

PRIMEFOCUS

Tri-Valley Stargazers



April 2015



Meeting Info

What:

Unraveling the High-Energy Universe with NuSTAR

Who:

Dr. Julia Vogel, LLNL

When:

April 17, 2015
Doors open at 7:00 p.m.
Meeting at 7:30 p.m.
Lecture at 8:00 p.m.

Where:

Unitarian Universalist Church in Livermore
1893 N. Vasco Road

Inside

News & Notes	2
Journal Club	3
Calendar of Events	3
Member Photos	5
What's Up	6
NASA's Space Place	7
Membership/Renewal	8

April Meeting

Unraveling the High-Energy Universe with NuSTAR and Peering at the "Dark Side" of the Cosmos

Dr. Julia Vogel

The Nuclear Spectroscopic Telescope Array (NuSTAR) is a NASA small explorer mission and was launched in June 2012. Its primary mission goal is to bring the high-energy Universe into focus. It studies the cosmos at its extremes by observing exploding stars, hidden black holes and other exotic objects in an entirely new light. In addition, NuSTAR is also looking at a closer and more familiar star - our Sun- to understand its high-energy emission better and search for dark matter particles, which are expected to make up about 25% of all matter in the universe while "normal" matter as we know it contributes a mere 5%. Together with ground-based experiments, such as the CERN Axion Solar Telescope (CAST), NuSTAR will shed some light on the "dark side" of the Universe.

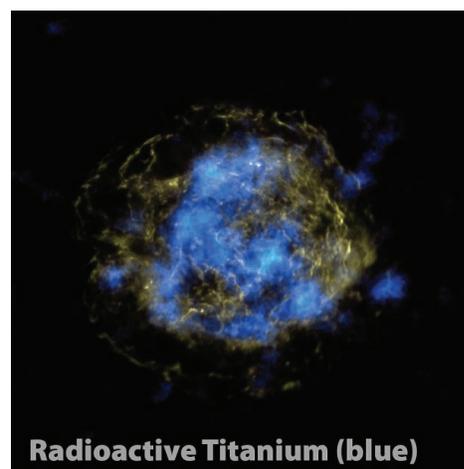


Image Caption: Composite image of supernova Cassiopeia A. Radioactive titanium, seen in blue, as observed by NuSTAR. Yellow shows non-radioactive material detected by the Chandra X-Ray observatory.. Credit: NASA/JPL-Caltech/CXC/SAO

Dr. Julia Vogel is a staff scientist in the X-ray Science and Technology group of the Physics Department at Lawrence Livermore National Laboratory (LLNL). She works on solar axion dark matter searches (CAST, IAXO) and hard X-ray astronomy using focusing multilayer-coated X-ray optics (NuSTAR). She received her Ph.D. from the Albert-Ludwigs University of Freiburg, Germany, in 2009 in experimental astroparticle physics. Her primary research interests include the search for dark matter using novel, low-background detectors in combination with X-ray optics (CAST, IAXO experiments). Currently her work focuses on the application of advanced multilayer techniques in astrophysics. As a member of the NuSTAR instrument and science team, Julia studies neutron stars with very high magnetic fields (called magnetars) using this state-of-the-art NASA Small Explorer mission. NuSTAR is also scheduled for solar observations and Julia will work on using these data to search for axions combining her astroparticle research work with X-ray astronomy instrumentation and analysis.

News & Notes

2015 TVS Meeting Dates

The following lists the TVS meeting dates for 2015. The lecture meetings are on the third Friday of the month, with the Board meetings on the Monday following the lecture meeting.

Lecture Meeting	Board Meeting	Prime Focus Deadline
Apr. 17	Apr. 20	
May 15	May 18	Apr. 24
Jun. 19	Jun. 22	May 29
Jul. 17	Jul. 20	Jun. 26
Aug. 21	Aug. 24	Jul. 31
Sep. 18	Sep. 21	Aug. 28
Oct. 16	Oct. 19	Sep. 25
Nov. 20	Nov. 23	Oct. 30
Dec. 18	Dec. 21	Nov. 27

Money Matters

As of March 23rd the TVS checking account balance is \$14,528.10. This includes a deposit of \$756.40 from the proceeds from our sales of donated equipment at the SJAA Spring Auction.

