PRIMEFOCUS

Tri-Valley Stargazers

October 2017

Meeting Info
What:
Hayabusa Spacecraft Reentry over Australia

Who:
Prof. Chris Kitting, Cal State U, East Bay

When:
October 20, 2017
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

October Meeting

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Applying methods developed largely for analyzing meteors, an international team led by Peter Jenniskens at SETI and NASA/Ames has been analyzing satellite reentries. Such observations are used to calculate trajectories and measure luminosity to test heat shields in preparation for unusually fast sample return missions, such as from asteroids and eventually Mars.

After a very successful airborne campaign for analyzing a large spacecraft reentry in 2008, long-time Tri-Valley member Chris Kitting was selected to lead a 2010 NASA ground team to analyze the fastest spacecraft reentry yet, of the Japanese asteroid return spacecraft and capsule, Hayabusa.

From a vantage point 80 km from the predicted reentry ground track, we observed and imaged the spectacular, rapid reentry (see header image above). Triangulation against background stars, in comparison with observations from a team located north of the track, allowed determination of the impact location, and Japanese recovery of their capsule with this first ever asteroid sample returned to Earth.

We observed the main spacecraft at an altitude of 123 km, and then the small capsule suddenly emerged at 105 km altitude, already separated from the main vehicle. Of prime importance was characterizing the performance of the capsules unique new heat shield design. The intensity of the luminosity in the wake of the capsule fluctuated markedly before, during, and after peak heating, suggesting a variable ablation process. Such analyses precisely characterize orbital trajectories and also the fate of particles in the atmosphere during the reentry of spacecraft and meteors. In addition, we reported on our detection of a sonic boom from the spacecraft's shock wave reaching us on the ground. Our logistics had formidable challenges, but we were rewarded with annual "Group Achievement Awards" from NASA/Ames and NASA.

Professor Christopher L. Kitting earned his Biol. Sci. B.S. at University of California, Irvine, then Ph.D. as a Stanford University Graduate Fellow. Kitting joined the Cal State University East Bay (Hayward) Biological Sciences Faculty in 1985. His major contributions to Ecology include non-destructive (often photographic) sampling during multidisciplinary monitoring of virtually entire ecosystems, from algae to marine mammals, to our water and atmosphere.

Kitting has received over 24 major honors since the Ph.D., including team leader in a Hydrolab underwater lab display in the Smithsonian, D.C., nominations for Outstanding Professor Awards, and 2010 NASA-Ames Group Achievement Awards for his recent, second NASA atmospheric mission, as team leader.

Should you wish to support the work of Cal State University, East Bay, Chis will welcome tax deductible contributions to the "CSUEB Wildlife Ambassador Fund." Contributions can also be made online at: via www.csueb.edu "give" "designation: other" : type in "Wildlife Ambassador Fund (DO237-12150)".

News & Notes

2017 TVS Meeting Dates

The following lists the TVS meeting dates for 2017. 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**
Oct. 20	Oct. 23	
Nov. 17	Nov. 20	Oct. 27
Dec. 15	Dec. 18	Nov. 24

Money Matters

As of the last Treasurer's Report on 9/18/17, our club's checking account balance is $14,759.82.

TVS membership has reached 118 members--the highest number in over a decade!

H2O Observatory Report

At the July TVS board meeting it was decided that the club will buy a 2" Feather Touch rotatable FTF2020BCR focuser as part of the ongoing upgrades to the 1.5" Marling telescope. Gert Gottschalk to talk to Starlight Instruments to make sure we are getting exactly what we need. Observatory director Chuck Grant will install the new focuser when it arrives.

Outreach Star Party: Help Needed

November 8: Banta Elementary School near Tracy

Please contact Eric Dueltgen for more information.

Club Star Parties: 2017 Autumn

The following club star party have been approved by the TVS Board:

October 21: Tesla Winery star party (Orionids Meteors)

TVS Agreement with East Bay Regional Parks District (EBRPD)

TVS has negotiated a new usage agreement with the EBRPD for our Del Valle observing site. TVS President, Rich Combs has signed the agreement and it has been mailed to EBRPD. Many thanks to Eric Dueltgen and Dave Feindel who represented TVS at the meeting with EBRPD.

