LCWS12 International Workshop on Future Linear Colliders

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SIMPLIFIED MODELS OF ILD AND SID DETECTORS: SIMULATIONS AND SCALED TEST BENCH

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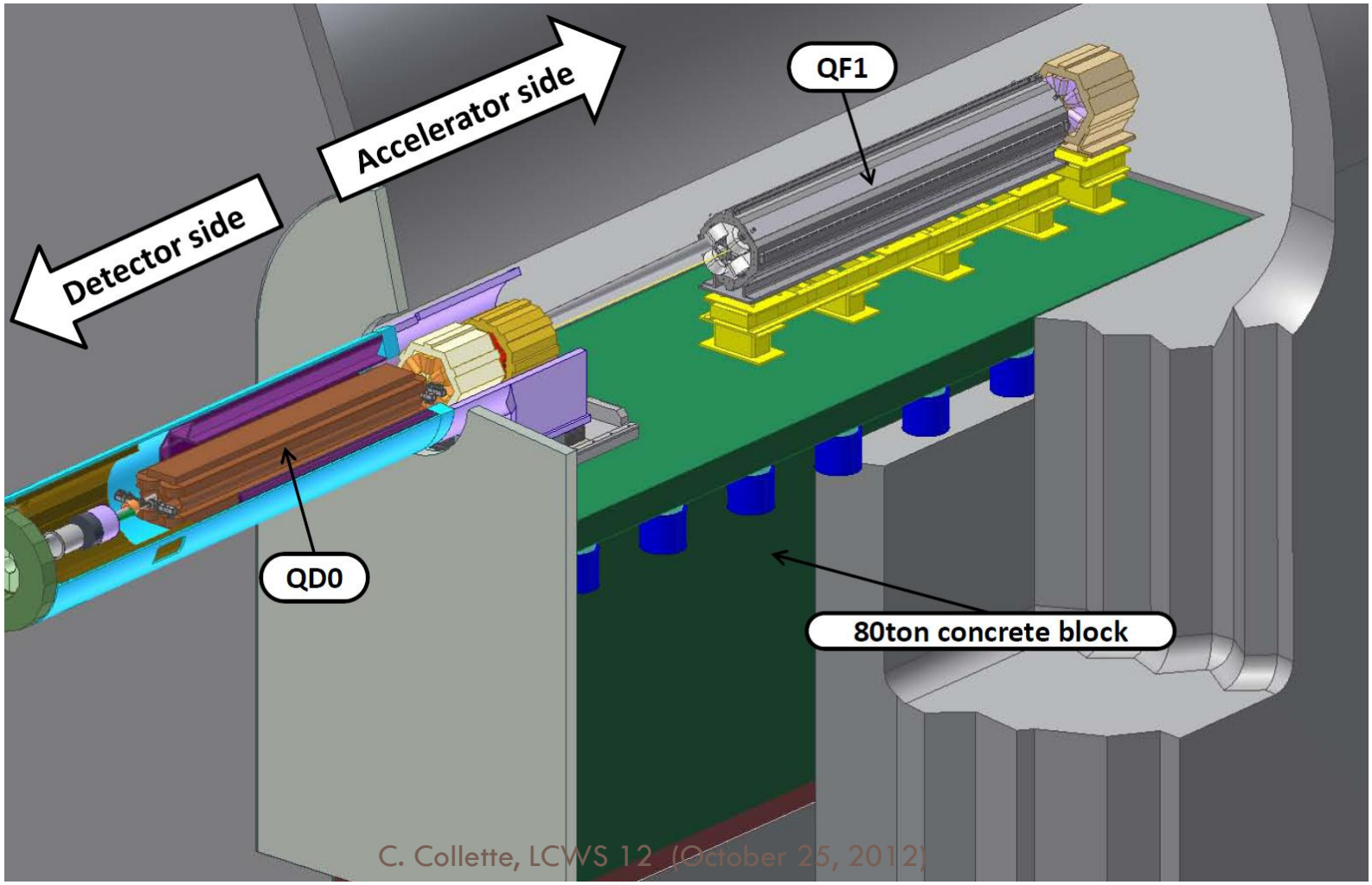
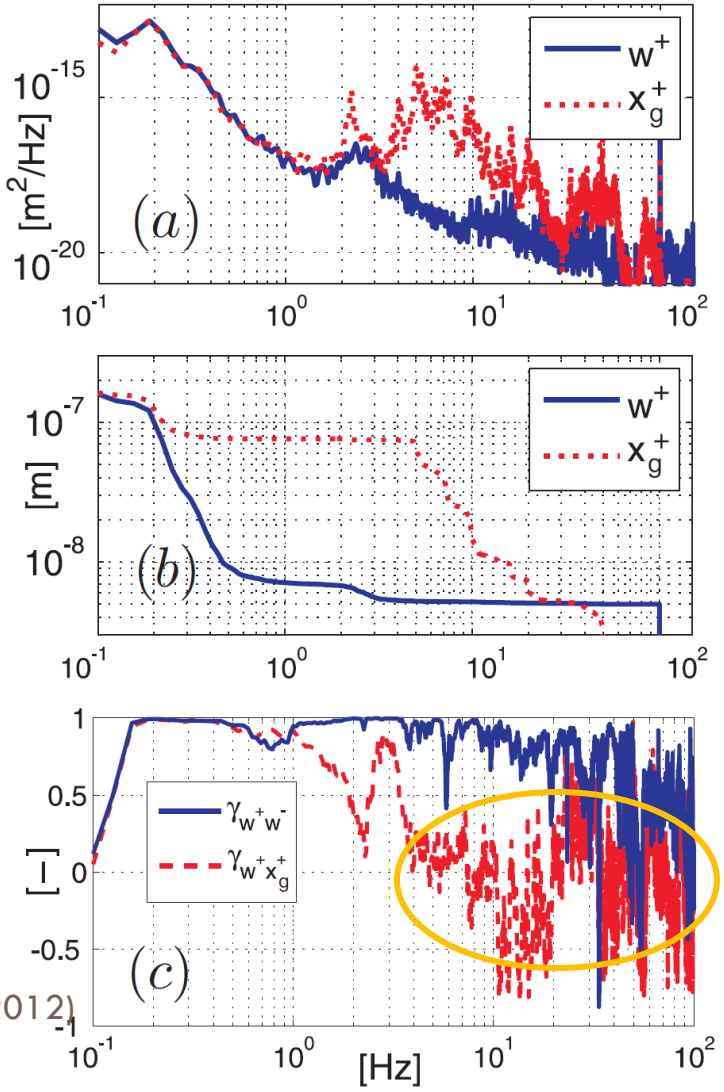
CLIC final focus

