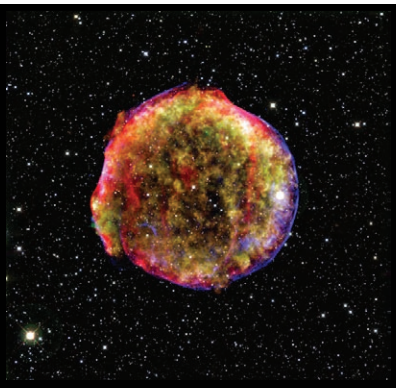
PRIMEFOCUS
Tri-Valley Stargazers

January 2014



TVS
Tri-Valley Stargazers

Meeting Info

What:
Type Ia Supernovae, the Best Bang Since the Big One

Who:
Dr. Rob Hoffman

When:
January 17, 2014
Doors open at 7:00 p.m.
Lecture at 7:30 p.m.

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

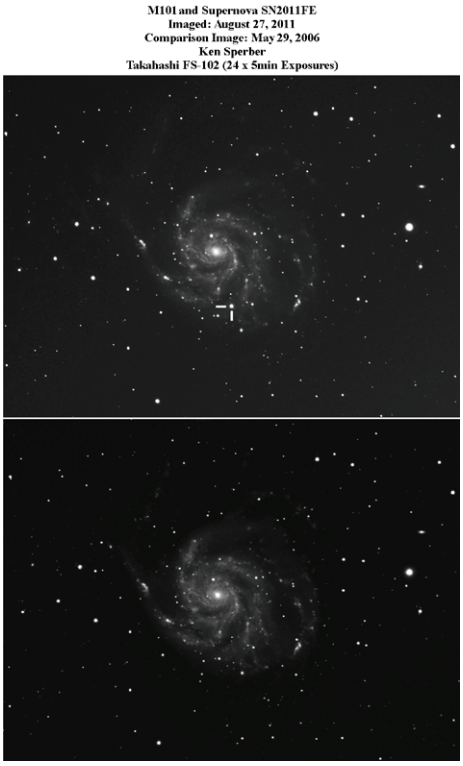
Inside

January Meeting

Type Ia Supernovae, the Best Bang Since the Big One

Dr. Rob Hoffman

The use of Type Ia supernovae (SNe Ia) as "standard candles" for distance determination has brought about a revolution in modern cosmology, showing the first clear evidence of "dark energy" and the acceleration of the expanding universe. SNe Ia result from the thermonuclear explosion of an accreting white dwarf. After a thousand years of convection, hot spots develop a burning front starting near the center of the star that propagates outward and accelerates through its interactions with turbulence, ultimately leading to the complete disruption of the progenitor. The resultant nucleosynthesis determines the emergent light curve and spectra, the observational signatures of SNe Ia. But until these events are understood from first principles, there remains the possibility that evolutionary effects (e.g., metallicity, asymmetric explosion, rotation, or chaos causing single or multiple points of ignition) might influence our interpretation of cosmological parameters, making the use of SNe Ia in an era of ``precision cosmology'' questionable.



Caption: Comparison images showing Type Ia Supernova 2011FE in M101. Image Credit: Ken Sperber

This presentation will explore recent highlights of our efforts to develop first principles understanding through the application of multi-dimensional hydrodynamic models of SNe Ia.

Dr. Rob Hoffman is a research physicist in the Computational Nuclear Physics group at LLNL. He received BA's in math & physics and PhD in astrophysics from the University of California at Santa Cruz. His day job involves applying nuclear physics to pressing issues of stockpile stewardship and the National Ignition facility. He has also published over 50 papers on his astrophysical research with an emphasis on stellar evolution and nucleosynthesis in massive stars and supernovae.

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**
Jan. 17	Jan. 20	
Feb. 21	Feb. 24	Jan. 31
Mar. 21	Mar. 24	Feb. 28
Apr. 18	Apr. 21	Mar. 28
May 16	May 19	Apr. 25
Jun. 20	Jun. 23	May 30
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 November 29, 2013 the TVS checking account balance is:

Checking $11,959.97

Dues Are Due

TVS' membership year runs from January to December, so now is the time to renew your membership. Our membership rates remain unchanged from last year, as do the subscription rates for Astronomy and Sky & Telescope. We no longer offer the "Regular" membership level since we do not send out printed copies of the newsletter. Rather, at the "Basic" membership level we contact you via e-mail to let you know that a .pdf of the newsletter is available. The renewal form can be found on the back of this newsletter or on our website under the Membership link. Please make our Treasurer's New Year especially wonderful by sending in your renewal today.

