Friends Of Galileo ASTRONOMY CLUB

Greg Smith – editor

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Program: The Aurora Borealis
Robert McGown

Meeting: April 17 2019
Mark Morris LGIC

Seeing from a Different Angle

I have just returned from the Magic Kingdom in Florida. I had a great time with my wife and daughter (who ran a 10k race at Disney World). What struck me the most; astronomy speaking was the angle of the Sun and stars. Granted I could not see many stars with all the light pollution, but what was a big reminder was that the stars were all out of place. They were way too high in the sky. I had a hard time figuring out what I was looking at. The sun was as high as it ever gets in the summer, so I had too small of a shadow for April.

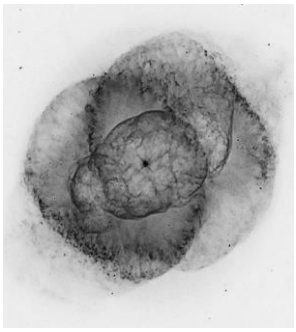
This made me realize that my familiar night sky is not everyone's night sky. I have seen the night sky from other latitudes and even south of the equator. But the sky was so different that it was not even close to what I was used to looking at, I might as well have been on another planet.

As I was coming home, flying across the US, I became aware of another perspective of the sky. In the middle of the country there is an actual horizon. At the St, Louis airport as we changed planes, I got a view of the actual horizon. A view of the flatness of a real horizon is amazing. I now understand what a friend told me, "Here you have no view; the hills are in the way".

Here in western Washington, we actually have no horizon. We have hills and mountains that hide the horizon. We have to wait for the stars to climb way above the horizon to clear the hills before we can see anything. For a moment I got what I'd call 'horizon envy'; the ability to see the stars as they actually rise from the 'edge' of the Earth. I know the closest we can get to a horizon is at the ocean with its flat 'edge' at sunset but that is in only one direction.

The perspective of seeing a 360 degree horizon must make someone feel, as they lay flat on the ground, that they are falling into the sky. The stars touch your feet as you look 'down', the stars touch your hands as you look to each side and as you look 'up' the stars are at the top of your head. You are surrounded by stars every way you look.

Every Day is a Star Filled Day
Every Night is a Starry Night

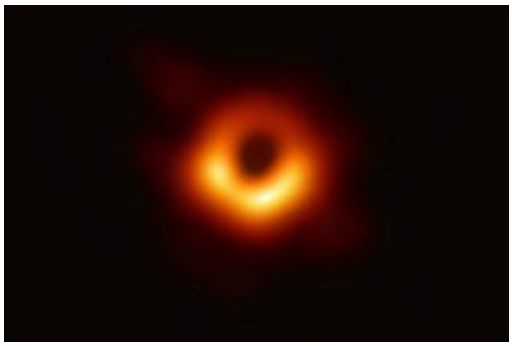


The Elusive Black Hole has been Seen

Eureka! Scientists Photograph a Black Hole for the 1st Time

By Mike Wall 3 days ago Science & Astronomy

Black holes have finally been dragged out of the shadows.



The Event Horizon Telescope, a planet-scale array of eight ground-based radio telescopes forged through international collaboration, captured this image of the supermassive black hole in the center of the galaxy M87 and its shadow.
(Image: © EHT Collaboration)

Black holes have finally been dragged out of the shadows.

For the first time ever, humanity has photographed one of these elusive cosmic beasts, shining light on an exotic space-time realm that had long been beyond our ken.

"We have seen what we thought was unseeable," Sheperd Doeleman, of Harvard University and the Harvard-Smithsonian Center for Astrophysics, said today (April 10) during a press conference at the National Press Club in Washington, D.C.

Doeleman directs the Event Horizon Telescope (EHT) project, which captured the epic imagery. These four photos, which were unveiled today at press events around the world and in a series of published papers, outline the contours of the monster black hole lurking at the heart of the elliptical galaxy M87.

The imagery is mind-blowing enough in its own right. But even more significant is the trail the new results will likely blaze, researchers said.

"There's really a new field to explore," Peter Galison, a professor of physics and the history of science at Harvard, said in an EHT talk last month at the South by Southwest (SXSW) festival in Austin, Texas. "And that's ultimately what's so exciting about this."

Galison, who co-founded Harvard's interdisciplinary Black Hole Initiative (BHI), compared the imagery's potential impact to that of the drawings made by English scientist Robert Hooke in the 1600s. These illustrations showed people what insects and plants look like through a microscope.

"It opened a world," Galison said of Hooke's work.

A telescope the size of Earth

The EHT is a consortium of more than 200 scientists that has been in the works for about two decades. It's a truly international endeavor; funding over the years has come from the U.S. National Science Foundation and many other organizations in countries around the world.

