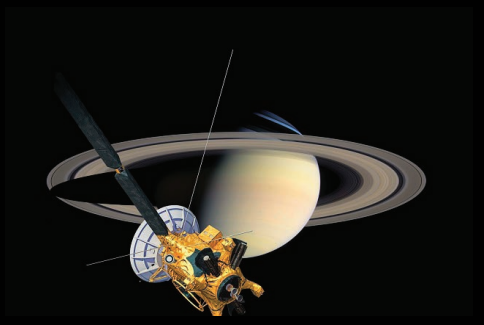
PRIMEFOCUS

Tri-Valley Stargazers

January 2016



TVS

Tri-Valley Stargazers

Meeting Info

What:
The History and Science of Lick Observatory

Who:
Dr. Paul Lynam

When:
January 15, 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

Inside

January Meeting

The History and Science of Lick Observatory

Dr. Paul Lynam

Caption: 3-meter Shane Telescope at Lick Observatory. Credit: Ken Sperber

Lick Observatory, wholly owned and operated by the University of California, was the first astronomical observatory purpose-built at altitude. It demonstrated the practicality of large-scale glass substrate reflecting telescopes for research. It was the fulcrum upon which the United States pivoted to dominance in observational astronomy at the close of the 19th century and the dawn 20th. This presentation offers a little known history of James Lick, what motivated him to establish Lick Observatory and the processes and people that lead to the establishment of what was for decades the world's foremost astronomical observatory, located in the county of Santa Clara. Even prior to completion, Lick Observatory was making important discoveries, developing technologies and setting standards. It continues to train generations of scientists and inspire the wider public --- a role it has fulfilled for over 100 years. Lick remains at the forefront of scientific and technological advances, annually enabling over 200 Californian astronomers to undertake and publish front line, cutting-edge research. Lick continues to pioneer and has much more work to do. Some outstanding contributions from Lick's history and current work shall be highlighted, as well as some prospects for the future.

Dr. Paul Lynam is an astronomer and Morrison fellow at Lick Observatory, which is located on Mount Hamilton. An amateur astronomer since childhood, he received a B.Sc. (honours) in physics from the University of Central Lancashire, a M.Sc. in physics from the University of Kent at Canterbury, and in 2000 a Ph.D. in astrophysics from Liverpool John Moores University. He subsequently worked at the Max-Planck-Institute for Extraterrestrial Physics, the headquarters of the European Southern Observatory, including a Chile-based ESO fellowship supporting operations of the Very Large Telescope at Cerro Paranal and later as an operations astronomer at Paranal. In 2011 Paul Lynam joined the staff of Lick Observatory. His research focuses on properties of giant galaxies, clusters of galaxies, the large-scale structure of the Universe, and cosmic flows. A regular contributor to public outreach activities, Paul Lynam is also a member of the Institute of Physics and a Fellow of the Royal Astronomical Society.

News & Notes

2016 TVS Meeting Dates

The following lists the TVS meeting dates for 2015. 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**
Jan. 15	Jan. 18	
Feb. 19	Feb. 22	Jan. 29
Mar. 18	Mar. 21	Feb. 26
Apr. 15	Apr. 18	Mar. 25
May 20	May 23	Apr. 29
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 December 21, 2015 the TVS checking account balance is $12,438.19.

TVS 2016 Dues are Due

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. The term of membership is one calendar year - January through December. Note: As an option, Patron Membership, which grants use of the club's 17.5" reflector at H2O, has once again become available at the annual rate of $100.00.

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.

Comet Catalina Now Visible

Comet Catalina (C/2013 US10) has moved into the Northern Hemisphere. Presently, it is bordering on visibility with the unaided eye. The comet crossed into Canes Venatici on January 9, is closest to Earth on January 12 (66.9 million miles), and crosses into Ursa Major on January 14, when it will be about 1 degree north of Alkaid. On January 16 it will be about 2 degrees southwest of M101, and on the 17th it will be about 3.5 degrees northeast of Mizar. Many excellent photos of the comet have been posted on the internet, including some that show the tail interacting with the solar wind. For more information see: http://www.skyandtelescope.com/observing/comet-catalina-sails-into-northern-skies111120151111/

