ABOVE THE FOG

• BULLETIN OF THE SAN FRANCISCO AMATEUR ASTRONOMERS •

Vol. 69, No. 05 – May 2020

IN THIS ISSUE

Due to ongoing developments regarding the spread of the COVID-19 virus and recommendations by the city and state regarding event hosting, the events listed below may be subject to change. Please see important updates reflected in our schedule or check for announcements via the SFAA website, e-mail, or on social media. If you have any further questions, please feel free to e-mail members of the board for information.

01. SFAA PRESIDENT'S NOTE | ONLINE LECTURES

The COVID-19 pandemic continues to limit the kind of activities SFAA can bring to our members and the public. Our star parties and in-person lectures are on hold until further notice. But thanks to advances in technology in the last decade, we can now host live events with hundreds of attendees scattered throughout the globe.

We will have our first online lecture this coming Wednesday May 20th. Please see page 6 of this newsletter for the details. We are not sure when we will be allowed to resume in-person meetings, so we have begun to organize next month's lecture to be online as well. We will do this every month until it is safe to meet again.

Our goal is not to replace in-person meetings, but to continue to take advantage of all the world class astronomers and astrophysicists in the Bay Area, willing to share their knowledge with the public. And online lectures are the best and safest way to do that right now.

As the state and our community begins to open, we will begin announcing more activities instead of cancelations, but only as long as we can provide them in a way that is safe and following the recommendations of health professionals. It may still be a while until we can go back to our regular schedule of monthly events, but these lectures will help tide us over until then.

Clear skies,
PJ Cabrera, SFAA President

02. SFAA & BAY AREA ASTRONOMY EVENTS

MAY 2020 – AUGUST 2020

Details: http://www.sfaa-astronomy.org/events

PLEASE CHECK THE SFAA WEBSITE REGULARLY FOR IMPORTANT UPDATES REGARDING THE IMPACT OF THE COVID-2019 VIRUS ON SCHEDULED EVENTS

Wednesday, May 20, 7:30 pm – 9:15 pm
Virtual Meeting and Lecture, Live Stream Link

SATURDAY, MAY 23RD MT. TAM MEMBERS' NIGHT HAS BEEN CANCELLED

Thursday, June 4, 8:00 pm – 11:00 pm
City Star Party, Presidio at Parade Grounds in San Francisco

Wednesday, June 17, 7:30 pm – 9:15 pm
Meeting and Lecture, Randall Museum

Saturday, June 20, 7:30 pm – 2:00 am
Mt. Tam Members' Night (arrive BEFORE sunset)

Thursday, July 2, 8:00 pm – 11:00 pm
City Star Party, Presidio at Parade Grounds in San Francisco

Wednesday, July 15, 7:30 pm – 9:15 pm
Meeting and Lecture, Randall Museum

Saturday, July 18, 7:00 pm – 2:00 am
Mt. Tam Members' Night (arrive BEFORE sunset)

Saturday, July 25, 7:00 pm – 12:00 am
Mt. Tam Public Star Party (arrive BEFORE sunset)

Thursday, July 30, 8:00 pm – 11:00 pm
City Star Party, Presidio at Parade Grounds in San Francisco

Saturday, August 15, 7:30 pm – 2:00 am
Mt. Tam Members' Night (arrive BEFORE sunset)

Wednesday, August 19, 7:30 pm – 9:15 pm
Meeting and Lecture, Randall Museum

Saturday, August 22, 7:00 pm – 8:00 pm
Mt. Tam Public Star Party (arrive BEFORE sunset)

Thursday, August 27, 7:30 pm – 10:30 pm
City Star Party, Presidio at Parade Grounds in San Francisco

GET LIVE HELP WITH YOUR TELESCOPE!

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Are you a new telescope owner?

Or perhaps you could use some help with alignment, collimation, or other adjustments?

Like playing guitar or dancing the tango, learning to operate a telescope can, with great effort, be learned on your own.

However, it's much easier and more enjoyable to learn hands-on with experienced individuals.

