

# Fully Symmetrical Single-Suspension Electrodynamical Loudspeaker using a Halbach Array

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# Summary

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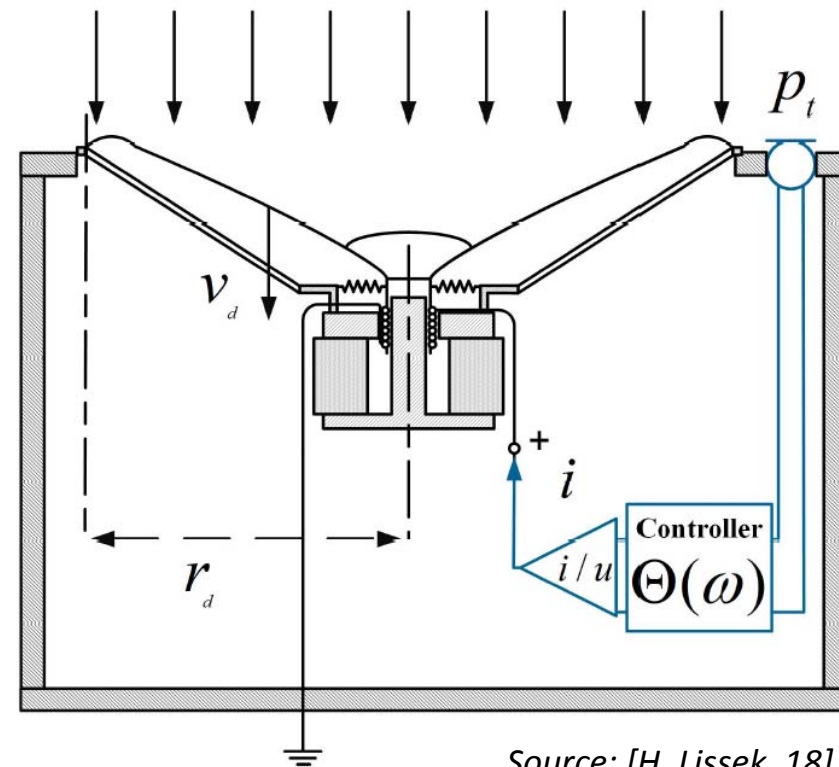
- Motivations
- Constraints and proposed solutions
- Halbach array
- Multiphysics full wave model.
- Conclusions



# Motivations

- Decades old design
- Robust
- Simple
- Actively controllable
- Very practical resonator:

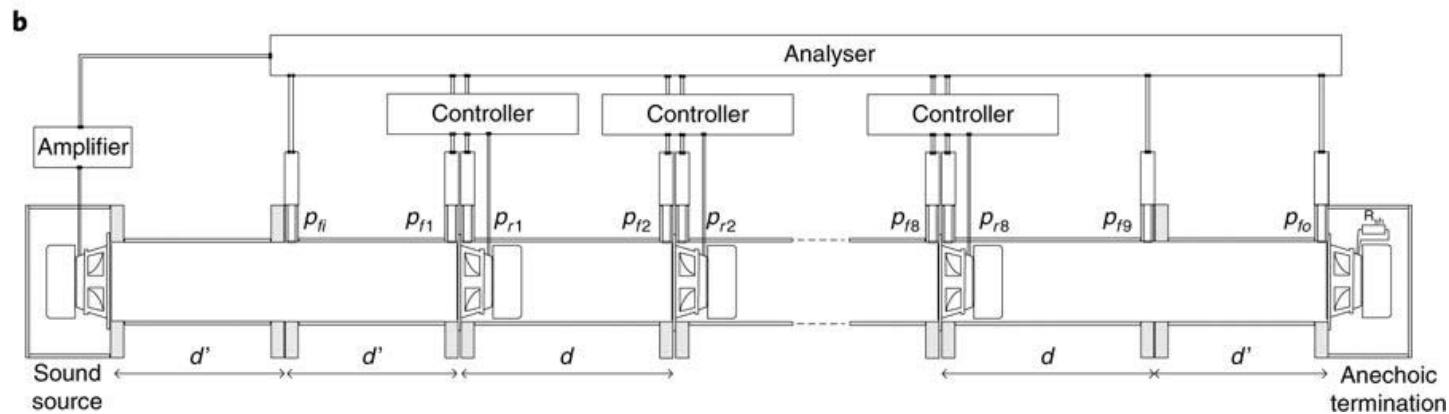
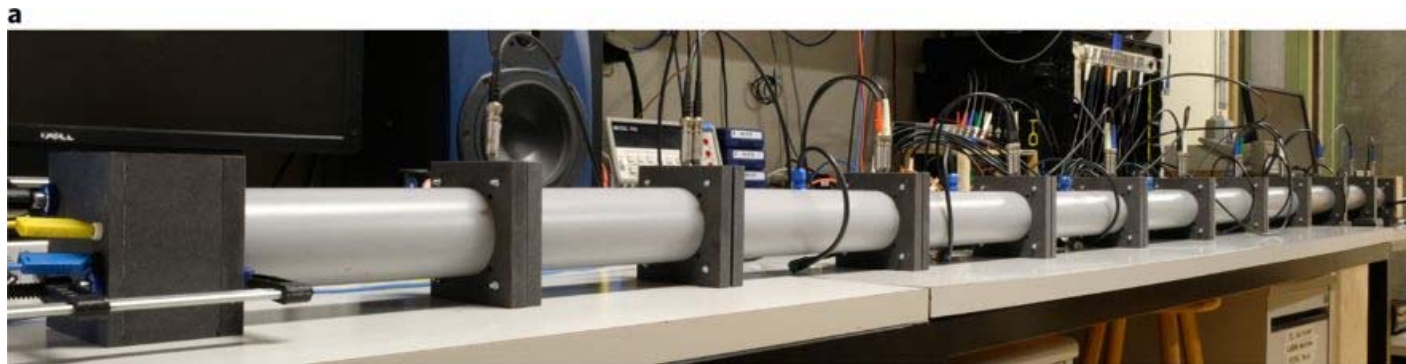
$$Z_{ms} = R_{ms} + j\omega M_{ms} + \frac{1}{j\omega C_{mc}}$$



