

# PRIMEFOCUS

Tri-Valley Stargazers

May 2005



## Meeting Info:

### What

Flash-Bang: How stars behave when we don't stereotype them as spheres.

### Who

David Dearborn

### When

May 20, 2005  
Conversation 7:00 p.m.  
Lecture 7:30 p.m.

### Where

Unitarian Universalist  
Church in Livermore  
1893 N. Vasco Road

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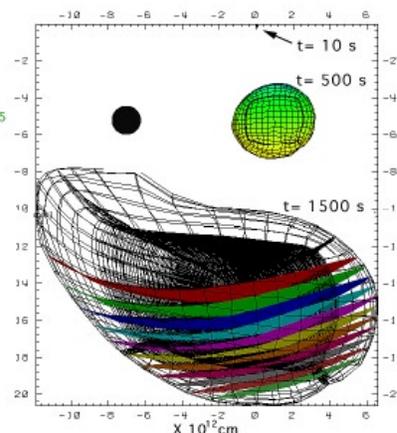
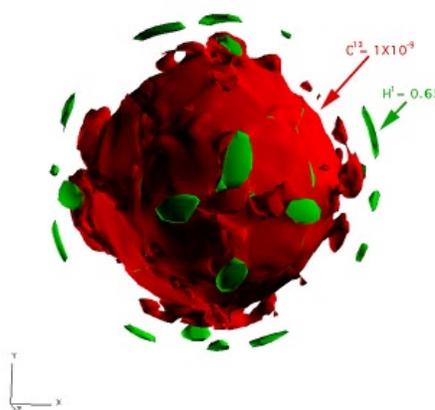
## May Meeting

Flash-Bang: How stars behave when we don't stereotype them as spheres.

*David Dearborn*

Stars provide the fundamental quantitative units for measuring the universe. They set the scale(s) for determining distances, provide the best limits on age, and drive the chemical evolution. Stars have also been used as physics laboratories, providing useful constraints in atomic, nuclear, and particle physics. To date, almost all modeling of stars has been one-dimensional, an approximation that rigorously applies only to a minority of stars. Even in spherical (single) stars, the models are dependent on approximating complex three-dimensional (3-D) processes like convection. To improve this limitation, we have constructed Djehuty, a 3-D stellar evolution/structure code that operates on massively parallel machines with the best available physical data (Opacities, EOS, etc.) as well as new algorithms.

This code has been applied to a number of astronomical situations. In this presentation we will present work in progress on understanding the long-standing problem of core convection and overshoot on the main sequence. Recent results will also be presented on the helium flash, an important stage of evolution that is little studied, as it is numerically difficult to model and critically dependant on the time development convection. Finally, results will be presented from modeling a new supernova mechanism as the possible explanation of the remnant, Sgr A East. In it we examine the compression of a white dwarf that results from penetration of a star into a strong gravitational potential (a GR effect). For large black holes ( $M > 1000$  solar masses), compression dominates over the tidal effect (for a white dwarf sized object), and can ignite the star.



## News & Notes

### Welcome New Members

We'd like to welcome new members—**Michael Love** and his son, **Keith**.

### 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 May 8th deadline is for the May issue).

Lecture Meeting	Board Meeting	Prime Focus Deadline
May 20	May 23	May 8
June 17	June 20	June 6
July 15	July 18	July 3

### Money Matters

At the March Board meeting, Treasurer **Gary Steinhour** reported the TVS account balances (as of April 16 2005):

Checking	\$1,872.00	
CD #1	\$3,457.00	matures 05/17/05
CD #2	\$2,443.34	matures 05/27/05
CD #3	\$1,081.23	matures 07/16/05

### A Passing

I am sorry to report that one of our members, Paul Caswell, passed away on April 16th. Paul had been our historian up until a few months ago.

Paul received his Bachelor of Science degree in Electrical Engineering from Tri-State University in Angola, Indiana. He served in the U.S. Air Force during WWII. After the war, he worked as an aerospace engineer at Lockheed Martin, retiring in 1989.

Paul was an avid sailor and enjoyed sailing his ketch, *Windlass II*, on San Francisco Bay. Besides being a member of TVS, he was also a member of the Tri-Valley Woodcarvers and volunteered for the ValleyCare Auxiliary. Paul's enthusiasm and smile will be missed.