TVS Solar Telescope on Order

The Lunt LS60THa, a 60mm solar telescope with an integrated pressure-tuned Hydrogen-alpha filter has been ordered, with a deposit of \$182.28 having been paid. Lunt gave us a 7% educational organization discount. The telescope is currently on back order and delivery is expected in July.

School Star Party: April 23 (Volunteers Needed)

April 23, Mendenhall Middle School in Livermore: Rich Combs is capping off his Project ASTRO Partnership with Katie Smiley at Mendenhall Middle School with a star party on Thursday, April 23. Katie teaches four eighth-grade classes with 25-30 students in each class. Rich anticipates a good crowd, including family members. We will be setting up on a grassy area next to the school at El Padro Park, where no electricity is available. The school's address is 1710 El Padro Dr, Livermore, and El Padro Park is next to the school to the north. Rich suggests TVS'ers arrive at about 7:15 to be ready to start at 7:45. Rich will hold open an unloading area at the curb, but parking is limited at the park. Rich may start with an activity while it is getting dark. Venus, Jupiter, and a crescent Moon will all put in an appearance. Any and all Tri-Valley Stargazers are invited, with or without a scope. Unaided eye and binocular objects would be a nice addition to the usual scope treats. More details at the meeting Friday.

If you can be of assistance in sharing the excitement of astronomy with interested minds, please contact Rich to volunteer your assistance (vice_president@trivalleystargazers.org).

TVS Yosemite Star Party: July 17-18

Bob McKoon will be coordinating this year's TVS star party at Glacier Point, Yosemite National Park. We were lucky in drawing the nearly-new Moon weekend of July 17-18. TVS members who bring telescopes for public observing will receive free camping at the Bridalveil campgrounds. The Moon, with ~6% of the disk visible, will set by 10pm. On these dates sunset occurs at about 8:25pm with sunrise at about 6:00am. Contact Bob for more information (rmckoon@yahoo.com).

TVS Winery Star Party: April 18

The inaugural TVS Winery Star Party will be Saturday, April 18th (the day after our April general meeting) at Tesla Vintners in Livermore! Tesla Vintners is located on Tesla Road near Mines Road, and it has reasonably dark skies overhead and to the south, considering its urban location. The winery is private property, and we are the guests of Steve Powell, the owner. *This first star party is only open to club members and their guests.* Future star parties at the winery may be open to the public as well.

The sun sets at 7:45 PM that night, with the new moon setting shortly after. Plan to arrive around 7:00 PM to allow yourself plenty of time to set up and become familiar with the location. The winery has two entrances. The main entrance is likely to be closed, so plan on using the unmarked delivery entrance, the one closer to Mines Road. The winery has a large parking area in the middle of the grounds plus a large open field in the back. We are welcome to use both, but lights from the Wente winery to the east can be a problem in the back. The winery also has a bathroom which we will be able to use. The star party will run through midnight. Please plan on joining your fellow club members there and help make this inaugural in-town star party a success.

TVS H2O Open House: May 9

The first 2015 TVS Open House will be on Saturday, May 9. Interested club members, especially those who have paid a key deposit but have not yet completed an orientation visit are especially encouraged to attend. We will meet at the corner of Mines Rd. and Tesla Rd., and depart to H2O at 6:30pm in a caravan led by Chuck Grant. Admission is \$3/car; please bring the exact amount. The site is primitive, with 2 pit toilets, and no running water. Bring warm clothes, and food and water for the evening. Use a flashlight with a red filter so that people's dark adaptation is not ruined by white light. Check the TVS website for the latest information.

Header Image: The grazing incidence optics of NuSTAR on the assembly machine at Columbia University's Nevis Laboratory. On the left is a close up of the individual layers separated by graphite spacers that have been glued together with epoxy. Credit: see: <http://www.nustar.caltech.edu/page/optics>

Cyanide and Life?

If you have watched one to many episodes of *Forensic Files*, you know that cyanide, HCN, is a deadly substance. However, it and its more complex organic forms are essential components for the formation of amino acids. HCN is believed to form via gas phase chemistry, while the more complex cyanides, such as HC₃N and CH₃CN, form on ice grains. These and other complex organics have been identified in comets, thus fostering the possibility that precursors to life may have been delivered to Earth due to cometary impacts.

