

Feedback on the creation of a scientific show using immersive sound

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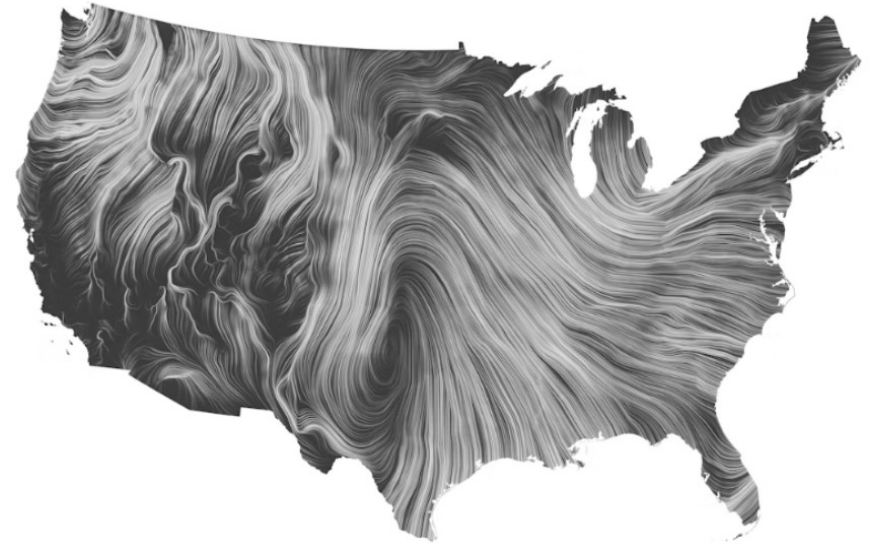
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(Lab-STICC) CNRS, UMR 6285, Technopole Brest-Iroise CS 83818 29238 Brest Cedex 3 FRANCE

(3) BeSpline, an Adamson company, 11 rue des Grandes Cultures, 93100 Montreuil

- Science & arts, examples
 - 2014: World Science Festival, Good Vibrations: The Science of Sound. Conference with artists and scientists
 - 2018: Scientific Concert research megaprojects set to music by the Geneva Brass Quintet (EPFL, Lausanne, Switzerland)
 - 2024-2025 : Exhibition “Seeing the Unseeable: Data, Design, Art”



"WIND MAP," VISUALIZATION OF WIND PATTERNS IN THE US ON NOVEMBER 2, 2013, FERNANDA VIÉGAS AND MARTIN...

Fernanda Viégas and Martin Wattenberg <http://hint.fm/projects/wind/>

- Aim
 - Attract undergraduate students to scientific studies
 - Present acoustics in an original manner to non scientific public
- Idea
 - Use music to illustrate the physical principles of acoustics
 - Mix and alternate scientific presentation and music
- Public
 - Concerts given inside and outside universities
 - Undergraduate students, science festival, general public
- Ophonius
 - Quintet (3 saxophones, drums, bass)
 - 3 professional musicians, 2 teachers and researchers in acoustics



- Intensity, pitch, timbre
 - Creation 2009 → 2011



- Physics of musical instruments
 - Creation 2014 → 2018



Shows

- Sound perception, show “IMMERSONS”
 - Creation march 2022 → January 2024

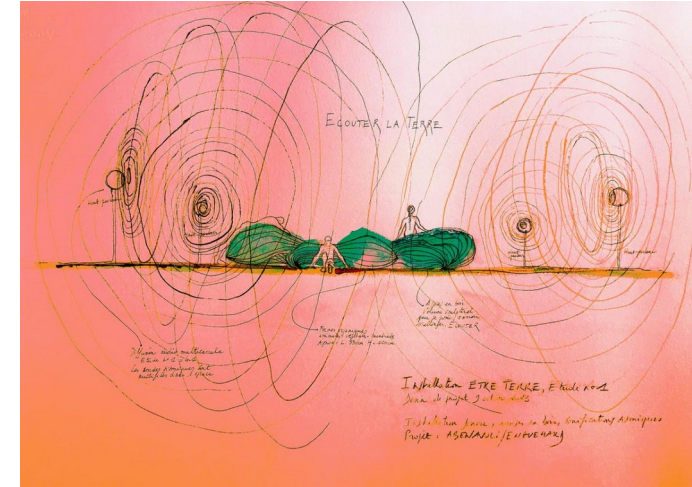


Description of the project “IMMERSONS”

