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Dynamic characterization: first findings from MultiMat experiment

1st Workshop of ARIES WP17 PowerMat
27-28 Nov 2017 | Politecnico di Torino, Turin, Italy

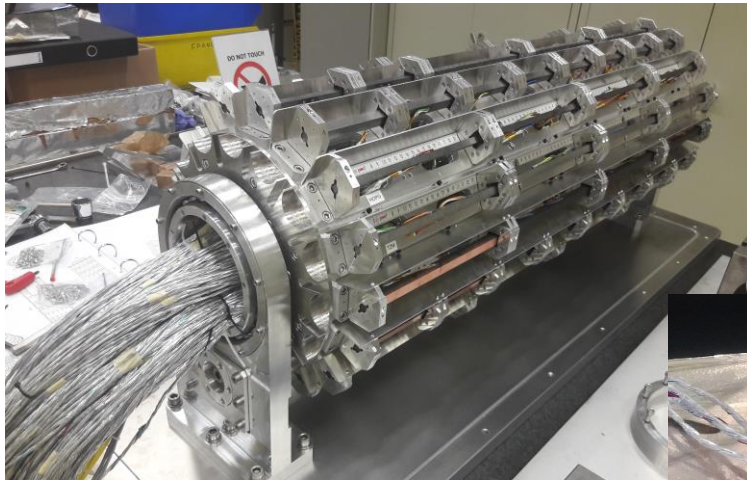
Claudio Fichera
CERN

Outline

- Experimental data
 - Transient analysis – 4 MHz (0÷23 ms)
 - Stationary analysis – 100 Hz (0÷30 s)
- Material characterization
 - Axial waves
 - Transversal waves
 - Flexural waves
 - Temperature profiles
- Conclusion

Introduction

- The MultiMat experiment is a complex system fully equipped of sensors.

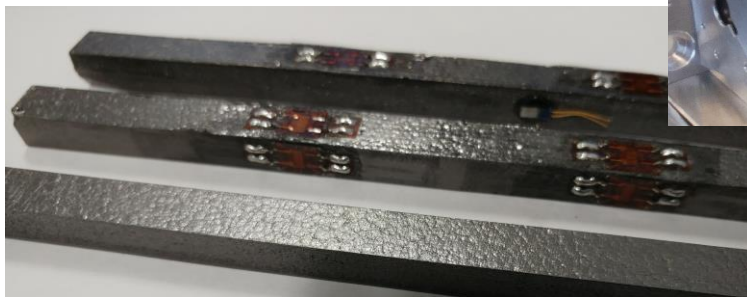


Barrel

- 335 electrical strain gauges
- 112 electrical temperature probes
- LDV



Target Station

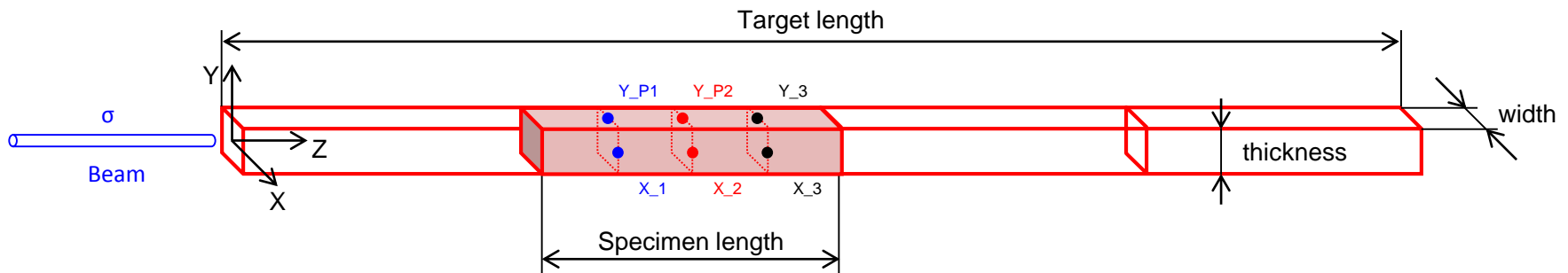


Instrumented Specimen

- Dynamic analysis
- Stationary analysis

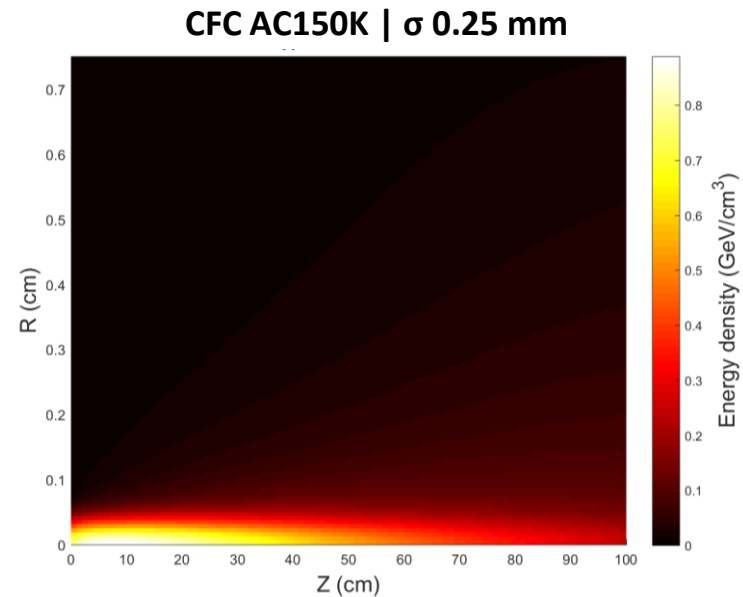
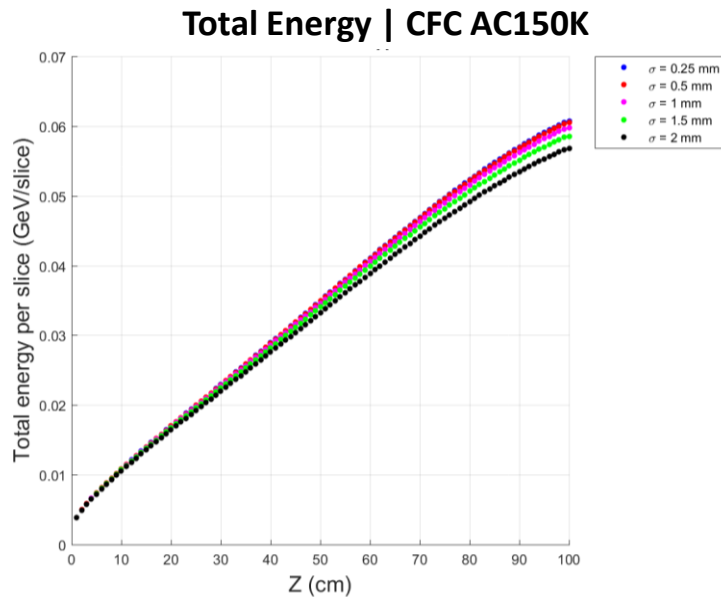
Sensors layout

- Each target station has a specific sensors layout.
- In general, a series of longitudinal/transversal strain gauges and thermal probes are placed along two sides of the specimen.

