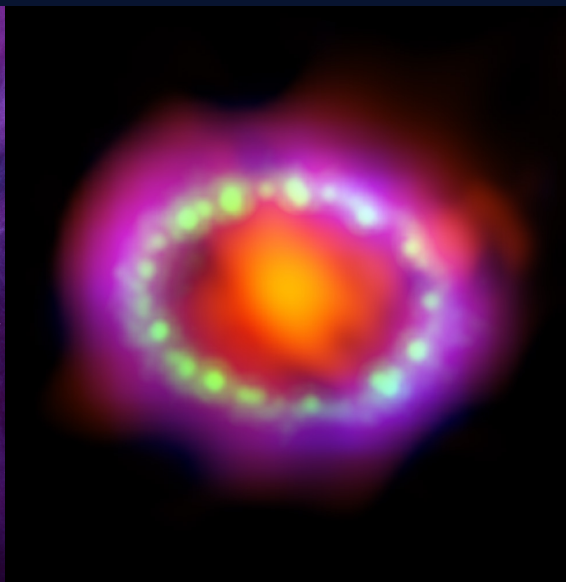
National Aeronautics and Space Administration

A Universe of SOUND



Sonification is the process that translates data into sound, anda new project brings our high-energy Universe to listeners for the first time. Scientists are using NASA's Chandra X-ray Observatory and other instruments around the world and in space to help us experience the cosmos through sound. Whether it comes from vocal chords in our throats or the surface of the Sun, sound plays a valuable role in our understanding of the world and cosmos around us.

What is sound?

Every sound begins with a vibration. When those vibrations travel through the air, they can enter the human eardrum where they are eventually turned into electrical signals that our brain interprets as sound. These vibrations can come from many sources here on Earth, as well as those in our Solar System and even across our Universe.

Sound travels in a wave and has its own distinct properties. One of these is frequency, which is the measurement of how many peaks (or troughs) of a wave pass a particular point over a certain period of time. Frequency is most often measured in the unit of the Hertz (Hz), which is the number per second. In general, humans can hear in the range of 20 to 20,000 Hz. An elephant can hear in the range below humans, while dogs and cats are sensitive to much higher-frequency sounds.

SCAN ME

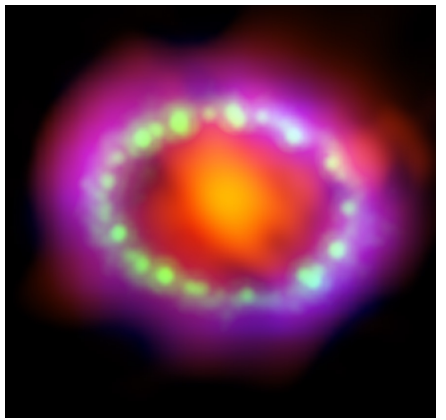
To listen to the sounds of the universe, scan the code above.

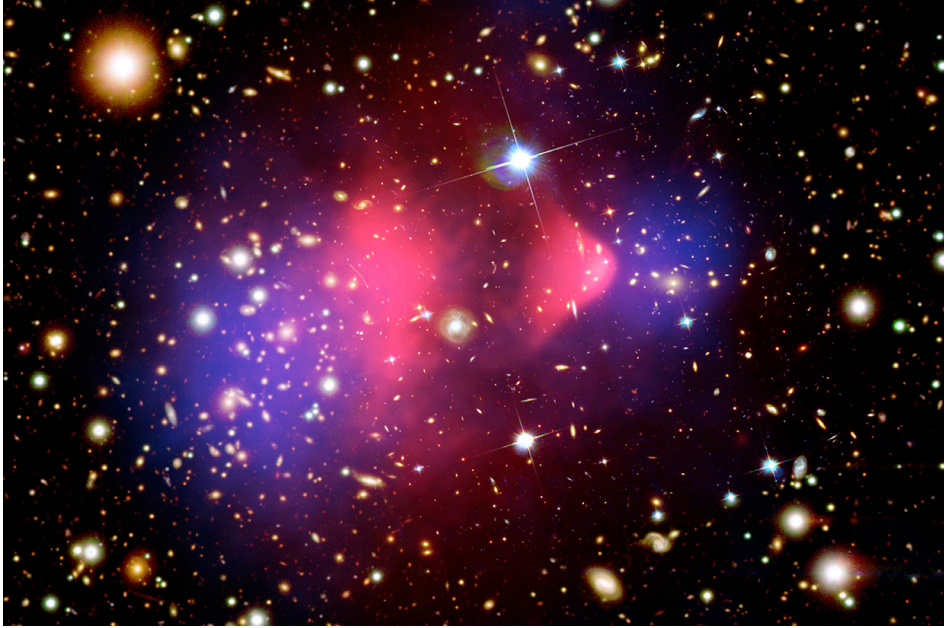
Crab Nebula

The Crab Nebula's combination of rapid rotation and a strong magnetic field generates jets of matter and anti-matter flowing away from its poles, and winds outward from its equator. For the translation of these data into sound, which also pans left to right, each wavelength of light has been paired with a different family of instruments. X-rays from Chandra (blue and white) are brass, optical light data from Hubble (purple) are strings, and infrared data from Spitzer (pink) can be heard in the woodwinds. In each case, light received towards the top of the image is played as higher pitched notes and brighter light is played louder.

SN87A

On February 24, 1987, observers in the southern hemisphere saw a new object in the Large Magellanic Cloud, now known as Supernova 1987A (SN 87A). This time lapse shows a series of Chandra (blue) and Hubble (orange and red) observations taken between 1999 and 2013. This shows a dense ring of gas, which was ejected by the star before it went supernova, begins to glow brighter as the supernova shockwave passes through. As the focus sweeps around the image, the data are converted into the sound of a crystal singing bowl, with brighter light being heard as higher and louder notes. The optical data are converted to a higher range of notes than the X-ray data so both wavelengths of light can be heard simultaneously. An interactive version lets the user play this astronomical instrument for themselves.





Bullet Cluster

This image of the Bullet Cluster (known as 1E 0657-56) provided the first direct proof of dark matter, the mysterious unseen substance that makes up the vast majority of matter in the Universe. X-rays from Chandra (pink) show where the hot gas in two merging galaxy clusters has been wrenched away from dark matter, seen through a process known as "gravitational lensing" in data from Hubble (blue) and ground-based telescopes. In converting this into sound, the data pan left to right, and each layer of data was limited to a specific frequency range. Data showing dark matter are represented by the lowest frequencies, while X-rays are assigned to the highest frequencies. The galaxies in the image revealed by Hubble data, many of which are in the cluster, are in mid-range frequencies. Then, within each layer, the pitch is set to increase from the bottom of the image to the top so that objects towards the top produce higher tones.