

# PRIME FOCUS

Tri-Valley Stargazers

October 2003



## Meeting Info:

### What

*Star Hopping*

### Who

Robert Garfinkle, F.R.A.S.

### When

October 17, 2003  
Conversation at 7:00 p.m.  
Lecture starts 7:30 p.m.

### Where

Unitarian Universalist  
Church in Livermore  
1893 N. Vasco Road

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## October Meeting

### Star Hopping

*Robert Garfinkle, F.R.A.S.*

The speaker for our October meeting is Mr. Robert A. Garfinkle, the author of the astronomy book *Star-Hopping; Your Visa to Viewing the Universe* and co-author of *Advanced Skywatching*. His talk will be on the basics of how to star-hop to find your way among the stars. Star hopping is using the brighter stars, like links in a chain, to find the fainter objects that you want to observe.

Bob was born and raised in Alameda and holds Bachelor of Arts degrees in both History and English from Cal State University, Hayward. He has been an avid amateur astronomer since the 1960s. In 1985, Bob began writing astronomy articles and book reviews for *Astronomy* magazine. He is currently writing a major lunar observers' handbook. In 1997, Bob was elected a Fellow of the Royal Astronomical Society of London (F.R.A.S.). He is a life member of the Fremont Peak Observatory Association and a member of several local and international astronomical organizations, including the Eastbay Astronomical Society and the San Jose Astronomical Association.

In addition to his main observing telescope, a Meade 10-inch Schmidt Cassegrain, Bob owns a historic 1875 With-Browning reflecting telescope, once owned by several prominent British lunar observer/writers of the past 125 years.

In these heady days of the governor's recall, while serving as a member of the City Council of the City of Union City in 1993, Bob faced an attempt to recall him from office and beat it by one vote. Three months later, he was re-elected to a second term, coming in second in a field of eight candidates for three seats.

Whether you use a "Go-To" scope or a non-computerized instrument, all observers need to know how to star-hop across the night skies. So come hear Bob at the meeting and pick up some star-hopping tips.



## News & Notes

### Welcome

TVS welcomes our newest members to the club: **Stephen Bull, Gary Crown, Robert Mazza, and John Welsh.**

### 2003 TVS Meeting Dates

Below are the TVS meeting dates for the rest of the year. The lecture meetings are held on the third Friday of the month, with the Board meeting on the Monday following the lecture meeting. The *Prime Focus* deadline applies to that month's issue (e.g., the December 7th deadline is for the December issue).

Lecture Meeting	Board Meeting	Prime Focus Deadline
Oct. 17	Oct. 20	Oct. 5
Nov. 21	Nov. 24	Nov. 9
Dec. 19	Dec. 15	Dec. 7

### Money Matters

At the September Board meeting, Treasurer **Gary Steinhour** gave us the account balances (as of September 21, 2003) of TVS's accounts:

Checking	\$973.67	
CD #1	\$3,918.59	matures 11/17/03
CD #2	\$2,418.31	matures 11/27/03
CD #3	\$2,060.25	matures 10/16/03

### School Star Party Update

*Richard Campbell, TVS school star party chair*

There will be a star party at Emma Smith Elementary school in Livermore, October 24th. Keep in mind even if it's cloudy, we can give slideshow presentations and talks. If you have suggestions or materials to contribute, give me a call at 209-834-1324. You won't regret it!

Kids' astronomy joke of the month:

If meteorites are rocks that hit the surface of a planet, what are the ones that miss?

*Meteorwrongs!*

Clear skies, open minds!

### TVS Elections Coming Up

At our November meeting TVS will hold its annual elections. The current slate of officers have agreed to run again for their respective positions. However, any and all TVS members are encourage to run for any position they are interested in. Besides the Officer positions (President, Vice President, Treasurer, Secretary), positions on the Board of Directors are also available.

### Lumicon Hypered Film is Back

In case you astrophotographers didn't know, the new Lumicon is carrying hypered film as well as hypering kits once again. For info, visit their web site: [www.lumicon.com](http://www.lumicon.com).

### Halloween Treats

This year Halloween falls on a Friday, so there are bound to be lots of trick or treaters hitting the street as they won't have school the next morning.

In addition to the usual fare of astronomically correct candy (Milky Way, Starburst, etc.), why not give them an even better treat—a look through your telescope! Besides Mars, a first quarter Moon will be visible all through the trick or treating evening to give the costumed masses (and their parents!) their first up close views of Lunar craters. The Moon transits at 6:16 p.m. (PST) and sets at 11:05. Mars transits at 8:09 p.m. and sets at 1:37 a.m.