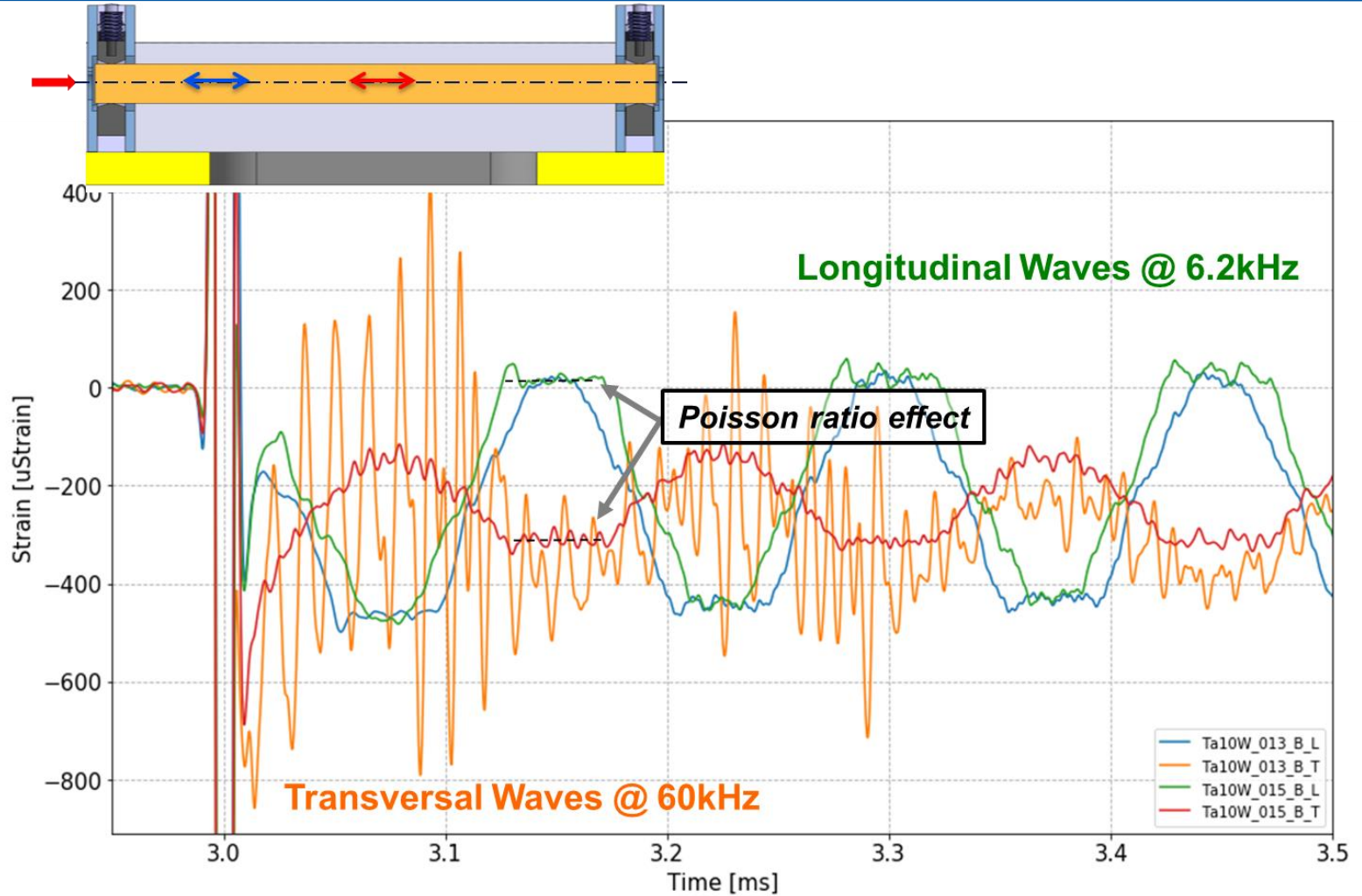


Energy deposition

- In order to start the data analysis, the most relevant sensors to take into account are those placed where the energy deposition is maximum.
- The energy distribution calculated by FLUKA is a crucial input.



Axial waves



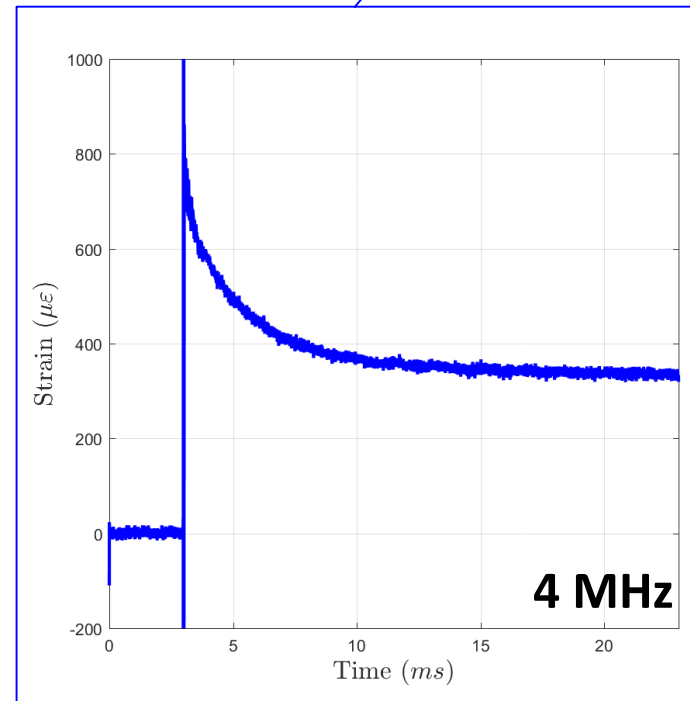
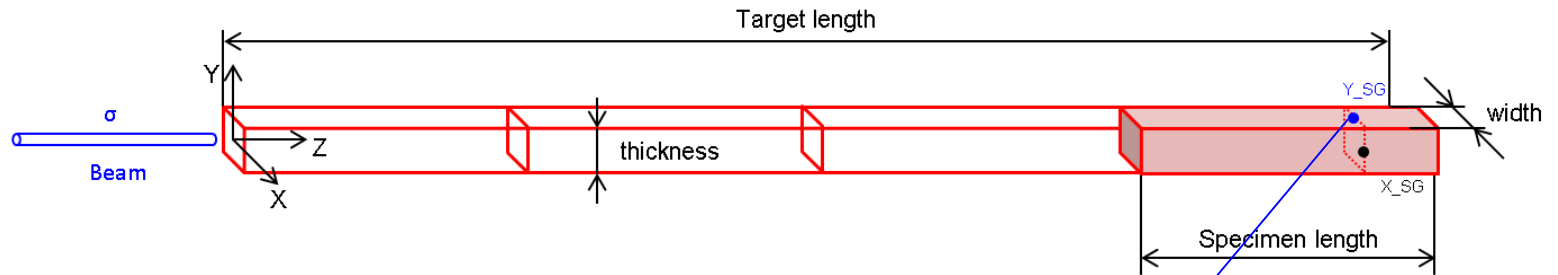
Axial waves

