PRIMEFOCUS

Tri-Valley Stargazers

December 2020

Meeting Info:
How to Build the World's Biggest Telescopes

Who:
Dr. Brian McLeod

When:
December 18, 2020
Meeting at 7:30 p.m.
Lecture at 8:00 p.m.

Where:
Virtual Meeting using: Zoom*
See the April or May issue of PrimeFocus for info on getting connected using Zoom.

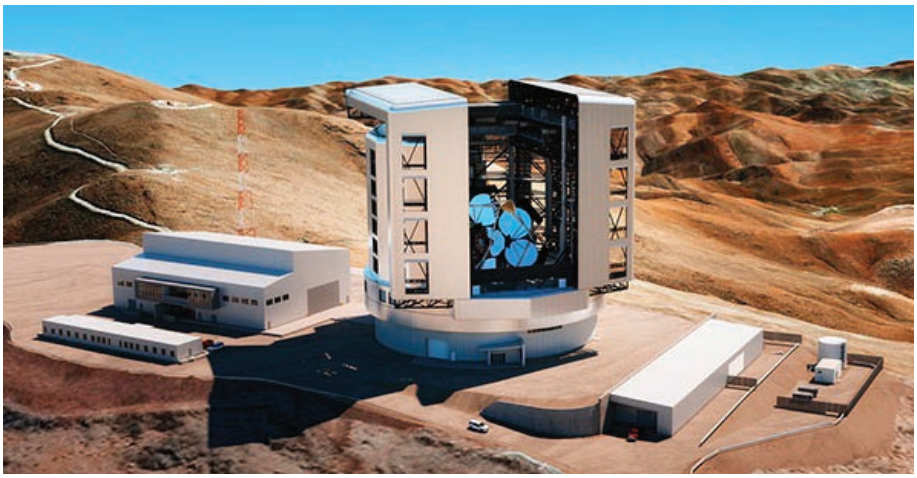
Inside

December Virtual Meeting Using "Zoom*"

How to Build the World's Biggest Telescopes

Dr. Brian McLeod, Harvard-Smithsonian Center for Astrophysics

Increasing our knowledge of how the universe works has always been enabled by technological development. From the invention of the telescope by Galileo, over 400 years ago, to the development of 8 to 10 meter class telescopes and the launch of the Hubble telescope at the end of the last century, fantastic new discoveries have been made by users of the latest and greatest telescopes. Progress continues to this day, with three major new telescopes under development world-wide. After a brief overview Brian will concentrate on the current development of the Giant Magellan Telescope, a 25m diameter telescope expected to see light later this decade on Las Campanas Peak in Chile. Here are some of the questions he will address: Who's designing and building it? What is the process for carrying out such a big project? Who will get to use it and what questions will they answer with the telescope?



Caption: Rendering of the Giant Magellan Telescope Facility. Credit: Giant Magellan Telescope - GMTO Corporation (https://www.gmto.org/2020/09/major-nsf-grant-accelerates-development-for-one-of-the-worlds-most-powerful-telescopes/)

Brian McLeod got his start in astronomical instrumentation in high school in the basement of TVS member Craig Siders where they refurbished a 3-inch Newtonian. From those first Ohio corn field observations he's made his way to state-of-the-art facilities on remote mountain tops in Arizona and Chile. He is an astronomer at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, where he leads a team developing the optical sensors that will keep the GMT's optics aligned and in the correct shape. Brian holds a BA in Physics from Cornell University and a PhD in Astronomy from the University of Arizona.

News & Notes

2020 and 2021 TVS Meeting Dates

Below are the TVS meeting dates. 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**
Dec. 18	Dec. 14	
Jan. 15	Jan. 18	Jan. 01
Feb. 19	Feb. 22	Feb. 05
Mar. 19	Mar. 22	Mar. 05
Apr 16	Apr. 19	Apr. 02
May 21	May 24	May 07
Jun. 18	Jun. 21	Jun. 04
Jul. 16	Jul. 19	Jul. 02
Aug. 20	Aug. 23	Aug. 06
Sep. 17	Sep. 20	Sep. 03
Oct. 15	Oct. 18	Oct. 01
Nov. 19	Nov. 22	Nov. 05
Dec. 17	Dec. 20	Dec. 03

TVS Election Results

The suite of officers elected during the November TVS meeting are:

President: Ron Kane

Vice President: Eric Dueltgen

Treasurer: John Forrest

Secretary: Ross Gaunt

Money Matters

As of the last Treasurer's Report on 11/23/20, our club's account balance is $57,835.48. This includes contributions to the H2O Rebuild fund.

