Acoustic Metamaterials : From conception to auralization

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MET ACOUS TIC INNOVATIVE SOLUTIONS

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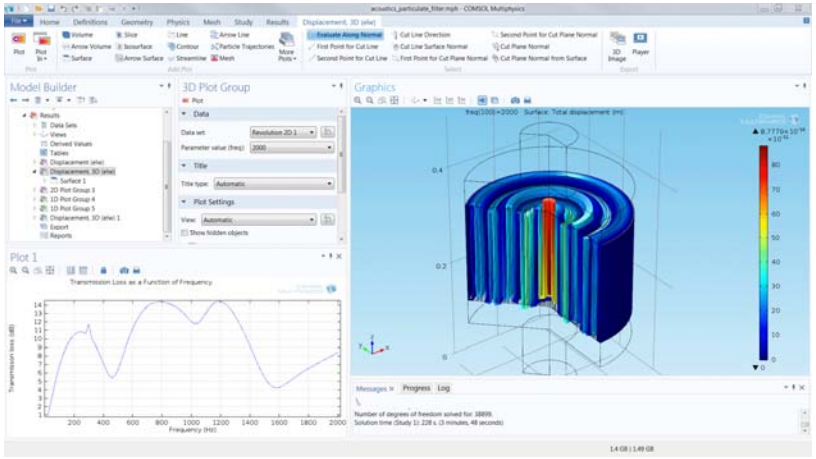
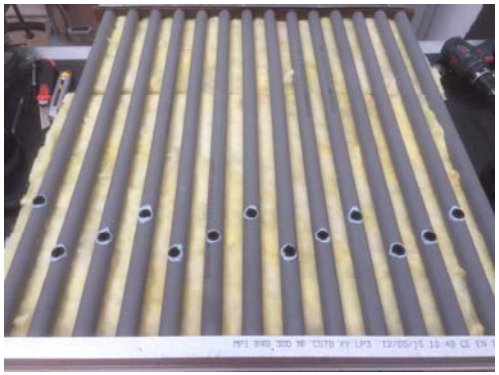
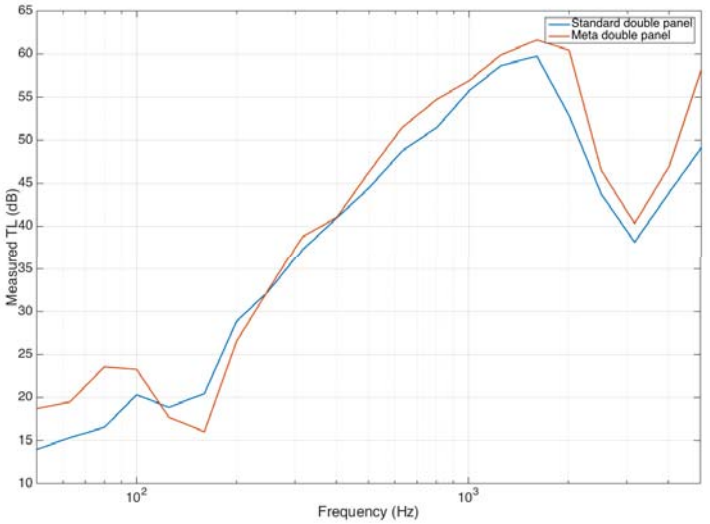
R&D services







Product characterization → **FEM simulations** → **Optimized solutions** → **Samples tests**

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Applicaton example : Room noise reduction

