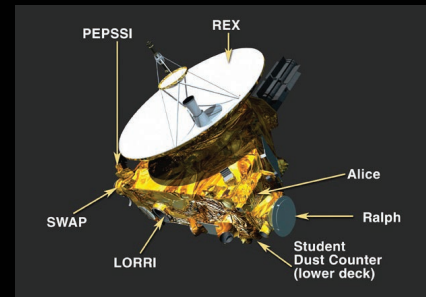


PRIMEFOCUS

Tri-Valley Stargazers



April 2018



Meeting Info New Horizons: The Geology of Pluto and Charon

Who:
Dr. Orkan Umurhan

When:
April 20, 2018
Doors open at 7:00 p.m.
Meeting at 7:30 p.m.
Lecture at 8:00 p.m.

Where:
Unitarian Universalist
Church in Livermore
1893 N. Vasco Road

Inside

News & Notes	2
Calendar of Events	2
SpaceX Iridium-4 Launch	4
What's Up	6
NASA's Space Place	7
Membership/Renewal Application	8

April Meeting

New Horizons: The Geology of Pluto and Charon Dr. Orkan Umurhan - NASA Ames Research Center

NASA's New Horizons spacecraft has revealed that Pluto and Charon exhibit strikingly different surface appearances, despite their similar densities and presumed bulk compositions. After an introductory background and a discussion about the New Horizons spacecraft, this talk will present an overview of our main findings centering on the fascinating geology of Pluto. Much of Pluto's surface can be attributed to surface-atmosphere interactions and the mobilization of volatile ices like N_2 and CH_4 by insolation. Many valley systems appear to be the consequence of glaciation involving N_2 ice. Other observed signs of geological activity requires or required internal heating – for example, the solid-state convection and advection of volatile ices in Sputnik Planitia

can be powered by present-day radiogenic heat loss. On the other hand, the prominent mountains at the western margin of Sputnik Planitia, and the strange, multi-km-high mound features to the south, probably composed of H_2O , are young geologically as inferred by light cratering and superposition relationships. Their origin, and what drove their formation so late in Solar System history, is under investigation. The dynamic remodeling of landscapes by volatile transport seen on Pluto is not unambiguously evident on Charon. Charon does, however, display a large resurfaced plain and globally engirdling extensional tectonic network attesting to its early endogenic vigor.

Dr. Orkan Umurhan is a mathematical physicist whose research focuses on evolutionary processes both on planetary surfaces of the outer solar system as well as the question of how planets form in protoplanetary disks. He has published on a number of topics including astrophysical flows and turbulence, fundamentals of shear flow instabilities, geomorphology and landform evolution and its modeling. Dr. Umurhan joined the New Horizons Geology and Geophysics Investigation Team in June of 2013. His main role on this mission has been in providing mathematical modeling framework for the various geophysical scenarios of interest and appropriate to the Pluto system. Dr. Umurhan occasionally writes blogposts for NASA about New Horizons and he is also a co-author of a graduate level textbook on fluid dynamics for physicists.



Caption: This composite of enhanced color images of Pluto (lower right) and Charon (upper left), was taken by NASA's New Horizons spacecraft on July 14, 2015. Credit: NASA/JHUAPL/SwRI

News & Notes

2018 TVS Meeting Dates

Below are the TVS meeting dates for 2018. The lecture meetings are on the third Friday of the month, with the Board meetings on the Monday following the lecture meeting.

Lecture Meeting	Board Meeting	Prime Focus Deadline
Apr. 20	Apr. 23	
May 18	May 21	Apr. 27
Jun. 15	Jun. 18	May 25
Jul. 20	Jul. 23	Jun. 29
Aug. 17	Aug. 20	Jul. 27
Sep. 21	Sep. 24	Aug. 31
Oct. 19	Oct. 22	Sep. 28
Nov. 16	Nov. 19	Oct. 26
Dec. 21	Dec. 17	Nov. 30

Money Matters

As of the last Treasurer's Report on 03/19/18, our club's checking account balance is \$16187.00.

