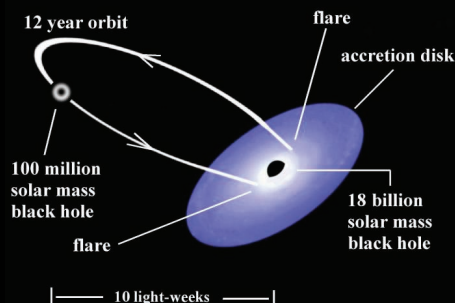


PRIMEFOCUS

Tri-Valley Stargazers



May 2016



Meeting Info

What:

Club Member Presentations

Who:

Don Dossa, Steve Adachi, Chuck Grant, Rich Combs, and ?

When:

May 20, 2016

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

May Meeting

Club Member Presentations

Don Dossa, Steve Adachi, Chuck Grant, Rich Combs, and ?

This month's main presentation will be at least a four ring circus! Four (or more) club members will give brief talks about a range of topics.

Don Dossa will provide insights about imaging of Jupiter. Since Jupiter is moving through the plane of Earth's orbit, multiple shadow transits of the Galilean moons are presently visible.

Steve Adachi will show how to tune up a German Equatorial mount. Learn some maintenance hints to protect your investment, and keep it in perfect running order.

Chuck Grant will talk about his preparations and equipment selection for the upcoming total solar eclipse in 2017 (and invariably wax poetic about his recently delivered Lundt solar telescope!). Hopefully, if the weather improves, Chuck will be able to tell us about his experience watching the Mercury transit of the Sun that will be visible this Monday morning (May 9), with the event underway at sunrise.

Rich Combs will discuss progress on the club scope upgrade and discuss the pitfalls of using trusses for amateur scopes.

We won't be surprised if a few other club members get the bug and have something to add, so join us for this one of a kind event. If you have a topic to add, contact Rich Combs (programs@trivalleystargazers.org) so he can be sure to fit you into the agenda.

We want you!

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News & Notes

2016 TVS Meeting Dates

The following lists the TVS meeting dates for 2016. 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
May 20	May 23	
Jun. 17	Jun. 20	May 27
Jul. 15	Jul. 18	Jun. 24
Aug. 19	Aug. 22	Jul. 29
Sep. 16	Sep. 19	Aug. 26
Oct. 21	Oct. 24	Sep. 30
Nov. 18	Nov. 21	Oct. 28
Dec. 16	Dec. 19	Nov. 25

Money Matters

As of the last Treasurer's Report on 4/18/16, our club's checking account balance is \$13,697.43.

Club Star Parties

This year's club star parties will be held on:

Saturday 5/28/16: H2O Open House

Saturday 6/25/16: Tesla Winery Star Party

Saturday 7/30/16: Tesla Winery Star Party

Saturday 8/27/16: H2O Open House

Saturday 9/24/16: Tesla Winery Star Party

The H2O Open Houses will be open to all club members and the public. On May 28 we will meet at the corner of Mines and Tesla and leave for H2O at 6:30 PM. Admission is \$3/car; please bring the exact amount. The site is primitive, with 2 pit toilets, and no running water. Bring warm clothes, and food and water for the evening. Use a flashlight with a red filter so that people's dark adaptation is not ruined by white light.

The Tesla Winery Star Parties will be open to club members and their guests. Start and end times for the parties will be announced later, but we usually plan to arrive at the observing site about 30 minutes before sunset and wrap up around midnight. Our Tesla Winery Star Parties will have a new twist this year. For those wishing to participate, each party will have a different observing theme. Additional suggestions include lunar features observing, planetary night, star cluster observing, beginner's night, and constellation identification. If you have an idea for another theme, please mention it to a board member during any meeting.

