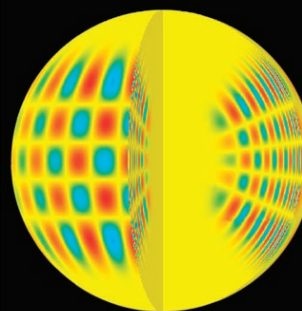


PRIMEFOCUS

Tri-Valley Stargazers



April 2014



Meeting Info

What:

Evidence for Supernova Injection Into the Solar Nebula

Who:

Dr. Gregory Brennecka

When:

April 18, 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

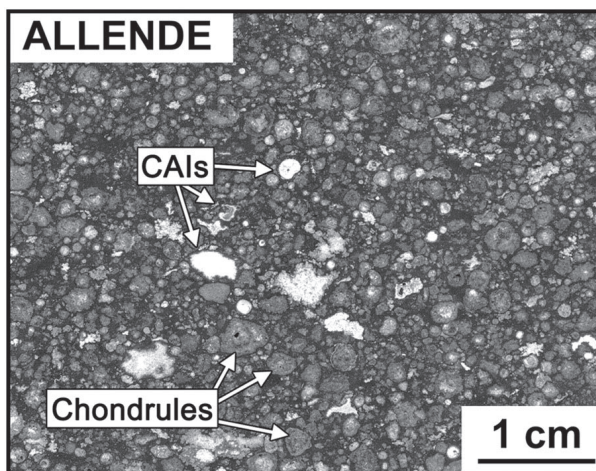
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Journal Club	2
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April Meeting

Evidence for Supernova Injection Into the Solar Nebula

Dr. Gregory Brennecka

A scenario of late supernova injection into the protoplanetary disk is consistent with formation of our Solar System in an active star-forming region of the galaxy. Slight differences between the non-radiogenic isotope compositions of the first solids in the Solar System (calcium-aluminum-rich inclusions, or CAIs) and terrestrial rocks are pervasive. Our work shows that the isotopic compositions of elements spanning a large mass range in CAIs, are uniform, and yet distinct from the average Solar System composition. Relative to younger objects in the Solar System, CAIs contain positive r-process anomalies in isotopes $A < 140$ and negative r-process anomalies in isotopes $A > 140$. This fundamental difference in the isotopic character of CAIs around mass 140 necessitates (i) the existence of multiple sources for r-process nucleosynthesis and (ii) the injection of supernova material into a reservoir untapped by CAIs. These distinct nucleosynthetic differences between CAIs and terrestrial rocks provide the isotopic character of the last significant supernova to input material into the Solar System. Further details of this work can be found at: <http://www.space.com/23164-supernova-explosion-seeded-solar-system-meteorites.html> and <http://www.pnas.org/content/early/2013/10/02/1307759110>



Caption: Calcium-Aluminum-rich Inclusions in the Allende meteorite. Credit: MacPherson and Boss, PNAS 2011;108: 19152-19158. See <http://www.pnas.org/content/108/48/19152/F1.expansion.html>

Dr. Gregory Brennecka received a PhD from Arizona State University in Isotope Geochemistry in 2011 with a thesis focused on documenting and understanding the natural variation in uranium isotopes in terrestrial and meteoritic samples. Much of his academic research and interest is now dedicated to determining isotopic characteristics of the first solids to form in the Solar System and what these characteristics can tell us about Solar System formation and early evolution. Dr. Brennecka is particularly interested in understanding short-lived radioisotopes and the role that supernova input had on the protostellar nebula and the early protostellar disk.

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
Apr. 18	Apr. 21	
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 April 4, 2014 the TVS checking account balance is:

Checking \$12,890.97

TVS Open Houses for 2014

The TVS Open House's for 2014 will be on Friday, May 23 and Saturday, August 16. The Friday, May 23rd date coincides with the potential new meteor shower that is expected to result from debris from Comet 209P/LINEAR (see p.30 of the May issue of S&T). This comet is making an extremely close pass by Earth on May 26 and it is possible that a meteor storm could result as Earth passes through debris from its tail. Interested parties, especially those who are not keyholders to H2O, will meet at the corner of Mines Rd. and Tesla Rd., and depart to H2O at 6:30pm in a caravan led by Chuck Grant. Admission is \$3/car; please bring the exact amount. The site is primitive, with 2 pit toilets, and no running water. Bring warm clothes, and food and water for the evening. If you plan to observe the meteor shower, a reclining lawn chair will be helpful. Use a flashlight with a red filter so that people's dark adaptation is not ruined by white light.

