Simulation Status

LAViSta

Laboratories in Annecy working on
Vibration Stabilization

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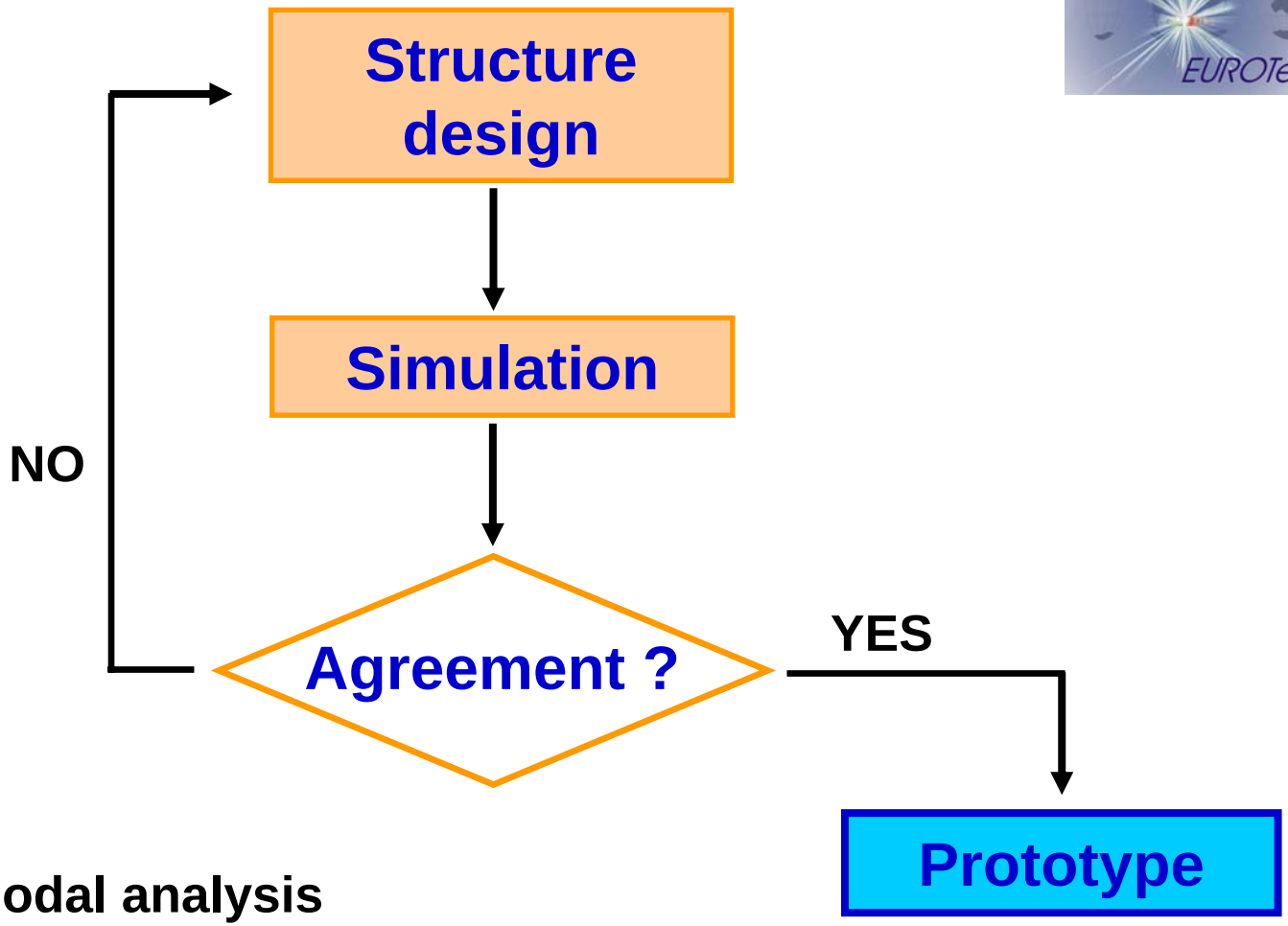
Overview

