

# PRIME FOCUS

Tri-Valley Stargazers

September 2005



## Meeting Info:

### What

*Scope Maintenance and  
a Little Night Sky*

### Who

TVS Members

### When

September 16, 2005  
Conversation 7:00 p.m.  
Lecture at 7:30 p.m.

### Where

Unitarian Universalist  
Church in Livermore  
1893 N. Vasco Road

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## September Meeting

### Scope Maintenance and a Little Night Sky

#### *TVS Members*

First we'll start off the meeting with a little Night Sky Network. Our Network coordinator, Rich Campbell, will talk about the latest segment of the program—black hole gravity. It's sure to be a weighty subject.

The main part of our meeting will be on scope maintenance. Owning a telescope, regardless of its size or shape, can give you plenty of nights of enjoyable views of the heavens. Provided it is performing at optimum levels.

From time to time you need to do a little maintenance on your scope to keep it in good working condition. Perhaps your mirror has collected a lot of dust over the years, dimming your views and decreasing contrast. Maybe the gears on your mount are getting stiff, or maybe too loose.

A lot of us know some work needs to be done with our scopes, but are a little hesitant to take on the cleaning/maintenance tasks for fear of making things even worse.

This month's meeting will be devoted to the proper care and feeding of your scope. Learn the correct way to clean your mirror (or lens). Learn what types of lubricants can be used on your gears, and which ones should be avoided. By the end of the evening you'll know the dos and don'ts of taking care of your scope. You'll be able to go home and tackle the scope chores you've been putting off for too long.

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## TVS to Auction off TV

Since the TVS now has a spiffy video projector that can be hooked up to a laptop or a VCR/DVD player, the board of directors has decided that the club no longer needs the big TV that sits in the storage closet taking up room.

So it's auction time! The TV in question is a 27" Zenith TV & Monitor (sorry, don't have the model number handy), with the usual video jacks and remote control. This TV has rarely been used.

The starting bid is \$50. You may e-mail your bid to [tvst@trivalleystargazers.org](mailto:tvst@trivalleystargazers.org) or call Debbie Dyke (925-461.3003). The auction closes at the start of the September meeting (7:30 p.m.). If the winner is unable to take possession of the TV at the meeting, s/he will need to make arrangements to pick up the TV at a later date. Cash or check (made out to Tri-Valley Stargazers) will be gladly accepted as payment.

Bid high and bid often! We will post the current high bid on the TVS web site home page.

## News & Notes

### Welcome!

TVS would like to welcome our newest member, **Ron Rodhe**.

### 2005 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 October 9th deadline is for the October issue).

Lecture Meeting	Board Meeting	Prime Focus Deadline
Sept. 16	Sept. 19	Sept. 4
Oct. 21	Oct. 24	Oct. 9
Nov. 18	Nov. 21	Nov. 6
Dec. 16	Dec. 19	Dec. 4

### Money Matters

At the August Board meeting, Treasurer **Gary Steinhour** reported the TVS account balances (as of Aug. 21, 2005):

Checking	\$1,353.56	
CD #1	\$3,482.64	matures 11/17/05
CD #2	\$2,461.46	matures 11/27/05
CD #3	\$0	matured 07/16/05

CD #3 was cashed out and deposited into our checking account.

### John Dobson Birthday Pins For Sale

John Dobson celebrates his 90th birthday on September 14th. I, your humble editor, was asked to design a commemorative pin for the event. The pins went on sale at the AANC-Con on August 27th and are still available for purchase. I'll have a supply of them available for purchase (\$5 each) at the September meeting.



John was born in China in 1915. He and his parents moved to San Francisco in 1927. He graduated from UC Berkeley in 1943 with a degree in chemistry. A year later, he became a monk at the Vedanta Monastery, where he remained for 23 years. In 1956 he built his first telescope. As a monk, he had no

money so he had to salvage bits and pieces of material to make his telescopes. His simple way of making telescopes has inspired thousands of men, women and children to undertake making their own scopes.

