PRIMEFOCUS

Tri-Valley Stargazers

June 2014

Meeting Info

What:
TVS Barbecue

Who:
TVS Members and Friends

When:
June 20, 2014
Set-up at 6:30 p.m.
Dinner at 7:00 p.m.

Where:
Unitarian Universalist
Church in Livermore
1893 N. Vasco Road

Inside

June Meeting

TVS Summer BBQ

Our June meeting will be our annual summer BBQ. Plan on working up an appetite by helping to set-up and get the charcoal going at about 6:30pm. We will start eating around 7:00pm. Please bring family, friends, and future TVS members to share in the festivities.

TVS will provide the burgers, condiments, drinks, and plastic ware. Members are asked to bring a side dish, salad, or dessert to share. Please bring enough to feed about 5-8 people. Use the first letter of your last name to determine which type of dish to bring: A-F Macaroni Salad or Potato Salad; G-L Green or Fruit Salad; M-R Appetizers; S-Z Dessert.

TVS Enthusiasm: 1, Meteor Shower/Weather: 0

As seen in the photo above, taken by Hilary Jones, the turnout for the May 23 TVS Open House was record-breaking. At least 13 carloads of people turned out for the the new meteor shower and observing, but cloudy weather and low meteor counts disappointed. The low meteor counts are consistent with the low dust production of the parent body, Comet 209P/LINEAR, which made its closest approach to the Sun in late May.

News & Notes

2014 TVS Meeting Dates

The following lists the TVS meeting dates for 2014. 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**
Jun. 20	Jun. 23	
Jul. 18	Jul. 21	Jun. 27
Aug. 15	Aug. 18	Jul. 25
Sep. 19	Sep. 22	Aug. 29
Oct. 17	Oct. 20	Sep. 26
Nov. 21	Nov. 24	Oct. 31
Dec. 19	Dec. 22	Nov. 28

Money Matters

Treasurer Roland Albers indicates that as of May 19, 2014 the TVS checking account balance is:

Checking $12,484.00

One More TVS Open House for 2014

The remaining TVS Open House for 2014 will be on Saturday, August 16. Interested parties, especially those who are not keyholders to H2O, 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.

TVS Yosemite Star Party

Bob McKoon will be coordinating this year's TVS star party at Glacier Point, Yosemite National Park. We were lucky in drawing the new Moon weekend of June 27-28. TVS members who bring telescopes for public observing will receive free camping at the Bridalveil campgrounds. On these dates sunset occurs at about 8:35pm with sunrise at about 5:50am. Contact Bob for more information (rmckoon"at"yahoo.com).

Golden State Star Party

The Golden State Star Party will be held from Wednesday, June 25 through Sunday, June 29th. See http://www.goldenstatestarparty.org/ to register for this annual event, and to find out details of the available amenities at the site.

Magazine Giveaway

TVS has back issues of *S&T* and *Astronomy* magazines freely available. If you are interested in being a recipient of these valuable resources of astronomical history, please make your interest known at a forthcoming club meeting. First come, first serve!

June 16, 7:30pm

Calendar of Events

What: Exploring Mars: A Decade of Discovery and Interpretation of the Red Planet
Who: Jeffrey Moore and Eldar Noe Dobrea, NASA Ames
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.

Join two planetary geologists on a fully immersive tour of the Red Planet. Using the latest high-resolution data collected by spacecraft currently in orbit around Mars, Morrison Planetarium's fulldome display will make you feel like you're flying over places where water once flowed and amazing processes still transform the Martian surface. Your expert tour guides for the evening will give you an introduction to what our many missions have taught us about Mars—as well as the mysteries that remain to be solved.

See http://www.calacademy.org/events/lectures/ for lecture and reservation information.