1. Final focus system vibrations
2. Modal analysis
3. Dynamic response predictions
4. Future prospects
5. Conclusions



Simulation :
- **Modal analysis**
- **Dynamic response prediction**

Improve design before building a prototype

Final focus system vibrations

Excitation spectrum

Ground motion

Cooling system

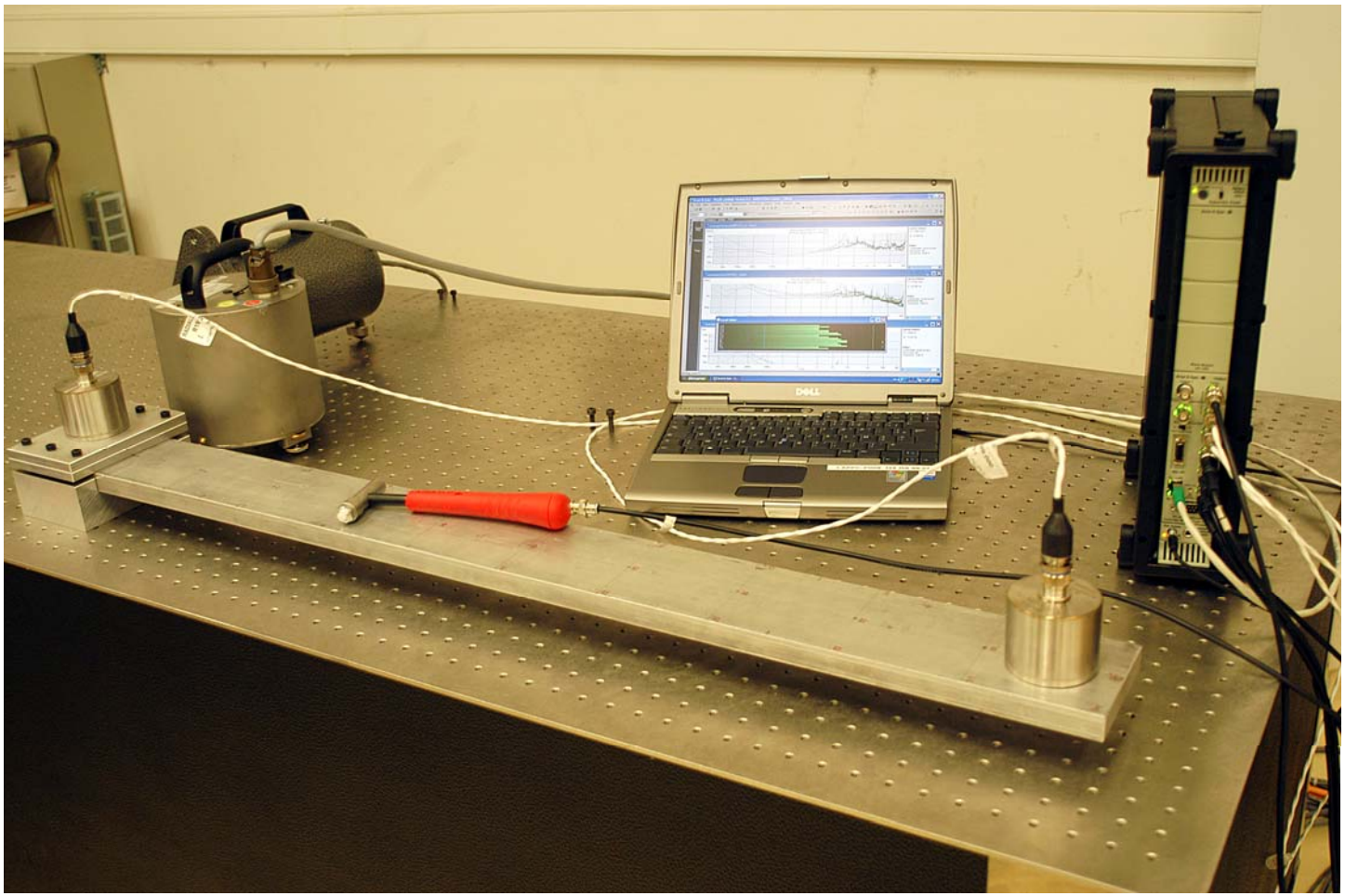
Air flows

Power supply system…

Structural resonances **(Amplified motions)**

Develop a know-how concerning modal analysis

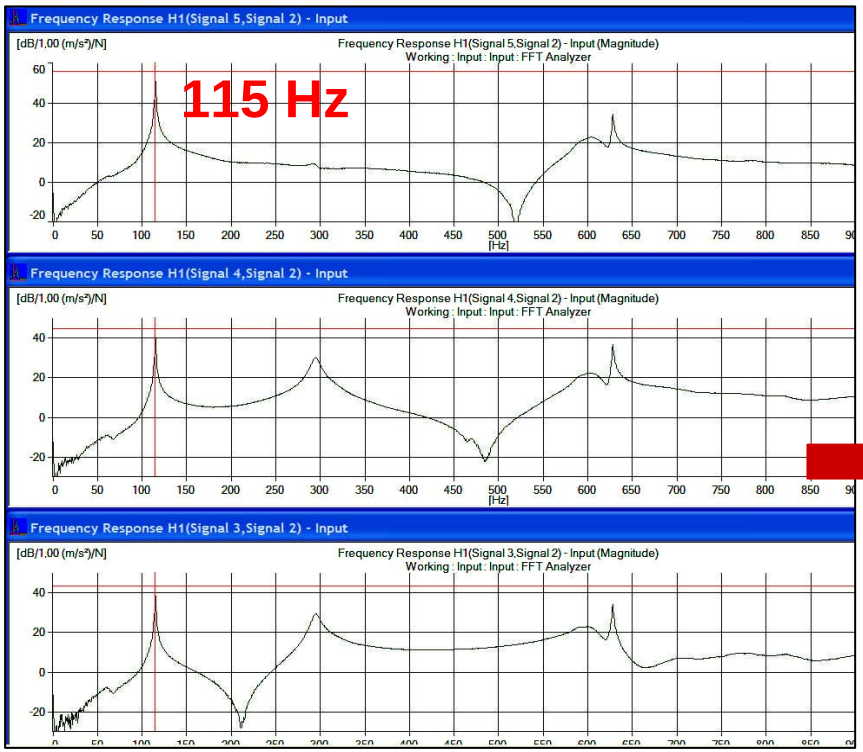
Experimental
Modal analysis



Experimental
Modal analysis

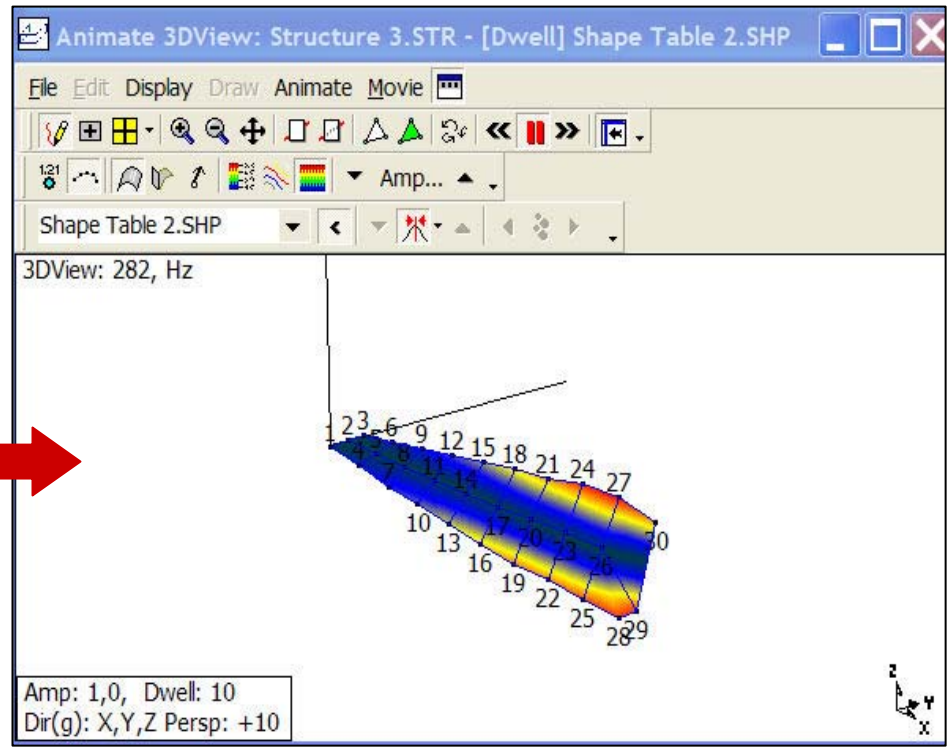
- PULSE

Fourier transform



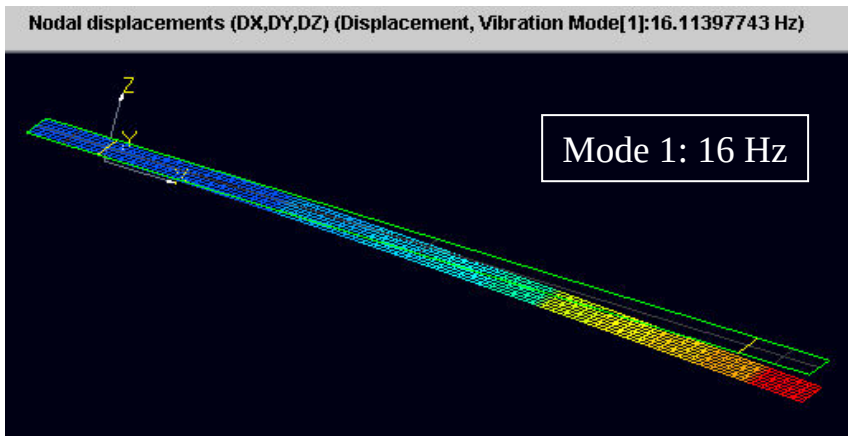
- ME' scope

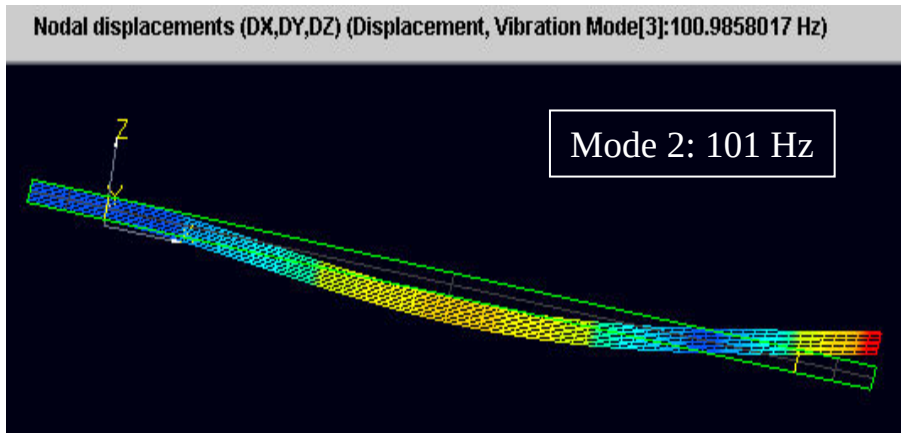
Mode shape



Numerical Modal analysis
- SAMCEF -

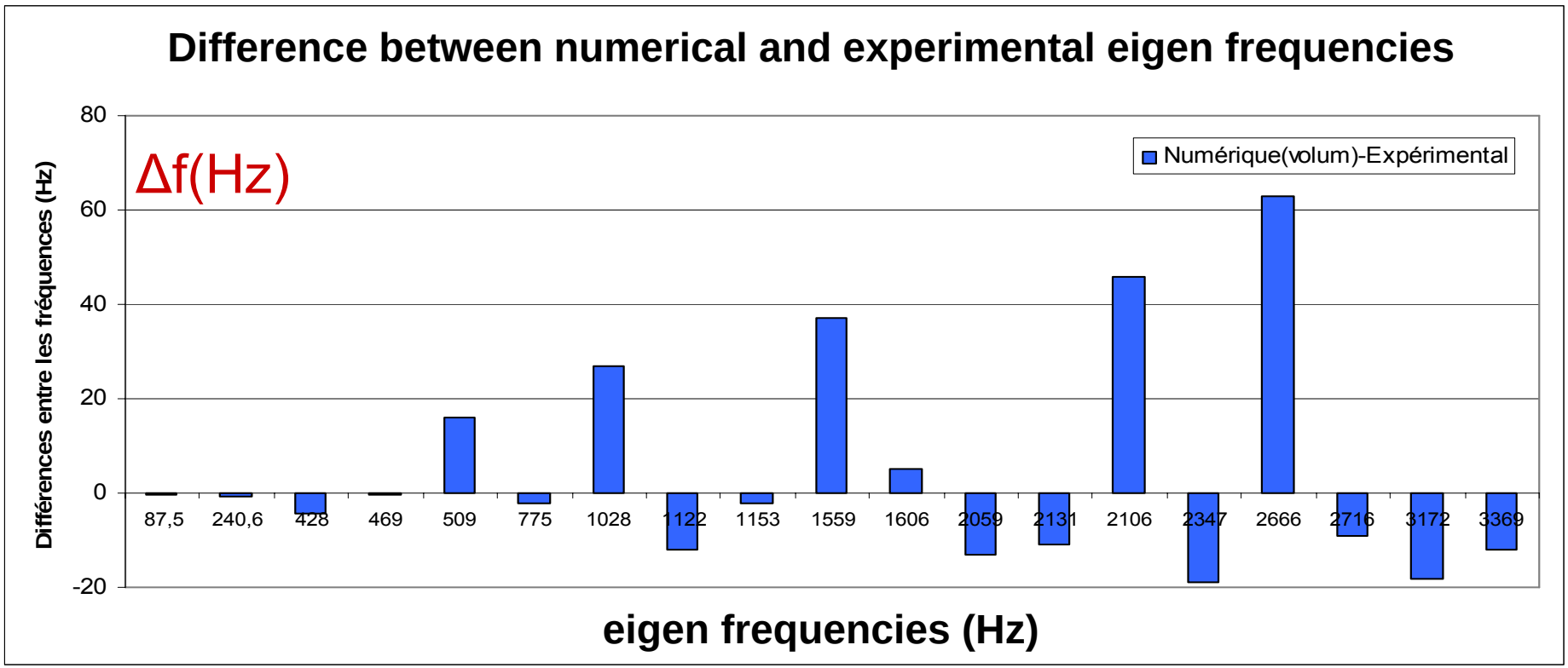
- Identify eigen frequencies
- Display mode shapes