Source: [H. Lissek, 18]



# Motivations



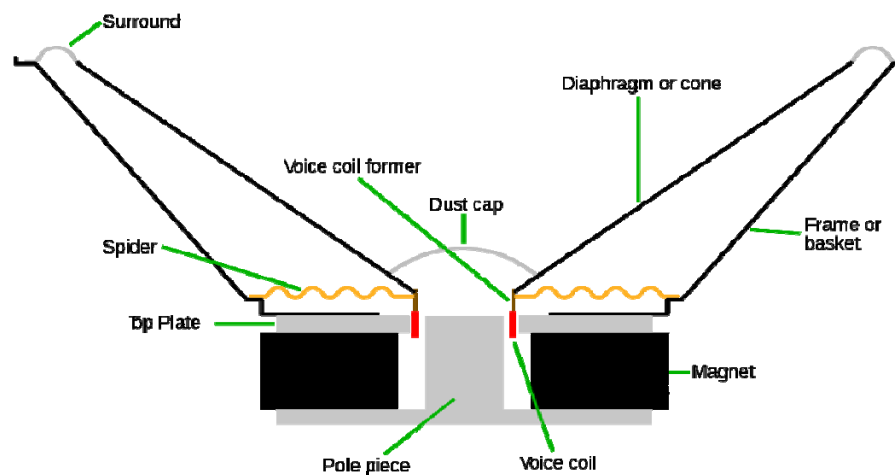
Source: [E. Rivet, 18]



# Motivations

- Several downsides:
  - Bulkiness at the back
  - Far from symmetrical
  - Non ideal response in current

➔ We want to fix this



# Constraints and solutions

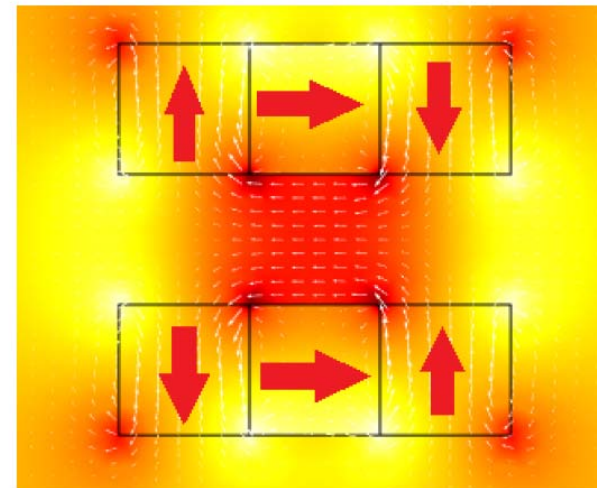
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- Fully symmetrical
- As thin as possible
- In the usual range of efficiency
- Low resonant frequency



