PRIMEFOCUS

Tri-Valley Stargazers

March 2018

Meeting Info
Optical Telescopes for Dummies

Who:
Dr. Lance Simms (LLNL) and Guests

When:
March 16, 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

March Meeting

Optical Telescopes for Dummies
Dr. Lance Simms - Lawrence Livermore National Laboratory

Have you ever looked at a telescope and wondered how the heck it actually works? When was this amazing device invented and how has it evolved over time? What is focal length and how does it relate to magnification? What's the difference between a reflector and a refractor? Or even more confusing: what's the difference between an arc-second and an inch? I'll try to answer these questions and more so that hopefully you'll walk away with a better understanding of telescopes and what to consider if you're in the market for one.

As part of the program, several club members have agreed to bring a refractor, a Schmidt-Cassegrain, and a Newtonian reflector to the meeting to discuss how they operate, and what accessories they use to get the most out of their night sky observing.

Caption: Ken Sperber at H2O on August 21, 2004. Image Credit: John Horvath

Lance Simms is a physicist/engineer at Lawrence Livermore National Laboratory. He received a B.S. in Physics from University of California: Santa Barbara in 2003 and a Ph.D. in Applied Physics from Stanford in 2009. His Ph.D. work focused on the application of Hybrid CMOS imagers in astronomy. Nowadays he loves working with whatever detectors he can get his hands on (infrared, visible, X-ray, you name it), and currently works with optical payloads in small satellites.

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
Mar. 16	Mar. 19	
Apr. 20	Apr. 23	Mar. 30
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 02/19/18, our club's checking account balance is $16,548.20.

Scheduled Club and Outreach Star Parties

The TVS Board has provided a list of Club and Outreach star parties that make use of resources that the club has access to, including H2O, Tesla Winery, and Del Valle East Bay Regional Park. Presently, there are also 3 Outreach star parties scheduled at local schools, and we anticipate many more being solicited as the weather turns nice. Plan accordingly so that you can enjoy the outings.

Wednesday, 03/23/18: Outreach party at Valley Christian Elementary School; setup 7:15

Wednesday, 04/11/18: Outreach party at Montevideo Elementary School in San Ramon; 7:45

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

Saturday, 04/21/18: Outreach party at Del Valle Arroyo staging area; 8:15

Saturday, 05/05/18: H2O Open House; 8:30

Saturday 06/16/18: TVS club party at Tesla Winery; 8:00

Saturday, 07/21/18: Outreach party at Del Valle Arroyo staging area; 8:15

Sunday, 08/12/18: Outreach Party (Perseids) at Del Valle ridge near park entrance; 8:15

Saturday, 09/15/18: Outreach party at Del Valle Arroyo Staging Area; 8:15; Perseid Meteor Shower peaks this night.

Saturday, 10/13/18: TVS club party at Tesla Winery; 6:00

Saturday, 11/10/18: Outreach party at Del Valle Arroyo staging area; 8:15

The H2O Open Houses are generally open to all club members and the public. The Tesla Winery club parties are generally open to club members and their guests. Please contact Eric Dueltgen for further information.

H2O Lock Combination to be Updated

Observatory Director Chuck Grant will be changing the lock combination at H2O this month. Once the new combination is available, Roland will be sending out an email with the new combination to all members who paid the H2O Access Fee for this year. Anyone who thinks they should have received the new combination but didn't should contact him.

Calendar of Events

March 19, 7:30pm

What: Seeing Our Universe in New Ways – the Infrared Sky Re-imagined
Who: Kimberly Ennico Smith, NASA Ames
Where: California Academy of Science, 55 Music Concourse 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.

In recent decades, our ability to study the universe with telescopes has been enabled by placing them on mountain tops, airplanes, balloons, rockets, and satellites. They have revealed a beautiful, mystifying, dynamic, and extraordinary place. Infrared light, in particular, penetrating deep into dark clouds, allows us to observe the birth of stars, measure the re-emission of the dust left behind by violent supernovae stellar deaths, and study the environments of gas and dust from which stars and planets form. Will these new observations bring us closer to learning how our universe works and where we come from?

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

March 23, 7:15pm-9:15pm

What: Intro to the Night Sky
Who: San Jose Astronomical Society
Where: Houge Park, 3972 Twilight Dr · San Jose, CA
Cost: Free

At our "Intro to the Night Sky" talk, learn about what's happening in the night sky in the coming month and what you can see from your own backyard in San Jose. Afterward take a walk down telescope row at our In-Town Star Party. The class and the star party are free, no reservations, just show up!

