

ABOVE THE FOG

• BULLETIN OF THE SAN FRANCISCO AMATEUR ASTRONOMERS •

Vol. 64, No. 3 – March 2016

GENERAL MEETING

THE PRESIDIO . OBSERVATION POST . BUILDING 211

211 Lincoln Boulevard, San Francisco

7:00 pm Doors Open . 7:30 pm Announcements . 8:00 pm Speaker

**PRESIDIOTREE CUTTING ROAD DETOUR INFORMATION
FEBRUARY 22 THROUGH MARCH 24, 2016 – See next page**

March 15, 2016

DR. AMY FURNISS, Ph.D.

THE VIOLENT UNIVERSE OBSERVED WITH THE FERMI TELESCOPE



The Fermi Gamma-ray Space Telescope was launched into space in June 2008. The main instrument is the Large Area Telescope (LAT). Dr. Amy Furniss will present the Fermi-LAT instrument and highlight its most interesting results after seven years of operation. Gamma-ray observations open a new window into the universe, allowing us the study of exotic and violent processes. These photons are also an important tool in the search for the dark matter that pervades the universe. One expected signal is gamma rays from annihilations of massive dark matter particles, and the LAT has made by far the most sensitive searches for this process. The high-energy sky seen by the Fermi-LAT is quite dynamic, including explosions of massive stars and their remnants and supermassive black holes in the centers of distant galaxies. The Fermi-LAT also enabled the identification of many cosmic particle

accelerators, including supernova remnants and active galactic nuclei, which are far more powerful than the largest particle accelerator on Earth, the Large Hadron Collider in Europe.

Dr. Amy Furniss moved into a post-doctoral position at Stanford University for 2 years after completion of her PhD in Physics at UC Santa Cruz in 2013. She is now an Assistant Professor at Cal State University East Bay in Hayward California and continues to collaborate closely with connections at both UC Santa Cruz and Stanford.

!!!! NOTE RE NEXT MONTH'S MEETING LOCATION – FOR APRIL ONLY !!!!
PLEASE NOTE: NEXT MONTH'S (APRIL 19) MEETING WILL BE HELD AT THE PRESIDIO OFFICER'S CLUB, LOCATED AT THE OPPOSITE END OF THE PRESIDIO PARADE GREEN FROM OUR REGULAR OBSERVATION POST MEETING LOCATION
(SEE MAP ON THIRD PAGE SHOWING ROUTE FROM OBSERVATION POST TO PRESIDIO OFFICERS' CLUB)

Section of Lincoln Boulevard Closed for Preventive Maintenance Tree Work

February 22 through March 24, 2016

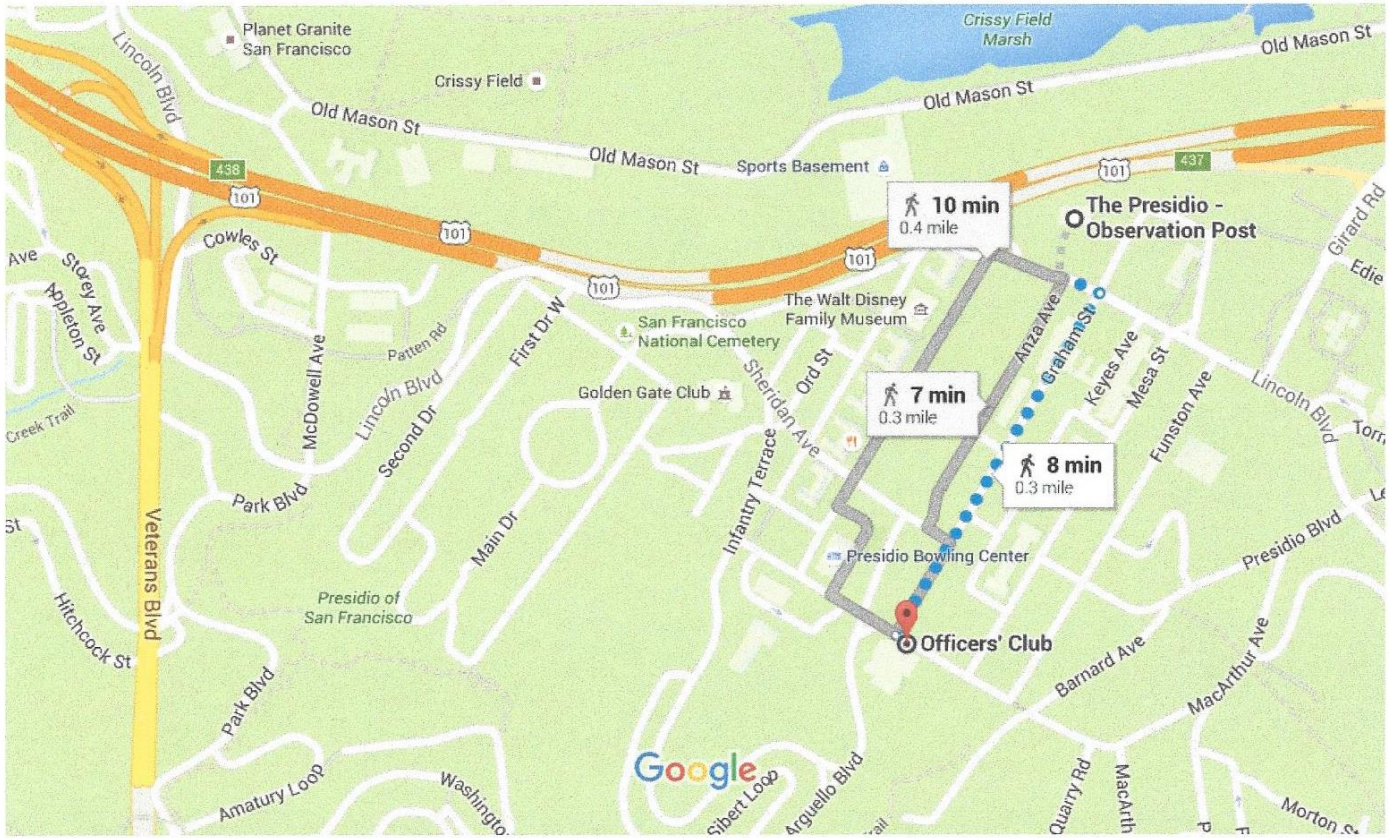
The section of Lincoln Boulevard between the cemetery entrance and the intersection with Park Boulevard/McDowell Avenue will be closed to vehicles for the duration of the project: Monday, February 22 through Thursday, March 24. The closure will be in effect seven days a week, 24 hours a day.

Detour Information

The eastbound detour route will be on McDowell Avenue, Mason Street, and Girard Road. The westbound detour route will be via Arguello, Washington, and Park Boulevards. Pedestrians and cyclists will be detoured to the Presidio Promenade trail adjacent to Lincoln Boulevard and may be stopped for a few minutes by personnel at the work zone while tree limbs are dropped.

The PresidiGo Around the Park Shuttle Crissy Field route will also use the westbound detour route, and PresidiGo stops at Montgomery/Sheridan, National Cemetery, and Building 682 (Schofield) will be closed. The PresidiGo South Hills route will not be affected.

During the closure period, the best way to access Crissy Field will be via the Marina Gate.



Map data ©2016 Google 500 ft

The Presidio - Observation Post

Use caution - may involve errors or sections not suited for walking

211 Lincoln Boulevard, San Francisco, CA 94129

- ↑ 1. Head east on Lincoln Blvd toward Anza Ave
----- 167 ft
- 2. Turn right onto Graham St
----- 0.3 mi
- ↶ 3. Turn left onto Moraga Ave
 - 📘 Destination will be on the right
 ----- 56 ft

Officers' Club

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

SFAA PRESIDENT'S NOTES FOR MARCH 2016

"Aha!"