TVS Lick Observatory Tour: June 7th

TVS has arranged with Lick Observatory to have a behind

the scenes tour on June 7. Unless required for official duty, our tour guide is expected to be Dr. Paul Lynam, Resident Astronomer of Lick Observatory, who spoke at TVS a few months back. *The tour is open to active TVS members only, and is limited to 30 people.* The start time will be 6:30pm and the end time will depend on the weather and the interest of the group. Weather permitting, observing through the 36-inch Great Refractor is planned. Tours typically last 4.5 to 5 hours.

Rich Combs will be accepting payment for the tour, which is estimated at \$20/person, assuming that 30 people sign up for the event. Participation is on a first come, first serve basis. The current plan is to first accept payment at this month's meeting, and if fewer than 30 people sign up at the meeting, then reservations can be made via PayPal payment to TVS. The payments page is: <http://www.trivalleystargazers.org/pay.shtml>. To pay for the Lick Tour simply fill in \$20 under "Other" (or more, if paying for more than one person), write "Lick Observatory Tour" in the "Explanation" box, and then click on "Pay Now". The advantage of using our PayPal account is that refunds can easily be issued in the event that the tour is overbooked. If there is sufficient interest, it may be possible to arrange for a second tour at a later date.

Calendar of Events

May 10, 12:00pm

What: Climate Simulations of Pluto in the Wake of the New Horizons Flyby

Who: Angela Zalucha, SETI Institute

Where: SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA

Cost: Free

Before the flyby of NASA's New Horizons spacecraft, one of the major sources of data about Pluto's atmosphere was ground-based observational data of light intensity as Pluto moved in front of a background star. From these data the temperature of Pluto's atmosphere as a function of altitude was derived using various techniques. These techniques rely on knowledge of the vertical temperature structure of Pluto's atmosphere before doing the calculation from light intensity to temperature, the very property that is being sought. Here I will make the distinction between the "inverse problem" and "forward problem" of analyzing ground-based stellar occultation data, and how we can ensure that we are comparing "apples to apples" when comparing stellar occultation data, model results, and data from other sources.

Header Image: Graphic of Blazar OJ287, which consists of 2 super-massive black holes. Credit: Gary Poyner. See: <http://www.eureka-lert.org/multimedia/pub/110849.php>

Calendar of Events (continued)

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

May 11, 7:00pm

What: Finding a New Earth: Exoplanets and the Habitable Zone
Who: Stephen Kane, San Francisco State University
Where: Smithwick Theatre, 12345 El Monte Road, Los Altos Hills, CA 94022
Cost: Free, \$3 parking (\$1 dollar bills or coin required)

Over the past two decades, more than 1,500 new planetary systems have been discovered, many of which include planets quite different from those in our own Solar System. A key step towards finding "Earth 2.0" will be to identify rocky planets that occupy the "Habitable Zone" of their stars. Dr. Kane will describe what the idea of a Habitable Zone means and show examples of known planets that lie in their star's Habitable Zone (even if the star is not like our sun). He will show how comparative planetology can be used for determining those properties of alien planets that dominate habitability.

For more information see: http://www.foothill.edu/news/newsfmt.php?sr=2&rec_id=4432 or phone 650-949-7888.

May 13, 7:15pm; June 10, 8:00pm

What: Friday Night Hikes
Who: Chabot Staff
Where: Chabot Space and Science Center, 10000 Skyline Blvd., Oakland, CA 94619
Cost: \$15 (does not include admission to the Center), RSVP recommended, Limited space, Call (510) 336-7373

Enjoy a hike through the beautiful redwoods! After the hike, stay and explore other amazing objects in the night sky through our telescopes (weather permitting) or tour the Telescope Makers Workshop. Hike will take place rain or shine.

See <http://www.chabotspace.org/events.htm> for more information,

or call (510) 336-7373.

May 14, 8:30pm

What: Searching for Life in Ocean Worlds of the Outer Solar System
Who: Dr. Chris McKay, NASA Ames Research Center
Where: Mt. Tamalpais State Park, Cushing Memorial Amphitheater, more commonly known as the Mountain Theater, Rock Spring parking area
Cost: Free

NASA's new program, "Ocean Worlds," focuses on the many oceans in the moons of the outer Solar System. Enceladus, Europa, and Titan are of particular interest. Where do we look, and how do we search for evidence of life?