## Calendar of Events

There seems to be a plethora of lectures and events happening in the next few months. Here are just a few:

### September 10, 8:00 p.m.

**What:** *Black Holes: The Science Behind the Science Fiction*

**Who:** Dr. Eliot Quataert (UC Berkeley)

**Where:** Mt. Tam

**Cost:** Free

What are black holes? How are they discovered? How do they give rise to some of the most remarkable and bizarre phenomena in the universe?

Program is held in the Mountain Theater on Mt. Tam. Weather permitting, after the lecture there will be telescope viewing in the Rock Spring parking lot. For more information visit [www.mttam.net](http://www.mttam.net) and the SFAA web site [www.sfaa-astronomy.org/sfaa/starparties/index.shtml](http://www.sfaa-astronomy.org/sfaa/starparties/index.shtml).

Event sponsored by the Mt Tamalpais State Park and coordinated by volunteers of the Mt Tam Interpretive Association.

Dress warmly and car pool if possible. Bring a flashlight! If the weather is questionable, call the Astronomy Program Hotline 415-455-5370 after 4:00 p.m. before heading up the mountain.

For additional information or to see the entire season of talks check our web site: [www.mttam.net](http://www.mttam.net).

### September 16, 5:30 p.m.

**What:** *UC Merced Star Party*

**Who:** Wil VanBreugel

**Where:** UC Merced

**Cost:** Free

Will VanBreugel will be hosting a UC Merced star party for the several hundred incoming freshmen on September 16th (note: the date has changed from last month's newsletter entry, and is the same as our meeting date). He would like this to be a BIG event, hopefully drawing in many other people from the valley. He will give a talk for about 1 hour while the sun sets and then go on to have people look through telescopes and get explanations from astronomy club members. The site, on the new campus near Merced, would not be great for good seeing, but it is the outreach and excitement that count most. If you want to help, contact Wil at [wil@igpp.ucllnl.org](mailto:wil@igpp.ucllnl.org).

### Newsletter header image: Mars

Mars is heading towards us for a close approach on October 29. This image was taken with "Rachel" (the 20" refractor at Chabot) using a 1.4x teleconverter in combination with a 2x barlow which gives the effect of a 2.8x barlow overall. The image was the result of combining 73 images with Registax, with final adjustment in Photoshop. The exposure for each picture was 1/30s. *Photo by: Conrad Jung*

**September 19, 7:30 p.m.**

**What:** *Dark Energy and the Runaway Universe*  
**Who:** Dr. Alex Filippenko (U.C. Berkeley)  
**Where:** Kanbar Hall, Jewish Community Center, S.F.  
**Cost:** \$4

There is now strong evidence that over the largest distances, our Universe is dominated by “dark energy” that makes space expand faster and faster with time. Einstein postulated “cosmic antigravity” of this type in 1917; ironically, he later retracted the idea as his “biggest blunder”.

The Jewish Community Center is at 3200 California Street at Presidio Avenue. Parking is available for \$1.25 per night across the street in the UCSF Laurel Heights campus parking lot. Parking in the JCCSF garage is \$1.25 per half hour.

For further directions, visit [www.jccsf.org](http://www.jccsf.org). For more information about the lecture series, visit [www.calacademy.org/planetarium](http://www.calacademy.org/planetarium).

**September 25, 2:00 p.m.**

**What:** *Book Launch Party for “Space Station Mars”*  
**Who:** Daniel San Souci  
**Where:** Chabot Space & Science Center, Oakland  
**Cost:** Free with General Admission

Join the popular Bay Area children’s author Daniel San Souci as he reads from his new book about the clubhouse crew and their quest to find flying saucers and make contact with Martians. [www.chabotspace.org](http://www.chabotspace.org)

**September 26, 1:40 p.m. - 2:30 p.m.**

**What:** *Astronomy for Recreation*  
**Who:** Andrew Fraknoi  
**Where:** Foothill College, Los Altos  
**Cost:** Free

Starting in the Fall of 2005, Foothill College will offer a new 1-unit astronomy seminar to accompany its popular beginning course, *Astronomy 10B (Stars, Galaxies, and the Universe)*.