- CFC AC150K: 144 bunches, σ 0.5 mm



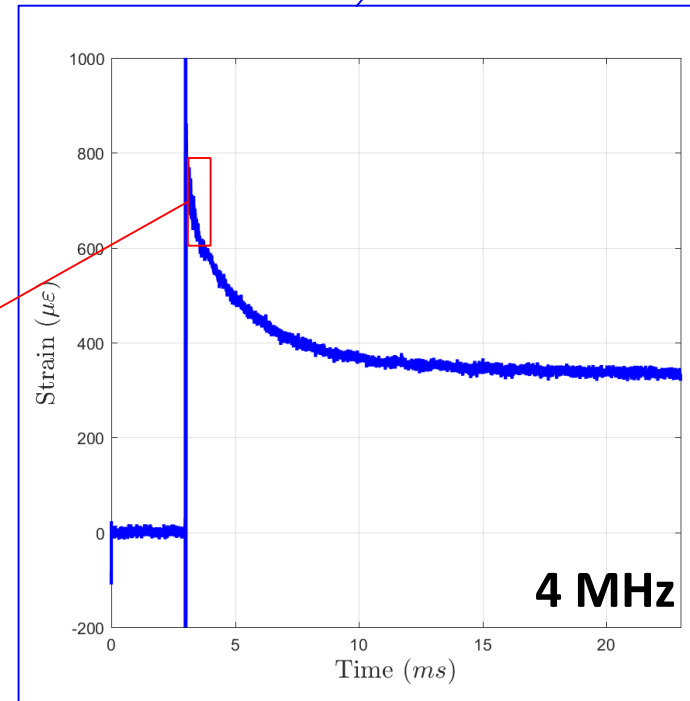
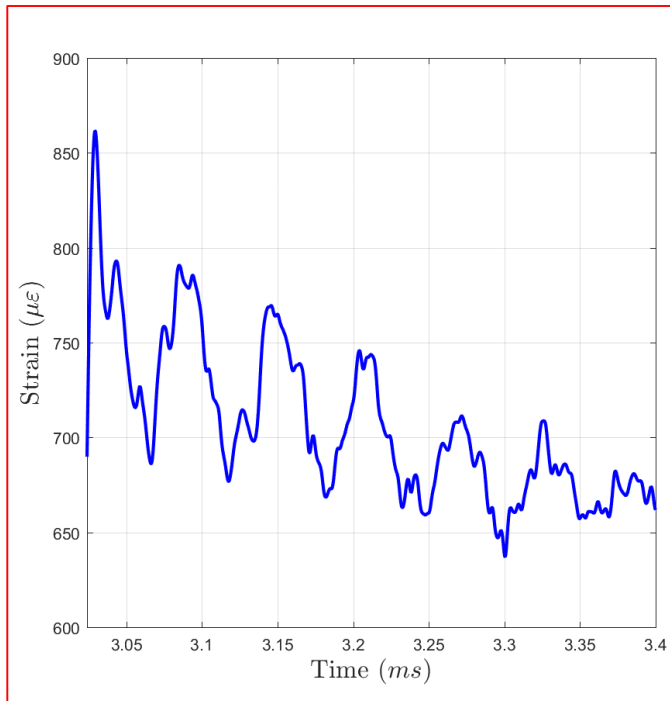
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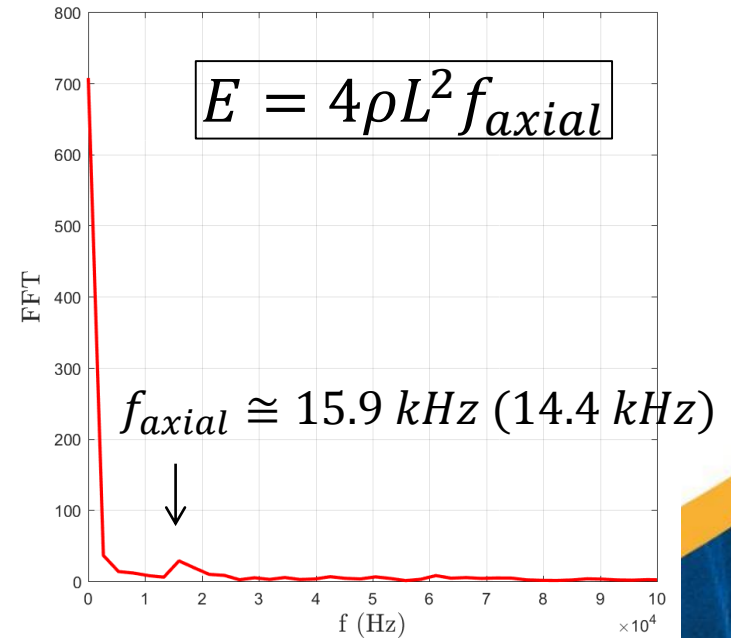
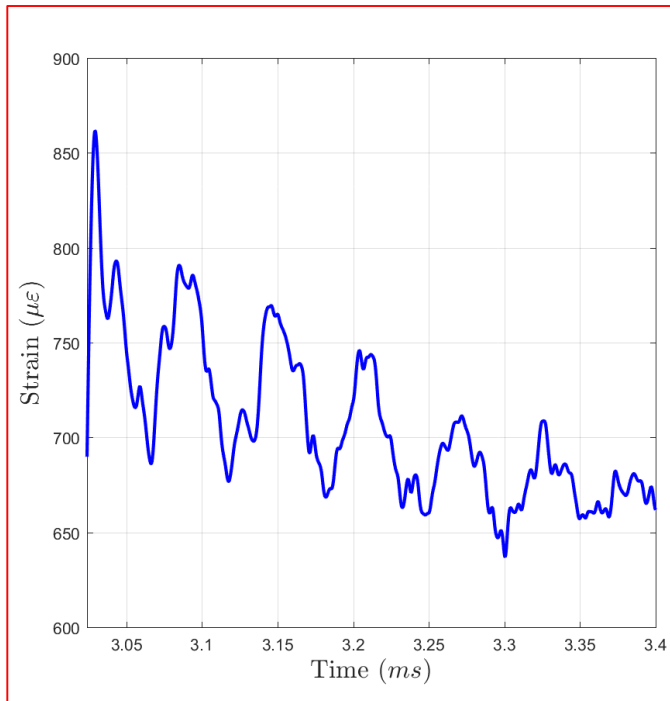
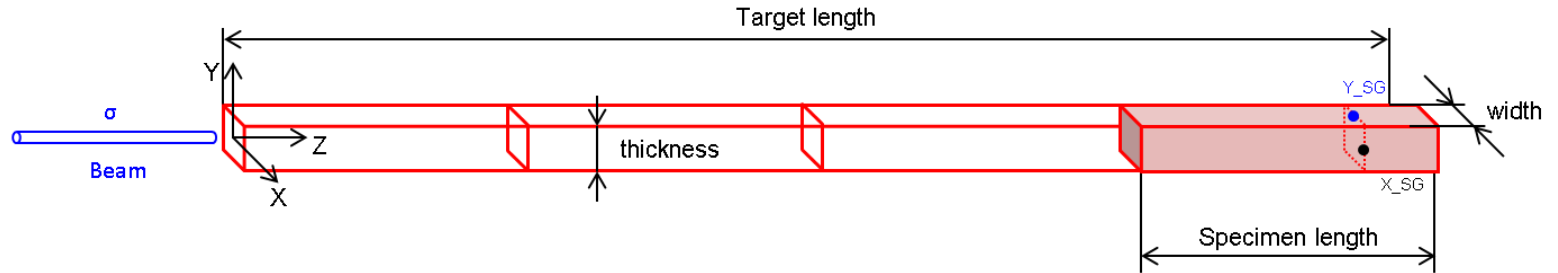
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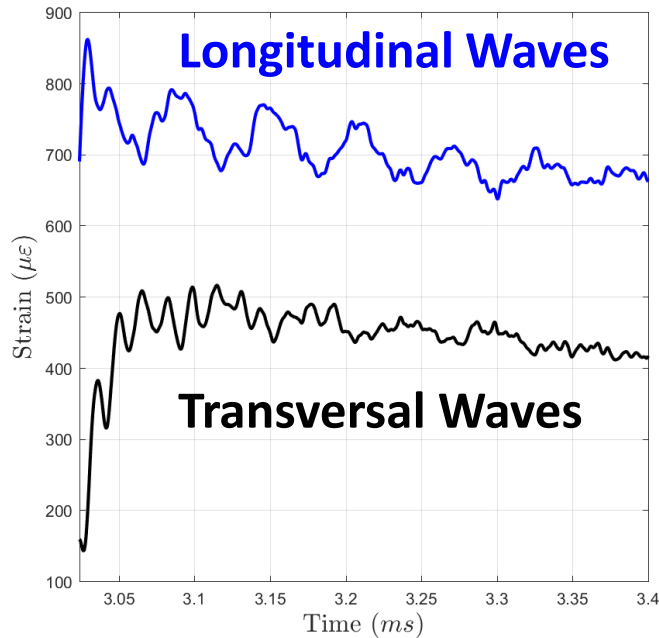
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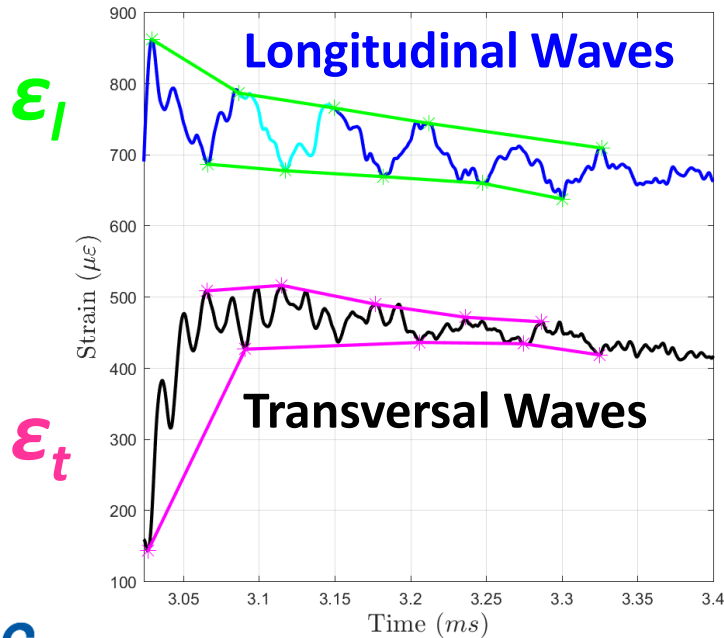
Axial waves

