

# PRIMEFOCUS

Tri-Valley Stargazers



July 2016



## Meeting Info

**What:**  
Summer BBQ

**Who:**  
TVS Members and Friends

**When:**  
July 15, 2016  
Set-up at 6:30 p.m.  
Dinner at 7:00 p.m.

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

## Inside

News & Notes	2
Calendar of Events	2
Lick Observatory Tour	5
What's Up	6
NASA's Space Place	7
Membership/Renewal Application	8

## July Meeting

### TVS Summer Barbecue

The July TVS 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.



TVS will provide hamburgers, veggie-burgers, and hotdogs, with a variety of toppings including cheese, mushrooms, bacon, etc.

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-D Appetizers
- E-J Dessert
- K-O Macaroni or Potato Salad
- P-Z Green or Fruit Salad

## News & Notes

### 2016 TVS Meeting Dates

The following lists the TVS meeting dates for 2016. 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
Jul. 15	Jul. 18	
Aug. 19	Aug. 22	Jul. 29
Sep. 16	Sep. 19	Aug. 26
Oct. 21	Oct. 24	Sep. 30
Nov. 18	Nov. 21	Oct. 28
Dec. 16	Dec. 19	Nov. 25

### Money Matters

As of the last Treasurer's Report on 6/20/16, our club's checking account balance is \$13,109.70.

### Club Star Parties

This year's club star parties will be held on:

Friday-Sunday 7/15-17/16: Yosemite Star Party

Saturday 7/16/16: Boy Scout Camp Mines Rd.

Saturday 7/30/16: Tesla Winery Star Party

Saturday 8/27/16: H2O Open House

Saturday 9/24/16: Tesla Winery Star Party

The Tesla Winery Star Parties will be open to club members and their guests. Start and end times for the parties will be announced later, but we usually plan to arrive at the observing site about 30 minutes before sunset and wrap up around midnight. For those wishing to participate, each party will have a different observing theme. Suggestions include lunar features observing, planetary night, star cluster observing, beginner's night, and constellation identification. If you have an idea for another theme, please mention it to a board member during any meeting.

Boy Scout Star Party: Volunteers are needed to bring telescopes to the star party at the Rancho Los Mochos Boy Scout Camp. The camp is on the right side of Mines Rd. just before the 15 mile marker, on the way toward H2O from Livermore. The start time is 8:30pm. Contact Eric for more information (coordinator"at"trivalleystargazers.org).

Yosemite Star Party, July 15-17: Eric Dueltgen will be coordinating this year's TVS star party at Glacier Point. TVS members who bring telescopes for public observing will receive free camping at Bridalveil campgrounds. The Moon is 4 to 2 days from being full, and sunset occurs at about 8:25pm with sunrise at about 6:00am. Contact Eric for more information (coordinator"at"trivalleystargazers.org).

The August 27 H2O Open House will be open to all club members and the public. We will meet at the corner of Mines and Tesla and leave for H2O at 6:30 PM. 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.

## Calendar of Events

### July 12, 12:00pm

What: Large Hadron Collider, Stage 2: The Search for New Particles and Forces

Who: Michael Peskin, Stanford University

Where: SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA

Cost: Free

In 2010, the CERN Large Hadron Collider (LHC) began its exploration of physics at distances 10,000 smaller than an atomic nucleus. From 2010 to 2013, the LHC was colliding protons at energies of 7 and 8 TeV (trillion electron volts). Many novel observations were made, including the discovery of the Higgs boson. However, the fundamental questions that motivated the LHC remain unanswered. Since last summer the LHC has been working at the higher energy of 13 TeV. New results have excluded some hypotheses and provided hints supporting others. In this talk, I will review the search for new basic interactions in nature and the experimental methods that the LHC brings to this question.