The seminar, called *Astronomy 105: Astronomy for Recreation*, will be an overview of astronomy as a hobby or avocation, for those who would like to find more ways to enjoy the cosmos. It is offered Monday afternoons, from 1:40 to 2:30 p.m., starting September 26. No background in science or special equipment will be required.

Among the topics the seminar will cover are:

- \* Where are the best places in the Bay Area to look through a telescope?
- \* Family Astronomy: Doing fun, hands-on astronomy projects with your kids or grand-kids.
- \* Constellation lore and constellation finding
- \* Astronomy and science fiction (movies and books)
- \* Eclipses and eclipse “chasing”: Where and when to go
- \* Buying and using binoculars or a telescope
- \* Local groups and projects you can get involved with
- \* Help getting your mind around the “big astronomy issues” in the news: black holes, the big bang, dark matter

To take Astronomy 105, students must sign up for *Astronomy 10B* at the same time (or must have taken 10B within the last three years). In the fall of 2005, *Astronomy*

<p><b>Officers</b></p> <p><b>President:</b> Chuck Grant cg@fx4m.com 925-422-7278</p> <p><b>Vice-President:</b> Rich Campbell r_photon@yahoo.com</p> <p><b>Treasurer:</b> Gary Steinhour garyjane1@yahoo.com</p> <p><b>Secretary:</b> Mike Rushford rushford@eyes-on-the-skies.org</p> <p><b>Board of Directors</b> Alane Alchorn, Jim Alves, Debbie Dyke, Gert Gottschalk, Stan Isakson, Mike Rushford, John Swenson.</p>	<p><b>Volunteer Positions</b></p> <p><b>Librarian:</b> Jim Alves jim_alves_engr@yahoo.com 925-634-0220</p> <p><b>Newsletter Editor:</b> Debbie Dyke ddfam@pacbell.net 925-461-3003</p> <p><b>Program Director:</b> unfilled</p> <p><b>Loaner Scope Manager:</b> John Swenson johnswenson1@comcast.net</p> <p><b>Webmaster:</b> Chuck Grant</p> <p><b>Observatory Director/ Key Master:</b> Chuck Grant</p> <p><b>School Star Party Chair:</b> Rich Campbell r_photon@yahoo.com 925-586-6453 (after 9 p.m.)</p>	<p><b>Public Star Party Chair:</b> Rich Campbell</p> <p><b>Historian:</b> Debbie Dyke</p> <p><b>Mentor:</b> Mike Rushford rushford@eyes-on-the-skies.org</p> <p><b>Addresses</b> <i>Mailing:</i> Tri-Valley Stargazers P.O. Box 2476 Livermore, CA 94551 <i>Lecture Meeting:</i> Unitarian Universalist Church 1893 N. Vasco Road, Livermore <i>Board &amp; Discussion Meetings:</i> Round Table Pizza 1024 E. Stanley Blvd., Livermore</p>	<p><b>Web &amp; E-mail</b> <a href="http://www.trivalleystargazers.org">www.trivalleystargazers.org</a> tvs@trivalleystargazers.org</p> <p><b>Eyes on the Skies</b> 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 <a href="http://www.eyes-on-the-skies.org">www.eyes-on-the-skies.org</a>.</p> <p><b>TVS E-Group</b> So how do you join the TVS e-group you ask? Just send an e-mail message to the TVS e-mail address (tvs@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.</p>
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## Calendar of Events *continued*

10B, which is designed for non-science majors and does not require math, will be available both during the day and in the evening at Foothill.

Astronomy 105 is especially recommended for students who are retired or working part-time, and are interested in spending a bit more time exploring their personal interests in astronomy. An optional Friday evening session at the Foothill College Observatory will be available for students in the course.

Both courses are taught by instructor Andrew Fraknoi.

For more information about *Astronomy 105*, see the web site: [www.foothill.fhda.edu/ast/ast105.htm](http://www.foothill.fhda.edu/ast/ast105.htm).