Short video

Initial idea

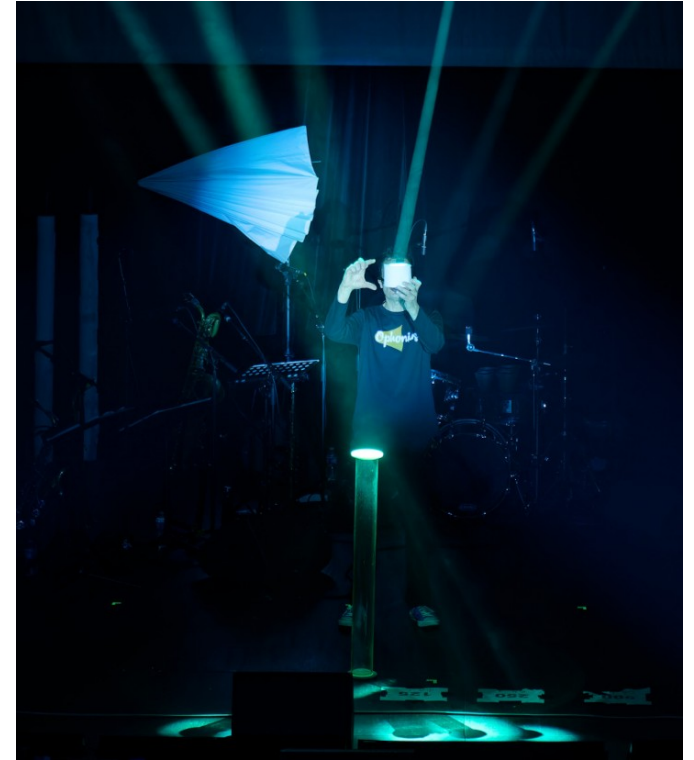
- Art and science festival Ressac (Brest)
- Collaboration between two labs (Lab-STICC and LAUM)
- Present the principles of human hearing to a large public
- Use of spatial sound



Être Terre, Etude n°2, variations océaniques
Lorella Abenavoli, Arthur Enguehard, RESSAC 2024