For more information see: <http://www.friendsofmettam.org/astrometry/schedule>

May 17, 12:00pm

What: Charon: Pluto's Fascinating Moon from New Horizons
Who: Ross Beyer, SETI Institute
Where: SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA
Cost: Free

Charon is Pluto's large companion, and last summer it went from a distant point of light to a full-fledged world in human understanding. Join us as we discuss the interesting fractured geology of Charon. Dr. Ross Beyer, member of the New Horizons team and a Research Scientist at the SETI Institute will take you on a tour of the canyons, faults, craters, smooth plains, enigmatic mountains, and all manner of terrains that New Horizons observed as it flew through the Pluto system.

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

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Officers

President:
 Chuck Grant
president@trivalleystargazers.org

Vice-President:
 Rich Combs
vice_president@trivalleystargazers.org

Treasurer:
 Roland Albers
treasurer@trivalleystargazers.org

Secretary:
 Jill Evanko
secretary@trivalleystargazers.org

Volunteer Positions

AANC Representative:
 unfilled

Astronomical League Representative:
 Dennis Beckley
alrep@trivalleystargazers.org

Historian:
 Hilary Jones
historian@trivalleystargazers.org

Loaner Scope Manager:
 John Swenson
telescopes@trivalleystargazers.org

Newsletter Editor:
 Ken Sperber
newsletter@trivalleystargazers.org
 925-361-7435

Observatory Director/

Key Master:
 Chuck Grant
h2o@trivalleystargazers.org

Program Director:
 Rich Combs
programs@trivalleystargazers.org

Publicity Coordinator:
 Andy Coutant
publicity@trivalleystargazers.org

Refreshment Coordinator:
 Laurie Grefsheim

Star Party Coordinator:
 Eric Dueltgen
coordinator@trivalleystargazers.org

Webmaster:
 Hilary Jones
webmaster@trivalleystargazers.org

Web & E-mail

www.trivalleystargazers.org
info@trivalleystargazers.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 (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.

Calendar of Events (continued)

May 24, 12:00pm

What: 400 years of Planetary Cartography - Mapping Channels on Mars
Who: Henrik Hargatai, NASA Ames Research Center
Where: SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA
Cost: Free

Since Galileo, astronomers and planetary scientists work hard to draw accurate representations of planetary surfaces. Planetary mapping today is a tool of geological investigation, landing site selection and also a visual statement of our ever expanding horizon of discovery. From copper engravings to dynamic online maps, the technique of presenting planetary maps changed a lot. In this presentation I will show some early examples of how planetary maps can communicate unspoken preconceptions (no, its not the canals), and show how we mapped the Navua Valles, which may have episodically provided habitable environments on the inner rim of Hellas Basin on Mars. The talk is part of the International Map Year celebrations.

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

May 31, 12:00pm

What: Sniffing Alien Atmospheres: Exoplanet spectro photometry
Who: Daniel Angerhausen, Goddard Spaceflight Center
Where: SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA
Cost: Free

Dr. Angerhausen will give a short introduction to the science of extrasolar planets, in particular the technique of transit, eclipse and phasecurve spectro-photometry. He will describe his various projects in this emerging field using state of the art spectroscopic and photometric instruments on the largest ground based telescopes, the 'flying telescope' SOFIA (Stratospheric Observatory for Infrared Astronomy) and the Kepler and Hubble space telescopes.

