

Astrophysics and Acousmatic Music

The art of throwing
everything in the air

and wondering where it went

Music of the spheres

This music was thought of
not as an audible sound,
but simply as a mathematical concept



Music of the n-dimensional hypercube

Acousmatic: sound one hears without seeing its originating cause
(Pythagorean disciples listened to his lectures from behind a curtain, unable to see him)

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triggered by sound, Homont [1996]

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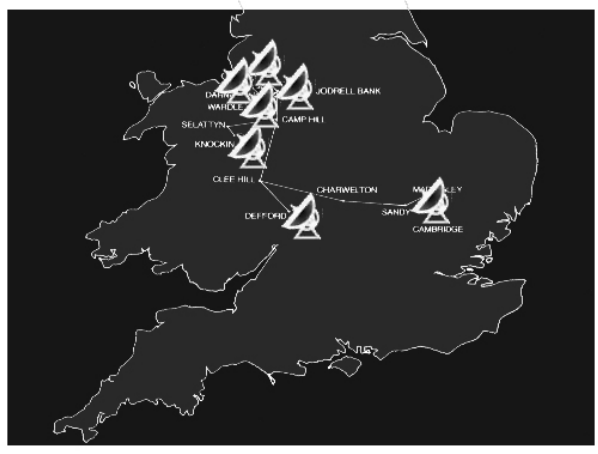
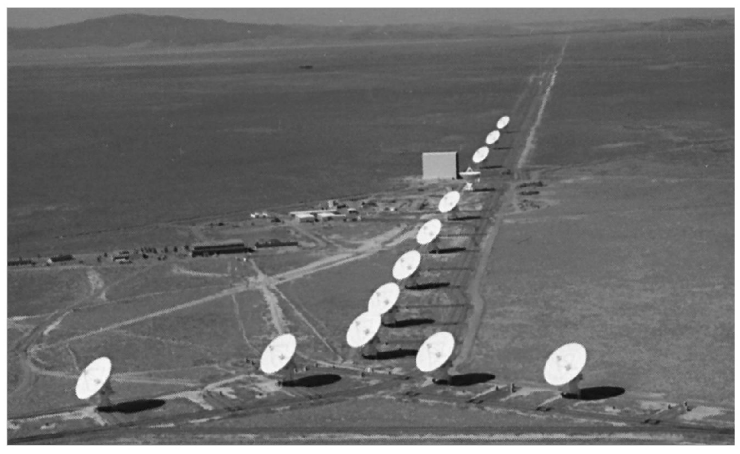
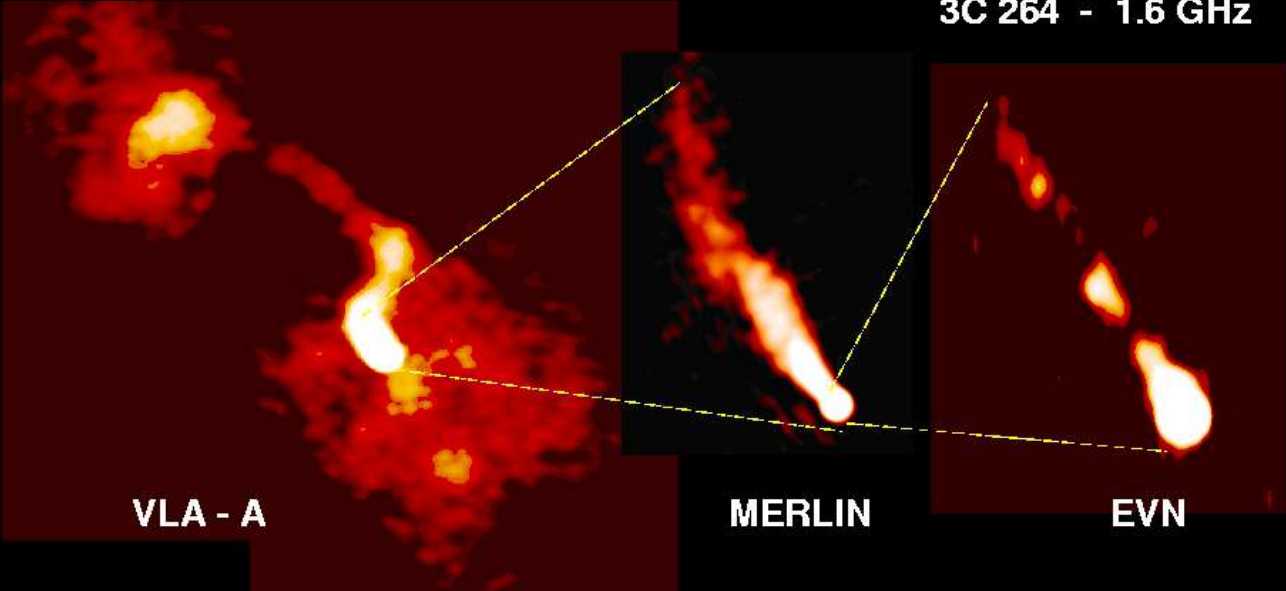
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the sound world is not a space into which we can enter;
it is a world we treat at a distance, Goehr [1999]



