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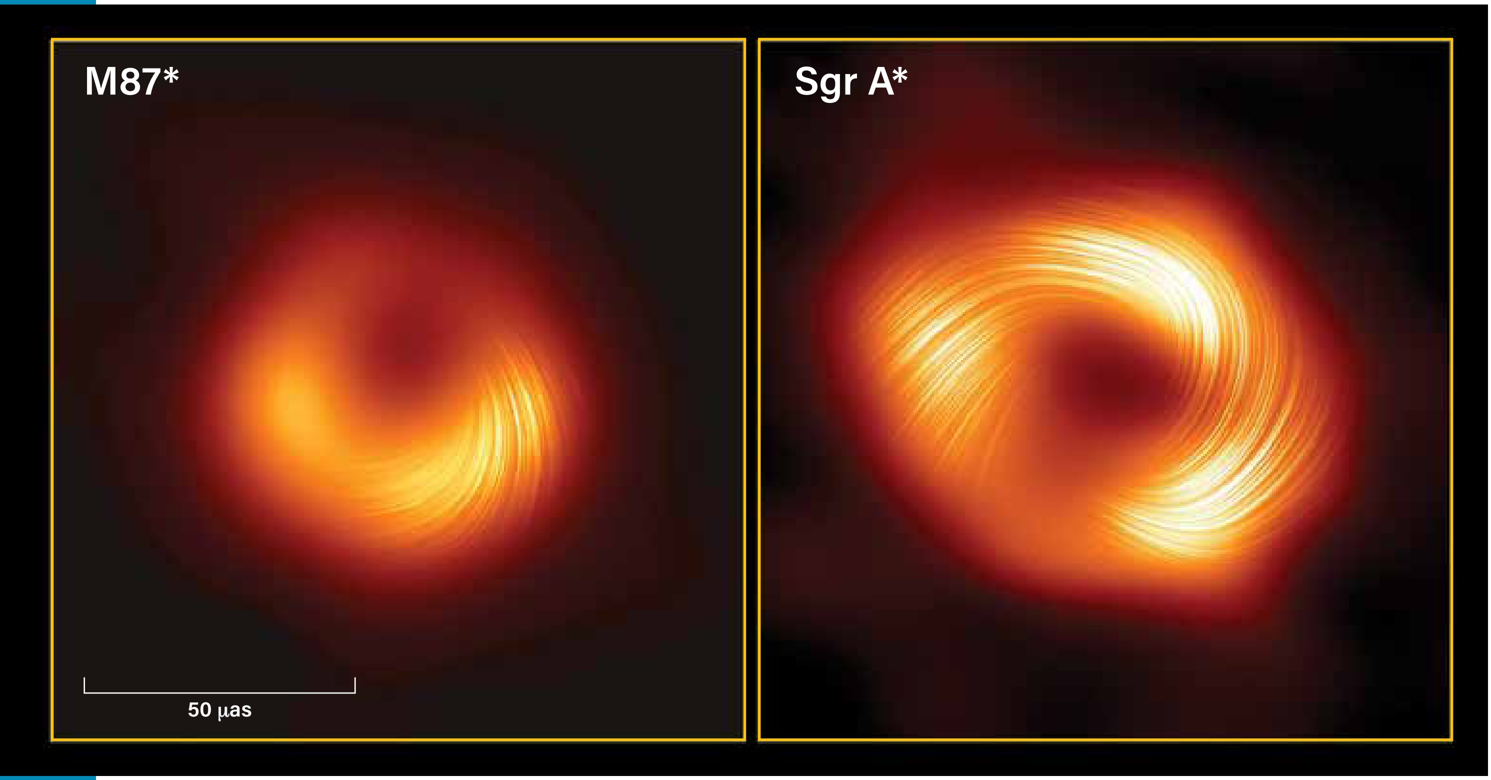
THE MILKY WAY'S CENTRAL BLACK HOLE COULD HAVE A HIDDEN JET

Imagery of our galaxy's supermassive black hole in polarized light reveals unexpected structure.



DOPPELGÄNGER. The orientation of polarization of light outside the event horizon of M87's and the Milky Way's central black holes is indicated by the lines overlaid. When seen in polarized light, M87* and Sgr A* look remarkably similar, suggesting they also have similar magnetic field structures. EHT COLLABORATION

» At 4 million times the mass of the Sun, the black hole at the center of the Milky Way Galaxy is rather humdrum, as far as supermassive black holes go. But a new analysis of data from the Event Horizon Telescope (EHT) reveals that it's more like its larger cousins than scientists thought.

The new study looks at the polarization of the light bent around our galaxy's central black hole, known as Sagittarius A* (or Sgr A*). The visualization produced by the team reveals a spiraling pattern of polarization, indicating that the black hole has a surprisingly strong and organized magnetic field. It may even be able to harness its magnetic field to fire out a jet of material, albeit a smaller version of the jets produced by the most powerful and voracious black holes.

Astronomers have yet to detect any jet, but if they do, "it might imply that almost every galaxy may have a hidden jet lurking at its center, but that we actually usually miss them because they're simply too weak," says Angelo Ricarte, a fellow at the Center for Astrophysics (CfA) | Harvard & Smithsonian in Cambridge, Massachusetts, and one of the leaders of the polarization analysis.

