

# PRIME FOCUS

Tri-Valley Stargazers

July 2005



## Meeting Info:

### What

*Summer BBQ Potluck*

### Who

TVS Members

### When

July 15, 2005

Set up 6:30 p.m.

Dinner at 7:00 p.m.

### Where

Unitarian Universalist  
Church in Livermore  
1893 N. Vasco Road

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## July Meeting

### Summer BBQ Potluck

*TVS Members, Family and Friends*

If it's summer time it must be BBQ time. Yes folks, it's TVS BBQ Potluck time again. TVS will provide the burgers (and veggie burgers), condiments, sodas, and all the plastic ware. Members are asked to bring a food dish to share. General rule of thumb is bring enough to feed eight people. As to what to bring, check the chart below. Use the first letter of your last name to determine which type of side dish to bring.

A-F	Macaroni or Potato Salad
G-L	Green or Fruit Salad
M-R	Appetizers
S-Z	Dessert



After dinner, if the skies are clear we'll pull out our loaner scopes and do a little stargazing. Like all our meetings, the BBQ is open to all. Take note that we're starting earlier than our usual start time—set up is at 6:30, dinner at 7:00. Bring your family and friends for an evening of eating and conversation (and maybe a little observing).

## Deep Impact

Did you see it? A group of TVSers at H2O were able to see it. **Gary Steinhour** reports:

“There were a few TVS'ers at H2O last night to witness the impact of comet Tempel 1. Those who showed up were **Chuck Grant, Ken Sperber, Dave Woolsey, Hilary Jones, Steve Goldenberg** and his family, and myself. We saw a definite but gradual brightening of the comet with a central bright spot 15 to 30 minutes or so after the predicted impact time.

Also observed were planets Mercury, Venus, Jupiter, Pluto, and Mars.

The Marling scope was on its mount and made available for those who were interested in taking a peek through it.”

At the Chabot Space & Science Center, the comet was not visible with the 36" Cassegrain—although we were able to pick it up (barely) using a digital SLR attached to the scope, taking 30-second exposures. Those images were downloaded, processed, and displayed on Chabot's movie screen for the assembled crowds to see.

# News & Notes

## Welcome!

TVS would like to welcome our newest member, **William Kuo**.

## 2005 TVS Meeting Dates

Below are the TVS meeting dates for the next few months. The lecture meetings are on the third Friday of the month, with the Board meetings on the Monday following the lecture meeting. The Prime Focus deadline applies to that month's issue (e.g., the July 3rd deadline is for the July issue).

Lecture Meeting	Board Meeting	Prime Focus Deadline
July 15	July 18	July 3
Aug. 19	Aug. 22	Aug. 7
Sept. 16	Sept. 19	Sept. 4

## Money Matters

At the June Board meeting, Treasurer **Gary Steinhour** reported the TVS account balances (as of June 19, 2005):

Checking	\$1,285.12	
CD #1	\$3,469.59	matures 08/17/05
CD #2	\$2,452.23	matures 08/27/05
CD #3	\$1,081.23	matures 07/16/05

## H2O Open House

If you missed our June 25th Open House, have no fear—our next Open House is on August 27. Meeting time has yet to be determined, but usually it's around an hour and a half before sunset. Details to follow in the next newsletter, and on the web site.

## Marling Scope Progress Report

The Marling scope is back in operation! The scope made its debut at the Open House in June. There are some minor tweaks that need to be made, but all in all it's up and running and ready for use by Patron Members.

## H2O Sports a New Roof

An intrepid group of TVSers took on the daunting task of re-roofing the observatory. On a previous work party, **Chuck Grant** and **Ken Sperber** removed the shingles in preparation to putting on a new roof. In the process, they discovered that some of the sheets of plywood underneath were rotting away. Uh-oh. We had to switch to Plan B.

On June 11th, **Chuck, Ken, Gary Steinhour, Dave Woolsey, Jason Lee, Jon Swenson, Hilary Jones, Debbie Dyke, and Gert Gottschalk** met at H2O. The group removed the plywood and several of the support braces that were in bad shape. Replacement supports were put in place, followed by new sheets of plywood.

Then came the hard (and messy) part.