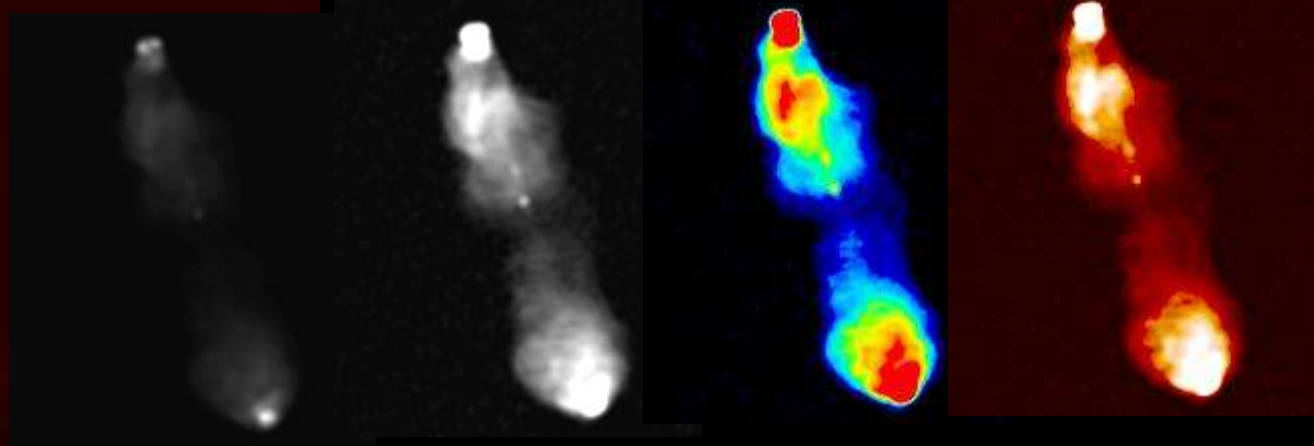
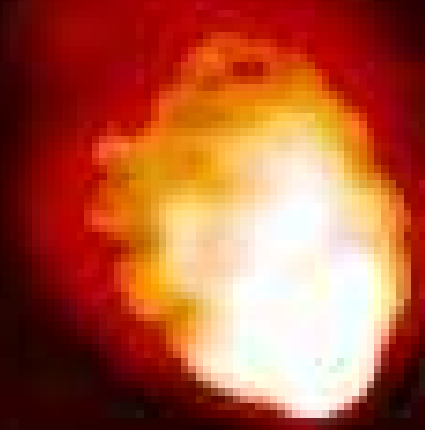
Jodrell Bank, UK