1 – Study context

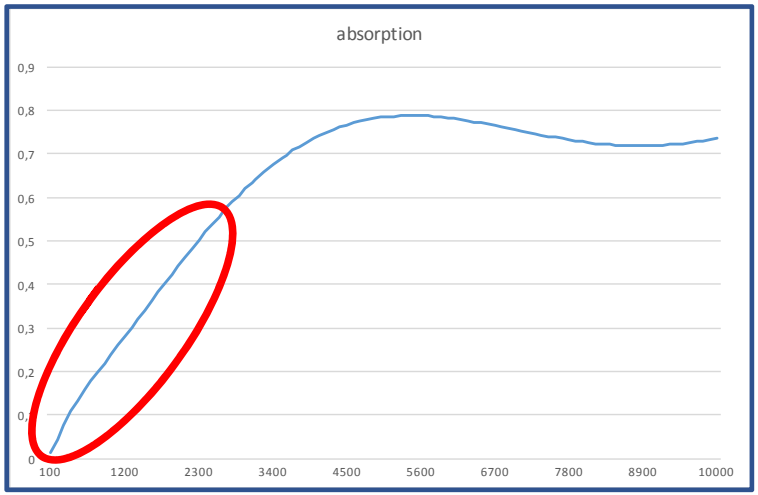
2 – Metamaterial definition and design

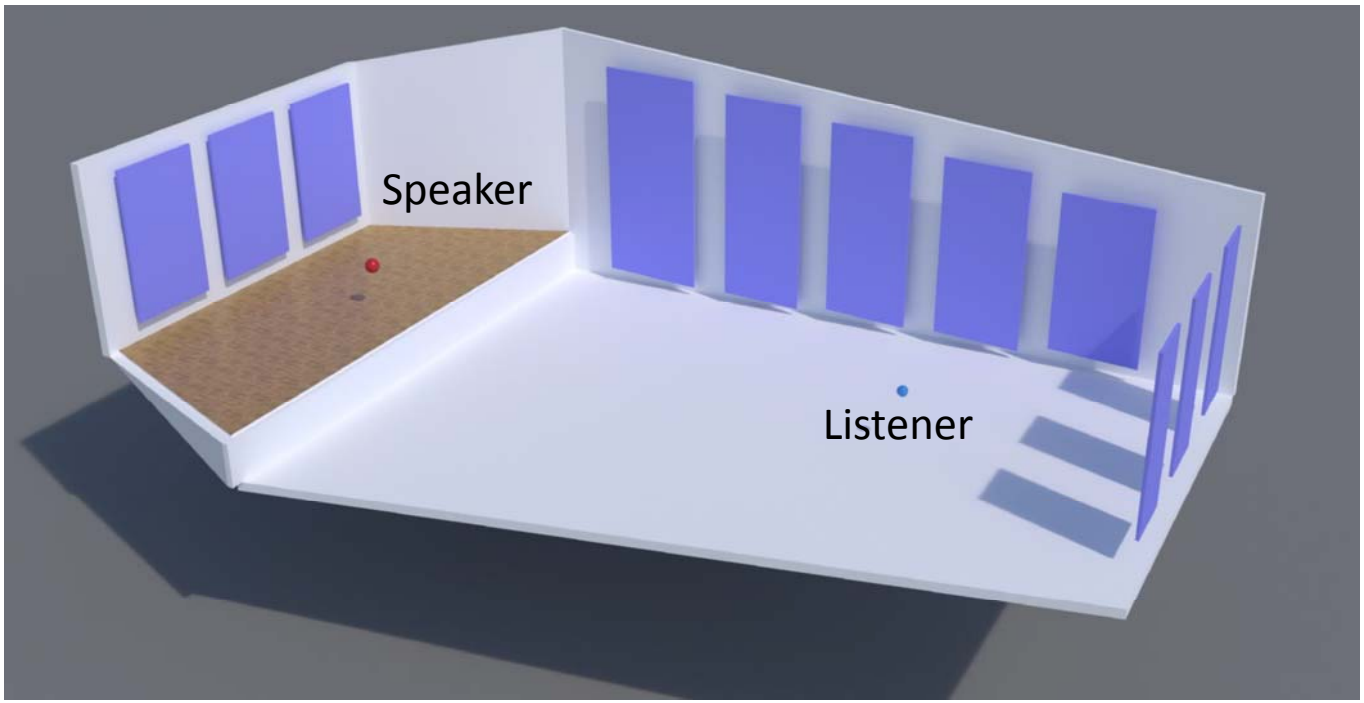
3 –Test (listen) the material

A concert hall with strong low frequency modes (100Hz – 200Hz)

Reverberation time

- Room Volume : 2000m^3
- Wall material : Gypsum
- 8cm thick treatment (Melamine)
- Treatment thinkess fixed





Applicaton example : Room noise reduction

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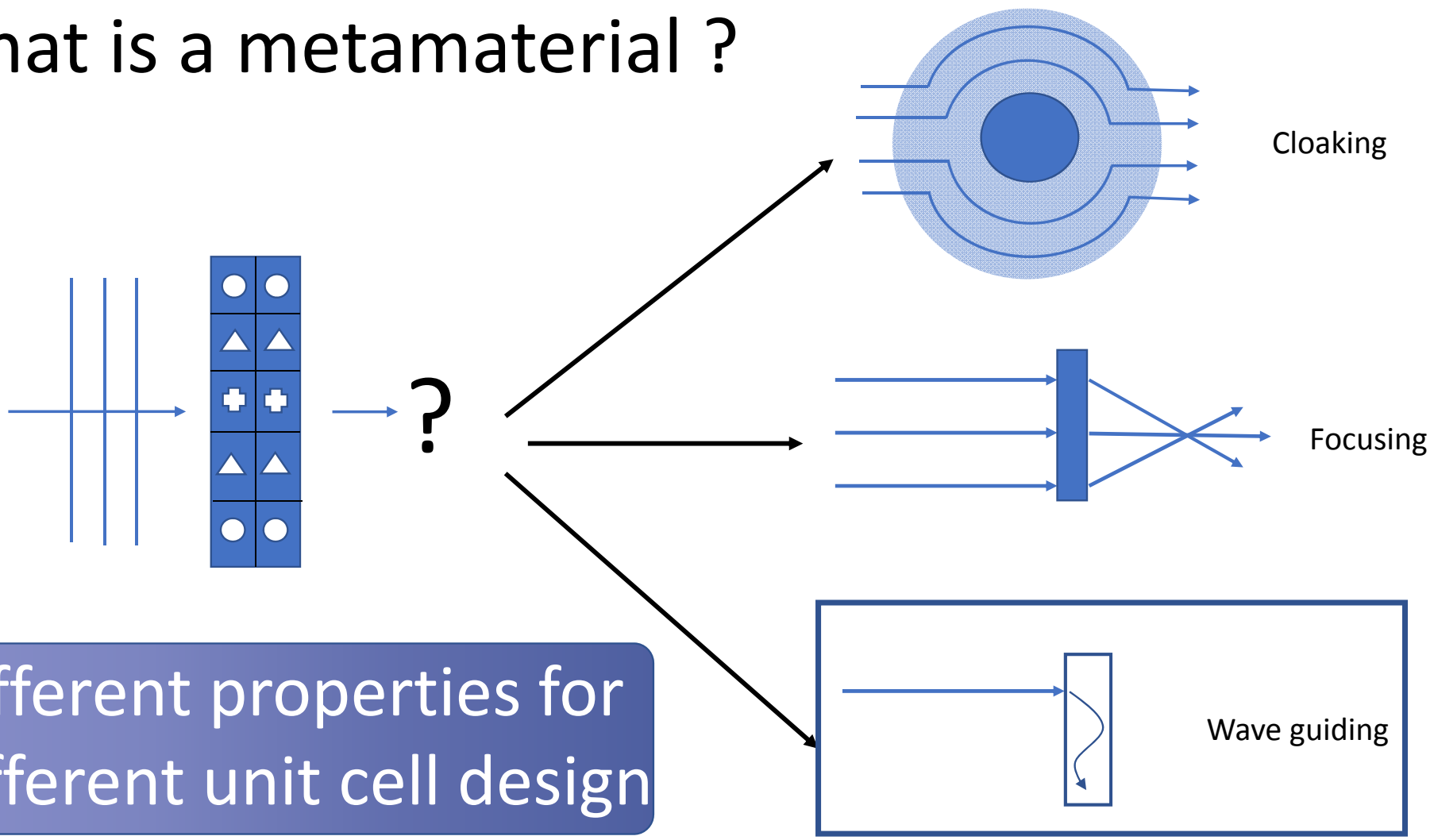
What is a metamaterial ?