Header Image: A Schmidt-Cassegrain telescope and a camera outfitted for solar observing and imaging. Image Credit: Ross Gaunt

Calendar of Events (continued)

It's all happening at Houge Park, in San Jose. Building # 1 is at the north end of the park, near the parking lot, and near the tennis courts, off Twilight Drive.

For more information see: https://www.meetup.com/SJ-Astronomy/events/243856011/ and https://www.sjaa.net/events/monthly-star-parties/

March 27, 7:00pm

What: Roving on Mars: Revving up for Future Exploration of the Red Planet
Who: Janice Bishop, Ginny Gulick, Pablo Sobron, SETI Institute
Where: SRI Conference Center, 301 Ravenswood Ave., Menlo Park, CA 94205 (Enter from Middlefield Rd.)
Cost: Free, Due to popularity of SETI events, registration in advance, beginning March 12, is strongly suggested

Orbiters, followed by rovers sent to Mars, have yielded a dramatic increase in knowledge about Mars over the past decade. Today, thanks to several years of data collected in situ and remotely, we have a better understanding of its geology and habitability potential. Three SETI Institute planetary scientists who have dedicated their careers to the study of the red planet will tell us what we have learned from those studies, and what the next steps are in the exploration of Mars with the next generation of rovers. Janice Bishop will introduce the candidate landing sites for upcoming martian rovers. She will focus on the mineralogy determined from the CRISM spectrometer at Mars and what that can tell us about Mars' early environment. Ginny Gulick will describe the fluvial morphology/water history of these sites as seen by the HiRISE and CTX cameras. Finally, Pablo Sobron will address the instruments scheduled for the Mars2020 and ExoMars rovers and how SuperCam, Sherlock and the ExoMars Raman/LIBS instrument will be used to explore mineralogy and organics at the future landing sites.

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

April 6, 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.

April 9, 7:30pm

What: Meet the Neighbors: Searching for Nearby Planets with the Transiting Exoplanet Survey Satellite
Who: Courtney Dressing, UC Berkeley
Where: California Academy of Sciences, 55 Music Concourse 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.

The NASA Kepler mission revealed that our galaxy is teeming with planetary systems and that Earth-sized planets are common, but most of the planets detected by Kepler orbit stars that are too faint to permit detailed study. Excitingly,

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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.

Club Member Astrophotos

Image Caption: Dave Lackey took this image of the Northern Lights from a location near Vik, Iceland, on February 11, 2018. He used a Nikon D750 and a Tamron 15mm lens for a 10 second exposure at f/2.8 using ISO-3200. The image faces due north, with Polaris just off the top center of the frame, and Ursa Minor hidden by the cloud that is right of center. The Milky Way is visible in Cepheus, to the upper-left. The green color of the aurora is caused by charged solar particles interacting with oxygen at an altitude of about 150 miles. Dave was travelling as part of an educational tour that included Dr. Paul Sutter, a cosmologist from Ohio State University, and Fraser Kane, the publisher of Universe Today. The tour also highlighted the diverse geology of Iceland.

Calendar of Events (continued)

the NASA Transiting Exoplanet Survey Satellite (TESS) should launch this spring and find hundreds of small planets orbiting stars that are close and bright. Unlike the Kepler planets, the TESS planets will be ideal targets for follow-up observations to determine their masses, compositions, and atmospheric properties. Dr. Dressing will describe the TESS mission and explain how in-depth analyses of the TESS planets will allow us to probe the compositional diversity of small planets, investigate the formation of planetary systems, and set the stage for the next phase of exoplanet exploration: the quest for biosignatures in the atmospheres of strange new worlds.

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

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.

