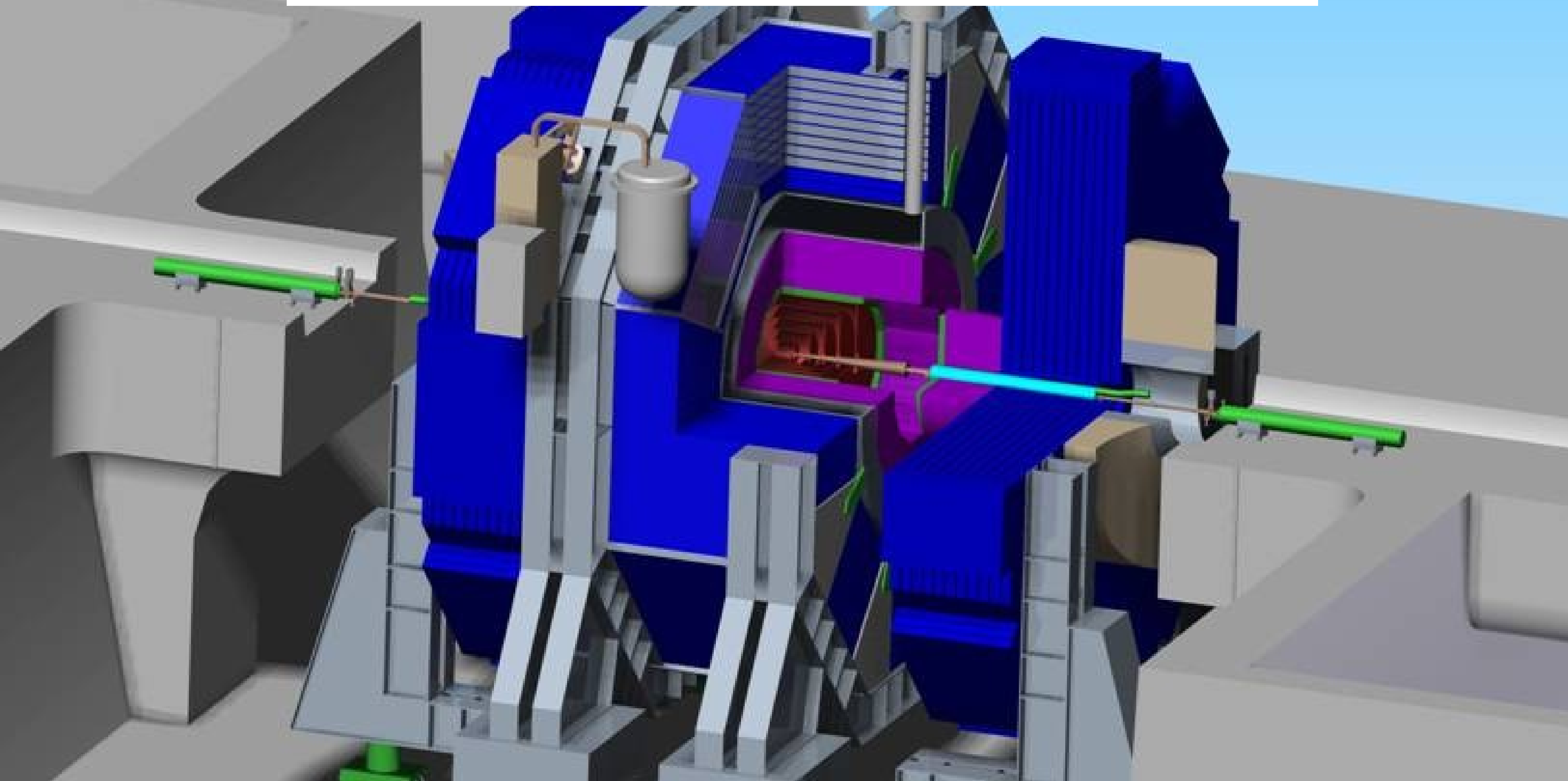
ALCPG11 Eugene- Oregon, March 2011



SiD MDI

Marco Oriunno, SLAC

Outline of the talk

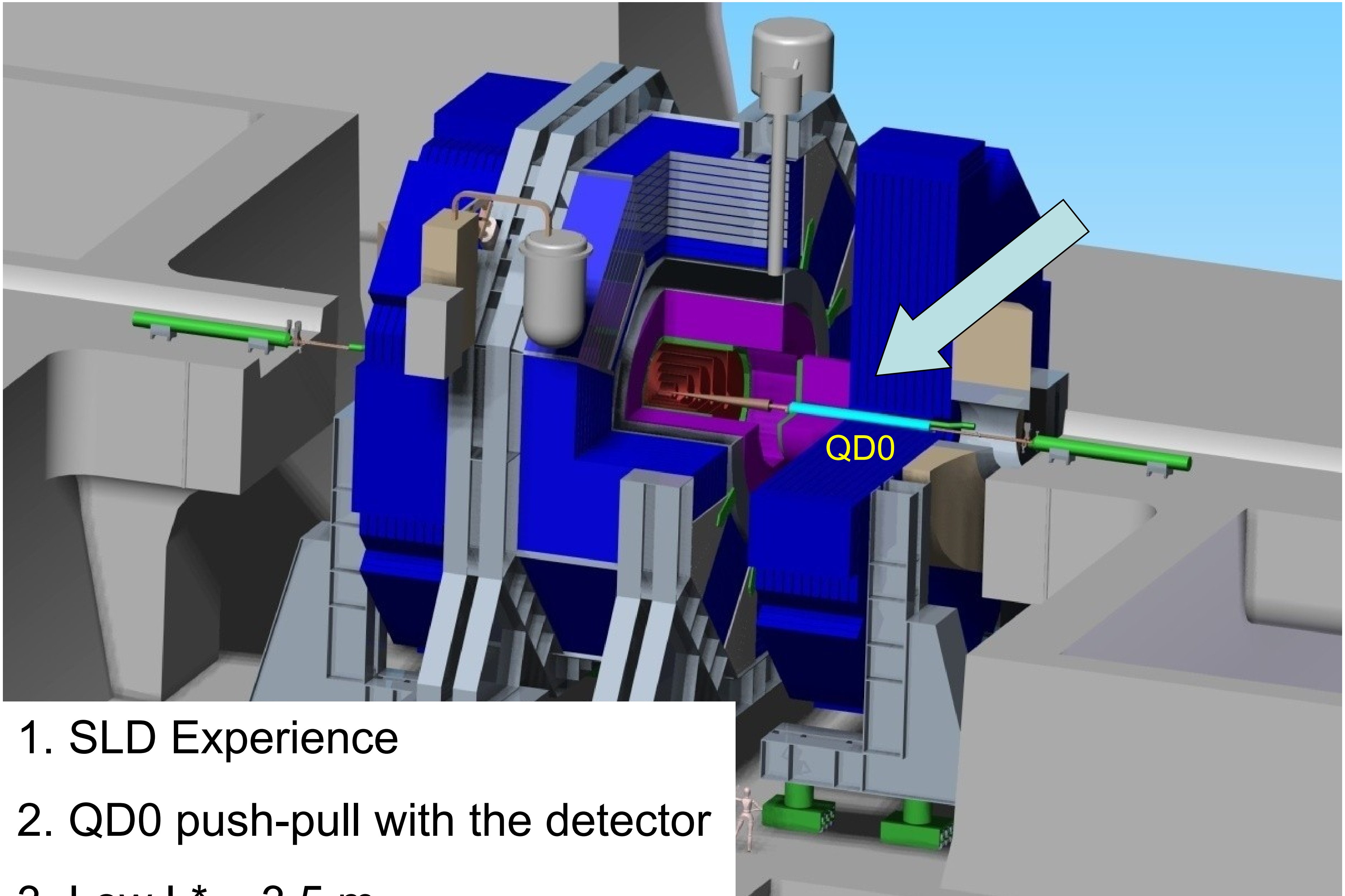
1. Push Pull

2. Vibrations

Other SiD - MDI talks in this conference :

Sunday,	Vibration Measurements and Transfer Functions at SLAC,	K. Bertsche
Monday,	Feedback Analysis with current xfer functions & beam parameters	G.White
Monday,	SR Update,	M. Sullivan
Monday,	HOM heating at the IP and in QD0,	A. Novohatski
Monday,	FSI Alignment,	K. Riles