Royal Astronomical Society of Canada (RASC) Handbooks and Calendars Available for Purchase

The club now has RASC Handbooks and Calendars available for purchase. The 2014 edition of the handbook is bundled with the *Earth Centered Universe* Planetarium Software (http://www.nova-astro.com/handbook/2014.html). This free software will function through March 31, 2015 and will not perform predictions for events later than December 31, 2015. Prices are the same as last year: $25 for the Handbook and $17 for the Calendar. See Roland Albers for purchases, or contact him via e-mail (rhalbers3"at"gmail.com) to arrange to pick up Handbooks and/or Calendars if you can't attend the meeting. For more information on the handbook and calendar, see http://www.rasc.ca/observers-handbook and http://www.rasc.ca//observers-calendar

Magazine Giveaway: Black Friday

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!

H2O Maintenance: Paint Needed

The H2O Observatory needs a new coat of paint. Please contact the Observatory Director, Chuck Grant, if you can donate two gallons of a neutral exterior paint to ensure the observatory structure remains weather-resistant.

Journal Club By Ken Sperber

Supernova 2011fe: Progenitor and Light Curves

Within 12 hours of its destruction, Supernova 2011fe was being observed by a multitude of space- and ground-based telescopes. This is the golden age of astronomical observing, with coverage extending from radio, submillimeter, infrared, visual, ultraviolet, X-Ray and Gamma-Ray wavelengths. The close proximity of SN2011fe in M101, 6.4Mpc, allowed for detailed spectrophotometric observations from 15 days before to ~115 days after peak brightness. These observations, presented in Pereira et al. (2013, Astronomy and Astrophysics), were obtained using SNIFS, the SuperNova Integral Field Spectrograph, that is mounted on the 2.2m University of Hawaii telescope located on Mauna Kea.

Observations conclusively indicated this to be a Type 1a supernova, which can arise in binary systems as a consequence of mass transfer from the secondary star, usually a Red Giant, to the primary white dwarf progenitor. This route to a Type 1a supernova explosion is termed the "single degenerate" pathway. As discussed in much more detail by this months speaker, Dr. Rob Hoffman, the increasing mass of the white dwarf causes the core to heat up. Eventually, this gives way to a thermonuclear explosion in which the white dwarf is completely destroyed.

The observations of Supernova 2011fe provided detailed information on the radioactive decay products of the supernova. Using the SNIFS data with UV and infrared data, the authors estimate that 0.56 +/1 0.11 solar masses of ^{56}Ni was synthesized in the explosion. The observations were also used to construct the inventory of elements present in the supernova progenitor, including an estimate of the amount of carbon that was not "burned" in the explosion. By examin-

Header Image: Tycho's Supernova Remnant: The hot, expanding debris of a supernova observed in 1572. Credit: X-ray: NASA/CXC/SAO, Infrared: NASA/JPL-Caltech; Optical: MPIA, Calar Alto, O.Krause et al. See: http://chandra.harvard.edu/photo/2009/tycho/

Journal Club (continued)

ing key spectral lines of silicon, sulfur, and carbon, the authors estimated a photosphere expansion velocity of 12,000 km s^{-1} at day -15, reducing to 8,000km s^{-1} at day +10 (relative to peak brightness). Through the period two weeks after peak brightness, signatures of carbon, oxygen, silicon, sulfur, and calcium were detected in the spectra. Subsequently, the spectra were dominated by iron emission from the radioactive decay of the ^{56}Ni, with evidence of chromium and cobalt also being present.

It is important to cross-compare observations of SN2011fe with other Type 1a supernovae, as Type 1a's have been used as "standardizable" candles that led to the discovery of the accelerating expansion of the universe by dark energy. According to the authors "Increased diversity in the near-UV at early times relative to later phases seems plausible from a physical standpoint. This region of the spectrum is sensitive to composition, density, and temperature of the outer layers of the ejecta, and at early times the spectrum forms in these layers." SN2009ig exhibited higher velocity absorptions of calcium and silicon than SN2011fe, while SN2011fe had a more pronounced carbon absorption feature, suggesting different compositions and/or fusion efficiencies between these progenitors.