TVS Welcomes New Members

TVS welcomes new members Ojas Girish, Girish Sivasubramanian, Ujwal Patel, and Alan Smith. Please say hello and chat with them during our Zoom meetings.

Time to Renew Club Membership for 2021

Now is a great time to become part of TVS. Membership is open to anyone with an interest in astronomy. Amateurs and professionals are equally welcome; skilled amateurs comprise the majority of the membership. You do not have to own a telescope in order to be a member.

Those renewing their club membership are encouraged to do so by using the online application before the end of December. Normally our memberships are only good for the calendar year, but anyone joining after October 1st will be given a membership for the remainder of 2020 and all of 2021. The regular club membership remains a bargain at $30. Student membership (full-time High School or College student) is only $10! To become a key holder to H2O, you must be 18 or older. There is a one-time $20 Key deposit and a $10 annual access fee.

You can join TVS or renew your membership online at:

http://www.trivalleystargazers.org/membership.shtml After filling out the application form you are connected to the PayPal payment form. You do not need to have a PayPal account to pay online, since PayPal will accept credit cards. Everyone is encouraged to use the online application. Alternatively, you can mail in the Membership Application on the last page of this newsletter along with a check to the Tri-Valley Stargazers, P.O. Box 2476, Livermore, CA 94551-2476. Note that TVS will not share your information with anyone. We only use the e-mail address to notify you when the newsletter becomes available.

All members agree to hold the 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.

H2O and Del Valle Sites Closed

In light of the state's and county's latest COVID-19 shelter-in-place orders (see https://covid19.ca.gov/stay-home-except-for-essential-needs/#regional-stay-home-order) instructing everyone to stay at home as much as possible, the Tri-Valley Stargazers Board of Directors has voted to immediately close our club observing sites at Hidden Hill Observatory and Del Valle Regional Park. The lock combinations will be changed soon and the sites will remain closed during the duration of the shelter-in-place order.

Members will be contacted via email when the site(s) are reopened. Also, see the TVS webpage for updates.

Outreach Star Party Schedule

Cancelled through December.

Contact Eric Dueltgen if you are interested in participating in future events (outreach"at"trivalleystargazers.org).

Calendar of Events

December 16, 7:00pm

What: A Rainbow of Exoplanets
Who: Dr. A. Tanner (Mississippi State U.) and Dr. I. Paulino-Lima (Blue Marble Institute of Science)
Sponsor: SETI Institute
Online: REGISTRATION REQUIRED; https://www.eventbrite.com/e/seti-talks-a-rainbow-of-exoplanets-tickets-131534010767

We identified an exoplanet color for the first time in 2013: HD

Header Image: A Geminid meteor imaged at H2O in 2017. Credit K. Sperber

Calendar of Events (continued)

189733b, a Jupiter-like exoplanet was determined to be dark-blue. Since then, astronomers have discovered more than 4,000 exoplanets and found out that a significant fraction of them are terrestrial. After detecting them, the next challenge is to image them, which will reveal their color. So what is the color of a lifeless terrestrial exoplanet? Will it be red because of rust like Mars, or blueish-white because of clouds in the atmosphere like Venus in visible light?

Among the 300 million potentially habitable planets in our galaxy, can we expect that more than one will indeed host a type of life? What will be the impact of this life on their colors? Can we expect this planet to have the same vegetation as our Earth? What colors are associated with the presence of microbiological activity on the surface of a planet? What do a planet's colors tell us about habitability on its surface? Astronomers predict that one day we will see the color of an Earth-like exoplanet.

December 19, 26, 9:00pm-10:30pm

What: Virtual Observing
Who: Chabot Staff
Sponsor: Chabot Space and Science Center
Online: https://chabotspace.org/events/events-listing/

Join our resident astronomers every Saturday evening live from Chabot's Observation deck! Each week, our astronomers will guide us through spectacular night sky viewing through Nellie, Chabot's most powerful telescope. Weather permitting we will be able to view objects live through the telescopes and our astronomers will be available for an open forum for all of your most pressing astronomy questions.

See the web link above to access the virtual observing vioas FaceBook or YouTube.

