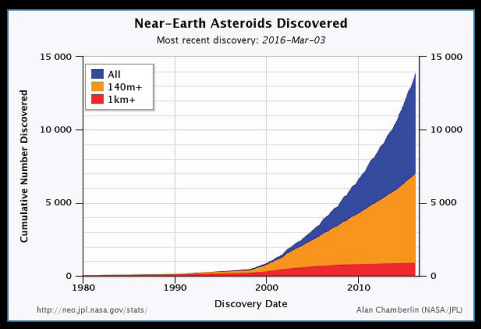
PRIMEFOCUS

Tri-Valley Stargazers



March 2016

Meeting Info

What:
Planetary Defense at LLNL: How to Protect Earth from Hazardous Asteroids

Who:
Dr. Megan Bruck Syal

When:
March 18, 2016
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

March Meeting

Planetary Defense at LLNL: How to Protect Earth from Hazardous Asteroids

Dr. Megan Bruck Syal

Asteroids headed for a collision with the Earth, if found early enough, can be acted upon to prevent the potentially devastating consequences of an impact. One technique to divert an asteroid, called kinetic impact, uses a spacecraft to crash into the body at high speeds. This approach delivers the momentum of the spacecraft, while also providing an additional boost of momentum through the production of impact crater ejecta exceeding the asteroid's escape velocity. For cases where the warning time is known well in advance and the asteroid is not too large, it is the preferred deflection mechanism, as described in a 2010 National Research Council report.

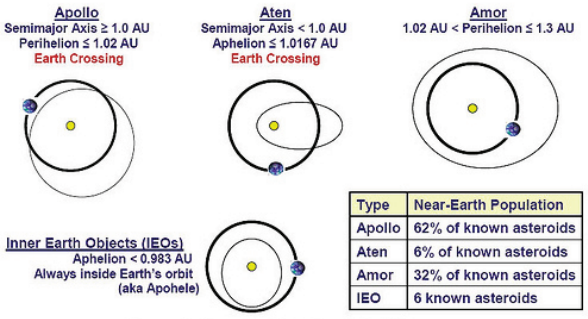


Figure 1. Near Earth Asteroid Orbit Types

Credit: http://neo.jpl.nasa.gov/faq/

Dr. Megan Bruck Syal and her Lawrence Livermore National Lab colleagues find that asteroid deflection by kinetic impact is sensitive to a range of asteroid characteristics, including strength, porosity, rotation, and shape. These and other asteroid properties may not be well constrained before an actual deflection mission is staged, leading to variability in the deflection outcome. By simulating a range of initial conditions for the target asteroids, researchers were able to quantify, for example, how greater target strength decreases the delivered momentum impulse and how, for an asteroid of constant size, added porosity can result in more effective deflections, despite the dampening of the shock waves produced during an impact. These results provide new information on the range of possible responses to a kinetic deflection attempt, which can directly inform the design of future kinetic-impact missions. Dr. Syal will also discusses the nuclear deflection technique, which is a potential option for large asteroids or when there is not enough advance notice for kinetic deflection to work.

Dr. Megan Bruck Syal is a postdoctoral researcher at Lawrence Livermore National Laboratory, working primarily on planetary defense problems. Numerical modeling of asteroid deflection and disruption, using shock physics codes such as Spheral, forms a large part of the current efforts. Other recently published work addresses carbon darkening at Mercury and the formation of lunar swirl regions at the Moon. Megan received her Ph.D. in Planetary Geosciences from Brown University in 2014 and B.A.'s in Astrophysics and Mathematics from Williams College in 2007.

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**
Mar. 18	Mar. 21	
Apr. 15	Apr. 18	Mar. 25
May 20	May 23	Apr. 29
Jun. 17	Jun. 20	May 27
Jul. 15	Jul. 18	Jun. 24
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 February 22, 2016 the TVS checking account balance is $$13,576.36. Upcoming expenses include the purchase of a new projector and screen for use during the club's general meetings. Compared to our current projector (now 12 years old), our new projector will be brighter (3000 vs. 1200 lumens), higher contrast, and higher resolution. It will also have an all-important HDMI input, allowing for a simple AV connection with most modern laptop computers. Our new screen will be about 50% taller and wider than our current screen, making presentations easier to see throughout the room.