### September 27, 7:30 p.m.

**What:** *Titan Through the Eyes of Huygens: A Quiet Little Place With a Nice Atmosphere*

**Who:** Dr. Chris McKay (NASA Ames)

**Where:** Randall Museum, San Francisco

**Cost:** Free

Titan, the largest moon of the planet Saturn, is the only moon in the solar system with a substantial atmosphere. New results from the NASA/ESA mission to the Saturn System, Cassini/Huygens, have shown us the surface of Titan and will help us understand this world that is strange and yet in many ways similar to our own.

Dr. Chris McKay is a Planetary Scientist and Astrobiologist with the Space Sciences Division of NASA/Ames Research Center.

The lecture is presented by the Planetary Society and The Planetary Society Bay Area Volunteer Network. On the web, visit The Planetary Society at [planetary.org](http://planetary.org) and The Bay Area Volunteer Network at [www.tpsbavn.org](http://www.tpsbavn.org).

The Randall Museum is located at 199 Museum Way, San Francisco. For driving/public transport directions, and map: <http://randallmuseum.org/planvisit.cfm>.

### September 28, 6:30 p.m.

**What:** *Einstein For Everyone*

**Who:** Andrew Fraknoi

**Where:** Sunnyvale Public Library

**Cost:** Free, but you need a ticket

How astronomers are proving Einstein's most bizarre ideas about space and time. A non-technical, illustrated lecture by Andrew Fraknoi (Chair of the Astronomy Program at Foothill College) at the Sunnyvale Public Library, 665 West Olive Avenue, Sunnyvale.

Free and open to the public, but tickets must be obtained in advance from the Adult Information Desk at the library (tickets available starting September 14 on a first come, first served basis; maximum of 4 tickets per person).

No background in science or math required!

A look at some of the strange predictions of Einstein's Theory of Relativity and how advanced telescopes on Earth and in space are allowing astronomers to demonstrate just how right Einstein's insights into the nature of space and time really were. There will be a particular focus on black holes large and small and why they may be more common than even Einstein dared to think.

### September 29 - October 1

**What:** *CalStar*

**Who:** SJAA and You

**Where:** Lake San Antonio

**Cost:** Free, but there is a per carpark fee of \$22 for one night, \$44 for two or three nights.

Registration is now open for the sixth edition of SJAA's dark sky star party CalStar.

CalStar will be held at Lake San Antonio the nights of Thursday Sept 29 through Saturday Oct 1, 2005. This is a nice low key way to end the summer observing season; a reasonable sunset time, catered dinners available for purchase on Friday and Saturday, and some of the darkest skies in California. To register or for more information see the web page [www.sjaa.net/calstar2005.html](http://www.sjaa.net/calstar2005.html). Sponsored by the San Jose Astronomical Association.

### October 5, 7:00 p.m.

**What:** *Jupiter's Tantalizing Moon: Water (and Life?) Under the Ice of Europa*

**Who:** Cynthia Phillips

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

**Cost:** Free, but parking is \$2 in quarters.

Astronomer Cynthia Phillips will give a non-technical, illustrated talk on *Jupiter's Tantalizing Moon: Water (and Life?) Under the Ice of Europa* in the Smithwick Theater, Foothill College, El Monte Road and Freeway 280, in Los Altos Hills, California.

Ever since robot spacecraft have been exploring the Jupiter system, one moon has especially captured the interest of astronomers. Although Europa's surface is cold and frozen, there is evidence that, under the ice, it has an ocean of warmer, liquid water. In her talk, Dr. Phillips will explore Europa's geology, focusing on the prospects for water and the possibilities of life in that deep alien ocean.

No background in science will be required for this talk, which will interest both fans of astronomy and the search for life.

Dr. Phillips is a Principal Investigator for a number of projects investigating Europa and Mars at the SETI Institute. She specializes in the geology of planetary surfaces and the search for life in the solar system. She worked with the Galileo spacecraft imaging team to help design observations of Europa and other moons of

## Astronomical insights

by David Feindel

Jupiter. She is co-author of *The Everything Astronomy Book* and *The Everything Einstein Book*, both published by Adams Media.

Co-sponsored by: NASA Ames Research Center, The Foothill College Astronomy Program, The SETI Institute, The Astronomical Society of the Pacific.

Call the series hot-line at 650-949-7888 for more info.