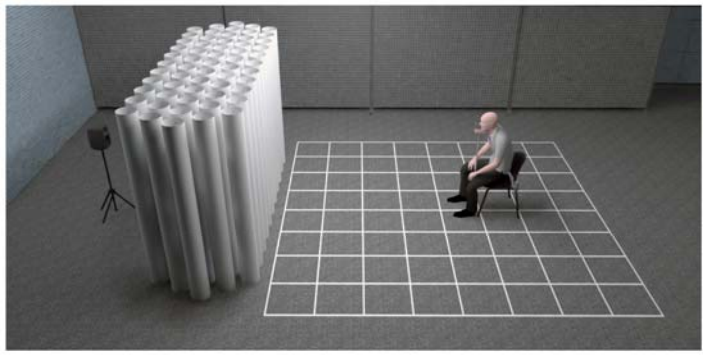
Different properties for different unit cell design

Metaporous for absorption

Porous material

+

Periodic resonant scatterers



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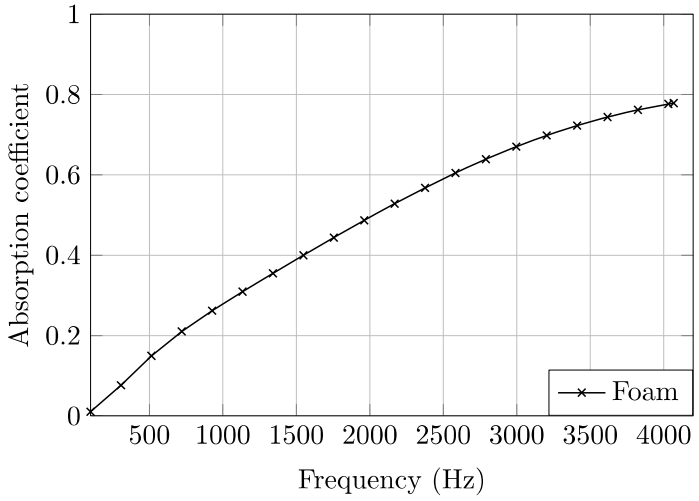
Metaporous material



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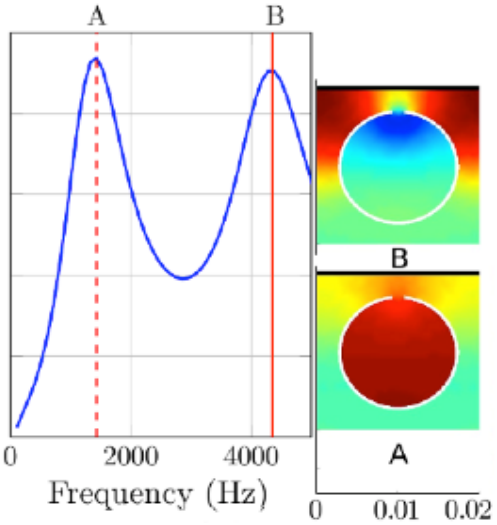

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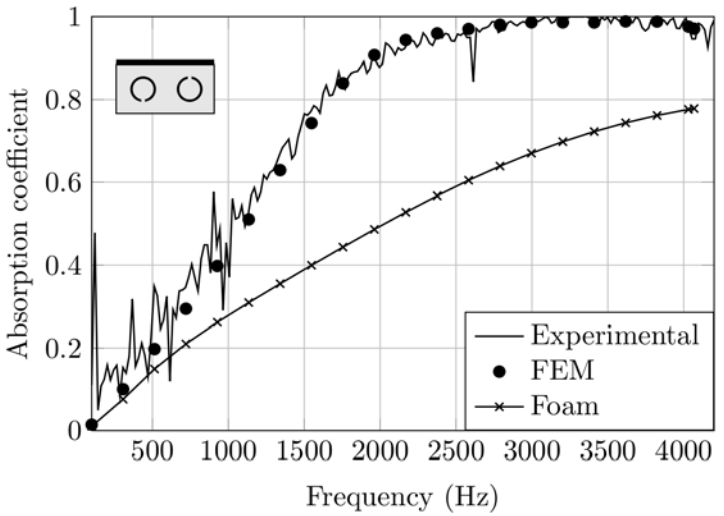
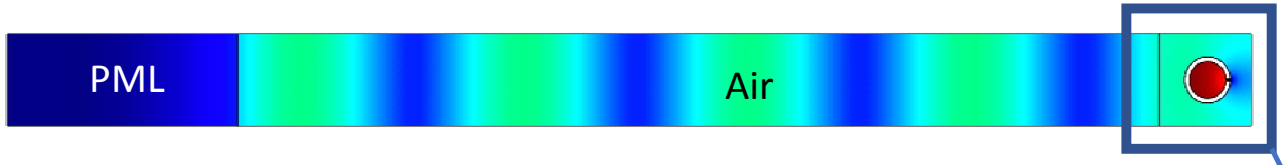