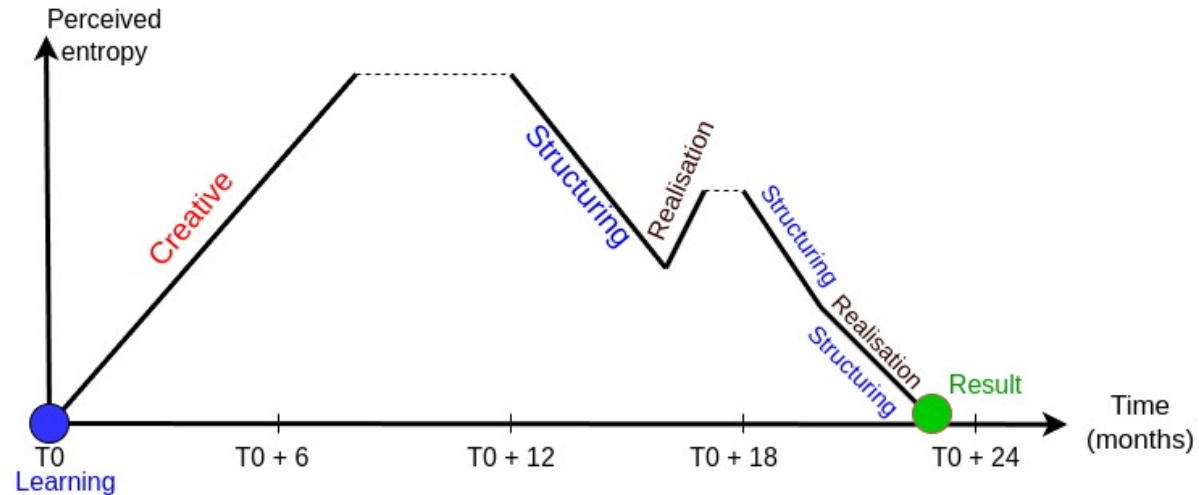
Constraints

- Creation process: 22 months maximum
- Working sessions of 3-4 days maximum
- 2 or 3 working sessions a year
- Show duration ~ 1 hour



Art and science process

1. Learning phase
2. Creative phase (brainstorming)
3. Structuring phase : scientific contents defined and arranged in a scenario
4. Realization phase
 - Design and build the scenography
 - Test the audio system
 - Finalize the entire show



