

# PRIMEFOCUS

Tri-Valley Stargazers

July 2004



## Meeting Info:

### What

*Summer BBQ & Potluck*

### Who

TVS Members & Family

### When

July 16, 2004

Set up at 6:30 p.m.

Dinner at 7:00 p.m.

### Where

Unitarian Universalist  
Church in Livermore  
1893 N. Vasco Road

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## July Meeting

### Summer BBQ & Potluck

#### *TVS Members*

Summer has officially begun, so it must be time for our annual BBQ and Potluck. Join us for a relaxing evening eating and chatting with fellow TVS members, friends and family.

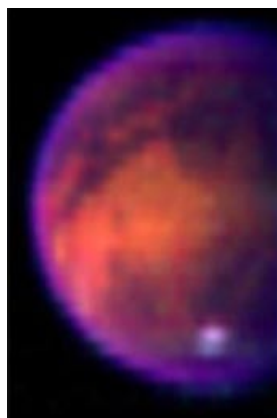
TVS will provide the hamburgers and veggie burgers, condiments, hot and cold drinks, plates and plasticware. TVS members are asked to bring a side dish to share with 8-10 fellow Stargazers. Use the first letter of your last name to determine which type of side dish to bring.

A-F	Appetizers
G-L	Macaroni or Potato Salad
M-R	Dessert
S-Z	Green or Fruit Salad

After dinner, if the skies are clear we'll pull out our loaner scopes and do a little stargazing. We also have a new short NASA DVD about Saturn that we can show.

Speaking of Saturn . . .

### Cassini-Huygens Safely Arrives at Saturn



After seven long years of traveling our solar system, the spacecraft Cassini finally arrived at Saturn. NASA/JPL have another success story to add to their long list of accomplishments. The images it has been sending back have been spectacular—especially those of Titan, Saturn's largest moon. Before this month, Titan was a featureless cloud covered body. Not anymore.

At the end of the year Cassini will launch the probe Huygens, which will take three weeks to travel to Titan where it will parachute down to the surface.

Titan

Peering through the layer of smog enshrouding Titan, these images from Cassini's visual and infrared mapping spectrometer reveals a surface covered with a variety of materials in the southern hemisphere.

Using near-infrared colors—some three times deeper in the red visible to the human eye—these images reveal the surface with unusual clarity. The color image shows a false-color combination of the three previously released images.

# News & Notes

## Welcome

TVS welcomes our newest members—**Gagan Bhatia** and **Ray Brown**.

## 2004 TVS Meeting Dates

Below are the TVS meeting dates for the next few months. The lecture meetings are on the third Friday of the month, with the Board meetings on the Monday following the lecture meeting. The *Prime Focus* deadline applies to that month's issue (e.g., the September 5th deadline is for the September issue).

Lecture Meeting	Board Meeting	Prime Focus Deadline
July 16	July 19	July 4
Aug 20	Aug 23	Aug 8
Sept. 17	Sept. 20	Sept. 5
Oct. 15	Oct. 18	Oct. 3
Nov. 19	Nov. 22	Nov. 7

## Money Matters

At the June Board meeting, Treasurer **Gary Steinhour** gave us the account balances (as of June 20, 2004) of TVS's accounts:

Checking	\$1,069.59	
CD #1	\$3,936.27	matures 08/17/04
CD #2	\$2,429.22	matures 08/27/04
CD #3	\$2,069.58	matures 07/16/04

## Upcoming TVS Star Parties

In the next couple of months, TVS will be hosting several major star parties.

### H2O Open House — July 10

Our second Open House of the summer observing season is on Saturday, July 10th. Members are to meet at the corner of Mines and Tesla to caravan down to the site. The caravan departs the meeting site at 7:00 p.m. There is a \$3 per car entrance fee (exact change). H2O is a primitive site, so plan accordingly.

### Yosemite — August 6 & 7

TVS hosts two public star parties at Glacier Point in Yosemite in exchange for free camping at the Bridalveil Campground. Besides getting lots of oohs and aahs from the public as they look through your scope, you also get some very dark skies.

After the public turns in for the night, you can stay up as late as you want observing faint fuzzies. When you're done for the evening pack up your scope and return to the campsite.

Space is limited, so contact trip coordinator Dave Rodrigues to RSVP. Dave can be reached at 510-483-

9191 or davevrod@aol.com. A group BBQ dinner is planned, with Bob McKoon coordinating the cooking efforts. This is a popular trip, with many repeat attendees. Why not join in on the fun?!