### October 10, 7:30 p.m.

**What:** *SETI: Pulling Signals Out of Cosmic Noise*

**Who:** Dr. Jill Tarter (Center for SETI Research)

**Where:** Kanbar Hall, Jewish Community Center, S.F.

**Cost:** \$4

SETI could succeed tomorrow, or it may be an endeavor for multiple generations. Recent workshops have laid out a roadmap for the next few decades. Three different approaches were identified: continue and expand the radio search; begin searches for very fast optical and infrared pulses from a million stars; and eventually build an omni-directional sky survey array capable of detecting strong, transient, radio signals from billions of stars.

The Jewish Community Center is at 3200 California Street at Presidio Avenue. Parking is available for \$1.25 per night across the street in the UCSF Laurel Heights campus parking lot. Parking in the JCCSF garage is \$1.25 per half hour.

For further directions, visit [www.jccsf.org](http://www.jccsf.org). For more information about the lecture series, visit [www.calacademy.org/planetarium](http://www.calacademy.org/planetarium).

## Astro Events

### Mars Approaches

Regardless of how many e-mails you received from well-meaning friends and family, Mars' closest approach to Earth wasn't on August 27th. That e-mail referred to Mars' close approach in 2003. And if you believed that "NO ONE ALIVE TODAY WILL EVER SEE THIS AGAIN", you will be relieved to know that that statement is false.

The truth is Mars makes a close approach to Earth about every two years. Some years it is closer than others depending on where the planets are in their respective orbits when they pass by each other.

This year, Mars will be at its closest to Earth on October 29th. Mars will be about 43 million miles away so you should be able to see the polar ice caps and a hint of the dark features with a moderate sized scope (say 6" or so). Unless a global dust storm rises up to wipe out our view.

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One of the reasons why I bought a new 115mm refractor on a manual alt-az mount was to learn to star hop. I picked M101 as one of my "reasonable" first DSO (Deep Sky Object) targets. Not as easy as M4 or M57 or M13, all of which have bright stars very close by, but still seemingly achievable. The hop starts from Alcor/Mizar, easy to identify. There's a chain of 4 stars all in the 4.5-5.5 mag. range that head off from there, each of them 1 to 2 degrees from the prior one. But try as I might, I couldn't find it from my backyard. I printed out finder charts and committed them to memory. I tried on a couple of nights, thinking perhaps that the seeing wasn't good enough, or the transparency left something to be desired. No luck.

So I moved my location to Del Valle. It is a good magnitude darker than my backyard; I can usually see all 7 Ursa Minor stars, the faintest of which is mag 5.0. Still no luck. So I then tried with my 200mm SCT from my backyard. Still nothing. And cheating using its goto put me into a seemingly blank portion of the sky. So I brought my SCT to Del Valle. And coincidentally, two TVS'ers with 200mm dobs showed up the same night. We looked at M101 in all three scopes. The mystery was revealed. M101 is faint. Real faint. It's a non-descript vaguely lighter patch when viewed from a place like Del Valle. No wonder I couldn't find it. And you can't really use the trick of high magnification to darken the sky and make it stand out; its too big and too diffuse for that. Dark skies are the magic trick needed—or lots more aperture. Lower expectations are also in order; you aren't going to see the spiral structure shown in pictures without a big scope or through a camera.

The numbers, as found in O'Meara's *The Messier Objects*:

Object	Magnitude	Size (arc min.)	Surface Brightness
M101	7.9	28.8 x 26.9	14.8
M31	3.4	180 x 60	13.6
M51	8.4	11.2 x 6.9	13.1
M81	8.4	11.2 x 4.3	12.8

Surface brightness is the term used to provide a better measure of a DSO's visibility; it is roughly the brightness of an object divided by its surface area (the actual math is more complicated than this; you math freaks will notice that  $7.9/(28.8 \times 26.9)$  does not equal 14.8). Surface brightness is measured in magnitudes/square arc minute, a unit as nebulous as M101 itself.

M31 deserves a special comment; although its surface brightness is dimmer than M51 or M81, it has a very bright inner core, which is what you easily see; the low surface brightness is primarily a function of its huge size and diffuse outer regions.