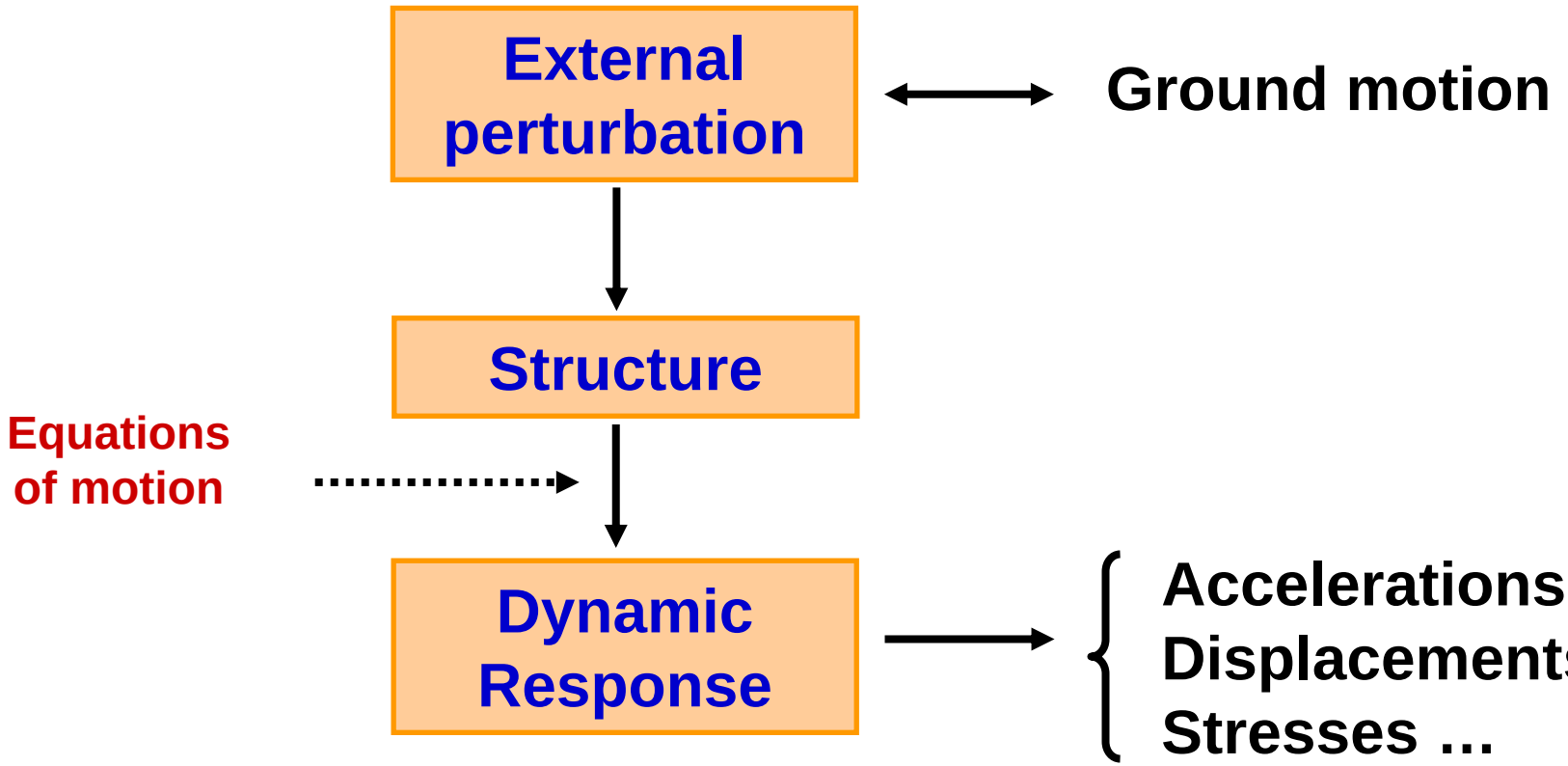
→ Modal tests on a free-free / free-fixed beam

Preliminary tests
- free free -

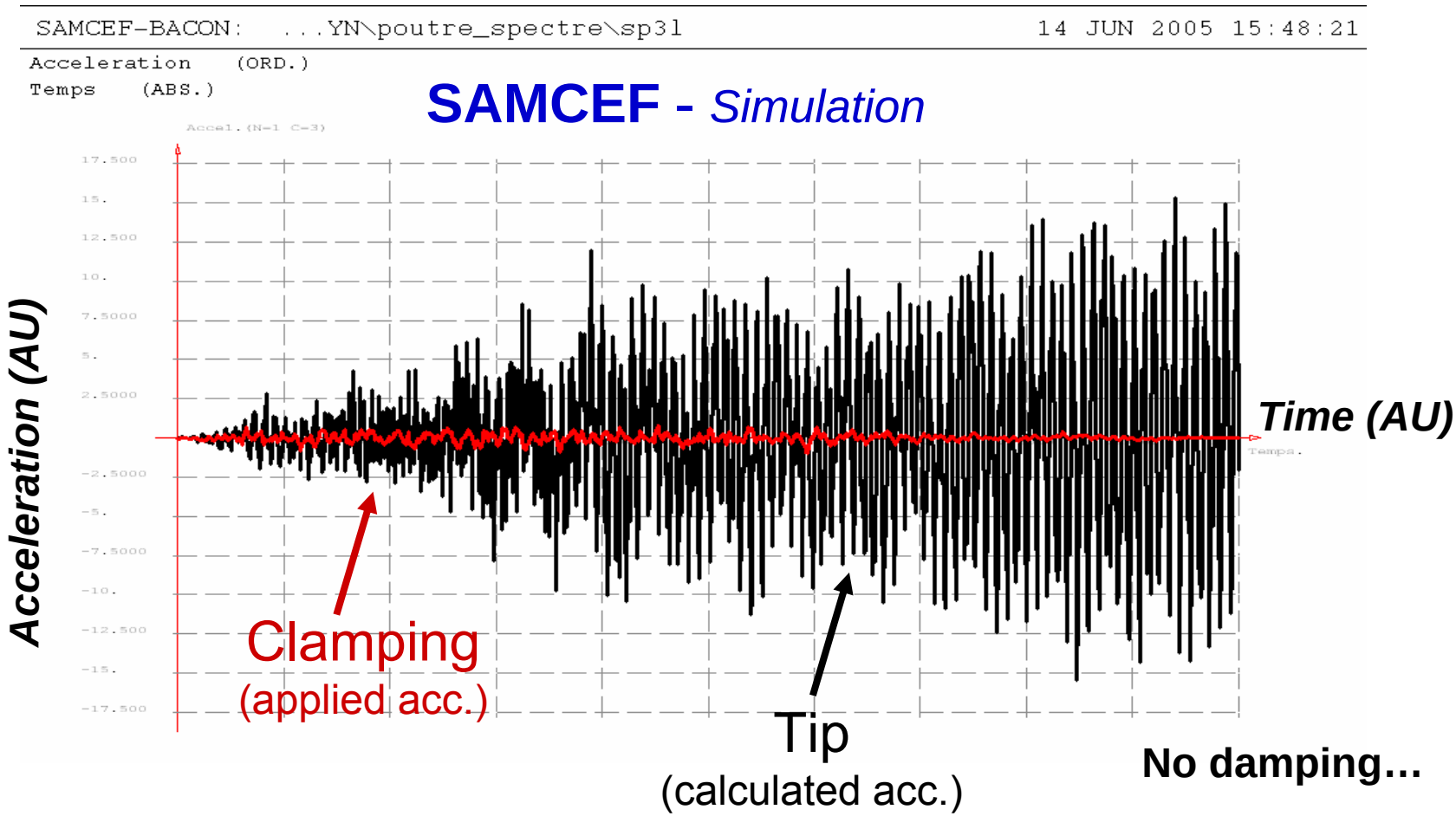


Good relative accuracy !