The work was published March 27 in two papers in *The Astrophysical Journal Letters*.

EYE OF THE STORM

The image is the latest in a groundbreaking series from the EHT, which began observations in 2017 as a network of eight radio telescopes around the globe. The team targeted two supermassive black holes: the one at the center of the galaxy M87, 55 million light-years distant, and the one at the heart of our own Milky Way.

Although the black hole M87* is much farther away than Sgr A*, it's much larger than Sgr A* and appears roughly the same size on the sky. Its heft also gives it a calmer overall appearance, in the same way that a hurricane appears more stable than a tornado, making its data easier to process.

In 2019, the international EHT team released their portrait of M87* — the first-ever image of a black hole's shadow and the light that gets bent around it. In 2021, the team reported how that light was polarized — meaning how the electromagnetic waves that make up the light are oriented. This is imprinted on light by the black hole's intense magnetic field, indicating how strong and organized it is.

The analysis of M87* showed a strong spiral signature, indicative of a strong magnetic field. This made sense, as M87* also sports a big, bright jet beaming out from the galactic core at near light-speed, powered by the black hole's rotation and magnetic field.

But the more turbulent appearance of Sgr A* proved harder to tame. In 2022, the EHT released their initial image of Sgr A*, which represents an average of the total light acquired by the telescopes. "That was already a huge challenge because all the techniques we had developed for M87 were broken by Sgr A*," says CfA fellow and project co-leader Sara Issaoun.

When the team began work on extracting a polarization image from the Sgr A* data, "we didn't expect to see anything," says Issaoun, as polarization "is even more challenging than working with total light." On top of that, the team also expected the relatively small size of Sgr A* to result in a weak, chaotic magnetic field.

But to their surprise, they quickly saw signs of structure, much like M87*. After spending some time training their imaging software, these details "came out again super easily," says Issaoun, "this beautiful kind of ordered spiral."

Intriguingly, that strong pattern is best matched in the team's models by black hole configurations and magnetic fields that ought to produce a jet. "We really need to be able to see the jet before we believe it," cautions Ricarte. "But it's very suggestive."

Issaoun says the EHT team thinks

JET-SETTING. The jet emanating from the center of galaxy M87 (imaged here by the Hubble Space Telescope) has been observed in all wavelengths. The first visual detection of the jet by an amateur astronomer was made by Barbara Wilson in a 20-inch reflector at the 1991 Texas Star Party. NASA AND THE HUBBLE HERITAGE TEAM (STSCI/AURA)

they can directly detect the jet in the next two years. "I think that's going to be the next adventure for us," she says.

THE VARIABILITY CRISIS

Other astronomers are also struck by the similarities between the two black holes. "It is surprising that Sgr A* and M87* would have similar magnetic fields, as they are two very different supermassive black holes," says Yvette Cendes, a CfA radio astronomer who was not involved in the work. She adds, "The claim of a hidden jet will definitely keep theorists busy for years."

Part of the puzzle is understanding why Sgr A* turned out to be less chaotic than predicted, in both total and polarized light — what theorists are calling "the variability crisis."

The conundrum affects more than just our understanding of supermassive black holes. Theorists think that jets from these black holes play a key role in their host galaxy's overall life story, determining how long a galaxy can form stars. That's because jets pump energy back out into a galaxy, which can blow away its reservoir of star-forming gas or heat it to the point where it can no longer collapse and make new stars.

Currently, says Ricarte, "the majority of cosmological simulations will only turn on a jet in more massive galaxies … because that is where we're confident that we see the jets. If they also exist in Sgr A*, that requires some kind of model modification." — MARK ZASTROW

QUICK TAKES

EUCLID DE-ICED
ESA's Euclid mission carried out a procedure to clear a buildup of water ice on the space telescope's mirrors, which was dimming its vision. Controllers had to take care to avoid excessive heat that could throw off its optical alignment.

A CHANCE OF SPACE TRASH
A 1.6-pound (0.7 kg) piece of a metallic post from a pallet of batteries discarded by the International Space Station in 2021 survived reentry and smashed through the roof of a Florida man's house March 8, 2024.

PLANETARY DIGESTION
At least one in every dozen stars appears to have swallowed one of its own planets, a survey of 91 stellar pairs finds. Looking at pairs with similar origins allowed researchers to identify the change in a star's chemical signature when it ingested a planet.

RADIO SANCTUARY
Astronomers gathered in Turin, Italy, March 21–22 to call for protecting the Moon's farside from radio interference. Shielded from Earth, the lunar farside is a pristine environment for radio astronomy, but future human exploration could disrupt it.

HEAVYWEIGHT BINARY
The pair of supermassive black holes at the center of elliptical galaxy B2 0402+379 weigh in at a combined 28 billion solar masses, making them the most massive black hole binary yet measured.

SINGLE-CELLED OPTIMISM
Lab experiments show that the Europa Clipper orbiter, set to launch to its namesake jovian moon later this year, can detect a single bacterial cell in a single grain of ice. The results raise hopes that the craft might find signs of life in water ejected from the moon's subsurface ocean.

— M.Z.