **Timothy Ferris** will speak at the banquet. Following Ferris's talk, the ASP will present its 2002 Annual Awards, including the Society's prestigious Bruce Medal for lifetime achievement in astronomical research. Banquet seating is extremely limited, so please sign up now! Admission to the reception and banquet is \$60.00.

For more details and for registration information, please visit the Society's web site at: [www.astrosociety.org/events/meeting.html](http://www.astrosociety.org/events/meeting.html).

### California Dreamin'

TVS member **Ken Sperber** took this photo of the California Nebula on 26 August 2000 using his 4" Takahashi, a f/5.9 focal reducer, a Deep-Sky filter, and hypered 35mm PPF film. It was a 76min exposure (from 02:36-03:52) that was scanned and processed at 150dpi. Look out Gert, I think you've got some competition!



## Star Parties

Check the club's web site ([www.trivalleystargazers.org](http://www.trivalleystargazers.org)) for updates and more information.

### September 7

#### Sycamore Grove Star Party, Livermore

TVS, in conjunction with the LARPD (Livermore Area Recreation and Parks District) will host a public star party at Sycamore Grove in Livermore. If you'd like to help, contact Roger Gathers at 925-455-6039. Set up time will be approximately 6:45 p.m. as sunset is at 7:28 p.m.

### Sept 7 thru Oct 12 Mt. Diablo Star Party

The Mt. Diablo Astronomical Society's public star parties on top of Mt. Diablo. Check their web site for more info: <http://www.mdas.net/mdaspublicnights.htm>. Listed are the dates and the topics they will be discussing for each star party.

September 7 "Why are the days getting longer?"

October 12 "Why is there a North Star?"

### September 28 H2O Open House

This will be TVS's final open house of the season. Meet at the corner of Mines & Tesla at 5:45 p.m. as the caravan will depart promptly at 6:00. Sunset is at 6:56 p.m. For those who have never been to the club's site, there is a \$3 per car fee so bring exact change. The observing site is primitive – there are two outhouses and no water or power outlets. Be sure to bring everything you think you might need (e.g., food, water, red flashlights, warm clothing in case it gets cold, extra batteries, your telescope or binoculars, etc.). Expect to stay until after midnight. If you have any questions, contact President **Chuck Grant** at 925-422-7278 or [cg@fx4m.com](mailto:cg@fx4m.com).

### October 3 – 5 Lake San Antonio

The San Jose Astronomical Association hosts the third annual **CalStar** dark-sky observing star party in Lake San Antonio, west of Highway 101. This is an observing only star party, so there will not be any vendors, speakers, prizes or food concession stands. Cooking facilities and picnic tables at the campgrounds are limited. There are some fire rings with BBQ grates, but you should plan to cook camping style. Campsites have potable water and toilets, and there are showers available for free in the park.

Pay at the park entrance, say you are attending the star party. Camping costs are reduced to \$32 per vehicle for 3 nights. Observers may stay Sunday night for an additional \$16.00.

For more info or to sign up, contact **Mark Wagner** at 408-356-1125 or visit [www.sjaa.net/calstar2002.html](http://www.sjaa.net/calstar2002.html).

## Astronomical Insights

by David Feindel

The evening started innocently enough, at the Arroyo Camp Star Party. About 20 people/telescopes showed up to display the celestial highlights to campers, including five TVSers. Problems, as usual, with local outdoor lighting left on, but a bit of the Milky Way was visible near the zenith nonetheless. "Want to see the Chocolate Star?" was the question that started it all. The Chocolate Star is the brownish-appearing companion to Eta Cas (a.k.a. Achird). There are many references to this pair on the web (as a matter of fact, it is one of the 100 pairs on the Astronomical League's Double Stars list ([www.astroleague.org/al/obsclubs/dblstar/dblstar2.html](http://www.astroleague.org/al/obsclubs/dblstar/dblstar2.html)), as well as several others. Interestingly enough, the six web references I found differed in reporting separation (11.7 to 12.7"), proper angle from 307 to 312 degrees, and color descriptions of "gold and purple" and "yellow and red"—but not "brownish"!

What the search also turned up were tremendous volumes of information in the US Naval Observatory's Double Star Library (<http://ad.usno.navy.mil/wds/dsl.html>), Stephen Austin State University Astronomy Department ([www.physics.sfasu.edu/astro](http://www.physics.sfasu.edu/astro) with an excellent explanation of eclipsing binary stars and computing their light curves), and most impressive of all, the Educational Observatory Institute ([www.edu-observatory.org/eo/eoi.html](http://www.edu-observatory.org/eo/eoi.html)) with pages of links to their own content on double stars, as well as recommended books, observational calendars, star charts, planetary data, and more. A five minute observation led to two hours of "computer astronomy" to learn more about what I saw.