Bring your telescope to a Star Party – we'll be happy to help!

BAY AREA ASTRONOMY EVENTS

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Long-time SFAA member, Kenneth Lum, assembles and reports a list of Bay Area Astronomy events. Check the following link for information and additional events: https://groups.yahoo.com/neo/groups/bayastro/info

03. SFAA VOLUNTEER OPPORTUNITIES

VOLUNTEER OPPORTUNITIES

Contact: SFAA Board (volunteer@sfaa-astronomy.org)

Star Party Volunteers ▪ City Star Parties ▪ Mt. Tam Star Parties	SFAA Board (volunteer@sfaa-astronomy.org)
Snack Volunteers	Linda Mahan (speakerchair@sfaa-astronomy.org)
Marketing Volunteers	PJ Cabrera (president@sfaa-astronomy.org)
Above the Fog Volunteers	PJ Cabrera (president@sfaa-astronomy.org)

Star Party Volunteers

SFAA hosts 2 to 3 star parties every month throughout the year, including City Star Parties in San Francisco and observation nights on Mount Tamalpais. We need **experienced SFAA members to serve as volunteers for these events**. If you've been to a few star parties, you're familiar with the procedures, and you're able to commit to attending these events, **we can use your help**!

Volunteers are responsible for: checking weather forecasts prior to scheduled events, coordinating with other volunteers, providing cancellation notice due to inclement weather or dangerous conditions (e.g. forest fires). Volunteers are expected to arrive to events early, welcome and orient members, and hold a brief huddle for all telescope operators to review procedures and answer questions.

For Mt. Tam events, volunteers are tasked with:

- members night: ensuring every vehicle belongs to an SFAA member and has a parking pass; at the end of the night, volunteers make sure members understand how to lock the gate on the way out; and
- public astronomy program: coordinating with Friends of Mt. Tam volunteers to manage visitor parking.

Volunteers receive an e-mail once a month to coordinate on upcoming star parties. If you're interested in volunteering, or if you have questions, please contact the SFAA board at volunteer@sfaa-astronomy.org.

Snack Volunteers

SFAA needs volunteers to bring light refreshments to our monthly meetings and lectures at the Randall Museum, on the **third Wednesday of each month**. Refreshments create a welcoming atmosphere for members and guests. Volunteers can donate snacks or provide receipts for expense reimbursement.

If you're interested in bringing refreshments, please send an e-mail to Linda Mahan at speakerchair@sfaa-astronomy.org and indicate which month(s) you can help with and what you'd like to bring.

Marketing Volunteers

SFAA needs volunteers to help post SFAA event updates to groups such as SFGate, SF FunCheap, Eventful, Bay Area Science, etc. If you're interested in marketing opportunities, please send an e-mail to PJ Cabrera at president@sfaa-astronomy.org.

Above the Fog Volunteers

SFAA distributes a monthly newsletter, *Above the Fog*. Volunteers are asked to submit an occasional article, astrophoto, and/or to serve as a member of the editorial team. If you're interested in contributing to these monthly newsletters, please send an e-mail to PJ Cabrera at president@sfaa-astronomy.org.

On behalf of the board of directors and your fellow SFAA members, thank you for your willingness to help out!

04. UPCOMING SFAA LECTURES 2020

PLEASE CHECK THE SFAA WEBSITE REGULARLY FOR IMPORTANT UPDATES REGARDING THE IMPACT OF THE COVID-2019 VIRUS ON SCHEDULED EVENTS

MAY 20TH | EKTA PATEL, PHD

Satellite Galaxies in the Local Group – Free Livestream
By Ekta Patel, PhD, Department of Astronomy, UC Berkeley

Our Local Group of galaxies is composed of our Milky Way, it's twin galaxy, Andromeda (M31), and the dozens of small "satellite" galaxies orbiting around each of them. Satellite galaxies are thought to be the building blocks of more massive galaxies, therefore, tracking the orbital histories of satellite galaxies in the galactic neighborhood is crucial to our understanding of how the Milky Way and Andromeda arrived at the properties observed today. Since galaxies are embedded in halos of dark matter - the invisible matter that makes up 85% of the matter in the Universe - satellite galaxies also act as tracers of this massive, mysterious matter.