The kids and their parents really enjoy being able to look through a telescope. The only really scary thing you have to worry about are clouds.

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## Calendar of Events

### Classic Sci-Fi Film Series Chabot Space & Science Center

The movies are shown in their original theater format at the 60' Tien MegaDome Theater. Tickets are \$5 per person and are available at the door, at [TicketWeb.com](http://TicketWeb.com), or the Chabot Box Office, 510-336-7373.

#### Movies:

*Sleepy Hollow*, October 31, November 1 & 2  
(with Johnny Depp & Christina Ricci; Rated R)

#### Showtimes:

Friday – Sunday on the first weekend of each month.  
Friday & Saturday – 7:30 p.m., Sunday – 4:00 p.m.

**Newsletter header image:** M104/NGC4594 - Sombrero Galaxy.

"One of the largest Hubble mosaics ever assembled, this magnificent galaxy is nearly one-fifth the diameter of the full moon. The team used Hubble's Advanced Camera for Surveys to take six pictures of the galaxy and then stitched them together to create the final composite image."

M104 is 28 million light-years away in the constellation of Virgo. The image is roughly 10 arcminutes wide (82,000 light-years) and was taken during May & June of this year, with an exposure time of 10.2 hours.

*Photo: NASA, The Hubble Heritage Team a (STScI)*

## Calendar of Events *continued*

### October 8, 7:00 p.m.

**What:** *The Mars Exploration Rover Mission: Following the Water*

**Who:** Dr. David Des Marais (NASA Ames)

**Where:** Smithwick Theater, Foothill College, Los Altos

**Cost:** Free. Parking on campus costs \$2.

Dr. Des Marais, a member of Science Operations Working Group for the mission, will describe the plans for landing two advanced rovers on the surface of the red planet in January. Both rovers will have instruments on board that can act as “robot geologists”, searching for evidence of past water on our neighbor planet.

The talk is part of the Silicon Valley Astronomy Lecture Series and is co-sponsored by NASA Ames Research Center, the Foothill College Astronomy Program, the SETI Institute, and the Astronomical Society of the Pacific.

To reach Foothill College, take Highway 280 to the Los Altos hills and take the El Monte Road exit. Call the series hotline at 650-949-7888 for more information.

### October 11-12

**What:** *115th Annual Meeting of the ASP (Astronomical Society of the Pacific)*

**Who:** Various Speakers

**Where:** Various Locations

**Cost:** Various Costs

The ASP’s annual meeting encompasses various activities throughout the Bay Area during two days. On the 11th, there will be a half-day tour of SLAC (Stanford Linear Accelerator Center), the ASP Annual Members’ Meeting (for ASP members only), and an awards banquet and ceremony with guest speaker **David Levy** in Emeryville.

The October 12th events include a series of speakers at Wheeler Auditorium at the UC Berkeley Campus.

Included are: **Sandra Faber, Matthew Malkan, Alex Filippenko, Shrinivas Kulkarni, Sumner Starrfield, Robert Lin,** and **Kevin Zahnle.**

The SLAC tour is \$25, Awards Banquet \$60, and the Lecture Series are priced at \$25 for students, \$30 for ASP members, and \$35 for the general public.

For online registration and info, go to: [www.astrosociety.org/events/meeting.html](http://www.astrosociety.org/events/meeting.html). You may also request info by mail or fax by calling 415-337-1100 x109.

### October 16, 7:30 p.m.

**What:** *Bright Lights, Big City: How the Most Massive Galaxies & Black Holes Live Together*

**Who:** Dr. Wil van Breugel (LLNL)

**Where:** Chabot Space & Science Center, Oakland

**Cost:** \$5

Astrophysicist Dr. Wil van Breugel describe two of the most massive objects in our universe today—and how researchers are approaching the questions these objects are posing by their coexistence.

### October 21, 7:30 p.m.

**What:** *How the Universe Got Its Spots*

**Who:** Dr. Janna Levin (Cambridge Univ.)

**Where:** Morrison Planetarium, San Francisco

**Cost:** Free

Our universe appears to stretch nearly thirty billion light years across. As far as the eye can see, there is no visible bound to space-time. Still the universe may not be infinite. A tenable possibility is that space itself is not only curved, as Einstein suggested, but that it is also connected, compact and finite. By searching for the shape and extent of space we are trying to locate ourselves in the vast expanding cosmos. Book signing to follow.