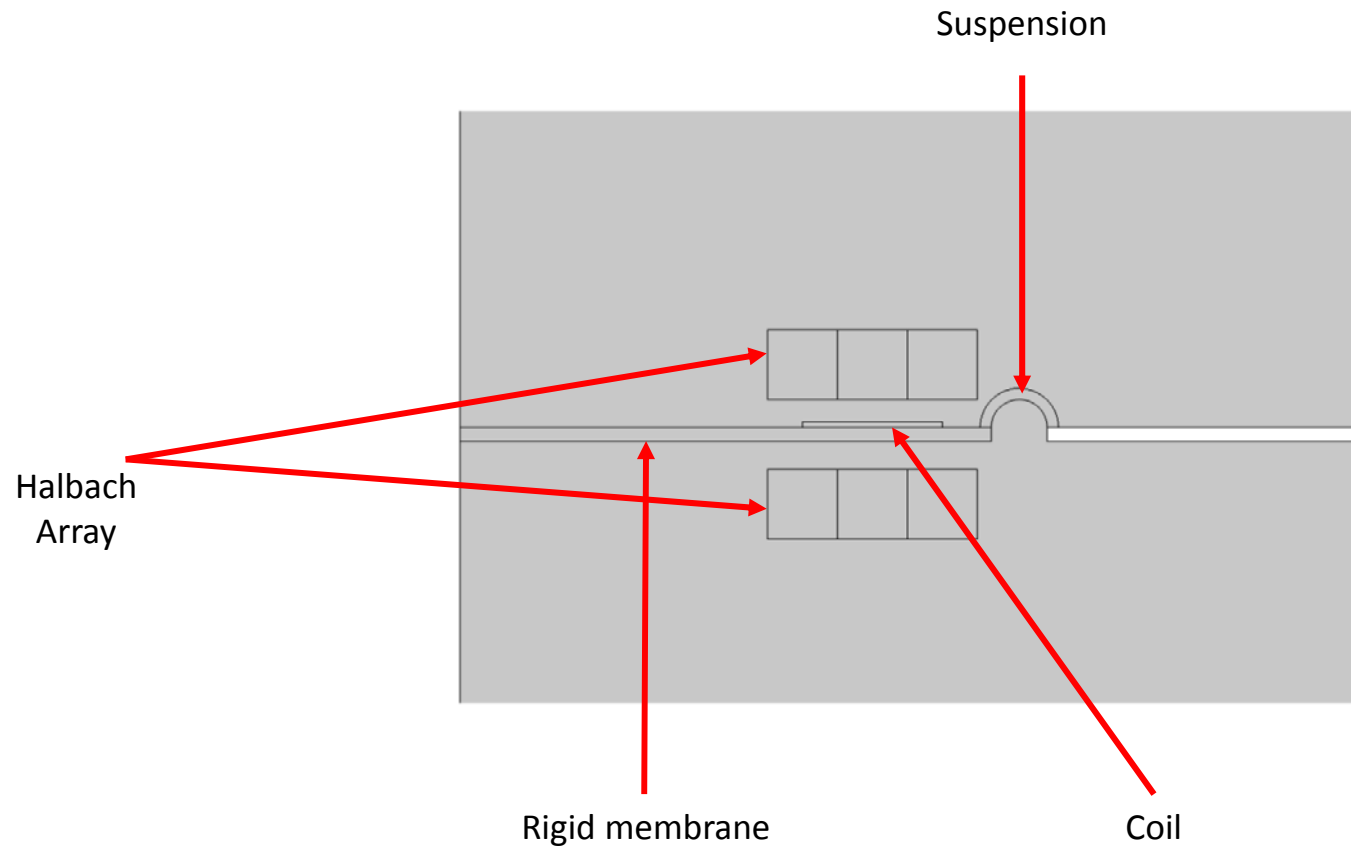
# Constraints and solutions

- Fully symmetrical
  - No magnet on the back
  - Excitation on the border of the membrane
- As thin as possible
  - Single suspension
  - Coil directly on the membrane
- In the usual range of efficiency
  - Halbach Array
- Low resonant frequency
  - Tuning of material
  - Size choice thanks to other constraints



# Constraints and solutions

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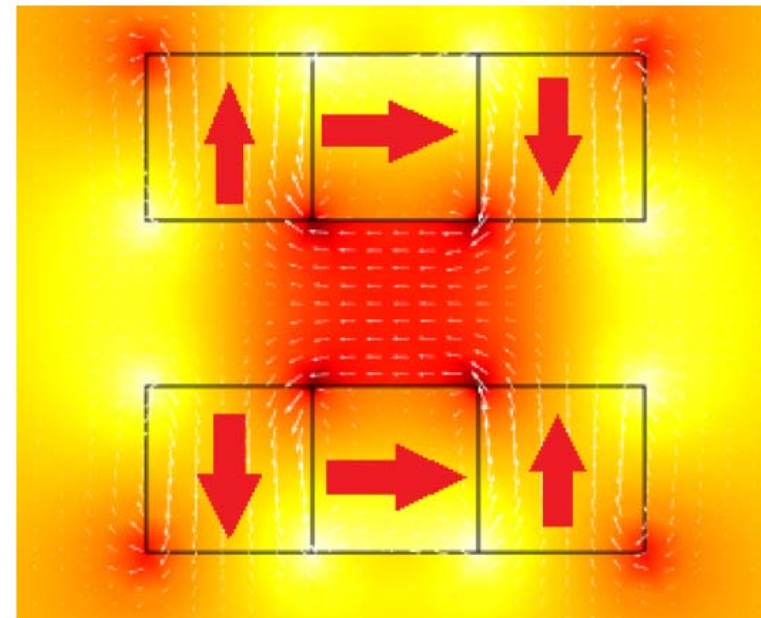