The shingles were in roll form and required cutting to the correct length. Once the sheets were ready, it was time for the tar "glue". The sticky stuff was brushed onto sections of the roof, then the shingle roll would be applied on top. Lather, rinse, and repeat. As the sun was setting, the final shingle roll was applied.

A few parts need to be touched up, but the roof is ready to take on the winter rains (or even the summer ones!).



Removing the damaged roof gave us a well ventilated observatory, perfect for getting the scope cooled down quickly.



The roof is completed, just before the sun goes down.

### Newsletter header image: Comet Tempel 1

This image of comet Tempel 1 was taken 67 seconds after it obliterated Deep Impact's impactor spacecraft. The image was taken by the high-resolution camera on the mission's flyby craft. Scattered light from the collision saturated the camera's detector, creating the bright splash seen in the image. Linear spokes of light radiate away from the impact site, while reflected sunlight illuminates most of the comet surface. The image reveals topographic features, including ridges, scalloped edges and possibly impact craters formed long ago.

Photo by: NASA/JPL-Caltech/UMD

# Calendar of Events

## July 16, 6:00 p.m.

**What:** *Cosmic Impact Night*  
**Who:** NASA-Ames Research Center  
**Where:** NASA-Ames, Mountain View  
**Cost:** Free

NASA Ames Research Center, located in California's Silicon Valley, will host *Cosmic Impacts*, the second installment in its highly successful Family Night Education Series, on Saturday, July 16, 2005. The event features exhibits and hands-on activities for the entire family, presentations by NASA experts, and 'galaxy viewing' where the public can see the moon, planets and other celestial objects through a field of telescopes (weather permitting).

*Cosmic Impacts* is free and open to the public. The doors of the NASA Exploration Center open at 6:00 p.m. and will remain open until 10:00 p.m. Telescope viewing will continue until 11:00 p.m. To reach NASA Ames, exit at Moffett Boulevard from U.S. Highway 101. Turn right over the overpass and follow the parking signs.

### Schedule of Events:

6:00-10:00 p.m. NASA Exploration Center  
Family exhibits and activities

7:00 p.m. Lectures

**Scott Sandford**, NASA research astrophysicist  
Presenting the latest images and results from the Deep Impact mission's July 4 rendezvous and impact with the comet Tempel 1.

**David Morrison**, senior scientist, NASA Astrobiology Institute.  
Presenting NASA's efforts to locate and identify

near-Earth asteroids that could pose an impact hazard to the Earth.

**Rusty Schweickart**, Apollo 9 astronaut  
Presenting the B612 Foundation's innovative and exciting plans to demonstrate how impact hazards to the Earth could be addressed by changing the orbit of an asteroid.

8:30-11:00 p.m. Galaxy Viewing

Join local amateur astronomers to view the impact craters on the moon and other celestial bodies.

Ames Family Nights are sponsored by the NASA Ames Education Office and are designed to engage the community in scientific exploration and to inform the public about NASA research and technology.

For more information visit: [www.nasa.gov/centers/ames/](http://www.nasa.gov/centers/ames/)

For more information about the NASA Ames Education Office, visit: <http://quest.nasa.gov>.

## August 13, 8:00 p.m.

**What:** *Exploring the Meaning of Life*  
**Who:** Dr. Emma Bakes (NASA-Ames)  
**Where:** Mt. Tam  
**Cost:** Free

What evidence is there for the universal formation of life throughout the cosmos? Come to the talk and find out!

Program is held in the Mountain Theater on Mt. Tam. Weather permitting, after the lecture there will be telescope viewing in the Rock Spring parking lot. For more information visit [www.mttam.net](http://www.mttam.net) and the SFAA web site [www.sfaa-astronomy.org/sfaa/starparties/index.shtml](http://www.sfaa-astronomy.org/sfaa/starparties/index.shtml).

### Officers

#### President:

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#### Vice-President:

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#### Board of Directors

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Debbie Dyke, Gert Gottschalk,  
Stan Isakson, Mike Rushford,  
John Swenson.

### Volunteer Positions

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Rich Campbell

### Historian:

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### Addresses

#### Mailing:

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

#### Lecture Meeting:

Unitarian Universalist Church  
1893 N. Vasco Road, Livermore

#### Board & Discussion Meetings:

Round Table Pizza  
1024 E. Stanley Blvd., Livermore

### Web & E-mail

[www.trivalleystargazers.org](http://www.trivalleystargazers.org)  
[tvst@trivalleystargazers.org](mailto: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](mailto: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).