An outstanding question was whether the processes that form the complex organics was efficient enough to overcome destruction by the intense ultraviolet light of a newly formed star. For the first time, these complex cyanides have been found in a newly formed protoplanetary disc of the star MWC480. The observations were made by Oberg et al. (2015, *Nature*, 520, 198-201) using the Atacama Large Millimeter/submillimeter Array (ALMA). The host star has a mass of ~1.8x the Sun, and it is surrounded by a protoplanetary disk that has a mass of 0.18 +/- 0.1 that of the Sun. The mass of this protoplanetary disk is 10x the minimum mass of the solar nebula that would have been needed to form our solar system.

With the high angular resolution of ALMA, the rotation of the protoplanetary disk was observed since the emission lines of these organic molecules exhibited double peaks, one peak being redshifted from the portion of disk that rotates away from our perspective, and the other peak being blueshifted from the portion of the disk that rotates toward us. These detections showed the complex cyanides to be present from 30-100 Astronomical Units away from the host star, corresponding to the comet forming region. Importantly, the ratios of HC₃N/HCN and CH₃CN/HCN are very close to those measured in comets that formed in our solar system! This indicates that the formation of complex organics is a common process in evolving protoplanetary disks and that precursors to life are common throughout the universe.

For more information see: <http://www.sciencedaily.com/releases/2015/04/150408131422.htm>

Calendar of Events

April 14, 12:00pm

What: Viewing Solar System Orbital Architecture through an Extrasolar Lens
Who: Konstantin Batygin, Caltech
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

The statistics of extrasolar planetary systems indicate that the default mode of planetary formation generates planets with orbital periods shorter than 100 days, and masses substantially exceeding that of the Earth. When viewed in this context, the Solar System, which contains no planets interior to Mercury's 88-day orbit, is unusual. Extra-solar planetary detection surveys also suggest that planets with masses and periods broadly similar to Jupiter's are somewhat uncommon, with occurrence fraction of less than ~10%. In this talk, Dr. Batygin will present calculations which show that a popular formation scenario for Jupiter and Saturn, in which Jupiter migrates inward from a > 5AU to a ~1.5 AU and then reverses direction, can explain the low overall mass of the Solar System's terrestrial planets, as well as the absence of planets with a < 0.4 AU. He will argue that under these conditions, a collisional cascade will ensue, generating a planetesimal disk that would have flushed any preexisting short-period super-Earth-like planets into the Sun. In this scenario, the Solar System's terrestrial planets formed from gas-starved mass-depleted debris that remained after the primary period of dynamical evolution.

For more information see: <http://www.seti.org/csc/lectures>, e-mail info@seti.org, or phone 650-961-6633.

continued on page 4

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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 (info@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)

April 21, 12:00pm

What: Paleoenvironmental Reconstruction and the Identification of Habitable Conditions on Ancient Earth and Mars Using Clay Minerals
Who: Tom Bristow, SETI
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

Abstract unavailable.

For more information see: <http://www.seti.org/csc/lectures>, e-mail info@seti.org, or phone 650-961-6633.

April 24 (6:30pm), May 1 (7:15pm)

What: Night Hikes
Who: You
Where: Chabot Space and Science Center, 10000 Skyline Blvd., Oakland, CA 94619
Cost: \$14, does not include general admission; RSVP recommended, space limited, register online or call (510) 336-7373

Enjoy a hike through the beautiful redwoods! After the hike, stay and explore other amazing objects in the night sky through our telescopes (weather permitting) or tour the Telescope Makers Workshop. Hike will take place rain or shine.

See <http://www.chabot.space.org/events.htm> for more information, or call (510) 336-7373.

April 25, 8:30pm

What: Stepping Out of the Nest
Who: Dr. Jacob Cohen, NASA-Ames, Chief-Scientist
Where: Mt. Tamalpais State Park, Cushing Memorial Amphitheater, more commonly known as the Mountain Theater, Rock Spring parking area
Cost: Free

How does research into the search for water and habitable planets, astrobiology, space biology, small satellites, advanced manufacturing, autonomous vehicles and synthetic biology make science fiction into science reality? NASA-Ames scientists have a vision for human flight from our Earthly nest to explore and live in space.

