FCC-France & Italy Workshop on Higgs,Top, EW, HF Physics in Lyon
Indico: S. GRABON Presentation materials
22/11/2022

LAPP
Laboratoire d'Annecy de Physique des Particules

Modelling process for vibrations estimation of the MDI

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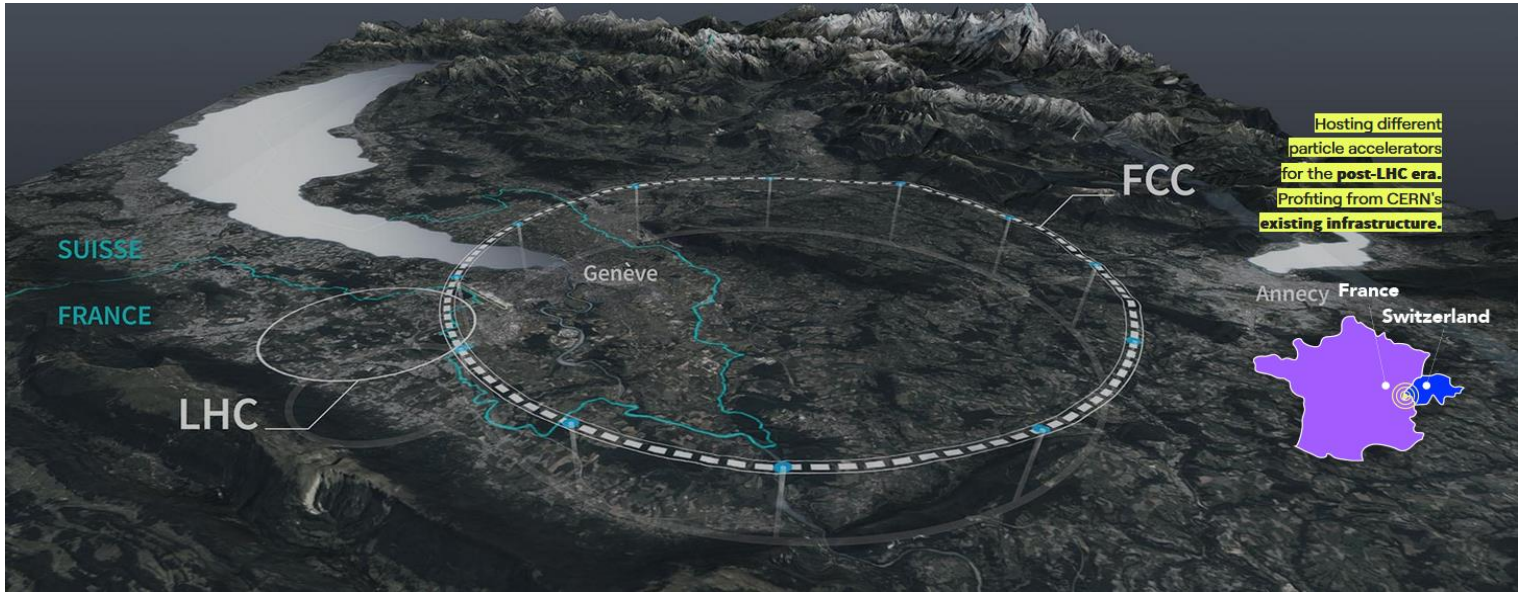
FUTURE CIRCULAR COLLIDER

