

# 2022 Workshop: Science as Art

Long title

Science as Art: Making the Invisible Wonders of Space Science Accessible

Conveners

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Description

The universe is filled with wonders, many of them invisible. As space scientists we have a privileged view of the universe. Even with years of physics, math, and programming, understanding space science is quite a challenge. However with these skills there is the potential to express space science fundamentals artistically and convey some of the wonders of the universe via broadly digestible media. This founding session will, at minimum, cover the physics of electromagnetic resonators found in space science as musical instruments, and will include a presentation of the visual art and underlying science of orthogonal magnetic basis vectors. The session will end with an open discussion of potential future projects. Presentations from the community are welcome.

Agenda

**Introduction** Russell Stoneback (Stoneris)

**Science as Art: Visualizing Plasma Electrodynamics using Orthogonal Multipole Magnetic Basis Vectors** Russell Stoneback (Stoneris)

We will explore the science behind Orthogonal Multipole Magnetic Basis Vectors (OMMBV), open source science software, as well as the artwork it produces. A collection of images will be shown relating to the direct scientific output, as well as the uncertainty of OMMBV calculations, to provide an unexpected view of the geomagnetic field and associated electrodynamics. OMMBV artwork provides a mechanism for some scientists, or members of the general public, to emotionally connect with the geomagnetic field and electrodynamics.

## **Science and Art: Using Art and Solar Eclipses to Extend Space Science and Open Source Software** Russell Stoneback (Stoneris)

A community-wide plan will be presented that leverages art, science, and the upcoming total eclipse, to enable the development of open source science infrastructure as well as enable significant progress on our understanding of space science, including tropospheric sources of ionospheric disturbances. The plan exemplifies the scientific and outreach goals of the newly formed Transformation to Open Science (TOPS) <https://science.nasa.gov/open-science/transform-to-open-science> at NASA while also weaving artwork and emotional engagement into the same framework. While science itself is supposed to be unemotional, humans are emotional, thus scientific outreach that includes opportunities for emotional attachment may be more effective.

## **Science as Art: The Light Guitar and Applications to Space Science** Russell Stoneback (Stoneris)

The light guitar is the equivalent of an acoustic guitar but for electromagnetic fields. The wooden body is replaced with metal and the oscillations of wood to produce sounds are replaced with high frequency currents to produce music in the form of electromagnetic waves. To get similar physical responses, the physical size of the electromagnetic waves is matched to acoustic waves, thus the general range for human hearing (20 Hz - 10kHz) is equivalent to 20 MHz - 20 GHz. While electromagnetic waves and sound waves do differ in some particulars, both waves satisfy the wave equation and have the same boundary conditions, thus generating the same type of resonant responses at the same wavelengths. Measurements of the light guitar can be applied via software to hear the effect of the new musical instrument. The same electromagnetic structures in the light guitar, a resonant capacitive cavity, and an aperture, are also found for the Earth and the Sun. Results for the transfer of power for Alfvén waves at high latitudes are shown for both the Earth and Sun. A short demo of the light guitar is planned at the end of the session during the break.

## **Wider Community Notes** Ryan McGranaghan

- [Origins podcast](#) (to explore these intersections through the trajectories of thought-leaders across them)
- Flourishing salons (in partnership with [CPNAS](#))
- Space for more trans-media knowledge sharing - the [Space Collection on PubPub](#) and the [Flourishing Commons substack space](#)

### Justification

Scientific outreach is a historically challenging problem. Some attempts at outreach focus on methods to convey scientific results, or to get people engaged in the process, like with citizen science. This session is a similar attempt but using a different approach that may resonate with a different group of people. Society is comprised of billions of individuals thus an array of approaches are likely required to get the broadest outreach possible. Within the community presenting science, and the tools of science, from a different perspective could potentially inspire other members of the community to work along similar lines, even potentially start some collaborative efforts.

The content of the session directly contributes to broader thinking about space physics and connections between systems. The visual art is generated from OMMBV, open source software used to generate orthogonal basis vectors from the International Geomagnetic Reference Field. The same OMMBV outputs are also a part of NASA ICON mission science. The use of electromagnetic resonators to create a guitar or other musical instrument combines seemingly unrelated fields. The art, which is simultaneously science, is outside typical scientific applications, and directly stimulates broader thinking about space science.

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Keywords

Music, Visual-Art, Space-Science, Wonder

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