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

April 19, 7:00pm

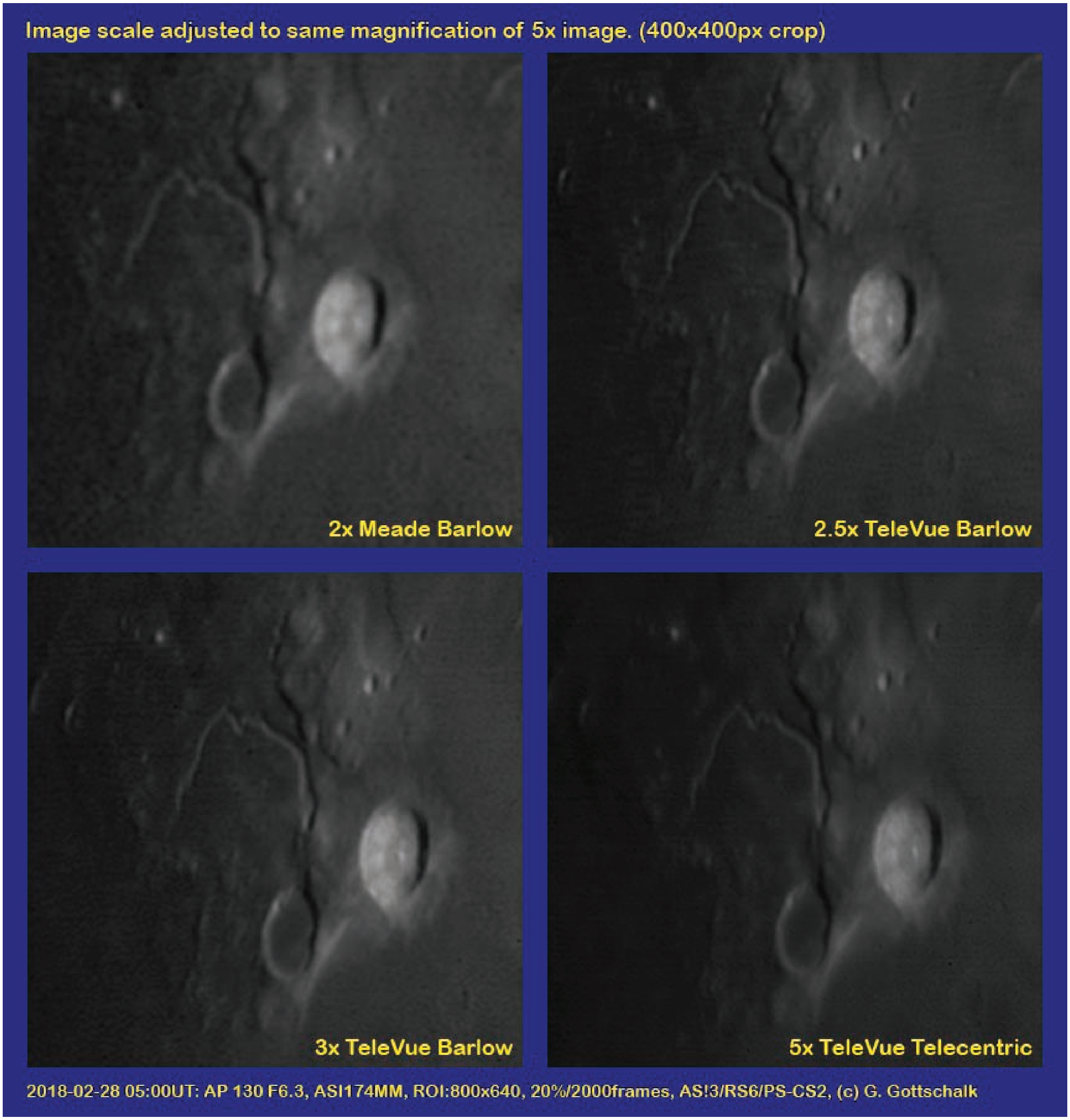
What: What Are We Protecting Mars From — And Why Do We Bother?
Who: John Rummel (SETI Institute) and Robert Zubrin (Lockheed Martin Astronautics)
Where: SRI Conference Center, 333 Ravenswood Ave., Menlo Park, CA 94205 (Enter from Middlefield Rd.)
Cost: Free, Due to popularity of SETI events, registration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

Pixels and Barlows By Gert Gottschalk



The other day I set out to compare a small collection of barlows for imaging with my 130mm refractor and an ASI174 monochrome camera. My goal is to match the resolving power of the telescope to the pixel size of the camera to ensure a high-quality well-sampled image. In my collection were a baseline 1.25inch Meade 2x barlow, two higher end models from TeleVue, 1.25inch 2.5x and 3x barlows. I also tested a TeleVue 5x telecentric lens on loan from a club member.