TVS Yosemite Star Party

David Feindel will be coordinating this year's TVS star party at Glacier Point, Yosemite National Park. We were lucky in drawing the new Moon weekend of June 27-28. Tri-Valley members who bring telescopes for public observing will receive free camping at the Bridalveil campgrounds. On these evenings, sunset occurs at about 8pm. On these dates sunset occurs at about 8:35pm with sunrise at about 5:50am. Contact David for more information (feindel1"at"comcast.net).

Golden State Star Party

The Golden State Star Party will be held from Wednesday,

June 25 through Sunday, June 29th. See <http://www.goldenstatestarparty.org/> to register for this annual event, and to find out details of the available amenities at the site.

Magazine Giveaway

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

Journal Club By Ken Sperber

Bang a Gong

Living in earthquake country, we Californians' probably know more about quakes and their effects than the "average Joe or Jane." What you may not realize is that the seismic waves that are caused by earthquakes can be used to study the interior structure of the Earth.

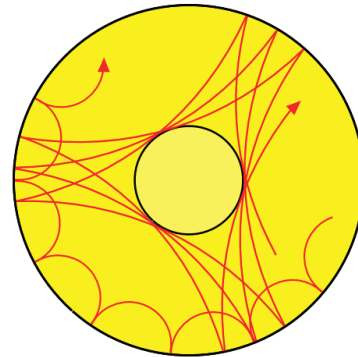


Image Caption: Paths of seismic waves. Author: Tosaka; GNU Free Documentation License via Wikipedia Commons (<http://en.wikipedia.org/wiki/File:%E5%A4%AA%E9%99%BD%E5%86%85%E9%83%A8%E3%81%AE%E5%AE%9A%E5%9C%A8%E6%B3%A2.PNG>).

Similarly, helioseismology is the study of oscillations in the Sun, and asteroseismology is the study of oscillations in extrasolar stars. The oscillations in stars arise not due to seismic activity, but arise from variations in the convective zone, which in some cases can cause the surface to move up and down by hundreds of kilometers. These variations affect the light output of the star. As you can see in the above schematic figure, the oscillations can have a short wavelength, such as those near the surface that are refracted in the upper layers of the star. Alternatively, longer wavelength oscillations penetrate more deeply into the star. Where the different wavelength oscillations are refracted depends on the density. The

Header Image: Computer generated image of a p-mode solar oscillation. Public Domain image from: http://en.wikipedia.org/wiki/File:Helioseismology_pmode1.png

density is affected by the composition, and temperature. One can learn about the size of the core, the convective and radiative zones, and differences in their rotation rates.

Numerous space missions (e.g., MOST, CoRot, Kepler) have provided asteroseismology data from extrasolar stars. Suarez et al. (2014; doi:10.1051/0004-6361/201322270) have demonstrated the usefulness of asteroseismology for understanding the structure of delta-Scuti stars, which are variable stars in the dwarf Cepheid class. The variations are mainly caused by ionized helium. When the star is most compressed the high degree of ionization raises the opacity of the layer. As such, the energy has difficulty being radiated to space. The layer heats up and the pressure rises causing the outer layers of the star to swell outward. As the degree of ionization decreases, the opacity drops and the radiative energy escapes more easily, with the outer layers falling back under the force of gravity to start the cycle over again.

For more information about asteroseismology and delta-Scuti stars see: <http://www.universetoday.com/110895/star-quake-how-super-suns-swing-and-what-it-could-look-like/>, <http://www.iaa.es/content/star-quakes-reveal-content-stars-which-are-hotter-and-more-massive-sun>, and http://www.aavso.org/vsots_delsct

Calendar of Events

April 14, 9:00pm-3:00am

What: Total Lunar Eclipse
Who: Saturday Night Space Talks: Faride Khalaf
Where: Chabot Space and Science Center, 10000 Skyline Blvd., Oakland, CA 94619
Cost: \$12 for members and guests

The deck will open at 9:00pm for a special presentation about the eclipse. Stay after the presentation for the late night viewing festivities.

A Lunar Eclipse occurs when the Moon passes through the shadow of the Earth. For this to happen the Sun, Earth, and Moon must be closely aligned with the Moon and the Moon located furthest from the Sun. Watch the Moon become deep red in color as this incredible phenomenon happens! Bring binoculars, blankets and warm clothes. Hot beverages will be for sale.