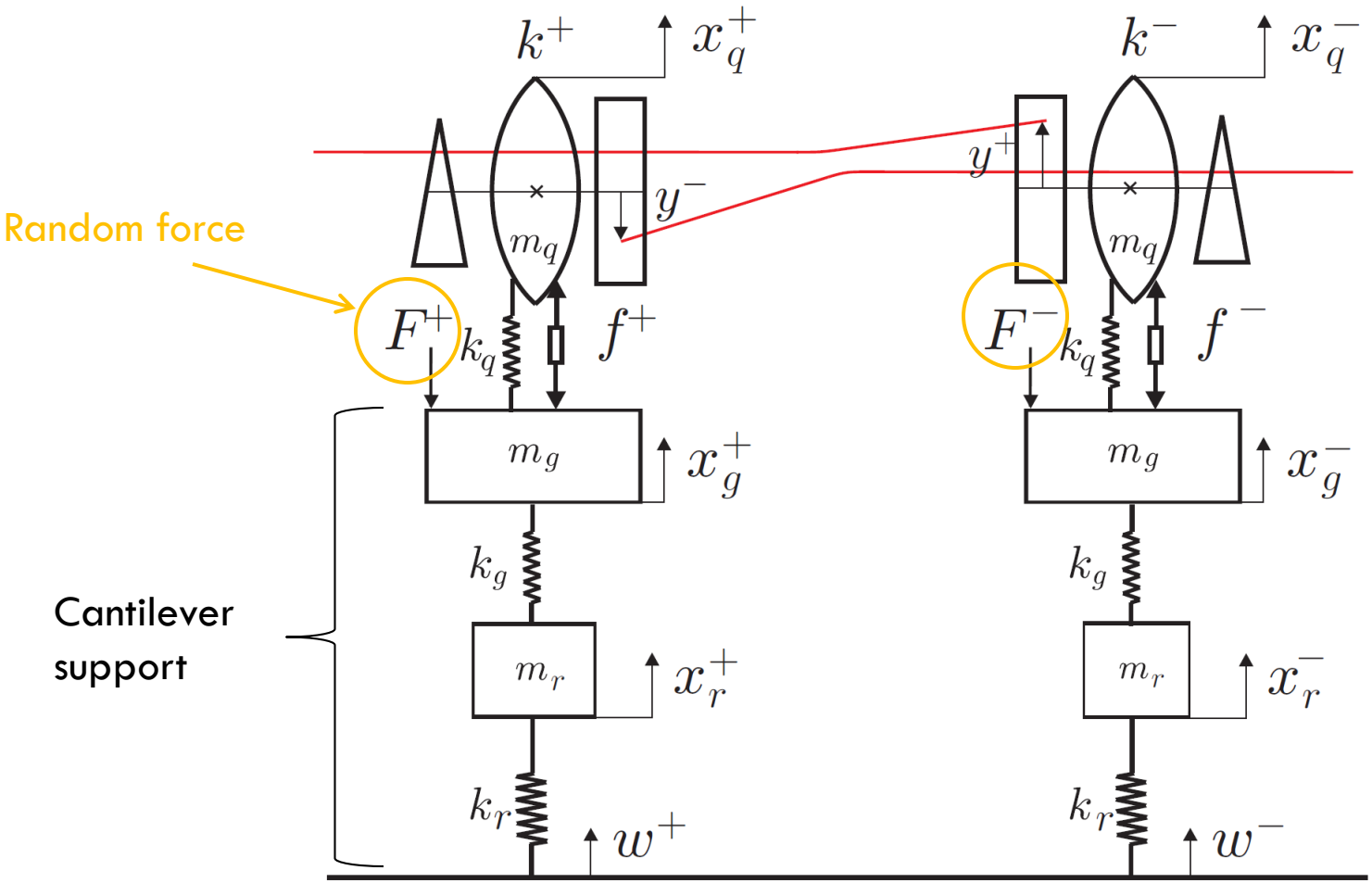


CMS Experiment (LHC tunnel)

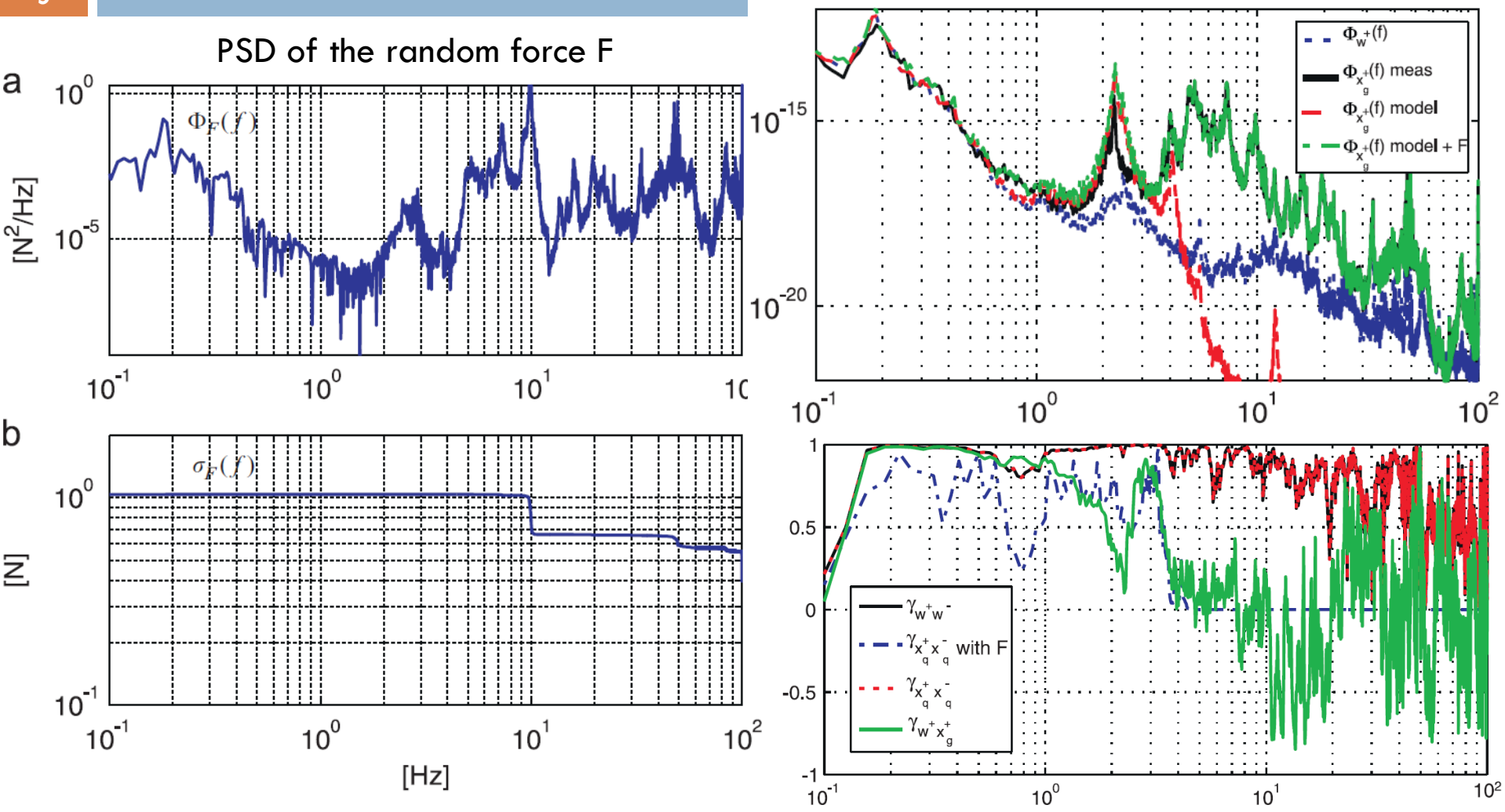


[C. Collette et al. "Control strategies for the final focus of future linear particle collider" ***Nuclear Instruments and Methods in Physics Research Section A*** Vol. 684 (August 2012), pp. 7-17]