This month I chose to add another tool to my astronomy arsenal—software for the Palm called *Planetarium*. Shareware (\$24) available at [www.aho.ch/pilotplanets](http://www.aho.ch/pilotplanets). For a long time, I thought that the low resolution and limited memory of PDAs made this level of software marginal. I was wrong. *Planetarium* is a quick, easy way to put together an observing plan, letting you know rise, transit, and set times. It has a good database of stars (up to 9,000), DSOs (up to 1,500), comets, and asteroids. One very useful capability is to flip views with the touch of a pen, to adjust from normal to reversed view (finder-scope view) to help locate stars. And yes, it has a "night mode" to display everything in red, but the Palm is still way too bright without some additional neutral density screen added. I used my Palm as a flashlight at a Star Party. There's also a rudimentary observer's log capability and telescope control capability (both untried). It won't replace *The Sky* or *Starry Night* on a PC, but you will get a lot of value out of it. And it's the perfect way to enjoy astronomy during boring meetings and presentations!

## What's Up *by Debbie Dyke*

All times Pacific Daylight unless otherwise noted.

### September

- 1 Sun Saturn 2.8° S of Moon 5:00 a.m.  
Mercury at greatest elongation East (27°) 3:00 a.m.  
1979 Pioneer 11 is the first spacecraft to fly past Saturn. Unless you count those aliens that keep flying by...
- 2 Mon **Labor Day**
- 4 Wed Jupiter 3.3° S of Moon 4:30 a.m.
- 6 Fri Possibility of the Zodiacal Light being visible in the east before morning twilight for the next two weeks.  
**New Moon** 8:10 p.m.
- 7 Sat **Sycamore Grove Star Party** in Livermore.  
Moon at perigee (222,422 mi.) 8:00 p.m.
- 8 Sun 1966 Star Trek debuts. Live long and prosper.
- 11 Wed 1816 Carl Zeiss born.
- 13 Fri **First Quarter Moon** 11:08 a.m.
- 14 Sat 1915 John Dobson born. Take your favorite Dob out and celebrate.
- 20 Fri **Tri-Valley Stargazers general meeting.** 7:30 p.m. at the Unitarian Universalist Church, 1893 N. Vasco Road, Livermore.
- 21 Sat **Full Moon** 6:59 a.m. This full moon is also known as the Harvest Moon.
- 22 Sun **Tri-Valley Stargazers discussion meeting.** 2:00 p.m. at the Round Table Pizza on 1024 E. Stanley Blvd., Livermore. Eat and gossip with your fellow members.  
**Fall Equinox** 9:55 p.m.
- 23 Mon **Tri-Valley Stargazers Board meeting.** 7:00 p.m. at the Round Table Pizza in Livermore.  
Moon at apogee (251,938 mi.) 8:00 p.m.  
1846 Neptune discovered in Berlin (apparently it got lost). Using the calculations provided by Urbain Jean Joseph Le Verrier, Johann Gottfried Galle spots the little blue-green disk in his scope.
- 28 Sat **H2O Open House.** Last one of the year, so don't miss out!  
ASP's annual meeting. Continues through Sunday 29.
- 29 Sun **Last Quarter Moon** 10:03 a.m.

### October

- 2 Wed 1608 J. Lippershey patents the telescope. Meade sues claiming they were first.
- 4 Fri 1957 Sputnik 1 is launched by the Soviet Union, becoming the first artificial satellite to orbit the Earth.
- 5 Sat Possibility of the Zodiacal Light being visible in the east before morning twilight for the next two weeks.
- 6 Sun **New Moon** 4:18 a.m.  
Moon at perigee (221,289 mi.) 6:00 a.m.  
1995 First extrasolar planet discovered orbiting 51 Pegasi.
- 7 Mon 1959 First photo of the "dark side" of the Moon taken by Luna 3. Fourteen years later, Pink Floyd decides that "dark side of the moon" would make a nifty album title.
- 10 Thurs Mercury 2.8° S of Mars low in the east at 6:00 a.m.  
1604 Kepler saw a supernova appear between Jupiter and Saturn (visually speaking, of course).

### A Letter from the President of the ASP

Alex Filippenko

Let me tell you a personal story about my introduction to the world of astronomy. As a kid, I had always been a science buff, playing at home with microscopes, magnets, and various gadgets. The snippets of astronomy that I heard in grade school and junior high were fascinating, and I yearned to learn more. So it was natural that I received a 6-cm refractor as a gift from my parents in December 1972, when I was a freshman in high school.

I still remember my first night with that telescope, nearly 30 years ago, as though it were only yesterday. Pointing toward a bright star, I was rewarded with a much brighter view, though of course it still looked like a tiny point of light with no details. A second bright star looked about the same, and the thrill was beginning to wane. I knew, though, that to find out where the “good stuff” is, I would have to consult more experienced amateur astronomers. So, I decided to have a quick look at a third bright star before giving up for the night. As I let go of the telescope and peered through the eyepiece, waiting for the jiggling to subside, I suddenly realized that I was viewing the planet Saturn, with its glorious set of rings! I was dazzled – the sight knocked my socks off! It didn’t matter that millions of people had seen Saturn before; that night, in my mind, I had “discovered” Saturn on my own, and the amateur astronomy bug bit me hard... really hard.