An alternative method for producing Type 1a supernovae is known as the "double degenerate" pathway. In this instance two white dwarf stars merge, giving rise to a supernova. Since most stars are actually part of binary systems, it is plausible that this pathway gives rise to a majority of Type 1a supernovae. One can distinguish single degenerate Type 1a events from double degenerate Type 1a events through X-Ray observations. In single degenerate events there is an accretion disk surrounding the progenitor that is made up of material from the secondary "donor" giant star. When the supernova explodes the interaction of the supernova shock front with the accretion disk and donor star gives rise to X-Rays. Observations suggest that in SN2011fe the secondary star, if present, would have to have been smaller than the Sun. Thus, it is possible that SN2011fe was of double degenerate origin. On the other hand, pre-nova images taken by HST in 2002 indicate the presence of two Red Giant stars in close proximity to the location of SN2011fe, which suggests the single degenerate pathway is also viable. Hopefully, further evaluation of the multispectral observations will clarify the origin of SN2011fe.

For more information, see: http://www.aanda.org/articles/aa/abs/2013/06/aa21008-12/aa21008-12.html, http://www.sciencedaily.com/releases/2013/06/130619122125.htm, http://en.wikipedia.org/wiki/Type_Ia_supernova, and http://blogs.discovermagazine.com/badastronomy/2011/08/25/astroalert-type-ia-supernova-in-m101/

Calendar of Events

January 7, Noon-1:00pm

What: Deciphering year-to-year wiggles on the Keeling Curve
Who: Weile Wang, NASA Ames Research Center
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

The concentration of carbon dioxide in the atmosphere was 315 parts per million by volume (ppm) when Charles Keeling started his measurement at the Mauna Loa Observatory, Hawaii, in 1958. It surpassed 400 ppm on May 9, 2013 for the first time in the 55-year continuous record of measurements. The

so-called 'Keeling curve' that shows the rapidly increasing atmospheric carbon dioxide concentration since 1958 is one of the most famous and important scientific findings of our time – yet a full and detailed understanding of the curve and its variations is still to be achieved. For instance, the year-to-year variability that appears as the 'wiggles' on the Keeling curve have long been linked to variations of the natural climate-carbon system. But questions remain about what (ocean versus land), where (tropics versus mid-high latitudes) and how (e.g., temperature versus precipitation) different drivers affect the observed variability. This presentation reviews the scientific literature on these questions and presents a simple yet robust analysis that points toward the most likely answer.

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

January 14, Noon-1:00pm

What: Large Synoptic Survey Telescope: Entering the Era of Petascale Optical Astronomy
Who: Mario Juric, LSST Group
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

The Large Synoptic Survey Telescope (LSST;http://lsst.org) is a planned, large-aperture, wide-field, ground-based telescope that will survey half the sky every few nights in six optical bands from 320 to 1050 nm. It will explore a wide range of astrophysical questions, ranging from discovering "killer" asteroids, to examining the nature of dark energy. The LSST will produce on average 15 terabytes of data per night, yielding an (uncompressed) data set of over 100 petabytes at the end of its 10-year mission. Dedicated HPC facilities will process the image data in near real time, with full-dataset reprocessings on an annual scale. A sophisticated data management system will enable database queries from individual users, as well as computationally intensive scientific investigations that utilize the entire data set. In this talk, I will give an overview of what LSST will deliver once operational, review implications of LSST-sized data sets on astronomy in the 2020s, and discuss how we as a community will need to prepare for the upcoming age of petascale datasets.

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

January 18, 7:30pm-8:30pm

What: A Thousand Words
Who: Faride Khalaf
Where: Chabot Space and Science Center, Space Cafe, 10000 Skyline Blvd., Oakland, CA 94619
Cost: Free member admission. RSVP required. Space is limited and by reservation only, so call (510) 336-7373.

Photography and science make great partners. During his voyage with HMS Beagle, naturalist Charles Darwin could have made great use of photographic equipment especially a modern high resolution digital camera. In this presentation we will navigate a handful of photographs and reveal some of the many useful capabilities of digital photography as a powerful tool for science.

See http://www.chabotspace.org/events.htm for more information.

January 21, Noon-1:00pm

What: Some Assembly Required: Nature's Instruction Booklet for Planetary Migration
Who: Rebekah Dawson, UC Berkeley
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

We once thought planets formed peacefully in situ in their natal disks and subsequently followed their orbits like clockwork. However, there is growing evidence that the typical planetary system forms with "some assembly required" and undergoes a dynamical rearrangement through planetary migration processes. The nature of this migration remains debated, in particular whether the migration is caused by smooth planet-disk interactions or violent multi-body interactions. Here I present work toward understanding Nature's instruction booklet for planetary migration in extra-solar planetary systems and our own solar system.