cnrs

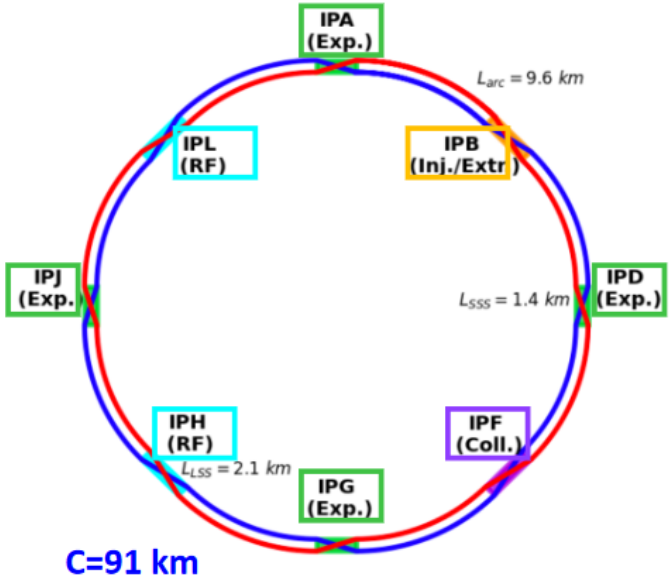
UNIVERSITÉ SAVOIE MONT BLANC

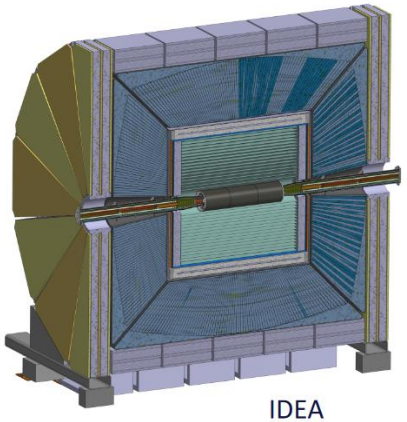
LAPP and FCC

FCC: Future Circular Collider
MDI: Machine-Detector Interface

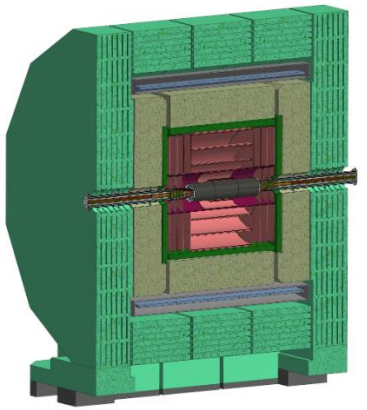


Laboratoire d'**A**nnecy de **P**hysique des **P**articules





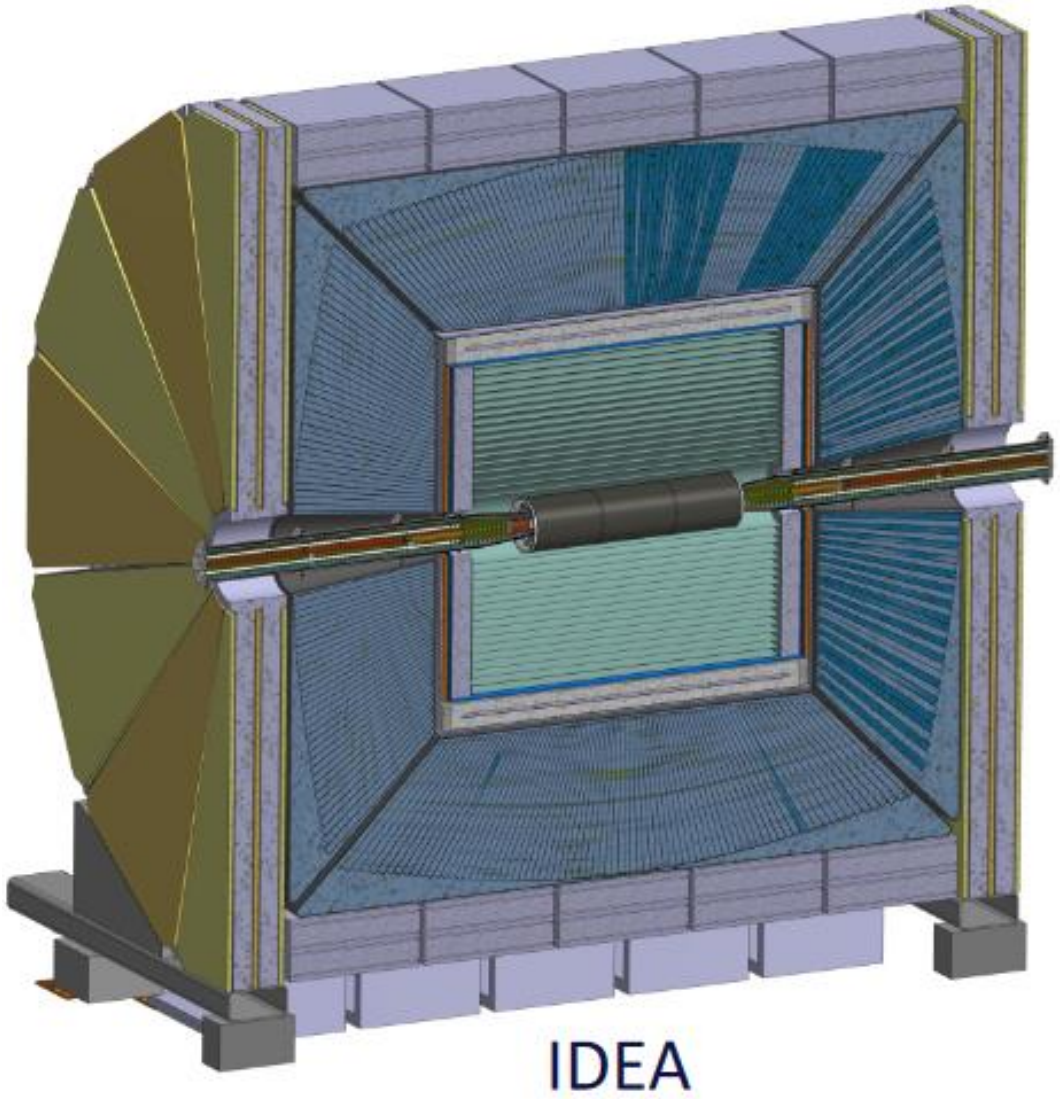