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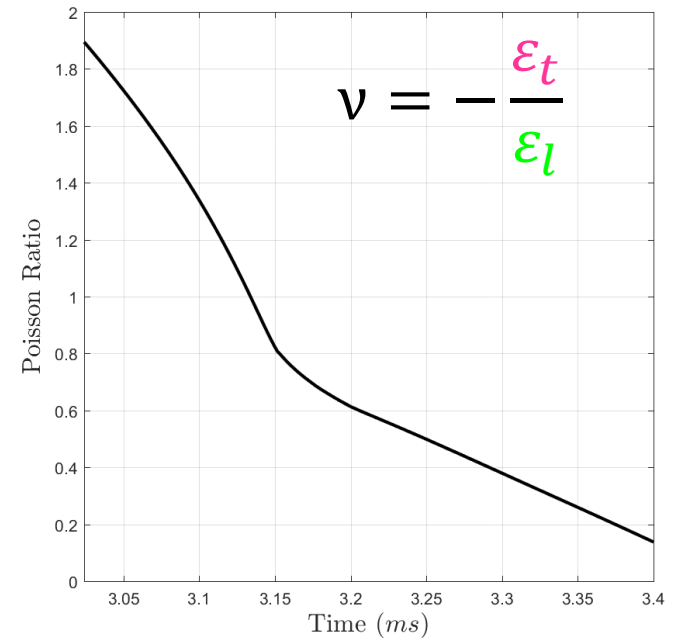
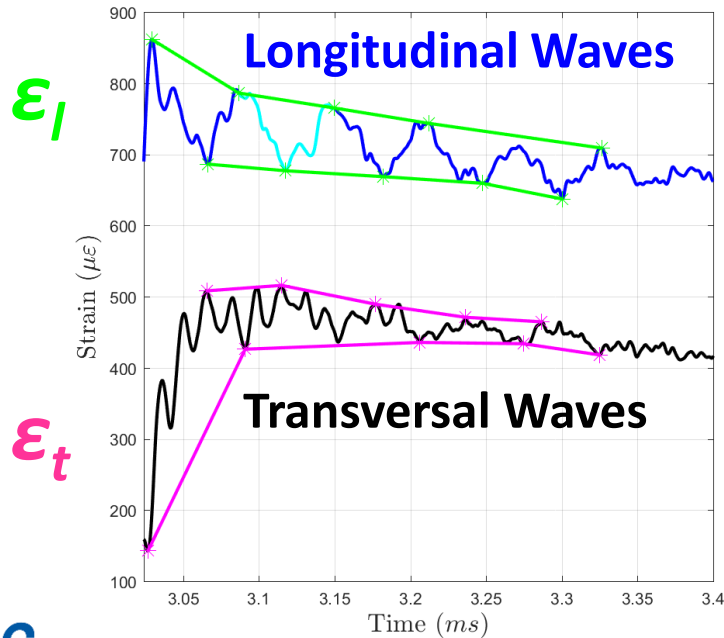
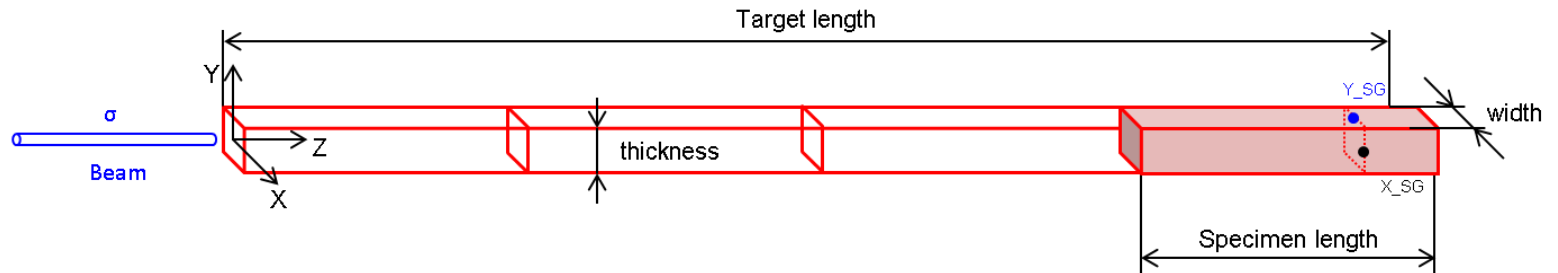
Axial waves