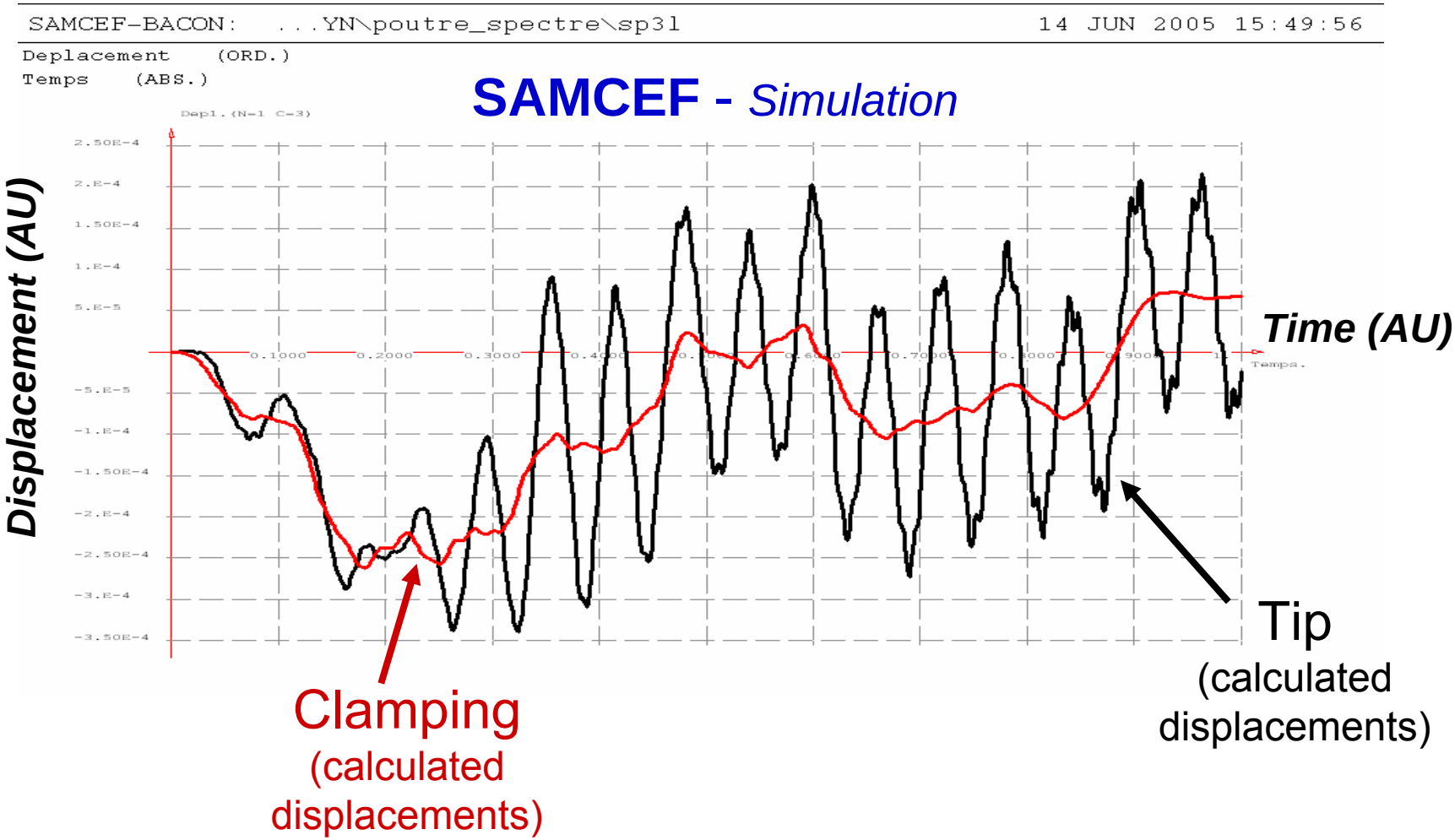
Dynamic response



Dynamic response (free–fixed beam)

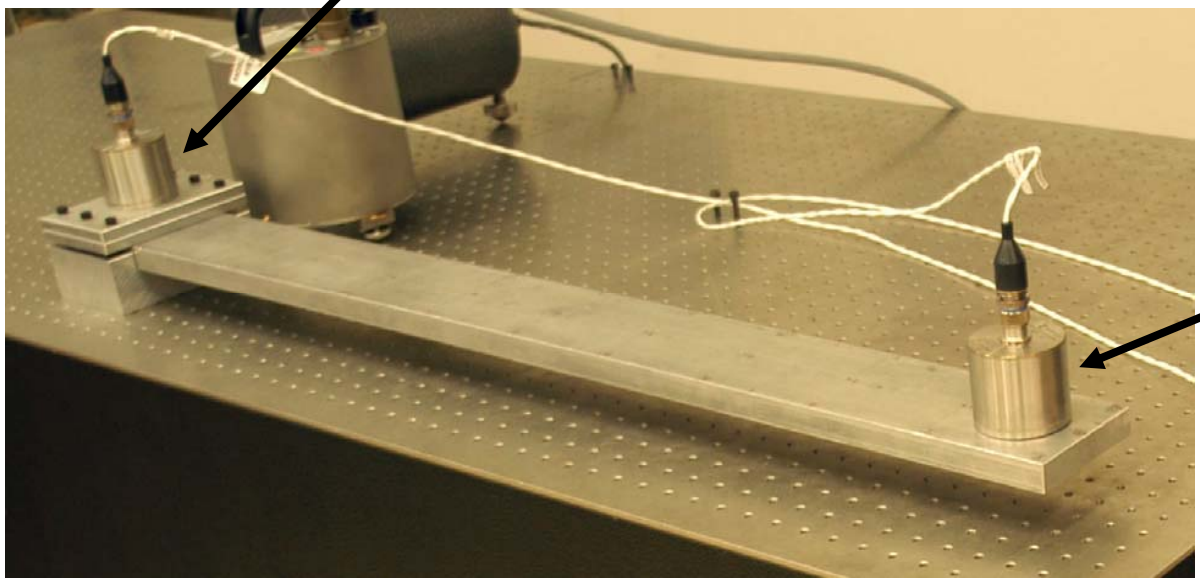


Dynamic response (free–fixed beam)



Dynamic response (free–fixed beam)

Data used as input for the simulation

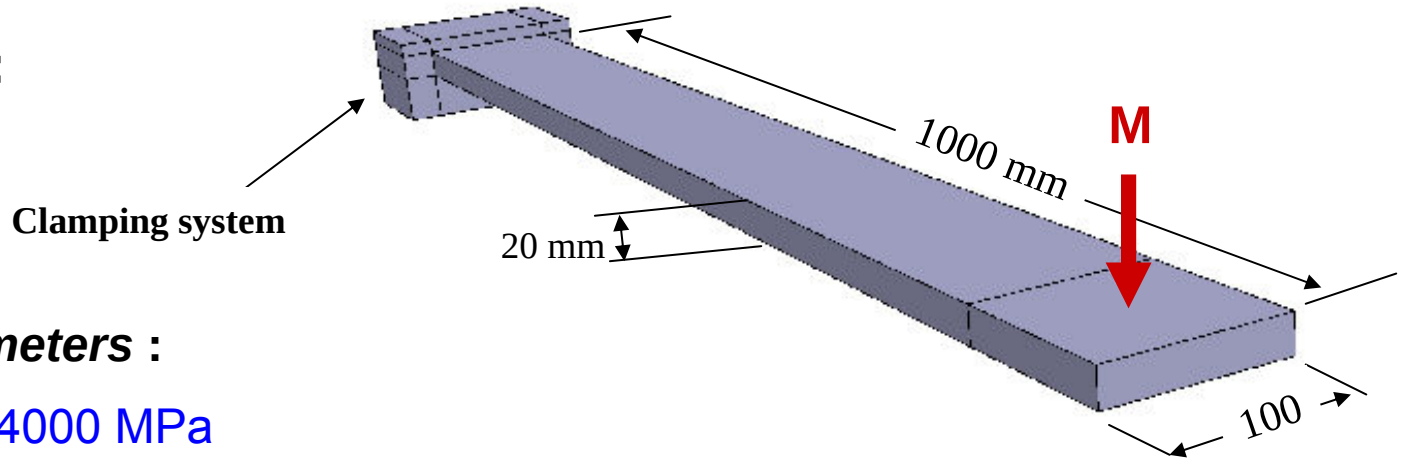


Data used for the comparison with simulation

→ Check the accuracy of the numerical prediction

Dynamic response (free–fixed beam)

Model used :