QD0 supported from the doors



1. SLD Experience
2. QD0 push-pull with the detector
3. Low L* ~ 3.5 m

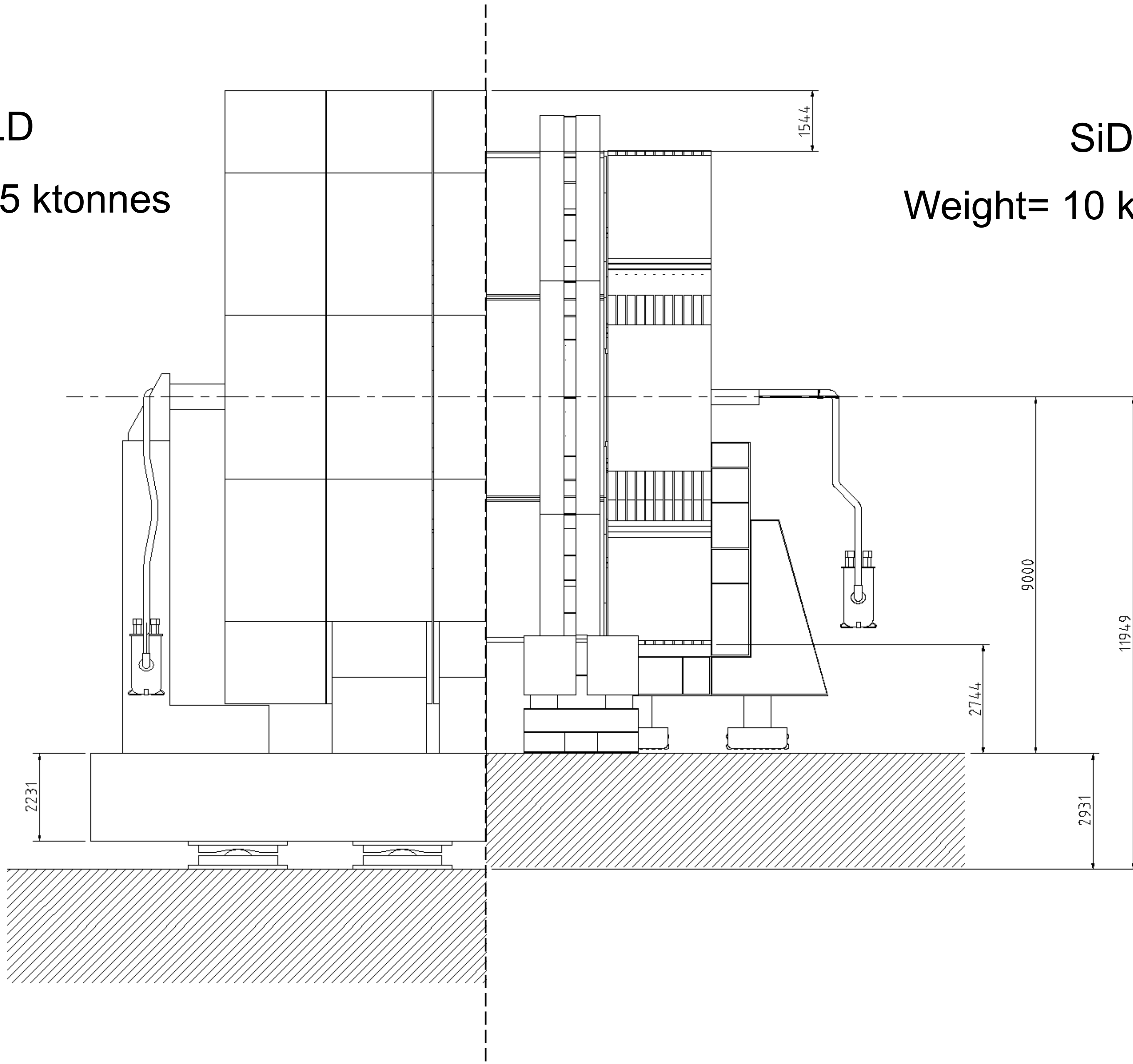
ILD and SiD differences

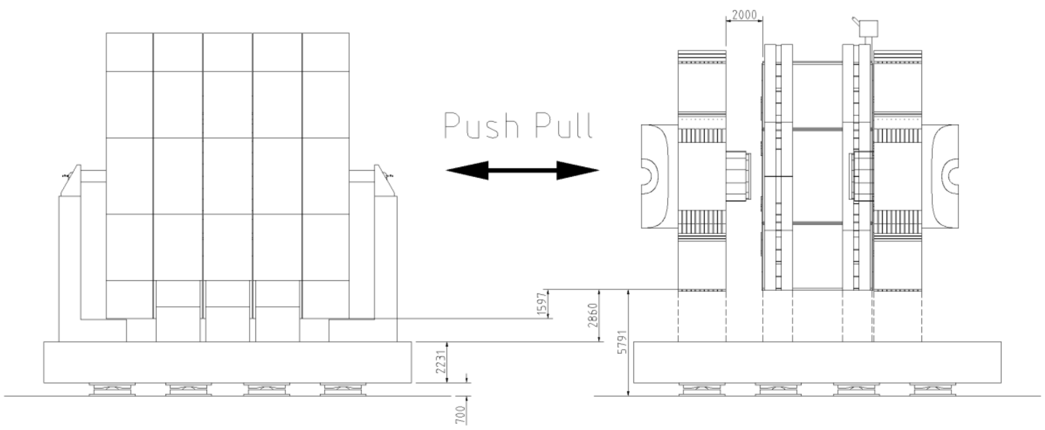
ILD

Weight= 15 ktonnes

SiD

Weight= 10 ktonnes

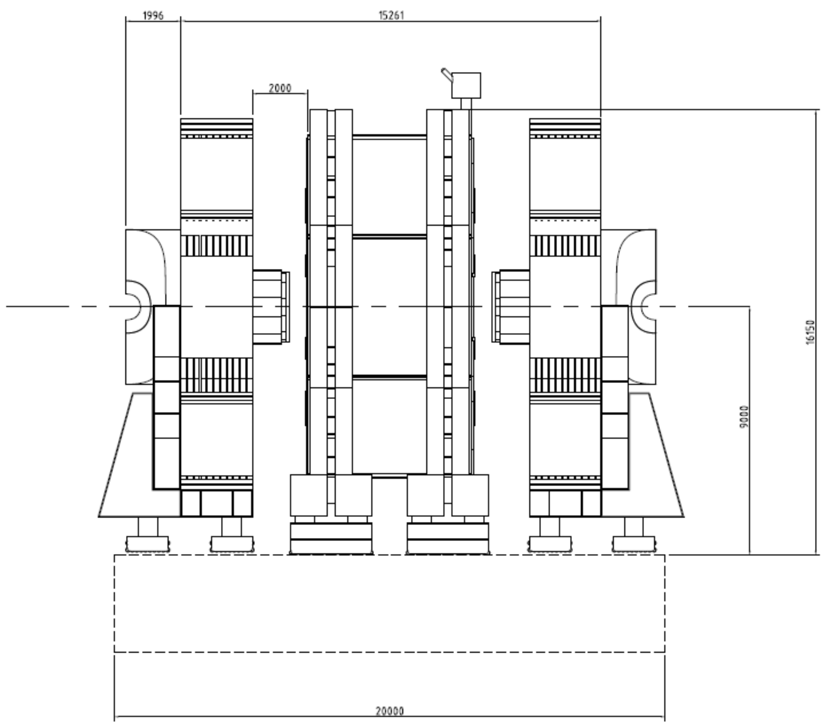