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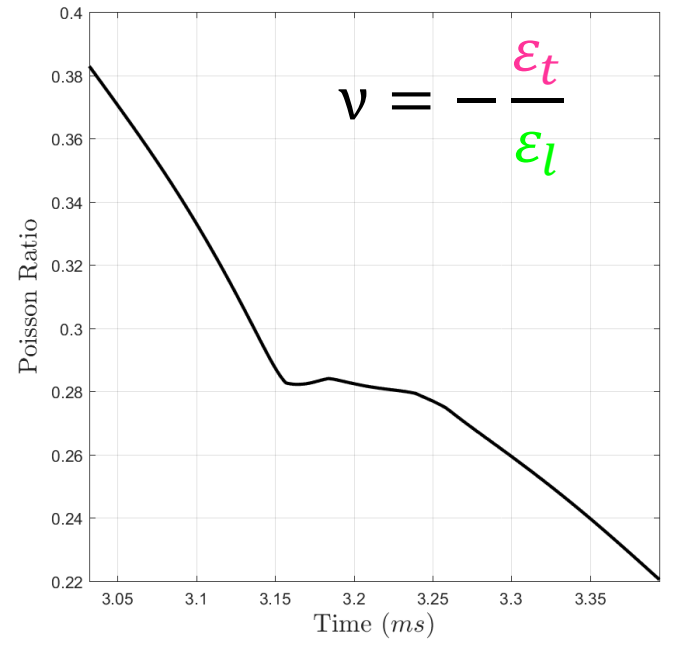
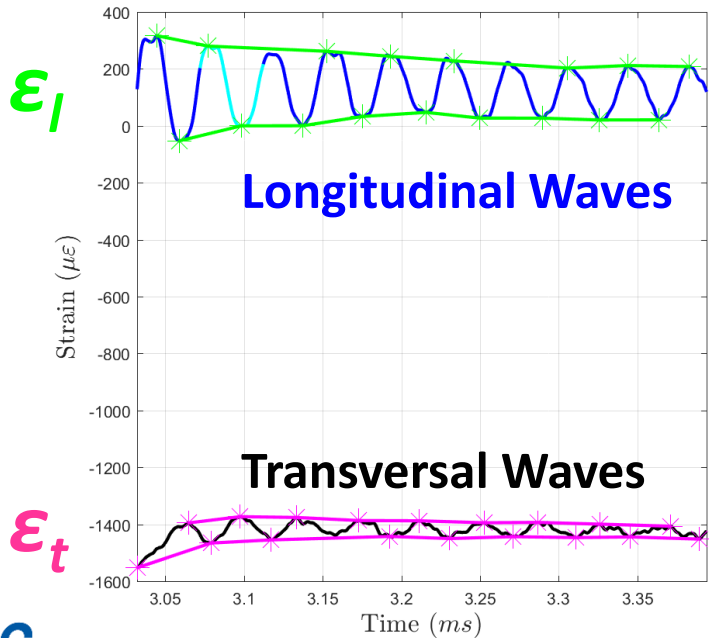
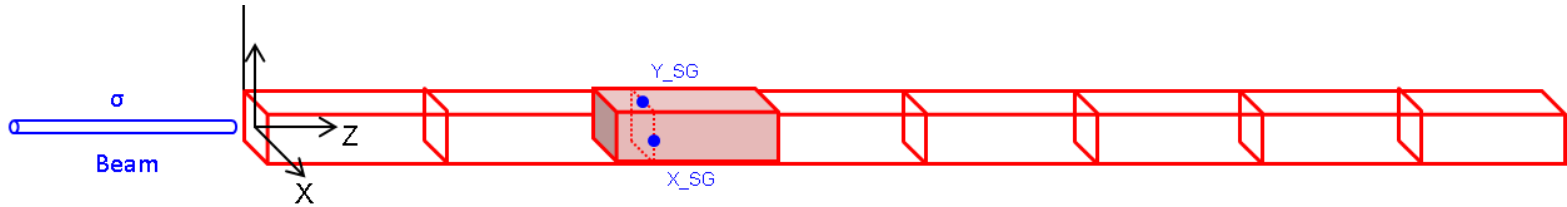
Axial waves