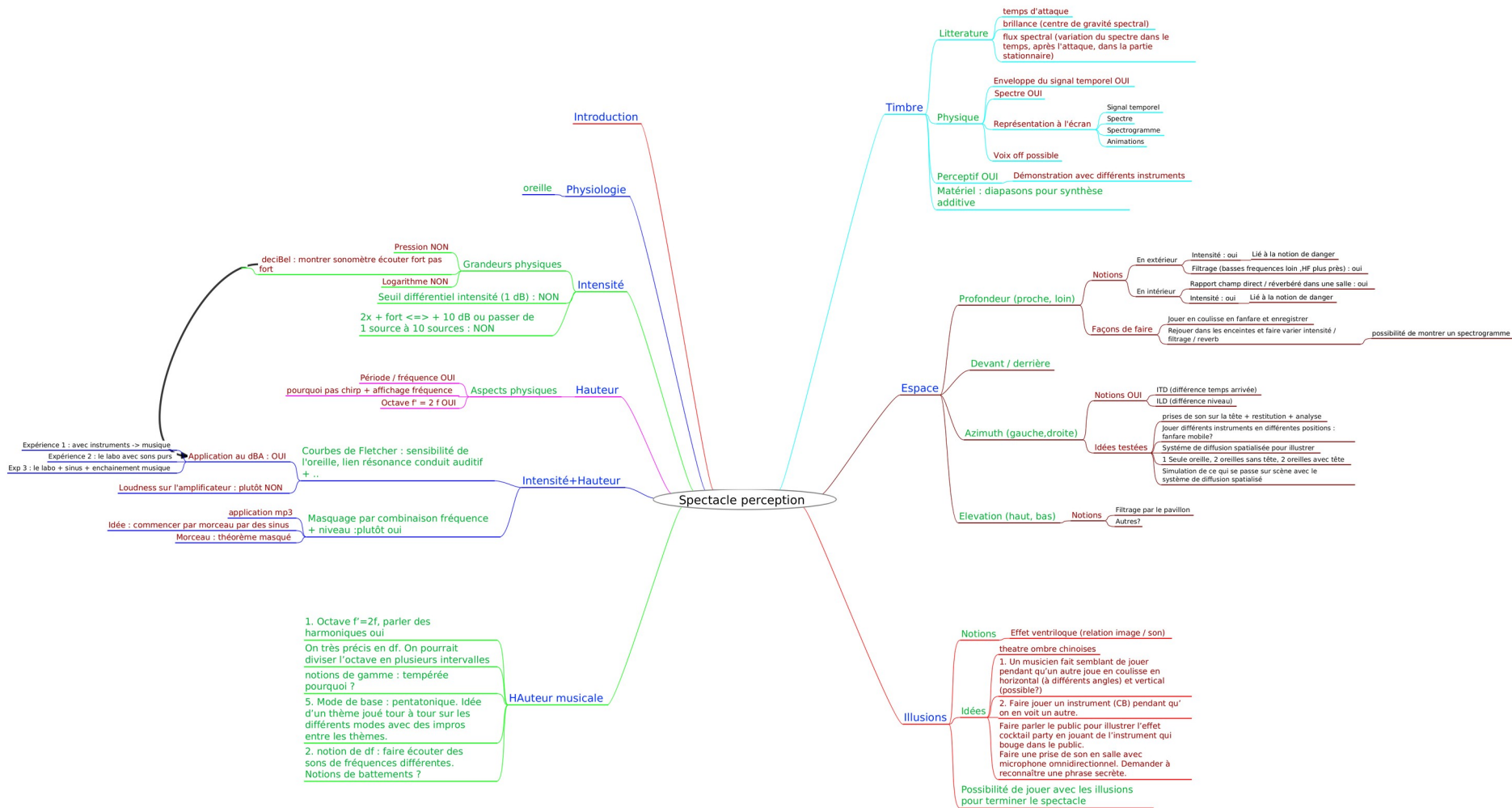
Learning scientific contents

- Initial phase (T0)
- Aim: provide with
 - a fundamental understanding of hearing,
 - the same terminology for musicians and acousticians
 - the same level of scientific education for musicians and acousticians
- 2 days lecture, 3 teachers
 - Physiology of hearing
 - Perception of intensity, pitch, timbre, space
 - Auditory scene analysis, audiovisual interaction
- Musicians very interested by this session
- Could be given in music schools if simplified