EBRPD will only partner with registered non-profit organizations. They were particularly impressed with TVS' extensive history of successful outreach events. Many thanks to Eric Dueltgen for organizing these, and to Ken Sperber and Hilary Jones for publishing them in our newsletter and website respectively; and to our members who volunteer at our numerous outreach events.

The agreement is with TVS alone. Anyone who wants to use the site must be a TVS member in good standing. EBRPD want us to make more frequent use of the observing site by not restricting access to only 20 'permit holders'. Rather, everyone intending to use the site must call the park supervisor in advance and inform them. We will be limited to 10 people at the site per night. The park supervisor will be able to tell anyone who calls if there are already ten people booked. We will also have access to a back-up site: the large gravel parking lot at the end of Arroyo Road; an excellent observing location as long as the nearby street light remains off. However, we cannot use both locations on the same night.

Image Caption: TVS members set up there telescopes at the East Bay Regional Park District outreach star party held at the Arroyo Road/Del Valle observing site. Image Credit: K. Ross Gaunt

The EBRPD is partnering with TVS to hold one or more public star parties each year.

TVS Outreach Reports

In addition to the Del Valle East Bay Regional Park District outing mentioned above, TVS also held outreach events at the the Livermore Public Library and at the Annual Airport Open House & Air Show.

Ross Gaunt reports that an enthusiastic group of more than 120 people came to the Livermore Library to stargaze on September 28th with TVS (see the image on the top of page 3). There were about 10 club members present with their telescopes and binoculars providing views of the Moon, Saturn & Titan, the Andromeda galaxy, the Ring Nebula, Albireo, M15 (globular cluster, NGC457 (ET cluster), and Lambda Pegasus (colored double stars).

On October 7, TVS Outreach Coordinator Eric Dueltgen and club member K. Ross Gaunt spearheaded solar observing at the Annual Airport Open House & Air Show held at the Livermore Airport. Eric brought the club H-alpha telescope and his 8" Dobsonian telescope equipped with a white light

Header Image: The Hayabusa return capsule and spacecraft debris reentering Earth's atmosphere over Australia. Dimmer, untrailed targets are background stars, used to triangulate trajectories. Image Credit: Julie Bellerose, Rick Nolthenius, and Chris Kitting

TVS Outreach Reports (continued)

Image Caption: Over 120 people lined up for views through telescopes at the TVS outreach event at the Livermore Library. Image Credit: K. Ross Gaunt

solar filter, and Ross brought his H-alpha telescope. Fellow club members Ozgur Aktas, Tina Chou, Ron Kane, and Ken Sperber provided assistance by informing the public about what they were viewing and/or helping with set-up and/or tear-down.

Over the course of the day about 300 hundred people came by the TVS booth to view the Sun. While a small sunspot was visible with the white light filter, the H-alpha telescopes revealed 3 prominences that wowed the public, with one youngster exclaiming that "it was the best thing my eye has ever seen!"

Coupled with the exciting airshow, plenty of food trucks, and available wine, the day was a feast for all the senses.

Image Caption: Solar observing at the TVS outreach event at the Livermore Airport. Image Credit: K. Ross Gaunt

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info@trivalleystargazers.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 (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

October 28, 7:30pm

What: Astrophotography for Everyone
Who: Jay GaBany, President & CEO, Advanced Imaging Conference
Where: Mt. Tamalpais State Park, Cushing Memorial Amphitheater, more commonly known as the Mountain Theater, Rock Spring parking area
Cost: Free

Advances in recent decades have allowed amateur astronomers to produce deep space and planetary pictures that rival those taken by professional observatories. This presentation will provide an overview of off-the-shelf instruments and methods anyone, with perseverance and patience, can use to take amazing astronomical images.

