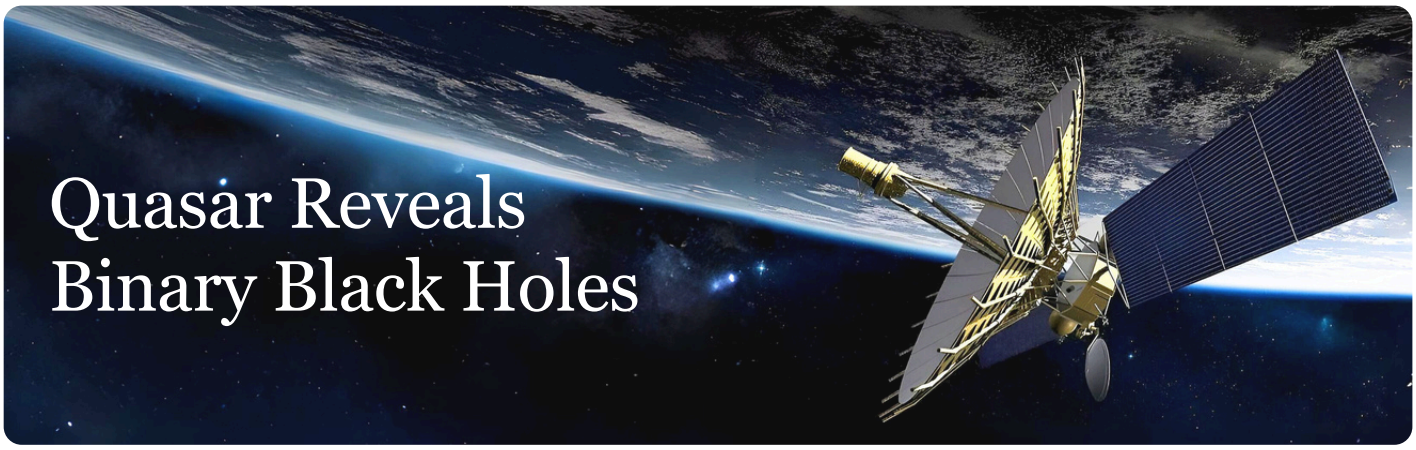
Astronomers Capture First-Ever Image of Two Black Holes Orbiting Each Other

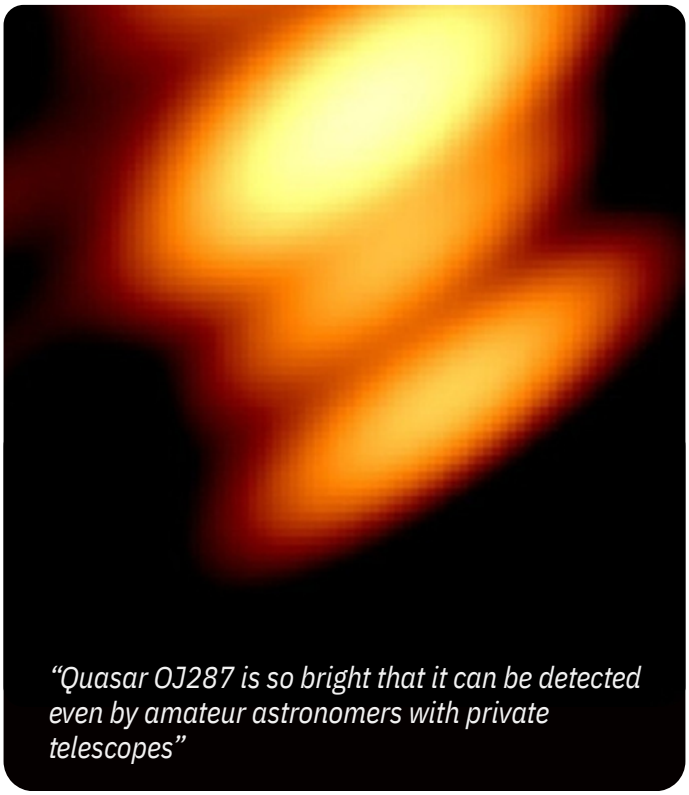


For the first time ever, astronomers have captured a radio image of two supermassive black holes orbiting each other inside at the heart of a distant quasar. This groundbreaking observation confirms the long-suspected existence of black hole pairs, a phenomenon that has been theorized but never directly observed; until now.

A quasar is a type of galaxy where the intense gravitational pull of a supermassive black hole at its core consumes surrounding gas and dust, creating an incredibly luminous display of energy. This extraordinary image, taken from the center of the quasar OJ287, provides the clearest proof yet of this cosmic interaction. Situated about 5 billion light-years away in the constellation Cancer, OJ287 is one of the brightest and most active regions in the universe.

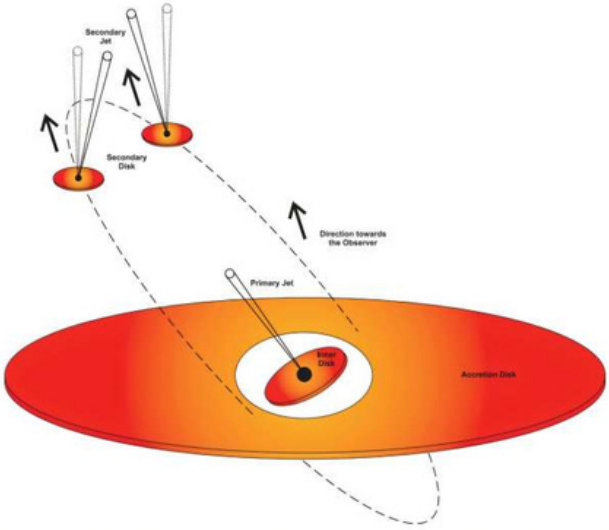
Earlier observations of OJ287 showed a massive jet of energy shooting out from the larger black hole, which is an enormous 18 billion times the mass of our Sun. However, a jet from the smaller black hole, which, despite being much less massive, still weighs in at an impressive 150 million times the mass of the Sun.