Please note: Eclipse is not guaranteed and weather permitting for outside viewing. Don't forget to bring your blankets

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

April 15, Noon-1:00pm

What: The WFIRST/AFTA astrophysics mission: bigger and better for exoplanets
Who: Tom Greene, NASA Ames Research Center
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

The Wide Field Infrared Survey Telescope mission is the highest priority large space project recommended by the 2010 Astronomy and Astrophysics Decadal Survey, and it is expected to begin development in 2017 when the James Webb Space Telescope is nearing launch. WFIRST was conceived to conduct wide field, near-infrared surveys for dark energy, exoplanet gravitational microlensing, and general astrophysics using a moderate aperture (~1.3-m) telescope. NASA has recently approved the use of a much larger, Hubble-sized (2.4-m) telescope that was donated by the National Reconnaissance Office. A science definition team is now studying a revamped WFIRST mission concept with this telescope, including a coronagraphic instrument for exoplanet and disk imaging and spectroscopy. This talk will highlight the mission's science potential including brief descriptions of its dark energy and general observer programs with more focus on

continued on page 4

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Refreshment Coordinator:

Laurie Grefsheim

Web & E-mail

www.trivalleystargazers.org
 tvs@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 (trivalleystargazers@gmail.com) 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)

its exoplanet microlensing survey and coronagraphic imaging and spectroscopy of nearby exoplanetary systems.

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

April 16, 7:00pm

What: Lifting the Cosmic Veil: Highlights from a Decade of the Spitzer Space Telescope

Who: Not listed

Where: Smithwick Theatre, 12345 El Monte Road, Los Altos Hills, CA 94022

Cost: Free, \$3 parking (coin required)

No abstract available.

For more information see: <http://www.foothill.edu/ast/index.php> or phone 650-949-7888.

April 21, 7:30pm

What: The Visualization of Astronomical Information: From Galileo to the Zooniverse

Who: Alyssa Goodman, Harvard University

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.

In 1610, when Galileo pointed his small telescope at Jupiter, he drew sketches to record what he saw. After just a few nights of observing, he understood his sketches to be showing moons orbiting Jupiter. It was the visualization of Galileo's observations that led to his understanding of a clearly Sun-centered solar system, and to the revolution this understanding then caused. Similar stories can be found throughout the history of Astronomy, but visualization has never been so essential as it is today, when we find ourselves blessed with a larger wealth and diversity of data, per astronomer, than ever in the past.

Using amazing new, and often free, software tools, we can immerse ourselves in data about the Universe. In a literal "immersion" setting, we can see data describing our Universe all around us on the "sky" of the Morrison Planetarium. In research, we can connect visualization, data mining, and statistical tools to each other in order to discover and understand new phenomena. In education, we can change the way we learn about the Universe by offering learners "real" data in rich, multimedia environments on desktop, touchscreen, and mobile computers. We can even use novel interfaces and gaming systems to let users interact with data, and the Universe, using whole body. Goodman will demonstrate the full power visualization brings to this range of endeavors, using examples spanning everything from a free, rich, "Universe

Information System" from Microsoft Research (WorldWide Telescope program), to a NASA-sponsored system for understanding the 3D data that the James Webb Space Telescope will send to Earth ("Glue"), to the Zooniverse, where hundreds of thousands of citizens join scientists in their quest to understand the Universe using "big data."

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

April 22, Noon-1:00pm

What: Greater than the Sum, a SETI Artist In Residence Special Event

Who: Marc Weidenbaum and Ed Frenkel, disquiet.com and UC Berkeley

Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA

Cost: Free

The third installment of the SETI Artist in Residence Program speakers series will feature two authors: Edward Frenkel, professor of mathematics at U.C. Berkeley, and Marc Weidenbaum, whose new book, for the 33 1/3 series, is about the Aphex Twin album Selected Ambient Works Volume II. Frenkel will talk about his recent book, *Love and Math: The Heart of Hidden Reality* (Basic Books), which the New York Times, among others, has praised for its passionate depiction of why "math deserves to be an integral part of our culture." Weidenbaum will describe his development of a globe-spanning network of hundreds of musicians and sound artists who have participated in the Disquiet Junto, his weekly series of compositional prompts that explore restraint as a creative springboard. Frenkel and Weidenbaum will pose questions to each other at the end, and the evening will be moderated by SETI's first artist-in-residence, Charles Lindsay

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

April 26, 7:30pm-8:15pm

What: A Visit to Johnson Space Center

Who: Faride Khalaf

Where: Chabot Space and Science Center, 10000 Skyline Blvd., Oakland, CA 94619

Cost: Included with General Admission.