Many of us can remember a specific moment or point in time where something clicked in our curious minds that made the lifelong connection with astronomy. For me it was the summer that I graduated from Ohio State and a good friend and I planned to travel across the country eventually making our way to San Francisco. We drove south from Columbus through the southern states to the Gulf of Mexico and then headed west to Texas. At this point we turned north into the southern part of New Mexico with its vast landscapes and drove up a section of the Guadalupe Mountains (formerly a reef in an ancient ocean) to Carlsbad Caverns National Park. The caverns alone are fascinating enough, deep and massive with a seemingly endless variety of incredible shapes of stone formed over millions of years. After our walking tour we sat in a stone amphitheater at the entrance to an opening of the caverns at dusk, listened to a Park Ranger describe a section of the caverns where the public is not allowed to go (you wouldn't want to anyhow, the Ranger emphasized) and watched as millions (and I do mean millions) of bats fly in a graceful, ascending spiral out of the caverns and into the night and feeding grounds in a river valley below. What a day! Huge caverns in a vast landscape with millions of bats – what could top this? After the bats had gone, we slowly walked to our vehicle and sat on the hood (it was a tough old IH TravelAll and could handle it) as the parking lot emptied and the rest of the tourists headed down the mountain to the motels in White's City. What a day!

Well, what about the night? We were perched at the edge of a mountain range that had a tremendous horizon in every direction. As we sat there the night sky grew darker from the sun now long set, but with no Moon, conversely lit up with innumerable stars everywhere and a swath of the sky dominated by the Milky Way so thick and bright I could hardly believe it was real and that I had never seen it before. The truth is, even though I had taken Astronomy 150 at OSU and had some knowledge of our galaxy, due to light pollution, humidity, dirty atmosphere, and not paying enough attention to what was visible, I had not seen so many stars and our galaxy this way before. It was overwhelming and it filled me with a wonder and fascination at the beauty of it all and an unquenchable curiosity to learn more and understand what I saw. The universe beckoned me that night in New Mexico and this would become a lifelong pursuit. Aha!

We would be interested in hearing about your "Aha!" moment when astronomy became your lifelong pursuit. SFAA members have a rich history to tell here and we think other members would relate and enjoy reading about such moments. Write it down and send your "Aha!" story to president@sfaa-astronomy.org and we will publish it in upcoming editions of Above The Fog. In fact, if we get enough response we would like to add an ongoing "Aha!" section to ATF.

Thanks,
Michael

Michael Patrick
President
San Francisco Amateur Astronomers



SFAA 2016 LECTURE SERIES UPCOMING LECTURES

CHANGE OF LOCATION FOR THIS MEETING !!!! ONLY !!!! TO PRESIDIO OFFICERS CLUB

April 19 DR. MARK MARLEY

THE NEW ERA OF EXOPLANET DISCOVERY



Although science fiction has long dreamed of their existence, it has only been 20 years since the announcement of the first confirmed extrasolar planets. We now know of thousands of worlds beyond our own solar system. Almost all of these planets were discovered by indirect means, mostly by searches for the subtle effects of these distant planets on their own suns. While astronomers have developed astounding methods for teasing out details about many of these planets, the vast majority will forever remain as little more than curves and dips on data plots. However as we enter the third decade of exoplanet science a new method of discovery is coming to the forefront: direct imaging. This method aims to block the light of stars so that the planets that orbit them can be directly detected. Directly imaged planets are not only somehow more satisfying, they also offer many more opportunities for in depth study since their light is naturally separated from that of their star. In my talk I will explain how direct imaging is already helping us to understand the origin and evolution of giant planets around young stars and I will discuss the promise this method holds in the search for life on Earth-like planets in the future.

Dr. Mark Marley is a Research Scientist at NASA's Ames Research Center in Mountain View. His research background includes studies on both solar system and extrasolar giant planets. He has served on multiple NASA teams helping to define the future of extrasolar planet discovery and characterization and is a member of the Gemini Planet Imager Exoplanet Survey team, which recently announced the discovery of its first directly imaged planet. Dr. Marley has been awarded the NASA Medal for Exceptional Scientific Achievement and has published 150 scientific papers. As a Consulting Professor he teaches courses on solar system and extrasolar planets at Stanford University.

May 17 DR. MARK SHOWALTER

Senior Research Scientist, SETI Institute

PLUTO ON THE HORIZON: OUR FIRST ENCOUNTER WITH THE DOUBLE PLANET



The more we learn about Pluto, the more interesting it becomes. In the last decade, four tiny moons have been discovered orbiting the central "binary planet," which consists of Pluto and its large moon Charon. Pluto itself has a thin atmosphere and shows signs of seasonal changes. Tantalizing evidence suggests that Charon may have volcanoes. However, even in our most powerful telescopes, Pluto and its moons are just dots in the sky. All of that changed on July 14, 2015, when NASA's New Horizons spacecraft flew past Pluto and provided our first close-up look at these distant worlds. In this lecture, Dr. Mark Showalter, a co-investigator on the New Horizons mission, will describe how he discovered two of the moons of Pluto and will discuss the results from the many first time images of Pluto from the New Horizons Mission.

His early work with Voyager data led to the discoveries of Jupiter's faint, outer "gossamer" rings and Saturn's tiny ring-moon, Pan. Starting in 2003, his observations with the Hubble Space Telescope led to the discoveries of "Mab" and "Cupid," small moons of Uranus now named after characters from Shakespeare's plays. In 2011, he began a Hubble observing program focused on Pluto, which led to the discoveries of two tiny moons. Their names, "Kerberos" and "Styx", were selected through an international naming campaign. Most recently, he discovered the 14th known moon of Neptune, whose permanent name has yet to be selected.

Dr. Mark Showalter is a Senior Research Astronomer at the SETI Institute who studies the dynamics of rings and small moons in the Solar System. He is the Principal Investigator of NASA's Planetary Data Systems, and works closely with the New Horizons Space Mission to Pluto. Dr. Showalter works on some of NASA's highest-profile missions to the outer planets, including Cassini, now orbiting Saturn, and New Horizons, which flew past Jupiter en route to its 2015 encounter with Pluto. Known for his persistence in planetary image analysis, Mark's work on the earlier Voyager mission led to his discovery of Jupiter's faint, outer "gossamer" rings and Saturn's tiny ring-moon, Pan.

June 2 MICHAEL PACKER CRACKING

GLOBULAR

CLUSTERS



The 160 spherical oceans of stars we call globular clusters (GCs) need aperture, good seeing and dark skies to resolve detail. But once observed to their core GC's can reveal an exquisitely rich sea of red giant and fuel spent stars that do not take us back to the big bang but rather show us time in its extreme. Michael's talk will cover the general properties of Globular Clusters and which ones to observe or image for detail. The talk will also show GC formation with some N-particle animation and the role these ancient clusters play in the new field of galactic archaeology.

Join San Francisco Amateur Astronomers on Mt. Tamalpais this summer to observe the many Globular Clusters made even more interesting after our speaker's presentation. Go to sfaa-astronomy.org for our complete observing schedule.

Michael Packer is an amateur astronomer of 25 years and lighting engineer designing optics for indoor and outdoor luminaires. He has a Masters of Physics from San Francisco State University and researched efficient lighting at Lawrence Berkeley National Laboratory.

SFAA FEBRUARY 6 MEMBERS NIGHT

Anthony Barreiro



PHOTO BY ROBERT HOLLOWAY

After being rained out for three consecutive months, SFAA finally had a decent night for our February 6 members night on Mount Tamalpais. There was a good turnout, at least 20 telescopes and over 40 members and guests. The early evening skies were partly cloudy, but we were still able to see a lot through the holes. While most people packed up and left by 10 pm, by 10:30 or 11, the sky was completely clear!

In this photo, SFAA secretary Anthony Barreiro is helping member Allison Broennimann align her telescope on the bright star Sirius in the constellation Canis Major, with Orion and Lepus visible to the right. Photo credit: Robert Holloway.

Our next Mt. Tam members night will be our annual Messier Marathon on Saturday March 5. SFAA members need to have a current 2016 California State Parks parking pass. If you need a new parking pass, please send an email with your mailing address to president@sfaa-astronomy.org.



Arduino and Astronomy - A year of tinkering at the Astronomical Society of the Pacific

The Astronomical Society of the Pacific is convening a focus group of tech-savvy astronomers interested in helping develop astronomy applications utilizing the Intel Edison and Curie microcontrollers. During a total of six sessions, participants will design prototype "make projects" focused on astronomy and space science content. For example, we may design and test Arduino controlled automated rockets, robotic tracking systems for telescopes, and automated systems for collecting spectroscopic data. The primary goal is to create a portfolio of engaging "Intel Inside" projects for amateur astronomers and astronomy enthusiasts that take advantage of the capabilities of the Intel Edison Development Board and Intel Curie Module.

Experience with programming and microcontrollers is preferred, however any background in actively using technology is acceptable. The sessions do not include basic training on Arduino or other microcontroller programming.