June 17, Noon-1:00pm

What: Ejecta from Impacts: New Experiments and Insight from Missions
Who: Brendan Hermalyn, SETI Institute
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

The ejection of mass during an impact event is a shock-driven process that shapes the distribution of materials on planetary surfaces. In particular, the velocity and mass distribution of material launched from an impact controls the ballistic emplacement and appearance of ejecta patterns, and is especially important for interpretation of impact mission data. This talk will present results from new temporally-resolved impact experiments conducted at the NASA Ames Vertical Gun Range, and will discuss applications to cratering on planetary surfaces and impact missions.

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

June 21, July 19, Aug. 16, 8:00pm-10:00pm

What: Telescopes Out of the Box
Who: Workshops
Where: Chabot Space and Science Center, 10000 Skyline Blvd., Oakland, CA 94619
Cost: Guests $50 per session, Members $45 per session. Reservations: (510) 336-7373

Remember how excited you were when you got that new

Header Image: Composite image of a portion of the Small Magellanic Cloud (NGC602) from the Hubble, Chandra, and Spitzer Space Telescopes. Credit: NASA, see http://www.spacetelescope.org/images/ngc602/

telescope? You were going to make all kinds of new discoveries in the sky, but now it's just collecting dust. With the clear summer skies, it's time to dust off those 'scopes and explore our Universe! Work with our expert astronomers on assembling and properly handling your telescope, and get tips for identifying objects in the night sky. Gain skills that will last a lifetime and impress your friends and family. Learn the basics in one class or sign up for all three and deepen your knowledge!

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

June 24, Noon-1:00pm

What: Red Dragon: Low Cost Access to the Surface of Mars using Commercial Capabilities
Who: Larry Lemke, NASA Ames
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

One of Ames' long-standing science interests has been to robotically drill deeply into Mars' subsurface environment (2 meters, or more) to investigate the habitability of that zone for past or extant life. Large, capable Mars landers would ease the problem of landing and operating deep robotic drills. In 2010, an Ames scientist realized that the crew-carrying version of the SpaceX Dragon capsule would possess all the subsystems necessary to perform a soft landing on Earth, and raised the question of whether it could also soft land on Mars. If it could, it might be a candidate platform for a Discovery or Mars Scout class deep drilling mission, for example.

After approximately 3 years studying the engineering problem we have concluded that a minimally modified Dragon capsule (which we call the "Red Dragon") could successfully perform an all-propulsive Entry, Descent, and Landing (EDL). We present and discuss the analysis that supports this conclusion. At the upper limits of its capability, a Red Dragon could land approximately 2 metric tons of useful payload, or approximately twice the mass that the MSL Skycrane demonstrated with a useful volume 3 or 4 times as great. This combination of features led us to speculate that it might be possible to land enough mass and volume with a Red Dragon to enable a Mars Sample Return mission in which Mars Orbit Rendezvous is avoided, and the return vehicle comes directly back to Earth. This potentially lowers the risk and cost of a sample return mission. We conclude that such an Earth-Direct sample return architecture is feasible if the Earth Return Vehicle is constructed as a small spacecraft. Larry Lemke will present and discuss the analysis that supports this conclusion.

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

June 28, 8:30pm

What: Masks of the Cosmos
Who: Prof. Wil van Breugel, UC Merced
Where: Mt. Tamalpais State Park, Cushing Memorial Amphitheater, more commonly known as the Mountain Theater, Rock Spring parking area
Cost: Free

Humans have always wondered about the Cosmos and their own place in it. Different cultures have believed that they have discovered its true nature, but might these ideas just be anthropological 'masks' projected on the universe?

For more information see: http://www.friendsofmttam.org/astronomy/schedule

July 8, Noon-1:00pm

What: Terrestrial Planet Atmospheres in the Aftermath of Giant Impacts
Who: Roxana Lupu, SETI Institute
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA

continued on page 4

Calendar of Events (continued)