Dr. Patel will explain how the individual orbital histories of these galaxies help us learn about the evolution of satellites themselves. Additionally, it will be demonstrated how the collective motion of these systems of satellite galaxies can reveal important characteristics of their host galaxies, including their dark matter halos.

Dr Ekta Patel is a Miller Fellow in the Department of Astronomy at the University of California Berkeley. She received her B.A. in Physics from New York University in 2014, and her PhD in Astronomy and Astrophysics from the University of Arizona in 2019. At the U of A's Steward Observatory she worked to analyze high resolution cosmological simulations, such as Illustris, to help us understand the dynamical history of the Local Group. At UCB, she is continuing her work on understanding the dynamics of satellite galaxies orbiting around the Milky Way and Andromeda. She has actively engaged with the public in a verity of ways in her career so far, including past involvement with Colors of Nature, Project Astro, and NOAO (National Optical Astronomy Observatory) Teen Astronomy Cafe.

Webinar & Streaming Details

SFAA is excited to be delivering our first virtual lecture. We are providing two viewing options. You may attend the virtual meeting "live," which includes the opportunity to participate in any chat discussions and ask questions of the speaker -or- you may attend the live-streaming event on our YouTube channel or Facebook page.

To attend the virtual meeting "live" with the opportunity to ask questions:

- Connect by 7:30pm on May 20th by clicking this meeting link: https://berkeley.zoom.us/j/91896840562.
- Clicking the link may prompt you to install the Zoom virtual meeting app. Once installed, you will be able to join the meeting.
- Once joined, you can test your audio and video, and greet other members.
- Board members will join the meeting early to help troubleshoot any problems with audio or video.
- The club welcome and announcements will begin at 7:45pm and the lecture will start at 8:00pm.

Alternatively, please visit the following channels to attend the live stream:

- SFAA YouTube channel: https://www.youtube.com/channel/UChuBJGp_iJYZ11q_ayA-q3A
- SFAA Facebook: https://www.facebook.com/groups/152754481404310

We'll see you there!

05. CALL FOR ASTROPHOTOGRAPHERS

Calling all astrophotographers!

We're looking for big sky images, Milky Way shots, the moon, deep space, solar flares… if the camera is pointing up at the sky, we want to see your photos. If you are interested in sharing your content with the SFAA for featuring in our newsletter and on our social media – Facebook, Instagram, and Twitter – please read the details below and consider entering a submission! (note: all featured submissions will credit the contributor)

Who can submit a photo?
Anyone that enjoys looking up at the night sky, members and non-members alike.

What kind of photos are we interested in?
As stated above, if it has to do with astronomy, especially the night sky, it is welcome. Got an amazing shot of the Milky Way with something on Earth in the foreground? Yes. Got a deep space shot of the pinwheel galaxy? Awesome.

What type of file format should be submitted?
JPG & PNG file formats are preferred.

What information should be included with the photo?
Your name, your social media handles (if you have them and would like to be tagged), the date and time you took the shot, and information about the shot itself (the target of the photo, equipment used, etc.). If you would like to provide additional information, including any background or stories, process for editing, etc., that is certainly welcome as well!

How to submit?
Email photos to images@sfaa-astronomy.org with the information stipulated above.

Where will the photos be used & featured?
In the SFAA newsletter – "Above the Fog" – and the SFAA social media platforms: Facebook private member group, Instagram, and Twitter. We may also feature it on other mediums, such as the SFAA website. If you would rather not be featured on one or more of these platforms, please include that with your e-mail submission.

If you have any questions, feel free to email images@sfaa-astronomy.org or vicepresident@sfaa-astronomy.org.