For more information see: <http://www.friendsofmounttam.org/astronomy/schedule>

April 28, 12:00pm

What: Shape Dynamics: A Relational View of the Universe
Who: Henrique Gomes, Perimeter Institute
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

Shape Dynamics is a new theory of gravity which removes the notion of local relativistic time from the guiding principles of gravity in the universe. It is a very promising approach which has been shown to be equivalent to Einstein's Theory of General Relativity, without being embedded in time. It is inspired by adherence to Mach's Principle, which is violated by Einstein's theory. Shape Dynamics provides new tools in the quest for a theory that describes quantum gravity. In the first part of the talk Dr. Gomes will review some of the Machian motivations for shape dynamics and sketch its construction. In the second half, Dr. Gomes will talk about recent developments on black holes in this formulation, and discuss some positive aspects of its ongoing quantization program.

For more information see: <http://www.seti.org/csc/lectures>, e-mail info@seti.org, or phone 650-961-6633.

May 2, 1:30pm and 3:00pm

What: Mars Mini Missions
Who: You at the Challenger Learning Center
Where: Chabot Space and Science Center, 10000 Skyline Blvd., Oakland, CA 94619
Cost: \$12 (does not include general admission)

Ever wonder what it's like to be an astronaut on a space mission? How does it feel to be a Mission Specialist guiding flights around the Solar System? Find out in our Challenger Learning Center® as you experience the thrill and excitement of a NASA simulated space mission! Become an important member on a dynamic team accomplishing the goals of your mission. You are a vital member of the crew! This adventure is recommended for space travelers ages 10 years to adult (younger children may participate when teamed with an adult).

See <http://www.chabot.space.org/events.htm> for more information, or call (510) 336-7373.

May 4, 7:30pm

What: Emerging Pictures of Distant Worlds
Who: Bruce Macintosh, Stanford University
Where: California Academy of Science, 55 Music Concourse Dr., Golden Gate Park, San Francisco, CA
Cost: Advanced ticketing required. Academy members \$8, Seniors \$10, General \$12. Reserve a space online or call 1-877-227-1831.

In less than two decades, more than a thousand planets have been discovered orbiting other stars. This has sparked a post-Copernican revolution, as we realize our solar system is not alone. However, we still don't know if our solar system is rare or unique - the powerful techniques that detect extrasolar planets are still too insensitive to see any of the planets in our solar system; and the known extrasolar planets are 'seen' through indirect methods such as Doppler shift or photometric measurements of their effects on their parent star. An

continued on page 5

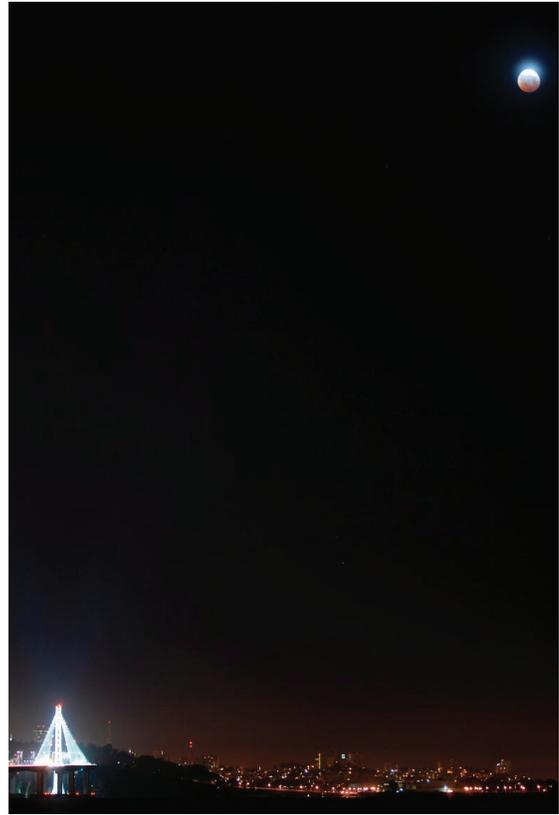


Image Caption: Images of the lunar eclipse of April 4, 2015, taken from the Marina Park Pathway in Emeryville, CA. Both images were taken with a Nikon D80 using a 70-300mm lens. The left image, a 2 second exposure, was taken at 5:21am, with the lens set to 300mm f/5.6 at ISO-400. The reddish hue is due to the scattering of blue wavelengths of sunlight that passed through the Earth's troposphere, while the blue tone to the upper-right is due to the absorption of red light by ozone in the Earth's stratosphere. The right image, a 10 second exposure, was taken at 5:29am, with the lens set to 70mm f/4.5 at ISO-200. A portion of the Bay Bridge and downtown San Francisco are seen in addition to the partially eclipsed Moon. Image Credit: Ken Sperber