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

June 7, 12:00pm

What: Quantum mechanics at the Macroscopic Scale
Who: Mark Kasevich, Stanford University
Where: SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA
Cost: Free

Quantum mechanics is a foundation of physics, chemistry and materials science. Still, there is an ongoing debate about the emergence of the classical, macroscopic world from the well-understood microscopic world of quantum mechanics. We contribute to this discourse by demonstrating quantum superposition of massive particles at the distance (0.5 m) and time scales (2 s) of everyday life, thereby advancing the state-of-the-art of atom de Broglie wave interferometry by nearly two orders of magnitude. In addition to testing a central tenet of quantum mechanics, we pave the way for new precision tests of gravity, including the possible observation of gravitational waves and tests of the equivalence principle. In related experimental work, we demonstrate that entangled clusters of approximately 1000 atoms can be used to achieve 10-fold improvement in the sensitivity of quantum sensors based on atomic transitions; the levels of performance achieved could not have been realized with any competing (non-entangled) method.

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

June 11, 8:30pm

What: The Beating Hearts of Galaxies
Who: Dr. Norbert Werner, Kavli Institute, Stanford
Where: Mt. Tamalpais State Park, Cushing Memorial Amphitheater, more commonly known as the Mountain Theater, Rock Spring parking area
Cost: Free

Did you know that black holes can blow bubbles? Join us on a fascinating journey through the Universe where you will learn about the intimate connection between the intergalactic gas, the birth and death of stars and galaxies, and the growth of supermassive black holes in the centers of galaxy clusters.

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

June 13, 7:30pm

What: New Horizons, NASA's Pluto-Kuiper Belt Mission
Who: Dr. Jeffrey Moore, NASA
Where: California Academy of Science, 55 Music Concourse Dr., Golden Gate Park, San Francisco, CA
Cost: Advanced ticketing required. Academy members \$8, Seniors \$10, General \$12. Reserve a space online or call 1-877-227-1831.

In 2006, NASA dispatched an ambassador to the planetary frontier, The New Horizons spacecraft. After 10 years and more than 3 billion miles, on a historic voyage that has already taken it over the storms and around the moons of Jupiter, New Horizons has shed light on new kinds of worlds on the outskirts of the solar system. On July 14, 2015, New Horizons flew 12,500 km (7,800 mi) above the surface of Pluto and

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Calendar of Events (continued)

continues into rare territory, as just the fifth probe to traverse interplanetary space so far from the sun and the first ever to travel to Pluto.

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

June 14, 12:00pm

What: Evolution of the Solar System Inferred from Sm-Nd Isotopic Studies

Who: Lars Borg, Lawrence Livermore National Lab

Where: SETI Institute Colloquium, Microsoft Silicon Valley Campus (Galileo Room), 1065 La Avenida St., Mountain View, CA

Cost: Free

Dr. Borg has recently conducted high precision SmNd isotopic analyses of a suite of 11 Martian basaltic meteorites in order to better constrain the age of planetary core formation on Mars. Dr. Borg will show how these data can be used to evaluate the merits and disadvantages of various mathematical approaches that have been employed in previous isotopic work on Martian core formation.

Dr. Borg will explain how Late accretional heating of Mars could either be associated with protracted accretion occurring at a quasi-steady state or alternatively be associated with a late giant impact. If this scenario is correct, then accretion of Mars-sized bodies takes up to 60 Ma and is likely to be contemporaneous with planetary core formation.

Dr. Borg will explain how this further challenges the concept that isotopic equilibrium is attained during primordial evolution of planets, and may help to account for geochemical evidence implying addition of material into planetary interiors after core formation was completed.

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

Journal Club By Ken Sperber

Ice Cube, Big Bird, and Blazars

Ice Cube is a neutrino detector located in Antarctica. Spread over a cubic kilometer, it consists ~5500 optical sensors deployed on 86 strings that extend to depths of 1.5-2.5km in the clear ice. Neutrinos rarely interact with matter, with more than 50 billion passing through every square centimeter every second. When neutrinos interact with water molecules, they can create leptons, which if energetic enough will emit Cherenkov radiation visible to the detectors. The Ice Cube science program is devoted to improved understanding of extreme astrophysical phenomena, such as Gamma-

Ray bursts, black holes, neutron stars, supernovae, and dark matter. Between May 2010 and May 2013 Ice Cube detected 37 neutrinos with energies ranging from 30 Tev to 2 Pev. Big Bird, as well as Bert and Ernie, are the names given to the highest energy neutrinos observed by Ice Cube. Their energies are about 2Pev, 1Pev, and 1Pev, respectively. One Pev (peta-electron volt) is a million billion (10^{15}) electron volts. For comparison, the energy of a visible light photon is only about 1.5 - 3.5 electron volts (wimpy, wimpy, wimpy).