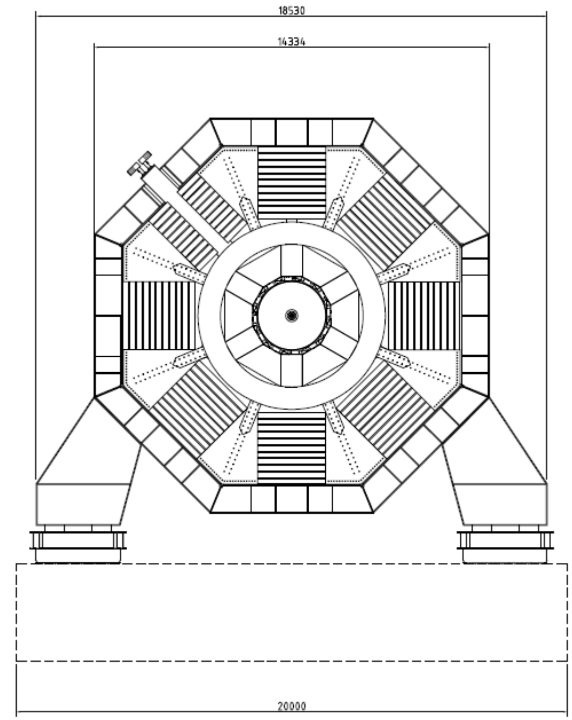


Option 3, ILD and SiD on platforms

Under Study

SiD Platform Functional Requirements





SiD nominal mass: Barrel   5000 T; (each) Door 2500 T

Dimensions:

Z = 20.0 m

X = 20.0 m

Delta Y = 9 m (Top of Platform to beamline)