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#### **Officers**

##### **President:**

Chuck Grant  
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##### **Vice-President:**

Rich Campbell  
r\_photo@hotmail.com

##### **Treasurer:**

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##### **Secretary:**

Maggie Halberg  
925-736-8627

##### **Board of Directors**

Alane Alchorn, Jim Alves,  
Mike Anderson, Paul Caswell,

Debbie Dyke, Gert Gottschalk,  
Mike Rushford, John Swenson.

#### **Volunteer Positions**

##### **Librarian:**

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##### **Newsletter Editor:**

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**Program Director:** unfilled

##### **Loaner Scope Manager:**

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##### **Webmaster:**

Chuck Grant

#### **Observatory Director/**

##### **Key Master:**

Chuck Grant

##### **School Star Party Chair:**

Rich Campbell  
r\_photo@hotmail.com  
209-834-1324 (evenings)

##### **Public Star Party Chair:**

Rich Campbell

##### **Historians:**

Paul Caswell & Debbie Dyke

#### **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)  
tvs@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). You may access it by visiting [www.eyes-on-the-skies.org](http://www.eyes-on-the-skies.org).

## Calendar of Events *continued*

### November 6, 7:30 p.m.

What: *Magnificent Mars*

Who: Dr. Ken Croswell

Where: Cody's Books, Berkeley

Cost: Free

The planet Mars has long offered the prospect of another living world in the solar system. Tonight, with an armada of spacecraft scrutinizing the red planet as never before, Harvard-trained astronomer and author Ken Croswell shows you the best color images of Mars and describes the planet from pole to pole, exploring Martian geology, the Martian atmosphere, Martian volcanoes, and Martian water, all organized around the four great elements of Mars: Earth, Air, Fire, and Water. Along the way you'll see nearly every image from Dr. Croswell's new book *Magnificent Mars*, including volcanoes over twice as tall as Mount Everest, canyons that could stretch from Ohio to California, and floods of water far greater than any known on Earth. Billions of years ago, on a world warmer and wetter, Mars may have given rise to life whose fossils await discovery today.

Ken Croswell earned his doctorate in astronomy from Harvard University and is the author of several highly acclaimed books, including *The Alchemy of the Heavens*, *Planet Quest*, *Magnificent Universe*, *See the Stars*, and *The Universe at Midnight*.

'Our little neighbor Mars will be the first New World of the century that has just dawned. Ken Croswell has done a superb job in outlining what is known, and what is suspected, about the next home of mankind beyond the Moon.' —Sir Arthur C. Clarke

"At last, a work that synthesizes the latest discoveries on the red planet into an accessible yet accurate form. *Magnificent Mars* is a magnificent book." —Robert Zubrin, author of *The Case for Mars* and president of the Mars Society

More at <http://KenCroswell.com> .

Cody's Books is at 2454 Telegraph Ave. (at Haste), three blocks south of UC Berkeley. Phone: 510-845-7852

### November 8, 4:00 p.m.

What: *Lunar Eclipse*

Who: Mt. Diablo Astronomical Society (MDAS)

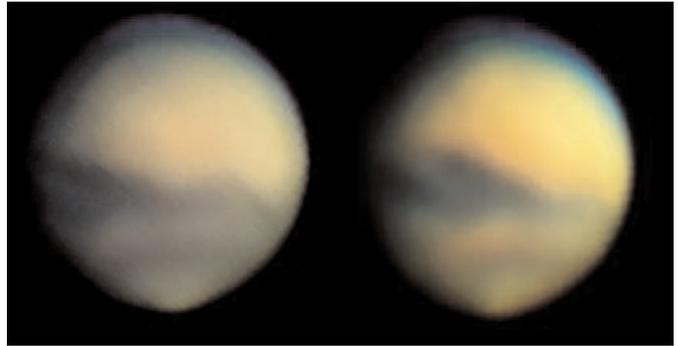
Where: Mt. Diablo

Cost: Free

Tonight there will be a total lunar eclipse. Watch the eclipse through a telescope! The members of MDAS will explain and discuss "Why do eclipses of the Moon happen?"

Visit the MDAS web site for more info: [www.mdas.net](http://www.mdas.net).

## Astro Events



Mars, September 19, 2003 at the TVS meeting.