### TVS E-Group

So how do you join the TVS e-group you ask? Just send an e-mail message to the TVS e-mail address ([tvst@trivalleystargazers.org](mailto:tvst@trivalleystargazers.org)) asking to join the group. Make sure you specify the e-mail address you want to use to read and post to the group.

## Calendar of Events *continued*

### August 20, 11:00 a.m. to 2:00 p.m.

**What:** *Happy Birthday Chabot!*

**Who:** Chabot visitors

**Where:** Chabot Space & Science Center, Oakland

**Cost:** Free with General Admission

Join the Chabot staff for free ice cream as Chabot Space & Science Center celebrates the fifth anniversary of its newest home on Skyline Boulevard in Joaquin Miller Park. Win a prize in a raffle! [www.chabotspace.org](http://www.chabotspace.org)

### August 27, all day

**What:** *AANC-Con 2005*

**Who:** You

**Where:** Randall Museum, San Francisco

**Cost:** \$25

The AANC (Astronomical Association of Northern California) is a group that promotes communication and coordination among Northern California astronomy clubs, planetaria, observatories, and businesses. TVS is a member of the AANC.

This year's conference is a celebration of Bay Area astronomy. The one day conference will have various speakers and vendors, as well as a celebration of John Dobson's 90th birthday with a 'Dob In A Day' scope making project.

Details are still in the works. Some of the speakers who are scheduled include author Timothy Ferris, and space artist Lynette Cook. A partial vendor list includes Celestron, Meade, Scope City, Parks Optical, Lumicon, and TeleVue.

Cost includes entrance to all lectures, exhibit space, workshop, plus a box lunch. T-shirts and lapel pins, designed by your editor, will be available for purchase online.

Check [www.planitarium.net/aanc/aanc-con2005/program\\_guide](http://www.planitarium.net/aanc/aanc-con2005/program_guide) for more info. Plans are in the works for online registration, although that hasn't happened yet at press time.

### September 10, 8:00 p.m.

**What:** *Black Holes: The Science Behind the Science Fiction*

**Who:** Dr. Eliot Quataert (UC Berkeley)

**Where:** Mt. Tam

**Cost:** Free

What are black holes? How are they discovered? How do they give rise to some of the most remarkable and bizarre phenomena in the universe?

Program is held in the Mountain Theater on Mt. Tam. Weather permitting, after the lecture there will be telescope viewing in the Rock Spring parking lot. For more information visit [www.mttam.net](http://www.mttam.net) and the SFAA web site [www.sfaa-astronomy.org/sfaa/starparties/index.shtml](http://www.sfaa-astronomy.org/sfaa/starparties/index.shtml).

## Astro Events

### Jupiter Transits

Below is a listing of transit times for various Jupiter related objects. The abbreviations are fairly straight forward: G=Ganymede, C=Callisto, I=Io, E=Europa, GRS=Great Red Spot, and if you see an 's' next to one of the moons, it means its shadow (e.g., Cs=Callisto's shadow); na means Jupiter is below the horizon or it is daylight at that time.

### July

Mon 11	GRS	9:30p	11:20p	na
	E	na	na	10:20p
	Es	10:08p	11:16p	na
Wed 13	G	na	na	9:08p
	GRS	11:07p	na	na
	Gs	11:25p	na	na
Thurs 14	GRS	na	na	10:53p
Sat 16	GRS	na	10:30p	na
Mon 18	I	na	na	9:59p
	Is	na	9:52p	11:08p
	E	10:19p	11:37p	na
	GRS	10:19p	na	na
Tues 19	GRS	na	na	10:06p
Wed 20	G	10:30p	11:45p	na
Thurs 21	GRS	na	9:40p	11:45p
Mon 25	I	9:45p	10:49p	na
	Is	10:55p	na	na
	GRS	11:05p	na	na
Thurs 28	GRS	na	10:30p	na
Sat 30	GRS	10:15p	na	na
Sun 31	GRS	na	na	10:00p