I promptly joined the Santa Barbara Astronomy Club and was inundated with helpful observing advice, unbridled

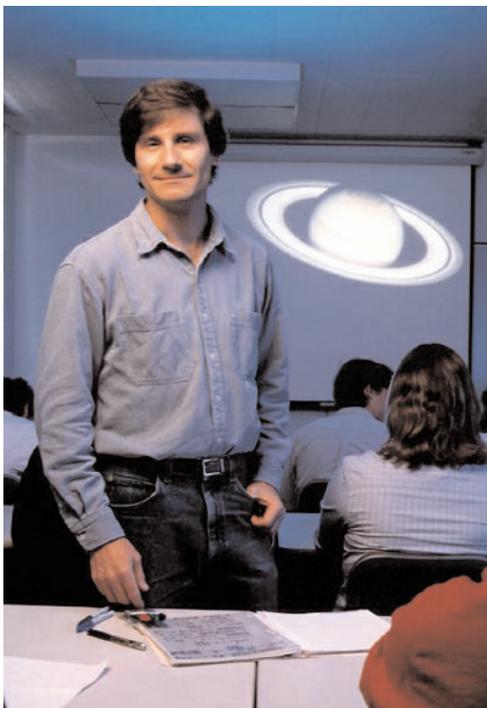
enthusiasm and camaraderie, great views of objects through telescopes much larger than mine, and informative presentations at the monthly meetings. I learned so much from my amateur astronomy buddies – it was incredible. And they showed the same love for explaining the wonders of the heavens to laypersons during public star parties and other events. I personally witnessed many people enthralled, inspired, and awed by what they saw and heard, the majesty of the Universe grandly displayed before them. It became clear to me that amateur astronomers were highly effective in bringing science to the public.

Now, three decades later, I am the President of the non-profit Astronomical Society of the Pacific (ASP), a main goal of which is the public dissemination of astronomical knowledge. I would not be in this fortunate position without my early exposure to amateur astronomy. Like you, we at the ASP want to explore the cosmos, and also excite and inform the general public about astronomy. YOU can help us by becoming a member of the ASP and thus supporting our educational activities – including Project ASTRO (a national astronomy education program), *The Teachers’ Newsletter*, an extensive catalog of astronomy-related products for educators and the public (members get a 10% discount), K-12 teachers’ workshops, public lectures, and much more. Also, you’ll receive our bimonthly *Mercury* magazine with insightful articles and other items. Please go to our web site at [www.astrosociety.org](http://www.astrosociety.org) and consider joining! Annual dues are only \$48 for individuals (\$35 for students) and \$75 for families.

Let me also take this opportunity to invite you to attend the ASP’s public symposium, co-sponsored by the Astronomical Association of Northern California (AANC) [www.aanc-astronomy.org](http://www.aanc-astronomy.org), on September 29, in Pimentel Hall at the UC Berkeley campus. It is entitled *The Cosmic Thread: From Stars to Life*, and features a stellar list of speakers (**Seth Shostak**, **Geoff Marcy**, **Jill Tarter**, **David Morrison**, and others). You can register at the ASP web site: \$35 for the general public, \$30 for ASP members, and \$25 for students. It is certain to be a great event. [Editor’s note: see page 4 for a lot more info about this event.]

Happy viewing!

Alex Filippenko  
Professor of Astronomy  
University Distinguished Teacher  
UC Berkeley  
[alex@astro.berkeley.edu](mailto:alex@astro.berkeley.edu)



**Alex Filippenko**  
and his old  
friend Saturn.

# PRIMEFOCUS



Tri-Valley Stargazers  
P.O. Box 2476  
Livermore, CA 94551

## Tri-Valley Stargazers Membership Application

Member agrees to hold Tri-Valley Stargazers, and any cooperating organizations or landowners, harmless from all claims of liability for any injury or loss sustained at a TVS function.

Name \_\_\_\_\_ Phone \_\_\_\_\_ e-mail \_\_\_\_\_

Address \_\_\_\_\_

Choose one: \_\_\_\_\_ I wish to download *Prime Focus* from the web (an e-mail notification will be sent to me when it's available for download). I understand that a paper version will *not* be mailed to me.  
\_\_\_\_\_ I wish *Prime Focus* to be mailed to me.

Do not release my: \_\_\_\_\_ address, \_\_\_\_\_ phone, or \_\_\_\_\_ e-mail information to other TVS members.

Membership category: \_\_\_\_\_ \$5 Student \_\_\_\_\_ \$20 Individual \_\_\_\_\_ \$25 Family  
\_\_\_\_\_ \$20 Hidden Hill Observatory (H2O) refundable key deposit (key property of TVS)  
\$ \_\_\_\_\_ Tax deductible contribution to Tri-Valley Stargazers  
\$ \_\_\_\_\_ TOTAL – Return to: Tri-Valley Stargazers, P.O. Box 2476, Livermore, CA 94551

Membership information: Term is one calendar year, January through December. Student members must be less than 18 years old, or still in high school.