Journal Club (By Ken Sperber)

The Stingray Nebula (Hen 3-1357): Now You See It, Now You Don't

Planetary Nebulae signal the end stage evolution of stars whose mass range from ~0.6-10x that of the Sun. The "in a nutshell story" is that after hydrogen fusion ceases in the core, the core contracts and heats up with the outer layers of the star expanding-the star becomes a red giant as it enters the Asymptotic Giant Branch on the Hertzsprung-Russell Diagram. Strong winds develop, causing the star to loose up to half of it mass, eventually revealing the hot core of the white dwarf in which fusion no longer occurs. The hot core produces copious amount of ultraviolet radiation (UV) that causes the expanding nebula to fluoresce, forming a Planetary Nebula. Eventually, the Planetary Nebula fades into obscurity as the nebular gas becomes too diffuse as it continues to expand into the cosmos. The Planetary Nebula stage of stellar evolution is short-lived, typically being ~10,000 years.

However, the story is a bit more complicated. Depending on the initial mass of the star, the contractive heating of the core can cause helium fusion that eventually results in an inert Carbon-Oxygen core. Once there is insufficient helium present for fusion in the shell around the CO core, fusion of the outer hydrogen shell begins. Over time this causes helium to build-up which can then cause a helium fusion flash. As the shells of hydrogen and helium undergo these fusion oscillations the star exhibits substantial changes in brightness. Ongoing mass loss due to strong winds provides the expanding nebula that fluoresces when the star reaches the White Dwarf stage.

Over the past few decade scientists have been lucky enough to witness a Planetary Nebula turn on, and now off again. Such is the curious case of the Stingray Nebula (Hen 3-1357) and its

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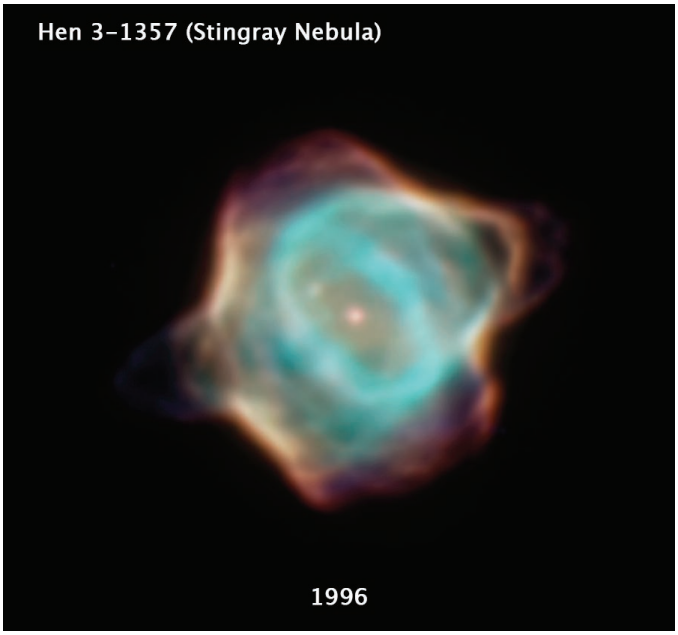
TVS Member Astrophotos

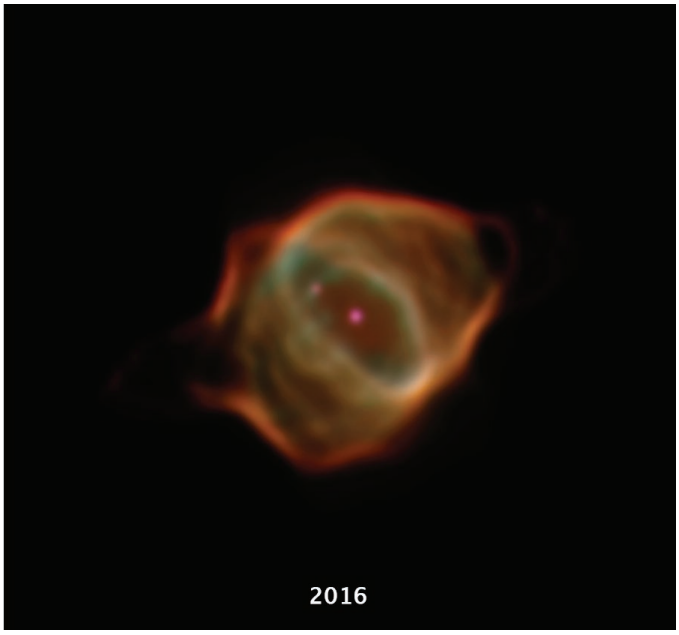
Caption: On November 26, Kai Yung produced an HDR image of the Moon using an Astro-Tech AT72EDII 72mm f/6 refractor, a TeleVue 2x Powermate, and ASI294mc pro camera. Using "lucky seeing" the best video frames were stacked and integrated using AutoStakkert!3, then processed via PixInsight to bring out the faint colors of the Moon. These enhanced colors give clues as to the mineralogy of the Moon's surface. Blue and orange shades indicate volcanic lava flows. The dark blues indicate areas richer in titanium-bearing minerals. Pink colors indicate iron-poor, aluminum-rich feldspars (which is a group of rock-forming tectosilicate minerals) that make up the lunar highlands. Orange and purple indicate regions that are relatively poor in titanium and iron.