06. BACKYARD ASTRONOMY GUIDE

As we remain sheltered-in-place, we'd like to share, once again, a list of books, websites, and mobile apps that might give you and your families a more intimate connection with our night sky. Though we may be apart, we are all fortunate to share a beautiful gaze at the night sky on a clear evening. We're calling this selection the "Backyard Astronomy Guide," though city dwellers are invited to read along as well!

Reading – Introductory

- The Backyard Stargazer: An Absolute Beginner's Guide to Skywatching With and Without a Telescope by Patricia Price
- NightWatch: A Practical Guide to Viewing the Universe by Terence Dickinson and Adolf Schalle
- Astronomy 101: From the Sun and Moon to Wormholes and Warp Drive, Key Theories, Discoveries, and Facts about the Universe by Carolyn Collins Petersen
- Exploring the Night Sky: The Equinox Astronomy Guide for Beginners by Terence Dickinson and John Bianchi
- To Know the Sky by Guy Ottewell
- The Monthly Sky Guide by Ian Ridpath and Wil Tirion

Reading – Intermediate & Star Charts

- The Total Skywatcher's Manual: 275+ Skills and Tricks for Exploring Stars, Planets, and Beyond by Astronomical Society of the Pacific
- The Night Sky Companion (from The Patrick Moore Practical Astronomy Series) by Tammy Plotner
- Stars and Planets by William S. Kals
- David Levy's Guide to the Night Sky by David H. Levy

Online Materials – resources that can be helpful, whether you're a casual newcomer or a veteran star gazer.

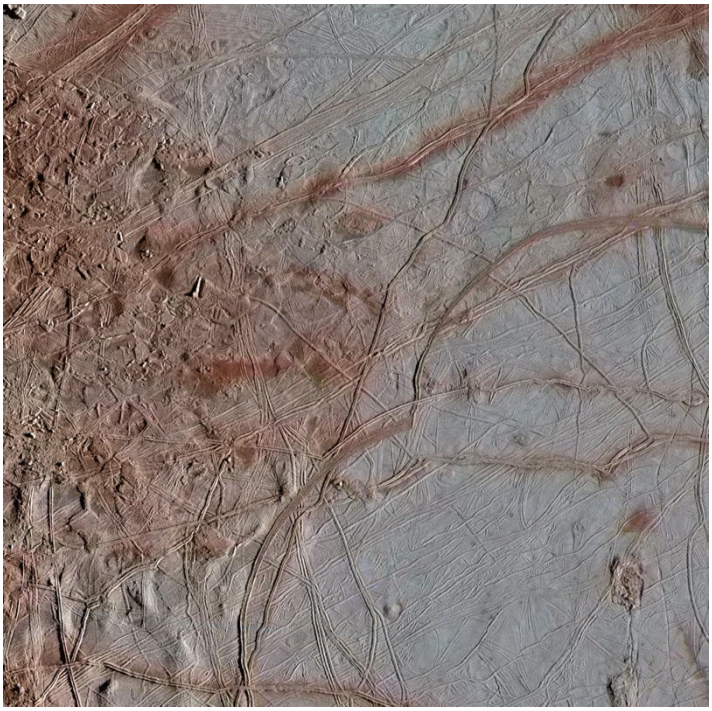
- Sky and Telescope Magazine (https://skyandtelescope.org/) – "This Week's Sky at a Glance" discussion and interactive star charts
- Astronomy Magazine (https://astronomy.com) – "The Sky this Week" discussion, interactive star charts, and participation in Citizen Science projects
- Astronomical Society of the Pacific (https://astrosociety.org) – science-based learning activities
- Space.com (www.space.com) – check out "What are star charts?" (https://www.space.com/star-charts.html), which features a link to an interactive (and printable) star chart

Mobile Applications – here are a few options to explore for your needs while navigating the night sky:

- Celestron SkyPortal (Free)
- Star Walk
- Sky Safari

Have tips or suggestions for next time? Please reach out to us at volunteer@sfaa-astronomy.org.