The project takes its name from a black hole's famed point of no return — the boundary beyond which nothing, not even light, can escape the object's gravitational clutches.

"The event horizon is the ultimate prison wall," BHI founding director Avi Loeb, the chair of Harvard's astronomy department, told Space.com. (Loeb is not part of the EHT team.) "Once you're in, you can never get out."

It's therefore impossible to photograph the interior of a black hole, unless you somehow manage to get in there yourself. (You and your pictures couldn't make it back to the outside world, of course.)

So, the EHT images the event horizon, mapping out the black hole's dark silhouette. (The disk of fast-moving gas swirling around and into black holes emits lots of radiation, so such silhouettes stand out.)

"We're looking for the loss of photons," EHT science council member Dan Marrone, an associate professor of astronomy at the University of Arizona, told Space.com.

The project has been scrutinizing two black holes — the M87 behemoth, which harbors about 6.5 billion times the mass of Earth's sun, and our own Milky Way galaxy's central black hole, known as Sagittarius A*. This latter object, while still a supermassive black hole, is a runt compared to M87's beast, containing a mere 4.3 million solar masses.

Both of these objects are tough targets because of their immense distance from Earth. Sagittarius A* lies about 26,000 light-years from us, and M87's black hole is a whopping 53.5 million light-years away.

From our perspective, Sagittarius A*'s event horizon "is so small that it's the equivalent of seeing an orange on the moon or being able to read the newspaper in Los Angeles while you're sitting in New York City," Doeleman said during the SXSW event last month.

No single telescope on Earth can make that observation, so Doeleman and the rest of the EHT team had to get creative. The researchers have linked up radio telescopes in Arizona, Spain, Mexico, Antarctica and other places around the world, forming a virtual instrument the size of Earth.

So much data

The EHT team has used this megascope to study the two supermassive black holes for two weeklong stretches to date — once in April 2017 and again the following year. The new imagery comes from the first observing run.

There are good reasons why it's taken two years for the project's first result to come out. For one thing, each night of observing generated about 1 petabyte of data, resulting in such a haul that the team has to move its information from place to place the old-fashioned way.

"There's no way that we can transfer this data through the internet," EHT project scientist Dimitrios Psaltis, an astronomy professor at the University of Arizona, said at the SXSW event. "So, what we actually do is, we take our hard drives and we FedEx them from place to place. This is much faster than any cable that you can ever find."

This slows and complicates analysis, of course. Data from the EHT scope near the South Pole, for example, couldn't get off Antarctica until December 2017, when it was warm enough for planes to go in and out, Marrone said.

Correlating and calibrating the data was also tricky, he added. And the team took great care with this work, given the momentous nature of the find.

"If you're going to come with a big claim of imaging a black hole, you have to have big evidence, very strong evidence," Doeleman said at the SXSW event (which served as an explainer of the EHT effort but did not announce any results).

"And on our project, we often think that people like [Albert] Einstein, [Arthur] Eddington [and Karl] Schwarzschild are kind of looking over our shoulders," he added, referring to physicists who helped pioneer our understanding of black holes. "And when you have luminaries kind of virtually checking your work, you really want to get it right."

What it all means

The EHT project has two main goals, Psaltis said: to image an event horizon for the first time ever and to help determine if Einstein's theory of general relativity needs any revisions.

Before Einstein came along, gravity was generally regarded as a mysterious force at a distance. But general relativity describes it as the warping of space-time: Massive objects such as planets, stars and black holes create a sort of sag in space-time, much as a bowling ball would if placed on a trampoline. Nearby objects follow this curve and get funneled toward the central mass.

General relativity has held up incredibly well over the century since its introduction, passing every test that scientists have thrown at it. But the EHT's observations provide another trial, in an extreme realm where predictions may not match reality. That's because astronomers can calculate the expected size and shape of an event horizon using general relativity, Psaltis explained.

If the observed silhouette matches the theory-informed simulations, "then Einstein was 100% right," Psaltis said. "If the answer is no, then we have to tweak his theory in order to make it work with experiments. This is how science goes."

And we learned today that no tweaks are needed, at least at the moment: EHT's M87 observations are consistent with general relativity, team members said. Namely, the event horizon is nearly circular and is the "right" size for a black hole of that immense mass.

"I have to admit, I was a little stunned that it matched so closely the predictions that we had made," EHT team member Avery Broderick, of the University of Waterloo and the Perimeter Institute for Theoretical Physics in Canada, said during today's news conference.

Such ground-truthing is vital to the scientific process, of course. Indeed, providing better information to feed into theories and simulations will likely be one of the EHT's biggest contributions, Loeb said.

"Doing physics is a dialog with nature," he said. "We test our ideas by comparing them to experiments; experimental data is crucial."

