Black Hole Eclipse

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April 12, 2007: NASA's Chandra X-ray Observatory has observed a remarkable eclipse of a supermassive black hole, allowing a disk of hot matter swirling around the hole to be measured for the first time.

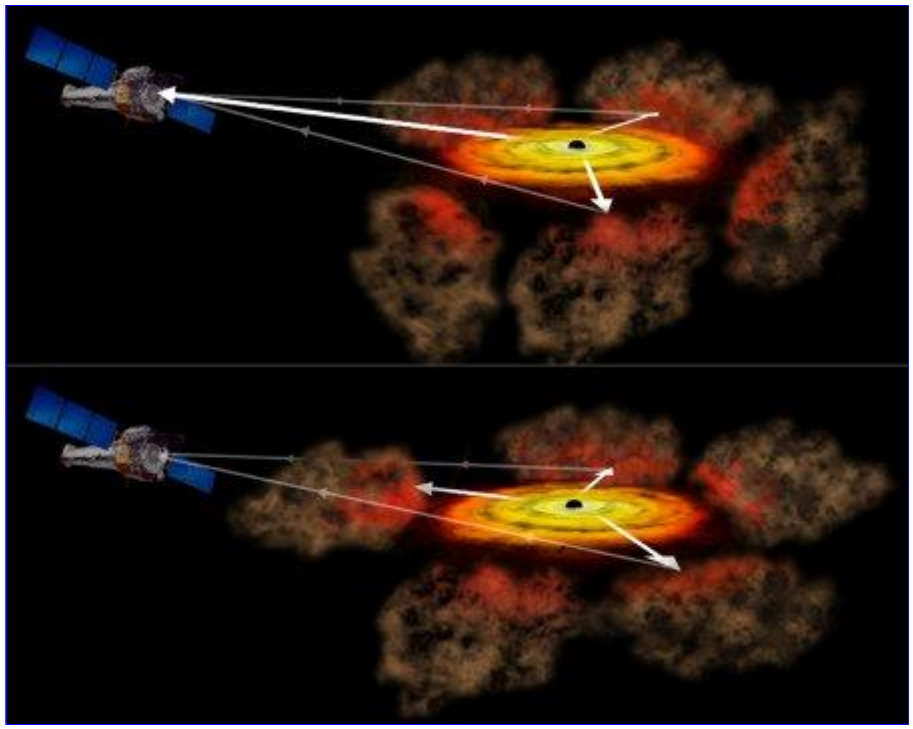
The supermassive black hole is located in NGC 1365, a spiral galaxy 60 million light years from Earth. It contains a so-called active galactic nucleus, or AGN. Scientists believe that a black hole at the center of the AGN is fed a steady stream of material from a surrounding disk. Matter just about to fall into a black hole should be heated to millions of degrees before passing over the event horizon, or point of no return. This super-heated disk material glows brightly in the X-ray part of the electromagnetic spectrum where Chandra can see it.

Right: The black hole eclipse occurred in the core of this barred spiral galaxy, NGC 1365. [More]

The disk of gas around the central black hole in NGC 1365 is much too small to resolve directly with a telescope. However, the disk was eclipsed by an intervening cloud. By recording the time taken for the disk to go in and out of eclipse, scientists were able to estimate the diameter of the disk.

"For years we've been struggling to confirm the size of this X-ray structure," said Guido Risaliti of the Harvard-Smithsonian Center for Astrophysics (CfA) in Cambridge, Mass, and the Italian Institute of Astronomy (INAF). "A serendipitous eclipse enabled us to make this breakthrough."

The Chandra team directly measured the diameter of the X-ray source as about seven times the distance between the Sun and the Earth or 7 AU (astronomical units). For comparison, if such a disk were placed in our own solar system, it would swallow all the planets out to Mars and most of the asteroid belt as well.



Above: An artist's concept (not to scale) of Chandra observing the black hole eclipse. [More]

According to these measurements, the source of X-rays is about 2 billion times smaller than the host galaxy NGC 1365 and only about 10 times larger than the estimated size of the black hole's event horizon. This is consistent with theoretical predictions.

"Thanks to this eclipse, we were able to probe much closer to the edge of this black hole than anyone has been able to before," said co-author Martin Elvis from CfA. "Material this close in will likely cross the event horizon and disappear from the universe in about a hundred years, a blink of an eye in cosmic terms."

In addition to measuring the size of this disk of material, Risaliti and his colleagues were also able to estimate the location of the dense gas cloud that eclipsed the X-ray source and central black hole. The Chandra data show that this cloud is one hundredth of a light year from the black hole's event horizon--much closer than anyone expected. So this is a bit of a puzzle.

"AGN [are among] the brightest objects in the cosmos and they are powerful probes of the early history of the Universe. It's vital we understand their basic structure," said Risaliti. "It turns out that we still have work to do to understand these monsters."

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NASA's Marshall Space Flight Center, Huntsville, Ala., manages the Chandra program for the agency's Science Mission Directorate. The Smithsonian Astrophysical Observatory controls science and flight operations from the Chandra X-ray Center, Cambridge, Mass.

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