### August

Tues 2	GRS	na	9:37p	na
Wed 3	Is	na	na	9:27p
Thurs 4	GRS	9:30p	na	na
Fri 5	Es	na	na	9:58p
Tues 9	GRS	8:44p	10:28p	na
Wed 10	I	na	9:13p	10:22p
	Is	9:13p	10:05p	na
Fri 12	GRS	na	na	10:07p
	E	na	9:10p	na
	Es	9:57p	na	na
Sun 14	GRS	na	9:37p	na
Fri 19	GRS	na	8:50p	na

## First Light: Beginners' Astronomy

by Richard Campbell

### Good to Go(To)?

The sage astronomer quipped, "This computerized telescope will point for you," and the crowd of beginning astronomers "Oooohed" and "Aaaahhed"... This scene plays out hundreds of times a night, all over the world, raising expectations of what a beginning telescope should do. But does GoTo really improve the stargazing experience? When the computer finds your star, have you lost the thrill of finding it yourself? Can GoTo telescopes do things Manual telescopes can't? In short, are we good to GoTo?

First, any telescope, GoTo or not, is inadequate if its aperture is too small. Some GoTo scopes' lenses are so anemic they can only see a tiny percentage of the stars in their computer database. Or if they can see them, they are so faint as to be unrecognizable. Yet, a medium-sized GoTo, say 5" and above, can see thousands of objects with clear definition. Good.

The GoTo Stargazer starts by placing her telescope on the ground and aligning its tripod with Polaris, the North Star (If she has an alt-azimuth mount, she skips that step). Then, she checks the battery power, and turns on the computer. After a perfunctory greeting, or warning ("Never point scope at the sun") the computer will prompt her to find and center two bright guide stars. She takes out her planisphere to identify the constellations that contain the stars, inserts a wide-angle eyepiece, glides the telescope to the guide stars and voila!, tells the computer it has centered them accurately. If her alignment was precise, she can now tell the computer to point the telescope to thousands of other celestial bodies. It's like a remote control for the universe.

Nice trick, yet the GoTo computer isn't changing the view—it's only helping you find objects. A 10" manual telescope can cost hundreds less than a 5" GoTo, and reveal a myriad of galaxies, stars and nebulae invisible in the 5". And what about the thrill of discovery? Would you rather scan the landscape with binoculars and find a bald eagle, or see it at a zoo where it's clearly marked?

When you stargaze manually, you dive deep into starfields, internalizing the normally invisible patterns of the night sky. Stars become signposts as you navigate the telescope to your celestial destination. On the way there, you might accidentally discover a cluster, comet or galaxy you would have missed since you look through the eyepiece as you move the telescope.

Yet are there times GoTo is the *best* way to go? Yes. If you want to track the International Space Station, or other satellites. If you want to find bright stars during the day, ditto. If you host an impatient crowd of growling astronomers (or children) who want to view dozens of galaxies *really fast*, GoTo is a must. Also, if the guide stars that

help you find an object are super-faint, manual finding can be near-impossible. In that special case, GoTo would be handy.

Perhaps there is a middle path where we could find the best of both Manual and GoTo observing. What if you could use GoTo for only the faintest objects (I mean, really, do we need GoTo to find the Moon)? Or have one manual scope and one computerized so you could enjoy both styles of stargazing. Even Clapton plays unplugged sometimes...

At the end of the night, either method can be 'good to go,' especially if you enjoy the view once you get there...

## Astronomical Insights

by David Feindel

### Cruising the (more) Southern Skies

I was fortunate to have the opportunity to take a week-long Caribbean cruise this summer. My first thought was "Wow! 19 degrees N latitude. I'm going to see a lot of new constellations!" Then I started thinking. Ships sail overnight to get to their next destination. Ships moving at 22 knots (the *Zuiderdam's* cruising speed) vibrate. And unless you happen to have a 22-knot tailwind, this means a strong wind is blowing. Continually. Big ships owned by big companies with big legal staffs have lots of lights on. All the time. So I reluctantly left my telescope at home and decided that my 10x binoculars would have to suffice.