Before we go into the details of the comparison, why do we insert barlow lenses into the imaging chain between the telescope and the camera in the first place? The answer has to do with the geometric size of the pixel in the camera sensor and the linear image scale of the focal plane of the telescope objective. The Rayleigh criterion gives us the angular resolution of the telescope:

$R_{ang} = 1.22 \times Lambda / Diameter$

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Pixels and Barlows (continued)

This is the angular diameter of the Airy disk. The results are expressed in Radians and when we punch it all into a spread sheet calculator we find that a 100mm telescope has an angular resolution of about 1.3arcsec for visible light. But that's the angular resolution and we want the linear resolution. To do that we have to multiply the angular resolution by the focal length of the telescope:

R_lin =R_ang * FL = 1.22 x Lambda * FL / Diameter

In the above formula the FL/Diameter term is the focal ratio of our scope. For example, if our 100mm scope has a focal length of 600mm, its focal ratio is F6. Again, putting all into a calculator the linear resolution equals 4.03microns.

The criterion to reproduce an image limited by the scope's resolution and the size of the sensor pixels is determined by the Nyquist Theorem, which states that in order to adequately reproduce a signal it should be periodically sampled at a rate that is 2X the highest modulation frequency you wish to record.

Our modulated signal is the linear size of the Airy disk of the telescope and our sampling is the pixel size of the camera sensor chip. To satisfy the Nyquist Theorem the repetition of the pixels has to be at least 2x the Airy disk. In the case of a 2-dimensional camera sensor the criterion actually scales up to 3.0x and if we are considering RGB filtered pixels for a color camera the number even goes to 5.5x.

<u>So does our camera and scope still match?</u>

Let's look again at our 100mm F6 scope and the ASI120 color camera. The camera has 3.75micron pixels. Note it's a color camera! The scope has a linear resolution (diameter of the Airy disk) of 4.03micron. That 4.03micron has to cover 5.5 pixel of the camera. But 5.5 pixel of the camera are 20.63micron. That doesn't fit!

<u>Barlow lens to the rescue</u>

This is where the barlow lens come into play. By using a negative lens, it makes the focal length of the scope (and thus the linear image scale) larger. This is exactly what we want and we can now give the exact answer to what magnification factor we need for the barlow in our example.

X Factor = 20.63micron / 4.03micron = 5.12x

For the perfect match of the 100mm F6 scope and the ASI120 color camera an approximately 5x barlow lens is needed. The table on p.7 summarizes magnification factors for different scopes and cameras.

To read the table pick your scope (column) and camera (row) and find the recommended barlow lens magnification factor at their intersection.

<u>Trying out different barlows</u>

I computed that the ideal magnification factor for my ASI174 camera and 130mm F6.3 scope would be 4.16x. This fell in between the small collection of barlow lenses and the telecentric lens that I had for my experiment.

How do we compare how each barlow lens performs to pull out the best sampling of the modulation of our image? As seen in the images on page 5, the trick is to bring all images to the same linear resolution and compare them. The 5x telecentric has the largest scale and it will become our reference. We take the other images and scale them up to match that reference image.

<u>What does it tell us?</u>

Let's compare the detail given from the various barlow lenses and the telecentric lens.

The Meade 2x clearly has too little magnification to help us sample enough detail of the scope to make a sharp image. At the desired scale the image has become fuzzy. We can't use this barlow lens for our imaging combination of scope and camera!

The TeleVue 2.5x and 3x are performing nicely. They give good detail. Maybe the 2.5x even has a slight edge over the 3x. We would expect a 4x barlow to be the ideal fit here, so the performance of the 2.5x is a bit surprising. But I have seen in previous experiments that it is of very good quality and performs very well. The 3x was only purchased recently and I have seen images from it being a bit soft.

As much as the 3x is a bit under the ideal 4x the 5x is a bit over the top. I also have to mention that the seeing conditions at the observing session were mediocre at best. So surely the 5x could not play out its full potential.

<u>Summary</u>

I'll still keep looking to find a 4x barlow. But for now the 3x and (surprisingly) the 2.5x are my choice for the scope and camera. The 2x will go back to the bottom of the box.