***Beam parameters* :**

E = 74000 MPa
ν = 0.34 (Poisson's ratio)
ρ = 2825 kg/m^3

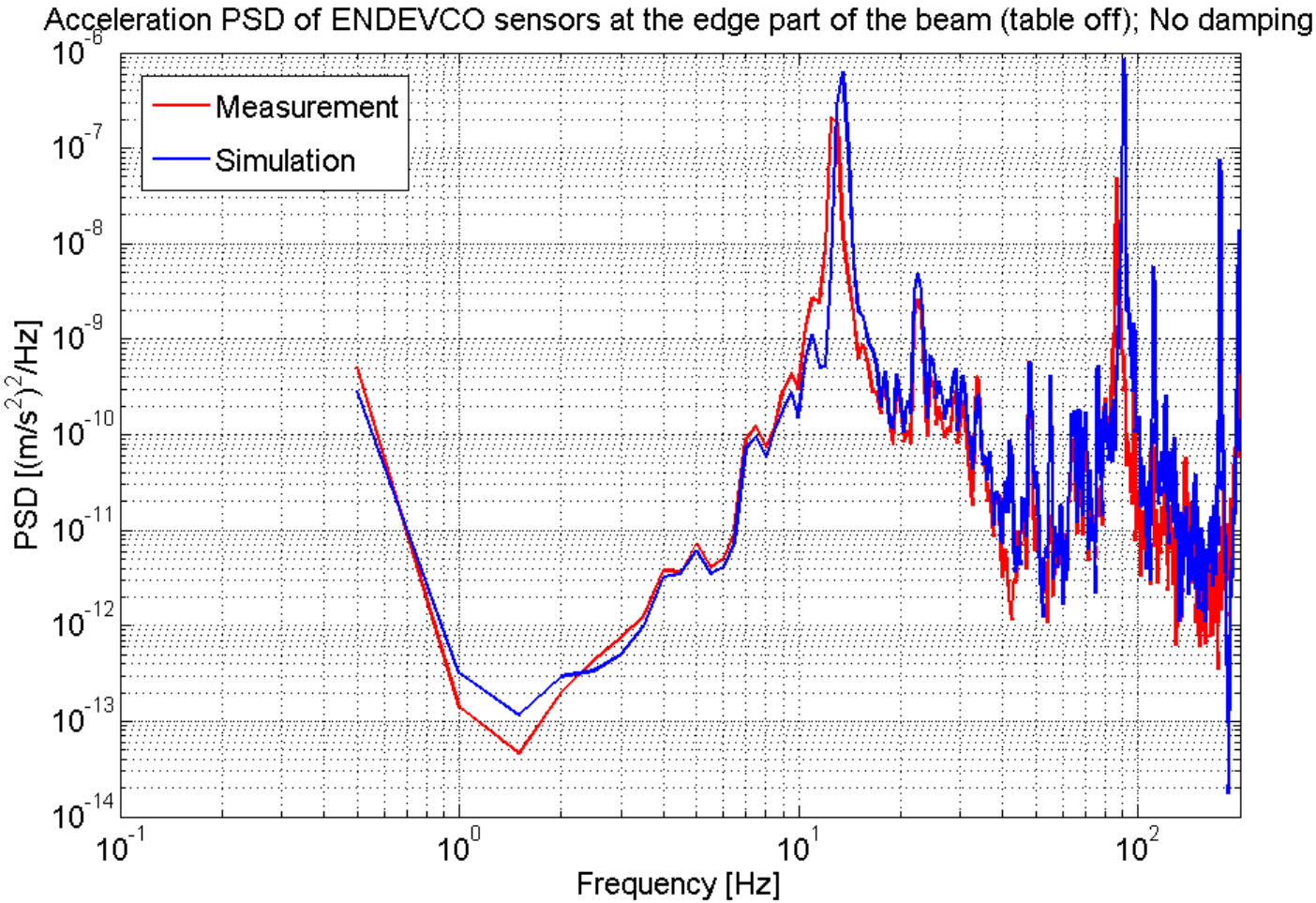
Damping : ε = 0 %

***Lumped mass* :**

M = 830 g

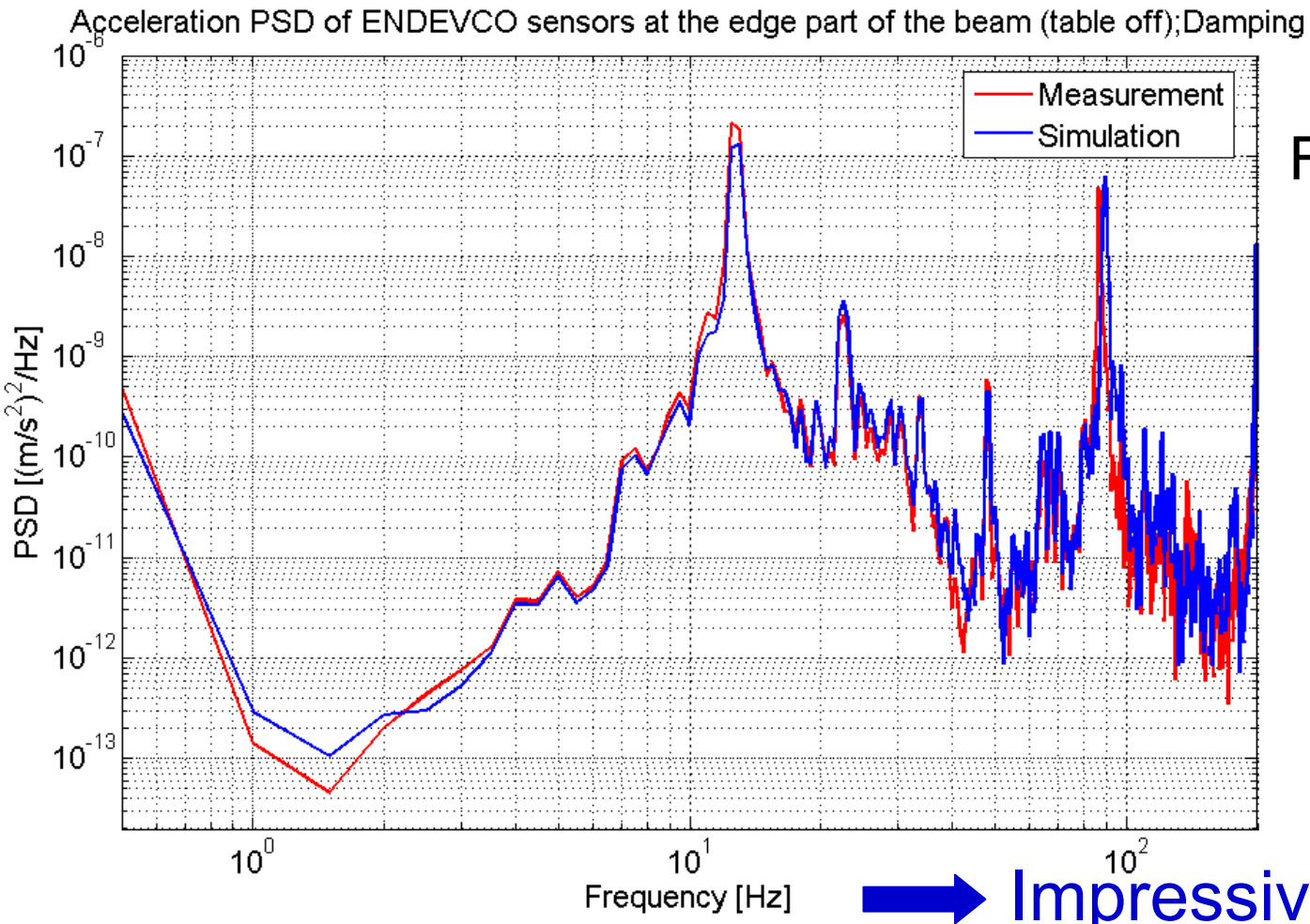
→ Structure modeled with "beam" elements

Dynamic response (free–fixed beam)



Good agreement

Dynamic response (free–fixed beam)