Positioning Tolerance on beamline

Consider points Z=+-max, X=0. Position to + 1mm wrt references in X,Y,Z

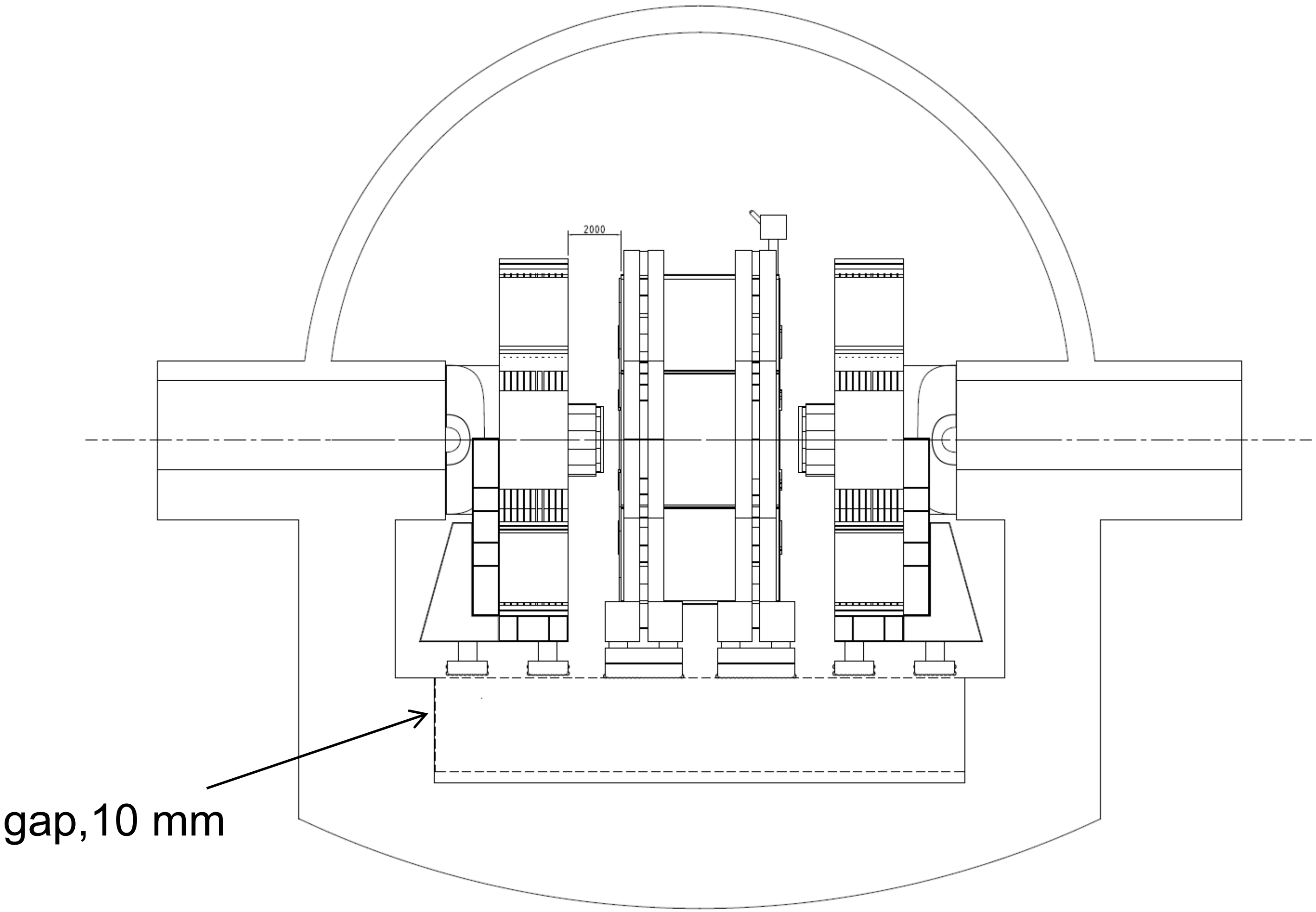
Consider points Z=+-max, X=+-max: Position to +- 1 wrt references in Y.

Static Deformations: <+-2 mm

Vibration budget < 50nm between 1 and 100 Hz, at the QD0’s (relative)

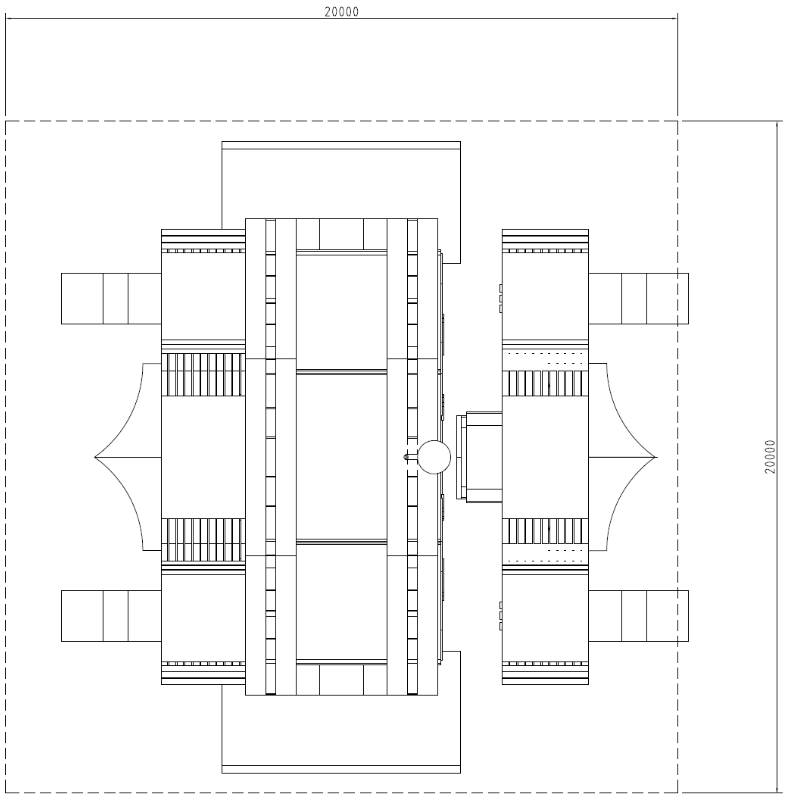
Seismic stability: Appropriate for selected site. (Beamline must be designed with sufficient compliance that VXD will survive)