Participants will receive a \$125 stipend for each session they attend. They will also receive a SparkFun Starter Pack for Intel Edison (a \$120 value), Intel Curie module, and other materials to create usable (and wearable!) projects. Lunch is provided at each session.

When: First Session takes place on Saturday, April 16, 2016, 10:00am - 3:00pm (we will schedule two subsequent sessions during the April 16 session)

Where: Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco, CA

To apply to join this focus group, go to: <https://www.surveymonkey.com/r/ZZW29MQ>



**SFAA INVITED TO PARTICIPATE IN
ONE BOOK ONE MARIN
FEBRUARY 4 – APRIL 5, 2016**



Each year the Marin County Free Library (MCFL) chooses a book to be read and discussed during the same time period at all branches. “The goal of One Book One Marin is to build a stronger, enriched community through library utilization, community dialogue, and the exploration of literature and culture. A variety of community partners collaborate to bring the community interesting programming and events related to the book throughout a three-month period, February – April, each year. Anyone can participate. All events are free and open to the public.”*

In early 2016 the book chosen to be discussed is “The Martian”, by Bay Area author Andy Weir. Events will culminate at Dominican University in San Rafael with Michael Krasny of KQED interviewing Mr. Weir followed by a book signing.

A CALL FOR SFAA MEMBER TELESCOPES

The MCFL has invited the SFAA to be a focal point of events in One Book One Marin by setting up telescopes at five branch libraries for the public to observe selected objects and have them explained. In addition, the SFAA has requested publicity to suggest the attending public bring their own binoculars to the observing event so as to participate with their instrument as well as SFAA telescopes.

In 2013 the SFAA participated in a similar event when the One Book was “Packing for Mars” by Mary Roach. Public participation at each library location was around 50 enthusiastic people of all ages. Our efforts were well received by the public and the enthusiasm was mutual.

The dates and locations for our observing events are as follows:

Set up: 5:30; Talk 6:40; Viewing 7:00-8:15	
Tuesday, March 8	Fairfax Library
Thursday, March 10	Point Reyes Library
Set up: 6:30; Talk 7:40; Viewing 8:00-8:45	
Tuesday, April 5	Marin City Library

Participating SFAA members will have VIP seating at the interview of Andy Weir by Michael Krasny at Dominican University.

SFAA members interested in having fun sharing their telescope and knowledge of the universe with the public at these events should contact:

Michael Patrick
Email: mdpatric@pacbell.net

*Marin County Free Library website, One Book One Marin page



Camping at Mt. Tam after Star Parties



Anthony Barreiro

SFAA board members Scott Miller and Anthony Barreiro have been in touch with Roberto Walton, the supervising ranger for Mount Tamalpais State Park, to develop a plan for SFAA members to camp at Mt. Tam after our star parties, rather than needing to drive all the way down the mountain late at night in the dark. We now have three options:

- SFAA members will now be permitted to sleep in our vehicles at Rock Springs until 7:00 am after our star parties, year round. Tent camping is **not** allowed at Rock Springs. There are porta-potties at Rock Springs, but no running water and no trash containers. Please bring plenty of water, and take all your trash with you when you depart.
- SFAA members can go to Pantoll or Bootjack campground during the day before a star party, set up a tent, and pay for a space -- just like any other visitor.
- SFAA members can set up a tent in the overflow lot at Pantoll and pay for the space -- again, just like any park visitor. You need to be out of the overflow lot by 9:00 am.

If you use Pantoll or Bootjack campgrounds, please remember that other campers are sleeping, and be very quiet when you arrive at the campground.

SFAA will continue to coordinate with the State Park and the Friends of Mount Tamalpais to provide a safe and enjoyable experience for our members, and for visitors to our public astronomy programs. If you have any suggestions for improvements, please contact Scott Miller at hscottmil@gmail.com or Anthony Barreiro at anthonybarreiro@yahoo.com.

Total Solar Eclipse of 2016 Mar 09

Ecliptic Conjunction = 01:55:37.5 TD (= 01:54:29.5 UT)
 Greatest Eclipse = 01:58:19.5 TD (= 01:57:11.5 UT)

Eclipse Magnitude = 1.0450 Gamma = 0.2609

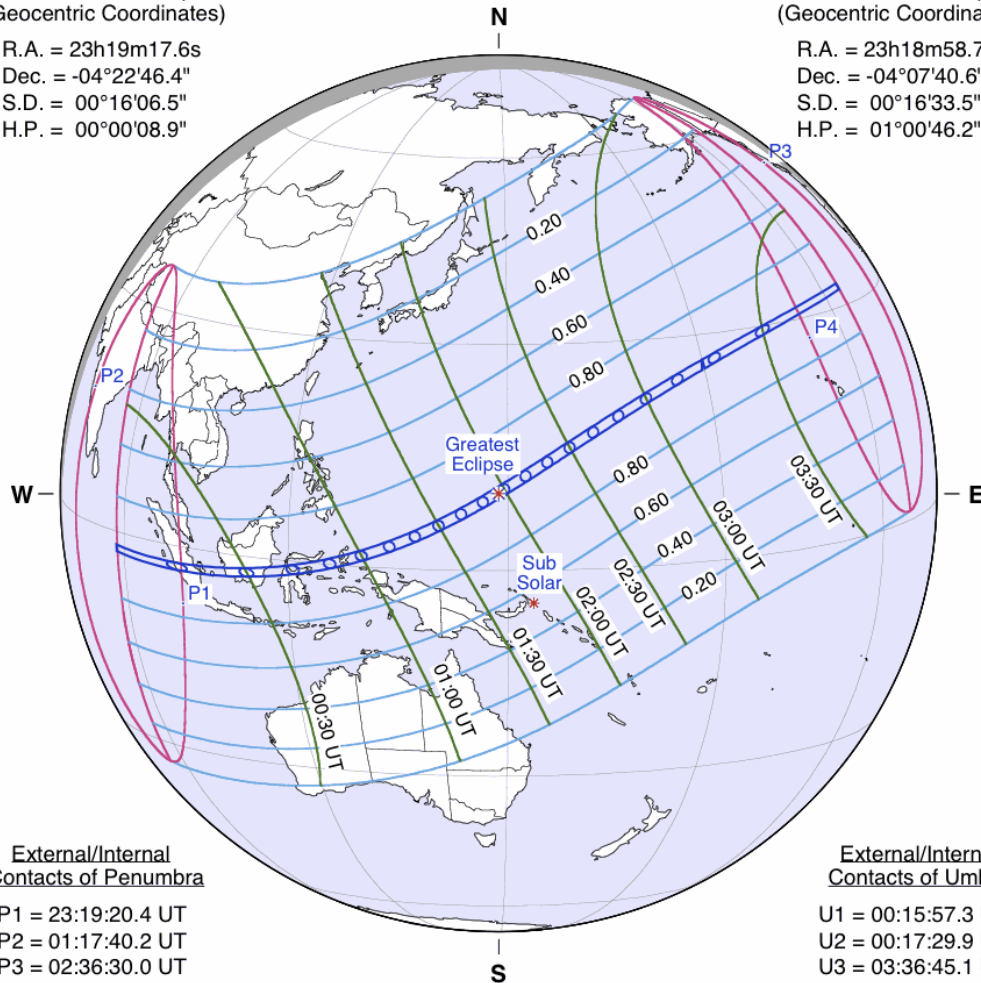
Saros Series = 130 Member = 52 of 73

Sun at Greatest Eclipse
 (Geocentric Coordinates)

R.A. = 23h19m17.6s
 Dec. = -04°22'46.4"
 S.D. = 00°16'06.5"
 H.P. = 00°00'08.9"

Moon at Greatest Eclipse
 (Geocentric Coordinates)

R.A. = 23h18m58.7s
 Dec. = -04°07'40.6"
 S.D. = 00°16'33.5"
 H.P. = 01°00'46.2"



External/Internal Contacts of Penumbra

P1 = 23:19:20.4 UT
 P2 = 01:17:40.2 UT
 P3 = 02:36:30.0 UT
 P4 = 04:34:55.4 UT

Constants & Ephemeris

$\Delta T = 67.9$ s
 $k1 = 0.2725076$
 $k2 = 0.2722810$
 $\Delta b = 0.0''$ $\Delta l = 0.0''$
 Eph. = JPL DE405