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

October 29, 2:30-3:30pm

What: Dark Matter Day
Who: In partnership with Lawrence Berkeley National Laboratory featuring Heather Gray, Zachery Marshall, and Dan McKinsey
Where: Chabot Space and Science Center, 10000 Skyline Blvd., Oakland, CA 94619
Cost: Free with admission. Members Free, Adult $18, Seniors (65+) $15, Youth (3-12) $14

Learn all about how scientist and researchers are using accelerators and underground detectors to hunt for the mysterious particles that make up dark matter. Though astronomers cannot see dark matter directly, we know that dark matter drives the accelerating expansion of the universe. Watch our planetarium show Phantom of the Universe, followed by short presentations and Q & A, with three world renowned scientists who research dark matter.

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

November 13, 7:30pm

What: Black Holes: An Up Close and Personal Look
Who: Feryal Ozel, University of Arizona
Where: California Academy of Science, 55 Music Concourse Dr., Golden Gate Park, San Francisco, CA
Cost: Advanced ticketing required. Academy members $12, Seniors $12, General $15. Reserve a space online or call 1-877-227-1831.

The Event Horizon Telescope is an experiment that is being performed on a large and ever-increasing array of radio telescopes that span the Earth, from Hawaii to Chile and from the South Pole to Arizona. In April of this year, the EHT collaboration has performed its first set of observations with this full array of telescopes in order to take the first ever picture of a black hole. This unprecedented spatial resolution and the novel methods of this experiment will allow us to get up close and personal with the black hole at the center of our Galaxy, Sagittarius A*, and the black hole at the center of the nearby galaxy M87. The ultimate goal is to test Einstein's theory of General Relativity by looking for its most bizarre prediction: a shadow that is a direct evidence for the event horizon of a black hole.

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

Journal Club By Ken Sperber

Io: Resurfacing Loki Patera

Since the 1970's, ground-based observations of Io have revealed that it undergoes changes in brightness. With this iconic Voyager 1 image from March 4, 1979 (see below), it was discovered that Io was volcanically active, with plumes extending up to 100 miles above the surface, and the volcanic activity and constant resurfacing of Io accounting for the brightness changes.

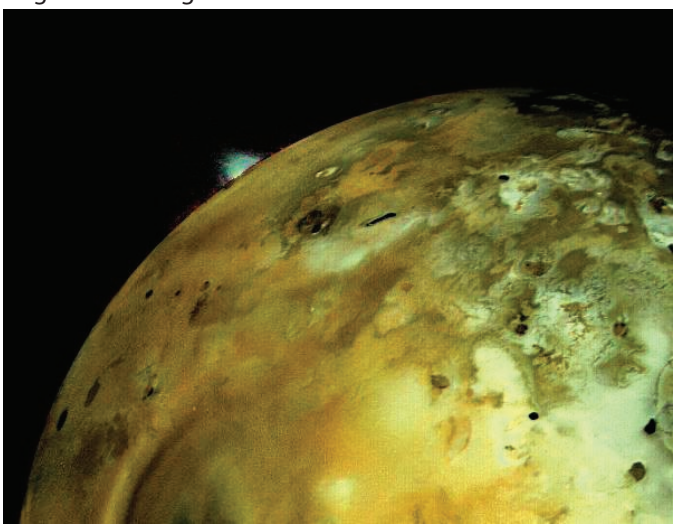

Image Caption: Voyager 1 discovery image of volcanic activity on Io.
Image Credit: NASA

One of the most prominent areas of volcanic activity on Io is Loki Patera, a lava lake that is about 127 miles across! At this size "it encompasses an area more than a million times that of a typical lava lake on Earth," according to Katherine de Kleer, a UC Berkeley graduate student. As such, Loki Patera has been the subject of intensive study. As seen on p. 5, the high-resolution image taken by Voyager 1 suggests that one is looking inside a caldera where there is an island surrounded by a warmer dark floor. Loki Patera varies in brightness on a time scale of 400-600 days. What has been debated for many years is whether the brightness variations were due to erup-

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Journal Club (continued)

tions or by overturning of the lava lake as the surface of the lake cools, becomes dense, and sinks into the lava lake.

