Nearby black hole is feeble and unpredictable

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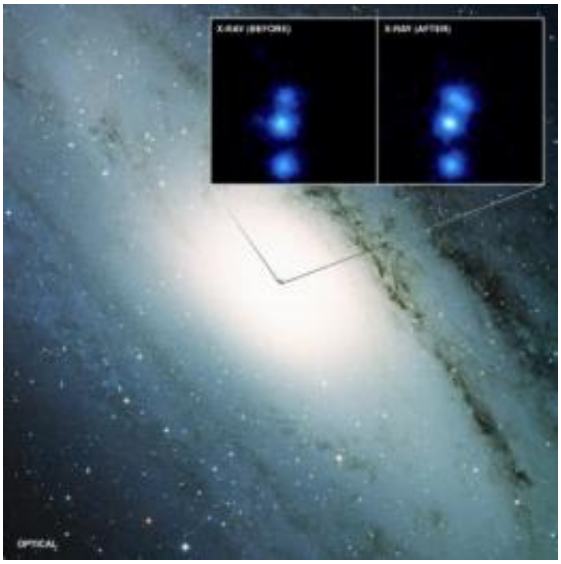

The large image here shows an optical view, with the Digitized Sky Survey, of the Andromeda Galaxy, otherwise known as M31. The inset shows Chandra images of a small region in the center of Andromeda. The image on the left shows a sum of Chandra images taken before January 2006 and the image on the right shows a sum of images taken after January 2006. Before 2006, three X-ray sources are clearly visible, including one faint source close to the center of the image. After 2006, a fourth source, called M31*, appears just below and to the right of the central source, produced by material falling onto the supermassive black hole in M31. Credit: X-ray (NASA/CXC/SAO/Li et al.), Optical (DSS)

For over 10 years, NASA's Chandra X-ray Observatory has repeatedly observed the Andromeda Galaxy for a combined total of nearly one million seconds. This unique data set has given astronomers an unprecedented view of the nearest supermassive black hole outside our

own Galaxy.

Astronomers think that most galaxies - including the Milky Way - contain giant black holes at their cores that are millions of times more massive than the Sun. At a distance of just under 3 million light years from Earth, Andromeda (also known as M31) is relatively close and provides an opportunity to study its black hole in great detail.

Just like the one in the center of the Milky Way, the black hole in Andromeda is surprisingly quiet. In fact, Andromeda's black hole, known as M31*, is ten to one hundred thousand times fainter in X-ray light that astronomers might expect given the reservoir of gas around it.

"The black holes in both Andromeda and the Milky Way are incredibly feeble," said Zhiyuan Li of the Harvard-Smithsonian Center for Astrophysics (CfA) in Cambridge, Mass. "These two 'anti-quasars' provide special laboratories for us to study some of the dimmest type of accretion even seen onto a supermassive black hole."

The decade-long study by Chandra reveals that M31* was in a very dim, or quiet, state before 2006. However, on January 6, 2006, the black hole became more than a hundred times brighter, suggesting an outburst of X-rays. This was the first time such an event had been seen from a supermassive black hole in the nearby, local universe.

After the outburst, M31* entered another relatively dim state, but was almost ten times brighter on average than before 2006. The outburst suggests a relatively high rate of matter falling onto M31* followed by a smaller, but still significant rate.

"We have some ideas about what's happening right around the black hole in Andromeda, but the truth is we still don't really know the details," said Christine Jones, also of the CfA.

The overall brightening since 2006 could be caused by M31* capturing winds from an orbiting star, or by a gas cloud that spiraled into the black hole. The increase in the rate of material falling towards the black hole is thought to drive an X-ray brightening of a relativistic jet.

The cause of the outburst in 2006 is even less clear, but it could be due to a sudden release of energy, such as magnetic fields in a disk around the black hole that suddenly connect and become more powerful.

"It's important to figure out what's going on here because the accretion of matter onto these black holes is one of the most fundamental processes governing the evolution of galaxies," said Li, who presented these results at the 216th meeting of the American Astronomical Society meeting in Miami, FL.

These results imply that the feeble, but erratic behavior of the black hole in the Milky Way may be typical for present-day supermassive black holes.

Provided by Harvard-Smithsonian Center for Astrophysics

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