Circumstances at Greatest Eclipse: 01:57:11.5 UT

Lat. = 10°07.3'N Sun Alt. = 74.8°
 Long. = 148°47.6'E Sun Azm. = 162.5°
 Path Width = 155.1 km Duration = 04m09.5s

Circumstances at Greatest Duration: 01:56:52.0 UT

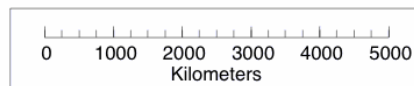
Lat. = 10°04'N Sun Alt. = 74.8°
 Long. = 148°42'E Duration = 04m09.5s

External/Internal Contacts of Umbra

U1 = 00:15:57.3 UT
 U2 = 00:17:29.9 UT
 U3 = 03:36:45.1 UT
 U4 = 03:38:20.7 UT

Geocentric Libration
 (Optical + Physical)

$l = -2.73^\circ$
 $b = -0.34^\circ$
 $c = -24.56^\circ$
 Brown Lun. No. = 1153



F. Espenak, NASA's GSFC
eclipse.gsfc.nasa.gov
 2014 Feb 22

**THE EXPLORATORIUM
COVERAGE OF TOTAL SOLAR ECLIPSE – TUESDAY, MARCH 8, 2016**

5PM-6PM, Totality 5:38PM San Francisco Time.
No need to actually go to the Exploratorium unless you want to for a nice day at the museum.

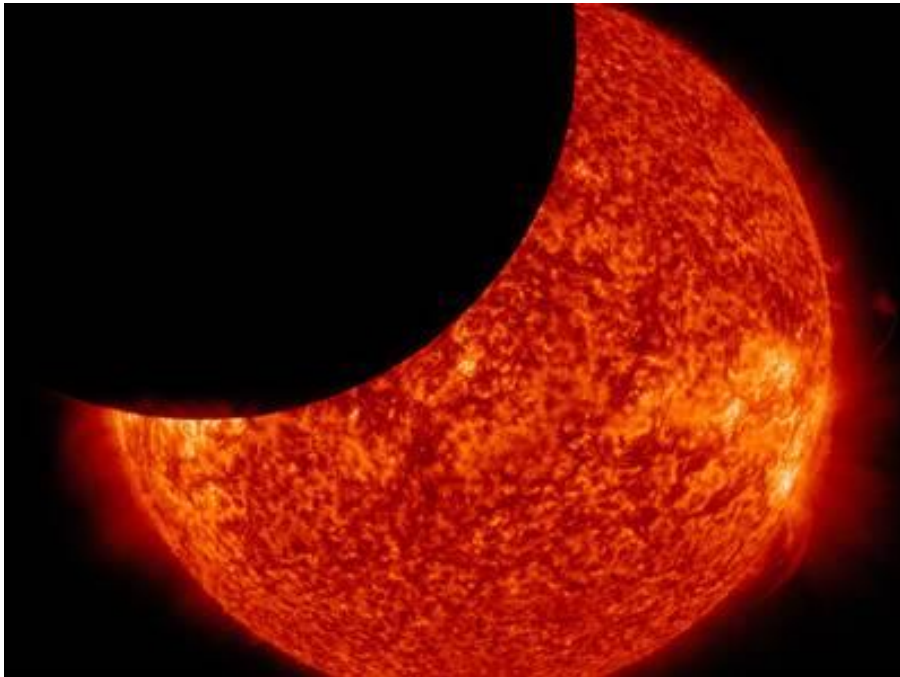
**Total Solar Eclipse: Live from Micronesia
Live Broadcast by the Exploratorium
www.exploratorium.edu/eclipse**

Webcast March 8/9, 2016

Live Program: 5:00–6:00 p.m. PST (1:00–2:00 a.m. UTC)
Telescope-Only Feed: 4:00–7:00 p.m. PST (12:00–3:00 a.m. UTC) on Tues. 3/8 for San Francisco.

OR

TOTALITY (4 minutes and 5 seconds)
March 8, 2016, 5:38 PM (San Francisco time)
or
March 9, 2016, 11:38 AM (local time) and 1:38 a.m.(Universal Time or UTC)



The Exploratorium in San Francisco is collaborating with NASA and the National Science Foundation to produce a live broadcast of the total solar eclipse from the Federated States of Micronesia on March 8/9, 2016. The fully eclipsed sun will be visible from only a few Pacific islands, but our live broadcast will make this amazing phenomenon available to hundreds of countries and millions of people around the world.

The “path of totality” for an eclipse is the area on earth where people can see the moon fully covering the surface of the sun. It is only 100 miles wide and moves in a curved path across the globe. The 2016 eclipse will be visible for a short time at sunrise in Indonesia; then the path will cross the Pacific Ocean and make

landfall at only a few atolls, including Woleai and Ifalik. With this remote, oceanic path, few people will see the 2016 eclipse live, but the Exploratorium is sending a team to Woleai to film and broadcast the event. Educators, students, and the general public will have access to a live program through the Internet, mobile phones, and television.

Since 1998, the Exploratorium has produced five highly successful live eclipse programs that reached an international audience of millions through the Internet, NASA-TV, and other media outlets. Our broadcast feeds have been shown in more than 100 NASA Learning Centers and in science museums around the globe. Each broadcast has surpassed the reach of the previous one, and we anticipate that Total Solar Eclipse: Live from Micronesia will break all

prior records.

The Exploratorium will produce a one-hour program that includes information about the eclipse and safe viewing techniques, and explores the Micronesian island we’re broadcasting from. It will feature stunning live eclipse imagery from four telescopes (1/4 disc and full-disc in white light and with H-Alpha filters).’The program will explore the science of the sun, using amazing, high-definition images and video from NASA satellites such as the SDO and STEREO missions. It will highlight NASA’s new MMS

mission, a multi-satellite endeavor to measure the magnetosphere that connects the earth and the sun.

In addition to the hour-long program, we will produce a second feed with telescope imagery of the entire eclipse, just over three hours, without any commentary. This will allow news stations and museums to conduct their own educational programs in whatever way best suits them.

We're also planning a third feed, a shorter version of the telescope-only feed with live Spanish narration provided by Exploratorium scientist Dr. Isabel Hawkins.

The Exploratorium's website and social media channels will provide eclipse information and dispatches from the broadcast team leading up to the event, allowing audiences to explore eclipse and solar topics through articles, online exhibits, and links to related content such as our Polynesian Navigation website. After the event, the website will carry an archived summary—and will begin preparations for

Eclipse 2017, whose path of totality will pass over North America and be visible to millions. Please join us in sharing this special celestial event with the world!

For press inquiries, please contact our press office: Shannon Elliot, seliot@... Maria Zilberman, mzilberman@...

For social media inquiries, please contact our social media coordinator: Emma Bailey, ebailey@...

For general info about live viewing or the project, please contact the project team: Nicole Minor, nminor@... Amaris Blackmore, ablackmore@...

For up-to-date information on webcast times and access methods, see our website: www.exploratorium.edu/eclipse

Astronauts, Rock stars, Astrophysicists and scientists need you NOW to organize Asteroid Day on June 30th!

<http://www.idealists.org/view/internship/cmmpPFBTChSP/>

Volunteer Opportunities at the California Academy of Sciences By Anthony Barreiro

Bing Quock, the Assistant Director of the Morrison Planetarium, has invited SFAA members to provide programming during these upcoming events at the California Academy of Sciences. Volunteers get free admission to the Academy. These events give us the chance to promote astronomy and the SFAA to a large number of interested people.

- March 10: **"Rocks" NightLife** (6-10pm)--this edition of the Academy's weekly "museum after dark" program for adults features a theme of rocks, which could easily extend to meteorites, asteroids, and other small solar system bodies, which is the subject of the new Planetarium show, "Incoming!," opening the following day. Broadly, any displays about astronomy (including telescope viewing on the Academy's living roof) are popular during NightLife, but some connection to the evening's "rock" theme is preferred to tie in with "Incoming!"
- April 14: **"Yuri's Day" NightLife** (6-10pm)--this annual celebration of Yuri Gagarin's pioneering spaceflight is a NightLife favorite, featuring astronomy displays, space-themed beverages, and live music.
- May 14: **Astronomy Day** (10am-4pm)--an annual observance since 1973, Astronomy Day is a day for amateur and professional astronomers to engage the public in anything and everything astronomical, from safe solar viewing (weather-permitting) and representation from local amateur groups, observatories, and educational programs to astronomy-themed maker projects (mirror-grinding, sundials, astro-gizmos), demos (astronomy apps, stargazing & satellite-watching websites), and space-crafts for kids. This day especially is wide-open to ideas! In past years SFAA members have offered solar telescope viewing, astrophotography displays (the Academy could provide a large plasma-screen monitor), small telescope demos and how-to's, and information about club activities and other local skywatching opportunities.

