

The cosmic radiation symphony: Soundtrack for a journey to Mars

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ABSTRACT

Space radiation (SR) is a constant threat to astronauts who journey away from the Earth's protective magnetosphere. Galactic cosmic rays (GCR) are atomic nuclei from remnants of supernovae and are omnipresent in outer space. These ionized particles travel close to the speed of light and when they traverse biological material, they leave behind a path of damage. Another space radiation threat is from our sun when solar particle events (SPEs), or bursts of energetic protons, occur. Exposure to space radiation can lead to cancer, cardiovascular disease, immune dysfunction, and cognitive and behavioral decrements. Yet humans cannot see, smell, taste, hear, or feel radiation, making it less tangible than other health threats and much more difficult to describe. This is an important gap in risk communication that the Space Radiation Element is working to close within NASA's Human Research Program.

Music and art are powerful means of communicating human emotions and feelings and are effective and creative ways to convey other types of information. In this work, the sonification process was used to transcribe or translate the physical nature of the SR environment on a 3-year mission to Mars into sound, a format perceptible to the human ear. A visual representation for the journey was also developed so the audience can both hear and envision the chronic presence of GCR and the acute and large bursts of energy present in SPEs. Data for this project were derived from the Radiation Assessment Detector on the NASA Curiosity Rover during its outbound cruise to Mars and on the Martian surface, as well as from models of the space radiation environment behind spacecraft shielding. Our data-driven audiovisual composition was realized using custom programmed digital signal processing and graphic design in the programming languages Pure Data and Processing. The data sonification was contextualized in time and space by calculating and visualizing the location of the spacecraft in relation to the other planets during the Mars mission. The finished work is a unique and powerful means of communicating the presence and risk of space radiation, accessible by people of all ages and scientific backgrounds.