Newly Reprocessed Images of Europa Show 'Chaos Terrain' in Crisp Detail



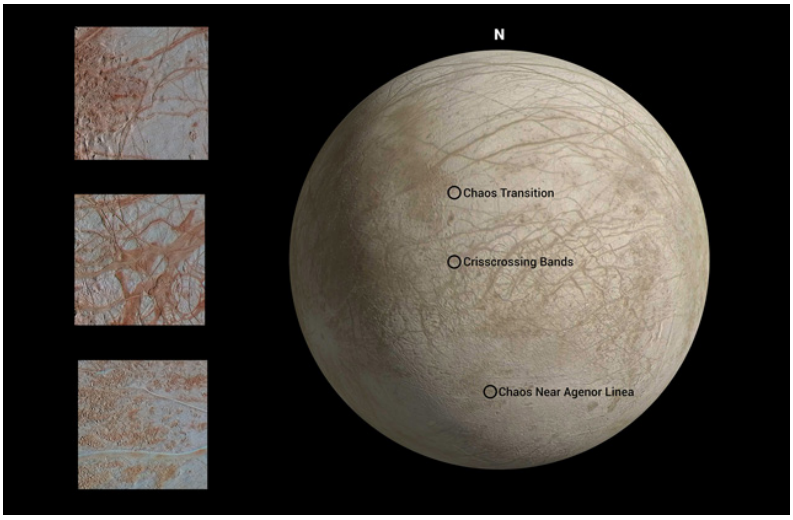
In this gallery of three newly reprocessed Europa images, details are visible in the variety of features on the moon's icy surface. This image of an area called Chaos Transition shows blocks that have moved and ridges possibly related to how the crust fractures from the force of Jupiter's gravity.

Image Credit: NASA/JPL-Caltech/SETI Institute

The surface of Jupiter's moon Europa features a widely varied landscape, including ridges, bands, small rounded domes and disrupted spaces that geologists call "chaos terrain." Three newly reprocessed images, taken by NASA's Galileo spacecraft in the late 1990s, reveal details in diverse surface features on Europa.

Although the data captured by Galileo is more than two decades old, scientists are using modern image processing techniques to create new views of the moon's surface in preparation for the arrival of the Europa Clipper spacecraft. The orbiter of Jupiter will conduct dozens of flybys of Europa to learn more about the ocean beneath the moon's thick icy crust and how it interacts with the surface. The mission, set to launch in the next several years, will be the first return to Europa since Galileo.

"We've only seen a very small part of Europa's surface at this resolution. Europa Clipper will increase that immensely," said planetary geologist Cynthia Phillips of NASA's Jet Propulsion Laboratory, a division of Caltech in Pasadena. As a Europa project staff scientist, she oversees a long-term research project to reanalyze images of the moon.



All three images were captured along the same longitude of Europa as Galileo flew by on Sept. 26, 1998, in the eighth of the spacecraft's 11 targeted flybys of Europa. High-resolution images revealing features as small as 500 yards (460 meters) across were taken through a clear filter in grayscale (black and white). Using lower-resolution color images of the same region from a different flyby, technicians mapped color onto the higher-resolution images - a painstaking process.

Enhanced-color images like these allow scientists to highlight geologic features with different colors. Such images don't show Europa as it would appear to the human eye, but instead exaggerate color variations to highlight different chemical compositions of the surface. Areas that appear light blue or white are made of relatively pure water ice, and reddish areas have more non-ice materials, such as salts.

Planetary scientists study high-resolution images of Europa for clues about how the surface formed. At an average of 40 million to 90 million years old, the surface we see today is much younger than Europa itself, which formed along with the solar system 4.6 billion years ago. In fact, Europa has among the youngest surfaces in the solar system, one of its many intriguing oddities.

The long, linear ridges and bands that crisscross Europa's surface are thought to be related to the response of Europa's icy surface crust as it is stretched and pulled by Jupiter's strong gravity. Ridges may form when a crack in the surface opens and closes repeatedly, building up a feature that's typically a few hundred yards tall, a few miles wide and can span horizontally for thousands of miles.

In contrast, bands are locations where cracks appear to have continued pulling apart horizontally, producing wide, relatively flat features.