## What's Up *by Debbie Dyke*

All times Pacific Daylight Saving Time unless otherwise noted.

### September

- 1 Thurs Jupiter and Venus  $1.25^\circ$  low in the West. 8:00 p.m.  
1979 Pioneer 11 is first craft to fly past Saturn.
- 2 Fri Mercury  $2.5^\circ$  South of the Moon, low in the East. 6:00 a.m.
- 3 Sat **New Moon.** 11:45 a.m.  
1976 Viking 2 lands on Mars at Utopia Planitia.
- 5 Mon **Labor Day.**  
1977 Voyager 1 launched toward Jupiter and Saturn.
- 6 Tues Venus, Jupiter, and the Moon low in the West. 8:00 p.m.
- 8 Thurs 1966 Star Trek debuts. It's ranked 52nd out of 54 shows.
- 9 Fri 1975 Viking 2 launched towards Mars.
- 11 Sun **First Quarter Moon.** 4:37 a.m.  
1816 Carl Zeiss born.
- 12 Mon 1758 Messier sees the Crab Nebula, making it the first item in his list of fuzzy comet-like objects.  
1959 Luna 2 becomes first spacecraft to impact the Moon.
- 14 Wed 1915 John Dobson born in China. Happy 90th birthday John!
- 16 Fri **Tri-Valley Stargazers general meeting.** 7:30 p.m. at the Unitarian Universalist Church,  
1893 N. Vasco Road, Livermore.  
Moon at perigee (223,451 miles). 7:00 a.m.  
Saturn  $1^\circ$  South of the Beehive Cluster (M44). 9:00 p.m.
- 17 Sat **Full Moon.** 7:01 p.m. This is the Harvest Moon.  
Mercury in superior conjunction. 8:00 p.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.
- 19 Mon **Tri-Valley Stargazers Board meeting.** 7:00 p.m. at the Round Table Pizza in Livermore.
- 21 Wed The Moon is between the Pleiades (M45) and Mars during the evening.
- 22 Thurs **Autumnal Equinox** 3:23 p.m.
- 23 Fri 1791 Johann Franz Encke born.  
1846 Gale and d'Arrest discover Neptune near the locations predicated by Adams and Le Verrier.
- 24 Sat **Last Quarter Moon.** 11:41 p.m.
- 28 Wed Moon at apogee (251,290 miles). 8:00 a.m.

### October

- 1 Sat 1958 NASA established by an act of Congress.
- 2 Sun For the next two weeks, look for the Zodiacal Light in the East before morning twilight.  
1608 J. Lippershey patents the telescope.
- 3 Mon Rosh Hashanah begins at sundown.  
**New Moon.** 3:28 a.m.
- 4 Tues 1957 Sputnik 1 is launched by the Soviet Union, becoming the first artificial satellite to orbit the Earth.
- 5 Wed Start of Ramadan.  
1882 Robert Goddard born.
- 6 Thurs 1923 Edwin Hubble discovers a Cepheid Variable in the Andromeda Galaxy.  
1995 Discovery of the first extrasolar planet (orbiting 51 Pegasi) announced.

## Improbable Bulls-Eye

by Dr. Tony Phillips

Picture this: Eighty-eight million miles from Earth, a robot spacecraft plunges into a billowing cloud almost as wide as the planet Jupiter. It looks around. Somewhere in there, among jets of gas and dust, is an icy nugget invisible to telescopes on Earth—a 23,000 mph moving target.

The ship glides deeper into the cloud and jettisons its cargo, the “impactor.” Bulls-eye! A blinding flash, a perfect strike.