### White Mountain — August 8 through 16

Right after the Yosemite trip is the annual White Mountain star party at the Barcroft High Altitude Research Station east of the Sierras. How high is 'High Altitude'? About 12,400 feet. High enough that there is an oxygen tank in the dining room.

The cost this year is \$55 per night. This includes a lovely bunk bed in a dormitory, truly fabulous meals (they have some of the best cooks working at the site), and really dark skies. Skies so dark that it has been said the Milky Way casts shadows.

The first night of the trip, Sunday August 8th, is at the Grandview Campground, just down the hill at around 8,600 foot elevation. This offers everyone a chance to get acclimated to the higher altitude. Grandview is a primitive campsite just like H2O—the only amenity is a pit toilet. There is no fee for staying at the campgrounds. For those who prefer such things as hot showers and flush toilets, one of the many motels at Mammoth Lakes is an alternate place to get acclimated. For more info on Grandview, visit [www.herronweb.com/cgnes/frames/counties/ca/inyo/grandview.html](http://www.herronweb.com/cgnes/frames/counties/ca/inyo/grandview.html). From the web site "... this site was full of astronomers taking advantage of the clear high mountain air, cloudless skies and absence of city lights."

On Monday, the gang makes the journey up to the station. Some may stop off at Schulman Grove to wander amongst the Bristlecone Pine trees. The Bristlecone trees are the oldest living things on the planet. For a little more info about the park, visit [www.fs.fed.us/r5/inyo/bcp/r5/inyo/recreation.html](http://www.fs.fed.us/r5/inyo/bcp/r5/inyo/recreation.html).

The journey from Grandview to Barcroft will take a couple of hours, with most of the travelling done on a winding dirt road. For some views of the station, visit [www.wmrs.edu](http://www.wmrs.edu). Because of the altitude, no one under 16 is allowed to stay at Barcroft.

Space is limited, so contact Dave Rodrigues to RSVP at 510-483-9191 or davevrod@aol.com.

#### Newsletter header image: M80 (NGC 6093) in Scorpius

This ball of stars is known as a globular cluster. Globular clusters are very old and orbit the central region of our galaxy. We see globulars orbiting other galaxies as well.

M80 is about 28,000 light years away. It contains hundreds of thousands of stars and is about 15 billion years old. It's about 7th magnitude, easily visible in a small scope.

Image Credit: The Hubble Heritage Team (AURA/STScI/NASA).

# Calendar of Events

## July 10 2004 – January 2, 2005

**What:** *Dragon Skies: Astronomy of Imperial China*

**Where:** Chabot Space & Science Center

**Cost:** General Admission

Chabot's newest exhibit opens Saturday, July 10th. Learn the secret knowledge of the emperor in this new exhibit that tells the 5,000 year-old story of ancient China's astronomical achievements. This exhibit includes ancient artifacts, such as armillary spheres and oracle bones, and hands-on interactives that invite visitors to predict the future, interpret signs and measure time.

[Editor's note: I've had a sneak preview of some of the exhibits. They are quite impressive and are amazing works of art. If you're interested in the historical side of astronomy, this is definitely an exhibit you'll want to see.]

July 10th is the Grand Opening, with events such as Dragon Dancers, martial arts demos, food carving demos, and *The Weaver & the Cowherd*, a play performed by the teen Galaxy Explorers. Plus there will be prizes and giveaways!

Reservations recommended. Please call the Chabot Box Office: 510-336-7373

## July 17, 6:00 p.m.

**What:** *Dragons in the Sky: Early Astronomy and Astrology in China as seen in Divinations and Inscriptions of the Shang Dynasty, circa 1299 BC*

**Who:** Dr. David Keightley

**Where:** Chabot Space & Science Center

**Cost:** \$5

China's earliest recordings of astronomical events were found on oracle bones. These bones were engraved and

then broken to also serve as a source of divining a person's future. Dr. David Keightley of UC Berkeley's Asian History Department, is considered one of the world's foremost experts on Oracle Bones. Hear him speak of their significance in the court of Imperial China, and how the preservation of these bones gives us a wonderful insight to the astronomy of the dynasties.

## July 20-24

**What:** *AstroCon 2004*

**Who:** ASP, AANC, ALPO, AAVSO

**Where:** Doubletree Hotel, Berkeley

**Cost:** Varies

The conference starts on July 20th with a reception and a talk by Dr. Gibor Basri. Most of the daytime events revolve around astronomical paper presentations. Highlights include optional events such as a star party at the Chabot Space & Science Center, lunch with David Levy, the ASP Awards Banquet featuring Dr. Geoff Marcy, and the closing banquet on board the USS Hornet (which is almost sold out), with former astronaut Alan Bean as the speaker, and bus tours to Muir Woods and the Napa Wine region.