Areas of so-called chaos terrain contain blocks that have moved sideways, rotated or tilted before being refrozen into their new locations. To understand how they might have formed, scientists study these blocks as if they are jumbled puzzle pieces.

The Galileo mission was managed by JPL for NASA's Science Mission Directorate in Washington. Additional information about Galileo and its discoveries is available on the Galileo mission home page at: http://solarsystem.nasa.gov/galileo/

More information about Europa and Europa Clipper is available at: europa.nasa.gov

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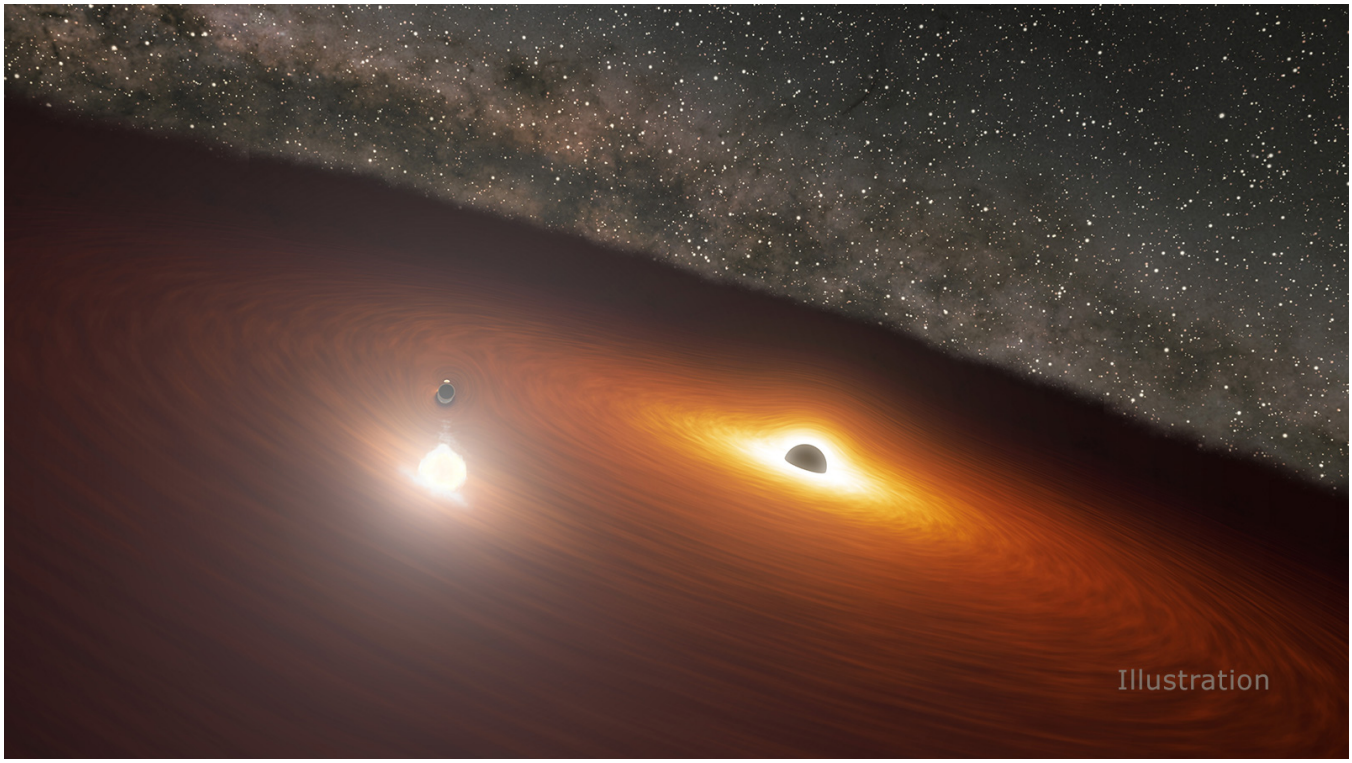
Spitzer Telescope Reveals the Precise Timing of a Black Hole Dance



This image shows two massive black holes in the OJ 287 galaxy. The smaller black hole orbits the larger one, which is also surrounded by a disk of gas. When the smaller black hole crashes through the disk, it produces a flare brighter than 1 trillion stars.