Calendar of Events (continued)

alternative to indirect detection is imaging - blocking out the light of the bright star to reveal the faint planet nearby. This is extremely challenging - the Earth is ten billion times fainter than the sun. In recent years, however, advances in technology have allowed a handful of giant planets to be seen directly.

Macintosh will discuss these planets - the first-ever images of other solar systems - and the technology that has allowed us to discover them. New instruments, such as the advanced Gemini Planet Imager, promise to find dozens more, including the youthful equivalent of our own Jupiter. We will also learn about the prospects for the future, including behemoth 30-m ground-based telescopes and the the WFIRST-AFTA space mission. The latter will use a repurposed military telescope to potentially image "super-Earth" planets around the nearest stars. The ultimate goal is detection of a second 'pale blue dot' - an Earth twin where we could even see the biosignatures of extrasolar life. Such a discovery may re-

quire even more advanced space telescopes - but will truly complete the evolution of our view of the universe.

See www.calacademy.org/events/benjamin-dean-astronomy-lectures for lecture and reservation information.

May 5, 12:00pm

What: Brown Dwarf Variability and implications for Exoplanets

Who: Tyler Robinson, ARC

Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA

Cost: Free

Abstract unavailable.

For more information see: <http://www.seti.org/csc/lectures>, e-mail info@seti.org, or phone 650-961-6633.

What's Up by Ken Sperber (adapted from S&T and The Year in Space)

All times are Pacific Daylight Time.

April

- 11 Sat Last-Quarter Moon (8:44pm)
- 18 Sat New Moon (11:57am)
- 19 Sun Mercury and faint Mars visible near crescent Moon, use binoculars (dusk)
- 20 Mon Crescent Moon forms a quadrilateral with Venus, Aldebaran, and The Pleiades (dusk)
- 22 Wed Lyrid Meteor shower, 15-20 Zenith-Hourly Rate; (11pm-Dawn)
- 25 Sat First-Quarter (4:55pm)
- 27 Mon The waxing gibbous Moon is ~5 degrees from Regulus
- 30- Thu- Mercury makes its best evening apparition of the year this week and next (dusk)

May

- 1-14 Fri- Mercury high above the west-northwest horizon, and to the lower-right of Venus. May1-Mercury is just left of M45, The Pleiades (about 1 hour after sunset)
- 3 Sun Full Moon (8:42pm)
- 4 Mon Waning gibbous Moon 5 degrees from Saturn, which is located near the head of Scorpius
- 6 Wed Eta Aquarid Meteor Shower peaks before dawn
- 11 Mon Last-Quarter Moon (3:36am)
- 17 Sun New Moon (9:33pm)
- 21 Thur Venus in Gemini, about 9 degrees to the upper-right of the waxing crescent Moon (evening)
- 23 Sat Jupiter about 6 degrees north of the Moon, which sets at about midnight
- 25 Mon First-Quarter (10:19am)
- 25 Mon Regulus about 5 degrees above the First-Quarter Moon
- 27 Wed Double shadow transit on Jupiter from 7:01pm-9:18pm
- 30 Sat The Moon draws closer to Spica all night long



The Cold Never Bothered Me Anyway

By Dr. Ethan Siegel

For those of us in the northern hemisphere, winter brings long, cold nights, which are often excellent for sky watchers (so long as there's a way to keep warm!) But there's often an added bonus that comes along when conditions are just right: the polar lights, or the Aurora Borealis around the North Pole. Here on our world, a brilliant green light often appears for observers at high northern latitudes, with occasional, dimmer reds and even blues lighting up a clear night.