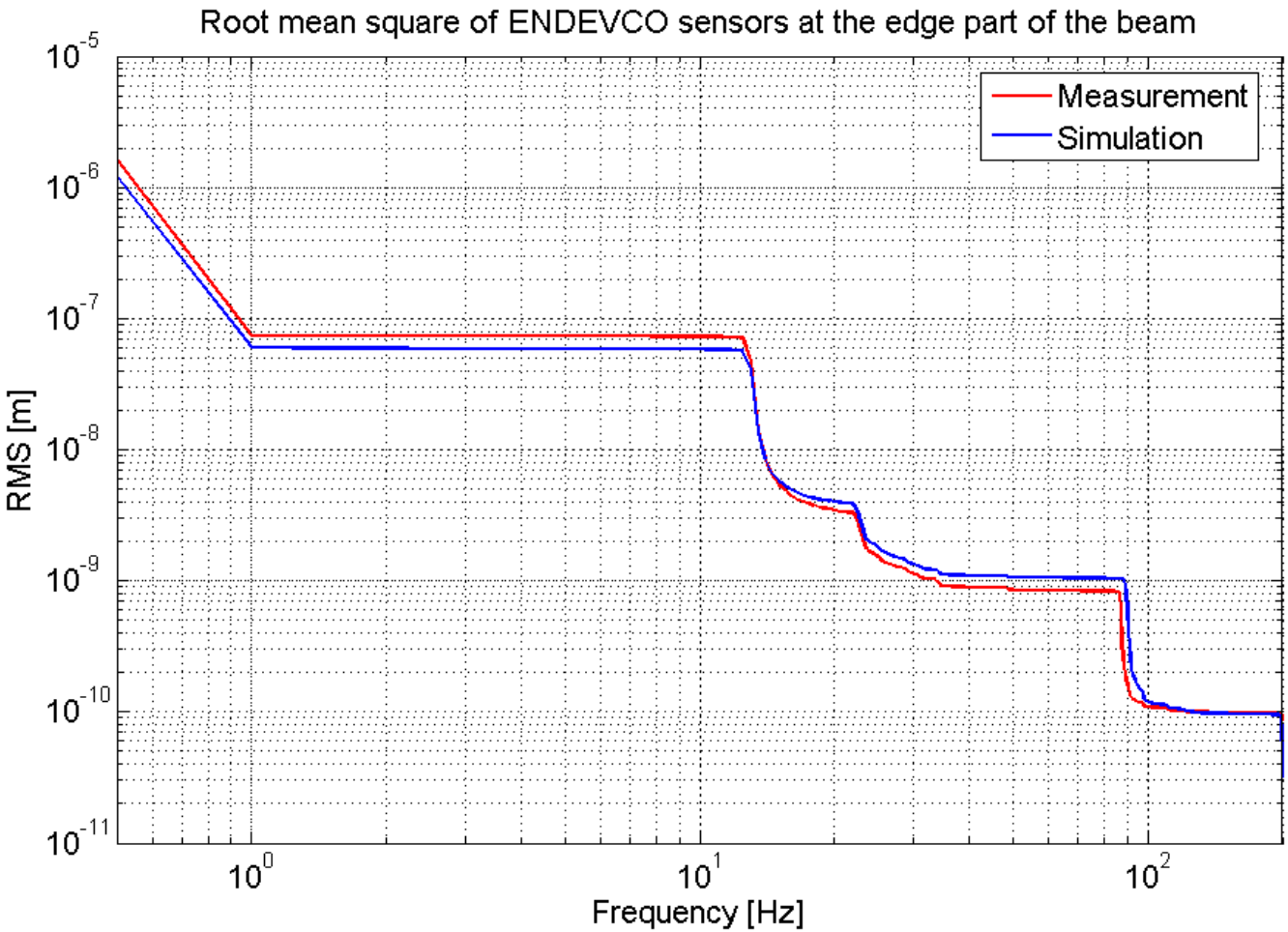
Fit parameters:

- Stiffness
- Damping
- …

Updated FE model

Impressive agreement

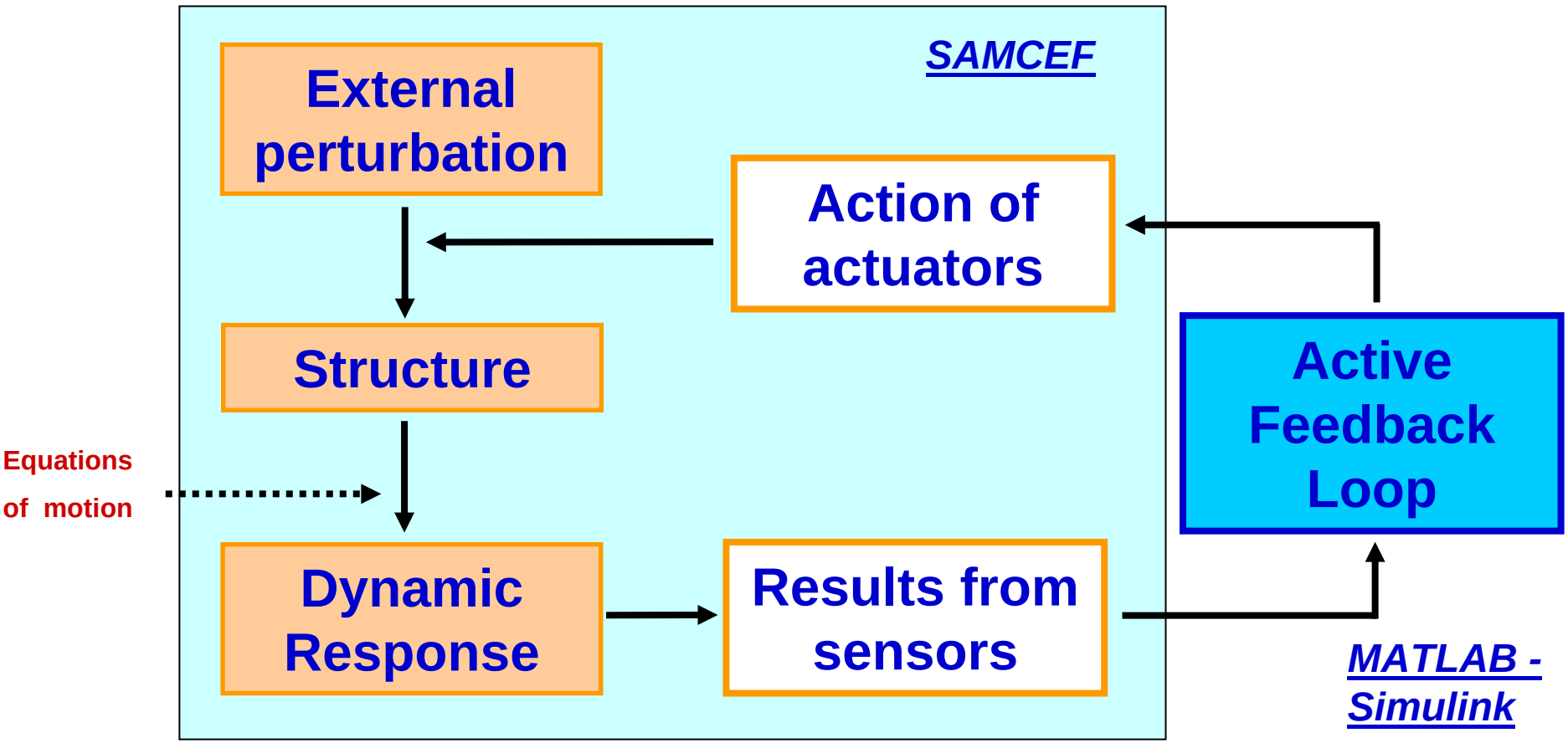
Dynamic response (free–fixed beam)