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

### July 18, 7:30pm

What: The Beauty of the Universe as Revealed by Hubble

Who: Zoltan Levay, Space Telescope Science Institute

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 Hubble Space Telescope is NASA's flagship space science mission. Hubble's long duration and its position in space, providing an unobstructed view of the universe for over 26 years, has led to a dramatic impact on astronomers' knowledge of the universe. Hubble also has become familiar to non-scientists.

Header Image: James Lick shoring up the base of the 36-inch Great Refractor at Lick Observatory. See p.5 for a summary of the private tour TVS took at Lick Observatory, hosted by Dr. Paul Lynam and Mr. Pat Maloney. Image Credit: Gert Gottschalk.

## Calendar of Events (continued)

tists through social media. One of the many reasons for this is a steady stream of dramatic, colorful images that show us wonders of the cosmos. A combination of objective techniques and subjective artistic principles translate Hubble's data into engaging views of cosmic landscapes. Computer modeling and visualization bring motion and volume to these views to illustrate the full depth of the dynamic universe.

See [www.calacademy.org/events/benjamin-dean-astronomy-lectures](http://www.calacademy.org/events/benjamin-dean-astronomy-lectures) for lecture and reservation information.

### July 19, 12:00pm

**What:** Exoplanets: Under a Microscope, and Through a Wide-field Lens  
**Who:** Sarah Ballard, MIT  
**Where:** SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA  
**Cost:** Free

Our Solar System furnishes the most familiar planetary architecture: many planets, orbiting nearly coplanar to one another. We can examine the composition and atmospheres of the Solar System planets in detail, even occasionally in situ. Studies of planets orbiting other stars (exoplanets) only begin to approach the precision of humanity's knowledge of Earth as of five hundred years ago. I will describe a two-pronged approach to the study of exoplanets. One approach involves time-intensive investigations of individual planets to eke out bulk density or single molecules in the planetary atmosphere. Another involves studies of the ensemble properties of planetary systems, and addresses the question of a "typical" planetary system in the Milky Way. With thousands of confirmed exoplanet discoveries and thousands more to follow soon, a judicious combination of these approaches is emerging. I'll showcase some of my own findings of other worlds (placing Earth in context), in addition to wider-field studies of typical planet occurrence and formation. I'll close with an opportunity to make inroads into the the detectabil-

ity of signatures of life.

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

### July 23, 8:30pm

**What:** Movie Night  
**Who:** 2010: The Year We Make Contact  
**Where:** Mt. Tamalpais State Park, Cushing Memorial Amphitheater, more commonly known as the Mountain Theater, Rock Spring parking area  
**Cost:** Free

See the thrilling sequel to Stanley Kubrick's 1968 sci-fi masterpiece, 2001: A Space Odyssey, based on Arthur C. Clarke's Novel 2010: Odyssey Two. Directed by Peter Hyams, starring Roy Scheider as an American astronaut sent on a joint U.S.-Soviet space mission to Jupiter to find out what happened to the missing crew of the original Jupiter mission.

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

### July 26, 12:00pm

**What:** Bringing Nuclear Power to Mars  
**Who:** Frank H. Shu, Professor Emeritus, UC Berkeley  
**Where:** SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA  
**Cost:** Free

Establishing a lunar base is probably a wise first step to colonizing Mars. The bare minimum for sustaining life on the Moon exists in the water brought by comets to the bottoms of some lunar craters. Electrolysis of this dirty water can produce clean oxygen (and hydrogen) for the lunar base. A reliable source of primary energy is needed for such tasks, but on the surface of the Moon there is no sunlight two weeks out of four, and no wind. Nuclear power is the default option, just as is the case of naval submarines where the crews

continued on page 4

#### **Officers**

**President:**  
Chuck Grant  
[president@trivalleystargazers.org](mailto:president@trivalleystargazers.org)

**Vice-President:**  
Rich Combs  
[vice\\_president@trivalleystargazers.org](mailto:vice_president@trivalleystargazers.org)