SiD Platform Functional Requirements

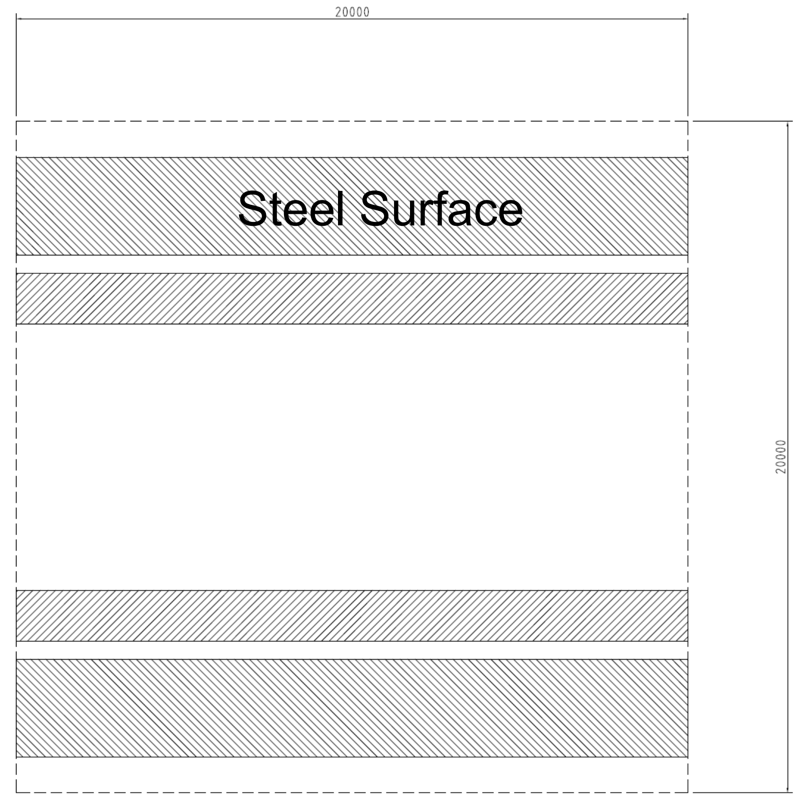


Wall clearance ~10 mm. Platform comes to side wall, there is no apron or apron matches platform elevation.

SiD Platform Functional Requirements



Detector on platform Top View

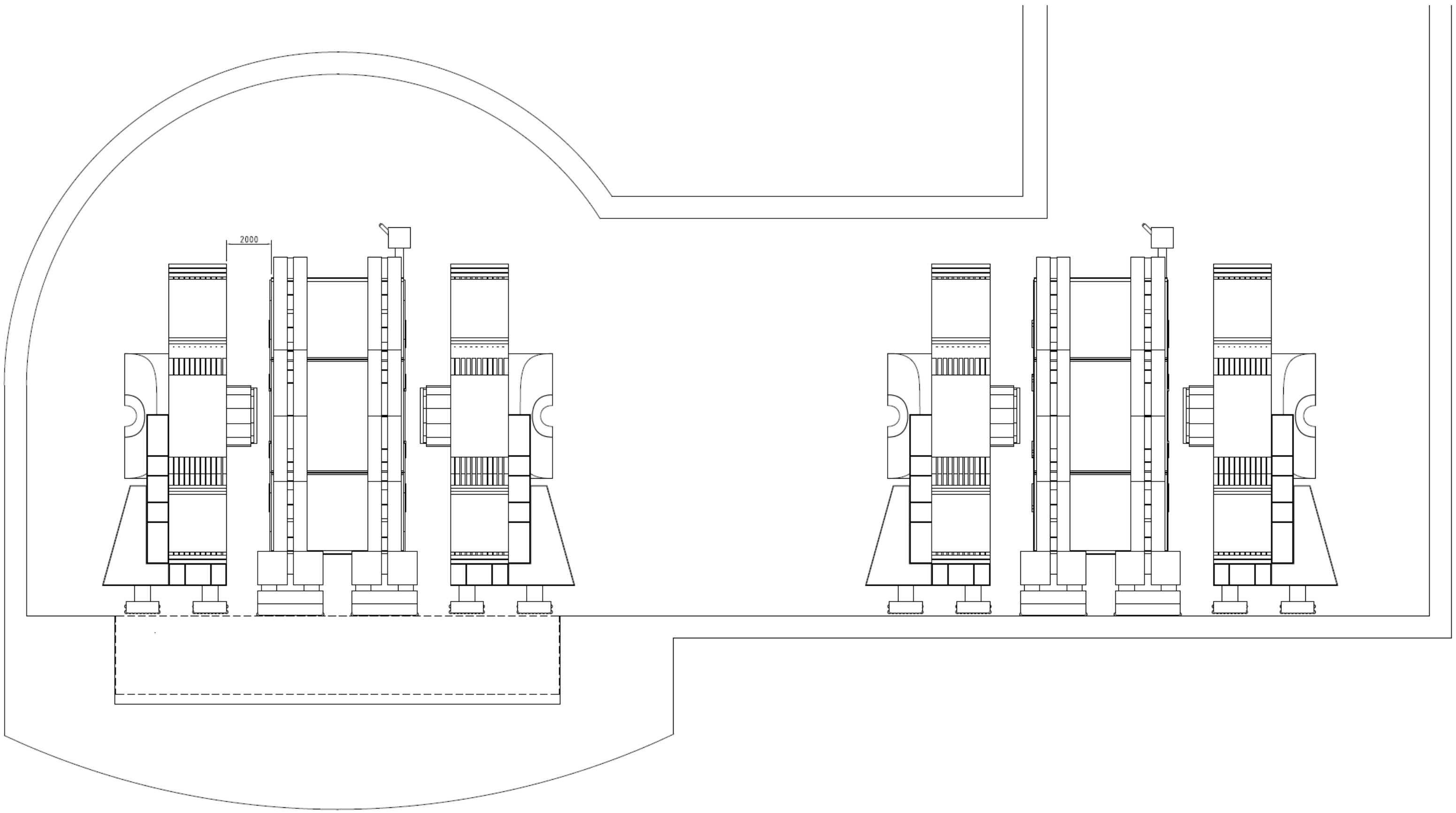


Platform Top View

Surface Features:

- Steel Surface near legs
- Steel rails for doors
- “Receptacles” for tie seismic tiedowns of SiD Barrel and Doors
- Removable Safety railings

SiD Platform Functional Requirements



Accelerations: <1 mm/s^2

Transport velocity: V>1 mm/s after acceleration

Life: 100 motion cycles.