RMS of the updated FE model

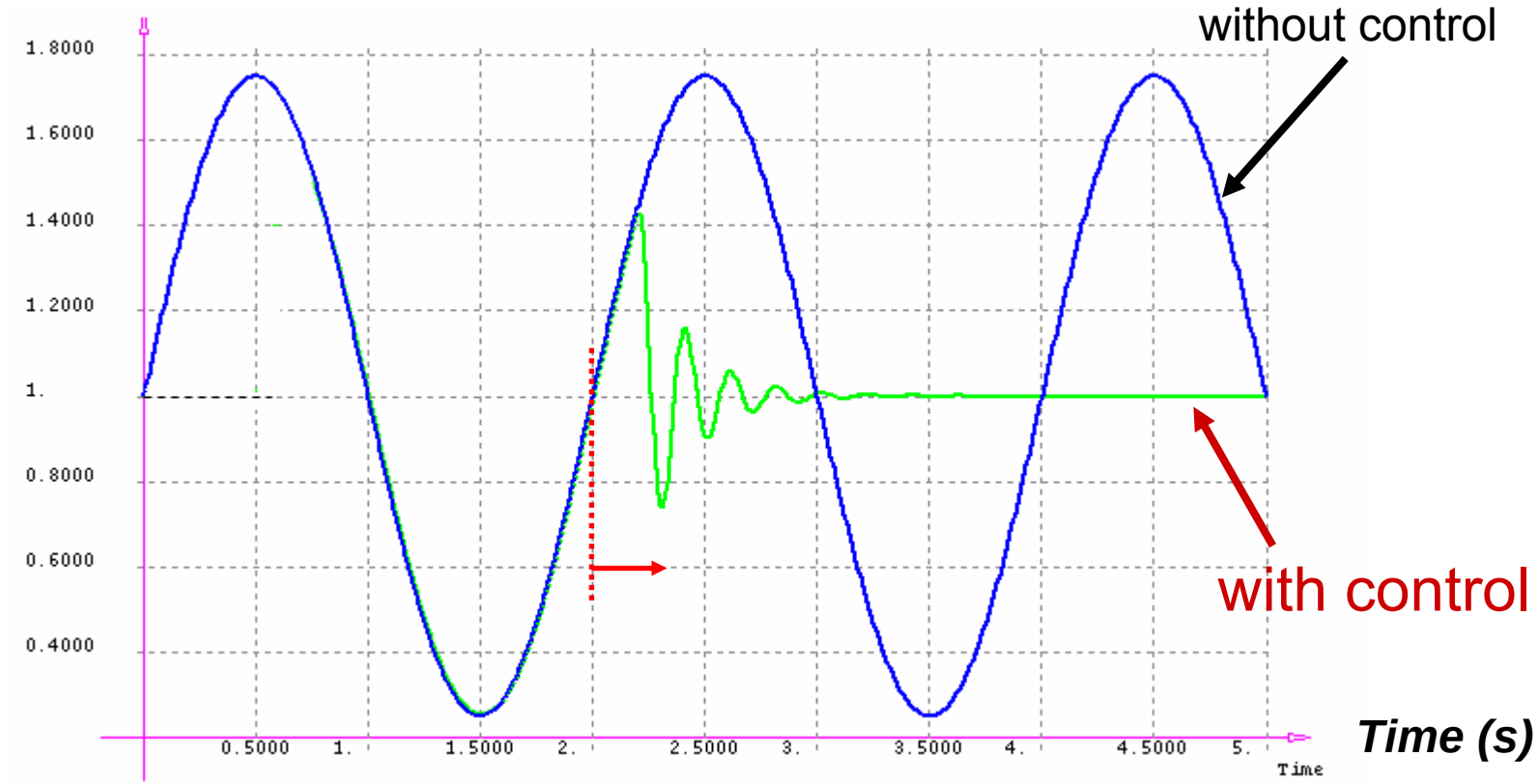
Future prospects

Simulation of the WHOLE SYSTEM:



Future prospects

Simulation of the WHOLE SYSTEM:

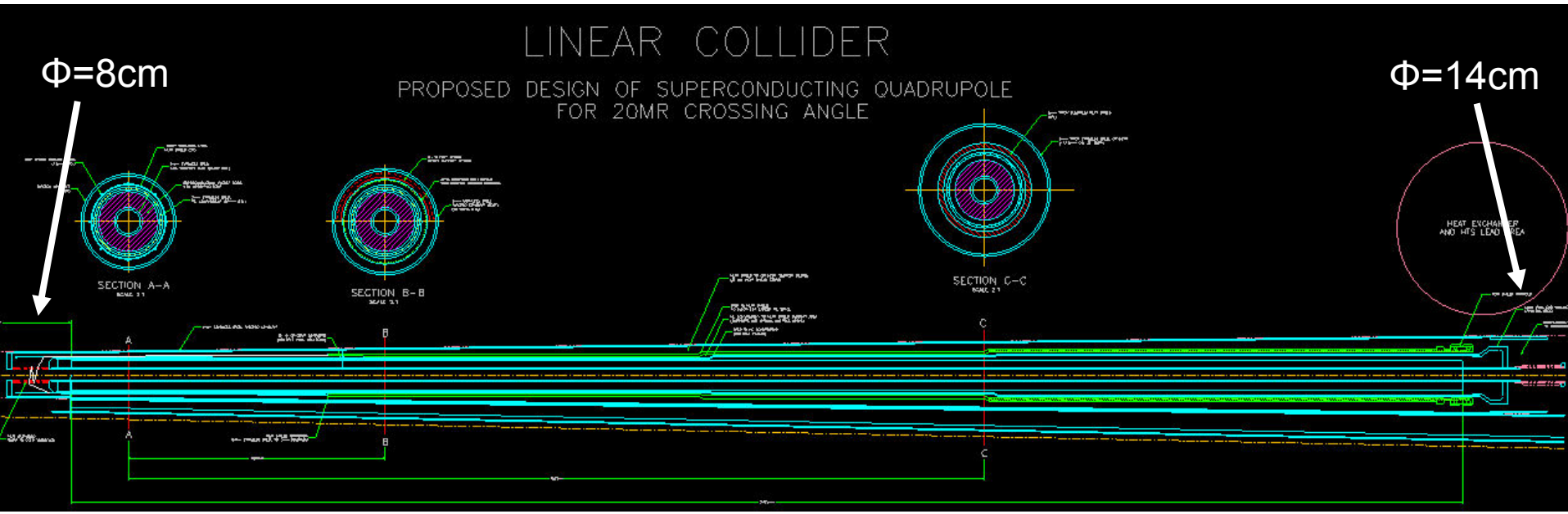


Dynamic response + active control

Future prospects

Prediction concerning the FF quad.

- Computer Aided Design – 1st version



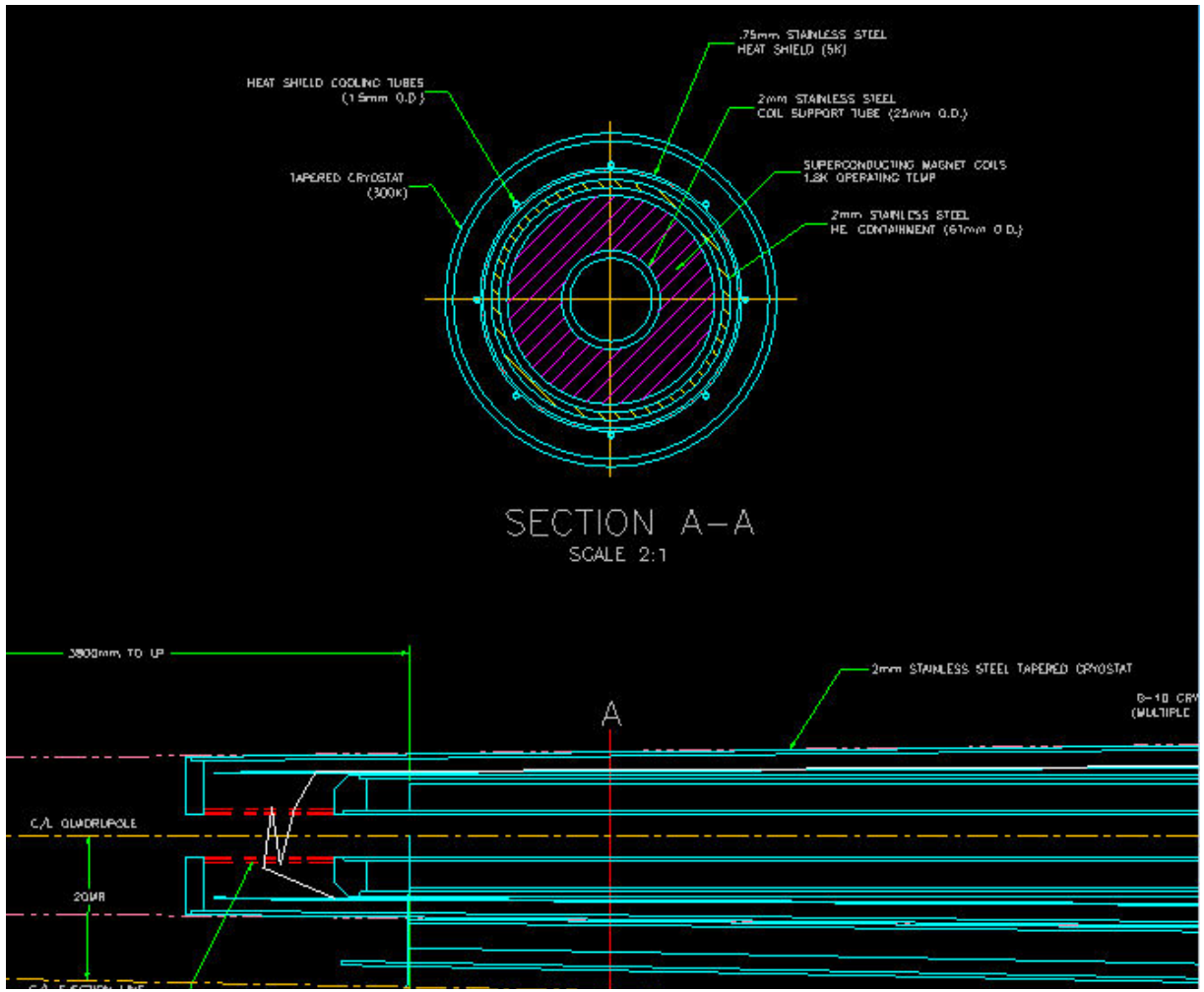
➡ Conical shape - 2.5 meter long

Future prospects

Prediction concerning the FF quad.