Outreach Star Parties

Wednesday, 04/18/18: Outreach party at Leo Croce Elementary in Livermore; 7:45pm

Saturday, 04/21/18: Outreach party at Del Valle Arroyo staging area; 8:15pm. Club observing after the public departs.

Please contact Eric Dueltgen for further information about the Outreach Star Parties.

Club Star Party: H2O Open House

Saturday, 05/05/18: The H2O Open House is generally open to all club members and the public. Club members who need to complete their first time orientation as keyholders are encouraged to attend. The caravan to H2O departs promptly at 6:30pm from the corner of Mines and Tesla Roads. Admission is \$3/car (bring exact amount). Bring your own beverages (no alcohol) and pre-cooked food (no open flames or BBQ's). Services: Two Pit toilets. For updates check: www.trivalleystargazers.org/ and for more site information see: www.trivalleystargazers.org/h2o.shtml

Calendar of Events

April 18, 7:00pm

What: The Hazards and Rewards of Near-Earth Asteroids
Who: Dr. Michael Busch, SETI Institute
Where: Smithwick Theatre, 12345 El Monte Road, Los Altos Hills, CA 94022
Cost: Free, \$3 parking (Credit Cards or \$1 dollar bills)

No details available.

Calendar of Events (continued)

For more information see: <https://foothill.edu/astronomy/> or phone 650-949-7888.

April 19, 7:00pm

What: What Are We Protecting Mars From — And Why Do We Bother?
Who: John Rummel (SETI Institute) and Robert Zubrin (Lockheed Martin Astronautics)
Where: SRI Conference Center, 333 Ravenswood Ave., Menlo Park, CA 94205 (Enter from Middlefield Rd.)
Cost: Free, Due to popularity of SETI events, registration in advance is strongly suggested

Mars is being given serious consideration for 21st century exploration. Elon Musk has plans to send humans to Mars within 7 years; NASA has flown rovers and landers; and NASA, the European Space Agency, and China have announced plans to each add a rover in 2020. India has orbited Mars, and others such as the UAE are developing their own orbiters. The planned 2020 rovers are part of a strategy that will include bringing samples back from Mars' surface to Earth.

NASA's Planetary Protection Office was created to "promote a responsible exploration of the solar system by implementing and developing efforts that protect the science, explorers, environments, and Earth," reflecting the non-contamination provisions of the UN Outer Space Treaty of 1967. Now, some scientists question the need for restrictive contamination guidelines, arguing that new exploration, and the direct search for life is being impeded. Is planetary protection slowing down exploration, and the search for life beyond Earth? Do we have the right to send robotic machinery, or even people, to Mars without giving biologists a chance study it, and look for life? What if that life is hidden underground and requires humans to find it?

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

April 21, 8:00pm

What: A Universe of Universes?
Who: Prof. Alex Filippenko, UC Berkeley
Where: Mt. Tamalpais State Park, Cushing Memorial Amphitheater, more commonly known as the Mountain Theater, Rock Spring parking area
Cost: Free

Many scientists now think that there might be more than a single universe. Our universe may be just one example in a far larger "multiverse," but an unusually complex one that is conducive to the existence of life. Come learn about the relevant lines of reasoning and their profound implications.

For more information see: <http://www.friendsofmonttam.org/astronomy/schedule>

Header Image: The New Horizons spacecraft and instruments. Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute

Calendar of Events (continued)

May 4, 6:00pm-10:00pm

What: \$5 First Fridays
Who: You
Where: Chabot Space and Science Center, 10000 Skyline Blvd., Oakland, CA 94619
Cost: \$5; <http://www.chabotspace.org/first-fridays.htm>

No details available.

Pre-purchase your tickets for \$5 First Friday at: <http://www.chabotspace.org/first-fridays.htm> or for more information, call (510) 336-7373.