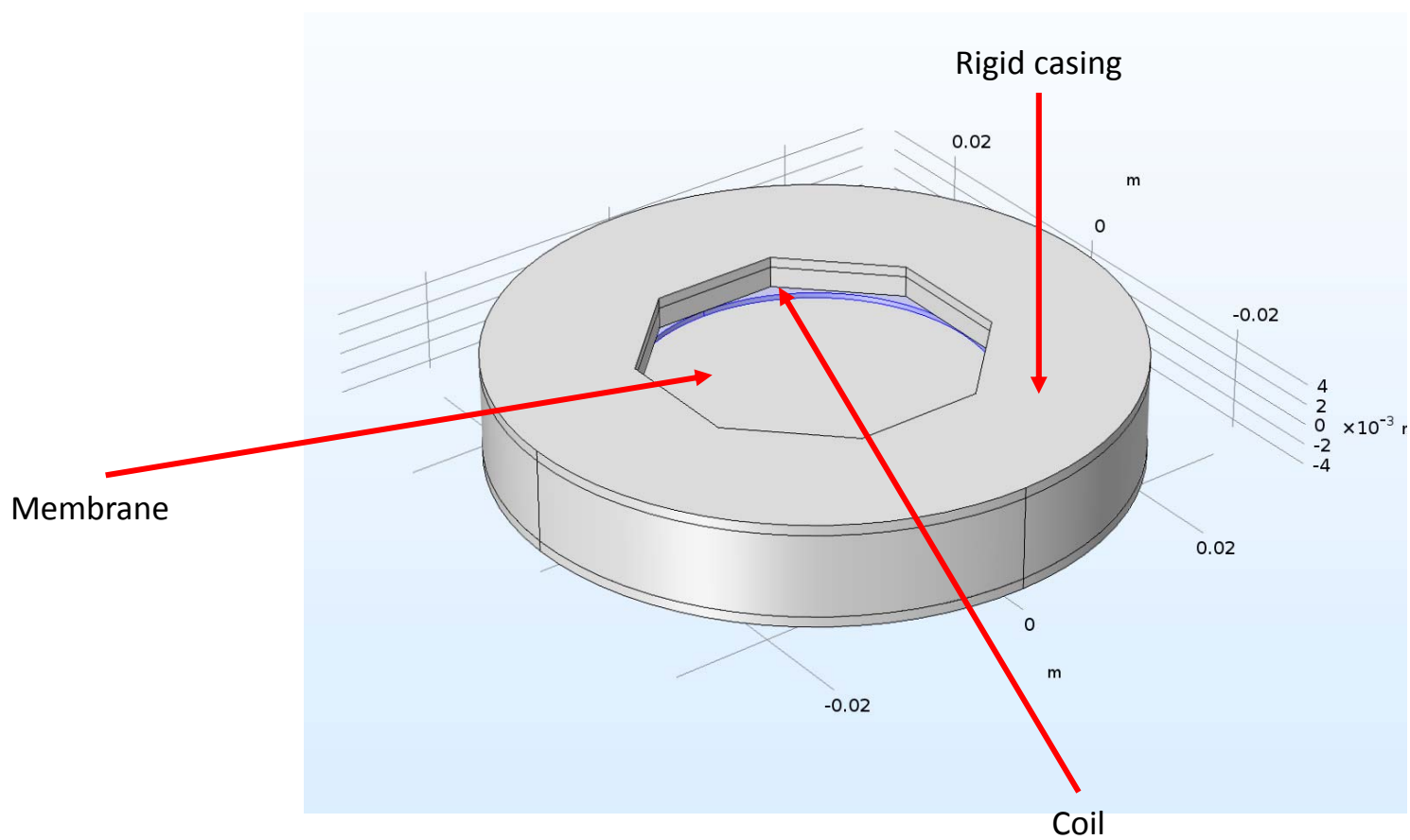
# Halbach Array

- Increase magnetic field (4 times)
  - Increase distance between magnets
  - Increase force factor
- Improve homogeneity