### School Star Party

On May 18th, we'll be at the Leo Croce Elementary School on 5650 Scenic Ave, Livermore (not too far from the Unitarian Church). The night is their Space Night "social" for the district's elementary school GATE (gifted and talented) students (grades 3-5) and their families. The event will run from 7:00-9:00 p.m. A retired astronaut will be the guest speaker from 7:00 to 7:30, with Q&A time after. Then the students/families will be free to do the other activities—including looking through our scopes.

### Marling Scope Progress Report

Slowly, but surely, the mount is getting closer to completion. The gear hubs are done; next up are the encoders.



### Mnemonic Rhyme of Right Ascensions

Our April speaker, Naishi Min, has come up with a terrific way to remember the RA of certain stars and constellations.

#### RA of Constellations

Square<sup>1</sup> zero, And. one two,  
Among the Sisters<sup>2</sup> four's passing through.  
Great Dog seven, five Orion,  
Little Dog eight, ten the Lion.  
Thirteen Virgo, sixteen Scorpio.  
Vega eighteen more, Altair nineteen more.  
Twenty-one the Goat,  
Twenty-three the Gate<sup>3</sup>.

1. Pegasus 2. Hyades & Pleiades 3. North Gate (Fomalhaut)

In other words, 0 hour RA passes through the Great Square; 1 & 2 RA pass through Andromeda; 4 RA passes between the Hyades & Pleiades, etc.

#### RA of Bright Stars

New Year Rings<sup>1</sup> shining by six,  
Fourteen Horns<sup>2</sup>, Gates and Cruz,  
Twenty Altair, Deneb and Vega,  
Al. Reg. Ant., Fomal.<sup>3</sup>, six apart.

1. a ring formed by Sirius, Rigel, Aldebaran, Capella, Pollux and Procyon around Betelgeuse 2. Great Horn (Arcturus) and Horn (Spica), South Gates ( $\alpha$  and  $\beta$  Centauri) 3. Aldebaran, Regulus, Antares, Fomalhaut.

#### Newsletter header image: M101

This image was taken using a Canon 20D digital SLR with the camera ISO setting at 800 on the early morning hours of April 14. The total exposure time was 30-minutes (six 5-minute exposures added together). The telescope used was a 7.5-inch f/4.

Photo by: Conrad Jung

# Calendar of Events

## May 14, 11:00 a.m. - 3:00 p.m.

**What:** SETI Institute's Science Day  
**Who:** You  
**Where:** NASA Ames, Public Affairs Bldg (Bldg 943), Eagle Room, Moffett Field, Mtn. View (No badging is necessary as this building is outside the main gate)  
**Cost:** Free

The SETI Institute invites everyone to its 2nd Annual Science Day. A half day of short talks featuring scientists and educators from the Institute's Center for the Study of Life in the Universe and Center for SETI Research

Refreshments will be served.

Open to the public, admission is free. But space is limited! To reserve your seat, please RSVP soon at: [www.seti.org/scienceday2.htm](http://www.seti.org/scienceday2.htm).

Some of the speakers confirmed so far:

**Cynthia Phillips:** *Exploration of Europa*

**Margaret Race:** *Planning for Missions to Mars: Astrobiology and Planetary Protection*

**Seth Shostak:** *SETI—The Big Picture*

**Rocco Mancianelli:** *The Salts of Mars and the Search for Life*

**Jill Tarter and Jack Welch:** *The Allen Telescope Array: An Update*  
*plus*

**Chris McKay** (NASA Ames) on *The Huygens Probe on Titan*

## May 14, 8:30 p.m.

**What:** *Ancient Astronomy, The First Science*  
**Who:** John Dillion (The Randall Museum, S.F.)  
**Where:** Mt. Tam  
**Cost:** Free

The pinnacle of ancient Greek science was the amazingly sophisticated astronomy developed more than 2,000 years ago at the legendary Museum of Alexandria.

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).

## May 18, 7:00 p.m.

**What:** *The Mars Exploration Rover Mission: A Year of Exploration and Discovery*  
**Who:** Nathalie Cabrol  
**Where:** Smithwick Theater, Foothill College  
**Cost:** Free, but it costs \$2.00 to park

Astronomer Nathalie Cabrol will give a non-technical, illustrated talk on *The Mars Exploration Rover Mission: A Year of Exploration and Discovery*.