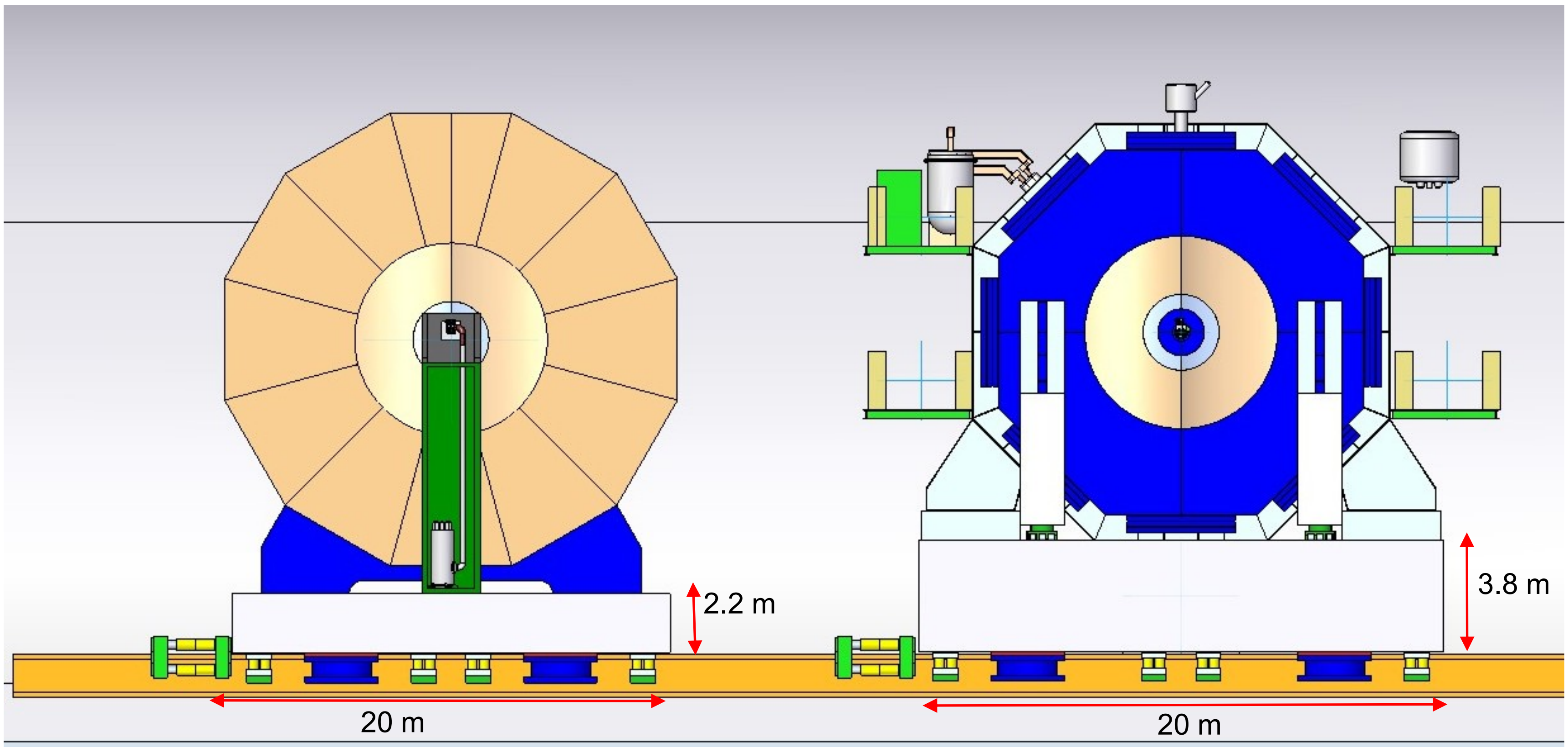
Reliability: Transport modularity must be such that repairs/replacement/maintenance can be accomplished in garage position and within 20 elapsed days.

Any equipment required for transport shall reside below the platform surface.