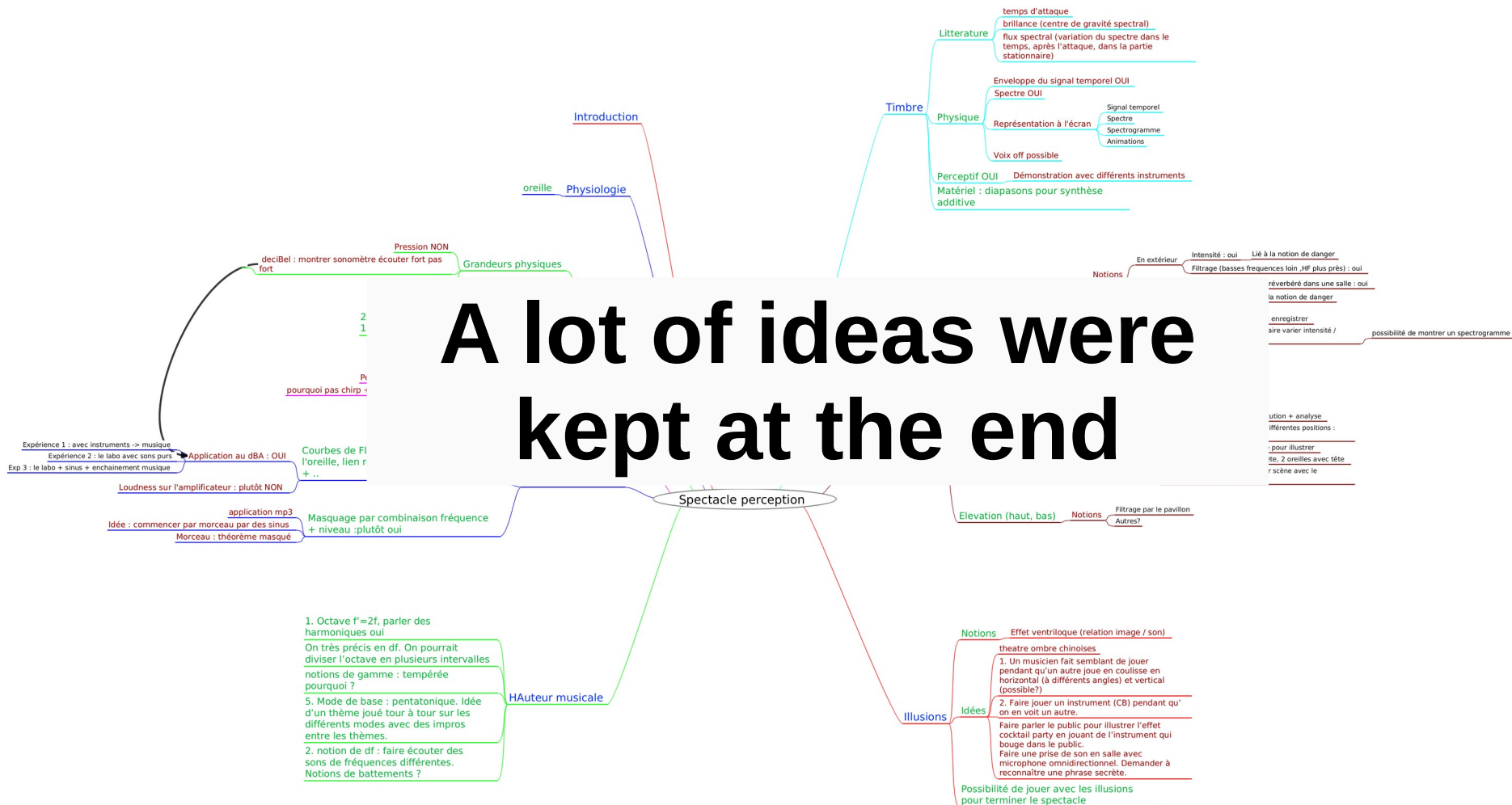
Creative phase

- T0 → T0 + 6 months
- Collaboration between scientists and artists
- Huge number of thoughts through discussions → create a new concept
- Wishes
 - The stage becomes a laboratory, the scientists are seen as researchers (rather than teachers)
 - Create new music to fit with the scientific concepts of hearing
 - Use a voice over
 - Use objects / items on stage

Creative phase



A lot of ideas were kept at the end



Structuring phase

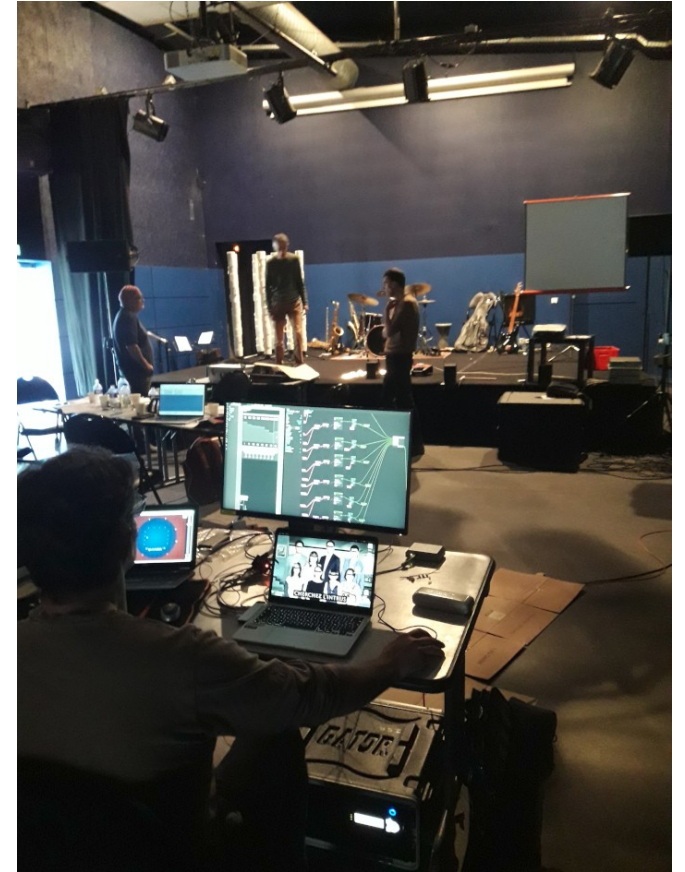
- T0 + 12 → T0 + 16 months
- Aim : increase the efficiency of the creation process
- Organization
 - Scientific team : scientific referee + scientists-musicians
 - Technical team : audio company + sound engineer + scientists-musicians
 - Artistic team : musicians + scientists-musicians + sound engineer (electroacoustic compositions)
- Output : script of the show