3C 264 - 1.6 GHz

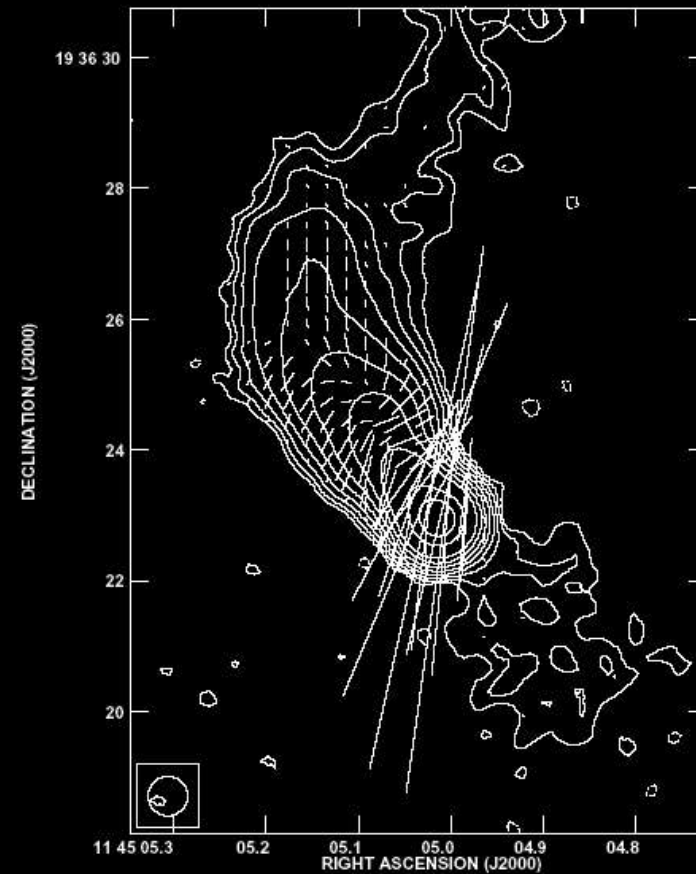




$10^{-9} \dots 10^9$



working in the middle of extremes



heisenberg: "can nature truly be this absurd?"

Astrophysicists try to describe the Universe

the seen and the unseen

— real and hypothetical

using the language of mathematics

transforming noise into data

and data into knowledge

$$ds^2 = (cdt)^2 - R^2(t) \left[d\chi^2 + S_k^2(\chi)(d\theta^2 + \sin^2 \theta d\phi^2) \right]$$