Metaporous for absorption : FEM simulations

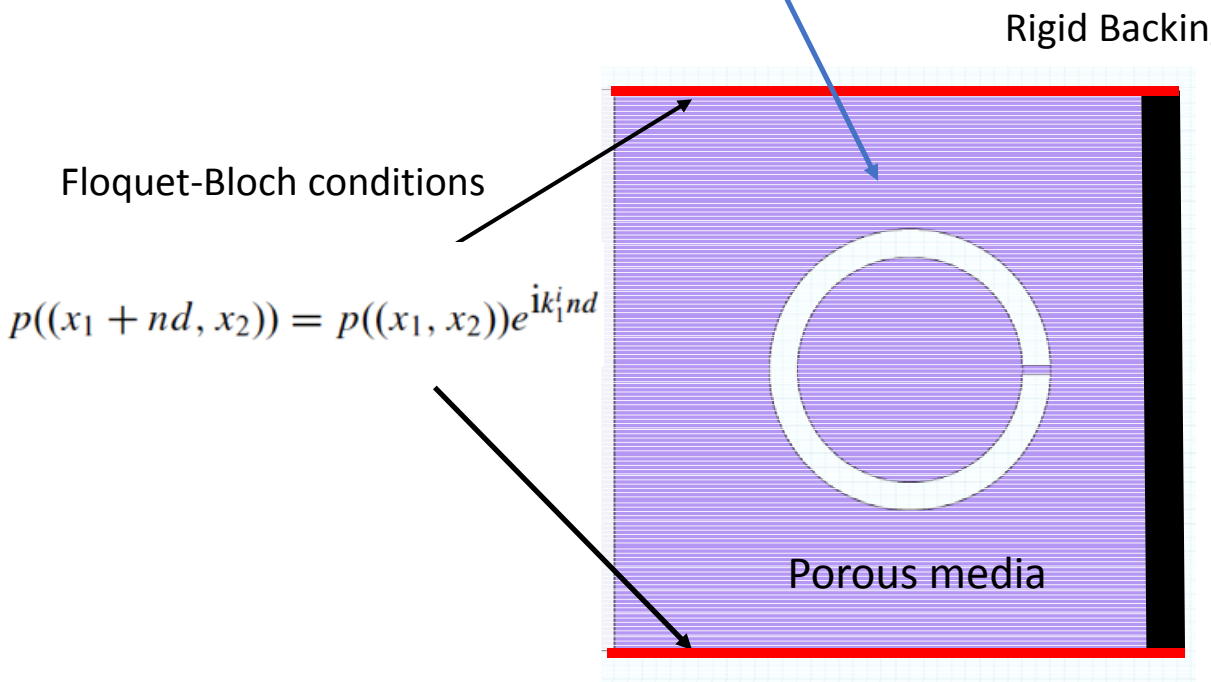


Comsol Components :

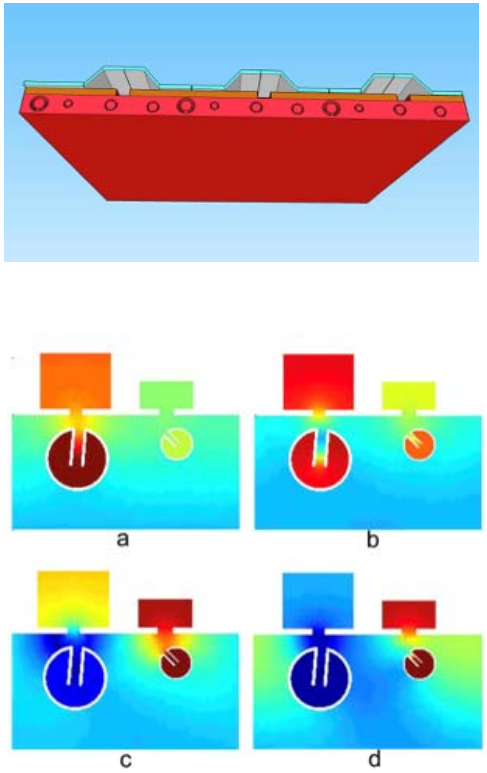
Acoustics, Strucural mechanics, Optimization

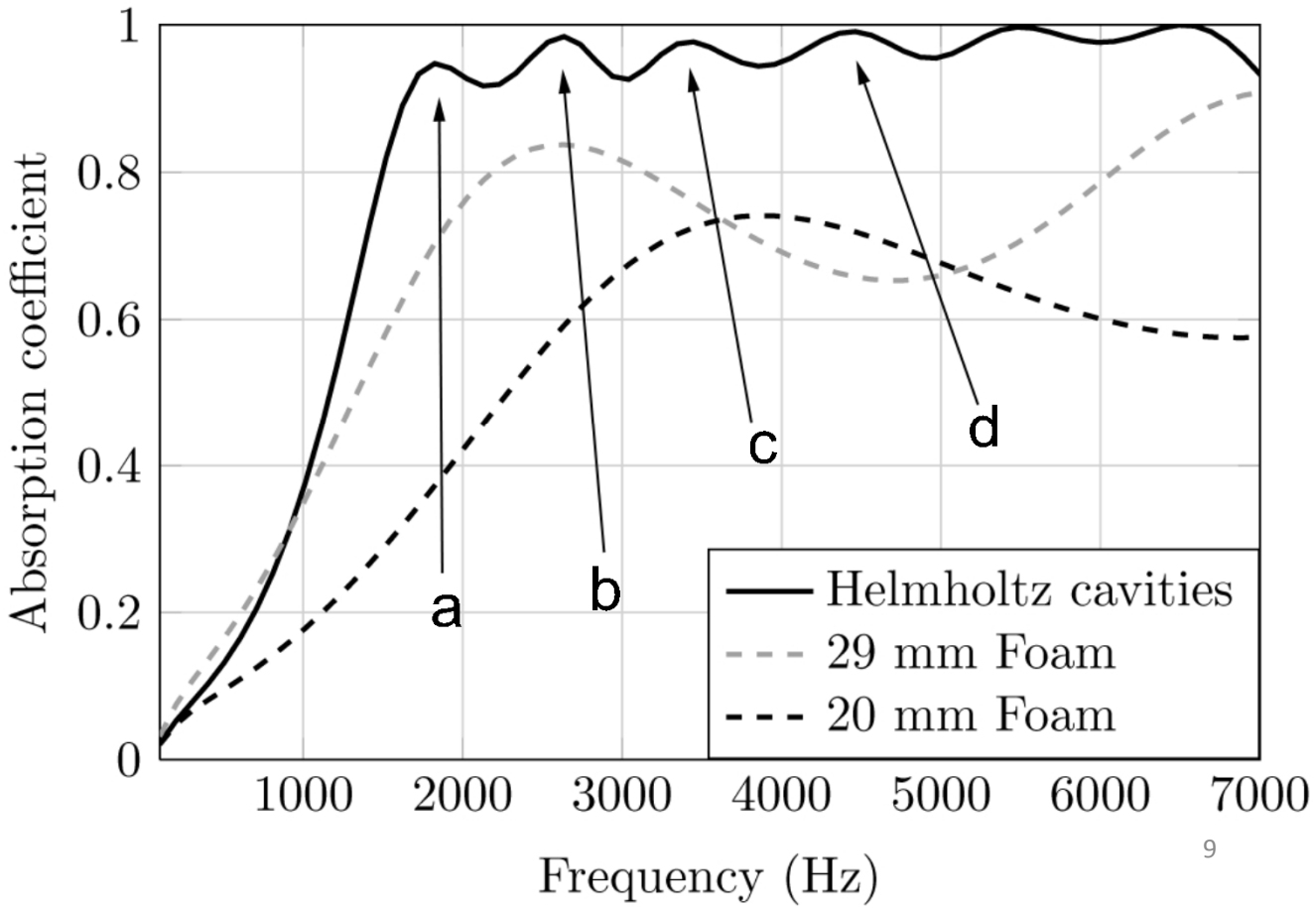
Settings

- Equivalent fluid model (JCA)
- Plane wave of diffuse field
- Rigid backing
- Floquet–bloch conditions
- Optimization on geometrical parameters