Full conference registration is \$95. One-day registration can be purchased for \$30. Conference registration is required for all events except the ASP Awards Banquet and the Gray Line bus tours. Don't forget to pick up a t-shirt and pin designed by yours truly (the editor).

For more info, visit the AstroCon web site: [www.astrocon2004.org](http://www.astrocon2004.org). The conference is organized by the ASP (Astronomical Society of the Pacific), the AL (Astronomical League), ALPO (Association of Lunar

### Officers

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Chuck Grant

#### **Observatory Director/**

#### **Key Master:**

Chuck Grant

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r\_photo@hotmail.com  
925-586-6453 (after 9 p.m.)

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Rich Campbell

### Historians:

Paul Caswell & Debbie Dyke

### Mentor:

Mike Rushford  
rushford@eyes-on-the-skies.org

### Addresses

#### *Mailing:*

Tri-Valley Stargazers  
P.O. Box 2476  
Livermore, CA 94551

#### *Lecture Meeting:*

Unitarian Universalist Church  
1893 N. Vasco Road, Livermore

#### *Board & Discussion Meetings:*

Round Table Pizza  
1024 E. Stanley Blvd., Livermore

### Web & E-mail

[www.trivalleystargazers.org](http://www.trivalleystargazers.org)

[tvst@trivalleystargazers.org](mailto:tvst@trivalleystargazers.org)

### Eyes on the Skies

Eyes on the Skies is a robotic solar telescope run by Mike Rushford ([rushford@eyes-on-the-skies.org](mailto:rushford@eyes-on-the-skies.org)). You may access it by visiting [www.eyes-on-the-skies.org](http://www.eyes-on-the-skies.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 ([tvst@trivalleystargazers.org](mailto:tvst@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*

and Planetary Observers) and the AAVSO (American Association of Variable Star Observers). The event is hosted by the AANC (Amateur Astronomers of Northern California), the EAS (Eastbay Astronomical Society), and the SJAA (San Jose Astronomical Society).

### July 24, 8:30 p.m.

**What:** *Supernovae, Dark Energy and the Accelerating Universe*

**Who:** Dr. Saul Permuter, Lawrence Berkeley Lab

**Where:** Mt. Tam

**Cost:** Free

Astronomers use exploding stars to investigate one of the biggest scientific mysteries of our day. Visit the Mt. Tam astronomy program web site for more information: [www.mttam.net](http://www.mttam.net).

Some Future Astronomy Programs (includes observing with the San Francisco Amateur Astronomers after the lecture):

July 24, 8:30 p.m.: Dr. Jeff Moore from NASA-Ames Research Center on *The New Horizons Pluto-Kuiper Belt Mission*

August 21, 8:00 p.m.: Dr. Phil Plait from Sonoma State University on *Bad Astronomy: Facing Down the Face on Mars*

September 18, 7:30 p.m.: Dr. Pascal Lee from the Mars Institute on *Humans on Mars*

October 16, 7:30 p.m.: Dr. Emma Bakes from the SETI Institute on *Exploring the Meaning of Life* Future Storytelling

October 23, 5:00 p.m.: Mary Ellen Hill's story *We are the Stars That Sing: The Story of the Universe*

Check out the Mt Tamalpais Interpretive Association web site: [www.mttam.net](http://www.mttam.net) or call 415-455-5370 for more information

### August 14, 6:00 p.m.

**What:** *The Mechanics of Heaven: Jesuit Astronomers at the Qing Court*

**Who:** Mark Mir

**Where:** Chabot Space & Science Center

**Cost:** \$5

While Europe was developing the telescope, Chinese astronomers were making impressive astronomical discoveries and taking highly accurate measurements of the heavens with instruments of their own. However, their science changed with the Jesuit missionary arrival in the 1500's. Mark Mir, of the Ricci Institute in San Francisco, will speak on Jesuit contributions to the field of Chinese astronomy, and how several were appointed to the court as Royal Astronomers.

## First Light: Beginners' Astronomy

by Richard Campbell

### USE WHAT YOU KNOW

When teaching constellations to the public, presenters always start with Ursa Major, the Big Dipper. Why? Because most people *recognize it*. Once you see the dipper, you can use its 'pointer stars' to locate Polaris, Arcturus, even obscure stars with newly discovered planets. Start with something most people know, and you can take people far...light years away, even.