Calendar of Events

January 12, 12:00pm

What: Life in the Universe — the Breakthrough Initiatives
Who: S. Pete Worden , Breakthrough Initiatives and Executive Director, Life in the Universe Division
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

On July 20, 2015, the 46th anniversary of the Apollo 11 moon landing, the Breakthrough Prize Foundation announced in London, UK a new initiative to study life in the universe. The announcement was made by Silicon Valley billionaire Yuri Milner and physicist Steven Hawking. The Breakthrough Initiatives currently consist of two primary elements, Breakthrough Listen which is a $100M renewed search for intelligent extraterrestrial signals, and Breakthrough Message, a global competition with a $1M prize to create, but not send a message representing humanity. S. Pete Worden, the former Center Director of the NASA Ames Research Center, is the Chairman of the Breakthrough Prize Foundation. He will talk about these initiatives in the broader context of our search for life in the universe.

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

January 19, 12:00pm

What: Observing the Reentry of Space Debris WT1190F
Who: Peter Jenniskens, SETI Institute
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

Dr. Jenniskens will describe the airborne observations he took

Header Image: Cassini at Saturn (artists impression). Credit: NASA/JPL-Caltech

part in of the re-entry of space debris on Nov 13, 2016. The International Astronomical Center (IAC) and the United Arab Emirates Space Agency recently hosted a team of veteran U.S. and German observers of spacecraft re-entries, including SETI Institute research scientist Peter Jenniskens, to study the predicted re-entry of an approximately 1-meter piece of space debris near Sri Lanka on November 13, 2015. "What makes the return of this man-made object so special," says IAC director Mohammad Odeh, "is that it moves on a very elongated orbit, returning to Earth only once every 23 days. When WT1190F, as it is called, finally hits the Earth's atmosphere, it comes in steeper and faster than normal."

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

January 23, 11:00am-4:00pm

What: Challenger Commemoration
Who: You/Chabot Staff
Where: Chabot Space and Science Center, 10000 Skyline Blvd., Oakland, CA 94619
Cost: Free with general admission

Join Chabot as we honor those astronauts lost on the Challenger Space Shuttle the morning of January 28, 1986. Learn what it's like to prepare for a mission to space in our astronaut training lab, discover some of the lessons developed by Christa McAuliffe (intended to be the first teacher in space), learn about space travel with demonstrations throughout the Center, and even take a simulated mission to Mars.

See http://www.chabotspace.org/events.htm for more information, or call (510) 336-7373..

February 2, 12:00pm

What: Exoplanet Spectroscopy with Diffraction Primary Objective Telescopy
Who: Tom Ditto, NIAC
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

When diffraction is employed as the primary collector modality of a telescope instead of reflection or refraction, a new set of performance capabilities emerges. A diffraction-based telescope forms a spectrogram first and an image as secondary data. The results are startling. In multiple object capability, the diffraction telescope on earth can capture 2 million spectra to R > 100,000 in a single night, better for a census of exoplanets by radial velocity than any prior art. In a space telescope in a direct observation mode, this type diffraction primary objective could reveal spectral analyses of individual exoplanets. We introduce three embodiments: THE MOST, HOMES and ADEDPT.

Tom Ditto has served as a Fellow of NASA Advanced Innovative Concepts and a P.I. in the National Science Foundation SBIR program working in holographic optics. He is also a Fellow of the Guggenheim Foundation, National Endowment for the Arts, and the American Film Institute. He promises a rousing media presentation.

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

February 9, 12:00pm

What: Geology After Pluto
Who: Jeff Moore, NASA Ames Research Center
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

Jeff Moore is the lead of the New Horizons Geology Team. He will talk about the discoveries made by the New Horizons mission on the fascinating fly by of the dwarf planet Pluto.

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

February 16, 12:00pm

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Calendar of Events (continued)

What: Potentially Biogenic Carbon preserved in a 4.1 Billion Year Old Zircon
Who: Elizabeth Bell, UCLA
Where: SETI Headquarters, 189 N. Bernardo Ave., Mountain View, CA
Cost: Free

Details unavailable.