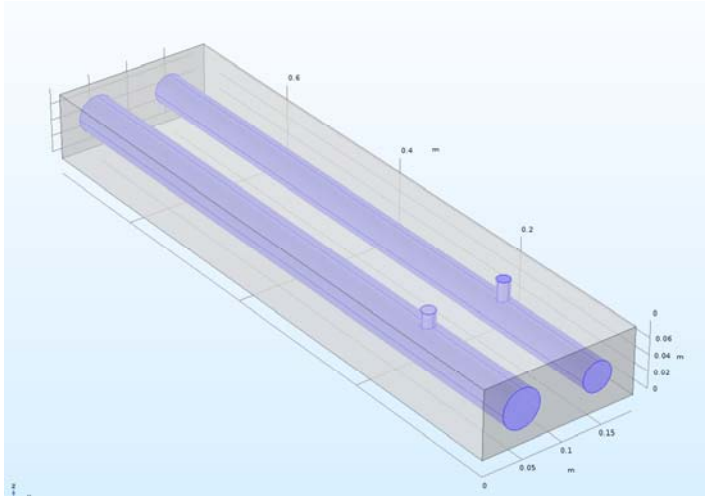


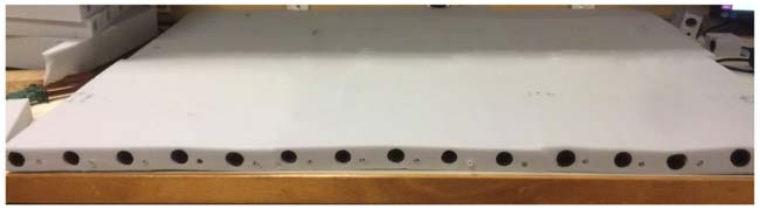
Metaporous for absorption : complex geometries