Club Star Parties

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

Saturday 4/9/16: Tesla Winery Star Party

Saturday 5/28/16: H2O Open House

Saturday 6/25/16: Tesla Winery Star Party

Saturday 7/30/16: Tesla Winery Star Party

Saturday 8/27/16: H2O Open House

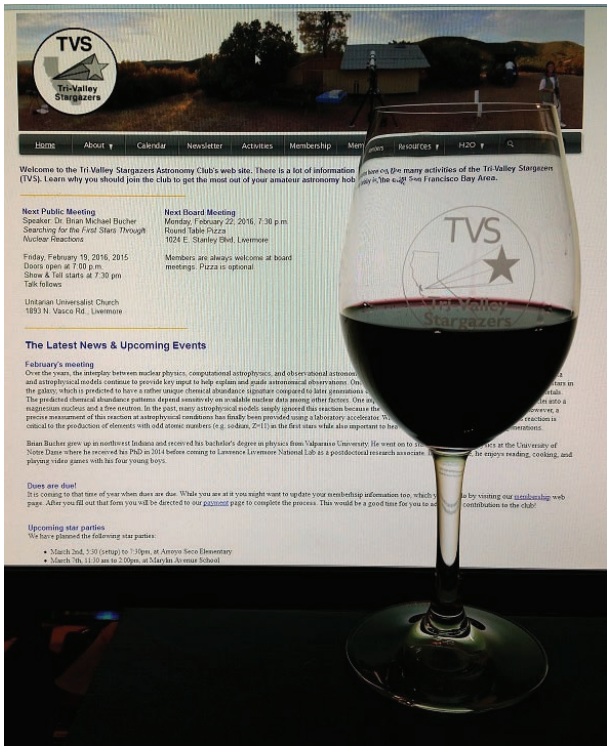
Saturday 9/24/16: Tesla Winery Star Party

The H2O Open Houses will be open to all club members and the pubic. 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. Mark your calendars now!

Our Tesla Winery Star Parties will have a new twist this year. For those wishing to participate, each party will have a theme and observing list associated with it. Themes suggested so far include a mini-Messier marathon, 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.

TVS Crystal Wine Glasses For Sale

TVS is offering elegant crystal wine glasses for sale to club members. You don't have to drink wine to enjoy the beautiful TVS logo-etched stemware. Use them for your favorite beverage, or they can be used as a beautiful container for small plants. They are the perfect gifts for loved ones or friends. Look for them at club meetings, where they will be sold for $10/each. Don't drink alone, buy two! Support TVS.



Journal Club By Ken Sperber

Milky Way and the Origin of the Smith Cloud

The standard model of galaxy formation dictates that galaxies grow hierarchically from smaller components. This is borne out by observations with the Hubble Space Telescope which finds that galaxies were much smaller in the distant past. Mergers between galaxies have been observed to be ongoing, as clearly depicted by the many photographs made by Halton Arp. We also know that the Milky Way and the An-

Header Image: Total number of Near-Earth asteroids discovered as of March 3, 2016. Image Credit: Alan Chamberlin (NASA/JPL) http://neo.jpl.nasa.gov/stats/

Journal Club (continued)

dromeda galaxy will collide in about 4 billion years.

The Space Telescope Science Institute indicates that there are hundreds of High Velocity Clouds (HVC) clouds in the vicinity of the Milky Way. Observations indicate that the Smith HVC, found by Gail Smith in the early 1960's using radio telescope data, will collide the with the Milky Way disk in 27 million years at a speed of about 73 kilometers per second! The Smith HVC is about 11,000 light years long and 2500 light years wide, and has a mass on the order of two million times that of the Sun.

At its present distance from the Milky Way, approximately 40,400 light years, it would span an apparent diameter of 30 Full Moons on our sky! Despite these kinematic features being known, the origin of the Smith HVC has been the subject of debate. Three possibilities exist; it could be (1) a failed galaxy, (2) an intergalactic gas cloud, or (3) a byproduct of Milky Way dynamics. If the elemental constituents could be identified, then one could begin to discriminate between these possibilities. In the former two cases the elemental constituents would be different from the of the Milky Way.

Fox et al. (2016, ApJL, 816, L11) have found an ingenious method for determining the elemental constituents of the Smith HVC. To characterize the elements, absorption spectra at ultraviolet (UV) wavelengths are required. The authors found three active galactic nuclei behind the Smith cloud. (Active galactic nuclei arise due to feeding supermassive black holes [SMBHs] at the center of a galaxy that emit copious amounts of high energy light from the accretion disk that orbits the SMBH and jets that are emitted perpendicular to the disk). As this UV light passes through the Smith cloud, absorption features are produced in the light spectrum from which elements and their concentration can be deduced. To obtain the spectra of elements heavier than hydrogen (referred to as metals by astronomers), the Cosmic Origins Spectrograph on the Hubble Space Telescope was used. The concentration of hydrogen (HI) was obtained by measuring the 21cm line with the 100-meter Byrd radio telescope at Green Bank.