At the end of the meeting, John Horvath had set up his scope and webcam out back for a little demo on video imaging. To get the image on the left, he used his Takahashi Sky-90 flourite doublet refractor w/focal length extender & 5x Powermate (f45 equivalent), Tak EM-10 EQ mount, IR blocker, and Logitech QuickCam Pro 4000 webcam. He took 500 frames, combined them and processed them with Registax 2.0 to get the final image.

The image on the right was taken the following night, September 20, at H2O. He used the same equipment set up, and created the image with 80 frames combined and processed with Registax 2.0.

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## ★ **First Light: Beginners' Astronomy** by Richard Campbell

*Martians mixed with Earthlings!*

You may have seen Mars' closest approach or opposition several weeks ago. As you looked up, did the young ones around you ask, "Are there Martians?" Instead of saying, "No" pause for a minute and consider the latest research on Martian meteor impacts. Some scientists believe *life on Earth* started with matter that arrived in a Martian meteorite billions of years ago. If that's true then *we* are the Martians! Tell the kids they might see a Martian if they look in the mirror!

Another way to mix your Earth experience with Mars is to *pick up some Earth*, preferably reddish soil, and put it in a plastic bag. Then go to your freezer and scoop some ice into a plastic bag. Bring both bags to the telescope, hold them in your hands as you look at Mars.

You are touching what you're seeing through the eyepiece! The two main surface features we can see through amateur telescopes are Mars' reddish soil (chemically similar to rust) and its carbon dioxide ice cap. Look at that ice cap while you can, for it's melting as Mars' summer progresses.

Why keep looking at Mars, even when it's past opposition? It's still relatively huge in the sky, and bigger than it will be at the *next* opposition, two years from now. So *keep in touch* with Mars, fellow Martians!

## Astronomical insights

by David Feindel

As Mars starts to dwindle into the distance, what other planets are visible these days? Having just returned from a long trip with a major case of jet lag on October 4, the immediate answer is Saturn. Waking up at 3:00 a.m., what better than to go out and catch a couple of hours observing before the sun comes up? By 3:00, Saturn is about 60 degrees above the horizon, well above the muck. Castor and Pollux are just to Saturn's left, with Orion just before meridian. You get the winter skies, without the winter rain and cold. Light pollution and air turbulence are at their minimums by then, providing good observing, given the limits of suburbia.

In addition to the obvious, I also enjoy searching for the moons of Saturn. There are eight that are within range of my 8" telescope:

Titan	mag. 8.3
Rhea	mag. 9.6
Tethys	mag. 10.1
Dione	mag. 10.8
Iapetus	mag. 11.0
Enceladus	mag. 11.6
Mimas	mag. 12.8
Hyperion	mag. 14.2

Watching these eight waltz around Saturn night to night is fascinating.

They do present some difficulties. Mimas, in particular, is a challenge. It is small and orbits very close to the outer edge of the rings (after all, it is responsible for creating the Cassini Division!). Mimas tends to get lost in the glare of Saturn when it is near the planet itself. Hyperion is difficult due to its magnitude; 14.2 is the edge of what an 8" scope is capable of. This time, there was a ringer in the view—at mag 8.4 SAO78867 was positioned as if it, too, was in orbit. But a quick reference to *Cartes du Ciel* resolved the issue. After studying it awhile, I half-convincing myself that I could see a difference; Titan, at 0.8 arc sec in diameter, wasn't quite a point source. The Dawes' Limit for an 8" scope is 0.6 arc sec, so it may be possible to see it as a small disc under good conditions. But I'll have to go find some other examples to make sure. The final difficulty was finding Iapetus. It was nearly at maximum elongation, about 10 ring diameters from Saturn.

Saturn with two of its moons, Dione and Tethys. Picture taken by Voyager 1 at a distance of 8 million miles (13 million km).



## Astro Events *continued*



### Total Lunar Eclipse

The Bay Area will witness a second total lunar eclipse this year (the first one was on May 16). On November 8, just after the Moon rises, the Moon will be fully eclipsed.