Let's use this idea to help us explain the planets, stars and galaxies.

### PLANETS and MOON:

1. Consider Mercury: one side as hot as your stove, the other far colder than your freezer
2. Saturn: average *thickness* of rings is as tall as a house. It would take you about 6 days of uninterrupted jet travel to go *the width*, though!
3. Neptune: Winds as fast, and faster than a jet plane
4. Earth's moon: Soil is as powdery as flour. Smallest crater visible in your telescope? The size of *Livermore* (guaranteed 'ooohs' and 'ahhhhs' from the kids).

### STARS:

1. Size of Earth compared to a typical star: a bb compared with a beach ball.
2. Sometimes stars looked clumped together like dough. Actually the space between stars is so great, it's like living in a neighborhood where your closest neighbor is 100 miles away.

### GALAXIES

1. Terence Dickinson writes in *Nightwatch*, "There are as many stars in the Milky Way galaxy as there are grains of sand in a sandbox."
2. For those of you who rarely play in sandboxes, get this: If you could shrink the solar system to the size of a coffee cup, our milky way galaxy would be the size of North America.

That last fact comes from an excellent book all about everyday comparisons, called *The Cosmic Mind Boggling Book* by Neil McAleer. It may be out of print, but if you find it, consider yourself lucky, for you will have found a *treasure chest* of great quotes. At the same time, let's create comparisons that speak to Tri-Valley Stargazers in particular. Such as, "*(x)* is as tall as a Unitarian Universalist Church," or "*(y)* is like a feather compared to a 17" loaner dob," or "the distance between those two stars is like two identical Naglers, one in the meeting hall, the other at Hidden Hill." And best of all, "the beauty of (celestial object) is as attractive as the layout of *Prime Focus*." Will Debbie publish the last sentence? Hmmmmm. I'm betting yes.

[Yes, I'll publish anything. - Editor]

## Astronomical insights

by David Feindel

Unfortunately, my promised killer hardware test has to wait another month. In five nights of observing this past month (more than my average, btw), not a single night had seeing good enough to support the 400x mag, required to collimate my SCT. But the time was not spent aimlessly. I spent two nights in Coma Berenices. Why I never got around to studying this constellation before is incomprehensible. M53 and NGC 5053, perhaps the least “globular” of all globulars; M64, the Black Eye Galaxy; NGC 4565, the Needle Galaxy; and M98-99-100 are all highlights in anybody’s book. All of these are now on my must-see list at Yosemite in a month.

I just love visiting Lick Observatory. The sense of history that permeates the place, the view of San Jose, the telescopes, the observing from 4400 feet altitude, the clear horizons, and the ambiance combine to make it a special place to me. This month’s excuse to visit was the first of their Music of the Spheres programs, with Golden Bough, a Celtic trio, playing. We arrived at the summit to find a cloudless sky but 20-30mph winds, which did not bode well for observing. I determined that James Lick did NOT have concerts in mind when he approved the building design. The acoustics left something to be desired, with the stage set up in the central lobby, and seats arranged down the two wings and front portal. The observing was better, even with the wind. The 36" scope was on NGC6543, the Cat’s Eye Nebula—an excellent target.

With “only” 160 people, I didn’t feel too guilty taking literally two minutes to study it. As usual, several amateurs also had their scopes set up. One poor soul had his ETX-90 on a camera tripod out front, first on the setting sun (with a solar filter), and later, aimed at Jupiter. The winds bounced the scope around so much, I feared for his scope’s future. The scopes in the back did better, being slightly out of the wind and being heavy scopes on heavy mounts—a 6" refractor on a pier and a 12 or 14" dob. But the wind’s effect was still noticeable. The moon and the Wild Duck looked excellent through the AP refractor. The two best lines of the evening: “Gee, the wind doesn’t seem to be bothering the 36" refractor very much” by someone obliquely pointing out (I think!) the advantage of a 50-ton mount and a dome; and “It’s not often I lose the ‘largest aperture present’ prize to a refractor!” (the dob owner).

This month’s read was *Alvan Clark & Sons, Artists in Optics* by Deborah Jean Warner and Robert B. Ariail. This book is clearly a labor of love; they have track down the whereabouts of a LOT of the optics, including many of the 3"- 4" objectives. One surprise to me was that they made 35 (!) refractors greater than or equal to 12 inches. It also lists the numerous portraits and other paintings that Alvan Clark created. But I was disappointed overall, expecting to learn more about the man himself, his company, the techniques they pioneered, and perhaps the discoveries made using Clark optics.