Cost: Free

The final assembly of terrestrial planets is now universally thought to have occurred through a series of giant impacts, such as Earth's own Moon-forming impact. In the aftermath of one of these collisions the surviving planet is hot, and can remain hot for millions of years. The presence of a dense post-impact atmosphere will affect both the cooling of the planet and our ability to detect it. Dr. Lupu will present modeling results regarding the structure, chemistry, and spectral signatures of the atmospheres consisting of vaporized rock material. The atmospheric gas is in equilibrium with the surface magma ocean, with compositions reflecting either the bulk silicate Earth (which includes the crust, mantle, atmosphere and oceans) or the Earth's continental crust as a separate case. Dr. Lupu and her colleagues found that these atmospheres are dominated by H2O and CO2, and present characteristic spectral features from HF, HCl, and SO2. They estimate that cooling timescales for post-giant impact Earths range between about 10^5 and 10^6 years, where the slower cooling is associated with the planet going through a runaway greenhouse stage.

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

July 14, 7:30pm

What: Black Holes, Magnetars and Millisecond Pulsars: The Wickedly Cool Stellar Undead
Who: Scott Ransom, Astronomer at the National Radio Astronomy Observatory and Research Professor at UVA
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.

The most massive stars burn the fastest and brightest and die spectacularly, exploding as supernovae and leaving behind some of the most fantastic objects in the Universe: neutron stars and black holes. These are fascinating objects themselves, but ever since Bell and Hewish discovered the first pulsar over 40 years ago, we've realized that we can use the neutron stars especially as powerful tools for basic physics and astrophysics as well. We currently know of more than 2000 neutron stars in our Galaxy, almost all of them as pulsars or magnetars. But recently, instrumentation improvements have been rapidly expanding the numbers of the so-called millisecond pulsars (MSPs). These systems, which spin hundreds of times per second, act as Nature's atomic clocks. Specialized "timing" observations of the MSPs are providing a wealth of science, including new tests of general relativity, fantastic probes of the interstellar medium, constraints on the physics of ultra-dense matter, new windows into the evolution of stellar systems both simple and complex, and the promise of a direct detection of massive ripples in space-time, gravitational waves.

See http://www.calacademy.org/events/lectures/ for lecture and reservation information.

July 15, Noon-1:00pm

What: Water Vapor at Europa's South Pole – Observations by the Hubble Space Telescope
Who: Lorenz Roth, Southwest Research Institute
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

With its subsurface water ocean and relatively young icy surface Europa is among the top candidates in the search for habitable environments in our solar system. Existence of water vapor plumes on Europa has long been speculated and could possibly provide accessibility of subsurface liquid reservoirs. Images of auroral emissions obtained in December 2012 by the Hubble Space Telescope (HST) revealed coincident signals from hydrogen and oxygen pointing to the existence of transient water vapor near the moon's south pole. The aurora is excited by impinging charged particles from Jupiter's huge magnetosphere, which interacts with Europa's atmosphere and interior water ocean.

Dr. Roth will provide an overview of the complex interaction between Europa and Jupiter's magnetosphere, the generation of the plume aurora signals and our HST detection method, and the important implications of the plume discovery for the future exploration of Europa and its hidden water ocean.

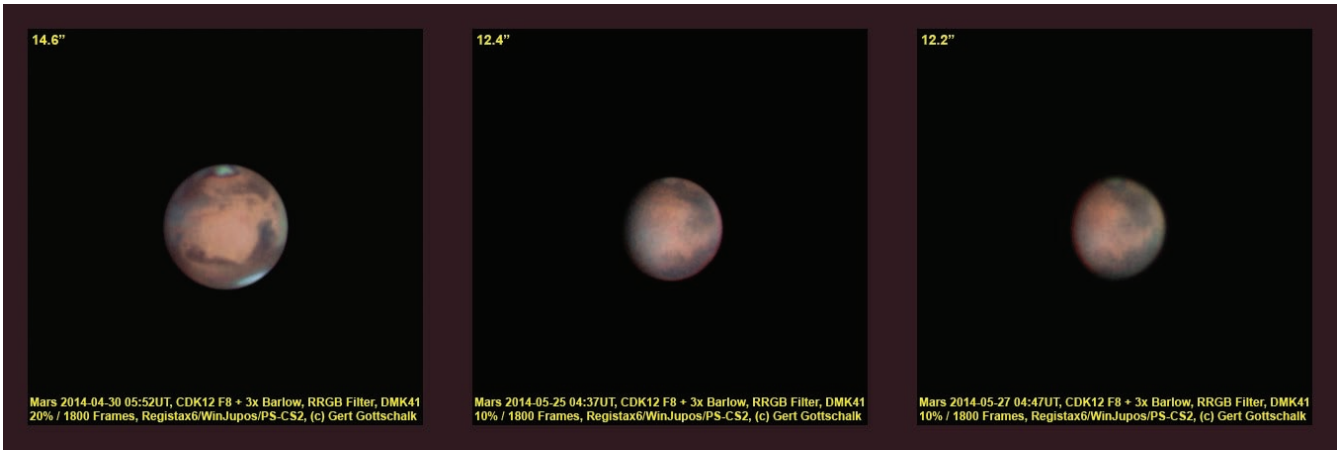
For more information see: http://www.seti.org/csc/lectures, e-mail info@seti.org, or phone 650-961-6633.