working with ambiguity

cosmology is an application of geometry

that takes on board quantum-mechanical uncertainty

to describe a space in which we might exist

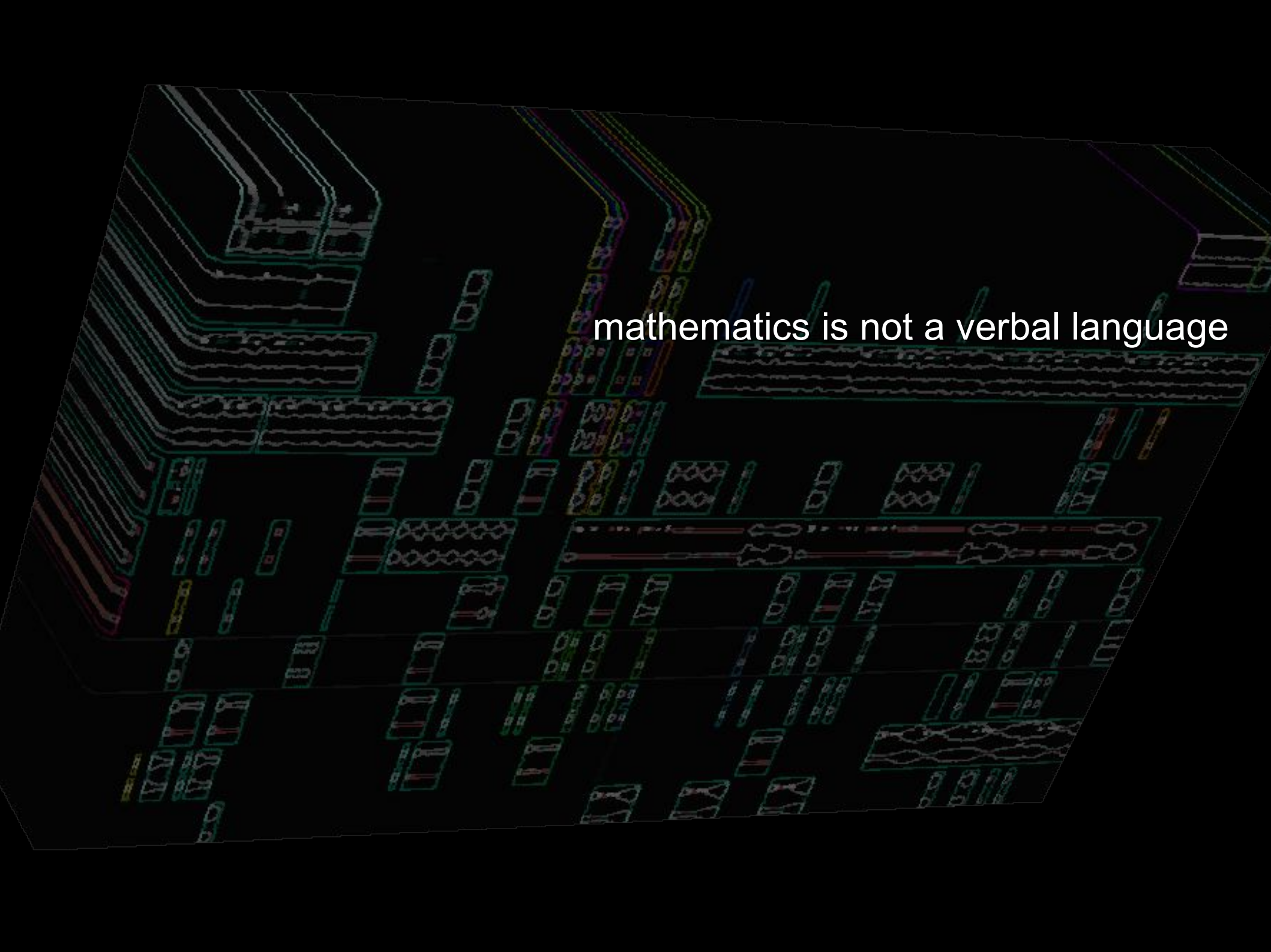
working with ambiguity

music is an application of physics

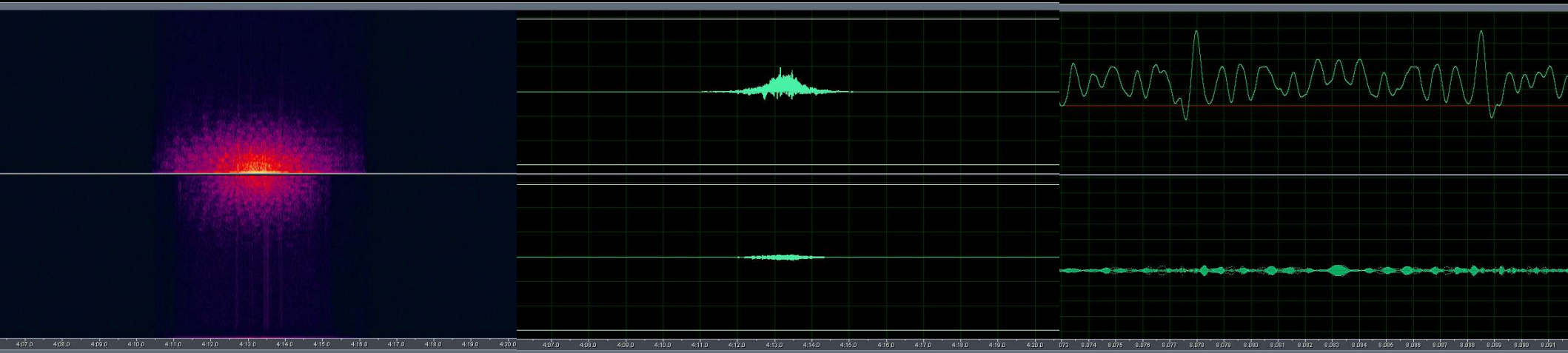
that takes on board an intangible aesthetic