For more than a year, two robot rovers named Spirit and Opportunity have explored our neighbor planet Mars, sending back remarkable pictures and detailed information about its surface. Dr. Cabrol will report on the ongoing work of the rovers and some of the discoveries it has made about the past and present of the red planet.

*continued page 4*

### Officers

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### Board of Directors

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 Debbie Dyke, Gert Gottschalk,  
 Stan Isakson, Mike Rushford,  
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### Volunteer Positions

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Chuck Grant

#### Observatory Director/

#### Key Master:

Chuck Grant

#### School Star Party Chair:

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### Public Star Party Chair:

Rich Campbell

### Historian:

Debbie Dyke

### Mentor:

Mike Rushford  
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### Addresses

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*Lecture Meeting:*  
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*Board & Discussion Meetings:*  
 Round Table Pizza  
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### Web & E-mail

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[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*

Dr. Cabrol is a member of the science team for the Mars Exploration Rover mission and a Principal Investigator for several science projects at the SETI Institute. She specializes in exploring regions of Earth that resemble Mars (including the highest lake on our planet). She was instrumental in the selection of one of the landing sites for the Mars rovers and is busily analyzing images and data from the mission.

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

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

### **May 23, 7:00 p.m. - 9:00 p.m.**

**What:** *Manya: A Living History of Madame Marie Curie*

**Who:** Susan Frontczak

**Where:** Livermore High School Performing Arts Theatre, Livermore

**Cost:** Free

The Lawrence Livermore National Laboratory, in partnership with the Livermore Valley Joint Unified School District, is hosting a one woman drama by renowned storyteller Susan Frontczak that exposes the struggles and triumphs of scientist Marie Curie. A two-hour presentation is being offered to the public, free of charge, from 7:00 to 9:00 pm at the Livermore High School Performing Arts Theatre on May 23rd. Seating is on a first-come, first-served basis. For more information about the program, visit [www.storystsmith.org/manya/pd.html](http://www.storystsmith.org/manya/pd.html)

### **May 27-29**

**What:** *Riverside Telescope Makers Workshop (RTMC)*

**Who:** Amateur Astronomers

**Where:** Camp Oakes, Big Bear City

**Cost:** Varies

The 37th annual RTMC Astronomy Expo will be held Friday, May 27, through Sunday, May 29, 2005 (Memorial Day weekend). It will be held at YMCA Camp Oakes, five miles southeast of Big Bear City on State Route 38 at Lake Williams Road, between mileposts 44 and 45. This location is about 50 miles north-east of Riverside in the San Bernardino mountains.

The theme for 2005 is "The History of Astronomy."

This year they will have an astroimaging contest, with entries displayed in the Astroimaging Pavilion tent near the dining hall. For the contest rules, visit the web site.

The Keynote Speakers this year will be Los Angeles documentary filmmakers Todd and Robin Mason. They will present an hour-long talk on some of the major technological and intellectual breakthroughs set against

sheer human will that enabled the giant Hale telescope to work, entitled *Palomar's 200-inch Telescope: The Impossible Challenge*.

Their presentation will also include an exclusive ten-minute preview sample from the PBS documentary they are working on, *The Journey to Palomar*, involving the first attempt to pour the 200-inch mirror glass for the Palomar telescope at Corning Glass Works in 1934 and a short slide show featuring 3D images of all three of Hale's observatories.

If you have any questions about the RTMC Astronomy Expo, please contact:

Robert Stephens  
8300 Utica Avenue, Suite 105  
Rancho Cucamonga, CA 91730  
(909) 948-2205  
[registrar@rtmcastronomyexpo.org](mailto:registrar@rtmcastronomyexpo.org)

### **June 6, 7:30 p.m.**

**What:** *Sun-Earth Connections—Scientific, Cultural, and Historical Perspectives*

**Who:** Dr. Isabel Hawkins (U.C. Berkeley)

**Where:** S.F. Jewish Community Center

**Cost:** \$4

The Sun, a sacred symbol in many cultures, serves as the topic of fascinating research by scientists who investigate the effects of our nearest star on Earth and other planets. Learn from cutting-edge research about how the interaction of the solar wind and other dynamic space weather phenomena affect our technology-dependent society today.

This lecture is part of the Morrison Planetarium Benjamin Dean Lecture Series. For more information, call 415-750-7141. Ticket purchase in advance of lecture date recommended.