Thinking of visiting the Space Center on your next trip to Houston? Faride shares his latest adventure touring the Center. Join him to view photos and highlights of visited spaces including the Neutral Buoyancy Lab and Mission Control Centers for the Apollo program and the ISS. Hear tips what to expect and on how to get the most out of your visit. Not sure you'll be visiting, then live vicariously through Faride as you join his journey.

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Calendar of Events (continued)

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

April 29, Noon-1:00pm

What: Dark Energy from the Largest Galaxy Maps
Who: David Schlegel, UC Berkeley
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

Dark energy is a phenomena causing the Universe to expand more rapidly than can be explained by Einstein's laws of gravity. Its discovery merited the 2011 Nobel Prize in Physics. The effects of dark energy imprint on large galaxy maps. The Baryon Oscillation Spectroscopic Survey (BOSS) on the Sloan Telescope has mapped 200 million galaxies in 2-D, and 1.5 million galaxies and quasars in 3-D. We measure the scale of the universe to percent-level precision at redshifts $z=2.4$, $z=0.6$ and $z=0.3$, from the deceleration to acceleration driven by dark energy. Recent maps are consistent with the "simplest" modification of Einstein's laws, the additional of a cosmological constant.

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

May 3, 8:30pm

What: Searching for Planets in Ophiuchus
Who: Dr. Chris McCarthy, San Francisco SU
Where: Mt. Tamalpais State Park, Cushing Memorial Amphitheater, more commonly known as the Mountain Theater, Rock Spring parking area
Cost: Free

Searchers for extrasolar planets are using two techniques, radial velocity and a new strategy for finding a new category of planets that do not orbit any star, the so-called "free-floating" planets.

For more information see: <http://www.mttam.net/astronomy/schedule.html>

May 5, 7:30pm

What: The Cosmic Cocktail: Three Parts Dark Matter
Who: Katherine Freese, Professor of Physics, University of Michigan
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 ordinary atoms that make up the known universe, from our bodies and the air we breathe to the planets and stars, constitute only 5% of all matter and energy in the cosmos.

The remaining 95% is made up of a recipe of 25% dark matter and 70% dark energy, both nonluminous components whose nature remains a mystery. Freese will recount the hunt for dark matter, from the discoveries of visionary scientists like Fritz Zwicky, the Swiss astronomer who coined the term "dark matter" in 1933, to the deluge of data today from underground laboratories, satellites in space, and the Large Hadron Collider. Theorists contend that dark matter consists of fundamental particles known as WIMPs, or weakly interacting massive particles. Billions of them pass through our bodies every second without us even realizing it, yet their gravitational pull is capable of whirling stars and gas at breakneck speeds around the centers of galaxies, and bending light from distant bright objects. In this talk Freese will provide an overview of this cosmic cocktail, including the evidence for the existence of dark matter in galaxies. Many cosmologists believe we are on the verge of solving this mystery and this talk will provide the foundation needed to fully fathom this epochal moment in humankind's quest to understand the universe.

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

May 6, Noon-1:00pm

What: The Cepheid Galactic Internet
Who: Tony Zee, Kavli Institute for Theoretical Physics, UC Santa Barbara
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.

May 13, Noon-1:00pm

What: Carbon Dioxide Snowfalls, Polar Caps, and the Climate of Mars
Who: Daniel Huber, SETI Institute
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

Like the Earth, Mars experiences seasonal cycles due to its ~25-degree axial tilt. Unlike the Earth, polar winter on Mars brings temperatures cold enough to freeze out the atmosphere, in the form of carbon dioxide surface frosts and snowfalls. The ice caps of Mars grow and shrink in response to seasonal changes in the polar heat balance. Since 2006, we have been monitoring the martian polar regions with multi-spectral thermal infrared measurements acquired by the Mars Climate Sounder (MCS). From these data, we retrieve vertical profiles of temperature and aerosol opacity,

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

All times Pacific Daylight Time.

