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# NASA: 'Old Faithful' Black Hole Ejects Mass Equal

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Subject: NASA: 'Old Faithful' Black Hole Ejects Mass Equal

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"OLD FAITHFUL" BLACK HOLE EJECTS MASS EQUAL TO AN ASTEROID

Scientists observing a disk of matter surrounding a black hole in our galaxy have discovered that the disk is periodically disrupted and hurled outward in opposite directions from the black hole, in jets moving at nearly the speed of light. The black hole replenishes the disk by pulling hot gas from the surface of a nearby "companion" star, and then undergoes another disruption, repeating the sequence at half-hour intervals.

The researchers represent teams at the California Institute of Technology, Pasadena, CA, the Massachusetts Institute of Technology (MIT), Boston, and NASA's Goddard Space Flight Center, Greenbelt, MD, which all worked to correlate the disappearance of X-ray emitting hot gas in the disk with the appearance, shortly thereafter, of rapidly expanding jets. Dr. Ronald Remillard of MIT and Dr. Jean Swank of Goddard are presenting X-ray results, obtained with NASA's Rossi X-ray Timing Explorer (RXTE), which show the disappearing disk. Dr. Stephen Eikenberry of Caltech is presenting new infrared observations which demonstrate that when the X-rays from the disk vanish, the jets suddenly appear. The observations will be the subject of a press conference by three of the researchers involved, to be held Jan. 7 during the winter meeting of the American Astronomical Society in Washington, DC.

The disks of hot gas, known as accretion disks, are commonly observed around black holes with orbiting stellar companions, but the near simultaneous disappearance of the disk and formation of the jet has never been seen before. It promises to shed light on the origin of the enigmatic jets, also commonly observed near accreting black holes, but poorly understood.

"The system behaves like the celestial version of Old Faithful," notes Dr. Craig Markwardt, a researcher working with Swank at Goddard. "At fairly regular intervals, the accretion disk is disrupted and a fast moving jet is produced."

"This jet is staggeringly more powerful than a geyser,"

adds Swank. "Every half-hour, the black hole, in the constellation Aquila, throws off the mass equal to that of a 100 trillion ton asteroid at nearly the speed of light (approximately 650 million miles per hour). This process clearly requires a lot of energy -- each cycle is equivalent to six trillion times the annual energy consumption of the entire United States."

"What is even more amazing is that we are seeing the first clues to the source of matter ejected in the jets -- the correlations we discovered indicate that the jet material must come from the inner disk. For years theorists have hypothesized that the jets come from somewhere close to the black hole, but no one had ever actually seen that direct link until now" said Eikenberry.

Black holes are very massive objects with gravitational fields so intense that near them, nothing, not even light, can escape their pull. While this prevents anyone from observing black holes directly, their presence can be inferred from effects on nearby matter. Many of the known or suspected black holes are orbiting a close "companion" star. The black hole's gravity pulls gas from the companion star into a swirling disk of material which orbits around the black hole, much as soap suds swirl around a bathtub drain. As it falls into the black hole, the gas in the disk is compressed and heated to millions of degrees, emitting X-rays.

"We found that the X-rays from the disk disappeared almost completely every half hour. About five minutes later, they would return again. The results of the X-ray observations, Eikenberry's infrared observations at Mt. Palomar, CA, and infrared and radio observations made by Dr. Felix Mirabel, Director, Centre d'Etudes de Saclay, France, and collaborators, showed that very shortly after the X-rays vanished, jets appeared at infrared and radio wavelengths. Since X-ray emitting hot gas in the disk disappears during these episodes, we all concluded that the matter in the disk must have escaped, probably flung out in the jets. As the black hole pulls more gas from its companion star, the disk appears again, along with the X-rays, and the cycle starts over," Swank said. Dr. Mirabel obtained results with the United Kingdom Infrared Telescope and the Very Large Array in New Mexico.

"The great value of these observations," notes Swank, RXTE project scientist, "is that potentially they are giving us a key to answer some big questions. It is remarkable how little we understand of these jets, because they are such a common and impressive phenomenon. In fact, black hole jet formation is rather mysterious because it's hard to understand how anything can be expelled from the vicinity of a black hole since its powerful gravity pulls everything in. I believe this black hole will prove to be one key to finding out lots of things about black holes and jets.

"This is like having a miniature quasar in your back yard; and, because it is much smaller, it changes over minutes and hours, rather than months and years. This will let us learn a lot in a much shorter period of time," said Elkenberry.

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Note to Editors: A video file, with computer animation and, will be broadcast on NASA TV Jan. 7. Images to support this story are available on the Internet at:
FTP://PAO.GSFC.NASA.GOV/newsmedia/JAN_AAS/BH
RXTE information is available at:
http://heasarc.gsfc.nasa.gov/docs/xte/XTE.html

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