Event	Time	Altitude
Penumbral phase begins	2:15 pm	-26°
Partial umbral eclipse begins	3:33 pm	-15°
<i>Moon Rises</i>	5:02 pm	0°
<b>Totality begins</b>	<b>5:06 pm</b>	<b>1°</b>
<b>Mid totality</b>	<b>5:19 pm</b>	<b>3°</b>
<b>Totality ends</b>	<b>5:31 pm</b>	<b>5°</b>
Partial umbral eclipse ends	7:05 pm	23°
Penumbral phase ends	8:22 pm	38°

To view this eclipse, you'll need a clear unobstructed view of the Eastern horizon. If we're lucky, we won't have the thick layer of haze interfering with the eclipse as we did earlier this year. But even without haze, it will still be a challenge to view the totally eclipsed Moon as it will be *really* close to the horizon—just 3° off the horizon during mid totality. We will miss the start of the penumbral and umbral portions of the eclipse as the Moon will be below the horizon.

There will be a total solar eclipse on November 23rd, but you'll have to share the view with the penguins as it will only be visible in Antarctica.

## What's Up *by Debbie Dyke*

All times Pacific Daylight Savings Time unless otherwise noted.

### October

- 9 Thurs Draconid meteors peak at 2:00 a.m.
- 10 Fri **Full Moon** (the Hunter's Moon) 12:27 a.m.  
1604 Kepler saw a supernova appear between Jupiter and Saturn (visually speaking, of course).
- 13 Mon Columbus Day.
- 14 Tues Moon at apogee (2551,529 mi/405,692 km) 7:00 p.m.
- 17 Fri **Tri-Valley Stargazers general meeting.** 7:30 p.m. at the Unitarian Universalist Church, 1893 N. Vasco Road, Livermore.  
The waning gibbous Moon just 5° from Saturn throughout the early morning.
- 18 Sat **Last Quarter Moon** 5:31 a.m.
- 19 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.
- 20 Mon **Tri-Valley Stargazers Board meeting.** 7:00 p.m. at the Round Table Pizza in Livermore.
- 22 Wed Orionid meteor shower peaks at 2:00 a.m.  
The waning crescent Moon passes to the north of Jupiter in the hours just before dawn.  
1975 Venera 9 becomes first spacecraft to return images of the surface of Venus.
- 24 Fri The Zodiacal Light may be visible in the east before morning twilight for the next two weeks.
- 25 Sat **New Moon** 5:50 a.m.  
Mercury in superior conjunction.
- 26 Sun **Daylight Savings Time ends 2 a.m.** Set clocks *back* 1 hour.  
Moon at perigee – large tides possible (222,299 mi/358,547 km) 4:00 a.m. PST  
Venus 0.08° north of the Moon 12:00 p.m. PST
- 27 Mon Ramadan begins.
- 31 Fri **Halloween**  
1992 The Vatican absolves Galileo of all heresy charges.  
**First Quarter Moon** 8:25 p.m. PST



### November

- 2 Sun The waxing gibbous Moon just 4.5° from Mars.
- 3 Mon 1957 Laika becomes the first dog in space.
- 4 Tues **Election Day**  
S. Taurid meteors peak at 2:00 p.m. PST
- 7 Fri 1994 The 10-meter Keck Telescope dedicated on Mauna Kea, Hawai'i.
- 8 Sat **Full Moon - Total Lunar Eclipse visible from the Bay Area** 5:19 p.m. PST  
1656 Edmond Halley born.
- 9 Sun Look for the Moon in between the Pleiades and the Hyades.
- 10 Mon Moon at apogee (251,907 mi/406,301 km) 4:00 a.m. PST
- 11 Tues **Veterans' Day**  
The waning gibbous Moon just 4° from M1.  
1572 Tycho Brahe witnesses the brightest supernova seen in 900 years. It appeared in Cassiopeia.

## (un)Fasten Your Seatbelts

by Patrick Barry & Dr. Tony Phillips

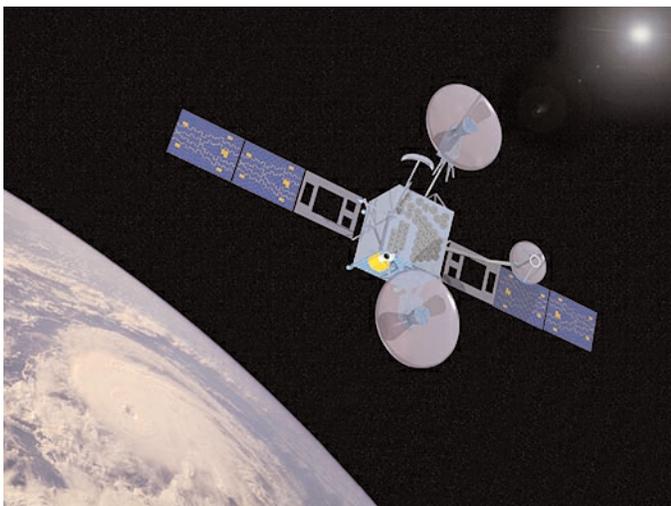
The “fasten seatbelts” light turns off, and you get up to ask the stewardess for a pillow; it’s going to be a long flight. Only a kilometer ahead in the cloudless sky, a downward draft of sheering winds looms. When the plane hits these winds, the “turbulence” will shake the cabin violently and you could be seriously hurt.

