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NEW OBSERVATIONS HELP EXPLAIN THE UNIVERSE'S MOST ENERGETIC OBJECTS

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The supermassive black hole at the centre of the Milky Way, which has a mass 4 million times greater than the Sun, is currently fairly quiet. | Photo Credit: Getty Images

Observations showing a roughly dough-nut-shaped cloud of cosmic dust and gas shrouding a huge black hole at the heart of a galaxy similar in size to our Milky Way are providing scientists with new clarity about the universe's most energetic objects.

Scientists said on Wednesday that their observations involving the supermassive black hole at the centre of galaxy Messier 77 and its surrounding cloud lend support to predictions made three decades ago about what are called "active galactic nuclei."

These are places at the centres of many large galaxies that have tremendous luminosity – sometimes outshining all of a galaxy's billions of stars combined – and produce the universe's most energetic outbursts seen since the Big Bang event 13.8 billion years ago. The energy arises from gas violently falling into a supermassive black hole that is surrounded by a cloud of tiny particles of rock and soot along with mostly hydrogen gas.

Black holes are extraordinarily dense objects possessing gravitational pulls so powerful even light cannot escape them. Supermassive black holes, which reside at the centre of many galaxies, including our own, are the largest of them.

Messier 77, also called NGC 1068 or the Squid Galaxy, is located 47 million light years – the distance light travels in a year, 9.5 trillion km – from the Earth in the constellation Cetus. Its supermassive black hole has a mass roughly 10 million times greater than our sun.

The observations, using the European Southern Observatory's Very Large Telescope in Chile's Atacama Desert, provided strong support for what is called the "unified model" of active galactic nuclei. This model holds that all active galactic nuclei are basically the same but that some appear from the vantage point of Earth to have different properties.

Some look intensely bright because the position of their ring-like cloud does not obscure the gas plummeting into the black hole from our viewing angle. Others look dark because the cloud blocks our view of what is truly happening.

Messier 77's active galactic nucleus is one of the dark ones, but the new observations indicate that it actually possesses the same qualities as the bright ones.

"The dust and gas in these clouds are probably blown out of the atmospheres of stars at a larger distance – hundreds of light years – from the black hole, and are falling in towards the centre under the influence of the black hole gravity," said Violeta Gamez Rosas, an astronomy doctoral student at Leiden University in the Netherlands and lead author of the research published in the journal *Nature.*

"Some clouds spiral in towards the black hole while others are pushed up into a 'fountain' that falls back onto the galaxy. Because of the dust, it is very difficult to see with telescopes what is going on in this region, but it is easier at infrared wavelengths than at normal visible wavelengths

because the dust does not absorb infrared light as much," said study co-author Walter Jaffe, a Leiden University astronomy professor.

The Milky Way's supermassive black hole, which has a mass 4 million times greater than the Sun, is currently "fairly quiet," Gamez Rosas said, but previously may have been more active like Messier 77's.

Gamez Rosas expressed satisfaction at studying active galactic nuclei.

"A lot of it is pure fascination with explosions on such gigantic scales, and the challenge of trying to explain them with what we think we know about physics," Gamez Rosas said.

"There is also the challenge of trying to build and operate telescopes to make these images of things so far away," Gamez Rosas added. "And there is the peace of mind that results from the knowledge that there is a large, complex, varied universe that goes its own way whatever we do on Earth."

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