IDEA



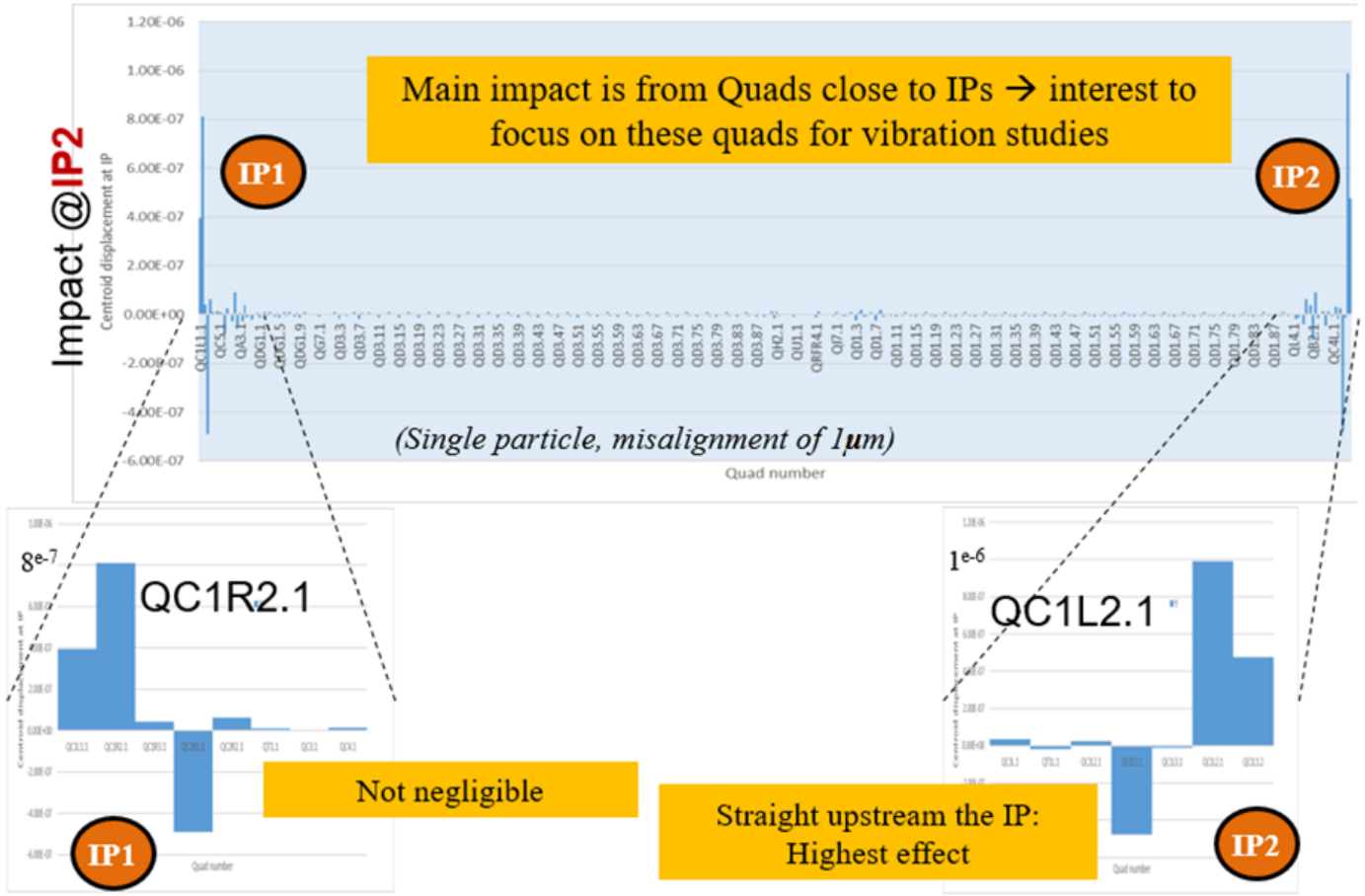
CLD

Presentation overview

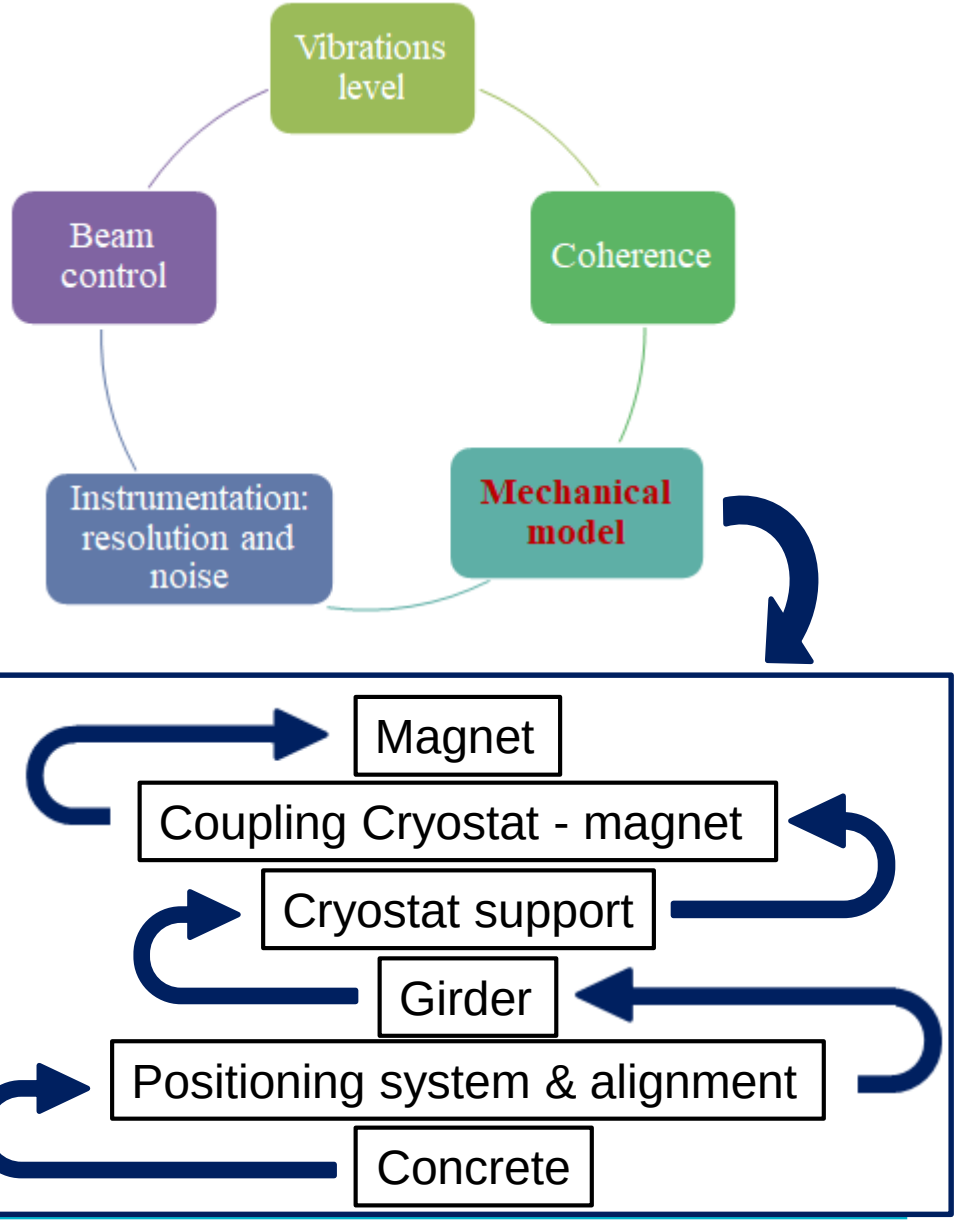
- Context
- Goal
- Current situation
- Overview of the process
- State space model's processing
- First results
- Summary
- LAPP's Cantilever Beam Prototype
- Measurements
- Perspectives