Journal Club by Ken Sperber

Exotic Star Candidate Discovered

In 1975, K. Thorne and A. Zytkow theorized a new class of supergiant star. Now called Thorne-Zytkow Objects (TZO's), these exotic stars consist of a neutron star surrounded by a diffuse stellar envelope. Essentially, TZO's are the product of stellar "cannibalism." TZO's originate in binary star systems in which the most massive star has gone supernova, resulting in a neutron star. Two scenarios are proposed for their formation: (1) As the companion star ages, its outer envelope expands to encompass the neutron star. The subsequent drag results in the neutron star spiralling into the core of the companion star, and (2) the supernova imparts a "kick" to the

continued on page 5



Caption: Gert Gottschalk has been regularly imaging Mars as it has passed through opposition and made its closest approach to Earth in 2014. The above images were taken on April 30, May 25, and May 27. As indicated in the panels, Mars' apparent diameter has shrunk from 14.6 arc seconds to 12.2 arc seconds over this ~1 month period. Obviously, the seeing was exceptional on April 30th, with the shrinking North Pole ice cap readily visible (north is up). It appears that cloud is covering the South Pole. The pronounced surface features include Syrtis Major (the dark region on the right extending north from the South Pole), Sinus Sabaeus and Sinus Meridionai (the dark region extending to the left from the South Pole), and the desert regions of Areia Arabia, Moab, and Eden at the center of the disk. On May 25 and May 27, the dark regions are Mare Erythraeum and Mare Acidalium, to the south and north respectively, with Tharsis Arcadia the desert region at the center-left. Gert used his CDK12 telescope at f/8 with a 3x barlow and a DMK41 camera. The best 20%, 10%, and 10% of 1800 image frames obtained on the respective nights were processed with Registax 6, WinJupos, and PhotoShop CS-2.

neutron star in the direction of the companion, where it becomes embedded in the core of the companion.

Levesque et al. (2014, *Mon. Not. R. Astron. Soc.*) report detection of the first candidate TZO. Since TZO's are expected to resemble Red Supergiant stars (RSG's), the authors performed a systematic study of 24 Milky Way, 16 Large Magellanic Cloud, and 22 Small Magellanic Cloud RSG's using the 3.5m Apache Point Telescope and the 6.5m telescope at Las Campanas. TZO's are distinguishable from RSG's by anomalously high abundances of Lithium, Rubidium, Strontium, Molybdenum, and Zirconium. The enhancements of these elements are measured with respect to Calcium, Nickel, and/or Iron. The elemental enhancements in TZO's occur due to the nuclear interrupted rapid-proton process (irp-process), which does not occur in other types of stars. The irp-process occurs where the star's atmosphere comes into contact with the high surface temperature of the neutron star. Additionally, since the neutron star is so hot, it causes the overlying atmosphere to convect (like a pot of water boiling on the stove) and thus fully mix the irp-process elements throughout the star's atmosphere.