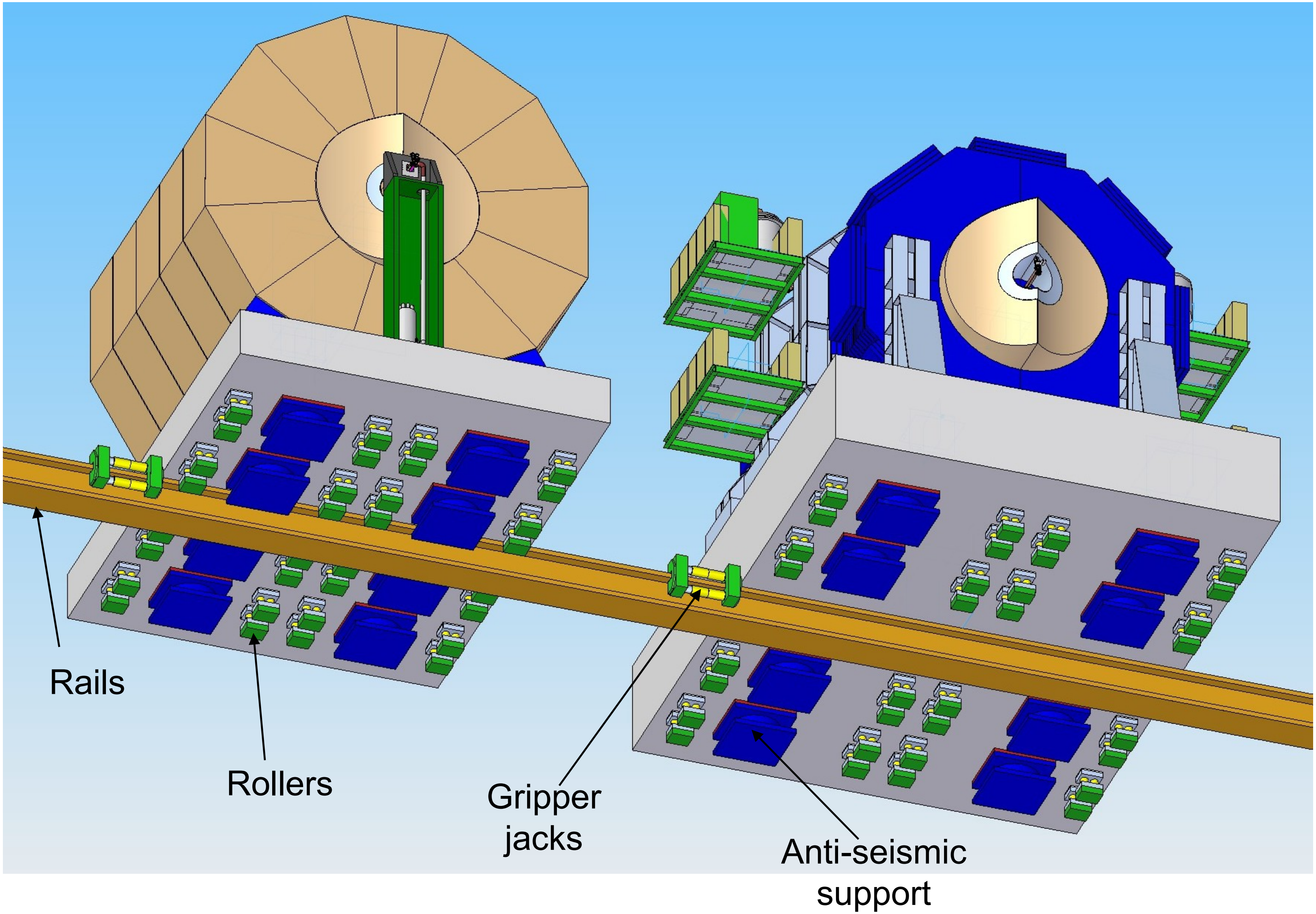
Transport equipment shall not eject particulates that reach platform surface (need spec on how much)

Thick platform

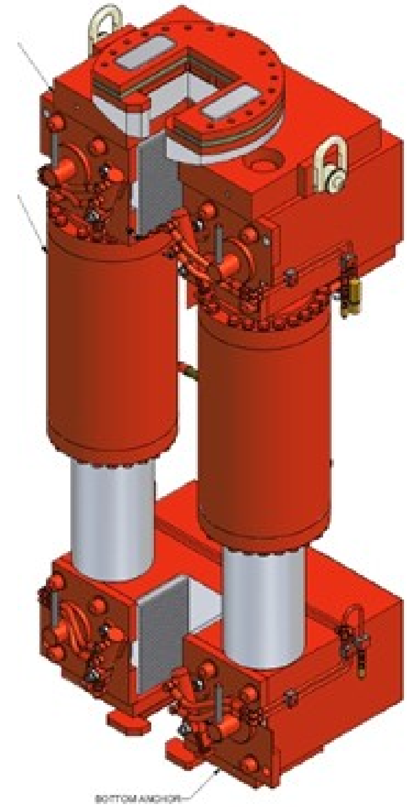
Extra Height to accommodate the difference of the two detectors



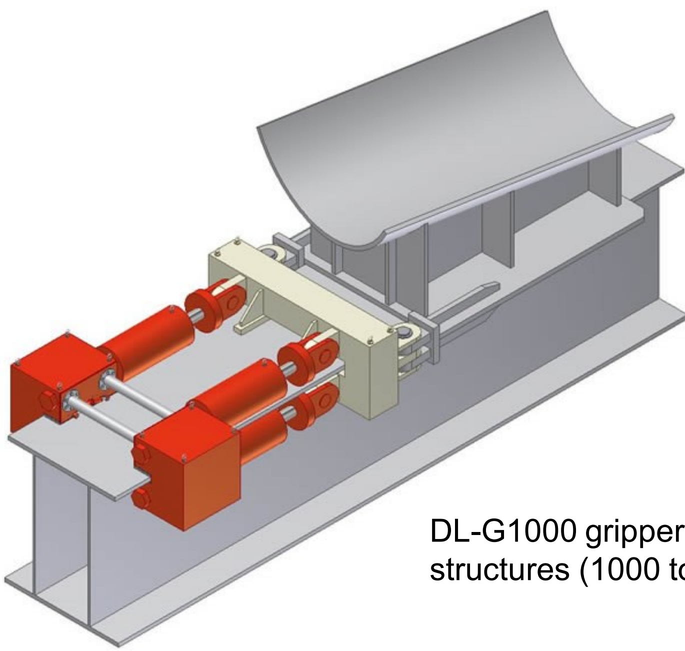
Gripper Jacks on rail



Motion system



Gripper Jacks, 1’000 T



DL-G1000 gripper jack for load out of offshore structures (1000 tonnes push / pull capacity)