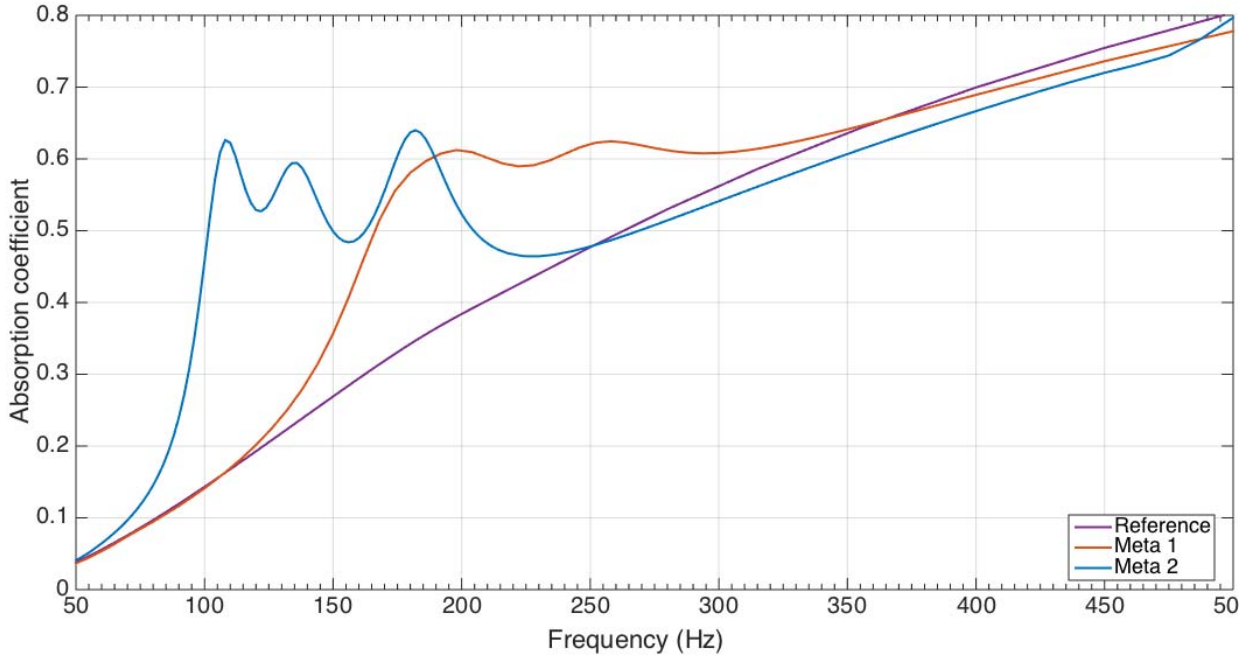




Metaporous for absorption : 3D models







Geometry dependant frequency band

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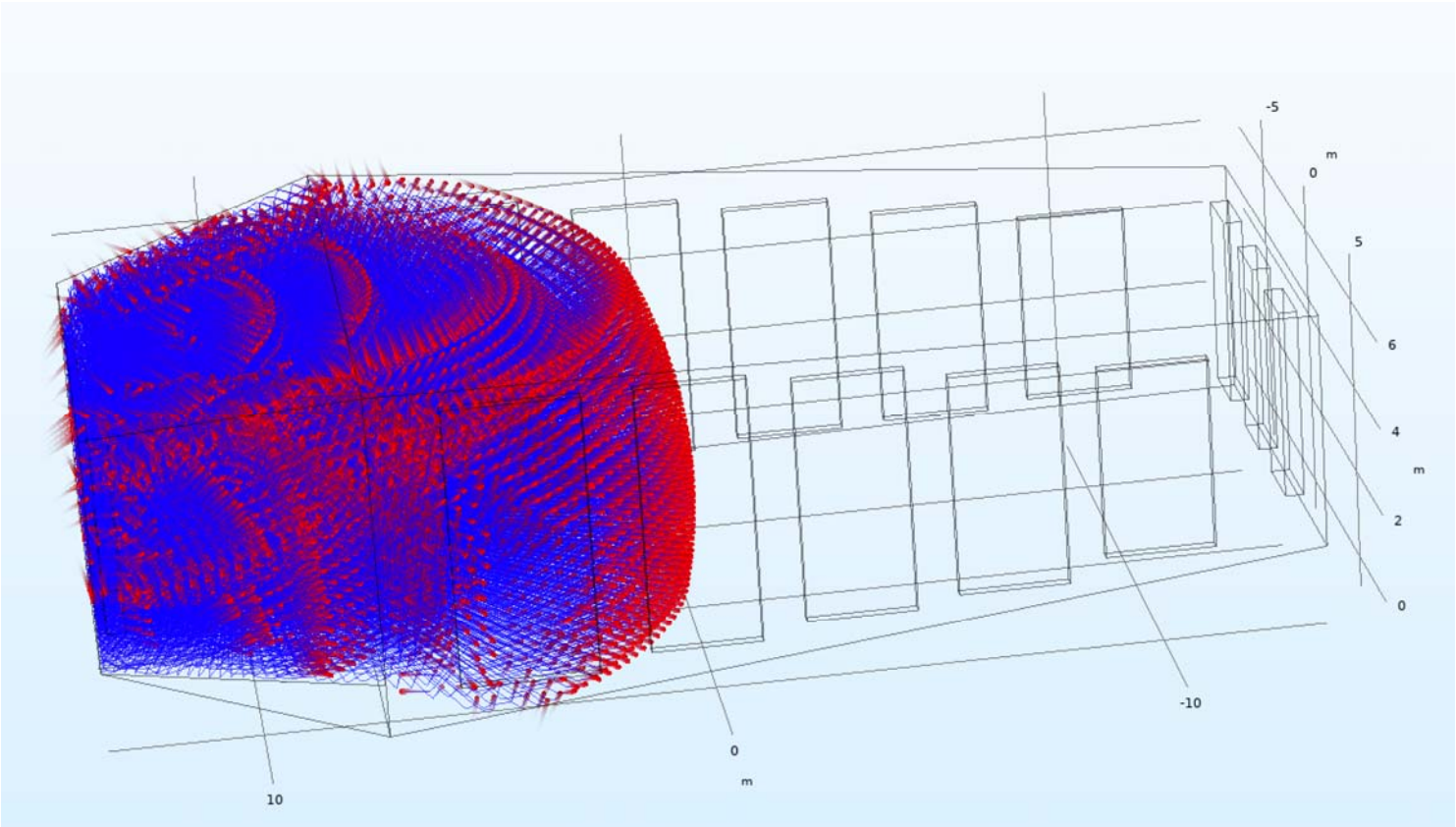
Auralization of the material : Impulse response

Reverberation

- Ray tracing method
- 63 – 16000 Hz
- 1/3 octaves
- More than 10000 rays
- 20min computation (32 go Ram)

