Black Hole Strikes Deepest Musical Note Ever Heard

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Astronomers have detected the deepest note ever generated in the cosmos, a B-flat flying through space like a ripple on an invisible pond. No human will actually hear the note, because it is 57 octaves below the keys in the middle of a piano.

The detection was made with NASA's Chandra X-ray Observatory and announced at a press conference today.

The note strikes an important chord with astronomers, who say it may help them understand how the universe's largest structures, called galaxy clusters, evolve.

Images

Hot gas in the Perseus cluster. Red is lower temperatures, green intermediate and blue the hottest. Blue areas are hard to see because they involve faint emissions near the edges of the cluster.

Artist's rendering of the sound waves makes their presence more distinct.

The Chandra data show sound waves rippling through hot gas that fills the Perseus cluster. The features were discovered by using a special image-processing technique to bring out subtle changes in brightness.

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The sound waves appear to be heating gas in the Perseus galaxy cluster, some 250 million light-years away, potentially solving a longstanding mystery about why the gas surrounding this cluster and others does not chill out as existing theory predicts.

The gas is apparently dancing excitedly to the eons-long drone of a deep B-flat.

Black hole music

Astronomers were not surprised to find the supermassive black hole making a strong sub-bass sound. Though these greatest known matter sinks are by nature dark and invisible, they create bright and chaotic environments in which many forms of radiation -- from radio waves to visible light to X-rays -- have been recorded. These electromagnetic waves all travel at the speed of light.

Sound waves are similar, but they travel far more slowly and are more physical in nature. Sound you hear, for example, can be produced by the visible compression and expansion of a stereo speaker. The waves physically compress the stuff through which they move, be it air, water, or hot interstellar gas.

Other studies have shown that the riotous activity around black holes -- where gas is accelerated to nearly light-speed -- produces many notes that are, all together, much like music. Collectively, the cosmos produce, scientists believe, a cacophonic symphony of inaudible tunes.

Musical production appears to be ubiquitous in Nature. Scientists often call it flicker noise, and it has also been detected in the X-ray outputs of magnetic fields within our solar system. Even Earth hums its own tune. Musical analogies are found in everything from seascapes to brainwaves.

Way out of range

The 53 hours of Chandra observations revealed a note that is more than a million billion times deeper than what you can

hear.

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

"The Perseus sound waves are much more than just an interesting form of black hole acoustics," said Fabian's colleague Steve Allen. "These sound waves may be the key in figuring out how galaxy clusters …grow."

Scientists had previously observed large amounts of hot gas infusing clusters. Given what's known, the gas should cool over time, however. Cooler gas would create areas of lower pressure near the center of a cluster, causing fringe gas to fall inward. In the process, trillions of stars would form.

This isn't what astronomers see when they look at clusters, though.

The Perseus cluster is the brightest known in X-rays, making it a good target for study. It has two large, bubble-shaped cavities that extend away from a central black hole. The cavities are formed by jets of material ejected from the black hole's surroundings, and the jets have been suspected of heating the outlying gas. But scientists couldn't see how.

A special image-processing technique was used to bring out subtle changes in brightness that revealed the presence of ripples -- the sound waves.

Fabian and Allen figure the sound waves, observed spreading out from the cavities, heat the gas. The amount of energy involved is staggering, equal to what would be produced if 100 million stars exploded.

A single, long-sounding note is produced by a sound wave in which the waves are the same size and shape continuously. The newfound note has been sounding, the researchers say, for about 2.5 billion years.

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