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

January 28, Noon-1:00pm

What: How to Search for Life in the Solar System
Who: Alfonso Davila, SETI Institute
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

Details unavailable.

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

January 31, 6:00pm-7:30pm

What: Future Fridays: Neutrino Hunters
Who: Ray Jayawardhana
Where: Chabot Space and Science Center, Space Cafe, 10000 Skyline Blvd., Oakland, CA 94619
Cost: $20 member; $23 on-members; $29 at the door.

Join us for a tantalizing preseason kick-off to our popular Future Fridays Community Conversations Series with author and renowned Astrophysicist, Ray Jayawardhana. In his latest book, Neutrino Hunters, RayJay takes us on a thrilling journey

into the shadowy world of neutrinos and recounts a captivating detective story with a colorful cast of characters and awesome cosmic implications.

Renowned scientist, award-winning writer and popular speaker Ray Jayawardhana holds the Canada Research Chair in Observational Astrophysics at the University of Toronto. A graduate of Yale and Harvard, he uses many of the world's largest telescopes to explore planetary origins and diversity. Described as a "rock star" among astronomers by Wired magazine and named as one of Canada's Top 40 Under 40 by the Globe & Mail newspaper, his discoveries have made headlines worldwide and led to numerous accolades. An avid traveler, Ray has visited some fifty-five countries, all seven continents, and the Arctic. Ray's scientific adventures have taken him from the steamy depths of a South African mine to the arid mountain peaks of the Chilean Andes; he has camped out on a remote ice field at the bottom of the world for five bone-chilling weeks and experienced the thrill of weightlessness on a parabola-hopping aircraft high above the Atlantic.

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

February 3, 7:30pm

What: The State of the University
Who: Timothy Ferris, Science Writer
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.

Since the discovery of galaxies and of cosmic expansion nearly a century ago, scientists have made estimable progress in establishing the age, evolution, and composition of the universe. But in doing so they have found that almost all of the observable universe is made of unknown materials. "Dark energy," evidently a property of the vacuum, constitutes 68 percent of the matter/energy in the universe. "Dark matter," which interacts gravitationally with normal matter but is otherwise invisible, accounts for another 27 percent. Everything humans have previously observed-all the stars, planets, and nebulae-weighs in at less than 5 percent. And that's just the observable universe. There's lots more, perhaps an infinite amount, beyond. This talk surveys what is currently known about the universe, then presents a new way of looking at nature that goes beyond classical science to offer a glimpse of how the cosmos may be investigated in the near future.

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

February 11, Noon-1:00pm

What: Planetary Defense Feasible - DE-STAR: A Planetary Defense and Exploration System
Who: Philip Lubin , UC Santa Barbara
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

Dr. Lubin will discuss how his team has proposed an orbital planetary defense system that is capable of beamed power allowing a number of directed energy (DE) possibilities including planetary defense, propulsion allowing relativistic probes and interstellar communications using existing technologies. Recent developments in photonics allow such a system whereas even a decade ago it would have been simply science fiction.

The main objective of DE-STAR would be to use the focused directed energy to raise the surface spot temperature of an asteroid to >3000K, allowing direct evaporation of all known substances. The same system is also capable of propelling spacecraft to relativistic speeds to allow rapid interplanetary travel and relativistic interstellar probes. The baseline system is also capable of propelling a 10^2, 10^3, 10^4 kg spacecraft to 1 AU in 3, 10, 30 days with speeds of about 0.4% the speed of light when used in a "photon rail gun mode".

The same system can also be used for communications out to extremely large distance. For example all the known Kepler planets would see the DE-STAR beacon as the brightest star in the sky (assuming their sky is like ours). The system is also visible at intergalactic distances (Andromeda for example). This brings up the question of a visible/ IR SETI search that we will discuss and their implications.

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

February 18, 7:00pm

What: Bullet Galaxies and Dark Matter
Who: Marusa Bradac, UC Davis
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

One of the greatest accomplishments in recent astrophysics is the creation of a model for the complete inventory of the Universe. All the observational data tells us with extremely high certainty that ordinary matter (every particle ever detected by every person who ever lived) makes up only one fifth of all the matter there is. The rest goes by the popular name of dark matter. Because it is dark, dark matter has been notoriously hard to detect; it doesn't emit or reflect radiation such as light or heat, and it can have only the feeblest of interactions with itself and ordinary matter.