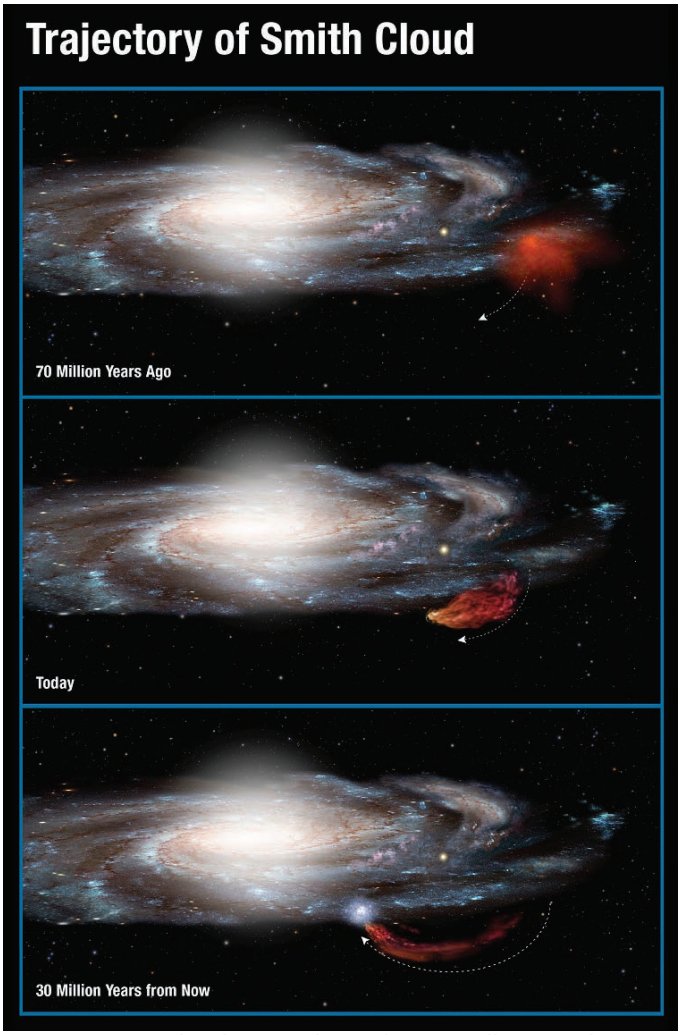


Image Caption: This diagram shows the 100-million-year-long trajectory of the Smith Cloud as it arcs out of the plane of our Milky Way galaxy. The Smith Cloud came out of a region near the edge of the galaxy's disk of stars 70 million years ago. The cloud is now stretched into the shape of a comet by gravity and gas pressure. Following a ballistic path, the cloud will fall back into the disk and trigger new star formation 30 million years from now. Image Credit: NASA, ESA, A. Feild and A. Fox.

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Journal Club (continued)

In the wavelength range 1250-1259 Angstroms, the profiles of three sulfur lines were measured. Sulfur is a good measure of the concentration of heavier elements since, according to the authors, it is "relatively undepleted onto dust." For each of the AGN lines of sight the spectral lines all exhibited Doppler shifts broadly consistent with the Smith HVC. Also, the sulfur/hydrogen concentrations were somewhat different along each of the lines of sight, ranging from 10-50% of the value measure in the Sun. The differences in velocities and a concentrations along the three AGN lines of sight indicates clumping of material in the Smith HVC.

Thought the S/H ratio is smaller than that of the Sun, the ratios are sufficiently high to indicate processing of material in previous generations of stars. This supports the hypothesis that the Smith HVC has it's origin in the Milky Way. The lower than solar concentration ratio suggests an origin in the outer disk of the Milky Way. If the Smith HVC had been a failed galaxy or an intergalactic gas cloud the S/H ratios would have been expected to be much lower, indicative of more pristine material.

The mechanism by which Smith HVC was created is still the subject of debate. It is the most massive HVC around the Milky Way, and the authors state that it is "unlikely that any star formation process in the (Milky Way) disk is energetic enough to explain the Smith HVC." The leading possibility is that the Smith HVC is due to cycling of material via a galactic fountain. Supernova explosions can eject gas from the galaxy, which then cools and falls back into the disk. However the large mass of the Smith HVC can only be explained if the fountain sweeps up additional gas from the corona of the Milky Way, as suggested by theoretical models. The remaining feature that is unexplained is that the Smith HVC is moving faster than the galactic rotation, a feature that is not commonly observed.