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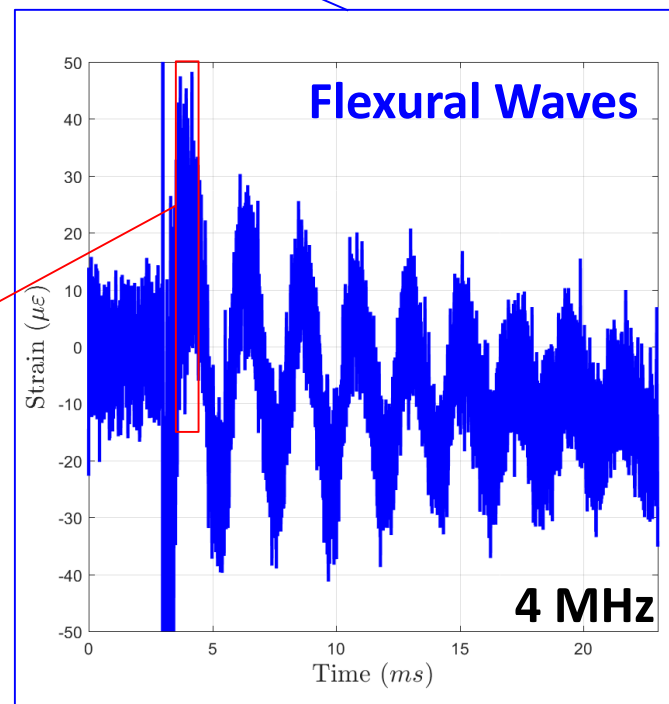
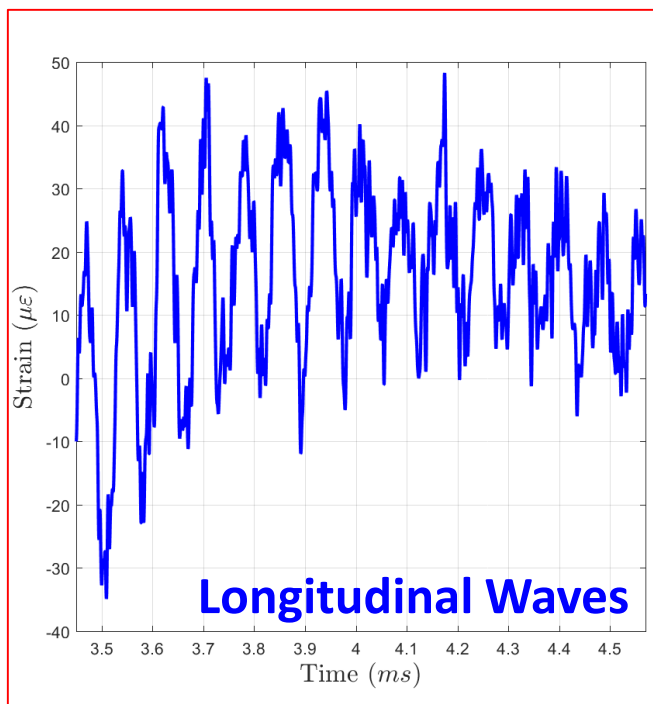
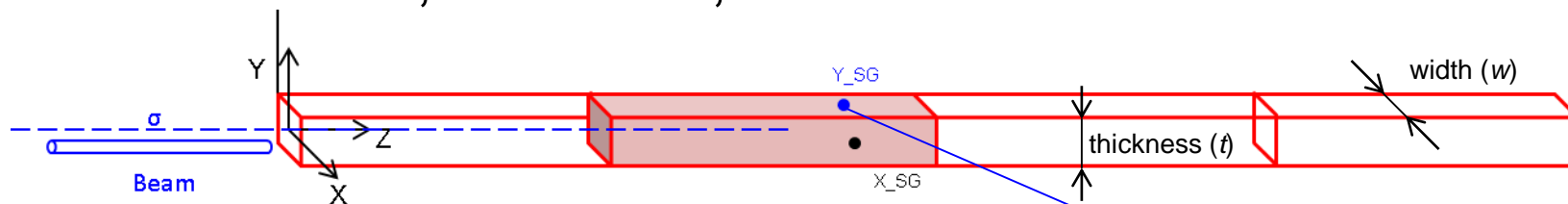
Axial waves

- CuCD: 24 bunches, σ 0.5 mm



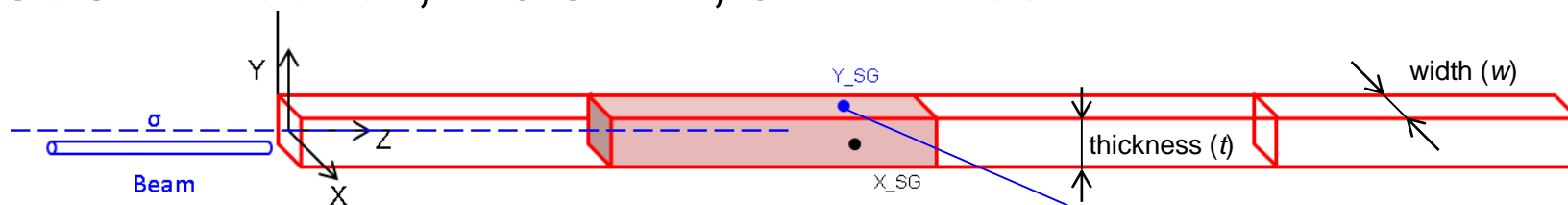
Flexural waves

- CuCD: 1 bunch, σ 0.5 mm, 3 mm offset



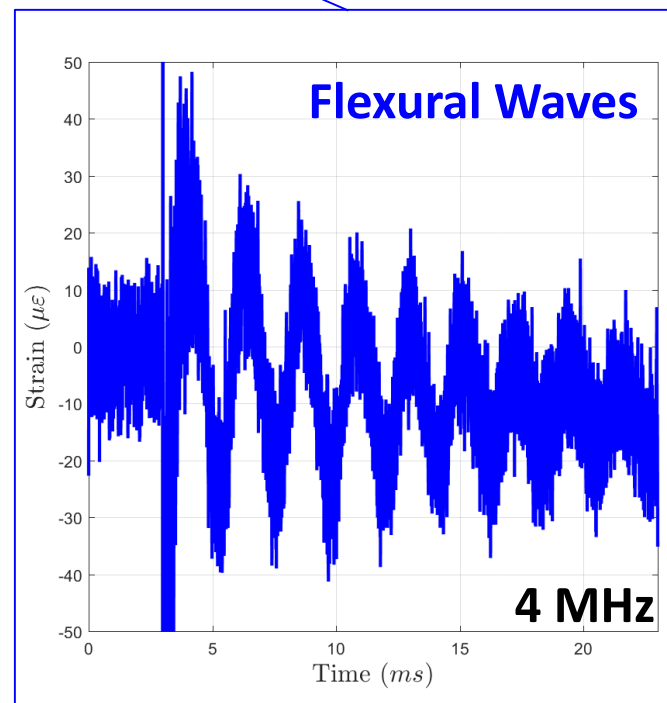
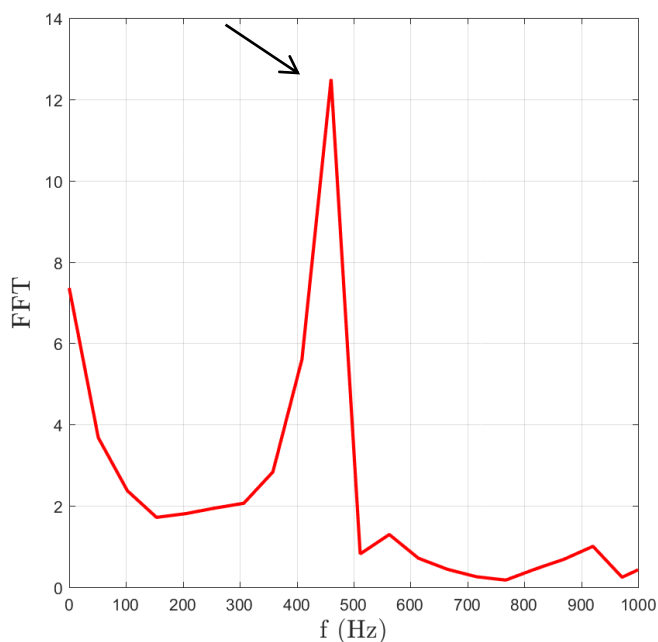
Flexural waves