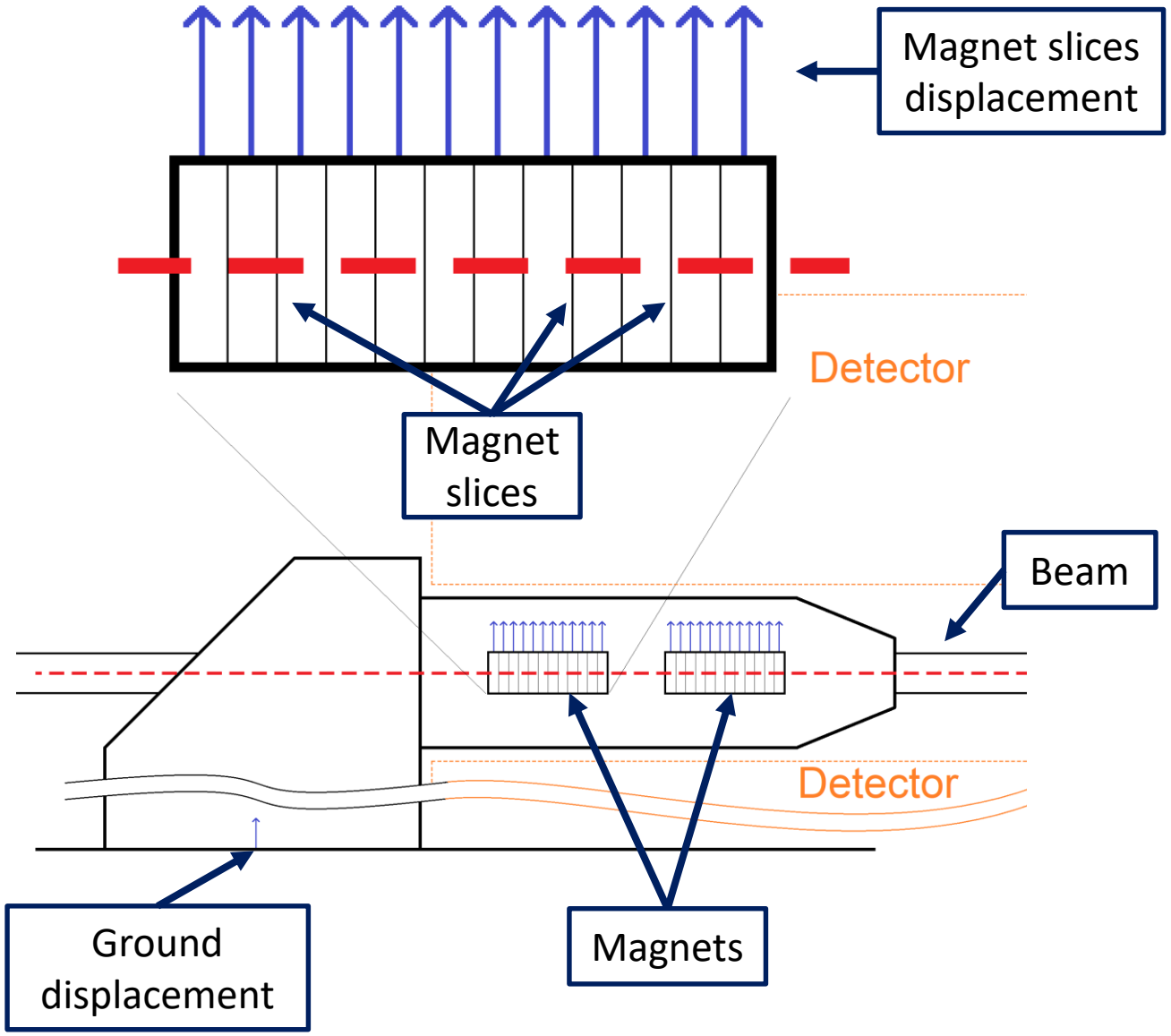
Context



Effect on the centroid displacement at IP2 of successive misalignment of the magnets between IP1 and IP2



Goal

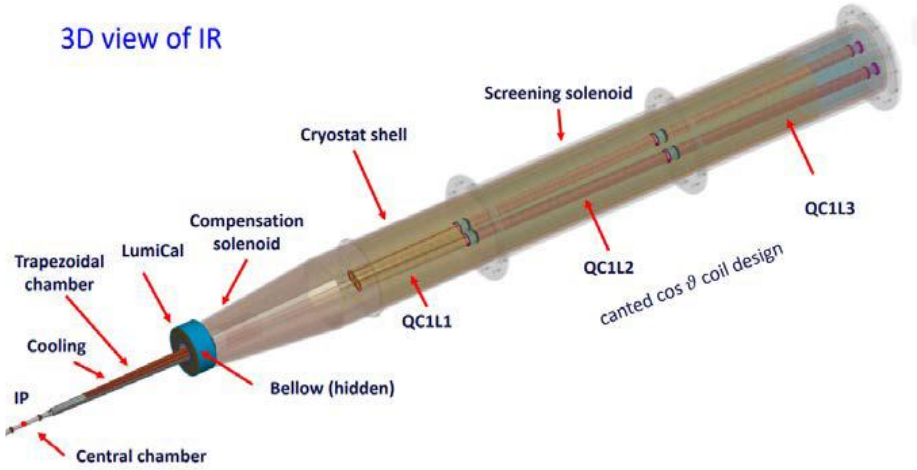


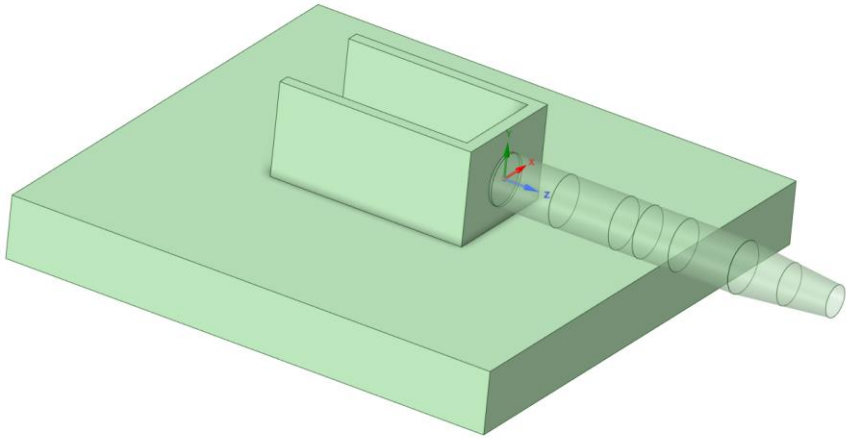
Magnet's dynamic behaviour → Emittance, luminosity

?