**NEW LECTURE LOCATION:** During the reconstruction of the Academy, the Dean Lectures have temporarily moved to the San Francisco Jewish Community Center at 3200 California Street (at Presidio Avenue). Parking is available across the street in the UCSF Laurel Heights campus parking lot for \$1.25 per night. Parking in the JCC garage is \$1.25 per half-hour. The #1 California, #3 Jackson, #4 Sutter, and #43 Masonic MUNI lines stop directly in front of the building. The #38 Geary and #24 Divisadero buses stop only a few blocks away.

### **Lick Observatory Summer Program**

A little reminder: those who are interested in the Lick Observatory summer program and getting a look through the 36" refractor—tickets go on sale May 16. Go to [www.icolick.org/public/sumvispro.html](http://www.icolick.org/public/sumvispro.html) for details.

## Astro Events

### Jupiter Transits

Below is a listing of transit times for various Jupiter related objects. The abbreviations are fairly straight forward: G=Ganymede, C=Callisto, I=Io, E=Europa, GRS=Great Red Spot, and if you see an 's' next to one of the moons, it means its shadow (e.g., Cs=Callisto's shadow); na means Jupiter is below the horizon or it is daylight at that time.

#### May

Thurs 12	GRS	9:44p	11:39p	1:46a
Sat 14	GRS	11:15p	1:20a	3:20a
Sun 15	GRS	na	9:15p	11:10p
	E	11:21p	12:39a	1:58a
Mon 16	Es	1:09a	2:18a	3:47a
	I	2:54a	4:00a	na
	Is	3:47a	na	na
Tues 17	GRS	9:00p	10:52p	12:51a
	I	9:22p	10:22p	11:31p
	Is	10:16p	11:13p	12:25a
Thurs 19	GRS	10:32p	12:28a	2:30a
Fri 20	GRS	na	na	10:18p
Sun 22	GRS	12:05a	2:05a	na
	GRS	na	10:00p	12:00a
	E	1:43a	3:04a	na
Tues 24	Gs	na	na	10:00p
	GRS	9:30p	11:34p	1:44a
Fri 27	GRS	na	9:08p	11:07p
Sun 29	GRS	12:51a	2:51a	na
	GRS	na	10:41p	12:50a
Tues 31	G	na	na	9:39p
	GRS	10:26p	12:25a	2:25a
	Gs	11:32p	12:33a	2:01a

#### June

Wed 1	I	1:00a	2:04a	na
	Is	2:04a	3:00a	na
Thurs 2	I	na	na	9:39p
	Es	na	8:50p	10:22p
	Is	na	9:28p	10:45p
Fri 3	GRS	12:02a	1:55a	na
	GRS	na	9:55p	11:45p
Sun 5	GRS	1:46a	na	na
	GRS	9:42p	11:30p	1:35a
Tues 7	G	10:47p	11:59p	1:28a
	GRS	11:15p	1:06a	na
Wed 8	GRS	na	na	10:52p

## Astronomical insights

by David Feindel

I'm slowly becoming a New England observer. Our seemingly constant presence of clouds and rain have changed my observing habits. When I don't see lots of clouds, its time to take the scope out and get an hour or two in of observing. Never mind that Castor and Pollux, 45° above the western horizon, are flashing occasional red and blue due to atmospheric diffraction. Never mind that the wind is blowing 10-15 mph. An hour or two observing, even just looking at any eye candy visible, is still relaxing to me and interesting.

Observing in this type of weather influences your gear a bit. First, a really sturdy setup is vital. I'm lucky in that my 8" SCT setup is heavy enough (about 50 lbs.) and compact enough that light winds don't faze it. You modify your location to be in the lee of a building or trees, giving up access to some of the sky. You observe from home, as it doesn't seem worth it to drive an hour to darker skies.

Your choice of targets is also changed. Saturn is still there, but the Cassini Division only appears intermittently. The bright moons are still there, but it seems more difficult to pick out the fainter ones. Splitting close double stars is hopeless; anything less than 4 or 5 arc seconds is out of range. Normally, I can see at least one diffraction ring around a 3rd or 4th magnitude star; in these conditions, there are none. "High power" means 15-20x per inch of aperture, or in my case, 143x. So you concentrate more on open clusters and the not-so-faint fuzzies that can be seen from suburban (i.e., fairly light-polluted) environments. The Auriga M's—M36, 37, and 38—become favorite early evening targets, as is M35 and M48. The Beehive (M44) and M67 a bit later.