- June 30: **Asteroid Day** and **Asteroid NightLife**--this will be the second annual Asteroid Day, organized by the B612 Foundation and held on the anniversary of the 1908 Tunguska Event. Asteroid Day promotes asteroid awareness and hopes to engage and educate the public with displays and presentations about the smaller and sometimes most-overlooked members of our solar system. Falling on a Thursday, Asteroid Day activities will be held both during the museum's daytime public hours (10am-5pm) and during NightLife (6-10pm).

If you're interested in helping with Astronomy Day, please contact Anthony Barreiro at anthonybarreiro@yahoo.com. If you're interested in helping with any of the Nightlife programs, please contact PJ Cabrera at pj.cabrera@gmail.com.



NASA – JPL What's Up - February 2016

What's Up - March 2016

Jane Houston Jones: What's Up for March

JUPITER, ITS MOONS AND MOON SHADOWS

Jupiter dominates the evening sky this month, rising at sunset and setting at dawn. On March 8th Jupiter reaches what is called 'opposition.' Imagine that Jupiter and the sun are on opposite ends of a straight line with Earth in between. This brings Jupiter its closest to Earth, so it shines brighter and appears larger in telescopes.

On the nights of March 14th and 15th, March 21st and 22nd and March 29th two of Jupiter's moons will cross the planet's disk. When the planet is at opposition and the sun shines on Jupiter's moons, we can see the moons' shadows crossing the planet. There are actually 11 of these double shadow transits in March.

The next 6 months will be awesome times for you to image Jupiter when it's highest in the sky--near midnight now and a little earlier each night through the late summer. Even through the smallest telescopes or binoculars you should be able to see the two prominent belts on each side of Jupiter's equator, the four Galilean moons: Io, Europa, Ganymede and Callisto, and with some difficulty Jupiter's Red Spot, when it's facing Earth.

NASA's Juno spacecraft will arrive at Jupiter on July 4th of this year and go into orbit around the giant planet. Right now the Juno mission science team is actively seeking amateur and professional images of the planet. These images are uploaded to a Juno website, and the public is invited to discuss points of interest in Jupiter's atmosphere. Locations will later be voted on. The favorites will be targets for JunoCam, the spacecraft's imaging camera. Once JunoCam has taken the images, they'll be posted online. Imaging participants can then process these raw mission images and re-upload them for others to view.

You can find out all about JunoCam at: www.missionjuno.swri.edu/junocam

And you can learn about all of NASA's missions, including Juno, at: www.nasa.gov

That's all for this month. I'm Jane Houston Jones.



SAN FRANCISCO AMATEUR ASTRONOMERS EXPEDITION

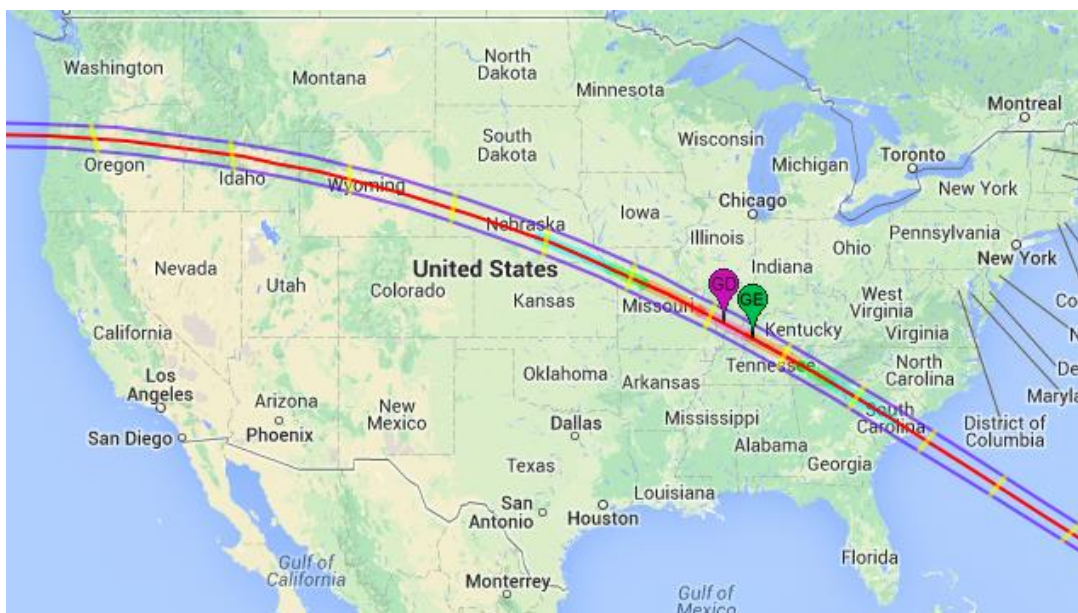
August 21, 2017

**TOTAL SOLAR ECLIPSE
Jackson Hole, Wyoming
(Teton Mountains)**

The San Francisco Amateur Astronomers is organizing an expedition to witness the August 21, 2017 Total Solar Eclipse. The eclipse will be visible across a broad swath of the USA, and club members will gather near Jackson Hole, Wyoming, to witness this spectacle high in the Teton Mountains. The trip is an opportunity for club members to gather in one place along the path of totality and journey together up the mountains for viewing of this spectacular astronomical phenomenon.

The club has arranged with a hotel in Teton Village, Wyoming, to enable advance bookings (2 years in advance!) with a special club rate of 10% discount. If you are a member of the SFAA and are interested in this, send an email to 2017eclipse@sfaa-astronomy.org and you'll be provided with additional details on the hotel and booking code. In the coming months the club will organize additional talks and events that will take place at the hotel on and before the date of totality. At this time, the most important thing is to book your hotel room so if you are at all considering this eclipse, get in touch and get your reservation in today. SFAA is not organizing air or ground transportation; that is left to each individual group or attendee.

If you have any other questions, send to 2017eclipse@sfaa-astronomy.org.



BAY AREA ASTRONOMY EVENTS

Kenneth Lum

As each month unfolds, check the following link for information regarding additional events
<http://tech.groups.yahoo.com/group/bayastro/?v=1&t=directory&ch=web&pub=groups&sec=dir&slk=94>

BAY AREA REGULARLY SCHEDULED EVENTS

**EVERY FRIDAY NIGHT
7:00 PM – 10:00 PM
excluding major holidays**

**The Telescope Makers'
Workshop**

**CHABOT SPACE AND
SCIENCE CENTER
10000 Skyline Boulevard
Oakland, CA 94619-2450**

THE TELESCOPE MAKERS' WORKSHOP is held every Friday night from 7pm - 10pm, excluding major holidays (e.g. Christmas Day and New Year's Day) that fall on Fridays. The Workshop is always closed on Memorial Day Weekend. Attendance every Friday night is not mandatory, and members work at their own pace. The Workshop meets at Chabot Space & Science Center, 10000 Skyline Blvd., Oakland.

Chabot's TMW is one of only a handful of regularly scheduled telescope making workshops in the U.S., and probably the world; it meets every Friday evening throughout the year, except Memorial Day weekend. It has been in operation since December of 1930, founded by Franklin B. Wright, and is currently run by Eastbay Astronomical Society member Rich Ozer, with help from other EAS members, Dave Barosso, Barry Leska, and others. The price of admission is FREE. All you have to do is show up, buy a mirror blank and a "tool" (typically around \$100 - \$200 depending on the size of the mirror) and start "pushin' glass!" We supply you with instruction, the various grits you'll need to first grind, and then polish and figure your mirror, and all the testing equipment needed. With a small bit of luck, you could wind up with a telescope that costs 1/3 or 1/4 the cost of a store-bought telescope, that is yet optically superior! It does take time - depending on how much time you put in on it, and other factors, it could take a few months or several months. But, it's a fun project, great for kids, and at the end you get a great telescope!

For more information call or email Richard Ozer at rozer@pacbell.net or phone (510) 406-1914.