Studied by Eva Montbarbon on MAD-X
(Work in progress)

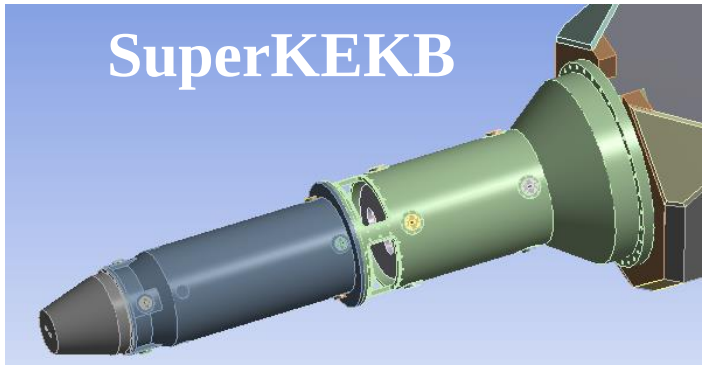
Current situation

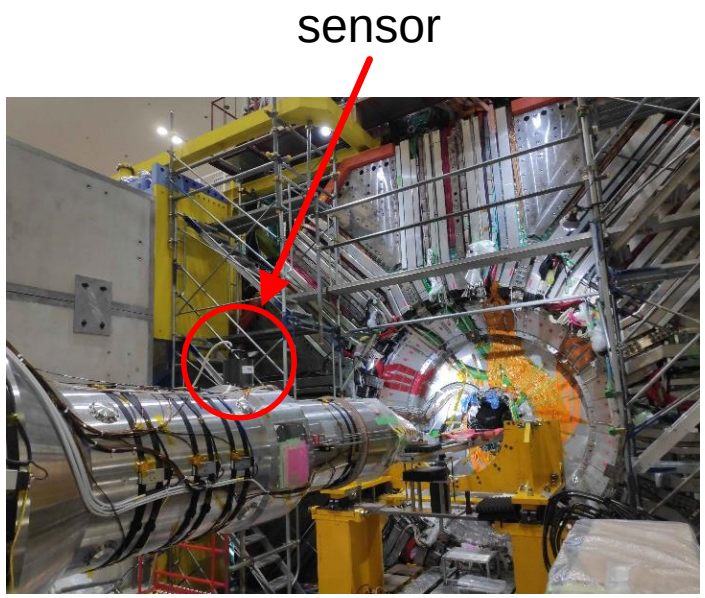




The design of the MDI is still in progress.

Development of the process using a simplified 3D model





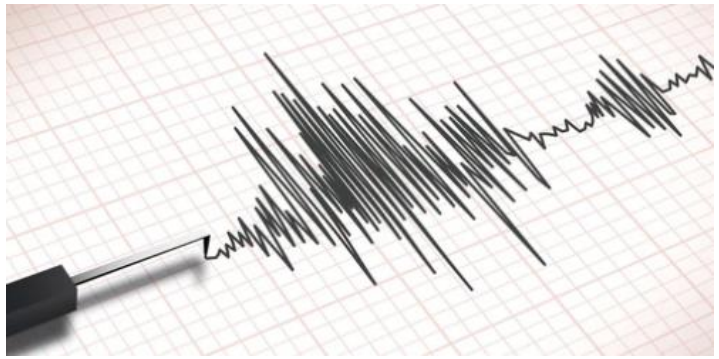
Similarities:

Similar beam, cryostat in cantilever

Difference:

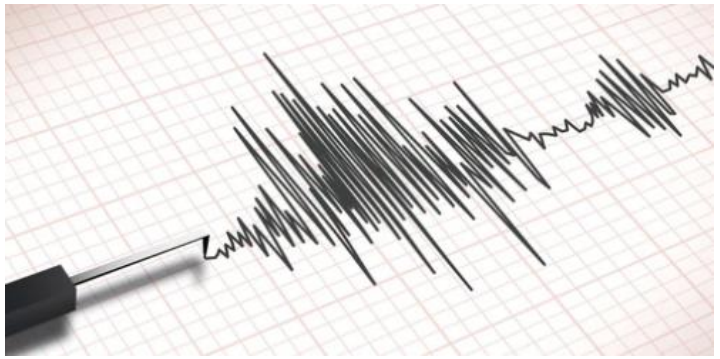
The HER and LER final focus magnets are not symmetrical inside the cryostat