Looking at OCs (open clusters) through an SCT, though, presents problems. With an f/10 focal ratio, you just are not going to have a wide field of view. I've upgraded to a 2" diagonal and a Meade 40mm wide angle eyepiece, which provides a 1.3° FOV, but that doesn't really provide a good "frame" for objects like M44, which span 1.5 or even 2 degrees. Worse, stars become seagull-shaped about 2/3 of the way towards the edge, destroying some of the beauty. I would have thought that any eyepiece would work with a "slow" f/10 telescope. I believe this distortion is in the eyepiece, but am not sure.

This drove me to peruse the web for information on wide-angle, low power eyepieces. Somewhat surprisingly, there does not seem to be a consensus on good EPs in the 38-45mm range. You can find reviews praising and panning Meade's SWA, Pentax's XL, TV's Panoptic, and UO's Konig. AstroMart to the rescue; a Pentax 40mm was listed for sale at a very good price, so I'll have a comparison for next month's issue.

## What's Up *by Debbie Dyke*

All times Pacific Daylight Saving Time unless otherwise noted.

### May

- 1 Sun 1006 A supernova in Lupus is discovered by Ali ibn Ridwan, with the Japanese, Chinese, and a Swiss monk also recording the event.
- 5 Thurs 1961 Alan Shepard becomes the first American in space with a 15 minute ride on Freedom 7. He was paid \$14.38.
- 8 Sun **New Moon** 1:45 a.m.  
Mother's Day.
- 11 Wed Mercury at greatest heliocentric latitude South.
- 13 Fri Saturn 7° South of the Moon 10:00 p.m.
- 14 Sat Mars 1.2° S of Uranus (75°) 4:00 a.m. (14th)  
Moon at apogee (250,852 mi.) 7:00 a.m.
- 16 Mon **First Quarter Moon** 1:57 a.m.  
Double shadow transit on Jupiter 3:48 a.m.  
1969 Venera 5 impacts Venus.
- 17 Tues 1969 Venera 6 impacts Venus.
- 18 Wed 1910 Earth passes safely through tail of Comet Halley.
- 19 Thurs Jupiter 4° N of Moon 9:00 p.m.
- 20 Fri **Tri-Valley Stargazers general meeting.** 7:30 p.m. at the Unitarian Universalist Church, 1893 N. Vasco Road, Livermore.  
Neptune stationary 8:00 p.m.
- 22 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.
- 23 Mon **Tri-Valley Stargazers Board meeting.** 7:00 p.m. at the Round Table Pizza in Livermore.  
**Full Moon** 1:18 p.m.  
The Moon occults Antares. Occultation in progress as the Moon rises. Antares reappears at 1:04 a.m.  
1980 The Tri-Valley Stargazers become incorporated as a non-profit organization.
- 26 Thurs Moon at perigee (225,829 mi) 4:00 a.m.
- 27 Wed Riverside Telescope Makers Conference (RTMC) begins. Conference ends on Sunday, 30th.
- 28 Sat 1959 First primates in Space—Able and Baker.
- 29 Sun 1919 Einstein's theory of general relativity is tested for the first time during a total solar eclipse.
- 30 Mon **Last Quarter Moon** 4:47 a.m.  
**Memorial Day.**  
Uranus 4° N of Moon 3:00 a.m.
- 31 Tues Mars 1.5° N of Moon as they rise together in the East, around 2:00 a.m.

### June

- 1 Wed 1858 Lick Observatory dedicated
- 2 Thurs Double shadow transit on Jupiter. Europa & Io's shadows start their transit during daylight. They reach the midpoint at 8:50 p.m. (Europa) and 9:28 p.m. (Io). The transit ends as Europa's shadow exits at 10:22 p.m., followed by Io's at 10:45 p.m.  
1858 G. Donati at Florence, Italy discovers one of the comets of the century, named Donati's Comet in his honor.

## Asian Tsunami Seen From Space

by Patrick L. Barry

When JPL research scientist Michael Garay first heard the news that a tsunami had struck southern Asia, he felt the same shock and sadness over the tremendous loss of human life that most people certainly felt. Later, though, he began to wonder: were these waves big enough to see from space?