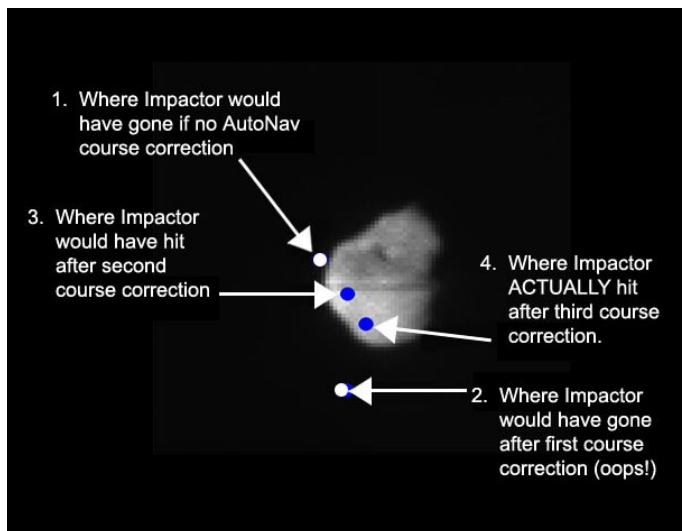
As incredible as it sounds, this really happened on the 4th of July, 2005. Gliding through the vast atmosphere of Comet Tempel 1, NASA’s Deep Impact spacecraft pinpointed the comet’s 3x7-mile wide nucleus and hit it with an 820-lb copper impactor. The resulting explosion gave scientists their first look beneath the crust of a comet.

*That’s* navigation.

Credit the JPL navigation team. By sending commands from Earth, they guided Deep Impact within sight of the comet’s core. But even greater precision would be needed to strike the comet’s spinning, oddly-shaped nucleus.

On July 3rd, a day before the strike, Deep Impact released the impactor. No dumb hunk of metal, the impactor was a spaceship in its own right, with its own camera, thrusters and computer brain. Most important of all, it had “AutoNav.”

AutoNav, short for *Autonomous Navigation*, is a computer program full of artificial intelligence. It uses a camera to see and thrusters to steer—no humans required. Keeping its “eye” on the target, AutoNav guided the impactor directly into the nucleus.



Comet Tempel 1, as seen by the Deep Impact impactor’s camera. Three last-minute AutoNav-controlled impact correction maneuvers enabled the Impactor to hit the bulls-eye.

The system was developed and tested on another “Deep” spacecraft: Deep Space 1, which flew to asteroid Braille in 1999 and Comet Borrelly in 2001. The mission of Deep Space 1 was to try out a dozen new technologies, among them an ion propulsion drive, advanced solar panels and AutoNav. AutoNav worked so well it was eventually installed on Deep Impact.

“Without AutoNav, the impactor would have completely missed the nucleus,” says JPL’s Ed Riedel, who led the development of AutoNav on Deep Space 1 and helped colleague Dan Kubitschek implement it on Deep Impact.

En route to the nucleus, AutoNav “executed three maneuvers to keep the impactor on course: 90, 35, and 12.5 minutes before impact,” says Riedel. The nearest human navigators were 14 light-minutes away (round trip) on Earth, too far and too slow to make those critical last-minute changes.

Having proved itself with comets, AutoNav is ready for new challenges: moons, planets, asteroids...wherever NASA needs an improbable bulls-eye.

Dr. Marc Rayman, project manager for Deep Space 1, describes the validation performance of AutoNav in his mission log at <http://nmp.nasa.gov/ds1/arch/mrlog13.html> (also check [mrlog24.html](http://nmp.nasa.gov/ds1/arch/mrlog24.html) and the two following). Also, for junior astronomers, the Deep Impact mission is described at <http://spaceplace.nasa.gov/en/kids/deepimpactor/deepimpact.shtml>.

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

## Astro Events *continued*

*continued from page 5*

At its closest approach, Mars will appear 20" in diameter—about 20% smaller than it was in 2003.

For the month of September, Mars’ diameter will range from 14 to 18". Since summer on Mars began in August, the South Polar Cap will be shrinking and the North Polar Cap will be getting larger. Also the dust-storm season is in full swing. Those of you who watched Mars’ approach in 2001 will remember the dust-storm that wiped out our view of the surface features for months.

If you have color filters, try them out to see what features they bring out. Red and orange bring out surface markings, blue shows more of the atmosphere and clouds.

The next close approach won’t be until December 2007, when Mars will only be about 16". We’ll have to wait until 2018 to get as good a view as we’ll have this year.

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.