The origin of such energetic neutrinos has been the subject of much debate. Higher energy events occur less often than lower energy events, and it has been suggested that it may be possible to identify the source of such extreme energetic neutrinos, such as active galactic nuclei. However, because the leptons that generate the Cherenkov radiation scatter about, Ice Cube can only "pinpoint" the direction from which the neutrino originated to within a radius of 10-20 degrees. As such, additional observations are required to assess the origin of the neutrinos.

Kadler et al. (2016, Nature Physics, doi: 10.1038/NPHYS3715) were interested in determining the origin of the Big Bird neutrino detected by Ice Cube on December 4, 2012. To do so, would require combining the Ice Cube results with satellite and ground-based observations. Judiciously watching the sky, the Fermi Gamma-Ray Space Telescope detected a 15-30x increase in Gamma-Ray emission from the Blazar PKS B1424-418 during 2012. This brightening occurred during the period when Big Bird was detected at Ice Cube, and the Blazar fell within the area of sky from which Big Bird originated. But, other Blazars and active galaxies were in the suspected source direction. Fortunately, the TANAMI (Tracking Active Galactic Nuclei with Austral Milliarcsecond Interferometry) project was observing about 100 AGN's in the Southern sky. TANAMI uses interferometry to link the telescopes of the Australian/South African Long Baseline Array, thus providing about 1 milliarcsecond spatial resolution. TANAMI found that the jet of PKS B1424-418 brightened by a factor of 4 during the period of the outburst detected by Fermi. No other AGN's in the vicinity exhibited such changes. The authors analysis indicates that they are 95% confident that Big Bird is associated with the outburst from Blazar PKS B1424-418.

Blazar, what's a Blazar? Blazar's belong to a class of objects known as active galactic nuclei (AGN). AGN are powered by supermassive black holes (SMBH) that are believed to lie at the center of nearly every galaxy. As material spirals into the SMBH it heats up due to friction and emits high energy radiation. While the SMBH of an AGN has a voracious appetite, much of the material is not consumed, but is rather collimated into jets that shoot out perpendicular to the rotating accretion disk. The level of activity of the AGN, and the type

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

All times are Pacific Daylight Time.

May

- 9 Mon Mercury transits the Sun (begins before sunrise; midpoint 7:58am, ends 11:42am; see p.48, May S&T)
- 13 Fri First-Quarter Moon (10:02am)**
- 13 Fri The Moon is 3-4 degrees below Regulus (evening)
- 14 Sat The Moon is about 4 degrees below Jupiter (evening)
- 21 Sat Full Moon (2:14pm)**
- 21 Sat Mars reaches opposition, and is located about 7 degrees below the Moon
- 22 Sun Saturn is about 4 degrees to the right of the Moon
- 29 Sun Last-Quarter Moon (5:12am)**
- 30 Mon Mars is 0.5AU from Earth, the closest in 10.5 years, with a diameter of 18.6 arc seconds

June

- 2 Thu Saturn at opposition, visible all night in Ophiuchus
- 3 Fri Crescent Moon 2 degrees below Mercury, binoculars suggested (20-30 minutes before sunrise)
- 4 Sat New Moon (8:00pm)**
- 9 Thu Regulus, the brightest star in Leo, is 7 degrees above and left of the crescent Moon (Evening)
- 10 Fri The Moon is halfway between Jupiter and Regulus
- 11 Sat The Moon forms a triangle with Jupiter and Sigma Leonis
- 12 Sun First-Quarter Moon (1:10am)**

of radiation emitted define the various subclasses of AGN.