The new results should also help scientists get a better handle on black holes, he and other researchers said. For example, EHT imagery will likely shine significant light on how gas spirals down into a black hole's maw. This accretion process, which can lead to the generation of powerful jets of radiation, is poorly understood, Loeb said.

In addition, the shape of an event horizon can reveal whether a black hole is spinning, said Fiona Harrison of the California Institute of Technology, the principal investigator of NASA's black-hole-studying Nuclear Spectroscopic Telescope Array (NuSTAR) mission.

"We've inferred the spin of black holes indirectly," Harrison, who's not part of the EHT team, told Space.com. EHT imagery provides "a direct test, which is very exciting," she added.

EHT's data revealed the M87 black hole is spinning clockwise, team members said today.

The project should also show how matter is distributed around a black hole, and EHT observations could eventually teach astronomers a great deal about how supermassive black holes shape the evolution of their host galaxies over long time scales, Harrison said.

EHT's results also mesh well with those of the Laser Interferometer Gravitational-Wave Observatory (LIGO), which has detected the space-time ripples generated by mergers involving black holes just a few dozen times more massive than the sun.

"Despite varying across a factor of billion in mass, known black holes are all consistent with a single description," Broderick said today. "Black holes big and small are analogous in important ways. What we learn from one [type] necessarily applies to the other."

And in case you're wondering about Sagittarius A*: The EHT team hopes to get imagery of that supermassive black hole soon, Doeleman said today. The researchers looked at M87 first, and it's a bit easier to resolve than Sagittarius A* because it's less variable over short timescales, he explained.

A new perspective?

Then there's the broader appeal of the newly released imagery — how it speaks to those of us who aren't astrophysicists.

The contributions in this arena could be significant, EHT team members and outside scientists said. Photos can change the way we think about ourselves and our place in the universe, Marrone noted, citing the famous "Earthrise" photo taken by Apollo 8 astronaut Bill Anders in December 1968. This image, which gave the masses a glimpse of our planet as it really is — a lonely outpost of life in an infinite sea of darkness — is widely credited with helping to spur the environmental movement.

Seeing a real-life black hole — or its silhouette, anyway — "is the stuff of science fiction," Harrison said. And we've seen just the project's first few photos, she added: "They're only going to get better."

Minutes of the March Meeting

Ted Gruber called the meeting to order. Next month's talk will be on the Aurora Borealis. May's program will be Greg Cermac.

Ted gave the Sky Report. Mars becomes visible high in the southwestern sky as darkness falls and remains visible until setting in the west round 11:30 pm. Jupiter, Saturn, and Venus remain visible in the pre-dawn southeastern sky. Jupiter rises first just past 3 am in mid-March followed by Saturn a little after 5 am. Venus rises last at about 6:30 am. Mercury returns to the morning sky in early April. It is visible low to the horizon just east of Venus about 30 minutes before sunrise. The Messier of the Month is M35. It is a magnitude 5.1 cluster in Gemini. It contains several hundred stars and is estimated to be about 110 million years old. Binoculars resolve the cluster's brightest stars, smaller scopes resolve fainter stars, and larger scopes resolve starts across the cluster.

Earth Day is Saturday, April 20th at the Cowlitz County Event Center from 10 am - 3 pm . Ted thanked Greg Smith for getting everything set up for this event. A volunteer sign up sheet is being passed around. The more people helping, the better.

Roy Gawlick got a message from Katy Olson at Cascade Middle School. She would like to possibly do a star party for students on either May 3rd or 4th, or May 10th or 11th.

We will have a Summer Solstice Star Party on June 21st at Willow Grove Park. There will not be a Wednesday Club meeting in June, instead it will be at the Star Party.

Bill Norvell will try to reserve Canterbury Park for our July and August meetings.

We need a new insurance policy that will cover all our events. Our policy now only covers us at Mark Morris. Mark Thorson will look into a new policy, possibly through the Astronomical League.

The Mt. St. Helen's Star Party is Saturday, August 24th for the public. There will be a private star party for the astronomers on Friday the 23rd.

Membership dues are due in May.

Meeting adjourned.

☞ April 2019 Meeting ☜

DATE: **Wednesday, April 17, 2019**
TIME 7:00 pm
PLACE: Mark Morris High School
Large Group Instruction Center
Use 17th Ave. entrance

PROGRAM Aurora Borealis”

SNACKS: Becky Kent
DRINKS: Hakkayya

Friends of Galileo Club Officers

PRESIDENT	Greg Smith
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SECRETARY	Becky Kent
TREASURER	Steve Powell
WEBSITE	Ted Gruber
NEWSLETTER ED.	Greg Smith
ALCOR	Tom Meek

Next Month's Newsletter Deadline

The deadline for items in next month's newsletter is:
Wednesday: seven days before next meeting.

Please feel free to send in your thoughts and experiences about your astronomical adventure.

Submit your material by E-mail to:

grlyth@msn.com