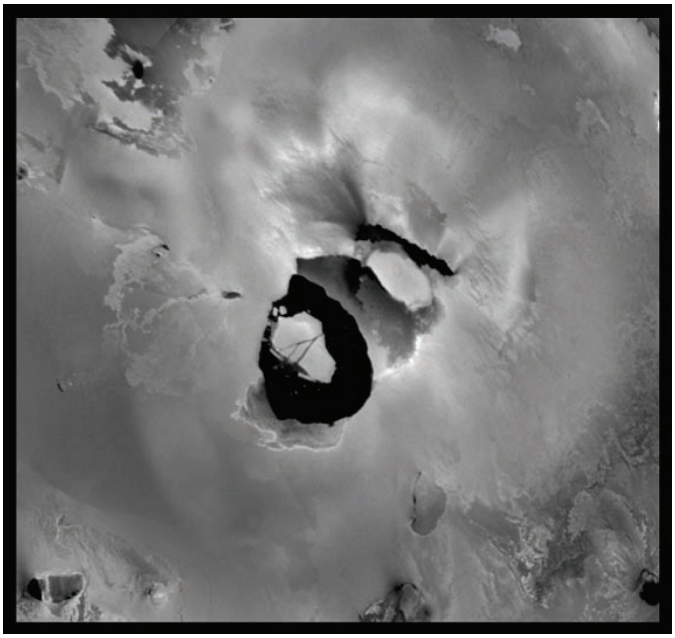

Image Caption: High-resolution Voyager 1 image of Loki Patera on Io. North is up and East is to the right. Image Credit: NASA

To address this issue, de Kleer et al. (2017, Nature, doi: 10.1038/nature22339) used the Large Binocular Telescope (LBT), located in Arizona, to observe the March 8, 2015 occultation of Io by Europa. The LBT uses twin 8.4m telescopes that are mounted side-by-side, which when used as an interferometer provide the resolving power of a 22.7m telescope. At infrared wavelengths, using adaptive optics the LBT can resolve objects about 60 miles in diameter on Io, and indeed in 2013 it showed two separate hotspots at Loki Patera. But, the resolution was improved dramatically due to the transit of Europa in front of Loki Patera. The transit took about 12 seconds to cover Loki Patera, and another 12 seconds to uncover it. Due to the high temperature of the surface, infrared observations could be made 8x per second, giving a spatial resolution of about 1.5 miles! According to co-author Michael Skrutskie of the University of Virginia "Loki was covered from one direction but revealed from another, just the arrangement needed to make a real map of the distribution of warm surface within the patera."

After data reduction, the authors were able to generate maps of the temperature distribution and lava age based on models of the cooling rate of silicate lava. These gradients in temperature and age indicate that a clockwise propagating wave, moving at about 0.6 miles per day, originated northwest of the island about 250 days before the observations. Additionally, a counter-clockwise propagating wave, travelling at about 1.5 miles per day, originated west-southwest of the island about 180 days before the observations. About 75 days before the observations the two waves converged southeast of the island, where the lava was found to be hottest, about 330K. One can envision the scenario whereby the oldest and coldest lava, where the waves originated, sinks and overturns with the cycle beginning over again. The difference in timing of the two waves and the propagation rates suggests differences in the lava discharge rates and/or magma properties.

Future Io occultations won't happen until 2021, at which time scientists will be ready to again observe Loki Patera at high resolution.

For more information see: http://news.berkeley.edu/2017/05/10/waves-of-lava-seen-in-ios-largest-volcanic-crater/, https://www.jpl.nasa.gov/spaceimages/details.php?id=PIA00710