**EVERY FRIDAY &
SATURDAY EVENING,
weather permitting
7:30 PM – 10:30 PM**

**CHABOT SPACE AND
SCIENCE CENTER
10000 Skyline Boulevard
Oakland CA 94619-2450
(510) 336-7300**

EXPLORE THE NIGHT SKIES AT THE CHABOT OBSERVATORIES

For more information: <http://www.chabotspace.org/>

Free Telescope Viewing

Regular hours are every Friday & Saturday evening, weather permitting: 7:30pm - 10:30pm

Come for spectacular night sky viewing the best kept secret in the Bay Area and see the magnificence of our telescopes in action!

Daytime Telescope Viewing On Saturday and Sunday afternoons come view the sun, moon, or Venus through Chabot's telescopes. Free with General Admission. (weather permitting)

12pm - 5pm: Observatories Open

<p>Sunset – 5:11 PM (TWICE MONTHLY)</p> <p>Inclement weather (clouds, excessive wind and showers) will cause the event to be canceled without notice.</p> <p>SAN MATEO COUNTY ASTRONOMICAL SOCIETY STAR PARTY</p>	<p>STAR PARTIES AT CRESTVIEW PARK, SAN CARLOS</p> <p>Come out and bring the kids for a mind expanding look at the universe</p> <p>The City of San Carlos Parks and Recreation Department and the San Mateo County Astronomical Society have open Star Parties twice a month. These events are held in Crestview Park, San Carlos California. Note that inclement weather (clouds, excessive wind and showers) will cause the event to be canceled without notice.</p> <p>For more information call Bob Black, (650)592-2166, or send an email to SMCAS@live.com or call Ed Pieret at (650)862-9602.</p> <p>Reasons to Attend</p> <p>If you have kids interested in space or planets bring them here for a real life view of planets, nebula, star clusters and galaxies.</p> <p>If you are thinking of buying a telescope or want help using a telescope you own, come here to talk with experienced users. If you think you might have an interest in astronomy come and talk to experienced amateur astronomers.</p> <p>Cautions</p> <p>Dress warmly and wear a hat.</p> <p>Visitors should park on the street and walk into the park so your headlights don't affect the observer's dark adaptation.</p> <p>Only park in the parking lot if you are arriving before dark and plan to stay until the end of the event.</p> <p>You shouldn't need lights but if you feel you do, only bring a small flashlight with the lens covered using red cellophane or red balloon.</p> <p>Please respect the telescopes and ask permission from the owner if you wish to touch.</p> <p>Parents, please watch your children.</p> <p>The park is residential, and adjacent to homes and backyards, please keep noise to a minimum.</p> <p>Schedule Time</p> <p>Astronomers arrive to set up at around sunset. Observing starts at about one hour after sunset and continues for two to three hours.</p>
<p>EVERY CLEAR SATURDAY MORNING OBSERVATORY 10:00 AM – 12:00 PM</p> <p>FOOTHILL COMMUNITY COLLEGE 12345 Moody Road Los Altos Hills</p> <p>Cost: Free</p>	<p>Solar observing with a Hydrogen alpha solar telescope every clear Saturday morning. This allows spectacular views of solar prominences and unusual surface features on the Sun not otherwise visible with regular white light telescopes. Admission is free.</p> <p>Foothill Observatory is located on the campus of Foothill College in Los Altos Hills, CA. Take Highway 280 to the El Monte Rd. exit. The observatory is next to parking lot 4. Parking at the college requires visitor parking permits that are available from the machines in the parking lots for \$ 3.00.</p>

<p>EVERY CLEAR FRIDAY EVENING 9:00 PM – 11:00 PM</p> <p>FOOTHILL COMMUNITY COLLEGE OBSERVATORY 12345 Moody Road Los Altos Hills</p> <p>Cost: Free</p>	<p>Foothill Observatory is open for public viewing every clear Friday evening from 9:00 p.m. until 11:00 p.m. Visitors can view the wonders of the universe through the observatory's computer-controlled 16- inch Schmidt-Cassegrain telescope. Views of objects in our solar system may include craters and mountains on the moon, the moons and cloud-bands of Jupiter, the rings of Saturn, etc. Deep space objects including star clusters, nebulae, and distant galaxies also provide dramatic demonstrations of the vastness of the cosmos. The choice of targets for Any evening's viewing depends on the season and what objects are currently in the sky.</p> <p>The public viewing programs at Foothill are free of charge and are open to guests of all ages. Please note that the observatory is closed when the weather is cloudy. Also note that visitor parking permits are available from the machines in the parking lots for \$3.00.</p> <p>Come to Foothill Observatory and join us in the exploration of our Universe!</p> <p>Foothill Observatory is located on the campus of Foothill College in Los Altos Hills, CA. Take Highway 280 to the El Monte Rd exit. The observatory is next to parking lot 4. Parking at the college requires visitor parking permits that are available from the machines in the parking lots for \$3.00.</p>
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BAY AREA EVENTS – MARCH 2016

<p>TUESDAY, 2/23 12:00 NOON</p> <p>SETI INSTITUTE COLLOQUIUM SERIES GALILEO AUDITORIUM MICROSOFT SVC BUILDING ONE 1065 La Avenida Mountain View, CA 94043</p> <p>Cost: Free</p>	<p>ANDREW SIEMION, UC BERKELEY THE BREAKTHROUGH INITIATIVE - LISTEN AND MEGASTRUCTURES AT KIC 8463</p> <p>Dr. Andrew Siemion, Director of the Berkeley SETI Research Center (BSRC) at the University of California, Berkeley, will present an overview of the Breakthrough Listen Initiative, 100-million-dollar, 10-year search for extraterrestrial intelligence. Dr. Siemion will also discuss other SETI efforts ongoing at the BSRC, including the successful citizen science project SETI@Home, as well as a concerted effort to undertake panchromatic observations of the mysterious Kepler star KIC 8462852.</p>
<p>TUESDAY, 3/08 5:00 – 6:00 PM</p> <p>EXPLORATORIUM Pier 15 (Embarcadero at Green Street) San Francisco, CA 94111</p> <p>Cost: Free Live Program</p>	<p>SEE NEWSLETTER COVERAGE</p>
<p>TUESDAY, 03/08/16 4:30 PM</p> <p>STANFORD UNIVERSITY Room 201 Stanford, CA 94305</p>	<p>ALEX VILENKIN, TUFTS UNIVERSITY BLACK HOLES FROM COSMIC INFLATION</p> <p>Cost: Free</p>

<p>Thursday, 3/10 6:00 PM - 10:00 PM</p> <p>CALIFORNIA ACADEMY OF SCIENCES 55 Music Concourse Dr. San Francisco, CA 94118 USA</p>	<p>ROCK ON NIGHTLIFE</p> <p>From rocks in space to rock 'n' roll, join us for NightLife's salute to rock in all forms.</p> <p>Be among the first to catch the Academy's latest original planetarium show Incoming!, narrated by George Takei-an out of this world, all-digital show exploring asteroids, comets, and the hard-hitting stories of our cosmic origins. View geology specimens, including meteorites, from the museum's renowned collection.</p> <p>From ancient rocks to modern rock legends, head to the swamp to check out a pop-up exhibit on groundbreaking rock music promoter Bill Graham, including vintage concert posters from The Fillmore and the post-show apple barrel made famous by this SF venue! At the Project Lab, hang with the UC Berkeley Museum of Paleontology and check out fascinating fossils found deep beneath the surface. Plus, make and take home your very own pet rock with Julia Jane Moore to the rocking soundtrack of DJ Omar (PopScene)</p> <p>Ready to rock?</p> <p>Website: http://www.calacademy.org/nightlife/rock-on-nightlife</p> <p>Cost: \$15 General, \$12 Members</p>
<p>THURSDAY, 3/10 7:00 PM</p> <p>SANTA CRUZ ASTRONOMY CLUB HARVEY WEST SCOUT HOUSE 326 Evergreen St Santa Cruz, CA 95060</p> <p>Cost Free</p>	<p>SUPERMASSIVE BLACK HOLES (AND HOW TO OBSERVE THEM CHEAPLY!)</p> <p>In this talk Martin Gaskell, UC Santa Cruz, will explain how you can can detect the effects of supermassive black holes in the centers of galaxies. He will give the main observational properties and explain how the energy is generated. He will particularly emphasize how observations can be made remarkably cheaply from your back yard.</p>
<p>Friday, 03/11/16 6:00 PM - 7:30 PM</p> <p>Chabot Space and Science Center 10000 Skyline Blvd</p> <p>Cost – Advance: \$26 General, \$23 Members, \$30 at door</p>	<p>CHRISTOPHER MCKAY FUTURE FRIDAYS: LIFE ON MARS: PAST AND FUTURE</p> <p>The search of past life on Mars is one of the key goal of NASA's astrobiology program. The indications from the missions to date are that we will have to drill meters below ground to find any preserved evidence of past life. Mars may have life in the future though. Humans may decide to set up permanent bases on Mars, as it may also be possible to restore the climate of Mars resulting in biology widespread on its surface. In his talk, McKay will explore the challenges and opportunities that impact our journey to Mars.</p> <p>Website: http://www.chabotspace.org/future-fridays.htm</p>