The subclasses include radio galaxies, Seyfert galaxies, quasars, and blazars. Radio emission occurs due to the synchrotron process in which charged particles spiral in magnetic fields when the jet interacts with extragalactic material. Seyfert galaxies have AGN that are about as bright as all of the stars in the galaxy, with the host galaxy being detectable. You might be surprised to know that you've probably seen one of more Seyfert galaxies, with M51, M66, M77, M81, M87, M88 and M106 being members of this class. Quasars are about 100x brighter than Seyfert galaxies, and their host galaxies are not usually detectable. Also, quasars are typically associated with galaxies that are billions of light years distant. When the jet of a quasar is directed toward Earth, it is termed a Blazar.

Despite their great distance, some Blazars can be seen in backyard telescopes. Last month, TVS Dave Lackey reported that he had seen Blazar Q1634+706, 14.14mag, whose light has taken ~8.6 billion years to reach us (see S&T July 2012, Sue French, Deep-Sky Wonders). I observed Blazar 3C454.3 at about 15.2mag in my 20" scope at H20 in late June 2014. This was after an outburst earlier in the month when it peaked at 13.5mag. Another interesting Blazar is OJ287, located about 3.5 billion light years distant. OJ287 is a binary SMBH that has periodic outbursts when the 100 million solar mass SMBH

crashes through the accretion disk of the 18 billion solar mass SMBH about which it orbits (see the header image on p. 1). This scenario was confirmed by successful predictions of the outbursts seen in December 2015. Valtonen et al. (2016. ApJL, 819, L37, doi:10.3847/2041-8205/819/2/L37) predicts that the next two outbursts are due in 2019 and 2022. Though some Blazars can be seen as point sources in amateur telescopes, there is added satisfaction when you realize the complexity of the physics at work, and seeing action that is taking place, in some cases, before the Earth was even created!

For more information see: <http://icecube.wisc.edu/> ; <http://kipac-web.stanford.edu/research/agn/>; <https://en.wikipedia.org/wiki/Blazar>; <https://en.wikipedia.org/wiki/Quasar>; https://en.wikipedia.org/wiki/Seyfert_galaxy; <http://hyperphysics.phy-astr.gsu.edu/hbase/electric/ev.html>; <https://en.wikipedia.org/wiki/Neutrino>; <https://www.sciencedaily.com/releases/2016/03/160310111931.htm>; <http://aasnova.org/2016/03/23/dance-of-two-monster-black-holes/>; <http://www.nature.com/nature/journal/v452/n7189/full/nature06896.html>; <http://www.nasa.gov/feature/goddard/2016/nasas-fermi-telescope-helps-link-cosmic-neutrino-to-blazar-blast>; <http://www.universetoday.com/112744/observing-alert-distant-blazar-3c-454-3-in-outburst-visible-in-amateur-telescopes/>

Hubble Shatters The Cosmic Record For Most Distant Galaxy

By Dr. Ethan Siegel

The farther away you look in the distant universe, the harder it is to see what's out there. This isn't simply because more distant objects appear fainter, although that's true. It isn't because the universe is expanding, and so the light has farther to go before it reaches you, although that's true, too. The reality is that if you built the largest optical telescope you could imagine -- even one that was the size of an entire planet -- you still wouldn't see the new cosmic record-holder that Hubble just discovered: galaxy GN-z11, whose light traveled for 13.4 billion years, or 97% the age of the universe, before finally reaching our eyes.

There were two special coincidences that had to line up for Hubble to find this: one was a remarkable technical achievement, while the other was pure luck. By extending Hubble's vision away from the ultraviolet and optical and into the infrared, past 800 nanometers all the way out to 1.6 microns, Hubble became sensitive to light that was severely stretched and redshifted by the expansion of the universe. The most energetic light that hot, young, newly forming stars produce is the Lyman- α line, which is produced at an ultraviolet wavelength of just 121.567 nanometers. But at high redshifts, that



line passed not just into the visible but all the way through to the infrared, and for the newly discovered galaxy, GN-z11, its whopping redshift of 11.1 pushed that line all the way out to 1471 nanometers, more than double the limit of visible light!