Overview of the process

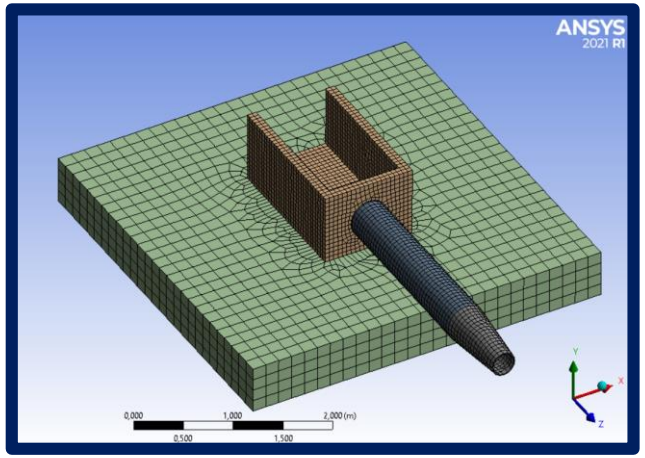


Input displacements

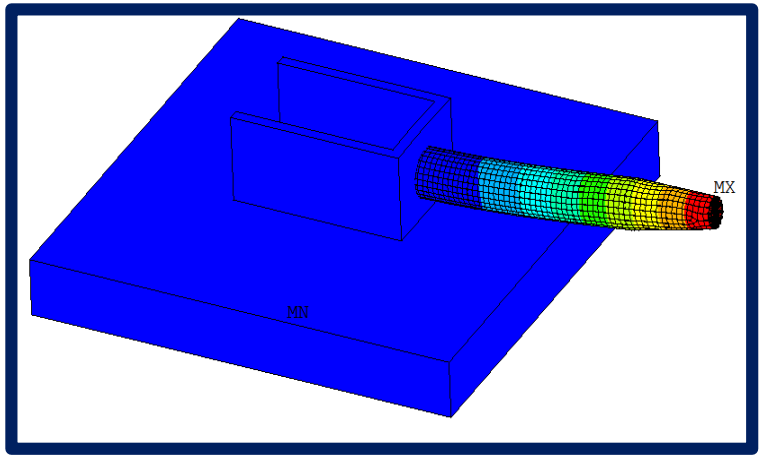
Simple mathematical model



Output displacements



1 Modelling



2 Modal Analysis

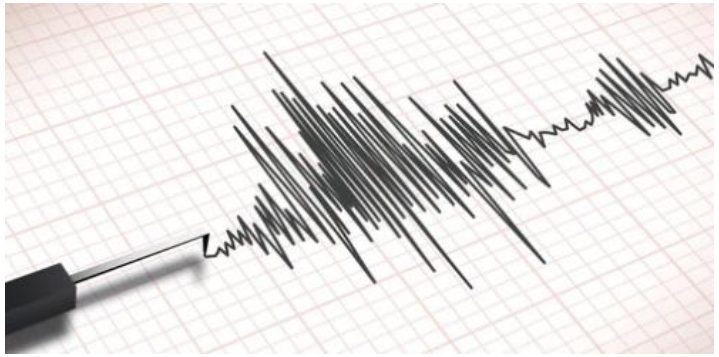
MATLAB®

3 State space model

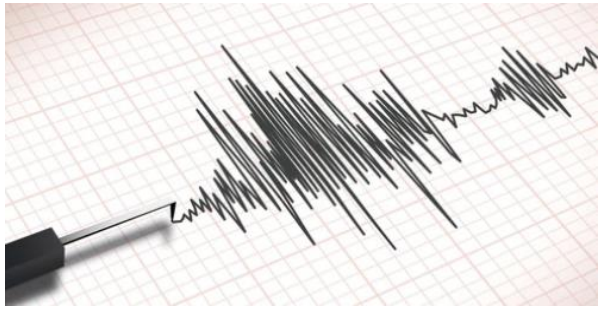
For more details see my previous presentation here: https://indico.cern.ch/event/1064327/timetable/ (12:00 Thursday, june 2)