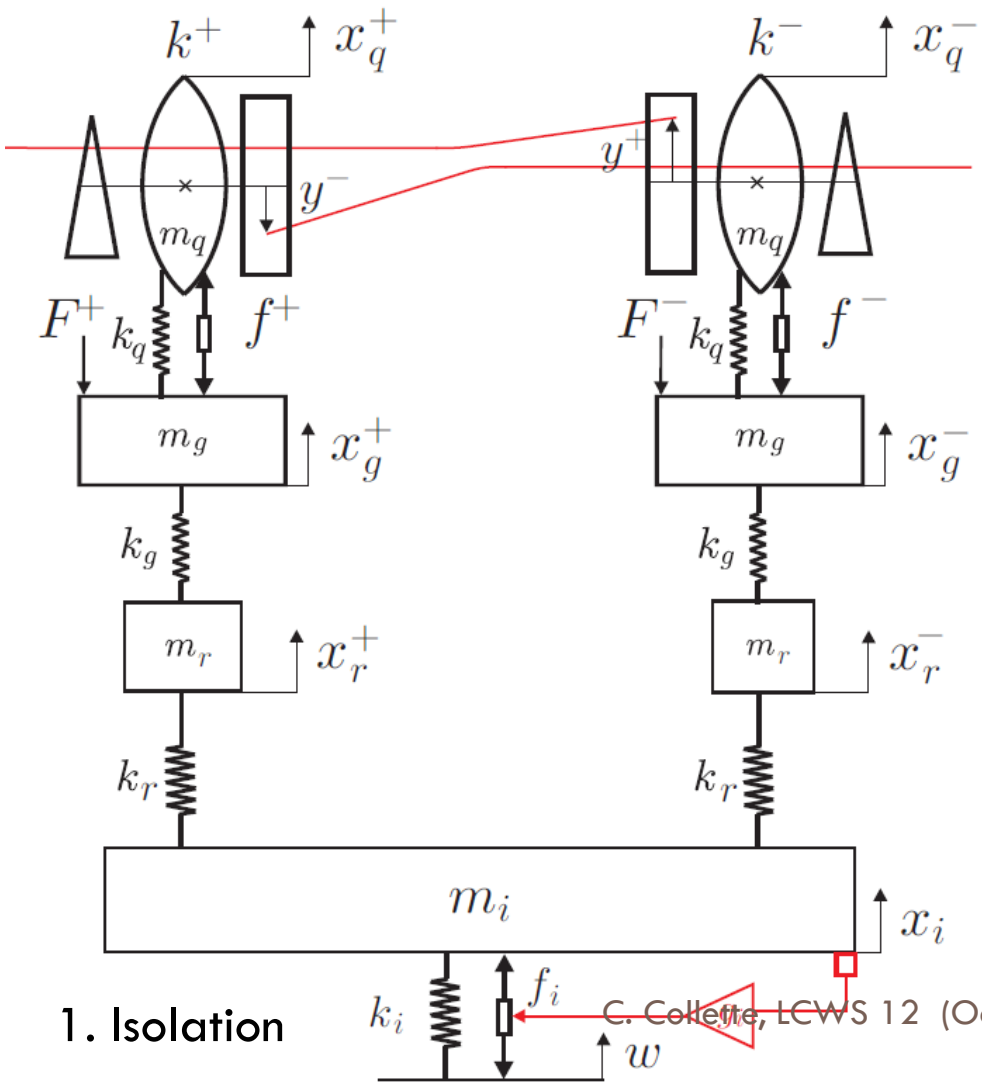
Simplified model



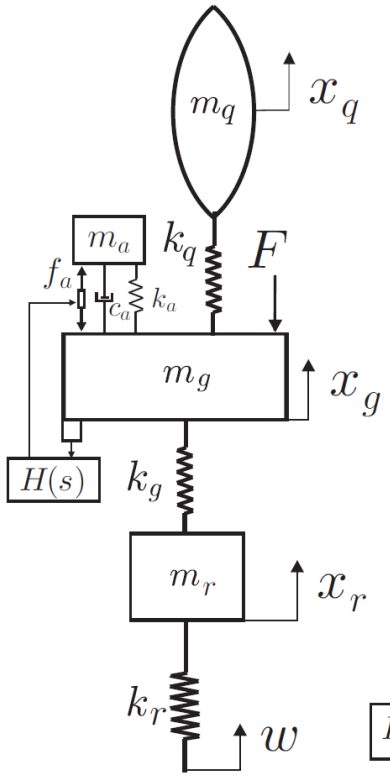
Model of the technical noise



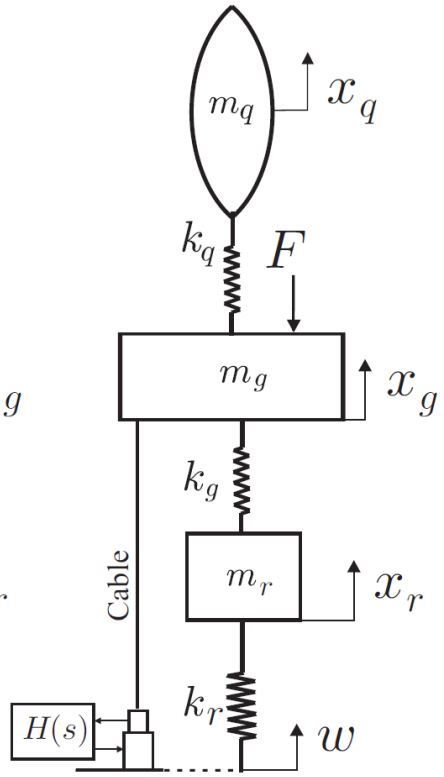
Solutions tested



1. Isolation



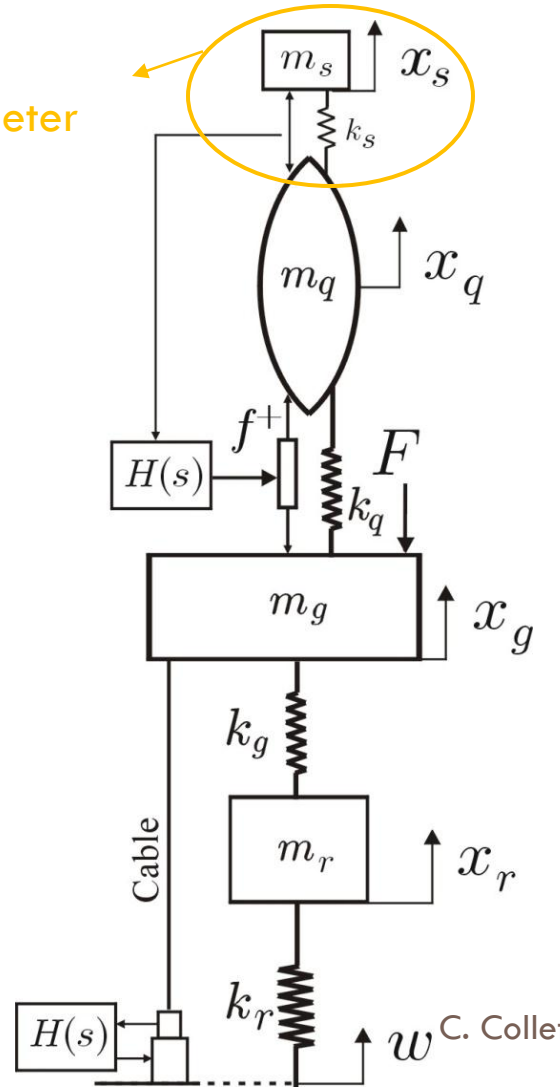
2. Damping

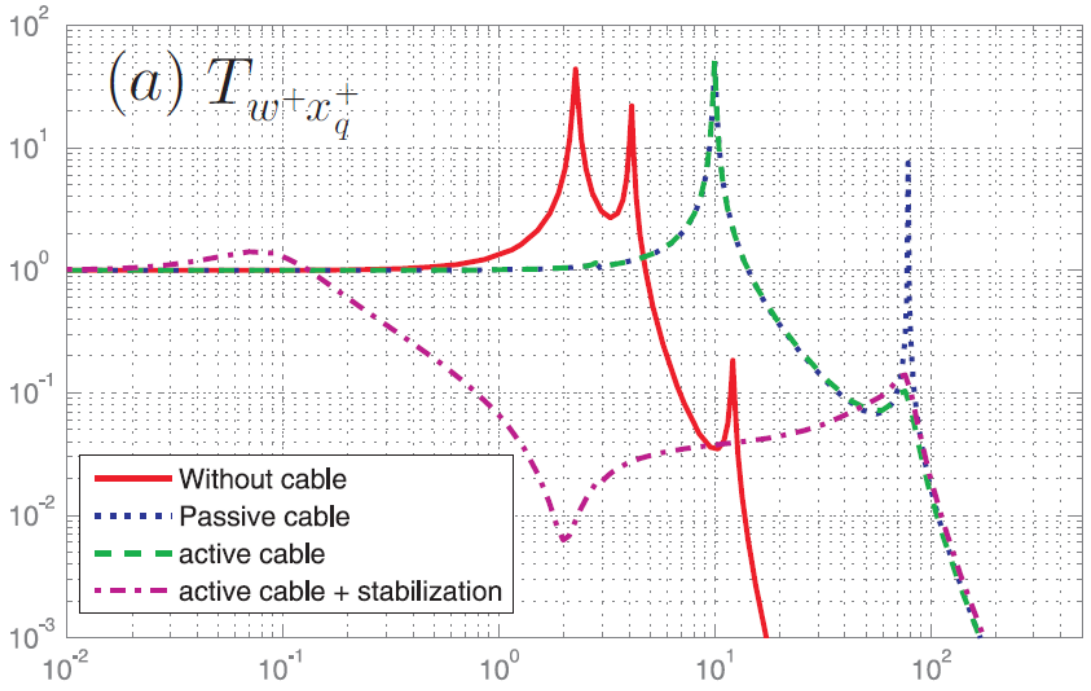


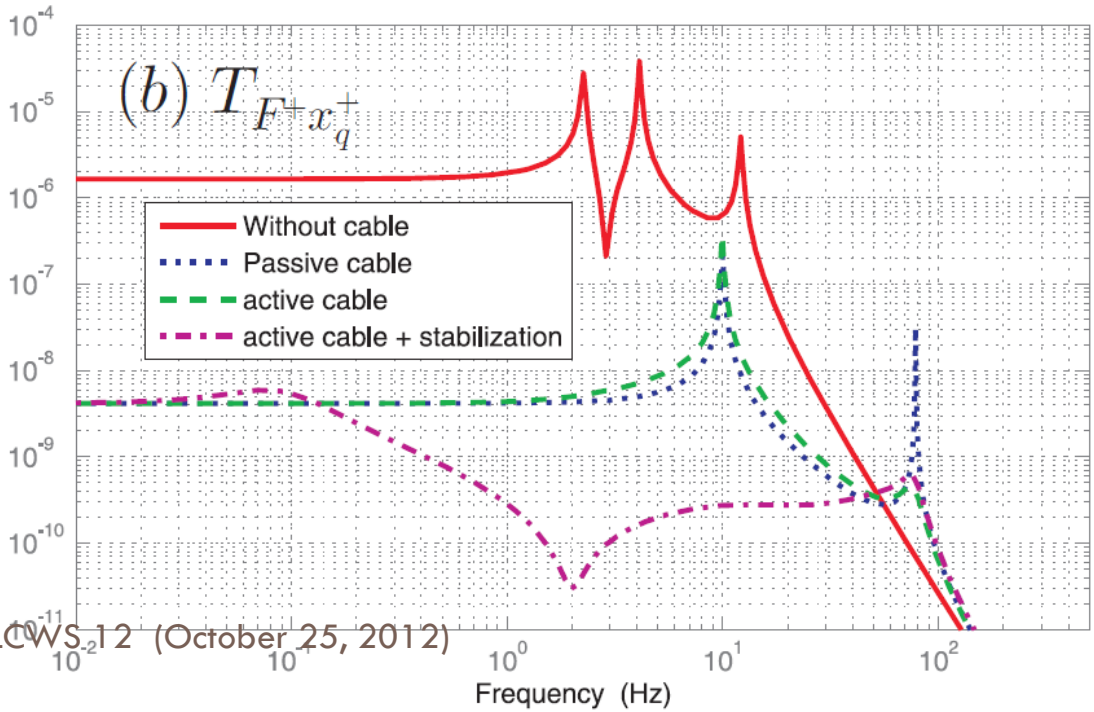
3. Stiffening

Example of results

seismometer







6.6.2 Support of the Final Focus Magnets

While the QF1 magnets of the final doublet will stay fixed in their positions, the QD0 magnets need to move with the detector during push-pull operation. The magnets are installed in a support structure which is supported from pillars residing on the push-pull platform. The support structure has a square cross section and is suspended from the solenoid cryostat using carbon-fibre tie rods (c.f. figure 6.6-9. This assembly allows the opening of the yoke end caps without interference with the alignment of the QD0 magnets. The inner silicon