Venus Phase shrinking. As Venus moved in for the June 8th transit in front of the sun, its phase was shrinking rapidly. While the planet was still an evening object, Sibylle Fröhlich took the images with her 8" f5 newtonian telescope 3x barlow lens and webcam. The video sequences from the webcam were processed using Registax to bring out the sharpest single frames, stack and filter them. Wavelet processing increased the detail of the images. They were then put together into a composite. Photo by: Sibylle Fröhlich

## What's Up *by Debbie Dyke*

All times Pacific Daylight Time unless otherwise noted.

### July

- 8 Thurs Saturn in conjunction with the Sun 10:00 a.m.
- 9 Fri **Last Quarter Moon** 12:34 a.m.  
1979 Voyager 2 passes by Jupiter.
- 10 Sat Mercury just 13' N of Mars very low in the West right after sunset.
- 11 Sun 1979 Skylab re-enters the Earth's atmosphere.
- 14 Wed Moon at apogee (251,839 mi/406,192 km) 2:00 p.m.  
1965 Mariner 4 makes first flyby of Mars and takes pictures.
- 16 Fri **Tri-Valley Stargazers general meeting.** 7:30 p.m. at the Unitarian Universalist Church,  
1893 N. Vasco Road, Livermore.  
1994 Comet Shoemaker-Levy 9 begins plunging into Jupiter. The plunging continues through the 20th.
- 17 Sat **New Moon** 4:24 a.m.
- 18 Sun **Tri-Valley Stargazers discussion meeting.** 2:00 p.m. at the Round Table Pizza on 1024  
E. Stanley Blvd., Livermore. Discuss astro stuff with your fellow members.  
1984 Svetlana Savitskaya becomes the first woman to take a walk in space.
- 19 Mon **Tri-Valley Stargazers Board meeting.** 7:00 p.m. at the Round Table Pizza in Livermore.  
Mars and Mercury just South of the thin crescent Moon low in the West just after sunset.
- 20 Tues 1969 Apollo 11 lands at Tranquillity, placing the first men on the Moon.  
1976 Viking 1 makes first robotic landing at Chryse Planitia on Mars.  
1999 Space capsule Liberty Bell retrieved from the bottom of the ocean.
- 23 Fri 1995 Alan Hale discovers his half of Comet Hale-Bopp.
- 24 Sat **First Quarter Moon** 8:37 p.m.
- 26 Mon Mercury at greatest elongation E (27°) 7:00 p.m. Mercury is visible low in the evening twilight.
- 27 Tues S. delta-Aquarid meteors peak at 12:00 p.m.
- 28 Wed 1851 First photo taken of a solar eclipse — the corona is discovered.
- 29 Thur Moon at perigee (223,400 mi/360,324 km) 11:00 p.m.
- 30 Fri 1971 Apollo 15 lands on the Moon. The next day, astronauts Scott and Irwin take a little spin in the  
Lunar Roving Vehicle.
- 31 Sat **Full Moon** 11:05 a.m.  
1774 Oxygen is discovered. Everyone takes a deep breath of relief.  
1964 Ranger 7 impacts Moon, taking the first closeup views of the Lunar surface.

### August

- 1 Sun 1818 Maria Mitchell born. She receives a gold medal from the king of Denmark for being the first to  
discover a comet.
- 5 Thurs Neptune at opposition 8:00 p.m.
- 7 Sat **Last Quarter Moon** 3:01 p.m.  
Mars at aphelion
- 8 Sun Mercury stationary 10:00 p.m.
- 11 Wed Moon at apogee (251,291 mi/405,292 km) 3:00 a.m.  
1877 Asaph Hall Sr. discovers Mars' moon Deimos.
- 12 Thurs **Perseid meteors** peak at 4:00 a.m.  
1977 Prototype shuttle Enterprise makes its first free flight.

## Space Weather

by Patrick Barry and Tony Phillips

Radiation storms, 250 mile-per-second winds, charged particles raining down from magnetic tempests overhead ... it sounds like the extreme weather of some alien world. But this bizarre weather happens right here at Earth.

Scientists call it “space weather.” It occurs mostly within the gradual boundary between our atmosphere and interplanetary space, where the blast of particles and radiation streaming from the Sun plows into the protective bubble of Earth’s magnetic field. But space weather can also descend to Earth’s surface. Because the Earth’s magnetic field envelops all of us, vibrations in this springy field caused by space weather reverberate in the room around you and within your body as much as at the edge of space far overhead.