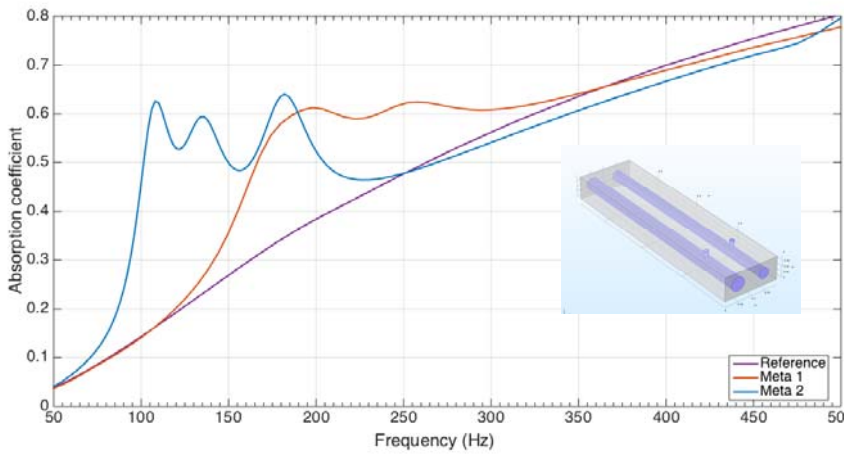


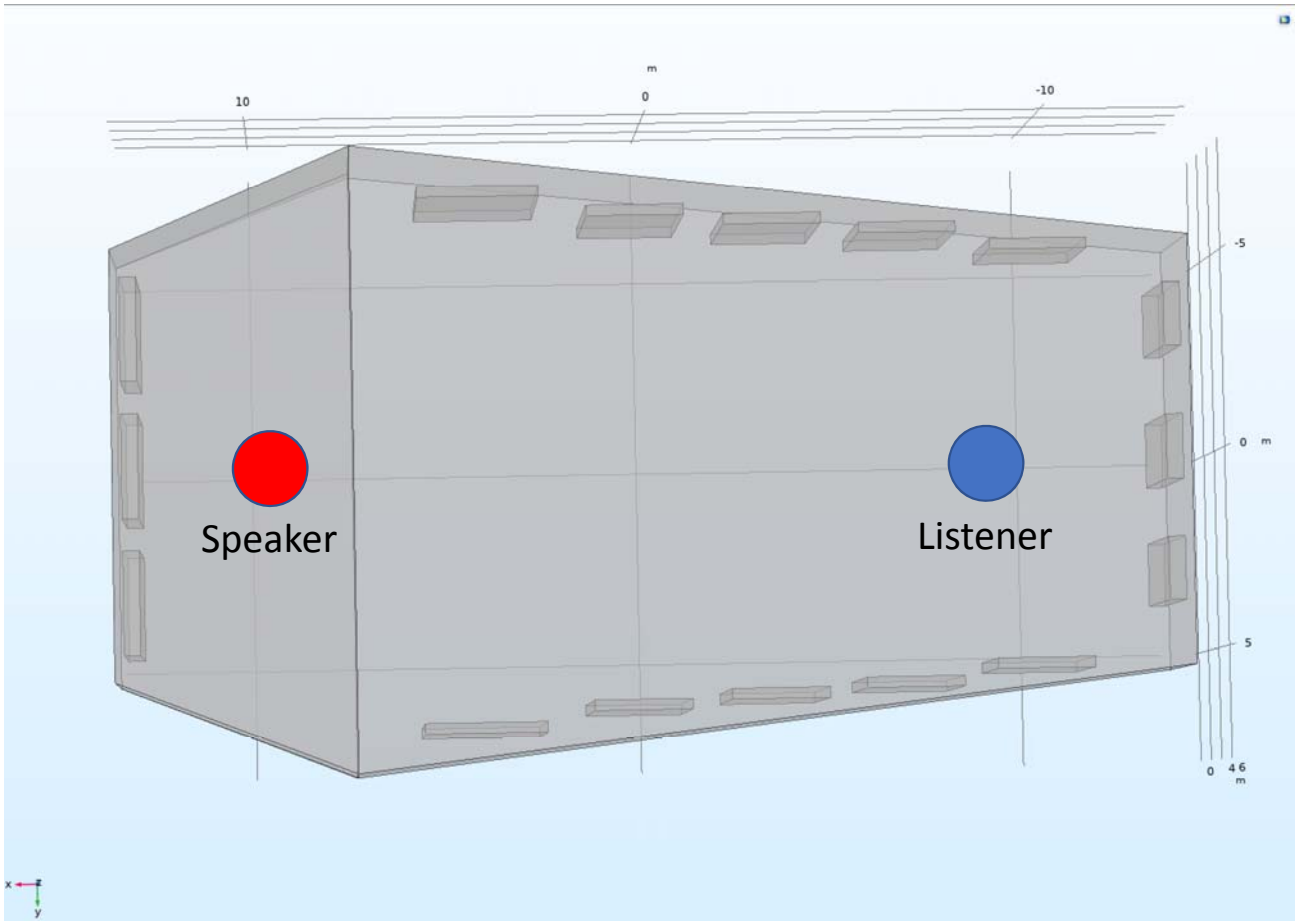
3- Room acoustics simulation

Auralization of the material : Impulse response

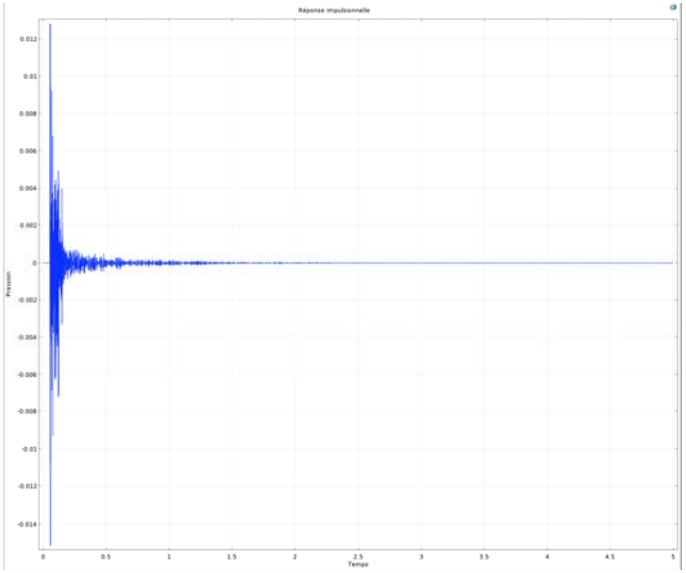
Reverberation time

- Room Volume : 2000m^3
- Wall material : Gypsum
- 8cm thick treatment (Melamine)