You don’t know about those winds, of course, and neither does the pilot. Today’s weather satellites can’t see winds in clear skies: they rely on the motion of clouds to infer which way the winds are blowing.

“Believe it or not, their best indication of wind sheer right now is warnings from aircraft that have gone through it ahead of them,” says Bill Smith of NASA’s Langley Research Center.

But a new satellite technology being pioneered by NASA and NOAA could improve this shaky situation. It’s called GIFTS, short for Geosynchronous Imaging Fourier Transform Spectrometer. GIFTS is an infra-red sensor that can detect winds in cloudless skies by watching the motions of atmospheric water vapor. Water vapor is mostly invisible to the human eye, but it reveals itself to GIFTS by the infra-red radiation it absorbs.

Smith is the lead scientist for EO-3, a satellite designed to test out this new technology. Slated for launch in 2005 or 2006, EO-3 will carry GIFTS to Earth orbit where it can produce 3-dimensional movies of winds in the atmosphere below.



EO-3, carrying the GIFTS instrument, will be in a geosynchronous orbit for extended monitoring of large regions of our planet and enabling observation of weather patterns at higher resolution than possible with existing geostationary satellites.

These wind data will not only improve safety, but also help the airlines save money. Knowing the winds along a flight route allows airlines to adjust the plane’s fuel load accordingly, thus reducing the weight that the engines must lift. Saved fuel means saved money and less pollution.

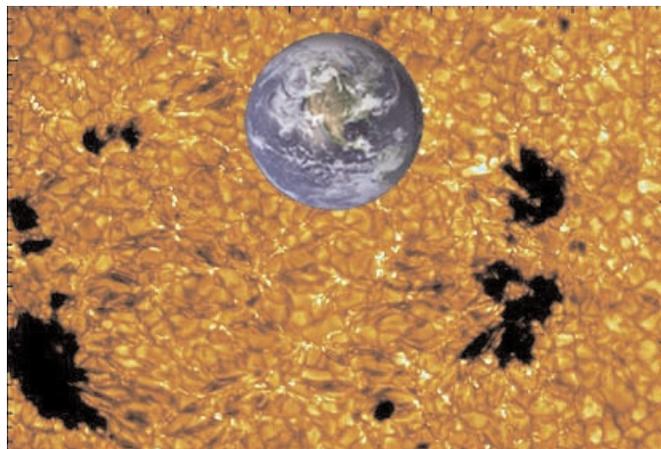
GIFTS can help planes avoid another potentially lethal problem, too: Ice forming on their wings. If a cloud contains “supercooled” water droplets whose temperature is below freezing, those droplets will form ice on the wings of planes that pass through it. By looking at about 1700 different frequencies of the light coming from clouds, GIFTS can measure the temperature of the cloud top and determine whether it contains water droplets that could cause aircraft icing. With information from GIFTS in hand, pilots can simply avoid clouds that appear dangerous.

Once EO-3 demonstrates the accuracy of GIFTS, airlines will be able to capitalize on this potential to make flying a cheaper and safer experience.

Learn more about the GIFTS instrument and other advanced technologies being tested on the EO-3 mission at [nmp.jpl.nasa.gov/eo3](http://nmp.jpl.nasa.gov/eo3). Kids can go to The Space Place to play a data compression game related to EO-3 at [spaceplace.nasa.gov/eo3\\_compression.htm](http://spaceplace.nasa.gov/eo3_compression.htm).

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

## News & Notes *continued*



Our last month’s speaker, Dr. Tom Berger, presented us with numerous images of sun spot details, including some fascinating time elapsed movies. The above image was printed in the October issue of *Sky & Telescope* (p. 26). I included the picture of the Earth to give some scale to the image. If you would like to see more detailed images of the sun, visit [www.lmsal.com/Press/SPD2003.html](http://www.lmsal.com/Press/SPD2003.html).

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.