**Treasurer:**  
Roland Albers  
[treasurer@trivalleystargazers.org](mailto:treasurer@trivalleystargazers.org)

**Secretary:**  
Jill Evanko  
[secretary@trivalleystargazers.org](mailto:secretary@trivalleystargazers.org)

#### **Volunteer Positions**

**AANC Representative:**  
unfilled

**Astronomical League Representative:**  
Dennis Beckley  
[alrep@trivalleystargazers.org](mailto:alrep@trivalleystargazers.org)

**Historian:**  
Hilary Jones  
[historian@trivalleystargazers.org](mailto:historian@trivalleystargazers.org)

**Loaner Scope Manager:**  
John Swenson  
[telescopes@trivalleystargazers.org](mailto:telescopes@trivalleystargazers.org)

**Newsletter Editor:**  
Ken Sperber  
[newsletter@trivalleystargazers.org](mailto:newsletter@trivalleystargazers.org)  
925-361-7435

#### **Observatory Director/**

**Key Master:**  
Chuck Grant  
[h2o@trivalleystargazers.org](mailto:h2o@trivalleystargazers.org)

**Program Director:**  
Rich Combs  
[programs@trivalleystargazers.org](mailto:programs@trivalleystargazers.org)

**Publicity Coordinator:**  
Andy Coutant  
[publicity@trivalleystargazers.org](mailto:publicity@trivalleystargazers.org)

**Refreshment Coordinator:**  
Laurie Grefsheim

**Star Party Coordinator:**  
Eric Dueltgen  
[coordinator@trivalleystargazers.org](mailto:coordinator@trivalleystargazers.org)

**Webmaster:**  
Hilary Jones  
[webmaster@trivalleystargazers.org](mailto:webmaster@trivalleystargazers.org)

#### **Web & E-mail**

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

work in closed environments for months at a time. However, the light water reactors of naval submarines are not a good choice for environments that lack large bodies of water, and we argue, as first realized by a former NASA Engineer, Kirk Sorensen, that molten salt reactors, of the type invented by Oak Ridge National Lab in the 1960s, are much better suited for a lunar base or a Mars colony.

Dr. Shu will discuss his patented design for a two-fluid molten-salt breeder-reactor that could use thorium mined on the Moon. He will close by considering two spin-off applications: (1) saving civilization on Earth from the worst ravages of climate change; and (2) using fission fragments for ion-propulsion that produces rockets two to three orders of magnitude faster than achievable with chemical rockets, making possible, perhaps, a first generation of starships

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

### August 1, 7:30pm

**What:** Unveiling the Dark Universe: A Tale of Fish Tanks, Wine Glasses, and the Smallest Dark Matter Clumps  
**Who:** Dr. Yashar Hezaveh, Kavli Institute, Stanford University  
**Where:** California Academy of Science, 55 Music Course 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.

What is “dark matter”? Observations show that 80% of the matter in our universe is dark matter. Dr. Hezaveh will discuss how ALMA, the world’s most sophisticated radio telescope, is used to observe some of the most distant galaxies to learn new things about dark matter. On their 12 billion light year journey to us, light rays from these galaxies pass near the dark matter halos of the intervening galaxies, bending their trajectories, causing the images here on the Earth to look distorted, like images in a funhouse mirror.

See [www.calacademy.org/events/benjamin-dean-astronomy-lectures](http://www.calacademy.org/events/benjamin-dean-astronomy-lectures) for lecture and reservation information.

### August 5, 6:00pm-10:00pm

**What:** \$5 First Fridays  
**Who:** Chabot Staff  
**Where:** Chabot Space and Science Center, 10000 Skyline Blvd., Oakland, CA 94619  
**Cost:** \$5 Call (510) 336-7373

At \$5 First Fridays you can join a Night Hike through the redwoods or enjoy various laser and planetarium shows. Admission also includes hands-on activities and live demonstra-

tions throughout the center, as well as any special events that are going on that evening. It’s fun for the whole family!