to contextualise a space in which we might exist

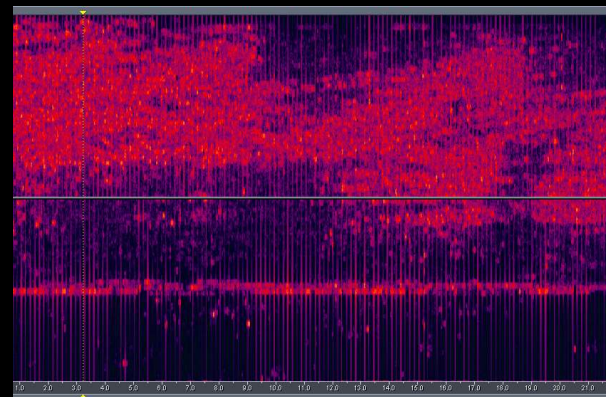
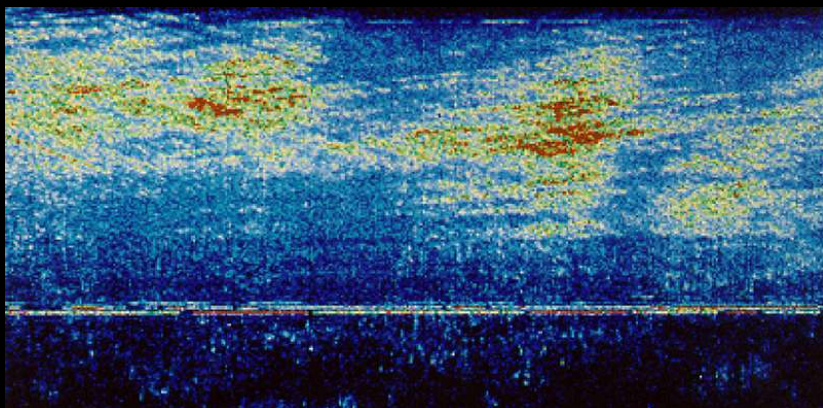
and increasingly utilises the Scientific Method (repeatable experimentation)

A complex, multi-layered circuit board with various components and traces. The board is populated with numerous integrated circuits, resistors, and other electronic components. The traces are densely packed and follow a complex routing pattern. The overall appearance is that of a high-density, multi-layer printed circuit board (PCB).