So he decided to check. At JPL, Garay analyzes data from MISR—the Multi-angle Imaging SpectroRadiometer instrument aboard NASA’s Terra satellite. He scoured MISR images from the day of the tsunami, looking for signs of the waves near the coasts of India, Sri Lanka, Indonesia, and Thailand.

Looking at an image of the southern tip of Sri Lanka taken by one of MISR’s angled cameras, he spotted the distinct shape of waves made visible by the glint of reflected sunlight. They look a bit like normal waves, except for their scale: These waves were more than a kilometer wide!

Most satellites have cameras that point straight down. From that angle, waves are hard to see. But MISR is unique in having nine cameras, each viewing Earth at a different angle. “We could see the waves because MISR’s forward-looking camera caught the reflected sunlight just right,” Garay explains.

In another set of images, MISR’s cameras caught the white foam of tsunami waves breaking off the coast of India. By looking at various angles as the Terra satellite

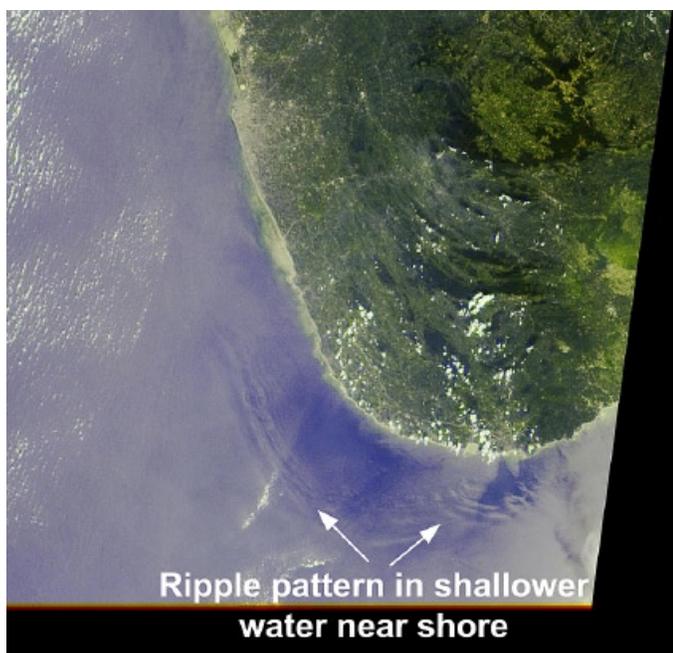
passed over the area, MISR’s cameras snapped seven shots of the breaking waves, each about a minute apart. This gave scientists a unique time-lapse view of the motion of the waves, providing valuable data such as the location, speed, and direction of the breaking waves.

Realizing the importance of the find, Garay contacted Vasily Titov at the National Oceanic and Atmospheric Administration’s Pacific Marine Environmental Laboratory in Seattle, Washington. Titov is a tsunami expert who had made a computer simulation of the Asian tsunami.

“Because the Indian Ocean doesn’t have a tsunami warning system, hardly any scientific measurements of the tsunami’s propagation exist, making it hard for Dr. Titov to check his simulations against reality,” Garay explains. “Our images provide some important data points to help make his simulations more accurate. By predicting where a tsunami will hit hardest, those simulations may someday help authorities issue more effective warnings next time a tsunami strikes.”

Find out more about MISR and see the latest images at [www-misr.jpl.nasa.gov](http://www-misr.jpl.nasa.gov). Kids can read their own version of the MISR tsunami story at [http://spaceplace.nasa.gov/en/kids/misr\\_tsunami](http://spaceplace.nasa.gov/en/kids/misr_tsunami).

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



This December 26, 2004, MISR image of the southern tip of Sri Lanka was taken several hours after the first tsunami wave hit the island. It was taken with MISR’s 46° forward-looking camera.

## First Light: Beginners’ Astronomy

by Richard Campbell

With March’s poetry kit, and 20 minutes of space-time, I composed the following:

### The Blue Star Poem

Night’s atmospheres

Rotate

a multitude of

Northern delights

Above the Hidden horizon

Galaxy, cluster and Veil

Shimmer

Light years above

this precious lens

I discover

A celestial footprint

The outer edge

of another Epoch

Stardust’s legacy

Like a blue star, it’s brief-lived and (hopefully) bright. I tell ‘ya stargazers, writing it beat twiddling thumbs or watching commercials! Your compositions accepted any-time...

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.