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

February 22, 7:30pm

What: Calling the Cosmos: How to Talk with Extraterrestrials
Who: Dr. Douglas Vakoch, President, SETI International
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.

For over a half century, astronomers engaged in SETI—the Search for Extraterrestrial Intelligence—have pointed radio telescopes to the heavens, seeking scientific evidence for life beyond Earth. If we succeed in detecting a signal from another world, what should we say in response? Should we do more, right now, to make ourselves known in the universe, even before first contact? Or is it dangerous to shout in the cosmos when we don't know who's out there? Dr. Vakoch will take you on a journey through our solar system and beyond as he explores the Pioneer plaque and the Voyager recording that are carried on spacecraft launched by NASA, placed there on the unlikely chance that these spacecraft, now drifting aimlessly through the galaxy, will someday be intercepted by advanced civilizations. Dr. Vakoch will argue that we should move beyond the symbolic messages that we've already sent into the cosmos. Instead, we should begin an ambitious project to transmit powerful, information-rich messages to nearby stars. If we can succeed in explaining to extraterrestrials what it's like to be human, we might even intrigue them enough to get a reply.

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

Journal Club By Ken Sperber

Taking the Temperature of Saturn's Rings

Saturn and its rings are always a "hit" at star parties. For many of us, our recollection of first viewing Saturn remains as vivid today as it was in childhood. We are privileged to live in the golden age of planetary discovery. As a boy I remember the 1965 flyby of Mars by Mariner 4 and watching its first images of the cratered surface being revealed line by line on my grandparents' TV. As young teen I recall the Pioneer missions that extended man's reach by providing our first reconnaissance of the outer solar system. Soon thereafter the Voyager missions provided a more comprehensive assessment of Jupiter and Saturn, with Voyager 2 also visiting Uranus and Neptune. Most recently, the New Horizons spacecraft completed our initial survey of the main bodies of the solar system with a flyby of Pluto. Wow, a front row seat to the exploration of the Solar System!!!

While the afore-mentioned missions were all flybys, Cassini, Earth's sentinel at Saturn, has been in orbit around Saturn since 2004. Dashing through the ring-plane on arrival, worries about the spacecraft's survival were for nought, luckily. When Cassini arrived at Saturn, it was late winter in the Saturnian Northern Hemisphere. The nominal mission ended in June 2008, and with the spacecraft in excellent health the Cassini Equinox mission commenced. At equinox in August 2009 the ring-plane would coincide with Saturn's orbital plane, and thus be edge-on to sunlight. As such, the rings would essentially disappear from view since they are so thin, being about 20-100 meters thick. As seen on page 5, the rings were just coming back into view 1.25 days after the spring equinox. Cassini provided this unique image since it was 20 degrees above the ring plane at the time the image was taken. As the rings passed though equinox there was an opportunity for Cassini to investigate the properties of the ring constituents.

The dramatic change in the amount of sunlight falling on the rings due to Saturn's seasons dominates the heating and thus the temperature of the rings. A secondary effect is the distance that Saturn is from the Sun, which varies from 9 to 10 astronomical units. Temperature variations of the rings also occur on diurnal time scales with the rings cooling when they pass through Saturn's shadow each day. Each of these different sources of temperature variation of the rings provides complementary information on the ring particle properties. At the equinox, the dominant source of ring heating is the infrared energy from Saturn. As such, the rings get progressively colder the farther away they are from Saturn. Furthermore, rings that are optically thin are warmer since they can be heated from above and below by energy radiating from both hemispheres of Saturn.

Morishima et al. (2015) used numerical models that take all of these factors into consideration, finding that they do a good job of predicting ring temperatures for all rings, except the A ring. At the equinox the A ring temperature was warmer than predicted, especially toward its center. After considering different possibilities, their analysis indicates that toward the center of the A ring the particles have higher thermal inertia.