<p>Sunday, 3/13/16 2:00 - 3:30 PM</p> <p>CIVIC CENTER LIBRARY 1188 South Livermore Avenue Livermore, CA 94550</p> <p>Cost: Free</p>	<p>DRONES: AN INTRODUCTION TO A MODERN PHENOMENON</p> <p>Do you own a drone? Thinking about getting one? Come learn all about these wildly popular devices.</p> <p>Alvin Alejandro, owner of the Bay Area company Aerial Vue (www.aerial-vue.com), and an expert in the field, will be discussing the various types and classification of drones, their different uses and who buys them. He will also speak about some of the myths and controversies that surround drone use right now and how new state and local laws affect drone owners. Come see actual aerial drones on display! Alejandro will also show videos of drones in action.</p>
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Check the following link for information regarding additional events
<http://tech.groups.yahoo.com/group/bayastro/?v=1&t=directory&ch=web&pub=groups&sec=dir&slk=94>

ARTICLES OF INTEREST

We have a special privilege this month of being able to include a hperlink to the article written by Bob Naeye, retired Editor of Sky and Telescope magazine on the subject of gravitational waves from two colliding black holes. I am able to include here just Bob's message and the hyperlink. Following that is NASA JPL's article, also on this subject.. Ed.

Dear Friends,

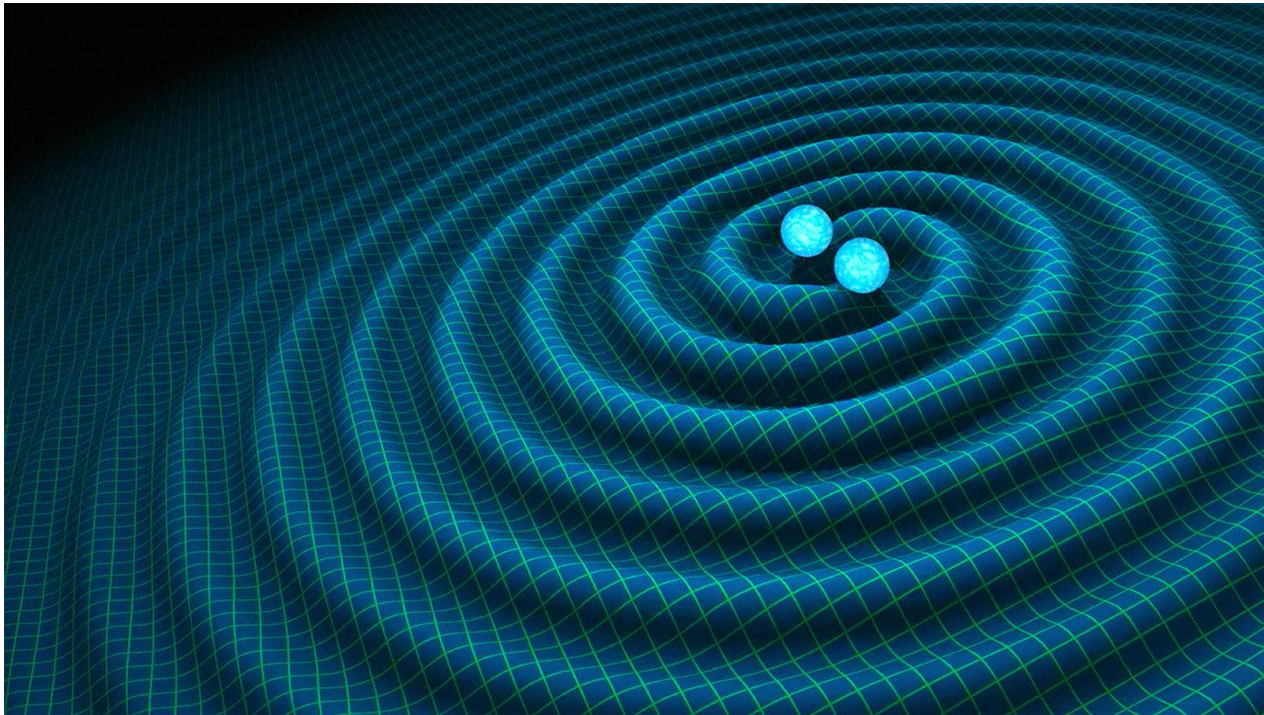
Earlier today, scientists involved with the U.S.-led LIGO project announced one of the most significant scientific discoveries in many years: the detection of gravitational waves from two colliding black holes. Gravitational waves are ripples in the fabric of space-time predicted a century ago by Albert Einstein. The waves are incredibly subtle and difficult to detect, so the LIGO discovery represents an immense technical achievement, and the leaders of the LIGO team will probably win the Nobel Prize later this year. Better yet, this is just the first direct detection of gravitational waves, it shows that LIGO will detect many more in the years ahead. This discovery opens an entirely new way of studying the universe, and I have no doubt that we will see many more great discoveries in the coming years. I have been involved in science journalism since the early 1990s, and I consider this the most important result I have covered besides since the discovery of planets outside the solar system. You can read my report here:

<http://www.skyandtelescope.com/astronomy-news/gravitational-wave-detection-heralds-new-era-of-science-0211201644/>

NASA JPL SCIENCE NEWS

FEBRUARY 11, 2016

GRAVITATIONAL WAVES DETECTED 100 YEARS AFTER EINSTEIN'S PREDICTION



An artist's impression of gravitational waves generated by binary neutron stars. Credits: R. Hurt/Caltech-JPL

Congratulations to the National Science Foundation, Caltech, MIT and the entire LIGO Team!

Background information and a replay of today's news conference announcing the detection are online at: <http://www.caltech.edu/gwave>

LIGO opens new window on the universe with observation of gravitational waves from colliding black holes.

For the first time, scientists have observed ripples in the fabric of spacetime called gravitational waves, arriving at the earth from a cataclysmic event in the distant universe. This confirms a major prediction of Albert Einstein's 1915 general theory of relativity and opens an unprecedented new window onto the cosmos.

Gravitational waves carry information about their dramatic origins and about the nature of gravity that cannot otherwise be obtained. Physicists have concluded that the detected gravitational waves were produced during the final fraction of a second of the merger of two black holes to produce a single, more massive spinning black hole. This collision of two black holes had been predicted but never observed.

The gravitational waves were detected on September 14, 2015 at 5:51 a.m. Eastern Daylight Time (09:51 UTC) by both of the twin Laser Interferometer Gravitational-wave Observatory (LIGO) detectors, located in Livingston, Louisiana, and Hanford, Washington, USA. The LIGO Observatories are funded by the National Science Foundation (NSF), and were conceived, built, and are operated by Caltech and MIT. The discovery, accepted for publication in the journal *Physical Review Letters*, was made by the LIGO Scientific Collaboration (which includes the GEO Collaboration and the Australian Consortium for Interferometric Gravitational Astronomy) and the Virgo Collaboration using data from the two LIGO detectors.

Based on the observed signals, LIGO scientists estimate that the black holes for this event were about 29 and 36 times the mass of the sun, and the event took place 1.3 billion years ago. About 3 times the mass of the sun was converted into gravitational waves in a fraction of a second -- with a peak power output about 50 times that of the whole visible universe. By looking at the time of arrival of the signals -- the detector in Livingston recorded the event 7 milliseconds before the detector in Hanford -- scientists can say that the source was located in the Southern Hemisphere.