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

All times are Pacific Daylight Savings Time

March

11	Sun	Daylight Savings Time Begins (2am)
11	Sun	Algol at minimum brightness for 2 hours centered on 9:50pm
17	Sat	New Moon (6:12am)
22	Thu	The Crescent Moon is less than 1º from Aldebaran
24	Sat	First-Quarter Moon (8:35am)
28	Wed	Venus and Uranus are less than 4º apart (Dusk)
29	Thu	In Sagittarius, Mars and Saturn are separated by 2º, with M22 1.5º below (Morning)
31	Sat	Full Moon (5:37am)

April

2	Mon	Mars about 1º below Saturn above the Teapot in Sagittarius. The Moon and Jupiter are located to the right in Libra (Dawn)
7	Sat	The Moon is above Saturn and Mars (Dawn)
8	Sun	Last-Quarter Moon (0:18am)
8	Sun	Algol at minimum brightness for 2 hours centered on 8:24pm
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 2º from Aldebaran in the Hyades
22	Sun	First-Quarter Moon (2:46pm)
22	Sun	The Moon is 2-3º below M44, the Beehive Cluster (Evening)
24	Tue	The Moon trails Regulus by about 3º in Leo (Evening)
29	Sun	Full Moon (5:58pm)
30	Mon	The Moon and Jupiter both shine brightly in Libra (Evening)

Pixels and Barlows (continued)

Table Caption: Scale factors for different camera-telescope combinations that are needed to match the resolving power of the telescope to the pixel size of the camera to ensure a high quality well-sampled image. To read the table pick your scope (column) and camera (row) and find the recommended barlow lens magnification factor at their intersection.

				APO 4"	C8	C11
			F/D	6.0	10.0	10.0
Camera	Pix[um]	Nyquist	Resolution[um]	4.03	6.71	6.71
EOS T6i	3.7	5.5	Factor X	5.05	3.03	3.03
ASI120	3.75	5.5	Factor X	5.12	3.07	3.07
ASI174	5.86	3	Factor X	4.37	2.62	2.62
DMK41	4.65	3	Factor X	3.46	2.08	2.08

Sixty Years of Observing Our Earth

By Teagan Wall

Satellites are a part of our everyday life. We use global positioning system (GPS) satellites to help us find directions. Satellite television and telephones bring us entertainment, and they connect people all over the world. Weather satellites help us create forecasts, and if there's a disaster—such as a hurricane or a large fire—they can help track what's happening. Then, communication satellites can help us warn people in harm's way.

There are many different types of satellites. Some are smaller than a shoebox, while others are bigger than a school bus. In all, there are more than 1,000 satellites orbiting Earth. With that many always around, it can be easy to take them for granted. However, we haven't always had these helpful eyes in the sky.

The United States launched its first satellite on Jan. 31, 1958. It was called Explorer 1, and it weighed in at only about 30 pounds. This little satellite carried America's first scientific instruments into space: temperature sensors, a microphone, radiation detectors and more.

Explorer 1 sent back data for four months, but remained in orbit for more than 10 years. This small, relatively simple satellite kicked off the American space age. Now, just 60 years later, we depend on satellites every day. Through these satellites, scientists have learned all sorts of things about our planet.

For example, we can now use satellites to measure the height of the land and sea with instruments called altimeters. Altimeters bounce a microwave or laser pulse off Earth and measure how long it takes to come back. Since the speed of light is known very accurately, scientists can use that measurement to calculate the height of a mountain, for example, or the changing levels of Earth's seas.

Satellites also help us to study Earth's atmosphere. The atmosphere is made up of layers of gases that surround Earth. Before satellites, we had very little information about these layers. However, with satellites' view from space, NASA scientists can study how the atmosphere's layers interact with light. This tells us which gases are in the air and how much of each gas can be found in the atmosphere. Satellites also help us learn about the clouds and small particles in the atmosphere, too.

When there's an earthquake, we can use radar in satellites to figure out how much Earth has moved during a quake. In fact, satellites allow NASA scientists to observe all kinds of changes in Earth over months, years or even decades.

Satellites have also allowed us—for the first time in civilization—to have pictures of our home planet from space. Earth is big, so to take a picture of the whole thing, you need to be far away. Apollo 17 astronauts took the first photo of the whole Earth in 1972. Today, we're able to capture new pictures of our planet many times every day.

Today, many satellites are buzzing around Earth, and each one plays an important part in how we understand our planet and live life here. These satellite explorers are possible because of what we learned from our first voyage into space with Explorer 1—and the decades of hard work and scientific advances since then.

To learn more about satellites, including where they go when they die, check out NASA Space Place: https://spaceplace.nasa.gov/spacecraft-graveyard

Image Caption: the launch of Explorer 1 from Cape Canaveral, Fla., on Jan. 31, 1958. Explorer 1 is the small section on top of the large Jupiter-C rocket that blasted it into orbit. With the launch of Explorer 1, the United States officially entered the space age. Image credit: NASA

Tri-Valley Stargazers
P.O. Box 2476
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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.