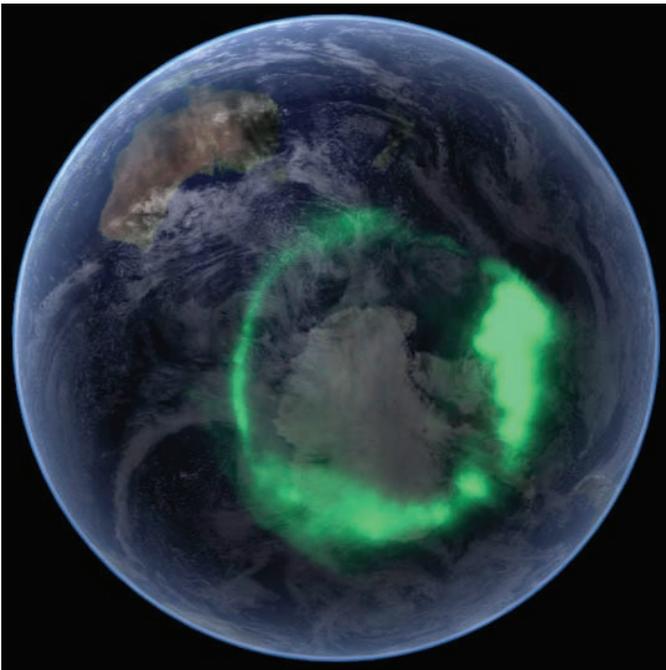


Image Caption: Auroral overlays from the IMAGE spacecraft. Credit: NASA Earth Observatory (Goddard Space Flight Center) / Blue Marble team.

We had always assumed that there was some connection between particles emitted from the Sun and the aurorae, as particularly intense displays were observed around three days after a solar storm occurred in the direction of Earth. Presumably, particles originating from the Sun—ionized electrons and atomic nuclei like protons and alpha particles—make up the vast majority of the solar wind and get funneled by the Earth's magnetic field into a circle around its magnetic poles. They're energetic enough to knock electrons off atoms and molecules at various layers in the upper atmosphere—particles like molecular nitrogen, oxygen and atomic hydrogen. And when the electrons fall back either onto the atoms or to lower energy levels, they emit light of varying but particular wavelengths—oxygen producing the most common green signature, with less common states of oxygen and hydrogen producing red and the occasional blue from nitrogen.

But it wasn't until the 2000s that this picture was directly confirmed! NASA's Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) satellite (which ceased operations in December 2005) was able to find out how the magnetosphere responded to solar wind changes, how the plasmas were energized, transported and (in some cases) lost, and many more properties of our magnetosphere. Planets without significant magnetic fields such as Venus and Mars have much smaller, weaker aurorae than we do, and gas giant planets like Saturn have aurorae that primarily shine in the ultraviolet rather than the visible. Nevertheless, the aurorae are a spectacular sight in the evening, particularly for observers in Alaska, Canada and the Scandinavian countries. But when a solar storm comes our way, keep your eyes towards the north at night; the views will be well worth braving the cold!



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

Tri-Valley Stargazers Membership Application

(or apply for membership online: www.trivalleystargazers.org/membership.shtml)

Contact information:

Name: _____ Phone: _____

Street Address: _____

City, State, Zip: _____

Email Address: _____

Status (select one): _____ New member _____ Renewing or returning member

Membership category (select one): Membership term is for one calendar year, January through December.

_____ Student member (\$5). Must be a full-time high-school or college student.

_____ Regular member (\$30).

_____ Patron member (\$70). Patron membership grants use of the club's 17.5" reflector at H2O. You must be a member in good standing for at least one year, hold a key to H2O, and receive board approval.

Hidden Hill Observatory Access (optional):

_____ One-time key deposit (\$20). This is a refundable deposit for a key to H2O. New key holders must first hear an orientation lecture and sign a usage agreement form before using the observing site.

_____ Annual access fee (\$10). You must also be a key holder to access the site.

Magazine Subscriptions (optional): Discounted subscriptions are available only to new subscribers. All subsequent renewals are handled directly with the magazine publishers.

_____ One-year subscription to Sky & Telescope magazine (\$32.95).

_____ One-year subscription to Astronomy magazine (\$34).

Donation (optional):

_____ Tax-deductible contribution to Tri-Valley Stargazers

Total enclosed: \$ _____

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. TVS will not share information with anyone other than other club members and the Astronomical League without your express permission.

Mail this completed form along with a check to: Tri-Valley Stargazers, P.O. Box 2476, Livermore, CA 94551.