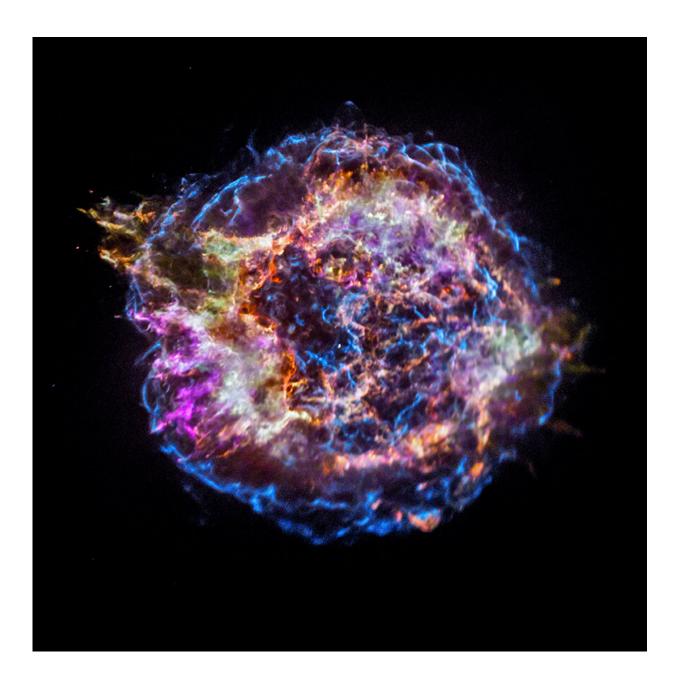# Data sonification: Sounds from around the Milky Way

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The center of our Milky Way galaxy is too distant for us to visit in person, but we can still explore it. Telescopes give us a chance to see what the Galactic Center looks like in different types of light. By translating the inherently digital data (in the form of ones and zeroes) captured by telescopes in space into images, astronomers create visual representations that would otherwise be invisible to us.

But what about experiencing these data with other senses like hearing? Sonification is the process that translates data into sound, and a new project brings the center of the Milky Way to listeners for the first time. The translation begins on the left side of the image and moves to the right, with the sounds representing the position and brightness of the sources. The light of objects located towards the top of the image are heard as higher pitches while the intensity of the light controls the volume. Stars and compact sources are converted to individual notes while extended clouds of gas and dust produce an evolving drone. The crescendo happens when we reach the bright region to the lower right of the image. This is where the 4-million-solar-mass supermassive black hole at the center of the Galaxy, known as Sagittarius A* (A-star), resides, and where the clouds of gas and dust are the brightest.

Users can listen to data from this region, roughly 400 light years across, either as "solos" from NASA's Chandra X-ray Observatory, Hubble Space Telescope, and Spitzer Space Telescope, or together as an ensemble in which each telescope plays a different instrument. Each image reveals different phenomena happening in this region about 26,000 light years from Earth. The Hubble image outlines energetic regions where stars are being born, while Spitzer's infrared image shows glowing clouds of dust containing complex structures. X-rays from

Chandra reveal gas heated to millions of degrees from stellar explosions and outflows from Sagittarius A*.

In addition to the Galactic Center, this project has also produced sonified versions of the remains of a supernova called Cassiopeia A, or Cas A, and the "Pillars of Creation" located in Messier 16. In Cas A, the sounds are mapped to four elements found in the debris from the exploded star as well as other high-energy data. The distribution of silicon (red), sulfur (yellow), calcium (green), and iron (purple) are revealed moving outward from the center of the remnant, starting from the location of the neutron star, in four different directions, with intensity again controlling the volume. There is also another version with fifth audio path moving along the upper left jet.

Cassiopeia A:

In the "Pillars of Creation" piece, the sounds are generated by moving horizontally across the image from left to right as seen in both optical and X-ray light. As with the sonification of the Galactic Center, the vertical position of the recorded light controls the pitch, but in this case it varies over a continuous range of pitches. Particular attention is paid to the structure of the pillars which can be heard as sweeps from low to high pitches and back. The two different "melodies" of optical and X-ray light can be enjoyed individually or simultaneously.

M16/"Pillars of Creation":

Sound plays a valuable role in our understanding of the world and cosmos around us. Explore how scientists are using NASA's Chandra X-ray Observatory and other instruments around the world and in space to study the cosmos through sound at the Universe of Sound website.