Journal Club (continued)

star of origin, SAO 244567. In the early 1970's it was identified as a B-Type star with an effective surface temperature of 21,000K. However, by the early 1990's nebular spectral lines were found, indicating that the system was transitioning into a Planetary Nebula. In 1996 the Hubble Space Telescope (HST) was trained on SAO 244567, and a well-defined Planetary Nebula appeared to have blossomed with the star having increased in temperature to 60,000K (below-left).

Unexpectedly, 2016 observations with the HST revealed that the nebula had substantially faded (below-right; Balick et al., ApJ, 2020). For OIII, one of the primary emission lines of Planetary Nebulae, its flux dropped by a factor of 900 from 1996 to 2016 due to recombination of electrons with O^{++} since the UV flux dropped and could no longer maintain such high ionization. Similarly, recombination of N^{++} and S^{++} resulted in increased lower-state ionization fractions of N^{+}





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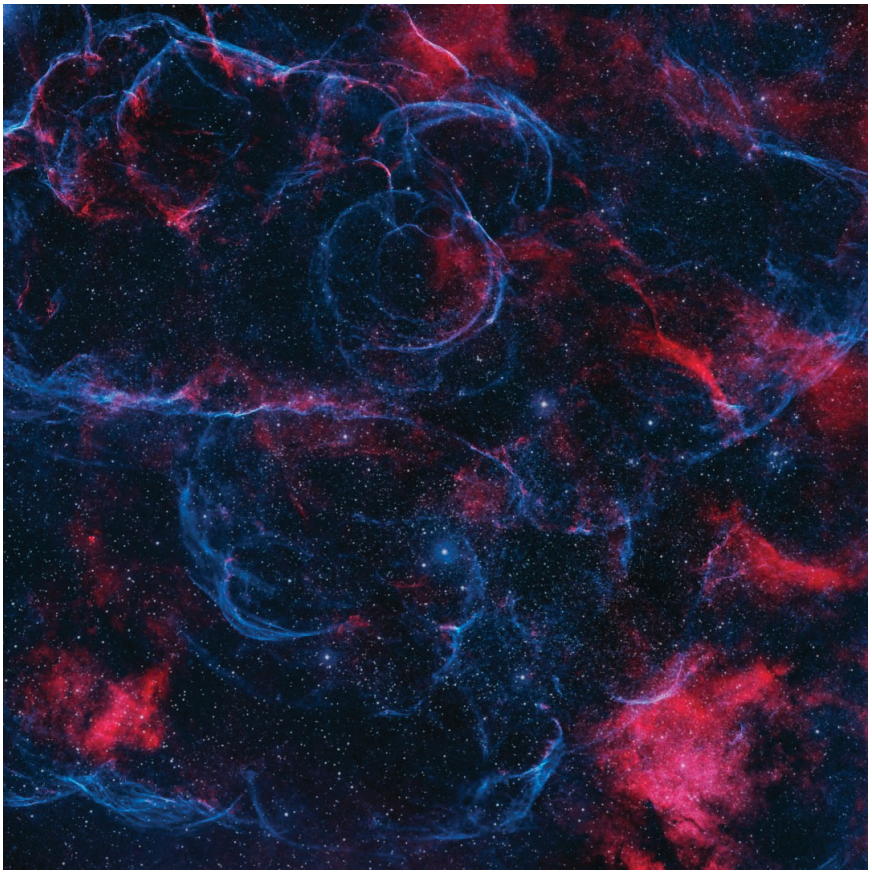
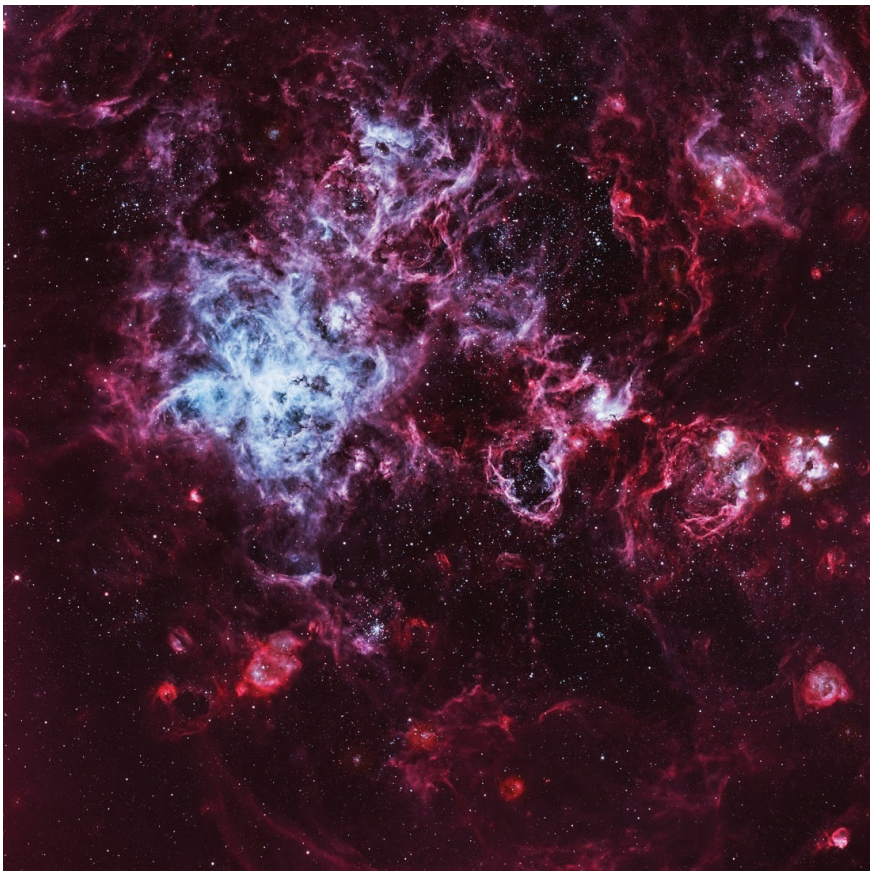
TVS Member Astrophotos (continued)





Caption: Moe Yassine post-processed these images from data obtained from a remote telescope in Australia. He states: "There are a few targets that I have always wanted to get but aren't accessible from Pleasanton. An opportunity presented itself at last years Advanced Imaging Conference (AIC) in San Jose to image a few of these and I took it. There were a number of vendors there for remote imaging. Now I have to say that imaging with a remote telescope is like fishing with dynamite, you basically just put in your RA and Dec and schedule time on the telescope and then wait for an email. It's definitely not as fun as imaging from the driveway, and there's a little less sense of accomplishment with this. The data comes out super clean, given that it's in a Bortle class 3, so you really don't need very much data at all. But with Covid and travel restrictions, traveling isn't really an option so this will have to do for now. Although I will say I still want to travel to Australia one day with my equipment and do this myself."

Top Image: The Vela Supernova Remnant was imaged with a Takahashi FSQ-106ED, a 0.73 focal reducer, and a FLI PL-16803 camera using Astrodon H-alpha and OIII filters. The total integration time was 2 hours.

Bottom Image: The Tarantula Nebula was imaged with an ASA 500N using a FLI PL-16803 camera and Astrodon H-alpha and OIII filters. The total integration time was 2 hours.