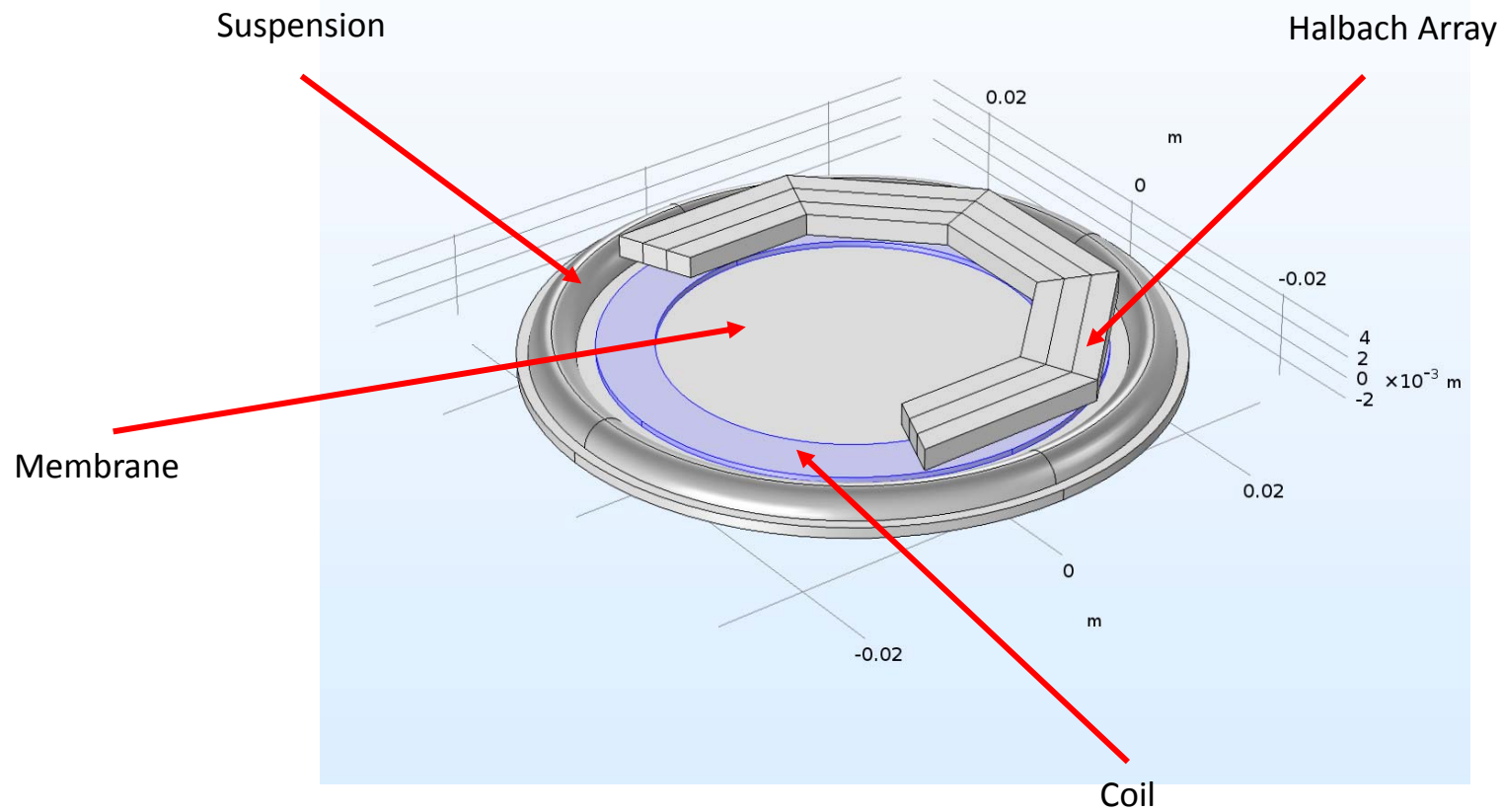


# Full wave model



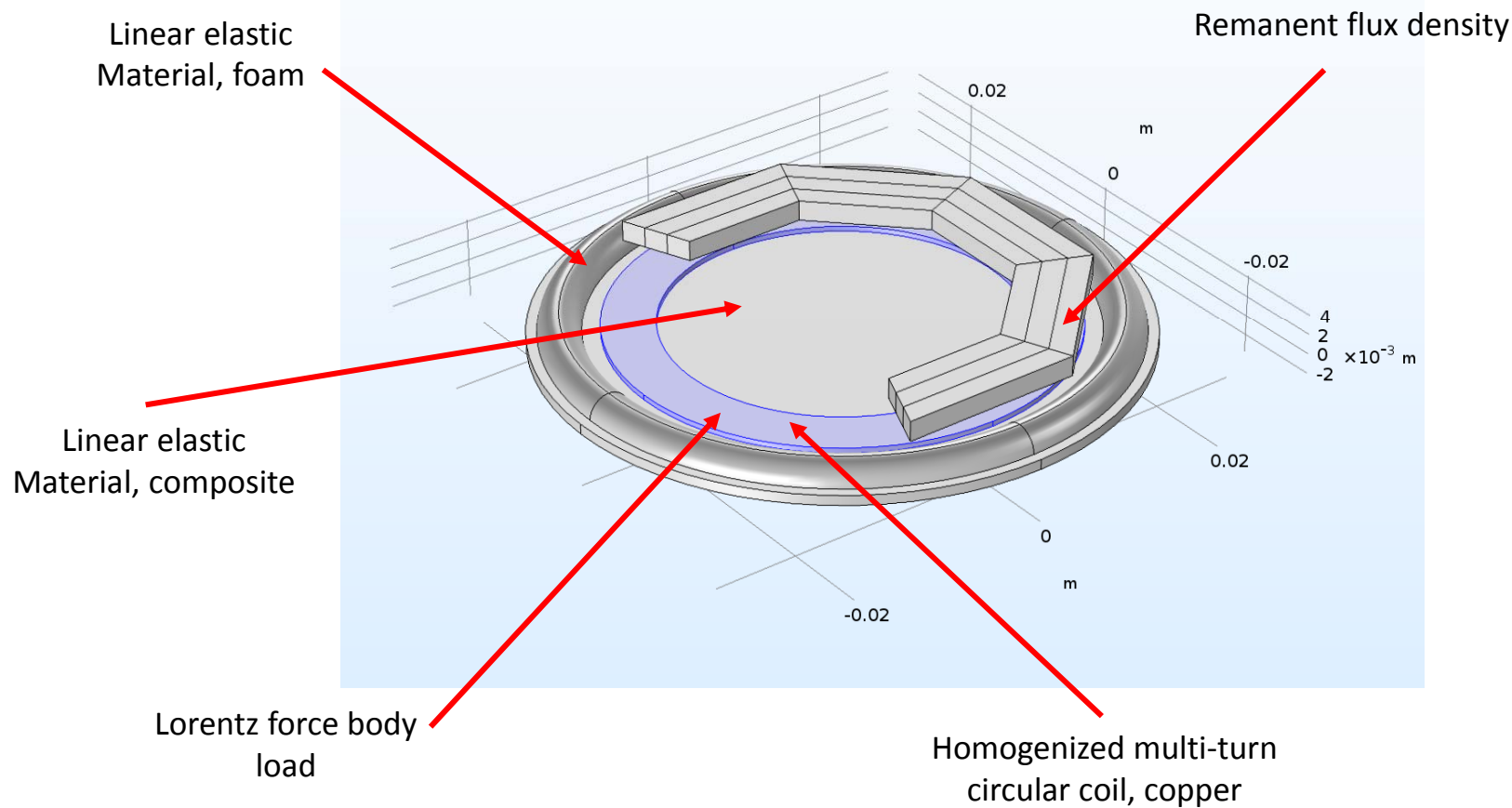


# Full wave model



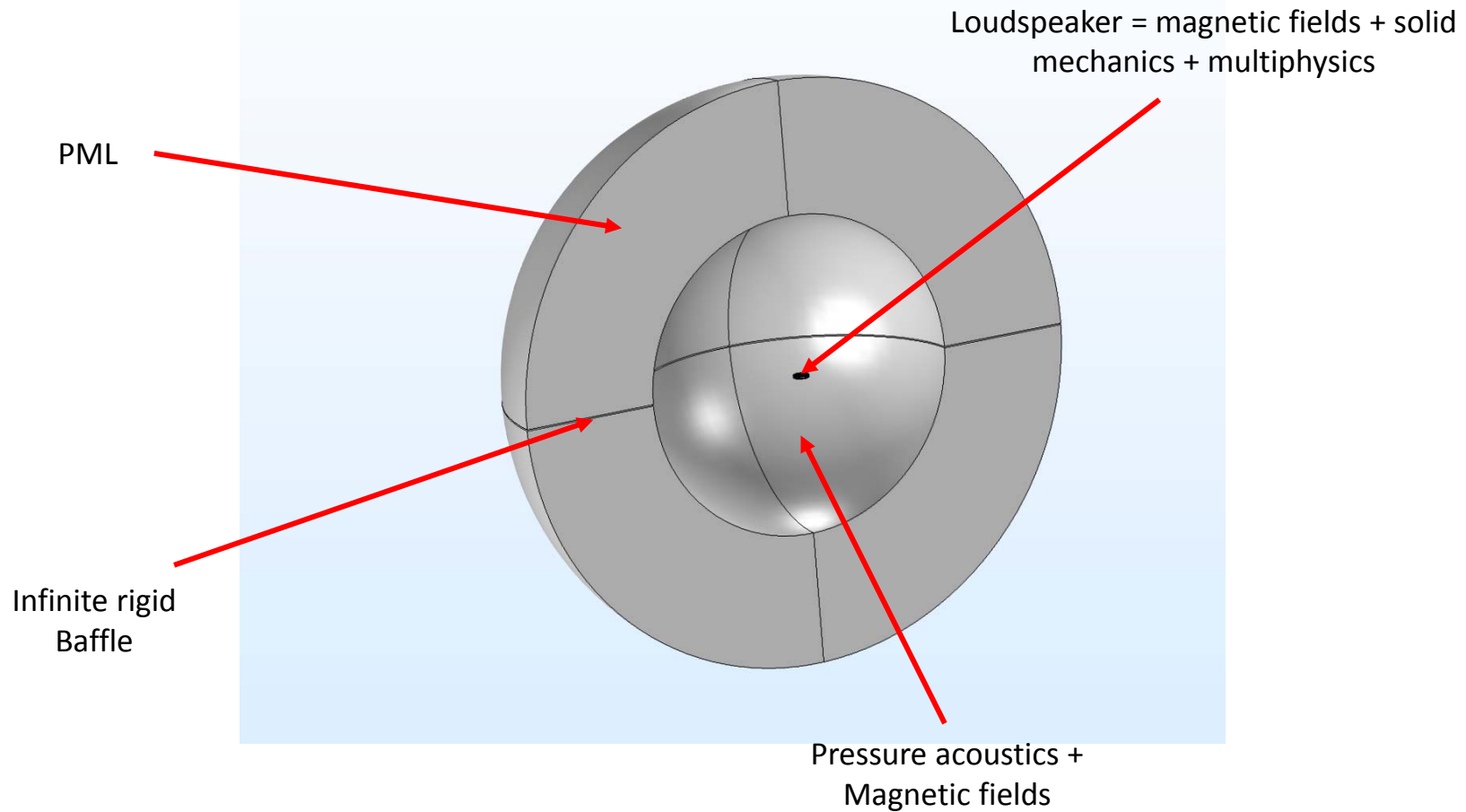