Credit: NASA/JPL-Caltech

Black holes aren't stationary in space; in fact, they can be quite active in their movements. But because they are completely dark and can't be observed directly, they're not easy to study. Scientists have finally figured out the precise timing of a complicated dance between two enormous black holes, revealing hidden details about the physical characteristics of these mysterious cosmic objects.

The OJ 287 galaxy hosts one of the largest black holes ever found, with over 18 billion times the mass of our Sun. Orbiting this behemoth is another black hole with about 150 million times the Sun's mass. Twice every 12 years, the smaller black hole crashes through the enormous disk of gas surrounding its larger companion, creating a flash of light brighter than a trillion stars - brighter, even, than the entire Milky Way galaxy. The light takes 3.5 billion years to reach Earth.

Timing of the Black Hole Dance: https://youtu.be/HBE8qBtQMuA

But the smaller black hole's orbit is oblong, not circular, and it's irregular: It shifts position with each loop around the bigger black hole and is tilted relative to the disk of gas. When the smaller black hole crashes through the disk, it creates two expanding bubbles of hot gas that move away from the disk in opposite directions, and in less than 48 hours the system appears to quadruple in brightness.

Because of the irregular orbit, the black hole collides with the disk at different times during each 12-year orbit. Sometimes the flares appear as little as one year apart; other times, as much as 10 years apart. Attempts to model the orbit and predict when the flares would occur took decades, but in 2010, scientists created a model that could predict their occurrence to within about one to three weeks. They demonstrated that their model was correct by predicting the appearance of a flare in December 2015 to within three weeks.

Then, in 2018, a group of scientists led by Lankeswar Dey, a graduate student at the Tata Institute of Fundamental Research in Mumbai, India, published a paper with an even more detailed model they claimed would be able to predict the timing of future flares to within four hours. In a new study published in the Astrophysical Journal Letters, those scientists report that their accurate prediction of a flare that occurred on July 31, 2019, confirms the model is correct.

The observation of that flare almost didn't happen. Because OJ 287 was on the opposite side of the Sun from Earth, out of view of all telescopes on the ground and in Earth orbit, the black hole wouldn't come back into view of those telescopes until early September, long after the flare had faded. But the system was within view of NASA's Spitzer Space Telescope, which the agency retired in January 2020.

After 16 years of operations, the spacecraft's orbit had placed it 158 million miles (254 million kilometers) from Earth, or more than 600 times the distance between Earth and the Moon. From this vantage point, Spitzer could observe the system from July 31 (the same day the flare was expected to appear) to early September, when OJ 287 would become observable to telescopes on Earth.

"When I first checked the visibility of OJ 287, I was shocked to find that it became visible to Spitzer right on the day when the next flare was predicted to occur," said Seppo Laine, an associate staff scientist at Caltech/IPAC in Pasadena, California, who oversaw Spitzer's observations of the system. "It was extremely fortunate that we would be able to capture the peak of this flare with Spitzer, because no other human-made instruments were capable of achieving this feat at that specific point in time."

Ripples in Space

Scientists regularly model the orbits of small objects in our solar system, like a comet looping around the Sun, taking into account the factors that will most significantly influence their motion. For that comet, the Sun's gravity is usually the dominant force, but the gravitational pull of nearby planets can change its path, too.

Determining the motion of two enormous black holes is much more complex. Scientists must account for factors that might not noticeably impact smaller objects; chief among them are something called gravitational waves. Einstein's theory of general relativity describes gravity as the warping of space by an object's mass. When an object moves through space, the distortions turn into waves. Einstein predicted the existence of gravitational waves in 1916, but they weren't observed directly until 2015 by the Laser Interferometer Gravitational Wave Observatory (LIGO).