For more information see: http://hubblesite.org/newscenter/archive/releases/2016/04 and http://www.sciencedaily.com/releases/2016/01/160128155751.htm

Calendar of Events

March 14, 7:30pm

What: How Will the World End: Death Plunge or Death Spiral?
Who: Dr. Mark Boslough, University of New Mexico
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.

Which would be worse for life on Earth: an asteroid impact or a global warming catastrophe? Dr. Boslough compares the "death plunge" of an asteroid into Earth's atmosphere and the resulting effects of an impact to the "death spiral" of irreversible human-caused change in the planet's climate and discusses whether one is more likely—or preventable—than the other.

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

March 15, 12:00pm

What: Surviving a methane monsoon: the bizarre cryogenic rains, flammable dunes and carbon hazes of Saturn's planet-moon, Titan
Who: Michael Carroll
Where: SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA
Cost: Free

In this talk, Author/artist Michael Carroll will explore the bizarre methane-filled seas and soaring dunes of Saturn's largest moon, Titan. Recent advances in our understanding of this planet-sized moon provide enough information for authors to paint a realistic picture of this truly alien world. Following his presentation, he will be signing his new science fiction adventure/mystery book, "On the Shores of Titan's Farthest Sea".

"Carroll's descriptions of oily seas and methane monsoons put you in that alien world, front and center…I can imagine future astronauts doing exactly the kinds of things Mike describes. I wish I could be one of them." Alan Bean, Apollo 12 astronaut.

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

March 22, 12:00pm

What: The Evolution and Explosion of Massive Stars
Who: Tuguldur Sukhbold, UC Santa Cruz
Where: SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA
Cost: Free

Massive stars (at least ~8 solar masses) play an essential role to the evolution of the universe. They lose energy in radiation and neutrinos as they evolve, to create elements necessary to life and to stir the interstellar medium. Upon their death, they experience a dynamical instability that often creates spectacular explosions, which are the birth cries of exotic compact remnants - neutron stars and black holes.

Image Caption: Left: Roland Albers receiving his Astronomical League award from Dennis Beckley for completing the Lunar Program. Image Credit: Rich Combs. Right: During the first quarter Moon a system of Lunar Rilles is prominently featured near the center of the lunar terminator. To the upper right of center is Mare Serenitatis, one of the great impact lava plains on the Moon formed in the heavy bombardment 3.7 to 3.8 billion years ago. In the periphery of the maria we often find lunar rilles. They come in different shapes, curved or straight. The straight rilles are thought to be grabens, geological features where the crust has split along fault lines and parts of the surface sunk down. The cooling of the lava from the maria could have triggered those fault lines, although the detailed formation process of the rilles is yet to be fully understood. The image was taken with a 160mm F6.6 APO refractor and a 3x barlow lens. About 2000 video frames were captured with a ZWO ASI 120MC USB camera. About 20% (400) of the sharpest were chosen and stacked (AutoStakkert!2.5.1.7) and wavelet sharpened (Registax6) followed by brightness adjust in Photoshop CS2. In the images North is up. Image Credit: Gert Gottschalk, Research Wikipedia, ESA.

The field of evolution and explosion of massive stars has progressed tremendously in the past half-century, yet there are still many issues remain at large. In this talk, soon to be Dr. Sukhbold will provide a generic overview of the problem and will discuss recent developments on surveying the explosion outcomes of massive stars (nucleosynthesis, remnants, light curves) through 1-dimensional calculations.

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

March 29, 12:00pm

What: The enigma of planetesimal formation: theoreti cal developments on cold-disk protoplanetary turbulence and small particle assembly
Who: Orkan Umurhan, UC Berkeley
Where: SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA
Cost: Free

No details available.

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

April 4, 7:30pm

What: Tiny Moons Around Asteroids
Who: Franck Marchis, Senior Researcher, SETI 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.

After decades of speculation, the existence of multiple asteroids---asteroids with one or several companions around them---has been observationally confirmed. Today more than 200 companions of asteroids are known, and half of them were discovered by large worldwide network of professional and amateur astronomers equipped with small and medium size telescopes. By detection of small dip in brightness due to mutual eclipse events, these surveys give us the opportunity to better understand these fascinating mini-planetary systems. Asteroid multiplicity is an astronomical prize for observers and theorists alike, since it helps constrain theories on the origin of our solar system. Dr. Marchis will briefly describe the powerful adaptive optics technology used today that make it possible to image several multiple asteroid systems. He will also present several NASA and ESA space mission concepts dedicated to explore these new worlds in-situ.

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

April 5, 12:00pm

What: Bringing Nuclear Power to Mars
Who: Frank H. Shu, University Professor Emeritus, UC Berkeley

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

All times are Pacific Standard Time until March 13 when Pacific Daylight Time begins.