The viewing actually turned out fairly well, given the limitations. The decks were awash with light, but the small verandah for our cabin turned out to be fairly dark, once all our neighbors went to sleep. It was somewhat sheltered from the wind. The views were somewhat limited—SE to N skies outbound, and SW to N skies on the return, from the horizon to about the zenith in altitude. Being tens to hundreds of miles from land, the skies are fairly dark, other than ship lights. I could occasionally see all 7 Little Dipper stars with direct vision, and easily see them all with averted vision. The Milky Way was "sort of" visible, although sometimes it looked more like a thin cloud cover than a galaxy. So overall a bit better than Del Valle, but not as good as H2O. And being so far from land meant no mosquitoes, a noxious hazard for astronomers in tropical latitudes.

The first thing I noticed looking up is that I was lost. Constellations are not where you expect them. The Little Dipper itself disappears half-way below the horizon at this latitude. The entire Summer Triangle is north of the E-W meridian, not south. Scorpius is well above the horizon, with its entire outline clearly visible. The "stinger" is

*continued page 7*

## What's Up *by Debbie Dyke*

All times Pacific Daylight Saving Time unless otherwise noted.

### July

- 4 Mon 1054 Chinese astronomers observe the Crab Nebula supernova.  
1997 Mars Pathfinder lands on Mars.  
1868 Henrietta Swan Leavitt born. Henrietta discovered over 2,400 variable stars and the relationship between period and luminosity in Cepheid variables.
- 5 Tues Venus at greatest heliocentric latitude North.
- 6 Wed **New Moon.** 5:02 a.m.
- 7 Thurs Mercury 1.6° South of Venus (26° E) 1:00 a.m.
- 8 Fri Moon at apogee (251,945 miles) 11:00 a.m.  
The thin crescent Moon, Venus, and Mercury low in the West. 9:00 p.m.  
Mercury at greatest elongation E (26°) 8:00 p.m.
- 9 Sat 1979 Voyager 2 passes by Jupiter.
- 11 Mon 1979 Skylab re-enters the Earth's atmosphere.
- 14 Thurs **First Quarter Moon.** 8:20 a.m.  
1965 Mariner 4 makes first flyby of Mars and takes pictures.
- 15 Fri **Tri-Valley Stargazers general meeting.** 7:30 p.m. at the Unitarian Universalist Church, 1893 N. Vasco Road, Livermore.
- 16 Sat 1994 Comet Shoemaker-Levy 9 begins plunging into Jupiter. The plunging continues through the 20th.
- 17 Sun **Tri-Valley Stargazers discussion meeting.** 2:00 p.m. at the Round Table Pizza on 1024 E. Stanley Blvd., Livermore. Discuss astro stuff with your fellow members.  
**New Moon** 4:24 a.m.  
Mars at perihelion.  
Antares 0.6° South of the Moon. Occultation starts at 8:08 p.m. (during daylight), ends at 8:58 p.m.  
1850 First photo of a star (Vega).
- 18 Mon **Tri-Valley Stargazers Board meeting.** 7:00 p.m. at the Round Table Pizza in Livermore.  
Mercury at aphelion.  
1984 Svetlana Savitskaya becomes the first woman to take a walk in space.
- 19 Tues 1846 Edward Pickering born.
- 20 Wed 1969 Apollo 11 lands at Tranquillity, placing the first men on the Moon.  
1976 Viking 1 makes first robotic landing at Chryse Planitia on Mars.  
1999 Space capsule Liberty Bell retrieved from the bottom of the ocean.
- 21 Thurs **Full Moon** (largest of 2005). 4:00 a.m.  
Moon at perigee (221,437 miles). 1:00 p.m. Expect large tides.  
1925 John Scopes convicted for teaching evolution.
- 22 Fri 1972 Venera 8 makes the first soft landing on Venus.
- 23 Sat Saturn in conjunction with the Sun. 10:00 a.m.  
1995 Alan Hale discovers his half of Comet Hale-Bopp.
- 27 Wed S. delta-Aquarid meteors peak at 6:00 p.m.  
**Last Quarter Moon.** 8:19 p.m.
- 28 Thurs 1851 First photo taken of a solar eclipse — the corona is discovered.
- 30 Sat 1971 Apollo 15 lands on the Moon. The next day, the astronauts Scott and Irwin take a little spin in the Lunar Roving Vehicle.
- 31 Sun 1774 Oxygen is discovered. Everyone takes a deep breath of relief.  
1964 Ranger 7 impacts Moon, taking the first close-up views of the Lunar surface.