According to general relativity, a pair of black holes orbiting around each other lose energy through the emission of gravitational waves, causing them to gradually approach each other over billions of years, and then much more quickly in the final minutes. During the final fraction of a second, the two black holes collide into each other at nearly one-half the speed of light and form a single more massive black hole, converting a portion of the combined black holes' mass to energy, according to Einstein's formula $E=mc^2$. This energy is emitted as a final strong burst of gravitational waves. It is these gravitational waves that LIGO has observed.

LIGO was originally proposed as a means of detecting these gravitational waves in the 1980s by Rainer Weiss, professor of physics, emeritus, from MIT; Kip Thorne, Caltech's Richard P. Feynman Professor of Theoretical Physics, emeritus; and Ronald Drever, professor of physics, emeritus, also from Caltech.

"With this discovery, we humans are embarking on a marvelous new quest: the quest to explore the warped side of the universe -- objects and phenomena that are made from warped spacetime. Colliding black holes and gravitational waves are our first beautiful examples," says Thorne.

"The description of this observation is beautifully described in the Einstein theory of general relativity formulated 100 years ago and comprises the first test of the theory in strong gravitation. It would have been wonderful to watch Einstein's face had we been able to tell him," says Weiss.

"Caltech thrives on posing fundamental questions and inventing new instruments to answer them," says Caltech president Thomas Rosenbaum, the Sonja and William Davidow Presidential Chair and professor of physics. "LIGO represents an exhilarating example of how this approach can transform our knowledge of the universe. We are proud to partner with NSF and MIT and our other scientific collaborators to lead this decades-long effort."

"Our observation of gravitational waves accomplishes an ambitious goal set out over five decades ago to directly detect this elusive phenomenon and better understand the universe, and, fittingly, fulfills Einstein's legacy on the 100th anniversary of his general theory of relativity," says Caltech's David H. Reitze, executive director of the LIGO Laboratory.

"This discovery is just the beginning," says Fiona Harrison, the Benjamin M. Rosen Professor of Physics and holder of the Kent and Joyce Kresa Leadership Chair of the Division of Physics, Mathematics and Astronomy. "Over the next years, LIGO will be putting general relativity to its most stringent tests ever, it will be discovering new sources of gravitational waves, and we will be using telescopes on the ground and in space to search for light emitted by these catastrophic events."

The existence of gravitational waves was first demonstrated in the 1970s and 80s by Joseph Taylor, Jr., and colleagues. Taylor and Russell Hulse discovered in 1974 a binary system composed of a pulsar in orbit around a neutron star. Taylor and Joel M. Weisberg in 1982 found that the orbit of the pulsar was slowly shrinking over time because of the release of energy in the form of gravitational waves. For discovering the pulsar and showing that it would make possible this particular gravitational wave measurement, Hulse and Taylor were awarded the Nobel Prize in Physics in 1993.

The new LIGO discovery is the first observation of gravitational waves themselves, made by measuring the tiny disturbances the waves make to space and time as they pass through the earth.

LIGO research is carried out by the LIGO Scientific Collaboration (LSC), a group of more than 1000 scientists from universities around the United States and in 14 other countries. More than 90 universities and research institutes in the LSC develop detector technology and analyze data; approximately 250 students are strong contributing members of the collaboration. The LSC detector network includes the LIGO interferometers and the GEO600 detector. The GEO team includes scientists at the Max Planck Institute for Gravitational Physics (Albert Einstein Institute, AEI), Leibniz Universität Hannover, along with partners at the University of Glasgow, Cardiff University, the University of Birmingham, other universities in the United Kingdom, and the University of the Balearic Islands in Spain.

"This detection is the beginning of a new era: The field of gravitational wave astronomy is now a reality," says Gabriela González, LSC spokesperson and professor of physics and astronomy at Louisiana State University.

The discovery was made possible by the enhanced capabilities of Advanced LIGO, a major upgrade that increases the sensitivity of the instruments compared to the first generation LIGO detectors, enabling a large increase in the volume of the universe probed -- and the discovery of gravitational waves during its first observation run. The US National Science Foundation leads in financial support for Advanced LIGO. Funding organizations in Germany (Max Planck Society), the U.K. (Science and Technology Facilities Council, STFC) and Australia (Australian Research Council) also have made significant commitments to the project. Several of the key technologies that made Advanced LIGO so much more sensitive have been developed and tested by the German UK GEO collaboration. Significant computer resources have been contributed by the AEI Hannover Atlas Cluster, the LIGO Laboratory, Syracuse University, and the University of Wisconsin-Milwaukee. Several universities designed, built, and tested key components for Advanced LIGO: The Australian National University, the University of Adelaide, the University of Florida, Stanford University, Columbia University of New York, and Louisiana State University.

"In 1992, when LIGO's initial funding was approved, it represented the biggest investment the NSF had ever made," says France Córdoba, NSF director. "It was a big risk. But the National Science Foundation is the agency that takes these kinds of risks. We support fundamental science and engineering at a point in the road to discovery where that path is anything but clear. We fund trailblazers. It's why the U.S. continues to be a global leader in advancing knowledge."

"The Advanced LIGO detectors are a tour de force of science and technology, made possible by a truly exceptional international team of technicians, engineers, and scientists," says David Shoemaker of MIT, the project leader for Advanced LIGO. "We are very proud that we finished this NSF-funded project on time and on budget, and delighted Advanced LIGO delivered its groundbreaking detection so quickly."

At each observatory, the two-and-a-half-mile (4-km) long L-shaped LIGO interferometer uses laser light split into two beams that travel back and forth down the arms (four-foot diameter tubes kept under a near-perfect vacuum). The beams are used to monitor the distance between mirrors precisely positioned at the ends of the arms. According to Einstein's theory, the distance between the mirrors will change by an infinitesimal amount when a gravitational wave passes by the detector. A change in the lengths of the arms smaller than one-ten-thousandth the diameter of a proton (10⁻¹⁹ meter) can be detected.

Independent and widely separated observatories are necessary to determine the direction of the event causing the gravitational waves, and also to verify that the signals come from space and are not from some other local phenomenon.

A network of detectors will significantly help to localize the sources. The Virgo detector will be the first to join later this year.

The LIGO Laboratory also is working closely with scientists in India at the Inter-University Centre for Astronomy and Astrophysics, the Raja Ramanna Centre for Advanced Technology, and the Institute for Plasma to establish a third Advanced LIGO detector on the Indian subcontinent. Awaiting approval by the government of India, it could be operational early in the next decade. The additional detector will greatly improve the ability of the global detector network to localize gravitational-wave sources.

Virgo research is carried out by the Virgo Collaboration, consisting of more than 250 physicists and engineers belonging to 19 different European research groups: 6 from Centre National de la Recherche Scientifique (CNRS) in France; 8 from the Istituto Nazionale di Fisica Nucleare (INFN) in Italy; 2 in The Netherlands with Nikhef; the Wigner RCP in Hungary; the POLGRAW group in Poland, and the European Gravitational Observatory (EGO), the laboratory hosting the Virgo detector near Pisa in Italy.



**San Francisco Amateur Astronomers
Application for New or Renewing Membership**

1. Memberships, with dues payment, are for one year running from standard renewal dates of 1 July to 30 June and 1 January to 31 December.
2. Submitting appropriate dues in April, May, June, July, August, September, membership will run to 30 June of the next year.
3. Submitting appropriate dues in October, November, December, membership will run to 31 December of the next year; submitting appropriate dues in January, February or March, membership will run to 31 December of the same year.
4. Renewals are maintained at the original membership date unless the renewal is made later than the original cutoff date (e.g. September or March as described in 3). In such cases the membership date is shifted to the next renewal date 30 June or 31 December.
5. New or renewal memberships sent in via USPS mail will have membership start date based on postmark date.

This application is for:

- New
- Renewing

Name: _____

Address: _____

Email: _____

Home Telephone (optional): _____

Cell Phone (optional): _____

Membership Type: Individual \$25.00 / Family \$30.00 / Student \$10.00 / Supporting \$75.00

Please mail to me a Mt. Tamalpais Parking Permit

To complete the membership process:

- A. Print and fill out this form
- B. Make check or money order payable to San Francisco Amateur Astronomers
- C. Mail this form and payment to:

**Treasurer, SFAA
PO Box 15097
San Francisco, CA 94115**

New members will be entered onto the SFAA roster on the Night Sky Network (NSN) and will receive a verifying email from the NSN with username and password for the NSN. Renewing members will have their information updated but will not receive an email from the NSN. Both new and renewing members will receive a verifying email from the SFAA Treasurer upon completion of the membership process.