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

### August 6, 8:30pm

**What:** Measuring Cosmological Distances with Supernovae  
**Who:** Dr. Xiaosheng Huang, University of SF  
**Where:** Mt. Tamalpais State Park, Cushing Memorial Amphitheater, more commonly known as the Mountain Theater, Rock Spring parking area  
**Cost:** Free

To measure distances to far-away galaxies, astronomers make use of “standard candles,” objects whose true brightness can be calibrated accurately. Prof. Huang will discuss Type Ia supernovae, the most powerful of all standard candles, including how to make them an even more useful tool for understanding the evolution of the cosmos.

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

### August 9, 12:00pm

**What:** Frontiers in Artifact SETI: Waste Heat, Alien Megastructures & Tabby’s Star  
**Who:** Jason Wright, Penn State University  
**Where:** SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA  
**Cost:** Free

In 1960, two papers provided visions for SETI. Giuseppe Cocconi and Philip Morrison proposed detecting deliberate radio signals (“communication SETI”), while Freeman Dyson (“artifact SETI”), proposed detecting the effects of massive energy supplies and artifacts. While communication SETI has now had several career-long practitioners, artifact SETI has, until recently, not been a vibrant field of study.

The launch of the Kepler and WISE satellites have provided new motivation for finding good targets for communication SETI. Dr. Wright will discuss the progress of the G Search for Extraterrestrial Civilizations with Large Energy Supplies, based on the search of waste heat, and the search for megastructures. The last of these led to the identification of KIC 8462852 (a.k.a. “Tabby’s Star”) as a candidate. This star, discovered by Boyajian and the Zooniverse Planet Hunters, exhibits unique and unexplained photometric properties, and continues to confound natural explanation.

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

## TVS Lick Observatory Tour By Ken Sperber



On June 7th, nearly 30 TVS members had the privilege of taking a private guided tour of Lick Observatory. Our generous hosts were Dr. Paul Lynam, resident astronomer of Lick Observatory, and Public Program Telescope Operator Mr. Pat Maloney. On the veranda, overlooking an old wooden structure that housed the first telescope on the mountain, Dr. Lynam provided an introduction to the site facilities, including discussing the long list of “firsts” in terms of equipment development and scientific discoveries that forever place Lick Observatory among the great observatories of the world.

We then commenced our walking tour, passing the astronomers’ dormitory, a pale cement building nicely ornamented with red brick, and the cafeteria, where surely many a famed astronomer revelled over the previous night’s discoveries with his/her brethren. Tucked around the corner, nearly unseen, is an all-sky observing device that is part of a network of monitors used to triangulate the origin of fireballs that grace our night sky. As we worked our way to the Shane 3m telescope, we passed the Automated Planet Finder, a 2.4m telescope that employs a high resolution optical echelle spectrometer to facilitate high precision radial velocity measurements to discover exoplanets. At the Shane telescope, Dr. Lynam described its history, operation, and maintenance. Our timing couldn’t have been more perfect, as the facility was brought to life to prepare for the night’s scientific observations. The telescope was put through its checkout, slewing about, as the dome above rotated and opened to the evening sky. We also toured the basement, where we saw the chamber in which the telescope mirror is periodically re-coated. We were also allowed to circumnavigate the catwalk that encircles the outside of the dome. Some of us even overcame our fear of



Image credits: Upper-left: Lick Observatory site (Hilary Jones), upper-right: Paul Lynam at the Shane Telescope (Gert Gottschalk), and lower-right: The 36-inch Great Refractor (Lawrence Brown).

continued on page 6

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

All times are Pacific Daylight Time.