Structuring phase

Aim	Scenery	Music
1- Perceive space		spatial sounds + voice over Marching band
<i>Transition</i>		<i>Electroacoustic composition</i>
2- Anatomy of the ear	Giant ear (Fig. 2)	
<i>Transition</i>		<i>Electroacoustic composition</i>
3- Sound level	Real time sound level meter	specific musical composition illustrating increasing sound level
<i>Transition</i>		<i>Electroacoustic composition</i>
4- Frequency definition	Giant simplified tuning fork	
5- Spectrum definition	5 giant tuning forks	
<i>Transition</i>		<i>Live music and real time spectrum</i>
6- Time envelope	String to represent the envelop	recorded music that is played backwards and forwards
<i>Transition</i>		<i>Live music introduced by time inverted sound</i>
7- Fletcher curve Demonstration of masking	Physical giant octave band analyzer	Recorded sine waves at different levels
<i>Transition</i>		<i>specific musical composition with masking effect</i>
8- Perception of space	Giant head	playing music around
<i>End</i>		<i>specific musical composition with spatial effects</i>

Realization phase

- Test and finalize the scenario live
 - Electroacoustic music pieces with spatial effects
 - Voice over
 - Items for experiments
 - Music and explanations
- Define and check the spatial audio quality of the sound system
 - Version 1: 24 small sized loudspeakers in a medium-sized room with the WFS based Sonic Emotion Wave I processor
 - Version 2 : spatial audio renderer for the final presentation (Adamson FletcherMachine + 24 loudspeakers + Usine Hollyhock software)

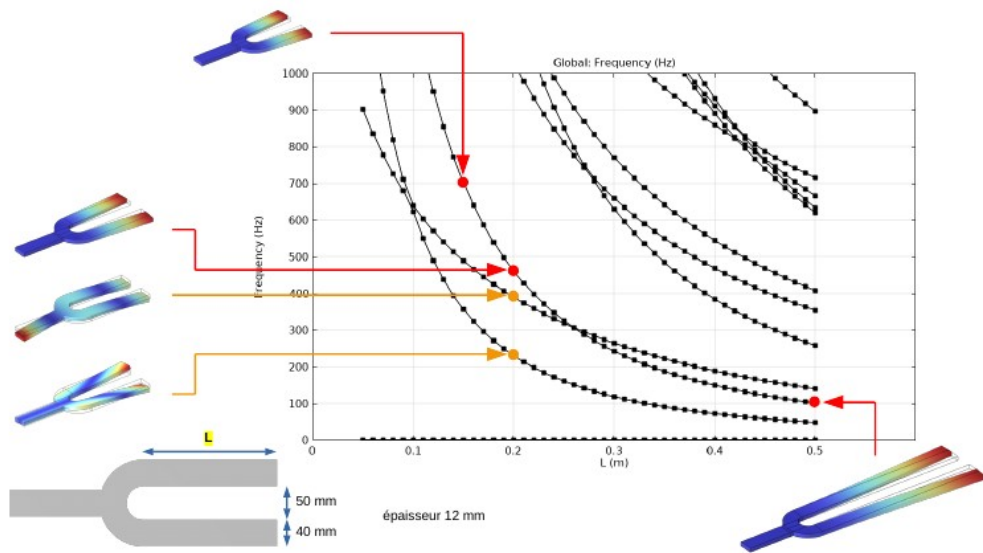


Realization phase (items)