Hubble itself did the follow-up spectroscopic observations to confirm the existence of this galaxy, but it also got lucky: the only reason this light was visible is because the region of space between this galaxy and our eyes is mostly ionized, which isn't true of most locations in the universe at this early time! A redshift of 11.1 corresponds to just 400 million years after the Big Bang, and the hot radiation from young stars doesn't ionize the majority of the universe until 550 million years have passed. In most directions, this galaxy would be invisible, as the neutral gas would block this light, the same way the light from the center of our galaxy is blocked by the dust lanes in the galactic plane. To see farther back, to the universe's first true galaxies, it will take the James Webb Space Telescope. Webb's infrared eyes are much less sensitive to the light-extinction caused by neutral gas than instruments like Hubble. Webb may reach back to a redshift of 15 or even 20 or more, and discover the true answer to one of the universe's greatest mysteries: when the first galaxies came into existence!

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!

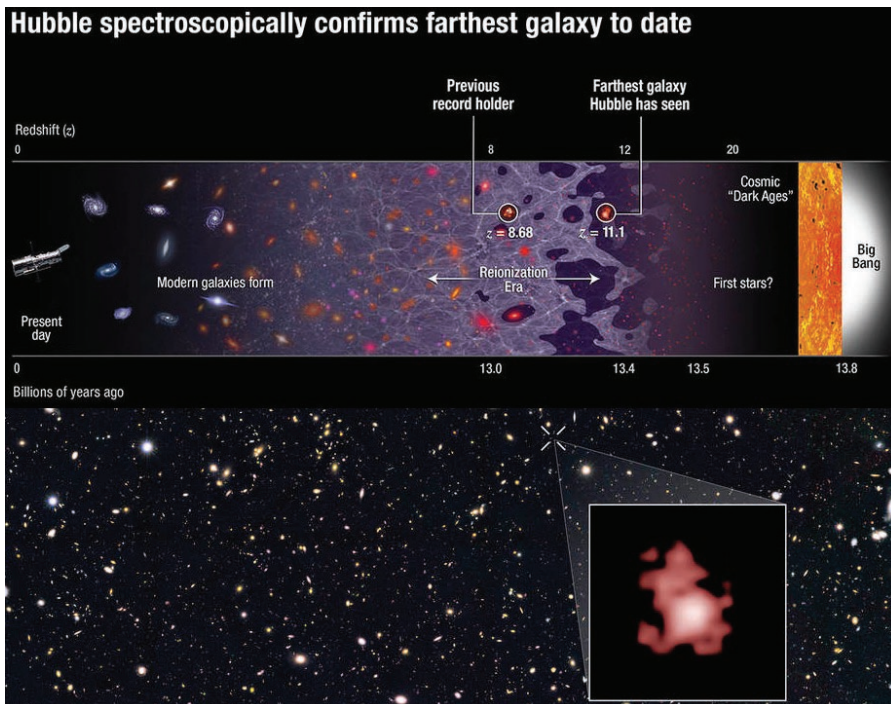


Image Credit: (top); NASA, ESA, P. Oesch (Yale University), G. Brammer (STScI), P. van Dokkum (Yale University), and G. Illingworth (University of California, Santa Cruz) (bottom), of the galaxy GN-z11, the most distant and highest-redshifted galaxy ever discovered and spectroscopically confirmed thus far.



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

Tri-Valley Stargazers Membership Application

(or apply for membership online: www.trivalleystargazers.org/membership.shtml)

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.

Magazine Subscriptions (optional): Discounted subscriptions are available only to new subscribers. All subsequent renewals are handled directly with the magazine publishers.

_____ One-year subscription to Sky & Telescope magazine (\$32.95).

_____ One-year subscription to Astronomy magazine (\$34).

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 other than other club members and the Astronomical League without your express permission.

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