UC Irvine astronomers spot largest known stream of super-heated gas in the universe

Discovery was made using NASA’s James Webb Space Telescope and other resources.

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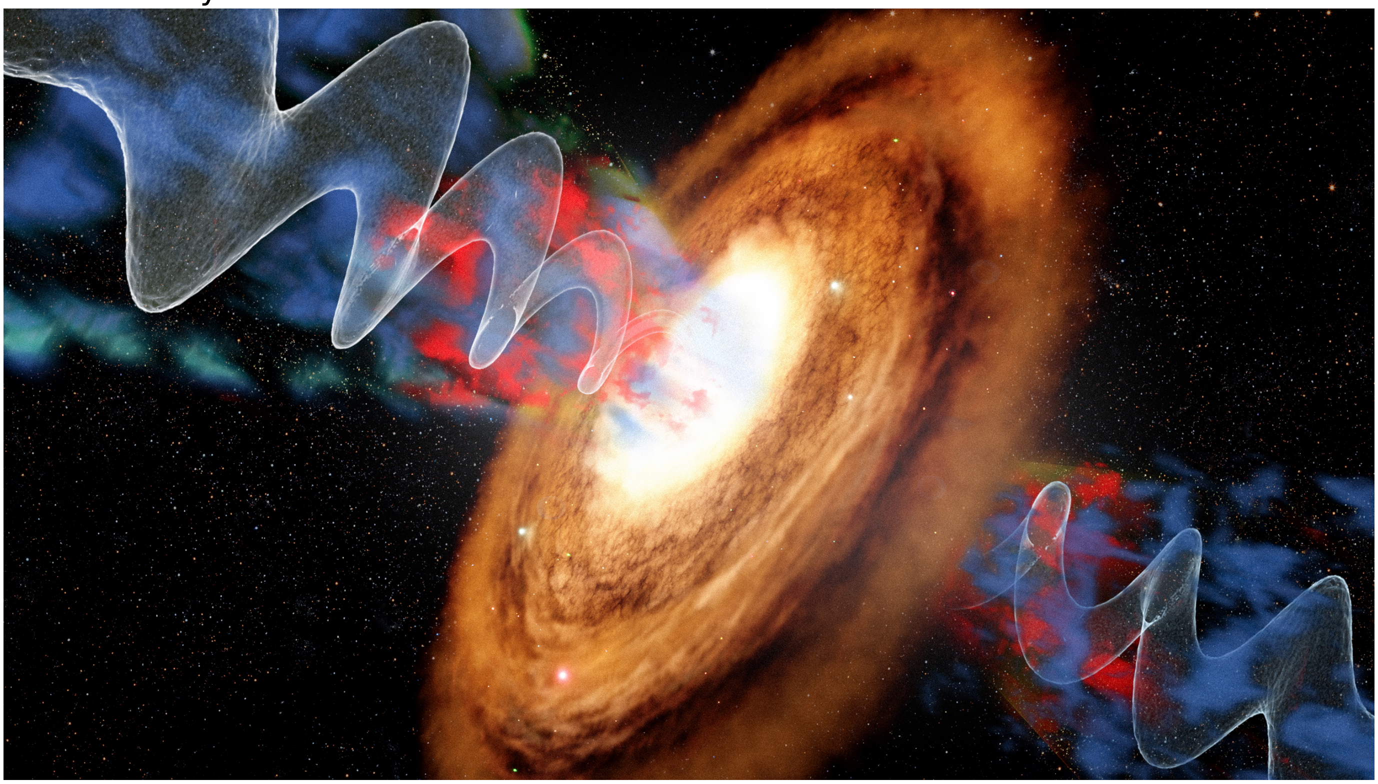

This artist’s rendering illustrates a precessing jet erupting from the supermassive black hole at the center of galaxy VV 340a. Optical observations from the W. M. Keck Observatory revealed extended, cooler gas pushed outward over thousands of light-years, while infrared data from NASA’s James Webb Space Telescope captured the super-heated coronal gas near the galaxy’s core.

Picture Credit:
W. M. Keck Observatory / Adam Makarenko

- UC Irvine astronomers found an unexpectedly large stream of super-heated gas at nearby galaxy.
- The team used NASA’s James Webb Space Telescope and other observatories.
- Project funding was provided by NASA and the National Science Foundation.

Irvine, Calif., Jan. 8, 2026 — University of California, Irvine astronomers have announced the discovery of the largest-known stream of super-heated gas in the universe ejecting from a nearby galaxy called VV 340a. They describe the discovery in *Science*.

The super-heated gas, detected by the researchers in data provided by NASA’s James Webb Space Telescope, is erupting from either side of the host galaxy in the form of two elongated nebulae as a result of an active supermassive black hole at the center of the galaxy. Each nebula is at least three kiloparsecs long (one parsec equates to roughly 19 trillion miles).