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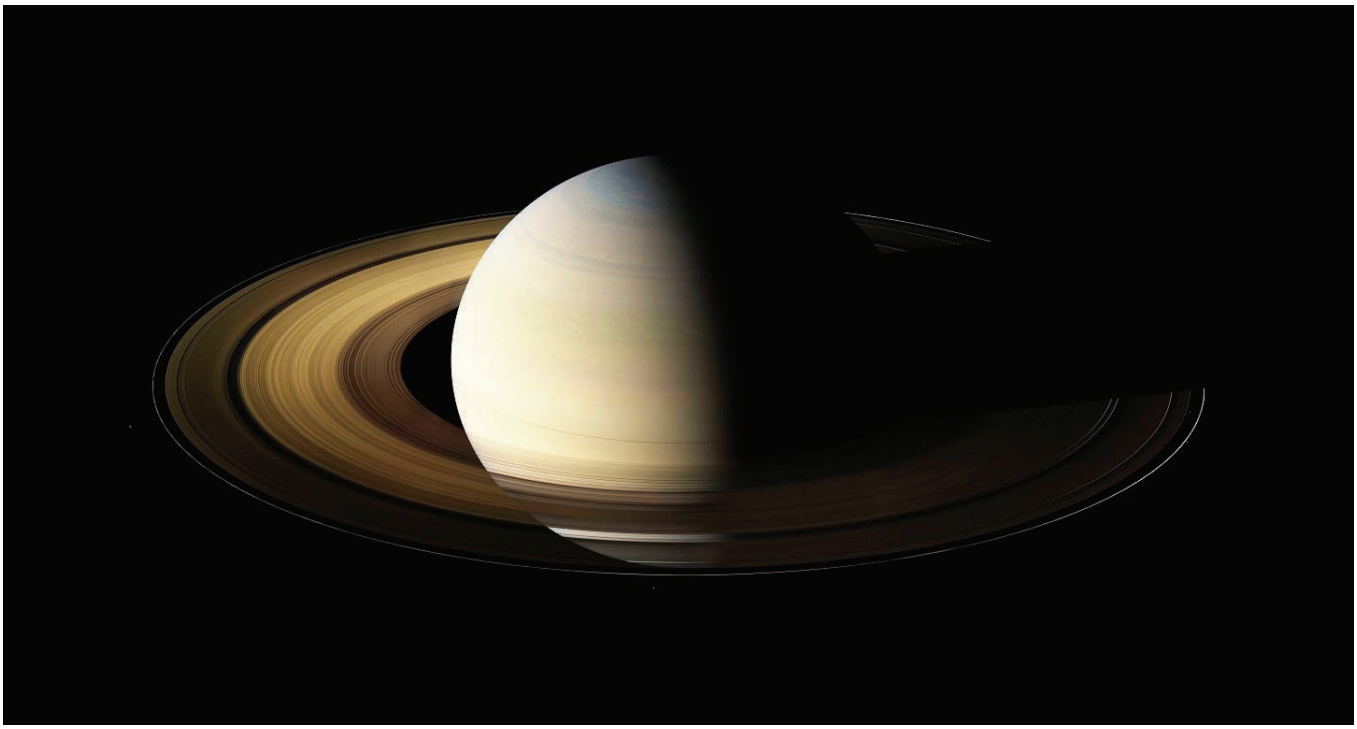

Image Caption: Cassini image of Saturn taken on August 12, 2009, 1.25 days after the spring equinox. Cassini was about 20 degrees above the ring plane and about 526,000 miles from Saturn. The outermost ring seen, the F ring, is very narrow and bright. Just interior to the F ring is the A ring, followed by the Cassini division and the B, C, and D rings. With no enhancement, the rings would be essentially invisible in this mosaic. To improve their visibility, the dark (right) half of the rings has been brightened relative to the brighter (left) half by a factor of three, and then the whole ring system has been brightened by a factor of 20 relative to the planet. So the dark half of the rings is 60 times brighter, and the bright half 20 times brighter, than they would have appeared if the entire system, planet included, could have been captured in a single image. For more information see: http://photojournal.jpl.nasa.gov/catalog/PIA11667

Thus, as the outer portion of the particles cool down there is heat transport from the center of the particle to its surface to maintain the higher surface temperature.