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

All times are Pacific Standard Time

December

13	Sun	The Geminid meteor shower peaks (Evening)
14	Mon	New Moon (8:17am)
16	Wed	The crescent Moon hangs 5^{o} below the close paring of Jupiter and Saturn (Dusk)
21	Mon	Longest night of the year. The winter solstice begins at 2:02am.
21	Mon	First-Quarter Moon (3:41pm)
21	Mon	Jupiter and Saturn are less then 6 arc minutes apart in a very rare close conjunction (Dusk)
23	Wed	The Moon sand Mars are separated by ~5^{o} (Evening)
25	Fri	Algol shines at minimum brightness for 2 hours centered on 9:27pm
26	Sat	The Moon is situated about halfway between the Hyades and the Pleiades (Evening)
28	Mon	Algol shines at minimum brightness for 2 hours centered on 6:16pm
29	Tue	Full Moon (7:28pm)
30	Wed	The Moon is ~4^{o} to the right/lower-right of Pollux (Evening)

January

1	Fri	Jupiter and Saturn are ~1^{o} apart (Dusk)
2	Sat	The Moon is ~4^{o} to the left of Regulus in Leo (Evening)
2-3	Sat-	The Quadrantid Meteor shower peaks at about 6:30am on January 3rd
6	Wed	Last-Quarter Moon (1:37am)
10	Sun	Jupiter, Saturn, and Mercury form a triangle in the west-southwest. Use binoculars (Dusk)
11	Mon	The crescent Moon and Venus are ~4^{o} apart in the southeast (Dawn)
11	Mon	Jupiter and Mercury are separated by are ~1.5^{o} in the west-southwest (Dusk)
12	Tue	New Moon (9:00pm)

Journal Club (continued)

and S+. If the current rate of fading persists, the nebula will be unseen in ~30 years.

What is the cause of the brightening of the nebula from the 1970's-1990's? Reindel et al., (MNRAS, 2016) suggest a late themal pulse due to a brief helium flash is the culprit. The resulting increase in temperature gave rise to strong UV ionization that made the Planetary Nebula visible. The evidence for this mechanism was obtained using the Cosmic Origins Spectrograph of the HST to study the central star at UV wavelengths. The authors used a non-local thermodynamic equilibrium (non-LTE) model of the stellar atmosphere along with the Potsdam Wolf-Rayet model atmosphere code to account for the impact of a stellar wind in reproducing the asymmetric elemental spectral line profiles. With the model, the authors identified Chromium at previously unidentified absorption features. Best-fit line profiles of various elements were used to derive the temperature of the central star during the different epochs of evolution and in considering the impact of changing surface gravity of the star between its bloated and compact states. Results indicate that the central star has a mass of 0.53-0.56 solar masses, and that it is returning to the Asymptotic Giant Branch where it will continue to shed mass through stellar winds. The central star will continue to evolve into a White Dwarf with the Planetary Nebula once again becoming a visible. The authors note that present non-LTE models cannot simultaneously reproduce all of the observed surface properties of the central star, thus indicating that improved physical understanding and theoretical models of dynamically evolving stars are needed.

For more information see:

https://www.nasa.gov/feature/goddard/2020/hubble-captures-unprecedented-fading-of-stingray-nebula

NASA Night Sky Notes

Visitors to Both Jupiter and Saturn

By David Prosper

Have you observed Jupiter and Saturn moving closer to each other over the past few months? On December 21, the two worlds will be at their closest, around 1/5 of a full Moon apart! While the two gas giants may appear close, in reality they are hundreds of millions of miles apart. Despite this vast distance, a select few missions have visited both worlds by using a gravity assist from giant Jupiter to slingshot them towards Saturn, saving time and fuel.