8

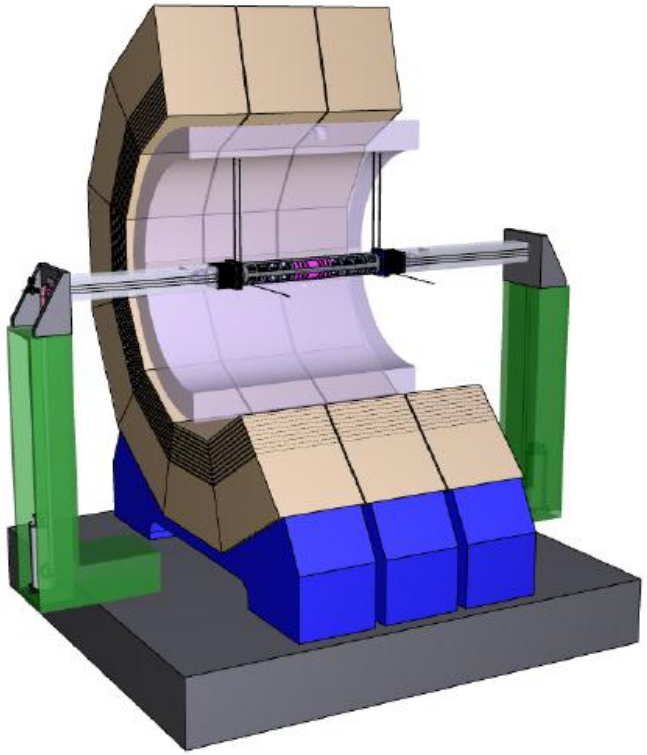
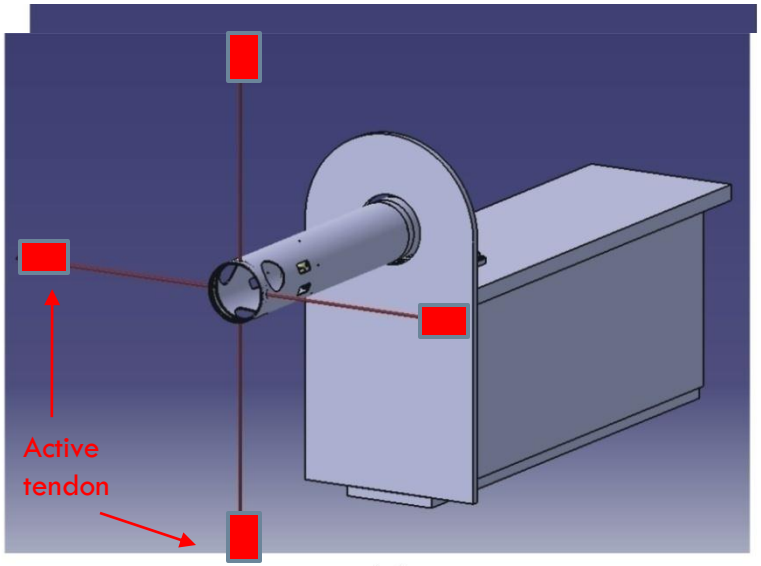


FIGURE 6.6-9. Support of the magnets in the detector. The inner detector part and the beam pipe are suspended from the TPC end flanges, not shown in this figure.

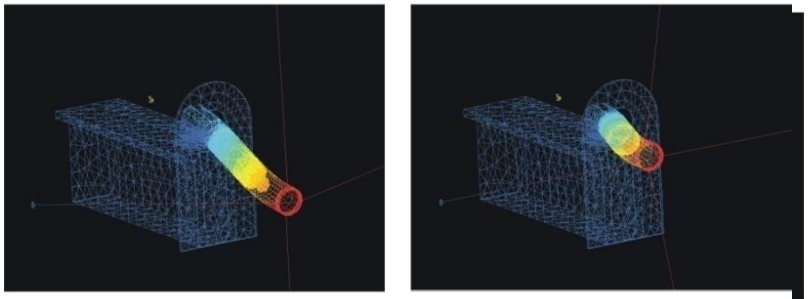
detectors (SIT, vertex detector) and the beam pipe are supported by a CFRP structure

Finite element model (Full scale)



(a)

$$\begin{cases} k_{cable} = 6.7\ 10^7\ N/m \\ L_{cable} = 3.32\ m \\ d_{cable} = 39.64\ mm \\ E_{cable} = 180\ Gpa \end{cases}$$



mode 1
52.78 *Hz*

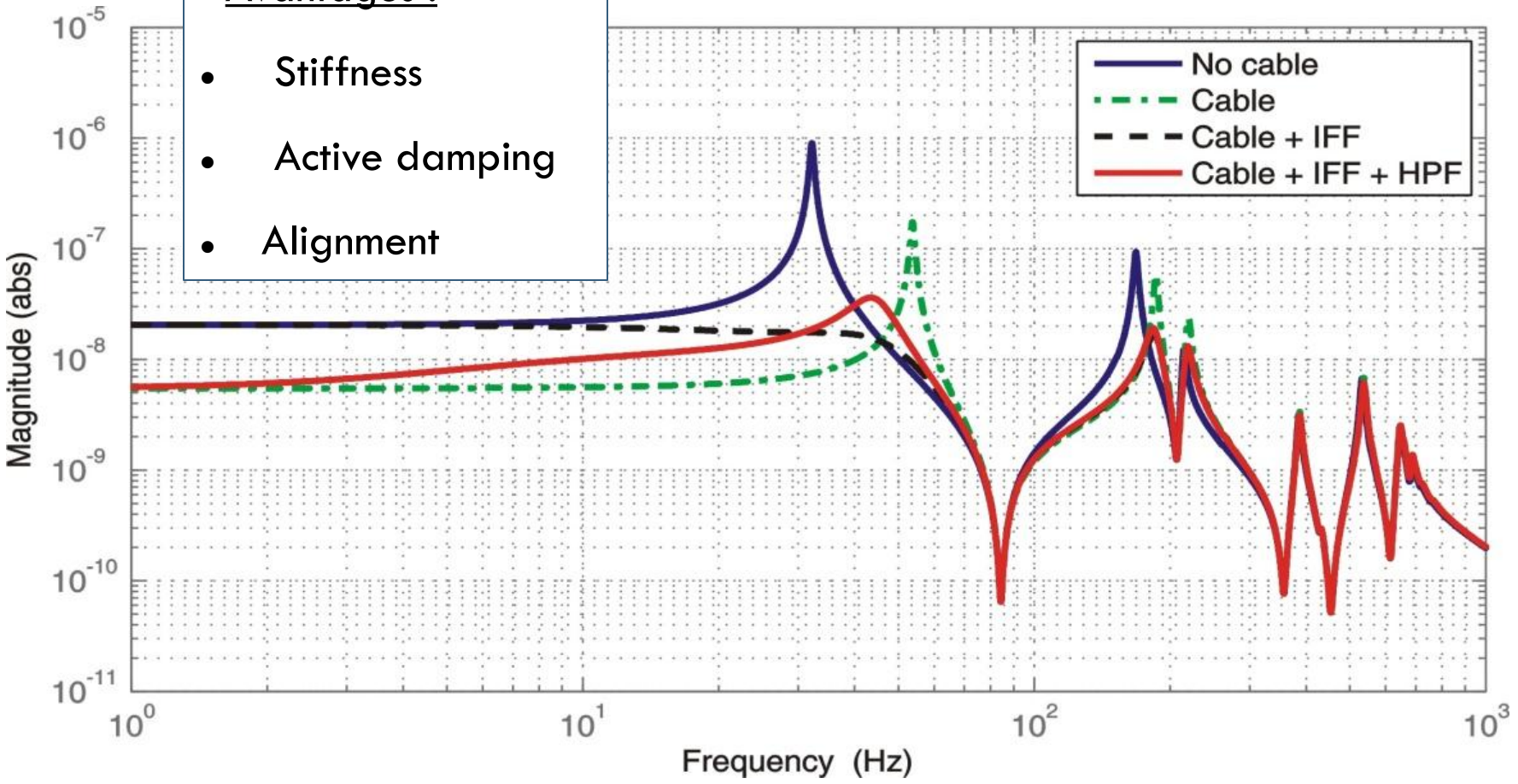
mode 2
54.15 *Hz*

Resonances frequencies multiplied by 2

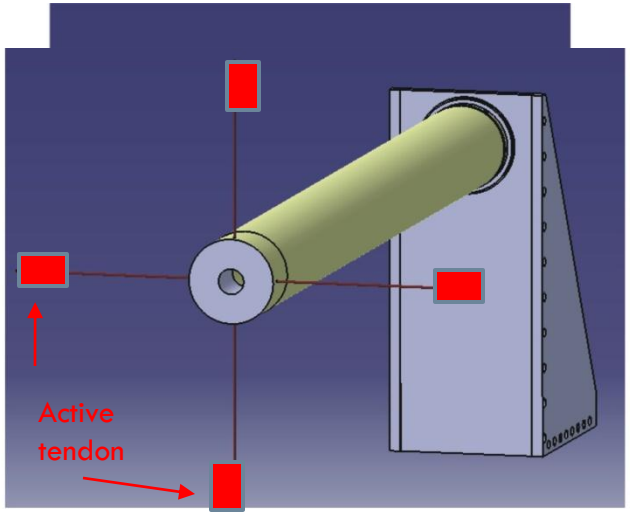
Numerical results

Avantages :