- CuCD: 1 bunch, σ 0.5 mm, 3 mm offset



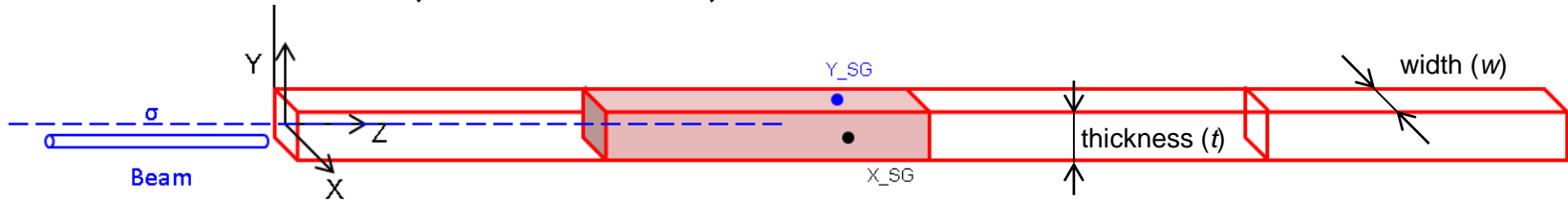
$$f_{flex} \cong 460 \text{ Hz (440 Hz)}$$

$$E = \frac{48\rho w^4 f_{flex}^2}{\pi^2 t^2}$$



Flexural waves

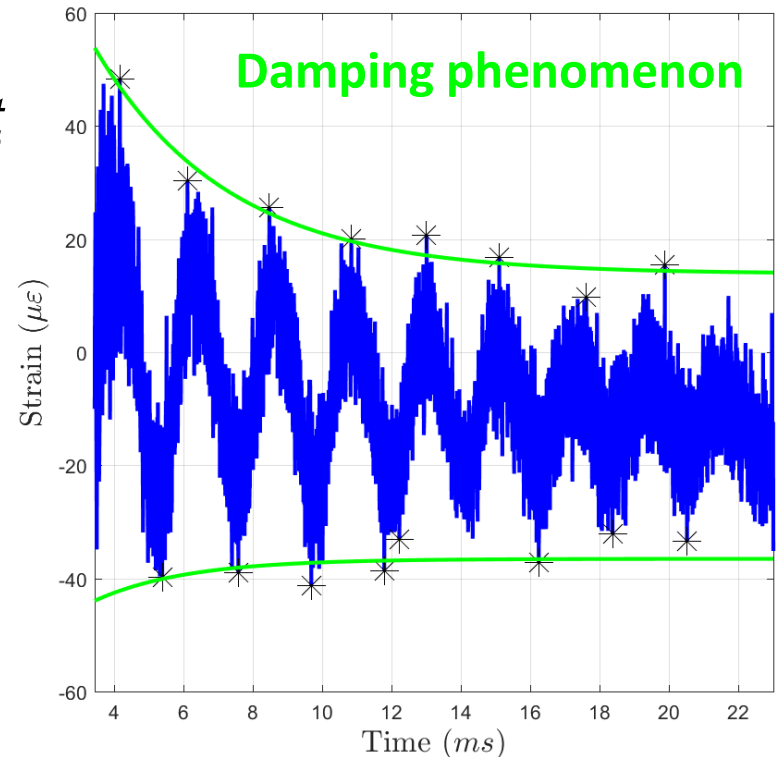
- CuCD: 1 bunch, σ 0.5 mm, 3 mm offset



- Damping can be reproduced by means of the logarithmic decrement method:

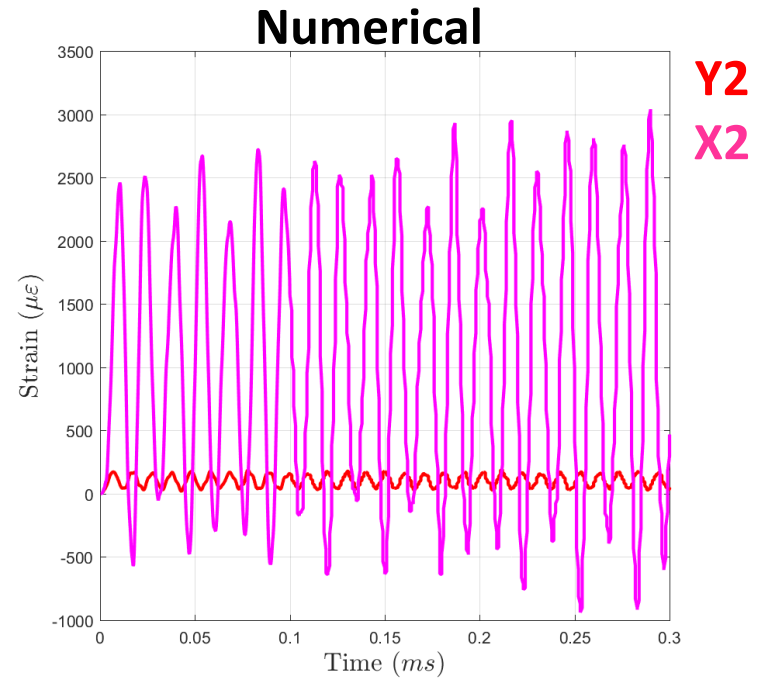
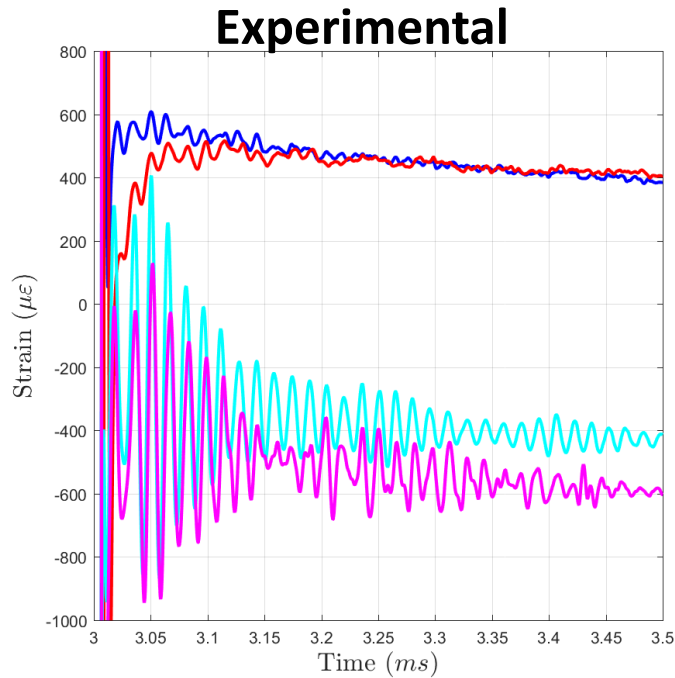
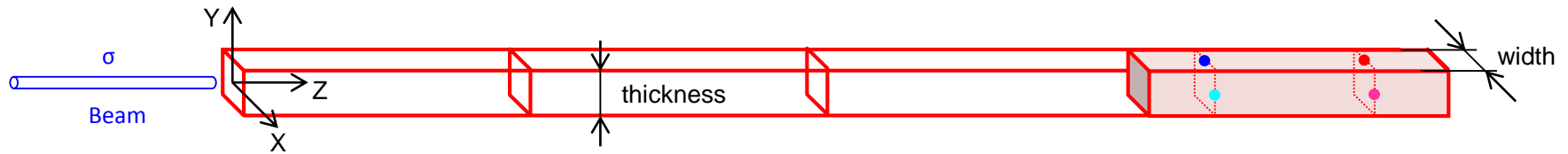
$$\varepsilon = G_0 + G e^{-\zeta 2\pi f_{flex} t}$$