- Giant ear



- Giant tuning forks



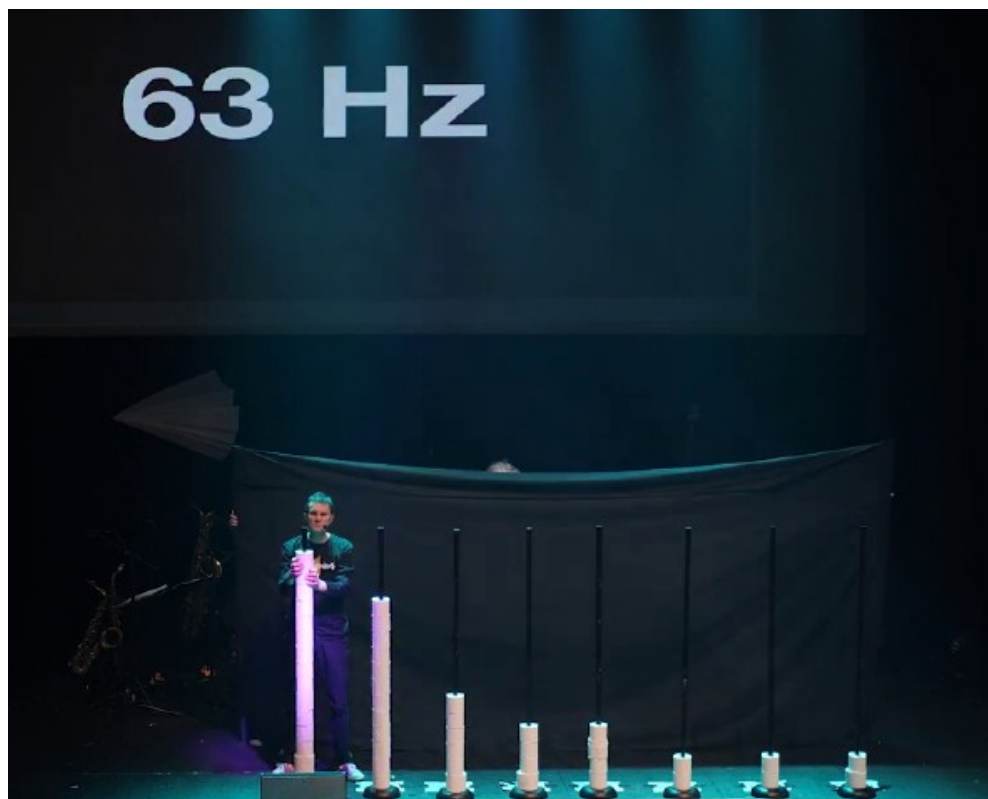
Model Comsol,
F Ablitzer (LAUM)



Tuning forks built with
water cutting machine

Realization phase (items)

- Giant sound analyzer



- Giant head



Results

- Presentation
 - Le Mans Sonore 2024
 - Audience: 1000 people in 3 days (500+ combined people, 500 pupils)
 - Very encouraging feedback from the public
- Spatial and immersive sound system
 - Gives good results
 - Strong spatial information for sound design pieces
 - Spatial naturalness wasn't spectacular (performer's voices and acoustic sources in the frontal area)
- Scientific contents
 - Significantly less than the original contents
 - Many topics not covered
 - Needs to do compromise when communicating scientific information

Conclusion

- New project
 - Scientific concert on sound perception
 - Completed in two years with a team with various skills (scientists, musicians, technicians, audio engineers, artists)
 - Numerous phases : brainstorming, idea structuring, script and musical writing, object creation, voice-over writing and recording, staging and light composition, performance
- For scientists
 - Creative process has an impact on teaching
 - Generation of ideas for student projects
- Future
 - Lightening of the electroacoustic system (for example, octophony) for presentation in different contexts

Partners

- Le Mans
 - Le Mans University (university scientific culture center, LAUM UMR CNRS 6613)
 - Le Mans metropolis
- Brest
 - RESSAC art and science festival
 - Lab-STICC CNRS, UMR 6285
 - CROUS, CLIP association
- BeSpline and Adamson companies
- Annick Augis for an outside view
- Ophonius
 - Christophe Ayrault, Olivier Batlle, Jean Marc Dormeau, Fabien Eckert, Bruno Gazengel
 - Samy Hidous (light composition)
 - Kenan Trevien (3D sound engineer and electroacoustic compositions)

Thanks for your attention!