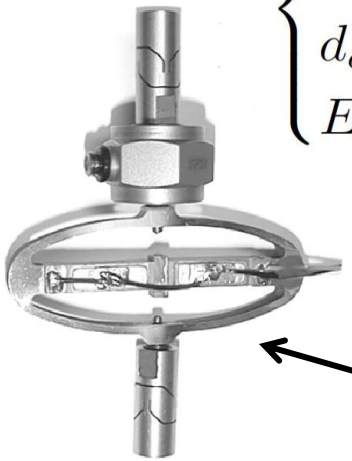
- Stiffness
- Active damping
- Alignment



Scaled test bench (in production)

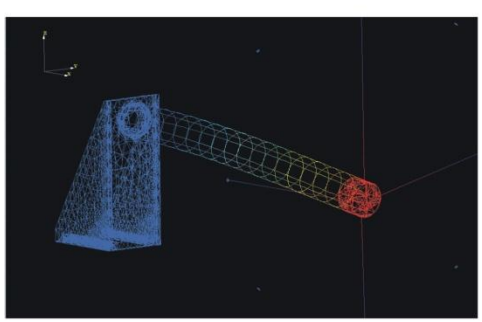


$$\begin{cases} k_{cable} = 1.62\ 10^5 N/m \\ L_{cable} = 0.2\ m \\ d_{cable} = 0.767\ mm \\ E_{cable} = 70\ Gpa \end{cases}$$

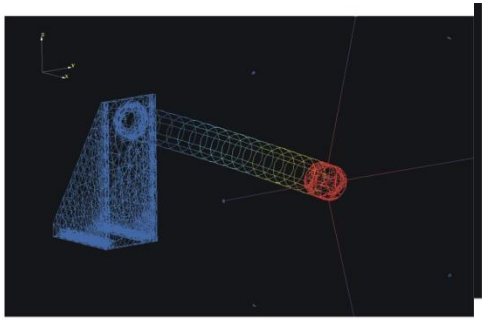


Active tendon:

APA100M+BK8200



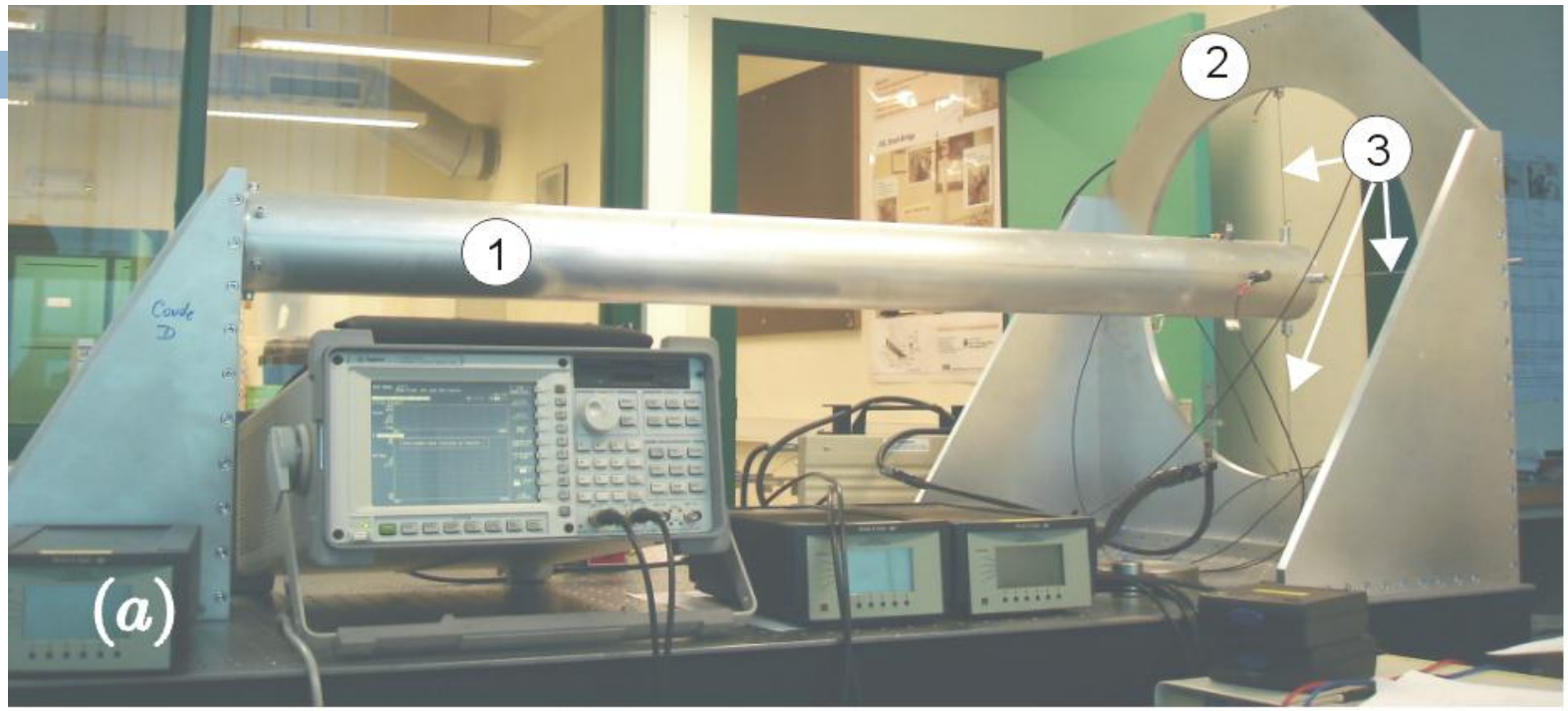
mode 1
55.06 *Hz*



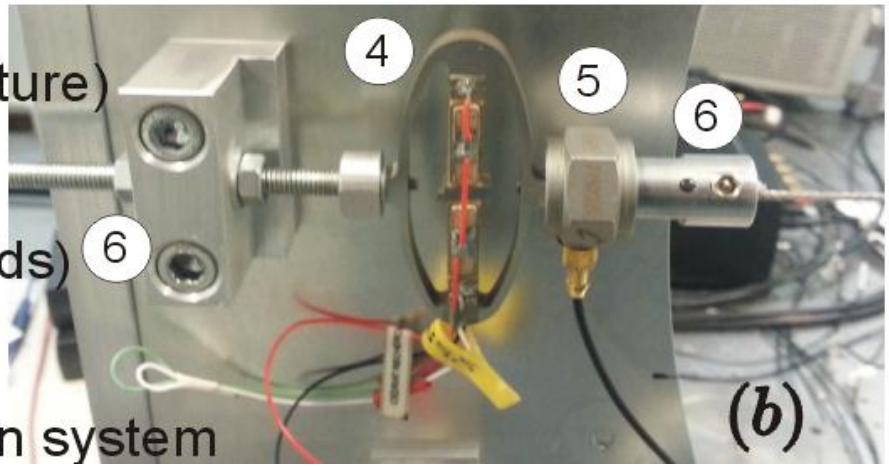
mode 2
55.96 *Hz*

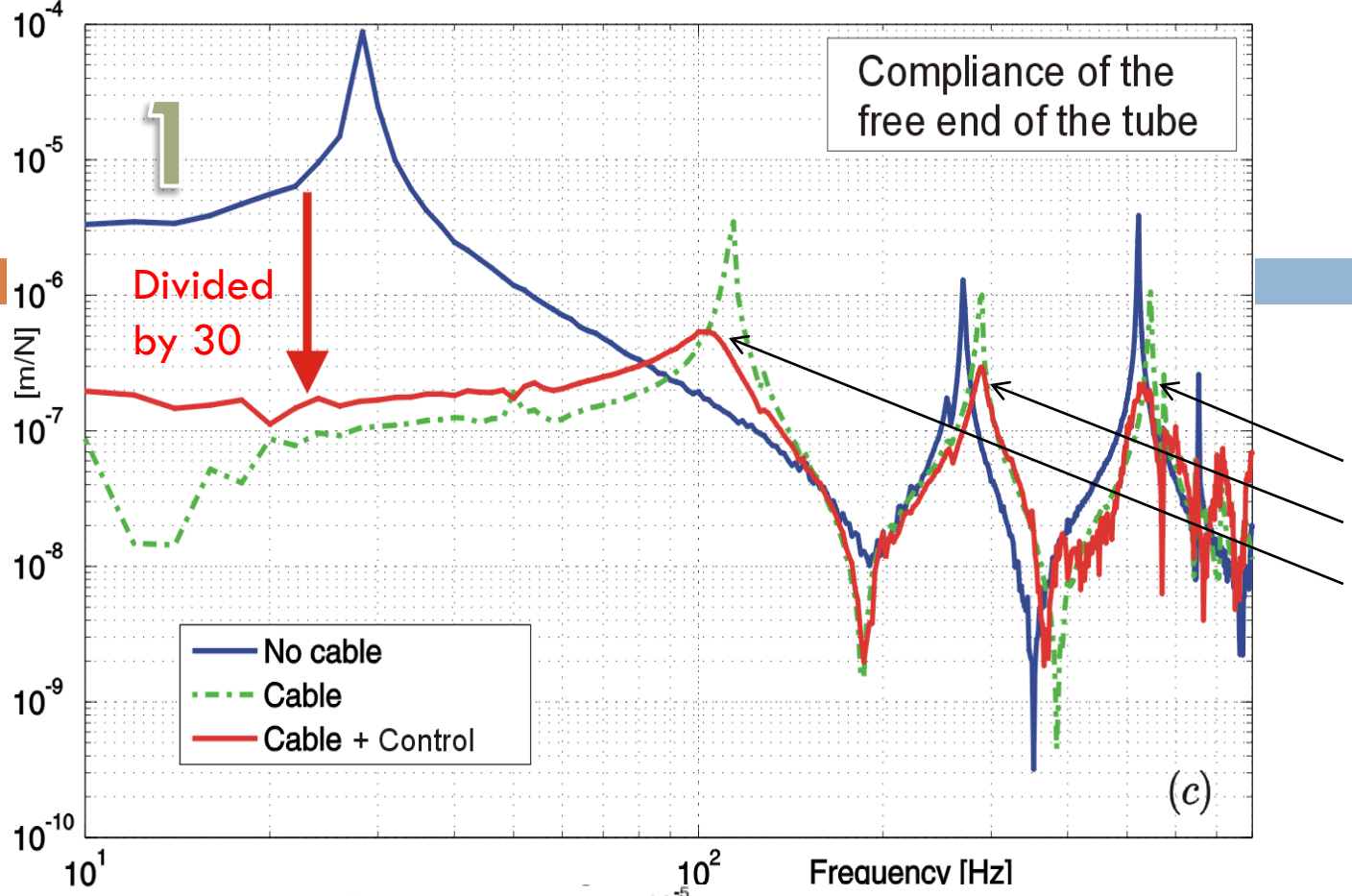
Resonances frequencies multiplied by 2

Experimental set-up



1. Cantilevered tube
   (corresp. to flexible structure)
2. Rigid frame
3. Carbon cables
   (corresp. to carbon tie rods)
4. Piezoelectric actuator
5. Force sensor
6. Dedicated fixation/tension system





2

Active damping of all the modes

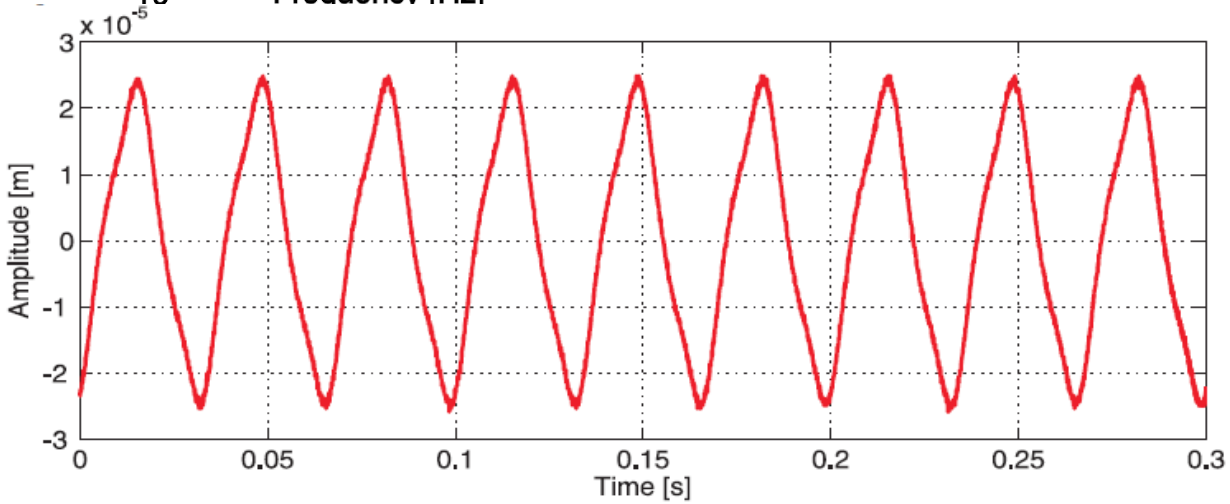
3

<u>Positioning:</u>

out of phase sinusoidal signals in the two vertical actuators:

Amplitude: 30 µm

Frequency: 30 Hz

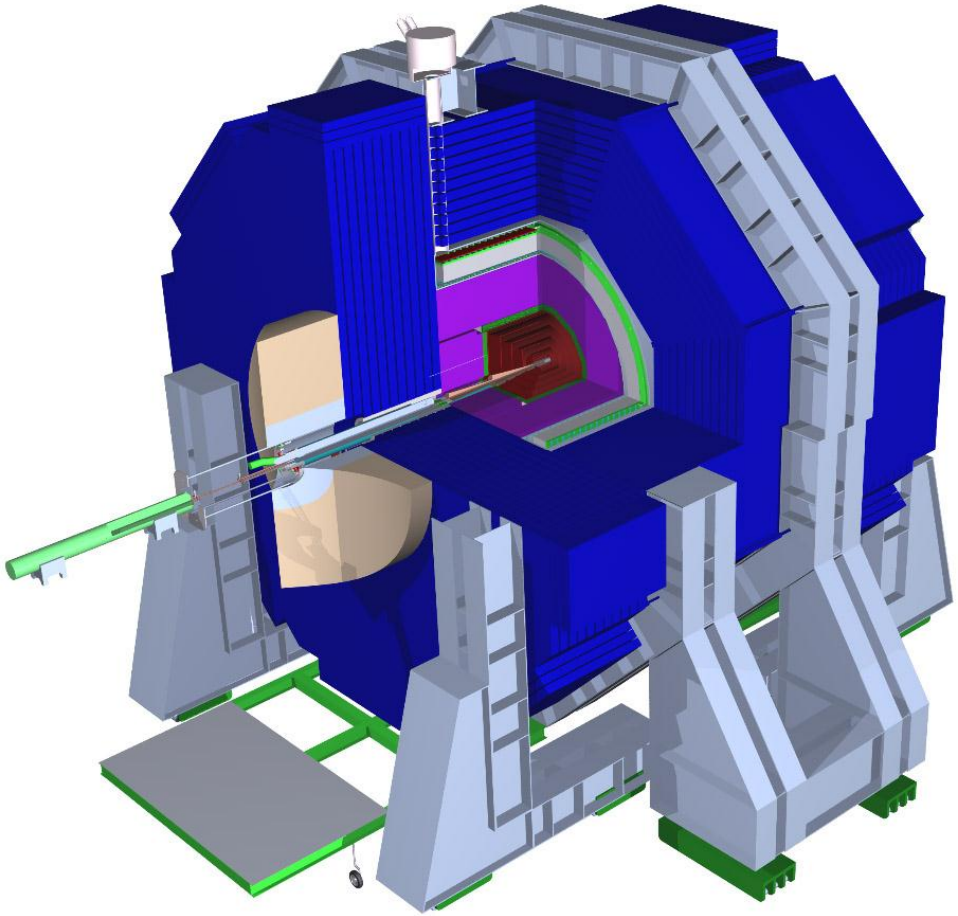


C. C

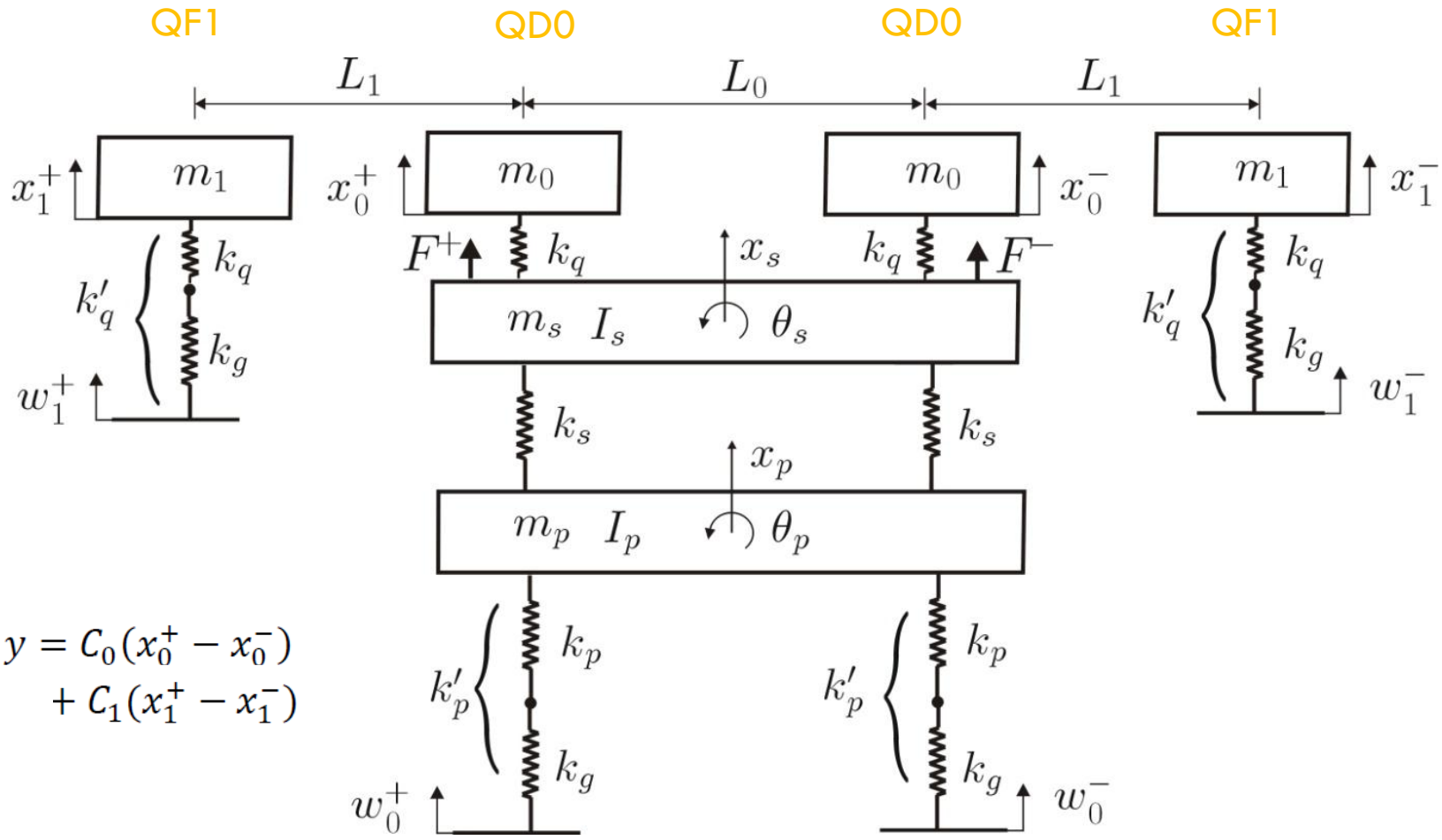
Simplified model of the SiD

Additional features:

- QD0s and QF1s
- Detector tilt
- Beam dynamics
- Soil model
- Technical noise model