# Full wave model

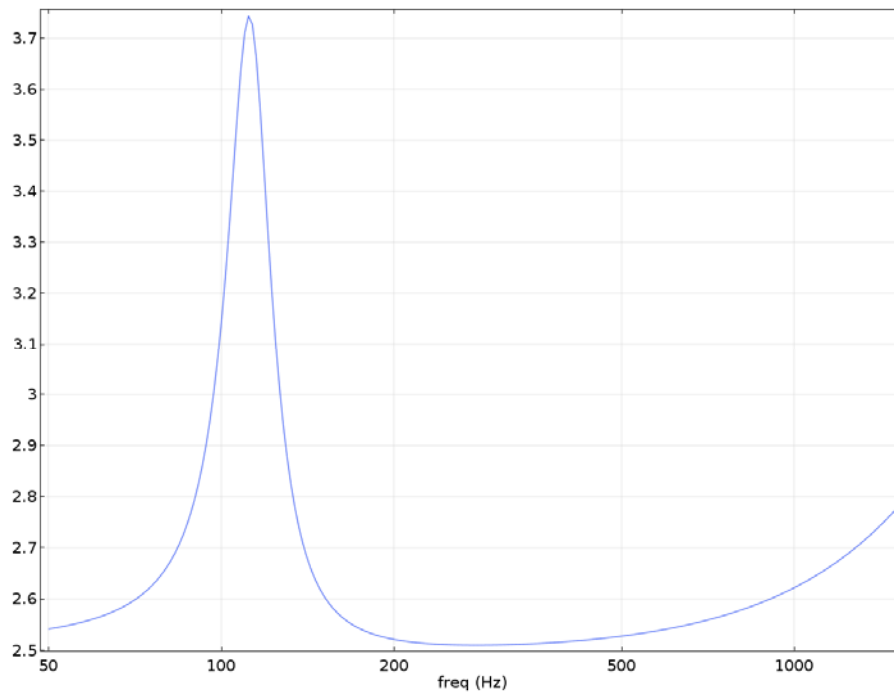




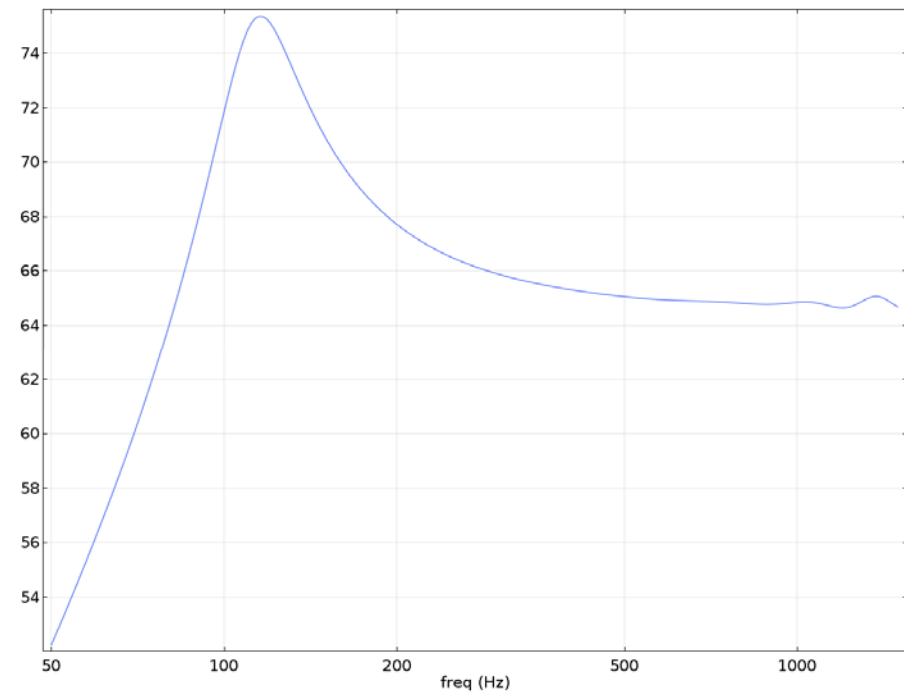
# Full wave model



# Full wave model

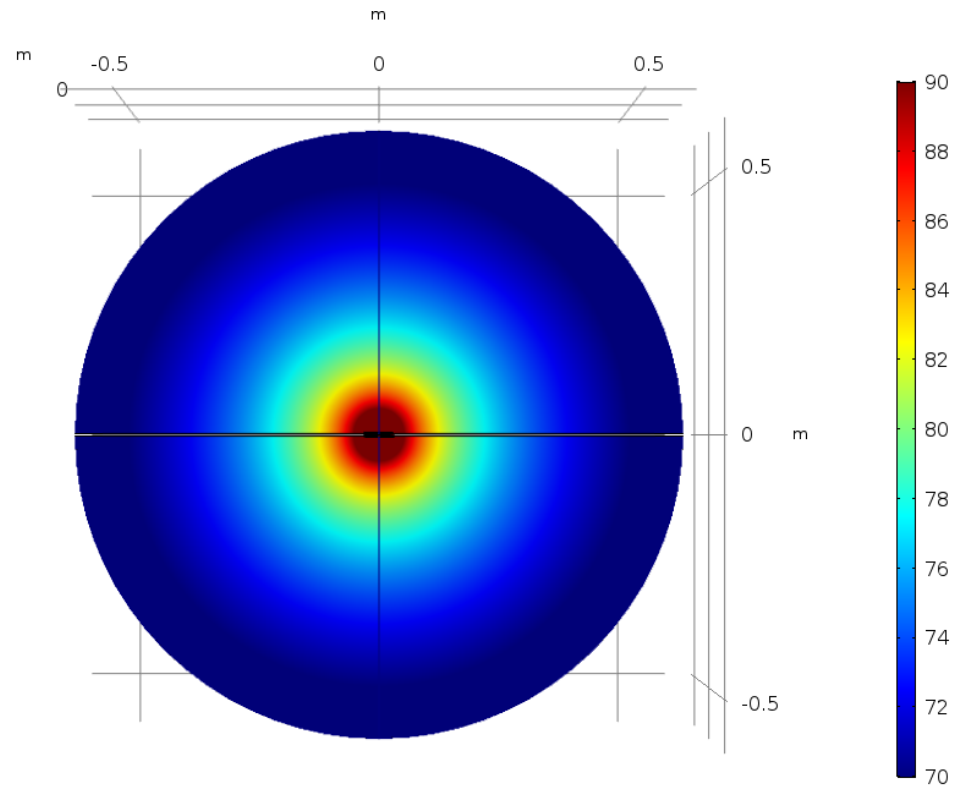


Electrical Impedance



Sound pressure level  
at 50cm

# Full wave model



Pressure level field

# Conclusions

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- Very flat loudspeaker
- Seems to be robust to roll modes
- Efficient enough

➔ To do :

Prototyping or a more complete study



Thank you !

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