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

All times Pacific Standard Time.

January

5	Sun	Jupiter at opposition (visible all night)
7	Tue	First-Quarter Moon (7:39pm)
11	Sat	Venus at inferior conjunction, located 5 degrees north of the Sun
14	Tue	Jupiter to the left of the nearly Full Moon
15	Wed	Full Moon (8:52pm)
18-02	Sat	Zodiacal light visible in the west from a dark location (80 minutes after sunset)
22-23	Wed-	The waning gibbous Moon to the lower right of Mars on the 22nd. On the 23rd the Moon is to the lower-left of Mars and close to Spica
23	Thu	Last-Quarter Moon (9:19pm)
25	Sat	Saturn 1-2 degrees from the waning crescent Moon (Dawn)
28-29	Tue-	Venus and the crescent Moon in conjunction (Dawn)
30	Thu	New Moon (1:39pm)
31-01	Fri-	Crescent Moon to lower-right of Mercury in the southwest (Dusk)

February

6	Thu	First-Quarter Moon (11:22am)
10	Mon	Jupiter to the left of the Moon
14	Fri	Full Moon (3:53pm)
16-02	Sun-	Zodiacal light visible in the west from a dark location (80 minutes after sunset)
19	Wed	Spica and Mars to left and above the Moon (Dawn)
22	Sat	Last-Quarter Moon (9:15am)
22	Sat	Saturn to the right of the Moon (Dawn)

Calendar of Events (continued)

So how do we know it is there? In this talk, I will discuss how astronomers observe the invisible matter in one of the true gems on the sky: a giant cluster of galaxies also called the Bullet Cluster..

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

The Big Picture: GOES-R and the Advanced Baseline Imager

By Kieran Mulvaney

The ability to watch the development of storm systems – ideally in real time, or as close as possible – has been an invaluable benefit of the Geostationary Operational Environmental Satellites (GOES) system, now entering its fortieth year in service. But it has sometimes come with a trade-off: when the equipment on the satellite is focused on such storms, it isn't always able to monitor weather elsewhere.

Caption: Io. Image credit: NASA / JPL-Caltech, via the Galileo spacecraft. Download photo here: http://photojournal.jpl.nasa.gov/catalog/PIA02308

"Right now, we have this kind of conflict," explains Tim Schmit of NOAA's National Environmental Satellite, Data, and Information Service (NESDIS). "Should we look at the broad scale, or look at the storm scale?" That should change with the upcoming launch of the first of the latest generation of GOES satellites, dubbed the GOES-R series, which will carry aloft a piece of equipment called the Advanced Baseline Imager (ABI).

According to Schmit, who has been working on its development since 1999, the ABI will provide images more frequently, at greater resolution and across more spectral bands (16, compared to five on existing GOES satellites). Perhaps most excitingly, it will also allow simultaneous scanning of both the broader view and not one but two concurrent storm systems or other small-scale patterns, such as wildfires, over areas of 1000km x 1000km.

Although the spatial resolution will not be any greater in the smaller areas than in the wider field of view, the significantly greater temporal resolution on the smaller scale (providing one image a minute) will allow meteorologists to see weather events unfold almost as if they were watching a movie.

So, for example, the ABI could be pointed at an area of Oklahoma where conditions seem primed for the formation of tornadoes. "And now you start getting one-minute data, so you can see small-scale clouds form, the convergence and growth," says Schmit.

In August, Schmit and colleagues enjoyed a brief taste of how that might look when they turned on the GOES-14 satellite, which serves as an orbiting backup for the existing generation of satellites.

"We were allowed to do some experimental imaging with this one-minute imagery," Schmit explains. "So we were able to simulate the temporal component of what we will get with ABI when it's launched."

The result was some imagery of cloud formation that, while not of the same resolution as the upcoming ABI images, unfolded on the same time scale. You can compare the difference between it and the existing GOES-13 imagery here: http://cimss.ssec.wisc.edu/goes/blog/wp-content/uploads/2013/08/GOES1314_VIS_21AUG2013loop.gif

Learn more about the GOES-R series of satellites here: http://www.goes-r.gov.

Kids should be sure to check out a new online game that's all about ABI! It's as exciting as it is educational. Check it out at http://scijinks.gov/abi

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.