May 5, 8:00pm-11:00pm

What: Astro-Imaging Workshop
Who: San Jose Astronomical Society
Where: Coyote Valley Open Space Preserve, 550 Palm Ave., Morgan Hill, CA
Cost: Free

SJAA is proud to sponsor this outdoor workshop to help those folks who are interested in learning about the mechanics of AstroPhotography and Imaging. Bring your questions, and/or your Canon or Nikon DSLR to connect to a working rig, and/or your complete astrophotography rig (battery powered)

For more information see: www.meetup.com/SJ-Astronomy/events/243778772/ and www.sjaa.net/calendar/

May 14, 7:30pm

What: Chasing New Horizons: Inside the Epic First Mission to Pluto
Who: Alan Stern (PI of NASA's New Horizons mission) and David Grinspoon (Astrobiologist)
Where: California Academy of Sciences, 55 Music Con-

course Dr., Golden Gate Park, San Francisco, CA
Cost: Advanced ticketing required. Academy members \$12, Seniors \$12, General \$15. Reserve a space online or call 1-877-227-1831.

On July 14, 2015, something amazing happened. More than 3 billion miles from Earth, a small NASA spacecraft called New Horizons screamed past Pluto at more than 32,000 miles per hour, focusing its instruments on the long mysterious icy worlds of the Pluto system, and then, just as quickly, continued on its journey out into the beyond. Nothing like this has occurred in a generation—a raw exploration of new worlds unparalleled since NASA's Voyager missions to Uranus and Neptune—and nothing quite like it is planned to happen ever again. At a time when so many think that our most historic achievements are in the past, the most distant planetary exploration ever attempted not only succeeded in 2015 but made history and captured the world's imagination.

How did they do it? Mission Leader Dr. Alan Stern and co-author Dr. David Grinspoon share the ultimate insider's look at this amazing mission. It is the story of decades-long commitment and persistence; political fights within and outside of NASA; and sheer human ingenuity in designing, building, and flying the mission. And Dr. Stern will give a preview of New Horizons' next encounter, as it performs a flyby of MU69 in the Kuiper Belt, 1 billion miles past Pluto, in 2019.

Copies of Dr. Stern's and Dr. Grinspoon's new book "Chasing New Horizons" will be available for purchase and signing following the presentation.

See www.calacademy.org/events/benjamin-dean-astronomy-lectures for lecture and reservation information

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TVS E-Group

To join the TVS e-group just send an e-mail message to the TVS e-mail address (info@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.

SpaceX Iridium-4 Launch By Chris Kitting



Image Caption: Chris Kitting with his various cameras and telescope used to image the SpaceX Iridium-4 launch that occurred on December 22, 2017 from Vandenberg Air Force Base, located about 100 miles from his observing site. With the chilly temperatures, seasonal gear was needed to keep the cold at bay. Image Credit: © C. Kitting, used with permission.

TVS Member Chris Kitting, from Cal State U. East Bay, had analyzed major satellite reentries, and spoke about that work recently at our monthly meeting. Chris then was encouraged by Ken Sperber's TVS presentation, then PrimeFocus article, on imaging rocket launches. Chris arranged to travel south for a SpaceX Falcon-9 rocket launch from Vandenberg Air Force Base, just north of Santa Barbara, for the evening of December 22, 2017. Another colleague, Rick Baldrige with Peninsula Astronomical Society, kindly provided plots of the planned launch trajectory.

Clouds reportedly were rolling in from the Pacific near Vandenberg, and it was even cloudier in the Bay area, so (at the last minute) Chris drove his equipment down Hwy 5, where forecasts were clear. A few hours south, he was <~100 mi from the launch site, with OK conditions, but some thin clouds. His various gadgets, seen above, worked pretty nicely, as first tests, including the use of various wavelengths (awaiting funding and journal publication) beyond visual.

The close view of the exhaust plume, seen on p.5 (© C. Kitting), was taken with only a 70mm lens on a standard 35-mm-size sensor (natural color), much like the human eye detected

during the spectacular sunset event, at that range. Many people witnessed the event, often accidentally, throughout southern California and beyond.