### July

- 15 Fri The Moon, Saturn, and Antares form a vertical line, setting at about 3am
- 19 Tue **Full Moon (3:56pm)**
- 26 Tue **Last-Quarter Moon (4:00pm)**
- 28 Thu Delta Aquariid Meteor shower peaks (predawn)
- 30 Sat Mercury shines 1/2 degree from fainter Regulus (Dusk)

### August

- 2 Tue **New Moon (1:44pm)**
- 3 Wed Jupiter low in west, with Mercury 16 degrees to its lower-right, and Venus 8 degrees to the lower-right of Mercury (~20 minutes after sunset)
- 4 Thu The thin crescent Moon pairs with Mercury (~20 minutes after sunset)
- 5 Fri The Moon and Jupiter are separated by about 2 degrees (Dusk)
- 10 Wed **First-Quarter Moon (11:21am)**
- 11- Thu- Watch for Sirius to rise in the east-southeast about 20 minutes before sunrise
- 11 Thu The Perseid meteor shower peaks on the morning of August 12
- 18 Thu **Full Moon (2:26pm)**
- 23-24 Tue- Saturn, Mars, and Antares form a vertical line about 6 degrees long (Evening)
- 24 Wed **Last-Quarter Moon (8:41pm)**
- 27 Sat Venus and Jupiter close together very low in the west (Dusk)

heights to take advantage of this unique opportunity. From this vantage point, high above the ground below, we were treated to an amazing sunset. Upon return to the main building, the gift shop was opened for our shopping pleasure, where most of us took the opportunity to purchase a souvenir to keep the memory of our visit close. We were then given an engaging presentation of the life of James Lick by Pat Maloney, the telescope operator.

Next up was our highly anticipated observing session on the 36-inch Great Refractor. Dr. Lynam told the tale that a telescope is not called "great" until an astronomer is injured during its use. He noted some well-known astronomers who have been injured, and in some cases killed, in the pursuit of science. That being said, as you can see in Lawrence Brown's picture of the 36-inch scope (p.5, lower-right), Pat Maloney was precariously perched at the nexus of the RA and Declination shafts to manually slew the telescope to targets of opportunity--no go-to on this beast (see a video of Mr. Maloney moving the scope on Gert's webpage). We were treated to views of the Globular Cluster M53. Unfortunately, there was a slight problem with the focuser, which had to be locked down. For my eye it was slightly out of focus and I could not fully appreciate the multitude of stars in the globular cluster. M51 was quite

a sight at this aperture, with the spiral arms jumping out at you. Given the long focal length of the telescope, Hilary Jones was impressed at how it filled the field of view compared "our tiny scopes!" For me, the view of M102 (NGC5688) was most impressive. In contrast M51, which is seen face-on, M102 is an edge-on galaxy through which a pencil thin dark dust lane splits the galaxy in two halves. However, it was clear the dust lane did not extend the full length of the galaxy. In groups of ten we visited the grave of James Lick, who lies at the base of the mount, as if he would otherwise have been forgotten for the legacy he gifted us.

I thank Hilary Jones for providing me with his impressions of the tour, and I thank Lawrence Brown, Gert Gottschalk, and Hilary Jones for providing the images used herein. More of their tour images and videos can be found at:

<https://groups.yahoo.com/neo/groups/trivalleystargazers/photos/photostream>

[http://www.trivalleystargazers.org/gert/lick\\_tour\\_20160607/licktour\\_20160607.html](http://www.trivalleystargazers.org/gert/lick_tour_20160607/licktour_20160607.html)

<http://www.darklights.org/temp/LickTour/>

## ubble's Bubble Lights Up the Interstellar Rubble

By Dr. Ethan Siegel

When isolated stars like our Sun reach the end of their lives, they're expected to blow off their outer layers in a roughly spherical configuration: a planetary nebula. But the most spectacular bubbles don't come from gas-and-plasma getting expelled into otherwise empty space, but from young, hot stars whose radiation pushes against the gaseous nebulae in which they were born. While most of our Sun's energy is found in the visible part of the spectrum, more massive stars burn at hotter temperatures, producing more ionizing, ultraviolet light, and also at higher luminosities. A star some 40-45 times the mass of the Sun, for example, might emit energy at a rate hundreds of thousands of times as great as our own star.