mathematics is not a verbal language



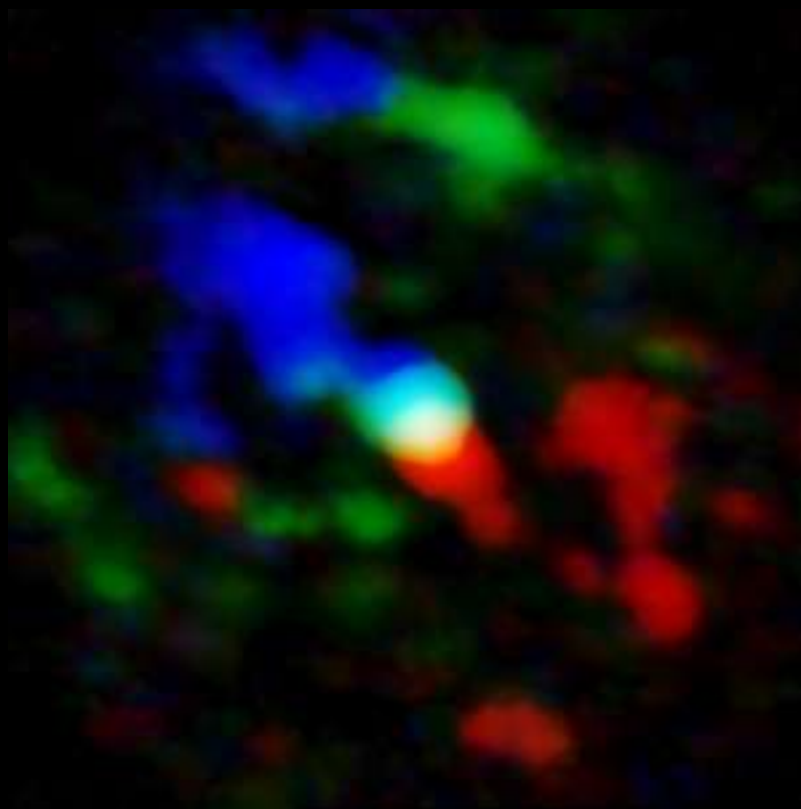
data sonification is acousmatic



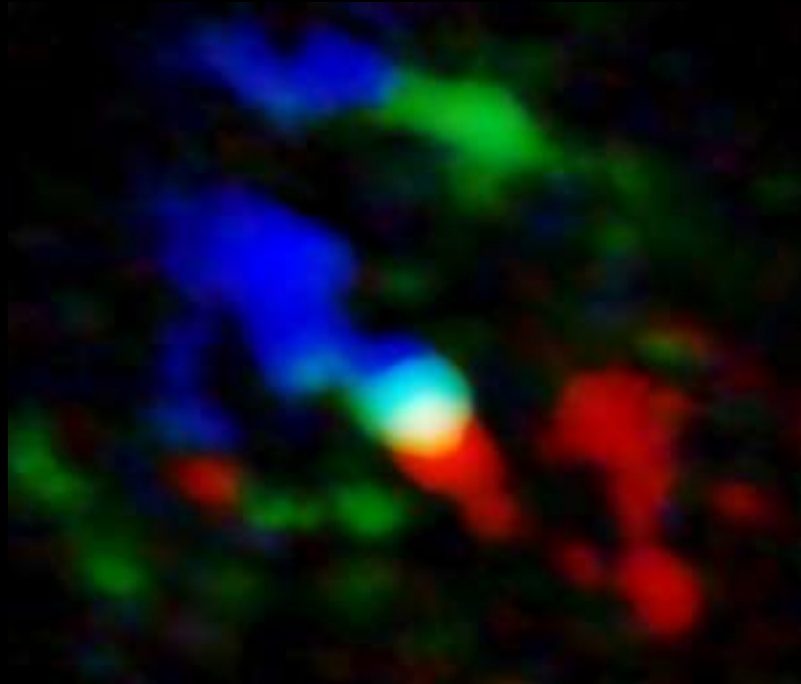
ngc4501



ngc4501



ngc4501



Take a Radio Spectral Cube and turn it into sound.

The cube is like an image, but instead of each pixel being a single "colour", it is actually an RF spectrum. Selecting a pixel with the mouse takes that spectrum and transforms the radio frequencies into an audible range, it then creates a sound with that spectrum.

Similarly, the radio frequencies have been transformed into visible colours so you can see them, blue for "higher frequency" and red for "lower frequency".

You can see and hear the structure of the spiral arms, even the discord in the middle where both are super-imposed.

Recipes for transformation

Ingredients A:

- 1 expanding universe
- 1 sound of your choosing

Take the expanding universe (e.g. FRW) and add sound with non-zero velocity relative to the observer. Convolve the frequency of the sound (time-dependent spectrum) with both the special relativistic frequency shift (due to the non-zero velocity) and the cosmological redshift (frequency as a function of time). The observer will hear “geo-music”.

Ingredients B::

- 1 black hole solution of Einstein's equations
- 1 sound of your choosing

Take the black hole solution(e.g. Schwarzschild) and add the sound with non-zero velocity relative to the observer. Convolve the frequency of the sound (time-dependent spectrum) with both the special relativistic (due to the non-zero velocity) and the gravitational redshift (frequency as a function of spatial position). The observer will hear geo-music. This can also give "gravitationally lensed" sound. Of special interest would be an observer listening to the music and simultaneously plunging into the black hole.

NGC 4501
IPC, B

topics for discussion

mathematics

- messing with the languages of structure
- moving beyond sonification|musicology

convergence of complex systems

- maths|art|physics|music|philosophy|beliefs
- relevance to performance

cosmology

- “a system of beliefs leading to an explanation of the mystery of existence” (Sandage, 1987)

NGC 4501
IPC, B

Collaborators:

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