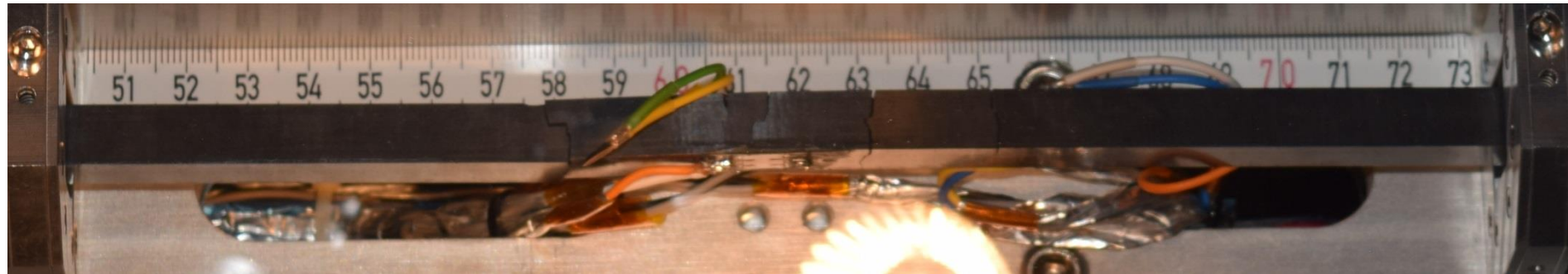
Damping ratio

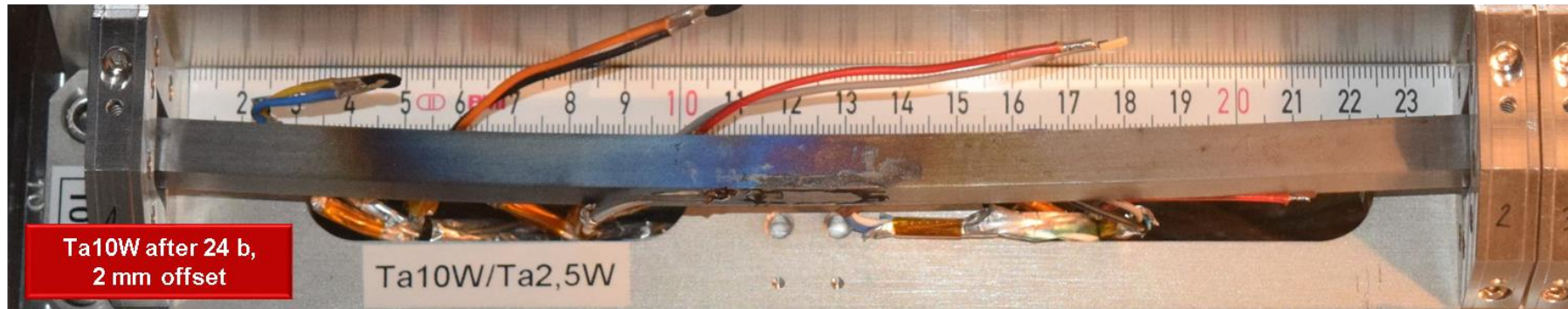
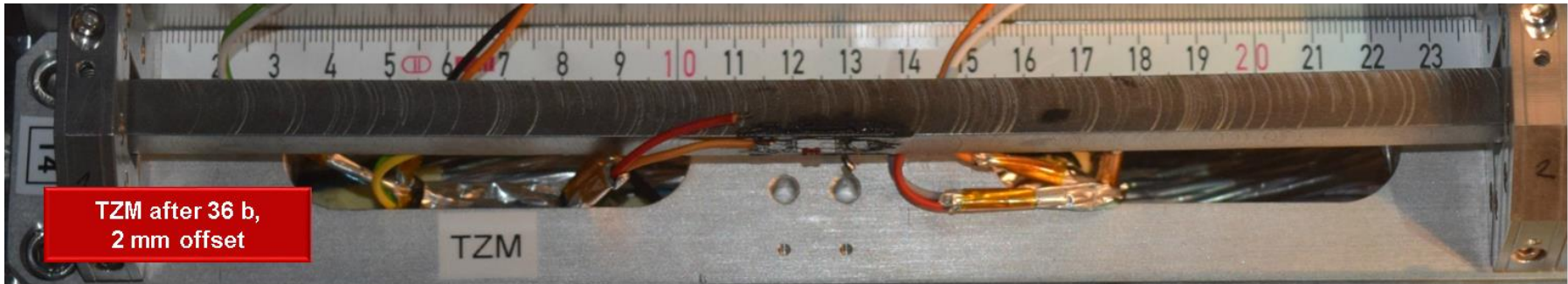


Experimental-Numerical comparison

- CFC AC150K: 144 bunches, σ 0.5 mm







Coating



Conclusion

- MultiMat gave us a huge amount of experimental data.
- Preliminary analysis shows a good agreement with what expected.
- Different analytical and numerical methods can be applied.
- Next: a lot of work to do!
 - To check all transient results;
 - To check all stationary results;
 - Post-mortem analysis;
 - Give input to FLUKA for energy deposition;
 - Mechanical characterization of materials to improve numerical results.



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Thank you for your attention!

Energy deposition