The Bubble Nebula, discovered in 1787 by William Herschel, is perhaps the classic example of this phenomenon. At a distance of 7,100 light years away in the constellation of Cassiopeia, a molecular gas cloud is actively forming stars, including the massive O-class star BD+60 2522, which itself is a magnitude +8.7 star despite its great distance and its pres-



ence in a dusty region of space. Shining with a temperature of 37,500 K and a luminosity nearly 400,000 times that of our Sun, it ionizes and evaporates off all the molecular material within a sphere 7 light years in diameter. The bubble structure itself, when viewed from a dark sky location, can be seen through an amateur telescope with an aperture as small as 8" (20 cm).

As viewed by Hubble, the thickness of the bubble wall is both apparent and spectacular. A star as massive as the one creating this bubble emits stellar winds at approximately 1700 km/s, or 0.6% the speed of light. As those winds slam into the material in the interstellar medium, they push it outwards. The bubble itself appears off-center from the star due to the asymmetry of the surrounding interstellar medium with a greater density of cold gas on the "short" side than on the longer one. The blue color is due to the emission from partially ionized oxygen atoms, while the cooler yellow color highlights the dual presence of hydrogen (red) and nitrogen (green).

The star itself at the core of the nebula is currently fusing helium at its center. It is expected to live only another 10 million years or so before dying in a spectacular Type II supernova explosion.

This article is provided by NASA Space Place. With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology. Visit [spaceplace.nasa.gov](http://spaceplace.nasa.gov) to explore space and Earth science!

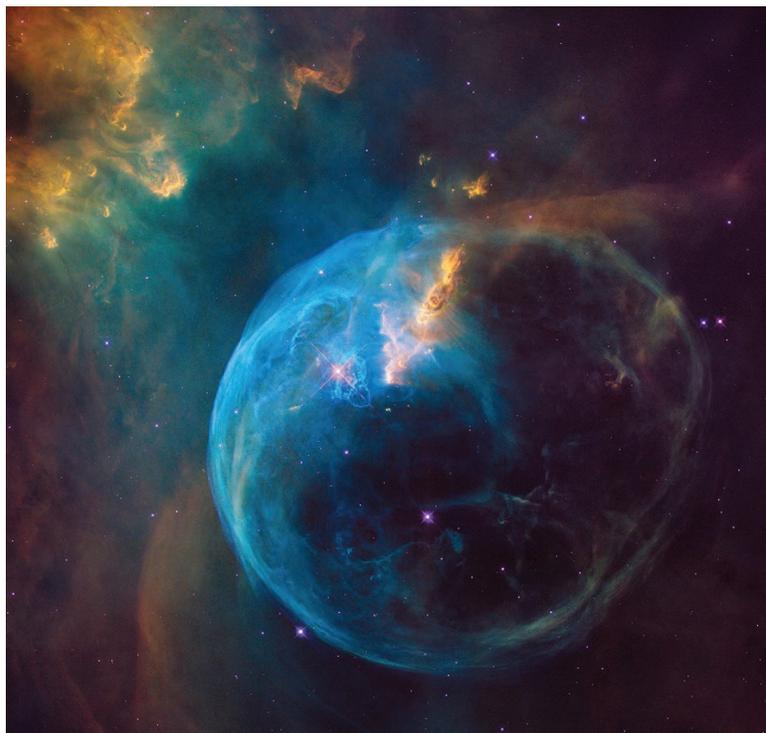


Image credit: Taken 229 years after its discovery by William Herschel, this image of the Bubble Nebula, NGC7635, was obtained using the Hubble Space Telescope [NASA, ESA, and the Hubble Heritage Team (STScI/AURA)].



Tri-Valley Stargazers  
P. O. Box 2476  
Livermore, CA 94551  
[www.trivalleystargazers.org](http://www.trivalleystargazers.org)

## Tri-Valley Stargazers Membership Application

(or apply for membership online: [www.trivalleystargazers.org/membership.shtml](http://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.