The key to the present study was the use of recently developed spectrographs that are sensitive enough to measure the spectral line widths of the relevant elements. Though Zirconium was not measured, it was necessary to find enhancements of Lithium, Rubidium, Strontium, and Molybdenum, since enhancements of any individual element could be explained by the nuclear s-process. By measuring the elemental abundances of the 62 candidate stars, the authors were able to characterize the typical elemental abundance ratios of RSG stars. One star, HV 2112, located in the Small Magellanic Cloud, had enhanced abundance ratios (mostly) consistent with that expected for TZO's. From a statistical point of view, the enhancements were confirmed with 99.7% certainty. There was one unexplained exception: though Rubidium was enhanced with respect to Nickel, it was not enhanced with respect to Iron. Additionally, although the other enhancements were all more than 3 standard deviations above the average elemental abundance ratios for the RSG stars, theory predicts that the enhancements should have been larger. There was also an enhancement of Calcium relative to Iron that is not predicted for TZO's. The above exceptions, however, may be a case where theoretical modelling of TZO's requires the integration of recent advances in "improved treatments of mixing length theory, (convective) overshooting, and more extensive (nuclear) reaction networks." Thus, improved theoretical models of TZO's will be needed to confirm that HV 2112 is indeed a TZO.

For more information see: http://www.universetoday.com/112374/astronomers-find-evidence-of-a-strange-type-of-star/ and http://arxiv.org/pdf/1406.0001v1.pdf

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

All times Pacific Daylight Time.

June

13	Fri	Full Moon (9:11am)
19	Thu	Last-Quarter Moon (11:39am)
21	Sat	Summer Solstice, the longest day of the year
24	Tue	The Moon and Venus are spectacularly close, with The Pleiades (M45) to their upper-left (Dawn)
27	Fri	New Moon (1:08pm)
29	Sun	Jupiter well to the right of the crescent Moon (Sunset)
29-12	Sun-	Ceres and Vesta less than 1/2 degree apart

July

3	Thu	Earth at aphelion (farthest from the Sun in 2014)
4-5	Fri-	Ceres and Vesta are 10 arc minutes apart in the sky (evening; see p.50 of the July S&T)
5	Sat	First-Quarter Moon (4:59am) in conjunction with Mars
7	Mon	The waxing gibbous Moon is close to Saturn
12-24	Sat-	Mercury 6 to 8 degrees below Venus (Dawn)
12	Sat	Full Moon (4:25am)
13	Sun	Mars is 1.3 degrees north of fainter Spica
18	Fri	Last-Quarter Moon (7:08pm)
24	Thu	The crescent Moon is 5 degrees to the right of Venus with Mercury to their lower-left (Dawn)
25	Fri	The crescent Moon is directly below Venus and to the lower-right of Mercury (Dawn)
26	Sat	New Moon (3:24pm)
28	Mon	Delta-Aquarid Meteor Shower (after-midnight; best for southerly latitudes)

The Hottest Planet in the Solar System

By Dr. Ethan Siegel

When you think about the four rocky planets in our Solar System—Mercury, Venus, Earth and Mars—you probably think about them in that exact order: sorted by their distance from the Sun. It wouldn't surprise you all that much to learn that the surface of Mercury reaches daytime temperatures of up to 800 °F (430 °C), while the surface of Mars never gets hotter than 70 °F (20 °C) during summer at the equator. On both of these worlds, however, temperatures plummet rapidly during the night; Mercury reaches lows of -280 °F (-173 °C) while Mars, despite having a day comparable to Earth's in length, will have a summer's night at the equator freeze to temperatures of -100 °F (-73 °C).