In fact, one way to see these “geomagnetic storms” is to suspend a magnetized needle from a thin thread inside of a bottle. When solar storms buffet Earth’s magnetic field, you’ll see the needle move and swing. If you live at higher latitudes, you can see a more spectacular effect: the aurora borealis and the aurora australis. These colorful light shows happen when charged particles trapped in the outer bands of Earth’s magnetic field get “shaken loose” and rain down on Earth’s atmosphere.

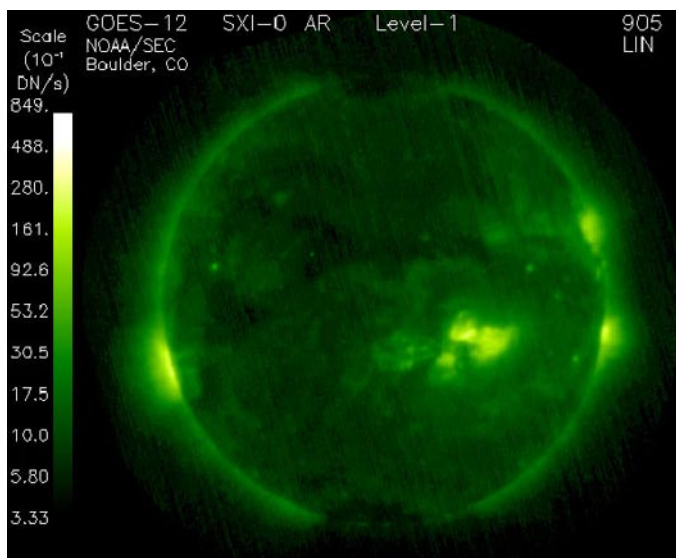
And because a vibrating magnetic field will induce an electric current in a conductor, geomagnetic storms can have a less enjoyable effect: widespread power blackouts. Such

a blackout happened in 1989 in Quebec, Canada, during a particularly strong geomagnetic storm. These storms can also induce currents in the metallic bodies of orbiting satellites, knocking the satellite out temporarily, and sometimes permanently.

Partly because of these adverse effects, scientists keep close tabs on the space weather forecast. The best way to do this is to watch the Sun. The NASA/ESA SOHO satellite and NOAA’s fleet of GOES satellites keep a constant watch on the Sun’s activity. If a “coronal hole”—where high-speed solar wind streams out from the Sun’s surface—comes into view, it could mean that a strong gust of solar wind is on its way, along with the geomagnetic storms it will trigger. And an explosive ejection of hot plasma toward the Earth—called a “coronal mass ejection”—could mean danger for astronauts in orbit. The advancing front of ejected matter, moving much faster than the solar wind, will accelerate particles in its path to near the speed of light, spawning a radiation storm that can threaten astronauts’ health.

Look for coming articles for more about space weather and about NOAA’s efforts to forecast these celestial storms. Meanwhile, read today’s space weather forecast at <http://www.sec.noaa.gov>. Kids can learn about the geostationary and orbits of the GOES satellites at [http://spaceplace.nasa.gov/en/kids/goes/goes\\_poes\\_orbits.shtml](http://spaceplace.nasa.gov/en/kids/goes/goes_poes_orbits.shtml).

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.



This image shows the outer solar atmosphere, or corona, as viewed by the GOES 12 Solar X-ray Imager (SXI). It shows the plasma at 4.0 MK (million degrees Kelvin). Bright areas are associated with sunspots seen in white light images and may produce explosive events known as flares. Dark regions are coronal holes where the fastest solar wind originates. Image courtesy of the Space Environment Center/NOAA.

## Astro Events



The transit of Venus. In this image, taken by our German reporter, Venus is just starting its trip across the sun.

Photo by Sibylle Fröhlich

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.  
\_\_\_\_\_ \$25 Basic. You will receive e-mail notification when the PDF version of *Prime Focus* is available for download off the TVS web site.  
\_\_\_\_\_ \$30 Regular. You will receive a paper version of *Prime Focus* in the mail.  
\_\_\_\_\_ \$32.95 One year subscription to *Sky & Telescope* magazine.  
\_\_\_\_\_ \$29 One year subscription to *Astronomy* magazine.  
\_\_\_\_\_ \$55 Two year subscription to *Astronomy* magazine.  
\_\_\_\_\_ \$20 Hidden Hill Observatory (H2O) refundable key deposit (key property of TVS).  
\$ \_\_\_\_\_ 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.