In the image, the gibbous moon is behind thin clouds. Backlighting from the distant sunset illuminated the water vapor trail from the main engines, burning liquid hydrogen and oxygen. Stage separation apparently caused the bulbous expanse, and the fleeting crescent below the separated spacecraft. Kitting's hi-res videos, awaiting publication, also showed that the spacecraft at the right was the reusable booster returning to Earth (onto a barge off Mexico) while the spacecraft at left continued toward a polar orbit, with ten Iridium-Next communication satellites.

A SpaceX recording of the launch can be seen at: <https://spaceflightnow.com/2017/12/22/falcon-9-iridium-next-4-mission-status-center/>

Kitting's subsequent attempt to image a Vandenberg launch was thwarted due to launch delays, which are common.

SpaceX Iridium-4 Launch (continued)



Image Caption: The exhaust plume of the SpaceX Falcon 9. The second stage pushes to orbit just after shutdown and separation of the first stage. The gibbous Moon, seen top-center, shines through thin cloud. Image Credit: © C. Kitting, used with permission.

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

All times are Pacific Daylight Time

April

- 15 Sun **New Moon (6:57pm)**
17-18 Tue Saturn, rising at about 1am, is at Aphelion, the farthest it has been from the Sun since 1959
18 Wed The thin crescent Moon is less than 2° from Aldebaran in the Hyades
22 Sun **First-Quarter Moon (2:46pm)**
22 Sun The Moon is $2-3^\circ$ below M44, the Beehive Cluster (Evening)
24 Tue The Moon trails Regulus by about 3° in Leo (Evening)
29 Sun **Full Moon (5:58pm)**
30 Mon The Moon and Jupiter both shine brightly in Libra (Evening)

May

- 2 Wed Venus and Aldebaran separated by $\sim 6^\circ$, setting in the WNW (Dusk)
4 Fri The Moon, Saturn, and Lambda Sagittarii form a triangle, with Mars trailing (Early Morning)
6 Sun The Eta Aquariid Meteor shower peaks. See S&T May 2018, p. 51 (Predawn)
7 Mon **Last-Quarter Moon (7:09pm)**
8 Tue Jupiter reaches opposition, visible all night
15 Tue **New Moon (4:48am)**
17 Thu Waxing crescent Moon and Venus separated by $\sim 6^\circ$ (Dusk)
19 Sat The Moon is 6° below M44, the Beehive Cluster
20 Sun Venus less than 1° from the Open Star Cluster M35 in Gemini
21 Mon **First-Quarter Moon (8:49pm)**
25 Fri The Moon and Spica $\sim 6^\circ$ apart
26 Sat The Moon and Jupiter form a triangle with Spica
29 Tue **Full Moon (7:19am)**
31 Thu The Moon and Saturn rise $\sim 2^\circ$ apart, with the separation growing to $\sim 4^\circ$ by sunrise

Measuring the Movement of Water on Earth

By Teagan Wall

As far as we know, water is essential for every form of life. It's a simple molecule, and we know a lot about it. Water has two hydrogen atoms and one oxygen atom. It boils at 212° Fahrenheit (100° Celsius) and freezes at 32° Fahrenheit (0° Celsius). The Earth's surface is more than 70 percent covered in water.



On our planet, we find water at every stage: liquid, solid (ice), and gas (steam and vapor). Our bodies are mostly water. We use it to drink, bathe, clean, grow crops, make energy, and more. With everything it does, measuring where the water on Earth is, and how it moves, is no easy task.

The world's oceans, lakes, rivers and streams are water. However, there's also water frozen in the ice caps, glaciers, and icebergs. There's water held in the tiny spaces between rocks and soils deep underground. With so much water all over the planet—including some of it hidden where we can't see—NASA scientists have to get creative to study it all. One way that NASA will measure where all that water is and how it moves, is by launching a set of spacecraft this spring called GRACE-FO.