## Moving a Mountain of a Dish

by Patrick L. Barry

Your first reaction: “That’s impossible!”

How on earth could someone simply pick up one of NASA’s giant Deep Space Network (DSN) antennas—a colossal steel dish 12 stories high and 112 feet across that weighs more than 800,000 pounds—move it about 80 yards, and delicately set it down again?

Yet that’s exactly what NASA engineers recently did.

One of the DSN dishes near Madrid, Spain, needed to be moved to a new pad. And it had to be done gingerly; the dish is a sensitive scientific instrument full of delicate electronics. Banging it around would not do.

“It was a heck of a challenge,” says Benjamin Saldua, the structural engineer at JPL who was in charge of the move. “But thanks to some very careful planning, we pulled it off without a problem!”

The Deep Space Network enables NASA to communicate with probes exploring the solar system. Because Earth is constantly rotating, a single antenna on the ground can communicate with a probe for only part of the day, when the probe is overhead. By placing large dishes at three locations around the planet—Madrid, California, and Australia—NASA can maintain contact with spacecraft around the clock.

To move the Madrid dish, NASA called in a company from the Netherlands named Mammoet, which specializes in moving massive objects. (Mammoet is the Dutch word for “mammoth.”)

On a clear day (bad weather might blow the dish over!), they began to slowly lift the dish. Hydraulic jacks at all four corners gradually raised the entire dish to a height

of about 4.5 feet. Then Mammoet engineers positioned specialized crawlers under each corner. Each crawler looks like a mix between a flatbed trailer and a centipede: a flat, load-bearing surface supported by 24 wheels on 12 independently rotating axes, giving each crawler a maximum load of 194 tons!

One engineer took the master joystick and steered the whole package in its slow crawl to the new pad, never exceeding the glacial speed of 3 feet per minute. The four crawlers automatically stayed aligned with each other, and their independently suspended wheels compensated for unevenness in the ground.

Placement on the new pad had to be perfect, and the alignment was tested with a laser. To position the dish, believe it or not, Mammoet engineers simply followed a length of string tied to the pad’s center pivot where the dish was gently lowered.

It worked. So much for “impossible.”

Find out more about the DSN at <http://deepspace.jpl.nasa.gov/dsn>. Kids can learn about the amazing DSN antennas and make their own “Super Sound Cone” at The Space Place, <http://spaceplace.nasa.gov/en/kids/tmodact.shtml>.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

## Astronomical insights *continued*

clearly double, even naked eye. Telescopium and Corona Australis were visible, as was a large part of Lupus. The latter three constellations were completely “unknown” to me until now.

The best views were merely scanning through the Milky Way, and looking at the brighter globulars. The Wild Duck (M11) was as wonderful as it always is. The Auriga Ms weren’t all that impressive given the 10x binocular view. The globulars M4, M13, and M92 were very noticeably globulars (although more than 10x magnification helps!). M31 was there, but not the size it should be. But the best views were merely staring at the stars, listening to the waves go by, and contemplating the immensity of it all.

Overall lessons learned—study the skies more before you go, or take good paper charts with you. I had my laptop with *The Sky* on it, but didn’t have anything to reduce light output from it, so it was unusable once the sky got dark. Binoculars are about the limit for magnification; and some sort of image stabilization helps. And lay off the rum punches.



Giant Deep Space Network antenna in Madrid is moved using four 12-axle, 24-wheel crawlers.

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



## PRIMEFOCUS

### 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 \_\_\_\_\_

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

- Membership category: \_\_\_\_\_ \$5 Student.  
\_\_\_\_\_ \$25 Basic. You will receive e-mail notification when the PDF version of Prime Focus is available for download off the TVS web site.  
\_\_\_\_\_ \$30 Regular. You will receive a paper version of Prime Focus in the mail.  
\_\_\_\_\_ \$32.95 One year subscription to Sky & Telescope magazine.  
\_\_\_\_\_ \$29 One year subscription to Astronomy magazine.  
\_\_\_\_\_ \$55 Two year subscription to Astronomy magazine.  
\_\_\_\_\_ \$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.