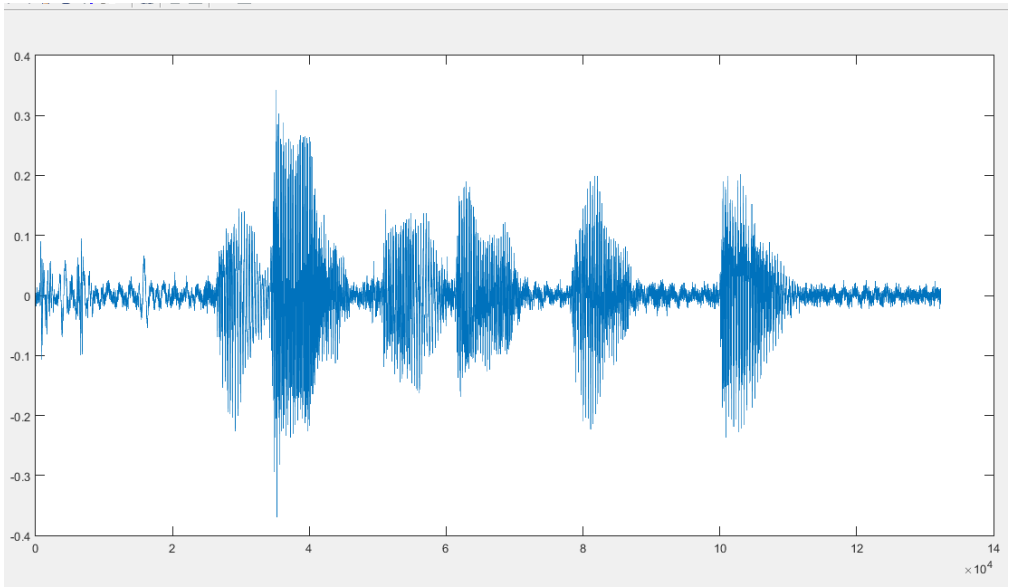


Auralization of the material : Convolution reverb



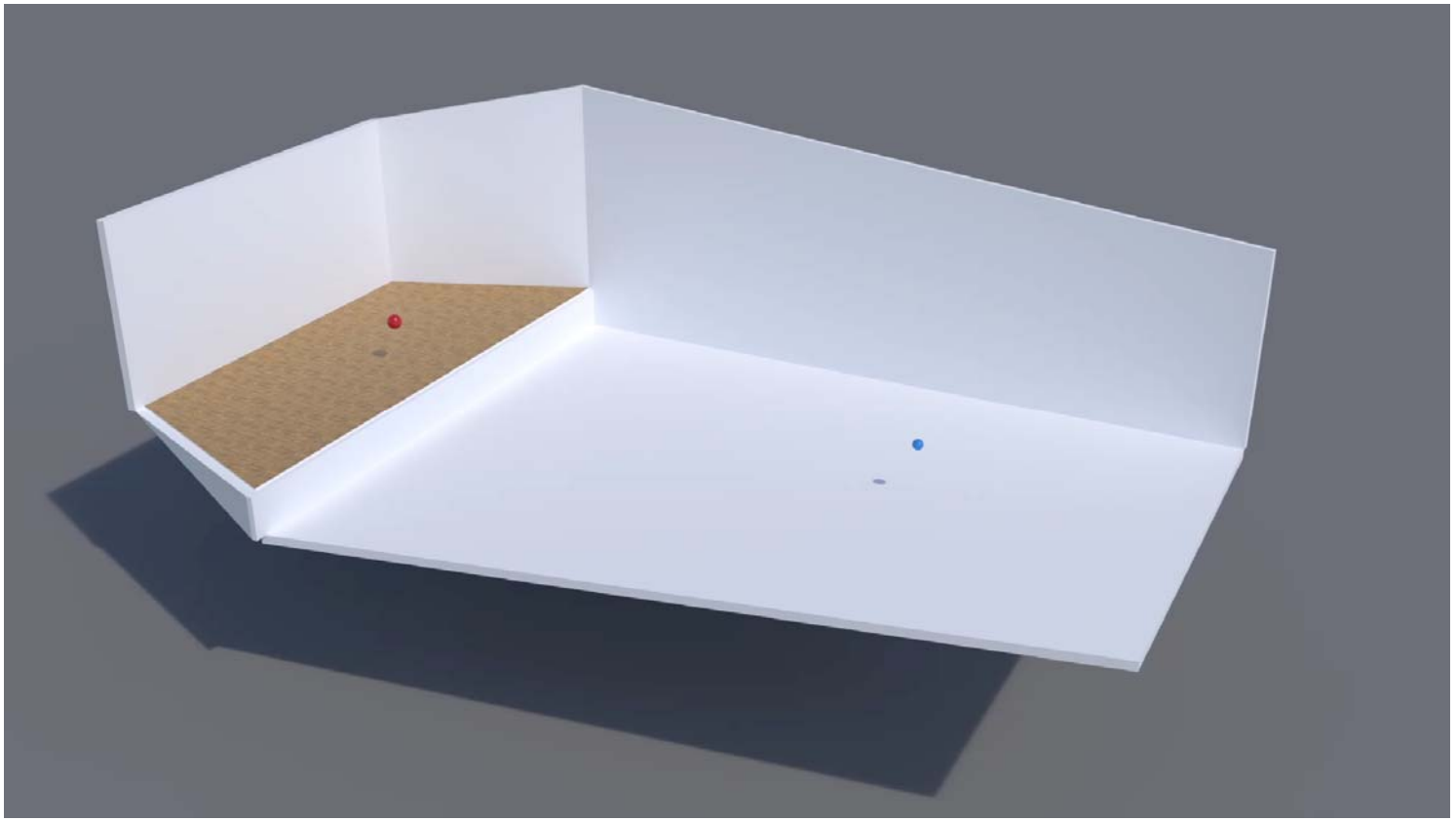
Impulse response of the room

Convolution reverb



Dry sound signal (in time)

3- Room acoustics auralization



Thank you for your « listening »

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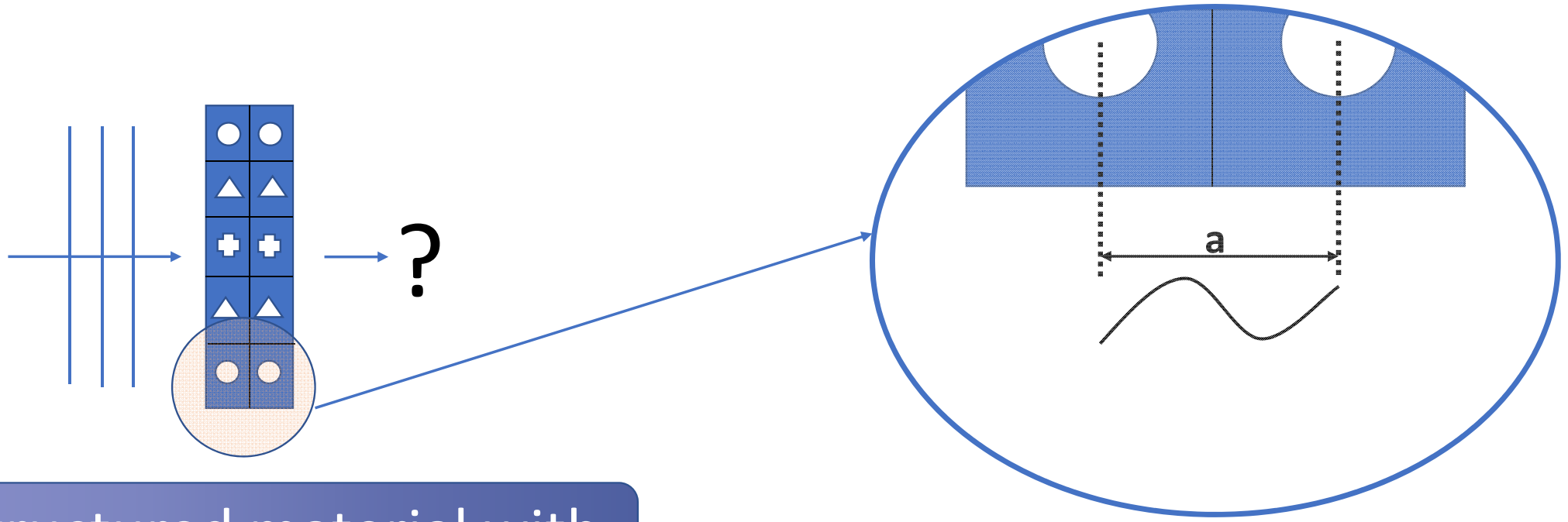

Structured material with extraordinary properties

High effect when $\lambda = a$

Design of efficient acoustic solutions

Absorption

- Wall treatment
- Ilets
- Baffles

Insulation

- Sandwichs
- Paritions
- Screens