By comparison, the entire disk of the VV 340a galaxy is about three kiloparsecs thick.

“In other galaxies, this type of highly energized gas is almost always confined to several tens of parsecs from a galaxy’s black hole, and our discovery exceeds what is typically seen by a factor of 30 or more,” said lead author Justin Kader, a UC Irvine postdoctoral researcher in physics and astronomy.

The team used radio wave images from the Karl G. Jansky Very Large Array radio astronomy observatory near San Agustin, New Mexico, to reveal a pair of large-scale plasma jets emerging from either side of the galaxy. Astronomers know that such jets, which energize super-heated gas and eject it from the galaxy, form as the extreme temperatures and magnetic fields produced in the gas fall into the active supermassive black hole at the galaxy’s center.

At larger scales, these ejecting jets form a helical pattern, indicating something called “jet precession” which describes the change in orientation of the jet over time, similar to the periodic wobble of a spinning top.

“This is the first observation of a precessing kiloparsec-scale radio jet in a disk galaxy,” said Kader. “To our knowledge, this is the first time we have seen a kiloparsec, or galactic-scale, precessing radio jet driving a massive coronal gas outflow.”

The team suggests that as the jets flow outward, they couple with material in the host galaxy, pushing it outward and exciting it to a highly energized state. This forms coronal line gas, a term borrowed from the sun’s outer atmosphere to describe the hot, highly ionized plasma. Crucially, this super-heated coronal gas is almost exclusively associated with the compact inner structure of the active supermassive black hole and rarely extends far into the host galaxy. It is usually not observed outside the galaxy, according to Kader.

The kinetic power of the outflowing coronal gas, Kader said, is equivalent to 10 quintillion hydrogen bombs going off every second.

“We found the most extended and coherent coronal gas structure to date,” said senior co-author Vivian U, a former UC Irvine research astronomer who is now an associate scientist at Caltech’s Infrared Processing and Analysis Center. “We expected JWST to open up the wavelength window where these tools for probing active supermassive black holes would be available to us, but we had not expected to see such highly collimated and extended emission in the first object we looked at. It was a nice surprise.”

The picture of the jets and the coronal line emission they create became clear after Kader and his team combined observations of VV 340a obtained with several different telescopes.

Observations from the University of California-administered Keck II Telescope in Hawaii revealed more gas extending even farther from the galaxy, all the way out to 15 kiloparsecs from the active black hole. The authors believe this cooler gas is a “fossil record” of the jet’s interaction history with the galaxy, debris from previous episodes of the jet ejecting material from the heart of the galaxy.

Observations of the coronal gas came from the Webb telescope, which, as the largest space telescope ever built, orbits the sun one million miles away from the Earth. Its instruments see the universe in the infrared part of the electromagnetic spectrum, which means the telescope can detect things that would otherwise be invisible to visible light telescopes.

The Webb telescope’s infrared capabilities were key in helping Kader and his team spot the coronal line emission, he said. VV 340a has a lot of dust, which prevents a visible light telescope like Keck from seeing much of what's happening in the galaxy's interior.

However, the dust doesn't block infrared light, so when the Webb telescope retrieved images of VV 340a, the existence of the coronal line gas erupting out of it became clear. The effects of such a gas jet on a galaxy can be massive. According to the study, the jet is stripping VV 340a of enough gas every year to make 19 of our own suns.

"What it really is doing is significantly limiting the process of star formation in the galaxy by heating and removing star-forming gas," said Kader.

A jet like this doesn't seem to exist in our own Milky Way galaxy. Kader explained that there appears to be evidence that suggests the Milky Way's own supermassive black hole had an active feeding event two million years ago – something Kader said our *Homo erectus* ancestors may have been able to see in the night sky here on Earth.

Now that the team has found the precessing jet and the associated outflowing gas, Kader and U agree that the next thing to do is to investigate other galaxies to see if they can spot the same phenomenon in order to understand how galaxies like our own Milky Way may turn out in the future.

"We are excited to continue exploring such never-before-seen phenomena at different physical scales of galaxies using observations from these state-of-the-art tools, and we can't wait to see what else we will find," U said.

Funding for this project was provided by NASA and the National Science Foundation.

About the University of California, Irvine: Founded in 1965, UC Irvine is a member of the prestigious Association of American Universities and is ranked among the nation's top 10 public universities by *U.S. News & World Report*. The campus has produced five Nobel laureates and is known for its academic achievement, premier research, innovation and anteater mascot. Led by Chancellor Howard Gillman, UC Irvine has more than 36,000 students and offers 224 degree programs. It's located in one of the world's safest and most economically vibrant communities and is Orange County's second-largest employer, contributing $7 billion annually to the local economy and $8 billion statewide. For more on UC Irvine, visit www.uci.edu.

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