The larger an object's mass, the larger and more energetic the gravitational waves it creates. In the OJ 287 system, scientists expect the gravitational waves to be so large that they can carry enough energy away from the system to measurably alter the smaller black hole's orbit - and therefore timing of the flares.

While previous studies of OJ 287 have accounted for gravitational waves, the 2018 model is the most detailed yet. By incorporating information gathered from LIGO's detections of gravitational waves, it refines the window in which a flare is expected to occur to just 1 1/2 days.

To further refine the prediction of the flares to just four hours, the scientists folded in details about the larger black hole's physical characteristics. Specifically, the new model incorporates something called the "no-hair" theorem of black holes.

Published in the 1960s by a group of physicists that included Stephen Hawking, the theorem makes a prediction about the nature of black hole "surfaces." While black holes don't have true surfaces, scientists know there is a boundary around them beyond which nothing - not even light - can escape. Some ideas posit that the outer edge, called the event horizon, could be bumpy or irregular, but the no-hair theorem posits that the "surface" has no such features, not even hair (the theorem's name was a joke).

In other words, if one were to cut the black hole down the middle along its rotational axis, the surface would be symmetric. (The Earth's rotational axis is almost perfectly aligned with its North and South Poles. If you cut the planet in half along that axis and compared the two halves, you would find that our planet is mostly symmetric, though features like oceans and mountains create some small variations between the halves.)

Finding Symmetry

In the 1970s, Caltech professor emeritus Kip Thorne described how this scenario - a satellite orbiting a massive black hole - could potentially reveal whether the black hole's surface was smooth or bumpy. By correctly anticipating the smaller black hole's orbit with such precision, the new model supports the no-hair theorem, meaning our basic understanding of these incredibly strange cosmic objects is correct. The OJ 287 system, in other words, supports the idea that black hole surfaces are symmetric along their rotational axes.

So how does the smoothness of the massive black hole's surface impact the timing of the smaller black hole's orbit? That orbit is determined mostly by the mass of the larger black hole. If it grew more massive or shed some of its heft, that would change the size of smaller black hole's orbit. But the distribution of mass matters as well. A massive bulge on one side of the larger black hole would distort the space around it differently than if the black hole were symmetric. That would then alter the smaller black hole's path as it orbits its companion and measurably change the timing of the black hole's collision with the disk on that particular orbit.

"It is important to black hole scientists that we prove or disprove the no-hair theorem. Without it, we cannot trust that black holes as envisaged by Hawking and others exist at all," said Mauri Valtonen, an astrophysicist at University of Turku in Finland and a coauthor on the paper.

Spitzer science data continues to be analyzed by the science community via the Spitzer data archive located at the Infrared Science Archive housed at IPAC at Caltech in Pasadena. JPL managed Spitzer mission operations for NASA's Science Mission Directorate in Washington. Science operations were conducted at the Spitzer Science Center at IPAC at Caltech. Spacecraft operations were based at Lockheed Martin Space in Littleton, Colorado. Caltech manages JPL for NASA.

For more information about Spitzer, visit: https://www.nasa.gov/spitzer

News Media Contact

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San Francisco Amateur Astronomers
PO Box 15097
San Francisco, CA 94115

Application for New or Renewing Membership

1. Memberships, with dues payment, are for one year running from the member's join or renewal date.

2. New or renewal memberships sent in via USPS mail will have membership start date based on postmark date.

3. SFAA is a 501(c)(3) nonprofit organization. Membership dues are tax-deductible, as allowed by law.

This application is for:

☐ **New**

☐ **Renewing**

Name: _____

Address: _____

_____

E-mail: _____

Phone (optional): _____

Membership Type: ☐ Individual - $30.00 ☐ Family - $35.00 ☐ Student - $10.00

☐ Supporting - $80.00 ☐ Institutional - $40.00

(All dues tax-deductible as allowed by law)

☐ **Please mail me a Mount Tamalpais Parking Permit (1 per membership)**

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

Both new and renewing members will receive a verifying email from the SFAA upon completion of the membership process.