SCIENCE NEWS
GALAXIES

B-flat Black Hole

The Chandra X-ray Observatory discovers sound waves from a supermassive black hole in the Perseus galaxy cluster.

by Vanessa Thomas

Who knew black holes could sing? Well, "bellow" might be a better term. The tune sounded by a supermassive black hole 250 million light-years away is actually a steady bass note like that of a cosmic fog horn warning surrounding material of the dangers of coming too close.

After observing the Perseus galaxy cluster for 53 hours in August 2002, the Chandra X-ray Observatory revealed ripples in the hot gas that fills the cluster. These ripples appear to be sound waves that would register as a B flat if we could hear the deep tone.

The team that discovered the waves determined their frequency by calculating the speed of sound in that environment and measuring the distance between wave crests. The frequency is about one cycle (or wave) per 9.5 million years or so — corresponding to a B-flat note about 57 octaves below "middle C" on a piano.

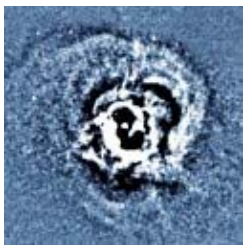
It's the deepest note ever detected and the first sound waves identified from a black hole.

"We have observed the prodigious amounts of light and heat created by black holes, now we have detected the sound," said team leader Andrew Fabian of the Institute of Astronomy in England.

The ripples extend hundreds of thousands of light-years from the supermassive black hole at the center of Perseus A (a.k.a. NGC 1275), the dominant member of the galaxy cluster. Fabian's group suspects they are created when two 50,000-light-year-wide cavities, excavated by jets from the black hole, push against the surrounding gas. These cavities also appear in Chandra's observations.

The sound waves could explain why the x-ray-emitting gas in the Perseus cluster has remained hot, rather than cooling off

This three-color x-ray image from Chandra shows x-ray emitting gas in the Perseus cluster. *NASA / CXC / IoA / A.Fabian et al.*



A special image-processing technique revealed subtle brightness changes in Chandra's observations. *NASA / CXC / IoA / A.Fabian et al.*

as astronomers would expect. When sound waves move through the gas, they're eventually absorbed by and transfer their energy to the gas. To provide the energy necessary to keep the gas heated, the sound must have been continuous for roughly 2.5 billion years.

Fabian and his colleagues targeted the Perseus cluster with Chandra because it's the brightest galaxy cluster in x rays. However, other galaxy clusters have cavities and stubbornly hot gas, so Chandra may find similar waves elsewhere.

This 1.4-MB animation shows the production of pressure waves in the interstellar gas of the Perseus cluster, caused by jets from a supermassive black hole. (Click on the image to download.) *Animation: NASA / CXC / A. Hobart; X-ray Image: NASA / CXC / IoA / A.Fabian et al.*

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