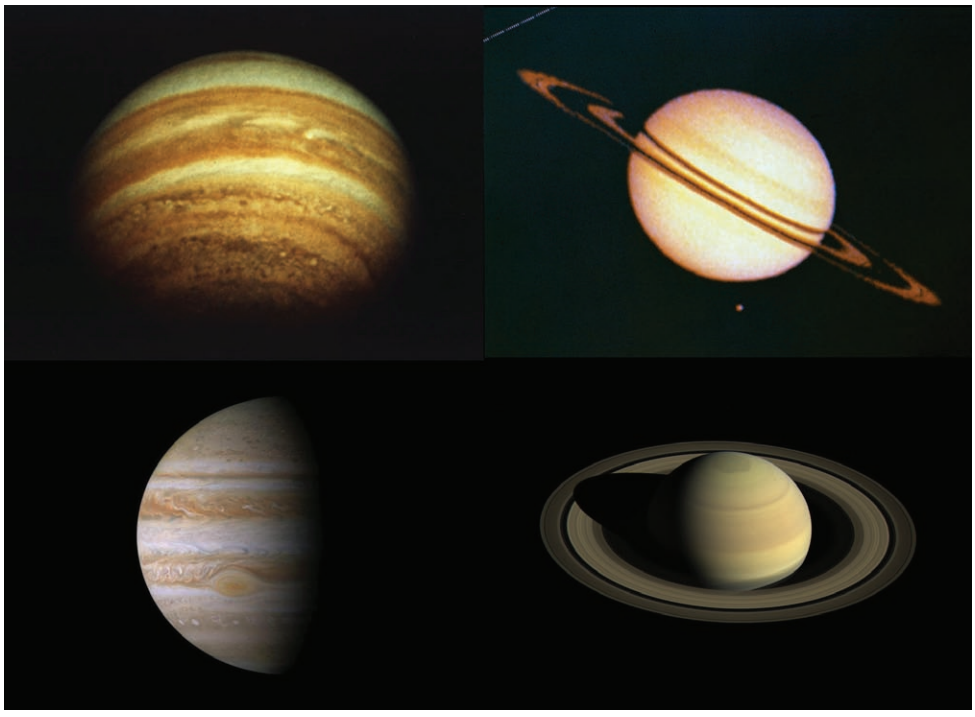
Pioneer 11 was the first mission to visit both worlds! Launched in 1973, the probe flew past Jupiter in late 1974, passing just 26,400 miles above its stormy clouds. In 1979, it became the first spacecraft to encounter Saturn. Pioneer 11 took the first up-close photos of Saturn and its satellites, and made many exciting discoveries, including the detections of its magnetic field and a faint "F" ring, before departing Saturn and eventually, the solar system.

The Voyager missions quickly followed up, taking a "Grand Tour" of the four largest and most distant planets in our solar system. Both probes were launched within two weeks of each other in 1977. Voyager 1 flew past Jupiter in March 1979, discovering Jupiter's faint ring and two new moons, along with active volcanoes on Io's surface! The probe then flew past Saturn in November 1980, discovering five new moons, a new "G" ring, mysterious ring "spokes," and "shepherd moons" shaping the rings. After a brief encounter with Titan revealed evidence of complex organic chemistry and liquid on the moon's frigid surface, Voyager 1 was flung out of the plane of the solar system. Following close behind, Voyager 2 took detailed photos of Jupiter's moons and cloud tops in July 1979. Flying past Saturn in August 1981, Voyager 2 measured the thickness of Saturn's rings and took detailed photos of many of its moons. This second explorer then captured images of Uranus and Neptune before leaving our solar system.

Cassini-Huygens was the last mission to visit both worlds. Launched in 1997, the mission flew past Jupiter in late 2000 and took incredibly detailed photos of its stormy atmosphere and faint rings. Cassini entered into Saturn's orbit on July 1, 2004. The Huygens probe separated from Cassini, landing on Titan to become the first probe in the outer solar system. Cassini discovered geysers on Enceladus, fine details in Saturn's rings, many more moons and "moonlets," the changing oceans of Titan, and seasonal changes on Saturn itself. After revolutionizing our understanding of the Saturnian system, Cassini's mission ended with a fiery plunge into its atmosphere on September 15, 2017.

What's next for the exploration of the outer worlds of our solar system? While Juno is currently in orbit around Jupiter, there are more missions in development to study the moons of Jupiter and Saturn. Discover more about future NASA missions to the outer worlds of our solar system at nasa.gov.

This article is distributed by the NASA Night Sky Network, a coalition of hundreds of astronomy clubs across the US dedicated to astronomy outreach. Visit nightsky.jpl.nasa.gov to find local clubs, events, stargazing info and more.



Caption: The difference in technology between generations of space probes can be stunning! The top two photos of Jupiter and Saturn were taken by Pioneer 11 in 1974 (Jupiter) and 1979 (Saturn); the bottom two were taken by Cassini in 2000 (Jupiter) and 2016 (Saturn). What kinds of photos await us from future generations of deep space explorers?

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. Note: NEW/Renewal memberships initiated after October 1, 2020 will be good through 2021!!!

_____ Student member ($10). Must be a full-time high-school or college student.

_____ Regular member ($30).

Hidden Hill Observatory Access (optional): Must be 18 or older.

_____ 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 (http://www.trivalleystargazers.org/privacy.shtml).

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