State space model's treatment

Calculation of the state-space matrices

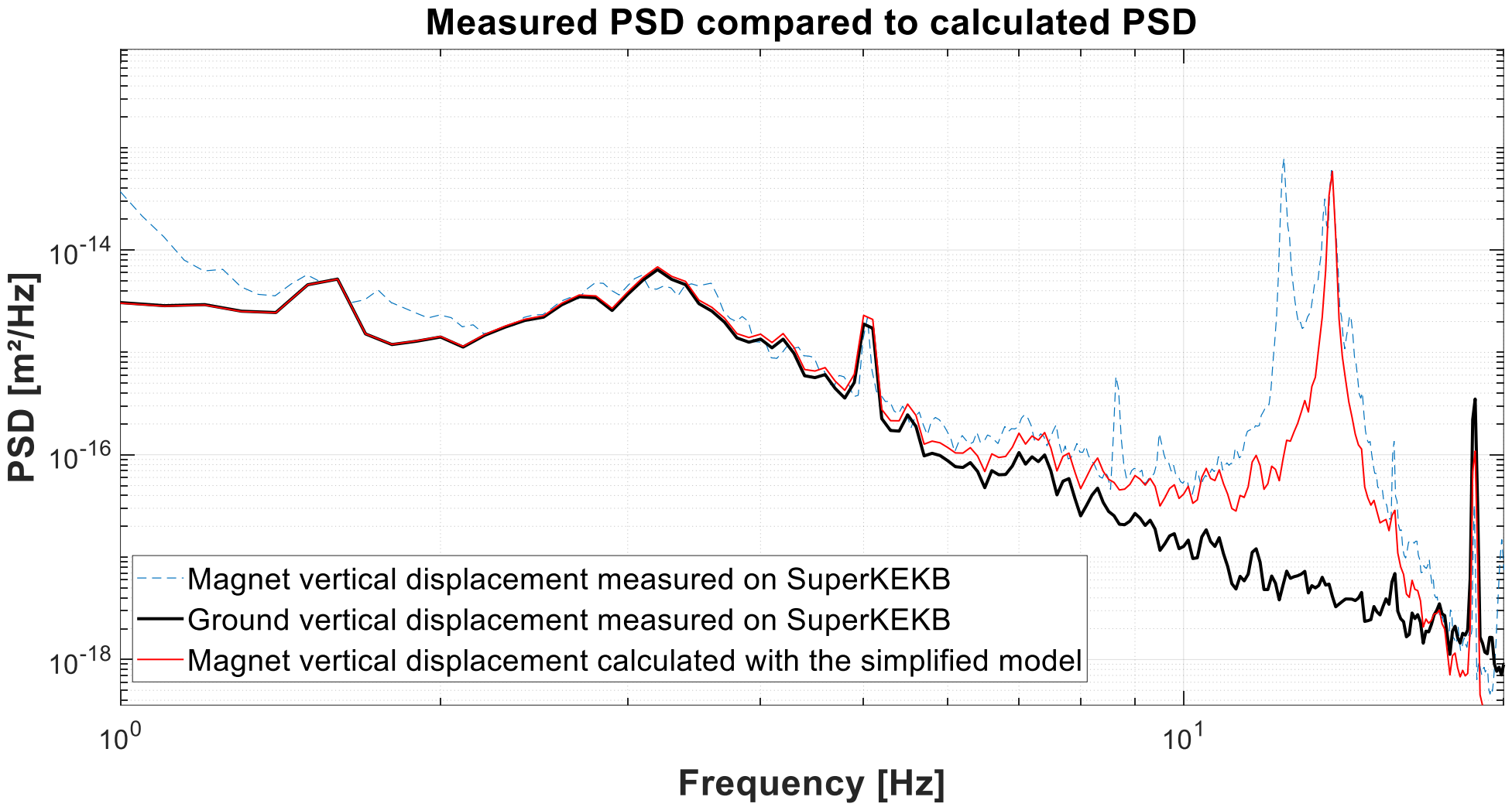


Input displacements



Output displacements

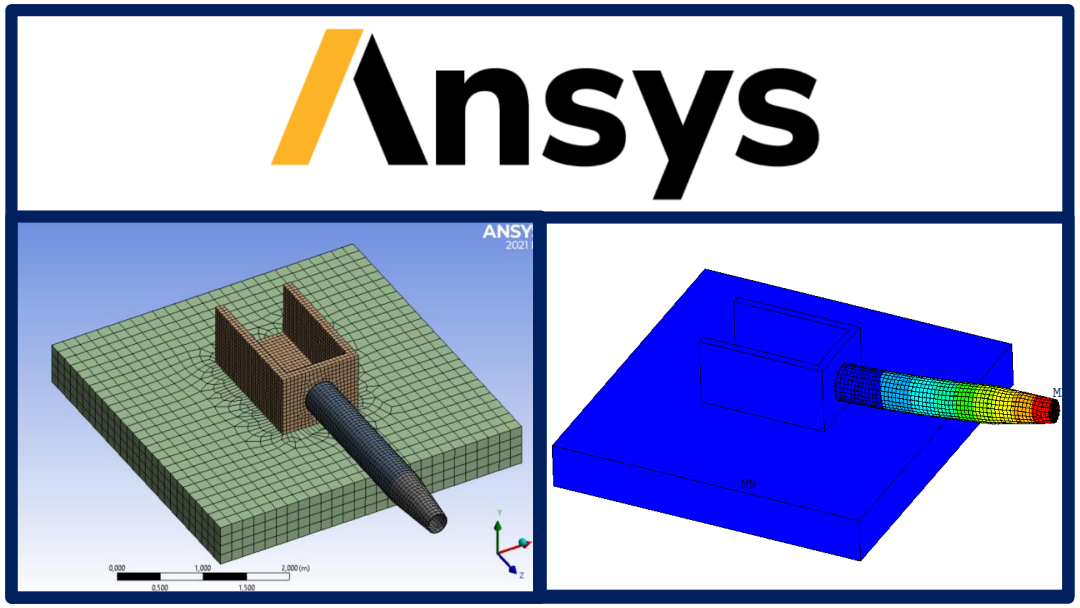
First results



It's a promising result using only a simplified model!

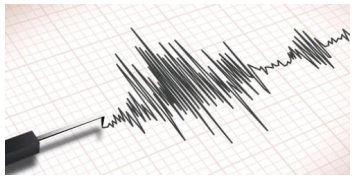
PSD : Power spectral Density

Summary



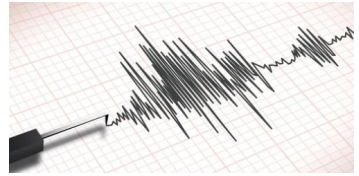
- very light model
- very fast calculation
- modal calculation independent of input displacements: only one FE calculation
- can't take into account non linearities