Insight Into the Binary Black Holes



"Quasar OJ287 is so bright that it can be detected even by amateur astronomers with private telescopes"

The Origins of Quasar OJ287



Schematic of the binary system of OJ287

The journey to understanding the enigmatic quasar OJ287 and its orbiting black holes stretches back decades, to a time when the very existence of black holes was still a matter of speculation. In 1982, as a master's student at the University of Turku, Aimo Sillanpää noticed something extraordinary: the brightness of OJ287 fluctuated on a consistent 12-year cycle.

This periodic pattern hinted at the presence of not one, but two black holes interacting at the galaxy's core.

At the time, no one could have imagined that these periodic dips and surges in brightness might be caused by two supermassive black holes in orbit around each other. Back then, the concept of quasars and black holes was still in its infancy, and the objects that Sillanpää observed were far from the focus of mainstream astronomy.

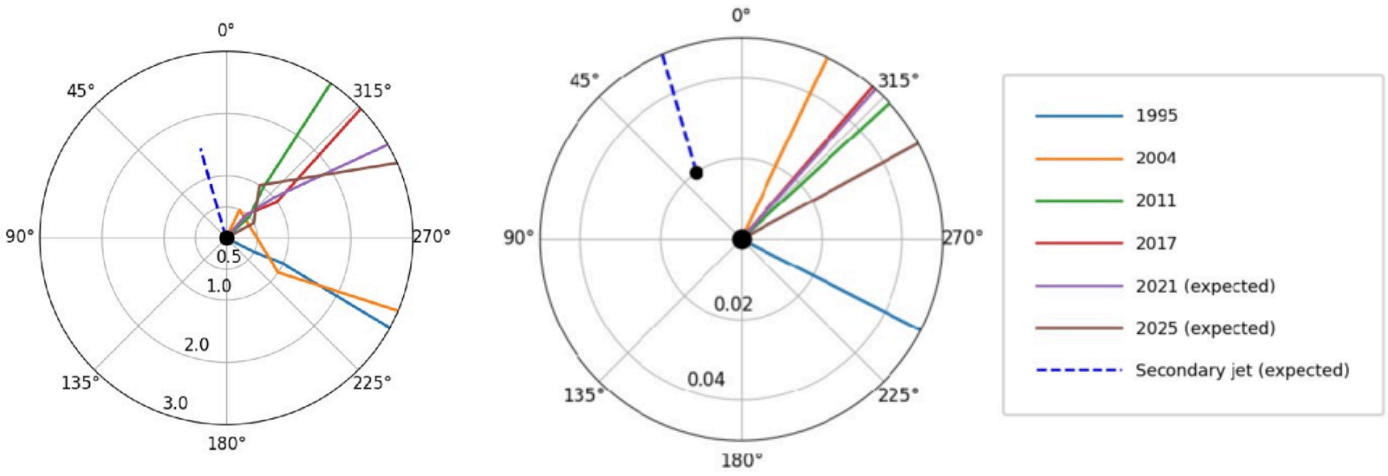
"What is special about OJ287 is that it has been thought to harbor not one but two black holes circling each other in a 12-year orbit, which produces an easily recognizable pattern of light variations in the same period."

~ Mauri Valtonen, University of Turku, Finland

Confirming the Binary Black Hole Model

It was only until four years ago, Researcher Lankeswar Dey, from Mumbai, India, working part-time at the University of Turku, finally unlocked the mystery of the orbital motion of the black holes at the center of OJ287. Dey's research provided a detailed explanation of the periodic fluctuations, but there was still one significant question remaining: could both black holes be observed simultaneously?

"For the first time, we managed to get an image of two black holes circling each other. In the image, the black holes are identified by the intense particle jets they emit. The black holes themselves are perfectly black, but they can be detected by these particle jets or by the glowing gas surrounding the hole."



A schematic, calculated by Lankeswar Dey, maps out the positions of both black holes and the jets they were emitting at the exact moment the image was captured.

This question was answered through NASA's TESS (Transiting Exoplanet Survey Satellite), which detected light emanating from both black holes. However, the light from the two black holes still appeared as a single point of brightness as its resolution wasn't sharp enough to separate the two objects visually. To clearly distinguish the pair, astronomers needed an image with about 100,000 times more resolution than a standard optical telescope could provide.

That became possible with help from RadioAstron, a Russian space telescope that used to orbit Earth at a distance nearly halfway to the Moon. By working in sync with radio telescopes on Earth using a technique known as Very-Long Baseline Interferometry (VLBI), it gave astronomers an incredibly sharp view; finally revealing both supermassive black holes and confirming their long-predicted orbit.

"The image of the two black holes was captured with a radio telescope system that included the RadioAstron satellite. It was in operation a decade ago, when OJ287 was imaged. The satellite's radio antenna went half-way to the Moon, which greatly improved the resolution of the image. In recent years, we have only been able to use Earth-based telescopes, where the image resolution is not as good."

The researchers identified a new type of jet coming from the smaller black hole in OJ287. Instead of a straight beam, this jet twists and bends, like water spraying from a spinning garden hose. This happens because the smaller black hole moves quickly around the larger one, causing its jet to change direction based on its motion.
They compare this behavior to "a wagging tail" predicting that the jet will continue to twist and shift as the smaller black hole changes speed and direction in the coming years.