For the warmer A ring particles the simplest scenario is that of a particle, 1-2 meters in size, for which the density and thermal inertia are uniform with depth. However, the best fit density of the uniform particle is too low to be consistent with the dynamical behavior of the A ring (self-gravity wakes, for those interested in the gory details.) Additionally, studies of diurnal variations of ring temperature indicate that ring particles have a fluffy exterior, at least 1 mm thick, surrounding a dense ice core. (The fluffy texture is believed to arise due to micro-meteoroid impacts that break up the particle). Compared to the diurnal cycle, the longer time that the particles are in the dark during the equinox allowed the authors to estimate whether the fluffiness extends deeper into the particle.

For the central warmest part of the A ring, the best fit particle diameter is about 1 meter, of which the fluffy exterior is about 10% of the radius, surrounding a water ice core. Toward the interior and exterior edges of the A ring, where the warming was not as large, the fluffy exterior takes up more of the particle radius with a smaller core and hence lower thermal inertia.

An important question is: Why are the denser particles with larger cores preferentially found toward the center of the A ring? One possibility is that embedded moonlets are shepherding the denser particles toward the center. In this case the A ring could be primordial since this injection of angular momentum would counteract the A ring resonances with Mimas, Janus, and Epimetheus that should cause the A ring to collapse on a time scale of 100 million years. Alternatively, in the absence of shepherding moonlets, the A ring might be less than 100 million years old, having been formed by destruction of a 100-km moon by a 10-km sized impactor. The location of the dense cores at the center of the ring are consistent with not enough time having elapsed for the denser chunks to have diffused across the A ring.

I hope I have conveyed to you some of the complexity of the Saturn ring system so that the next time you look at Saturn

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

All times are Pacific Standard Time.

January

9	Sat	Venus and Saturn less than 0.5 degrees apart in the southeast (dawn)
9	**Sat**	**New Moon (5:30pm)**
9-25	Mon-	Comet Catalina moves rapidly northward through Canes Venatici, Ursa Major, , Draco, and Camelopardalis
16	**Sat**	**First-Quarter Moon (3:26pm)**
19	Tue	The Moon occults Aldebaran (see p.49, January S&T)
23	**Sat**	**Full Moon (5:46pm)**
25	Mon	Regulus about 3 degrees from the Moon
27	Wed	Jupiter about 4 degrees above the Moon
29	Fri	Algol at minimum brightness for 2 hours centered on 6:05pm
30	Sat	The Moon is about 4 degrees to the upper-left of Spica. Mars is about 1.5 degrees from Alpha Librae
31	**Sun**	**Last-Quarter Moon (7:28pm)**

February

1	Mon	Mars 2-3 degrees from the last quarter Moon (predawn)
3	Wed	Saturn about 5 degrees below the Moon, Antares 8 degrees to the right/lower-right (~3am)
6	Sat	Mercury and Venus drawing close, crescent Moon nearby (dawn)
8-18	Mon-	Mercury and Venus ~4 degrees apart (dawn)
8	**Mon**	**New Moon (6:30am)**
14	**Sun**	**First-Quarter Moon (11:46pm)**
15-16	Mon	The Moon occults Aldebaran (1:03am on the 16th; see p.45, February S&T)
18	Thu	Algol at minimum brightness for 2 hours centered on 7:50pm
22	**Mon**	**Full Moon (10:20am)**
23	Tue	Watch the Moon move eastward relative to Jupiter
29	Mon	Mars about 5 degrees below the Moon (morning)

Journal Club (continued)

in a telescope you will have a greater appreciation for the hard work scientists have done to extract every bit of useful information sent back to Earth by Cassini. The best images of the rings will come just prior to Cassini's death plunge into Saturn in September 2017. The death plunge into Saturn will ensure that biological contamination of Enceladus or Titan by Cassini will never happen.