State space matrices



Input displacements

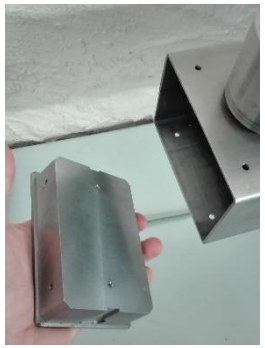
MATLAB®



Output displacements

MAD-X

LAPP's Cantilever Beam Prototype



Possibility to add masses

Cantilever beam prototype

Guralp CMG 6T

x,y,z
2*1000s/m
30s-80Hz
2,6Kg

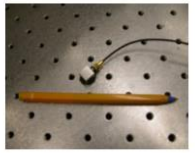
Wilcoxon 731A

z
1 Vs²/m
10 s -300 Hz
0,55Kg

PCB 393B12

z

10V/g
0,21Kg



B&K 4507B3

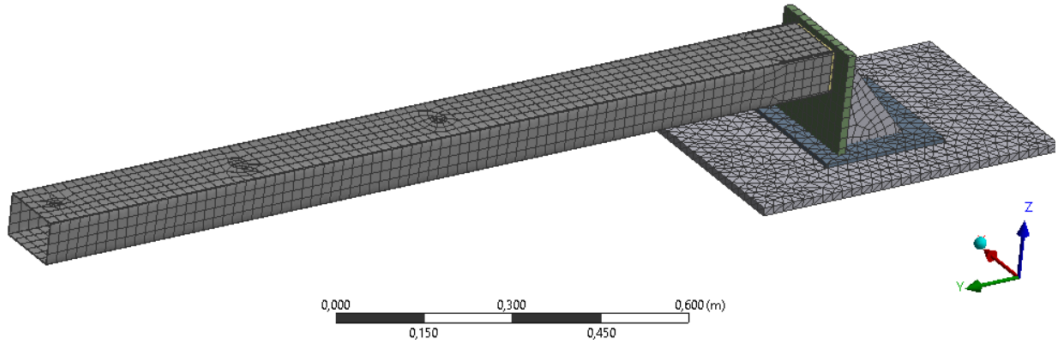
z

98mV/g
qq g

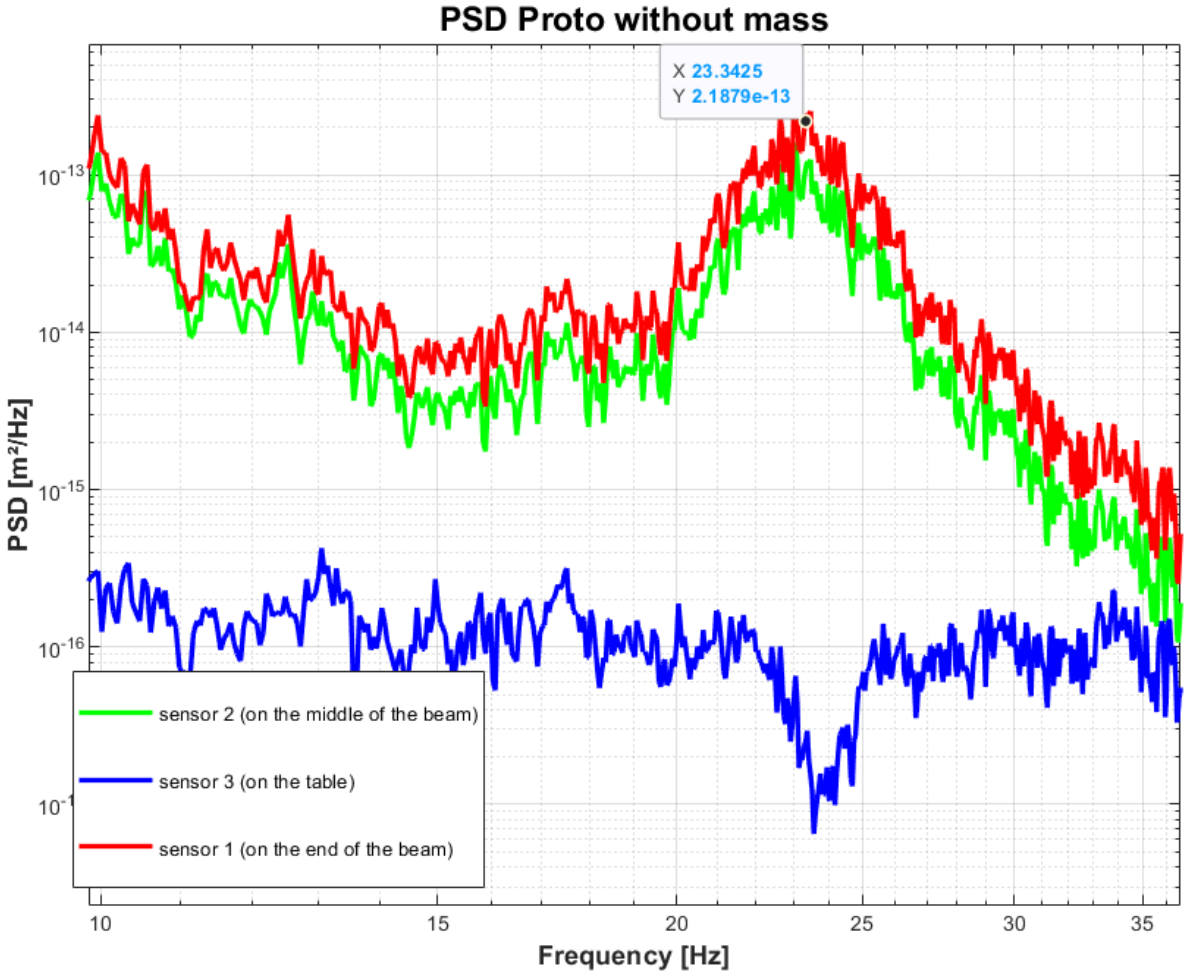
B&K 4524

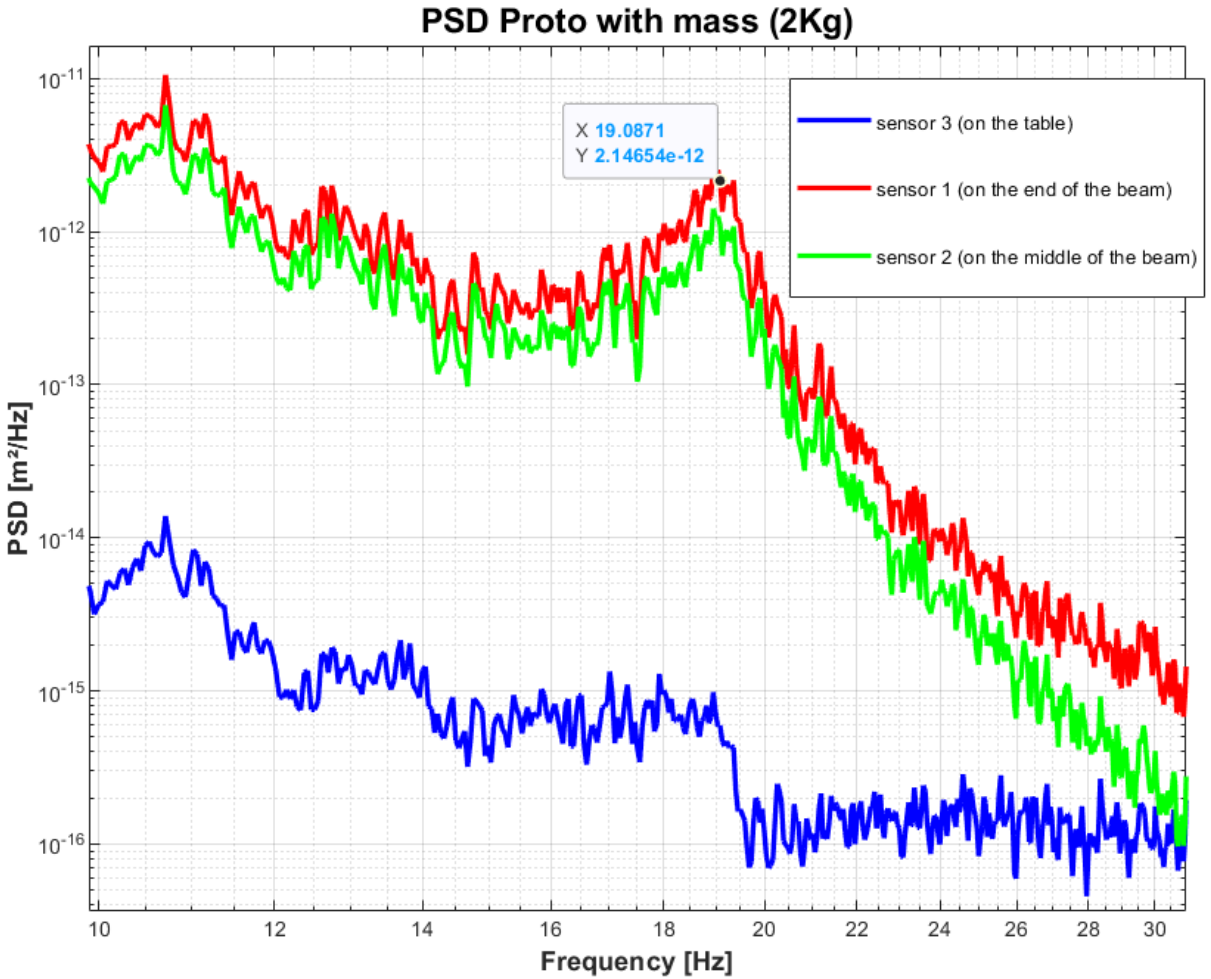
x, y z

98mV/g
qq g



Measurements on the prototype





We can easily change the first mode frequency by adding mass

Perspectives

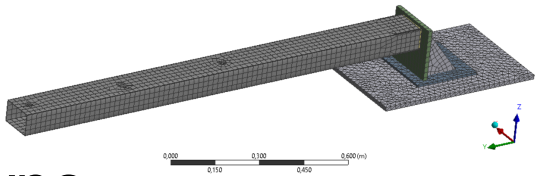
Short term

The prototype's configuration will evolve:

-It needs to be fixed directly on the concrete floor.

-The beam – plate interface must be adjusted. (more screws)

-Another mass must be machined.



The modeling process must be applied to the prototype.

Longer term

As the design of the MDI progresses, we will need different prototypes to characterize the dynamic behavior of the structure and estimate the impact on future emittance and luminosity.

In this purpose, we want to <u>improve our collaboration with the INFN</u>:

- Perform vibrational analysis on the cylindrical rigid structure
- Perform measures and vibrational analysis on prototypes (central chamber, bellow etc…)
- Incorporate other experiences on our prototype.

Thank you
for your attention!

Measurements on the prototype