April

- 8 Tue Mars at opposition (visible all night)
- 12 Sat Neptune is 0.7 degrees south of Venus
- 13 Sun Vesta, the brightest asteroid, at opposition (see p.50 February S&T)
- 14-15 Mon- Mars closest to Earth for 2014 (see p.50 March S&T)
- 14-15 Mon- **Total Lunar Eclipse Visible (Partial begins: 10:58pm, Total Begins: 00:06am)**
- 15 Tue **Full Moon (00:42am)**
- 17 Thu Saturn near the Moon (Dawn)
- 22 Tue The weak Lyrid Meteor Shower peaks this morning (see p.52 April S&T)
- 22 Tue **Last-Quarter Moon (0:52am)**
- 25-26 Fri- Crescent Moon to the upper-right (lower-left) of Venus on the 25th (26th; Dawn)
- 27 Sun Venus to the lower-right of the crescent Moon
- 28 Mon **New Moon (11:14pm)**

May

- 3-4 Sat- Crescent Moon near Jupiter
- 6 Tue Eta Aquariid meteor shower peaks before dawn
- 6 Tue **First-Quarter Moon (8:15pm)**
- 10-11 Sat- Saturn at opposition, closest to Earth and visible all night
- 13-14 Tue- The Moon and Saturn are in conjunction
- 14 Wed **Full Moon (12:16pm)**
- 15-16 Thu- Uranus is ~1.5 degrees north of Venus
- 16-28 Fri- Mercury above the west-northwest horizon during its highest apparition of 2014
- 21 Wed **Last-Quarter Moon (5:59am)**
- 23-24 Fri- TVS Open House. New meteor shower or meteor storm from debris of Comet 209P/LINEAR (see p.30 May S&T)
- 26-31 Mon- Comet 209P/LINEAR passes < 0.06AU from Earth, one of the closest comet approaches in history!
- 28 Wed **New Moon (11:40am)**

as well as surface properties such as ice granularity and dust content. This dataset provides an unprecedented view of the rich and complex ice caps and polar atmosphere. In this talk, I will highlight the dynamic polar processes at the heart of the martian CO₂ cycle, as revealed by MCS. We will see evidence for striking inter-annual repeatability, diverse thermal and precipitation regimes, and intense localized snowstorms. In light of these new observations, we will explore the implications for the present and past climate of Mars.

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



Old Tool, New Use: GPS and the Terrestrial Reference Frame

By Alex H. Kasprak

Flying over 1300 kilometers above Earth, the Jason 2 satellite knows its distance from the ocean down to a matter of centimeters, allowing for the creation of detailed maps of the ocean's surface. This information is invaluable to oceanographers and climate scientists. By understanding the ocean's complex topography—its barely perceptible hills and troughs—these scientists can monitor the pace of sea level rise, unravel the intricacies of ocean currents, and project the effects of future climate change.

But these measurements would be useless if there were not some frame of reference to put them in context. A terrestrial reference frame, ratified by an international group of scientists, serves that purpose. "It's a lot like air," says JPL scientist Jan Weiss. "It's all around us and is vitally important, but people don't really think about it." Creating such a frame of reference is more of a challenge than you might think, though. No point on the surface of Earth is truly fixed.

To create a terrestrial reference frame, you need to know the distance between as many points as possible. Two methods help achieve that goal. Very-long baseline interferometry uses multiple radio antennas to monitor the signal from something very far away in space, like a quasar. The distance between the antennas can be calculated based on tiny changes in the time it takes the signal to reach them. Satellite laser ranging, the second method, bounces lasers off of satellites and measures the two-way travel time to calculate distance between ground stations.

Weiss and his colleagues would like to add a third method into the mix—GPS. At the moment, GPS measurements are used only to tie together the points created by very long baseline interferometry and satellite laser ranging together, not to directly calculate a terrestrial reference frame.

"There hasn't been a whole lot of serious effort to include GPS directly," says Weiss. His goal is to show that GPS can be used to create a terrestrial reference frame on its own. "The thing about GPS that's different from very-long baseline interferometry and satellite laser ranging is that you don't need complex and expensive infrastructure and can deploy many stations all around the world."



Images credit: Artist's interpretation of the Jason 2 satellite. To do its job properly, satellites like Jason 2 require as accurate a terrestrial reference frame as possible. Image courtesy: NASA/JPL-Caltech.

Feeding GPS data directly into the calculation of a terrestrial reference frame could lead to an even more accurate and cost effective way to reference points geospatially. This could be good news for missions like Jason 2. Slight errors in the terrestrial reference frame can create significant errors where precise measurements are required. GPS stations could prove to be a vital and untapped resource in the quest to create the most accurate terrestrial reference frame possible. "The thing about GPS," says Weiss, "is that you are just so data rich when compared to these other techniques."

You can learn more about NASA's efforts to create an accurate terrestrial reference frame here: <http://space-geodesy.nasa.gov/>.

Kids can learn all about GPS by visiting <http://spaceplace.nasa.gov/gps> and watching a fun animation about finding pizza here: <http://spaceplace.nasa.gov/gps-pizza>.

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.