CA Design

1st version

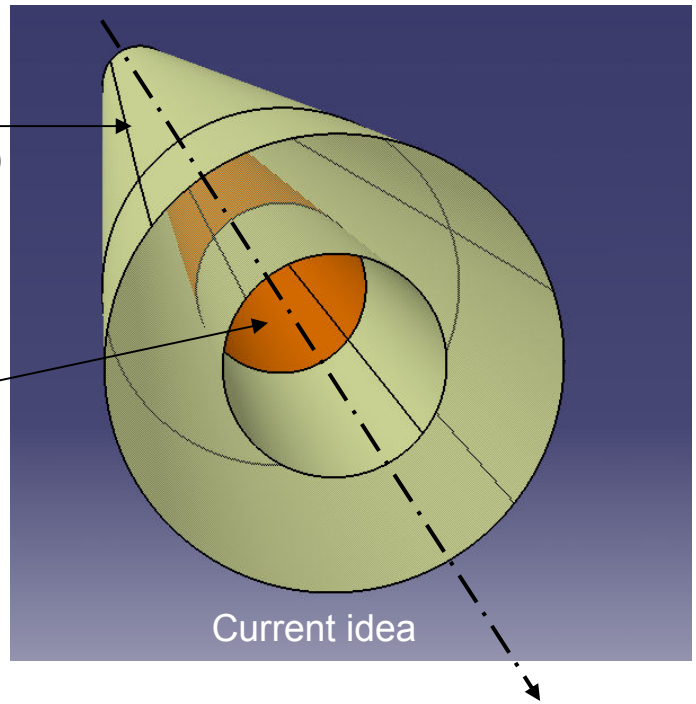


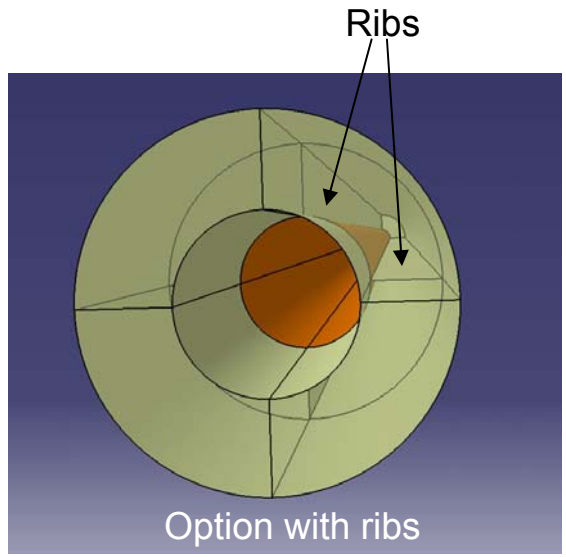
Future prospects

Prediction concerning the FF quad.

Outer shell
(Stainless steel; 2mm thick)

Inner part (magnet; massive part)



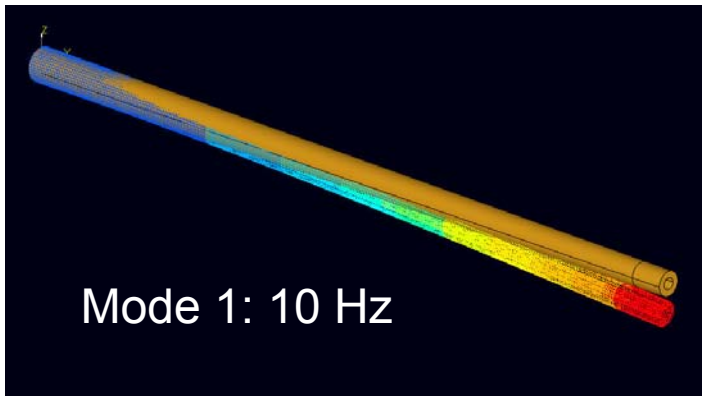


Future prospects

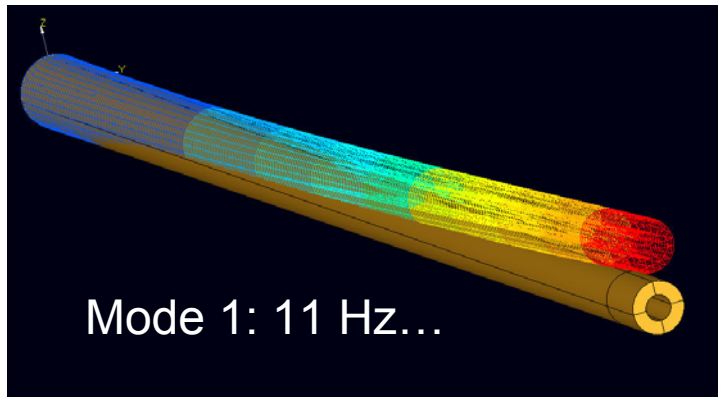
Prediction concerning the FF quad.

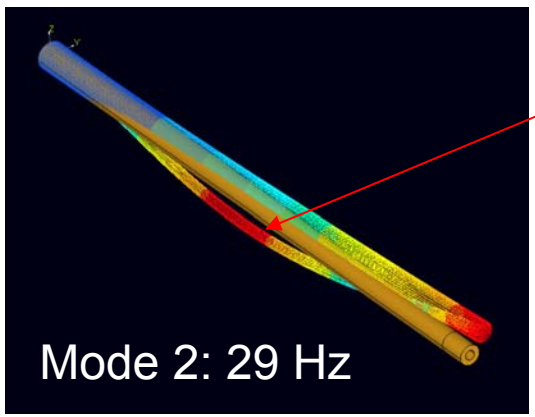
Option 1: no inner ribs

Option 2: with inner ribs

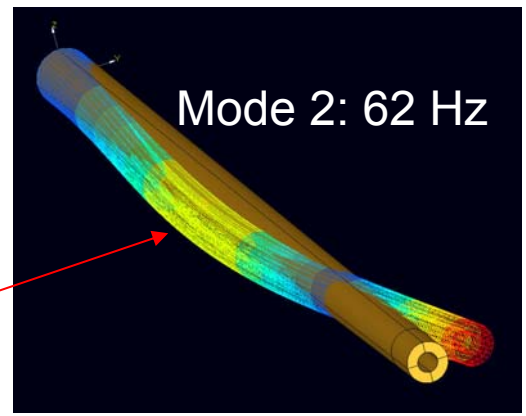


Fixed – Free configuration





The magnet is “decoupled” to the outer shell …

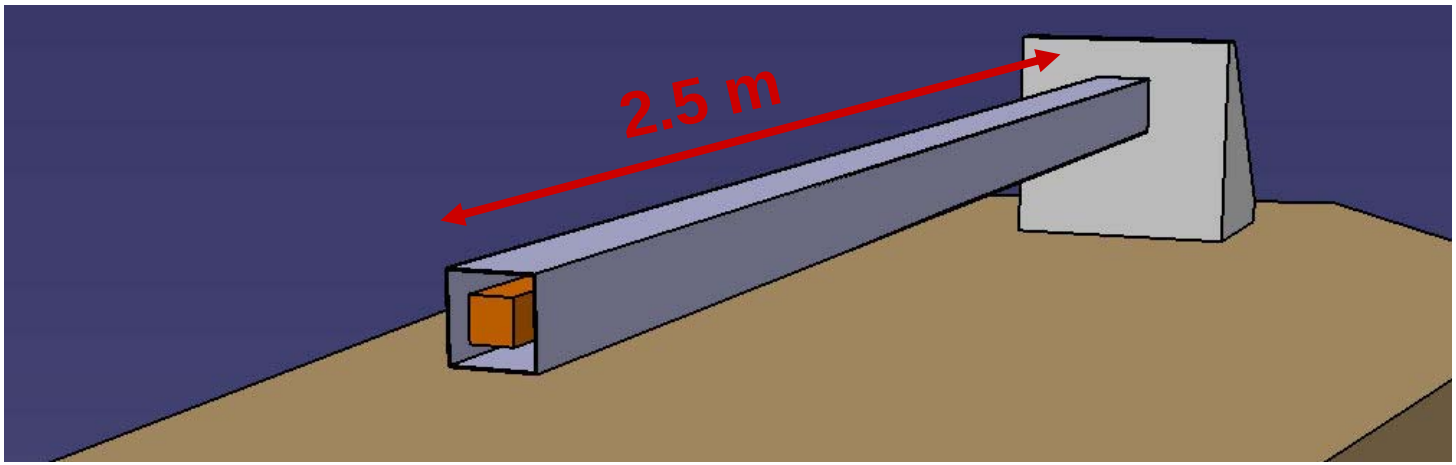


The inner ribs fix the magnet to the outer shell

Future prospects

Realization of a new test bench

- **Prototype** : *fixed-free structure*



- Representative prototype
- Easy Boundary Conditions → **Eigen frequencies**, **Square section**, **Hollow core (substruc.)**
- Adaptability

Conclusions

- Simulate dynamic response of structures
  - → **Check experimentally the accuracy of the models**
  - → **Get reliability of the FE models**
- Simulate modal analysis of the future FF quadrupole
  - → **Propose new design (inner supports …)**
  - → **Propose new materials (composite materials …)**

Conclusions

Perform simulations of the whole system :

- Combine simulation of structural dynamics / active control

→ **Improve efficiency of feedback loop**

- **Type of sensors / actuators**
- **Location of sensors / actuators along the structure**
- **Reliability of the feedback algorithm**
- **…**

Simulation could be a great help !...