GRACE-FO stands for the "Gravity Recovery and Climate Experiment Follow-on." "Follow-on" means it's the second satellite mission like this—a follow-up to the original GRACE mission. GRACE-FO will use two satellites. One satellite will be about 137 miles (220 km) behind the other as they orbit the Earth. As the satellites move, the gravity of the Earth will pull on them.

Gravity isn't the same everywhere on Earth. Areas with more mass—like big mountains—have a stronger gravitational pull than areas with less mass. When the GRACE-FO satellites fly towards an area with stronger gravitational pull, the first satellite will be pulled a little faster. When the second GRACE-FO satellite reaches the stronger gravity area, it will be pulled faster, and catch up.

Scientists combine this distance between the two satellites with lots of other information to create a map of Earth's gravity field each month. The changes in that map will tell them how land and water move on our planet. For example, a melting glacier will have less water, and so less mass, as it melts. Less mass means less gravitational pull, so the GRACE-FO satellites will have less distance between them. That data

can be used to help scientists figure out if the glacier is melting.

GRACE-FO will also be able to look at how Earth's overall weather changes from year to year. For example, the satellite can monitor certain regions to help us figure out how severe a drought is. These satellites will help us keep track of one of the most important things to all life on this planet: water.

You can learn more about our planet's most important molecule here: <https://spaceplace.nasa.gov/water>

This article is provided by NASA Space Place. With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology. Visit spaceplace.nasa.gov to explore space and Earth science!

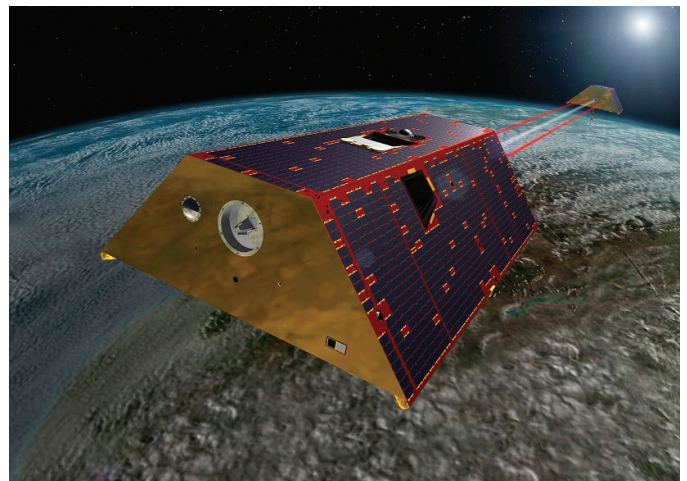


Image Caption: An artist's rendering of the twin GRACE-FO spacecraft in orbit around Earth. Credit: NASA



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

Tri-Valley Stargazers Membership Application

Contact information:

Name: _____ Phone: _____

Street Address: _____

City, State, Zip: _____

Email Address: _____

Status (select one): New member Renewing or returning member

Membership category (select one): Membership term is for one calendar year, January through December.

Student member (\$5). Must be a full-time high-school or college student.

Regular member (\$30).

Patron member (\$100). Patron membership grants use of the club's 17.5" reflector at H2O. You must be a member in good standing for at least one year, hold a key to H2O, and receive board approval.

Hidden Hill Observatory Access (optional):

One-time key deposit (\$20). This is a refundable deposit for a key to H2O. New key holders must first hear an orientation lecture and sign a usage agreement form before using the observing site.

Annual access fee (\$10). You must also be a key holder to access the site.

Donation (optional) :

Tax-deductible contribution to Tri-Valley Stargazers

Total enclosed: \$ _____

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. TVS will not share information with anyone except as detailed in our Privacy Policy (www.trivalleystargazers.org/privacy.shtml).

Mail this completed form along with a check to: Tri-Valley Stargazers, P.O. Box 2476, Livermore, CA 94551.