Member Astrophoto

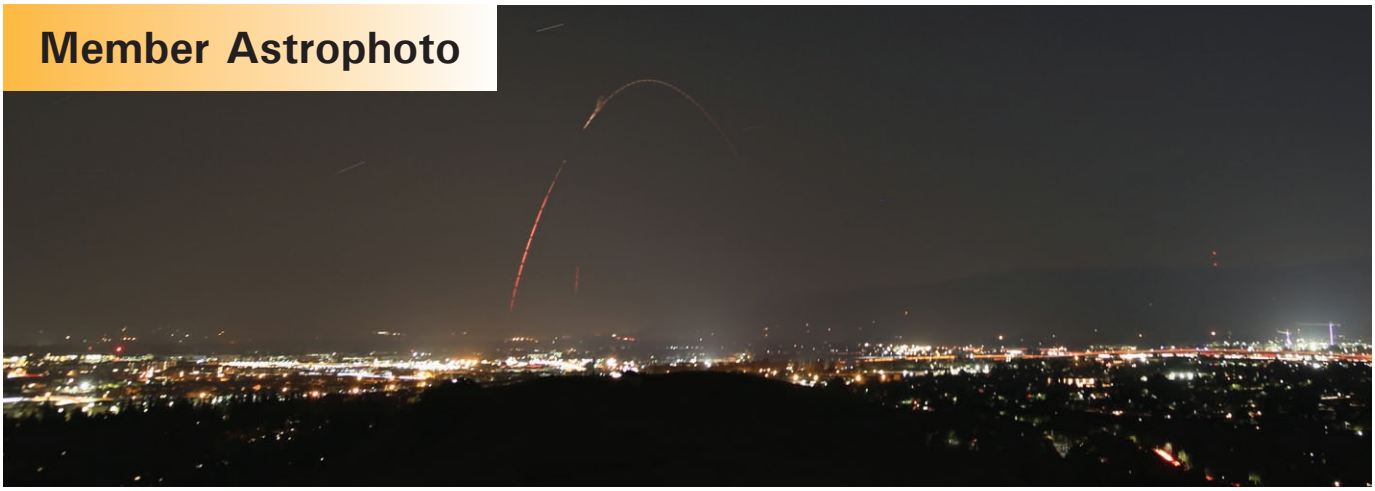

Image Caption: The SpaceX/Iridium 3 launch that took place from Vandenberg Air Force Base on October 9, 2017. Also seen is one of the landing burns of the first stage prior to landing on a barge at sea. This is a composite of 54 five-second exposures using a Canon 6D, ISO-400, 24 mm Sigma lens at f/4, taken from the Dublin Hills. Image Credit: Ken Sperber

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

All times are Pacific Daylight Time, until November 5 when Pacific Standard Time returns

October

12	Thu	Last-Quarter Moon (5:25am)
13	Fri	Algol at minimum brightness for 2 hours centered on 1:36am
15	Sun	The Moon occults Regulus. Only the reappearance is visible at ~3:11am
15-30	Sun-	The Zodiacal Light is visible in the east 120 to 80 minutes before sunrise
16	Mon	Algol at minimum brightness for 2 hours centered on 1:25am
17	Tue	Very thin crescent Moon hangs above Venus and left or lower-left of faint Mars in the east (Dawn)
19	Thu	New Moon (12:12pm)
20-22	Fri-	Modest Orionid meteor shower; best before dawn
23-24	Mon	Saturn about 6 degrees from the crescent Moon in the southwest (Dusk)
27	Fri	First-Quarter Moon (3:22pm)
29	Sun	Asteroid 2 Pallas at opposition, 8.3mag, visible all night

November

3	Fri	Full Moon (10:23pm)
4	Sat	Spica about 4 degrees to the right of Venus (Dawn)
7	Tue	Algol at minimum brightness for 2 hours centered on 7:56pm
10	Fri	Last-Quarter Moon (12:36pm)
11	Sat	Jupiter 2 degrees below Venus, barely above the east-southeast hosrizon (Dawn)
11	Sat	Regulus about 3 degrees to the lower-left of the Moon (Morning)
16	Thu	The Moon hangs 17 degrees below Mars. Jupiter and Venus are 6 and 9 degrees below the Moon (Dawn)
17	Fri	One day from New, the Moon forms a triangle with Jupiter and Venus low in the east-southeast (Dawn)
18	Sat	New Moon (3:42am)
20	Mon	The crescent Moon and Saturn pair in the southwest. Search for Mercury, 7 degrees below, with binoculars (Sunset)
24-25	Fri-	Algol at minimum brightness for 2 hours centered on 12:49am
26	Sun	First-Quarter Moon (9:03am)
27	Mon	Algol at minimum brightness for 2 hours centered on 9:38pm
28-	Tue-	Use binoculars to find Saturn and Mercury, located 3 degrees apart, in the southwest. They close in on each other over the next 9 days

Cassini Says Goodbye

By Teagan Wall

On September 15th, the Cassini spacecraft will have its final mission. It will dive into the planet Saturn, gathering information and sending it back to Earth for as long as possible. As it dives, it will burn up in the atmosphere, much like a meteor. Cassini's original mission was supposed to last four years, but it has now been orbiting Saturn for more than 13 years!