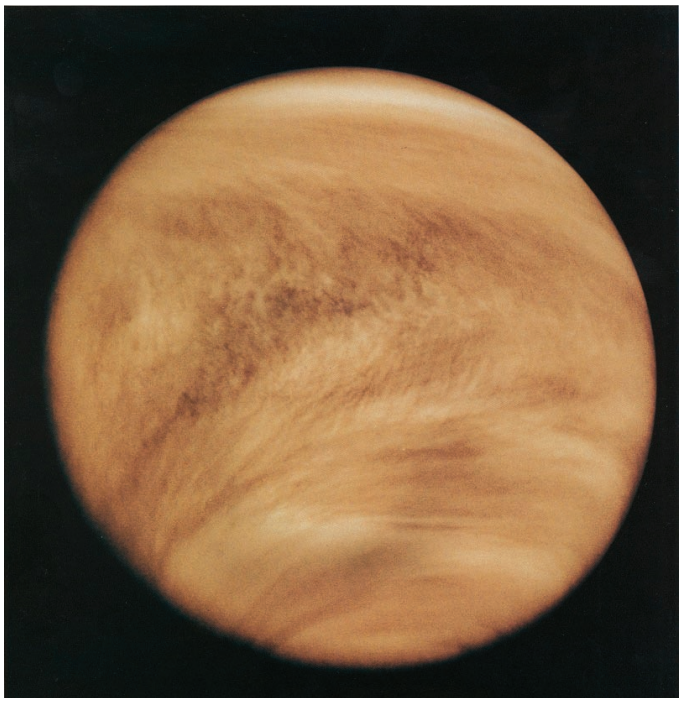


Image credit: composite of 25 images of the sun, showing solar outburst/activity over a 365-day period; NASA / Solar Dynamics Observatory / Atmospheric Imaging Assembly / S. Wiessinger; post-processing by E. Siegel.

Those temperature extremes from day-to-night don't happen so severely here on Earth, thanks to our atmosphere that's some 140 times thicker than that of Mars. Our average surface temperature is 57 °F (14 °C), and day-to-night temperature swings are only tens of degrees. But if our world were completely airless, like Mercury, we'd have day-to-night temperature swings that were hundreds of degrees. Additionally, our average surface temperature would be significantly colder, at around 0 °F (-18 °C), as our atmosphere functions like a blanket: trapping a portion of the heat radiated by our planet and making the entire atmosphere more uniform in temperature.

But it's the second planet from the Sun -- Venus -- that puts the rest of the rocky planets' atmospheres to shame. With an atmosphere 93 times as thick as Earth's, made up almost entirely of carbon dioxide, Venus is the ultimate planetary greenhouse, letting sunlight in but hanging onto that heat with incredible effectiveness. Despite being nearly twice as far away from the Sun as Mercury, and hence only receiving 29% the sunlight-per-unit-area, the surface of Venus is a toasty 864 °F (462 °C), with no difference between day-and-night temperatures! Even though Venus takes hundreds of Earth days to rotate, its winds circumnavigate the entire planet every four days (with speeds of 220 mph / 360 kph), making day-and-night temperature differences irrelevant.

Catch the hottest planet in our Solar System all spring-and-summer long in the pre-dawn skies, as it waxes towards its full phase, moving away from the Earth and towards the opposite side of the Sun, which it will finally slip behind in November. A little atmospheric greenhouse effect seems to be exactly what we need here on Earth, but as much as Venus? No thanks!

Check out these "10 Need-to-Know Things About Venus": http://solarsystem.nasa.gov/planets/profile.cfm?Object=Venus.

Kids can learn more about the crazy weather on Venus and other places in the Solar System at NASA's Space Place: http://spaceplace.nasa.gov/planet-weather.

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.
_____ $30 Basic. You will receive e-mail notification when the PDF version of Prime Focus is available for download off the TVS web site.
_____ $10 Hidden Hill Observatory (H2O) yearly access fee. You need to be a key holder to access the site.
_____ $20 H2O key holder fee. (A refundable key deposit—key property of TVS).
_____ $40 Patron Membership. Must be a member for at least a year and a key holder.
_____ $34 One year subscription to Astronomy magazine.
_____ $60 Two year subscription to Astronomy magazine.
_____ $32.95 One year subscription to Sky & Telescope magazine. Note: Subscription to S&T is for new subscribers only. Existing subscribers please renew directly through S&T.
$ _____ 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.