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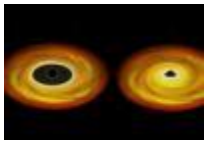

New Twists on the Milky Way's Big Black Hole

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The supermassive black hole at the center of our Milky Way Galaxy is heftier than thought and rotates at an amazing clip, new research shows.

For years scientists said the black hole contained about 2.6 million times the mass of the Sun. They now believe the figure is somewhere between 3.2 million and 4 million solar masses.

And a new study suggests all that mass, confined to an area about 10 times smaller than Earth's orbit around the Sun, spins around about once every 11 minutes. The Sun, for comparison, takes about a month to make a revolution on its axis. Earth spins once every 24 hours.

Black holes can't be seen or measured directly, because light passing near them gets trapped. So astronomers measure a black hole's mass by observing the orbital speed of nearby stars.

The new mass estimate was made by two separate groups, one at the University of California, Berkeley, and another at the University of California, Los Angeles, UC Berkeley physicist Reinhard Genzel told *SPACE.com*.

Fresh spin

More interesting, perhaps, is what appears to be a precise measurement of the supermassive black hole's spin rate made by Genzel's group.

Other studies have shown compelling evidence for the rotation of less massive black holes, formed when stars collapse. That's no surprise to astronomers, since these stellar black holes would logically retain the rotation of their progenitor stars. The first solid evidence for a spinning stellar black hole emerged more than two years ago.

Only hints of spin have been noted from supermassive black holes, each of which is thought to form and evolve hand-in-hand with the development of the galaxy in which it sits.

The location of the Milky Way's central black hole is well known. Called Sagitarrius A*, or Sgr A*, it sits about 26,000 light-years away, at the heart of the galaxy. It is surrounded by intense radio waves, X-rays and other radiation. Astronomers know the black hole is smaller than the diameter of Earth's orbit; they suspect it is about 10 times smaller but have not been able to measure it with enough precision to know for sure.

Genzel's team saw a flickering of near-infrared light they presume is generated by hot gas falling into the black hole, just before the gas disappears beyond the "event horizon," a point of no return for light and matter.

"If our interpretation is right, this is the first solid evidence for a spin of a massive black hole," Genzel said in an e-mail interview.

The black hole spins once every 11 minutes or so, Genzel estimates, though an exact figure is difficult to pin down. The estimate represents a pace equal to about 30 percent of the speed of light.

The data were collected by the 8.2-meter Kueyen telescope at the European Southern Observatory in Chile and detailed in a recent issue of the journal *Nature*.

"These observations, reflecting similar patterns seen earlier in X-rays, open a new window on this enigmatic source," said Ramesh Narayan of the Harvard-Smithsonian Center for Astrophysics, in an analysis of the work for the journal.

Theorists suspect other supermassive black holes, some containing as much matter as a billion Suns, should also spin.

Smaller scale

Not all black holes spin at the same rate, other investigations indicate. In fact, some may not spin at all.

Another recent study pinned down how X-ray emissions from fast-moving iron atoms near a stellar black hole can be used to determine whether or not the unseen central object is rotating.

The iron produces a distinct X-ray signature. The orbit of the atoms depends on the extent to which space around a black hole is curved. That mind-bending warpage, in turn, is determined by how much the black hole spins.

A spinning black hole drags space with it, allowing atoms to orbit closer to the black hole than if it were not spinning.

Observations by the European Space Agency's XMM-Newton satellite of a stellar black hole named XTE J1650-500 reveal some iron-generated X-rays just 20 miles from the event horizon. This black hole must be spinning rapidly, researchers say.

Data collected by NASA's Chandra X-ray Observatory, on a stellar black hole called Cygnus X-1, finds atoms no closer than 100 miles from the event horizon, providing no evidence that it spins.

Coming together

Meanwhile, efforts to understand whether and why lightweights and heavyweights rotate are converging.

Jon Miller, who worked on the recent stellar black hole research, said there is a high degree of correspondence between what happens to space around a spinning stellar black hole and its supermassive brethren.

"Because stellar black holes are smaller, everything happens about a million times faster, so they can be used as a test-bed for theories of how spinning black holes affect the space and matter around them," Miller said.

This article is part of SPACE.com's weekly Mystery Monday series.