The spacecraft has seen and discovered so many things in that time. In 2010, Cassini saw a massive storm in Saturn's northern hemisphere. During this storm, scientists learned that Saturn's atmosphere has water vapor, which rose to the surface. Cassini also looked at the giant storm at Saturn's north pole. This storm is shaped like a hexagon. NASA used pictures and other data from Cassini to learn how the storm got its six-sided shape.

Cassini also looked at some of Saturn's moons, such as Titan and Enceladus. Titan is Saturn's largest moon. Cassini carried a lander to Titan. The lander, called Huygens, parachuted from Cassini down to the surface of the moon. It turns out, Titan is quite an exciting place! It has seas, rivers, lakes and rain. This means that in some ways, Titan's landscape looks a bit like Earth. However, its seas and rivers aren't made of water—they're made of a chemical called methane.

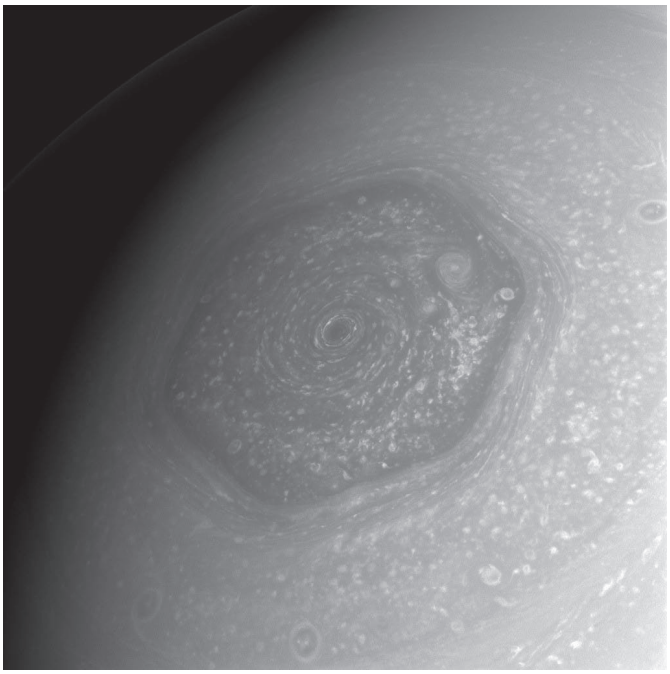

Image Caption: This image of the hexagonal storm on Saturn's north pole was taken by Cassini in 2013. Image credit: NASA/JPL-Caltech/ Space Science Institute

Cassini also helped us learn that Saturn's moon Enceladus is covered in ice. Underneath the ice is a giant liquid ocean that covers the whole moon. Tall geysers from this ocean spray out of cracks in the ice and into space, like a giant sneeze. Cassini flew through one of these geysers. We learned that the ocean is made of very salty water, along with some of the chemicals that living things need.

If there is life on Enceladus, NASA scientists don't want life from Earth getting mixed in. Tiny living things may have hitched a ride on Cassini when it left Earth. If these germs are still alive, and they land on Enceladus, they could grow and spread. We want to protect Enceladus, so that if we find life, we can be sure it didn't come from Earth. This idea is called planetary protection.

Scientists worry that when Cassini runs out of fuel, it could crash into Titan or Enceladus. So years ago, they came up with a plan to prevent that from happening. Cassini will complete its exploration by diving into Saturn—on purpose. The spacecraft will burn up and become part of the planet it explored. During its final plunge, Cassini will tell us more about Saturn's atmosphere, and protect the moons at the same time. What an exciting way to say goodbye!

To learn more about Saturn, check out NASA Space Place: https://spaceplace.nasa.gov/all-about-saturn

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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 ($100). 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.