March

21	Mon	Double Shadow Transit on Jupiter (6:23pm-8:31pm)
23	Wed	Penumbral Eclipse deepest at 4:47am (see p.50 March S&T); Full Moon (5:01pm)
29	Tue	Moon, Saturn, Mars, and Spica form an uneven quadrangle (morning)
31	Thu	Last-Quarter Moon (8:17am)

April

1	Fri	Algol at minimum brightness for 2 hours centered on 9:09pm
7	Thu	New Moon (4:24am)
9-	Sat-	Mercury: best evening apparition of 2016 for the next 2 weeks (north-northwest after sunset)
10	Sun	Aldebaran occulted by the Moon, disappears behind dark limb at 2:21pm, reappears at 3:37pm
13	Wed	First-Quarter Moon (8:59pm)
16	Sat	The Moon is 3-4 degrees below Regulus (evening)
17	Sun	The Moon is about 3 degrees below Jupiter (evening)
20	Wed	The Moon is about 4-6 degrees above Spica
21	Thu	Full Moon (10:24pm)
21	Thu	Lyrid Meteor Shower peaks at about 11pm
24	Sun	The Moon forma an irregular quadrangle, about 10 degrees in size, with Saturn, Mars, and Antares
29	Fri	Last-Quarter Moon (8:29pm)

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. Nuclear power is the default option, just as is the case of naval submarines where the crews need to live and work in closed environments submerged under the water of the ocean 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 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 for that matter, a Mars colony. Dr. Shu will then discuss his patented design for the best possible two-fluid molten-salt breeder-reactor (2F-MSBR) that one could build, using thorium that can be mined locally without requiring shipments from mother Earth. He will close by considering two spin-off applications:

(1) saving civilization on Earth from the worst ravages of climate change by scaled-up 2F-MSBRs;

(2) using the fission fragments of related nuclear fission reactions 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, or phone 650-961-6633

April 9 8:00pm

What: Dark Matter
Who: Dr. Holger Muller, UC Berkeley
Where: Mt. Tamalpais State Park, Cushing Memorial Amphitheater, more commonly known as the Mountain Theater, Rock Spring parking area
Cost: Free

No details available.

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

The Closest New Stars To Earth

By Dr. Ethan Siegel

When you think about the new stars forming in the Milky Way, you probably think of the giant star-forming regions like the Orion Nebula, containing thousands of new stars with light so bright it's visible to the naked eye. At over 400 parsecs (1,300 light years) distant, it's one of the most spectacular sights in the night sky, and the vast majority of the light from galaxies originates from nebulae like this one. But its great luminosity and relative proximity makes it easy to overlook the fact that there are a slew of much closer star-forming regions than the Orion Nebula; they're just much, much fainter.

If you get a collapsing molecular cloud many hundreds of thousands (or more) times the mass of our sun, you'll get a nebula like Orion. But if your cloud is only a few thousand times the sun's mass, it's going to be much fainter. In most instances, the clumps of matter within will grow slowly, the neutral matter will block more light than it reflects or emits, and only a tiny fraction of the stars that form—the most massive, brightest ones—will be visible at all. Between just 400 and 500 light years away are the closest such regions to Earth: the molecular clouds in the constellations of Chamaeleon and Corona Australis. Along with the Lupus molecular clouds (about 600 light years distant), these dark, light-blocking patches are virtually unknown to most sky watchers in the northern hemisphere, as they're all southern hemisphere objects.

In visible light, these clouds appear predominantly as dark patches, obscuring and reddening the light of background stars. In the infrared, though, the gas glows brilliantly as it forms new stars inside. Combined near-infrared and visible light observations, such as those taken by the Hubble Space Telescope, can reveal the structure of the clouds as well as the young stars inside. In the Chameleon cloud, for example, there are between 200 and 300 new stars, including over 100 X-ray sources (between the Chamaeleon I and II clouds), approximately 50 T-Tauri stars and just a couple of massive, B-class stars. There's a third dark, molecular cloud (Chamaeleon III) that has not yet formed any stars at all.

While the majority of new stars form in large molecular clouds, the closest new stars form in much smaller, more abundant ones. As we reach out to the most distant quasars and galaxies in the universe, remember that there are still star-forming mysteries to be solved right here in our own backyard

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 to explore space and Earth science!

Image Credit: NASA and ESA Hubble Space Telescope. Acknowledgements: Kevin Luhman (Pennsylvania State University), and Judy Schmidt, of the Chamaeleon cloud and a newly-forming star within it—HH 909A—emitting narrow streams of gas from its poles.

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.