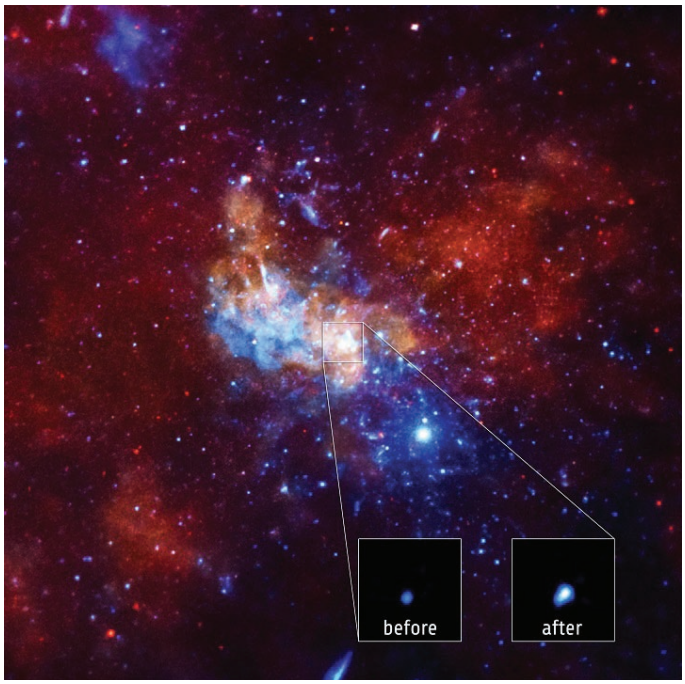
For more information see: http://astronomynow.com/2015/09/05/one-of-saturns-rings-is-not-like-the-others/ and http://saturn.jpl.nasa.gov/ Also see:

Morishima, R., et al. Incomplete cooling down of Saturn's A ring at solar equinox: Implication for seasonal thermal inertia and internal structure of ring particles. Icarus (2015), http://dx.doi.org/10.1016/j.icarus.2015.06.025

How Will We Finally Image the Event Horizon of a Black Hole?

By Dr. Ethan Siegel

One hundred years ago, Albert Einstein first put forth his theory of General Relativity, which laid out the relationship between spacetime and the matter and energy present within it. While it successfully recovered Newtonian gravity and predicted the additional precession of Mercury's orbit, the only exact solution that Einstein himself discovered was the trivial one: that for completely empty space. Less than two months after releasing his theory, however, the German scientist Karl Schwarzschild provided a true exact solution, that of a massive, infinitely dense object, a black hole.



Images credit: NASA/CXC/Amherst College/D.Haggard et al., of the galactic center in X-rays. Sagittarius A* is the supermassive black hole at our Milky Way's center, which normally emits X-ray light of a particular brightness. However, 2013 saw a flare increase its luminosity by a factor of many hundreds, as the black hole devoured matter. The event horizon has yet to be revealed.

One of the curious things that popped out of Schwarzschild's solution was the existence of an event horizon, or a region of space that was so severely curved that nothing, not even light, could escape from it. The size of this event horizon would be directly proportional to the mass of the black hole. A black hole the mass of Earth would have an event horizon less than a centimeter in radius; a black hole the mass of the sun would have an event horizon just a few kilometers in radius; and a supermassive black hole would have an event horizon the size of a planetary orbit.

Our galaxy has since been discovered to house a black hole about four million solar masses in size, with an event horizon about 23.6 million kilometers across, or about 40 percent the size of Mercury's orbit around the sun. At a distance of 26,000 light years, it's the largest event horizon in angular size visible from Earth, but at just 19 micro-arc-seconds, it would take a telescope the size of Earth to resolve it – a practical impossibility.

But all hope isn't lost! If instead of a single telescope, we built an array of telescopes located all over Earth, we could simultaneously image the galactic center, and use the technique of VLBI (very long-baseline interferometry) to resolve the black hole's event horizon. The array would only have the light-gathering power of the individual telescopes, meaning the black hole (in the radio) will appear very faint, but they can obtain the resolution of a telescope that's the distance between the farthest telescopes in the array! The planned Event Horizon Telescope, spanning four different continents (including Antarctica), should be able to resolve under 10 micro-arc-seconds, imaging a black hole directly for the first time and answering the question of whether or not they truly contain an event horizon. What began as a mere mathematical solution is now just a few years away from being observed and known for certain!

Note: This month's article describes a project that is not related to NASA and does not suggest any relationship or endorsement. Its coverage is for general interest and educational purposes.

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.