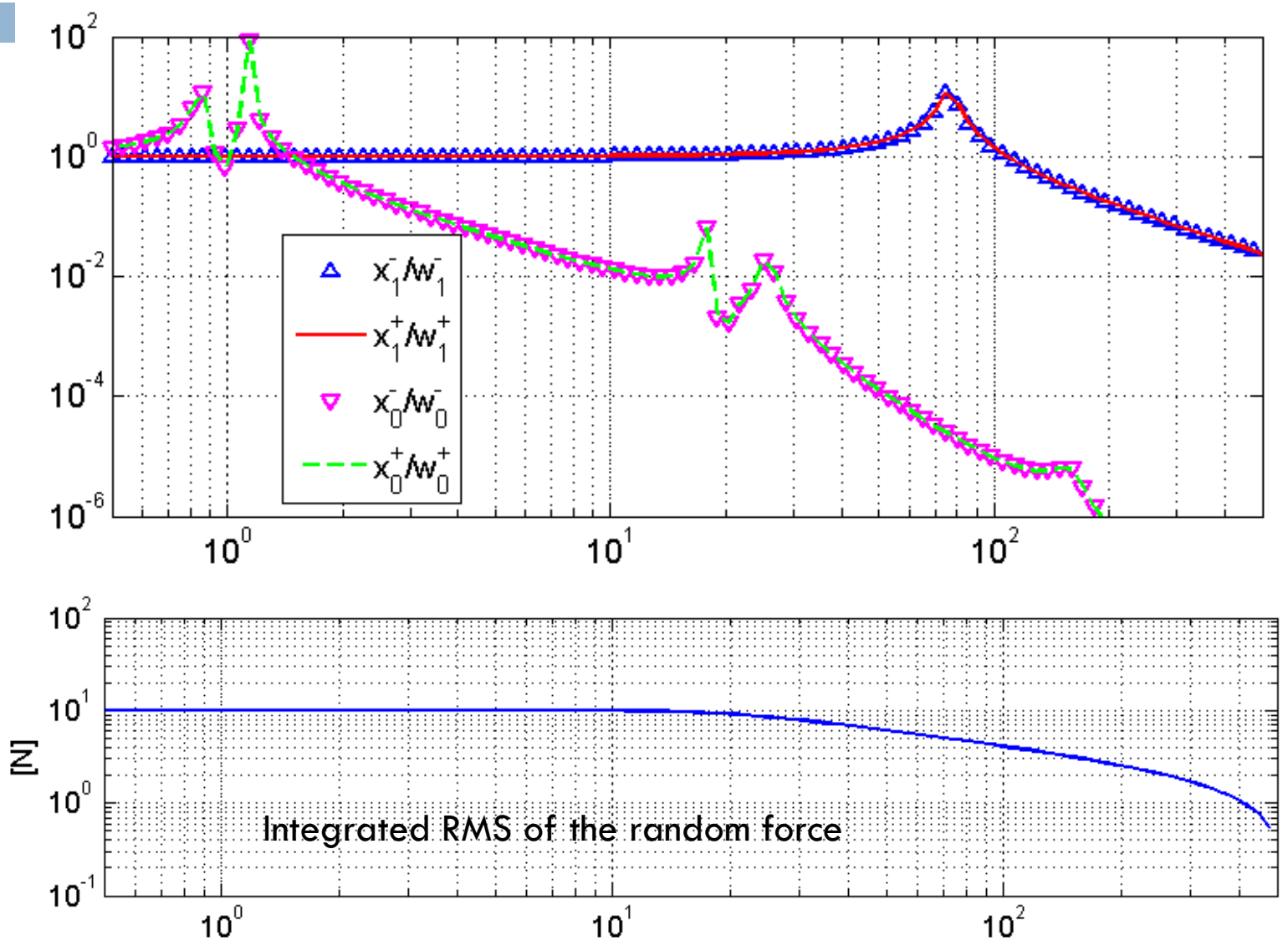


Simplified model of the SiD

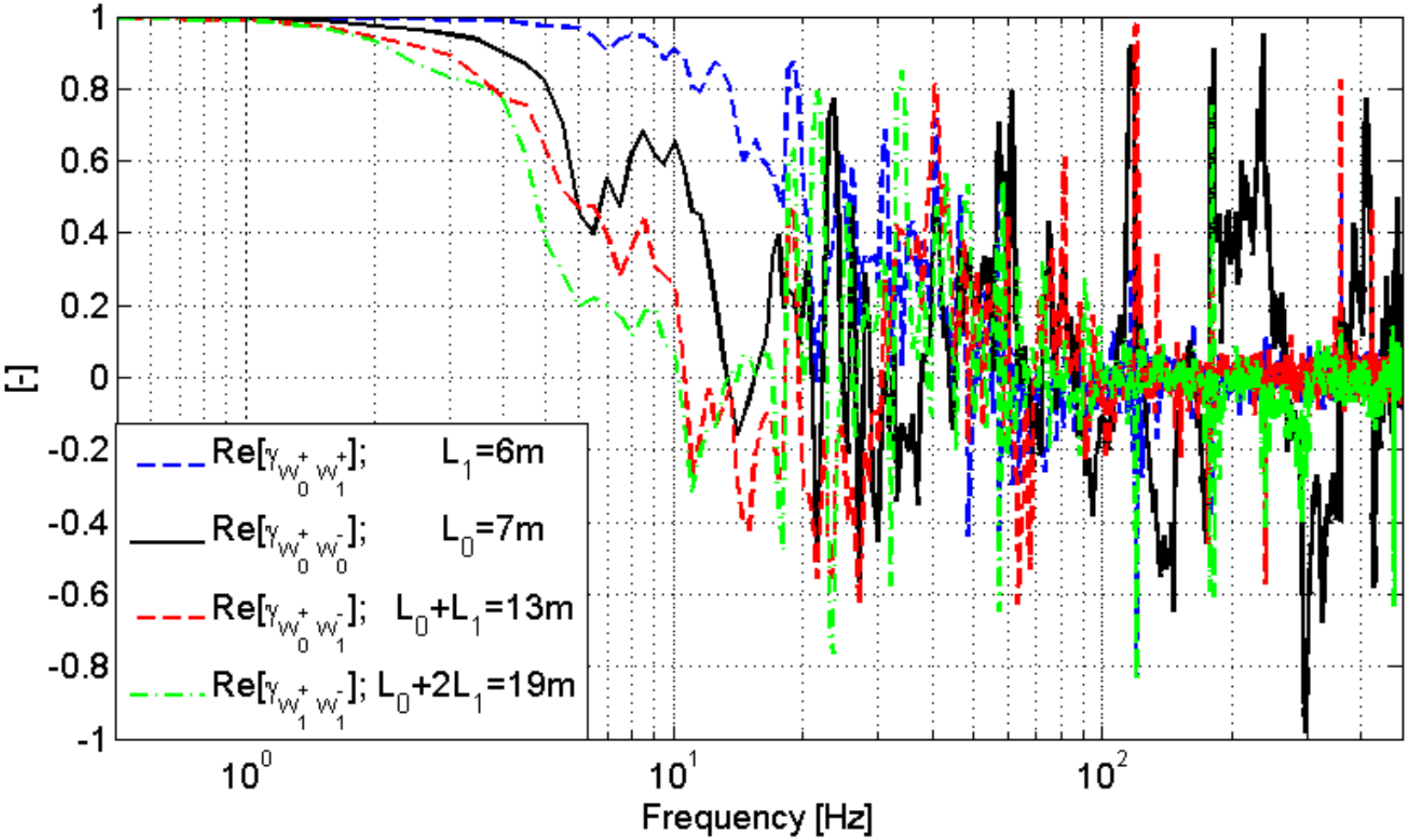


$$y = C_0(x_0^+ - x_0^-) + C_1(x_1^+ - x_1^-)$$

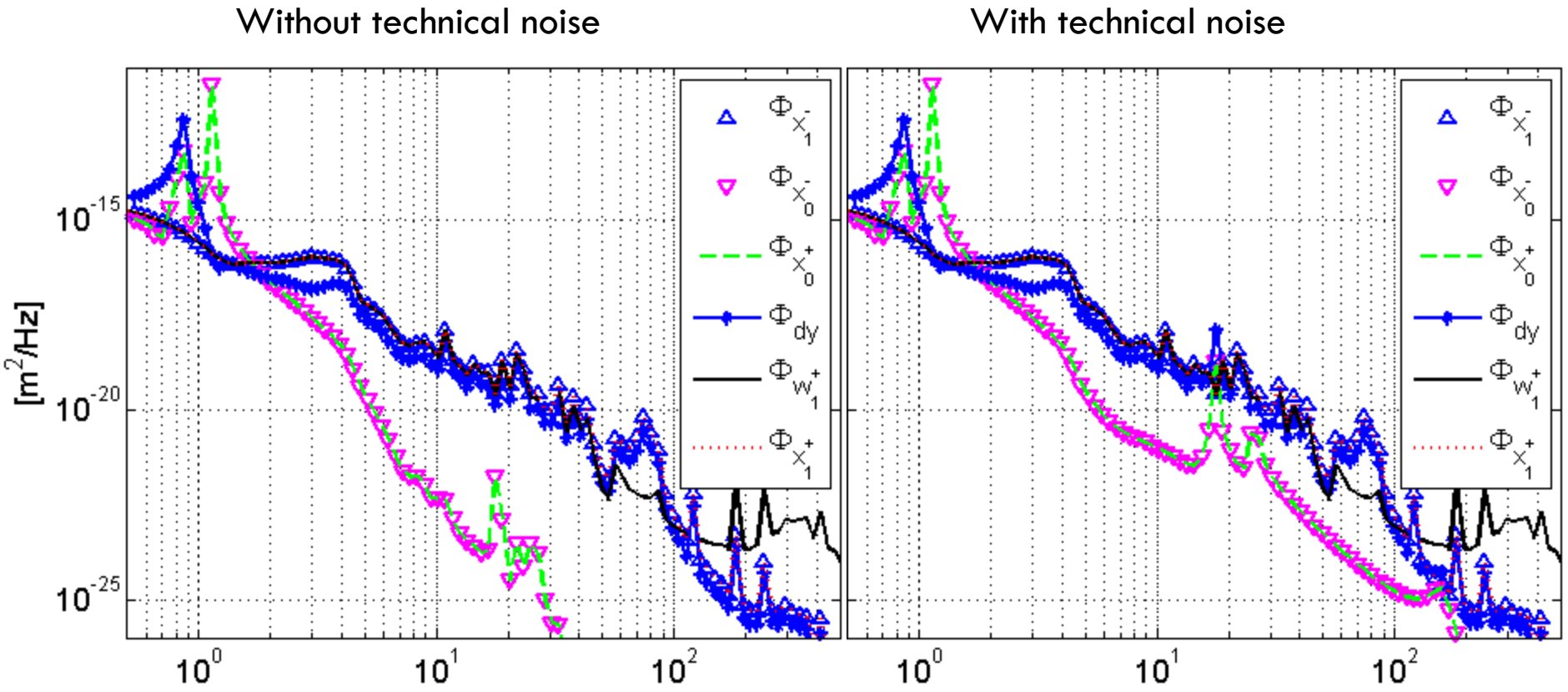
Simulations



Ground motion measurement at SLAC



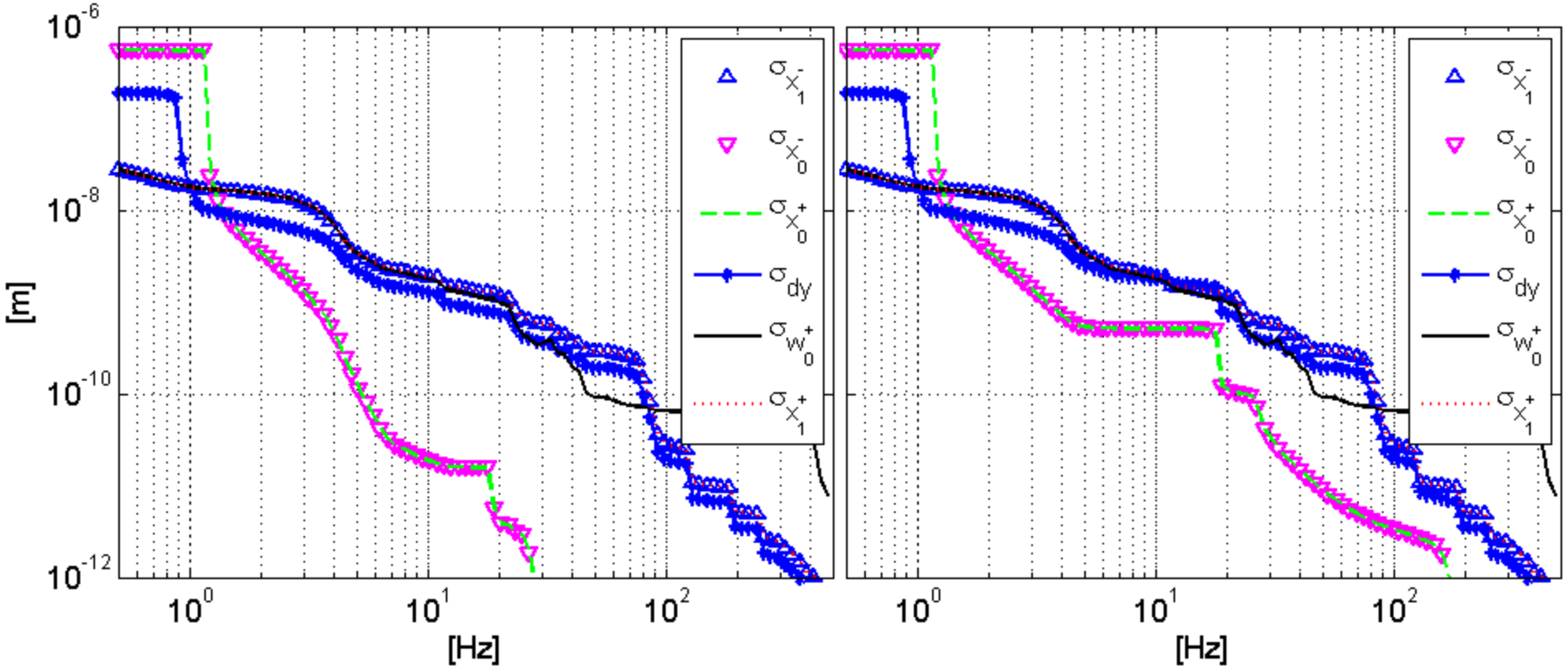
Power spectral densities



Integrated RMS

Without technical noise

With technical noise



QF1s play a big role; Technical noise is not very harmful

Conclusions

- Simplified model of the CLIC_ILD final focus, updated with ground motion model from CMS
- Proposal of active tie rods:
  - Improve the robustness to technical noise
  - Active structural damping
  - Positioning
- Results validated on a scaled test bench
- Simplified model of the SiD detector
  - QF1 plays a big role
  - Technical noise is not very harmful
  - Future work: Passive and active isolation of the QF1 and QD0