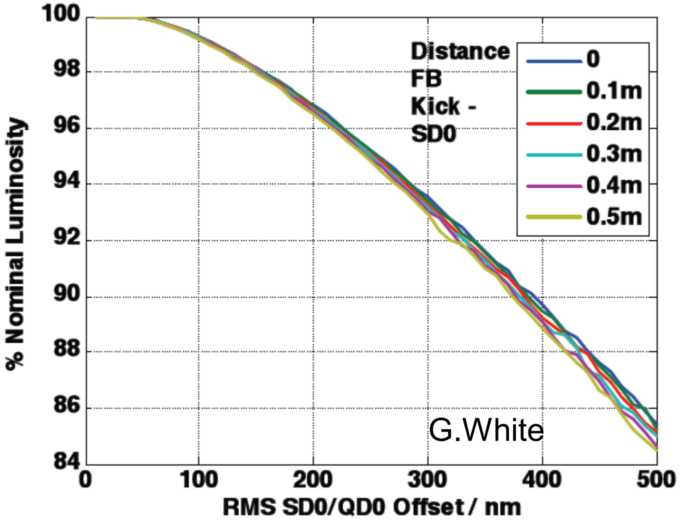
Vibrations

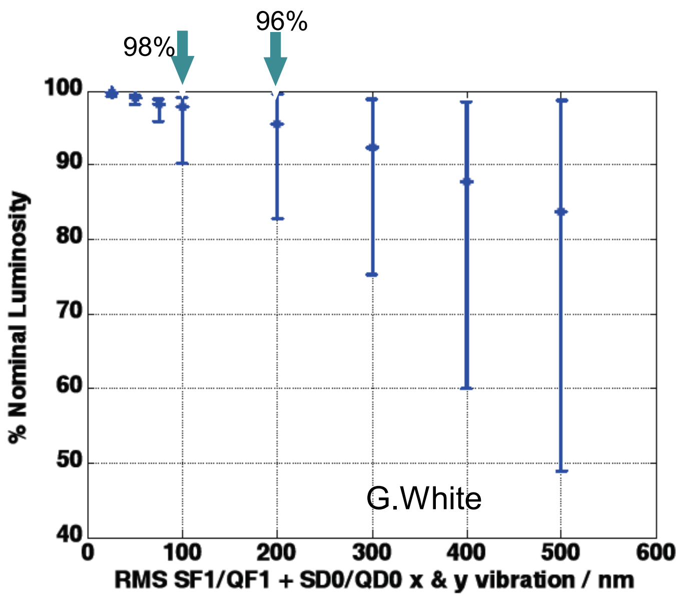
QD0 stability Requirements

Most acute luminosity loss mechanism due to relative jitter of final focusing magnet elements : Ground Motion and Mechanical vibration sources

ILC has Active Fast Feedback based on beam trajectory after collision

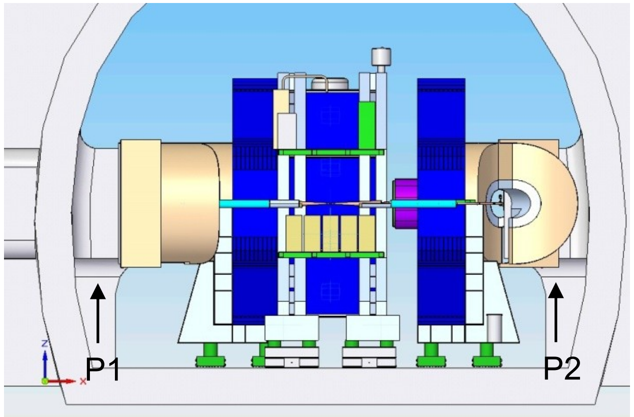
Max. Integrated displacement: 100÷200 nm > 5 Hz

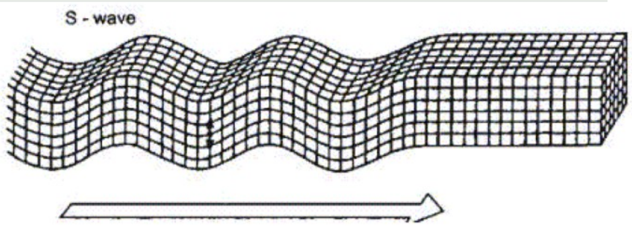




Lumi loss due to beam offset in SD0 (beamsize growth) and IP misalignment of beams

Vibrations : Absolute, Relative and Coherent and motion





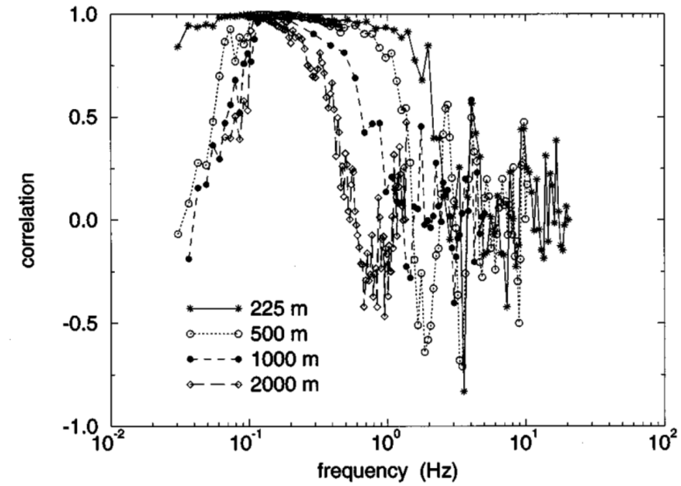


FIG. 3. Correlation spectra of ground motion measured at CERN in the LEP tunnel [7]. The distances between sensors were 225, 500, 1000, and 2000 m.

Coherence : $N_{12}(f) = \dfrac{p_{12}}{\sqrt{p_1 p_2}} = J_0(\omega L/v)$

If P1=P2, then :

Jo = 0th Bessel function

L= distance between points

v = speed of sound in rock, ~3 km/s

$$\rho(\omega,L) = p(\omega)2\{1 - \mathrm{Re}[N_{12}(\omega,L)]\}.$$

Relative displacement spectrum

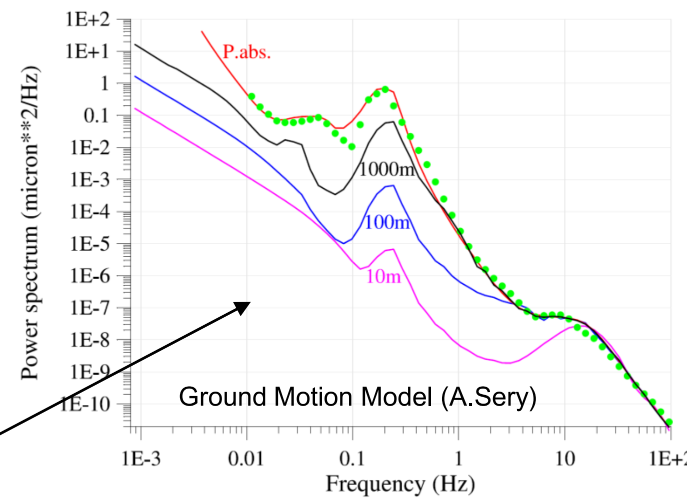
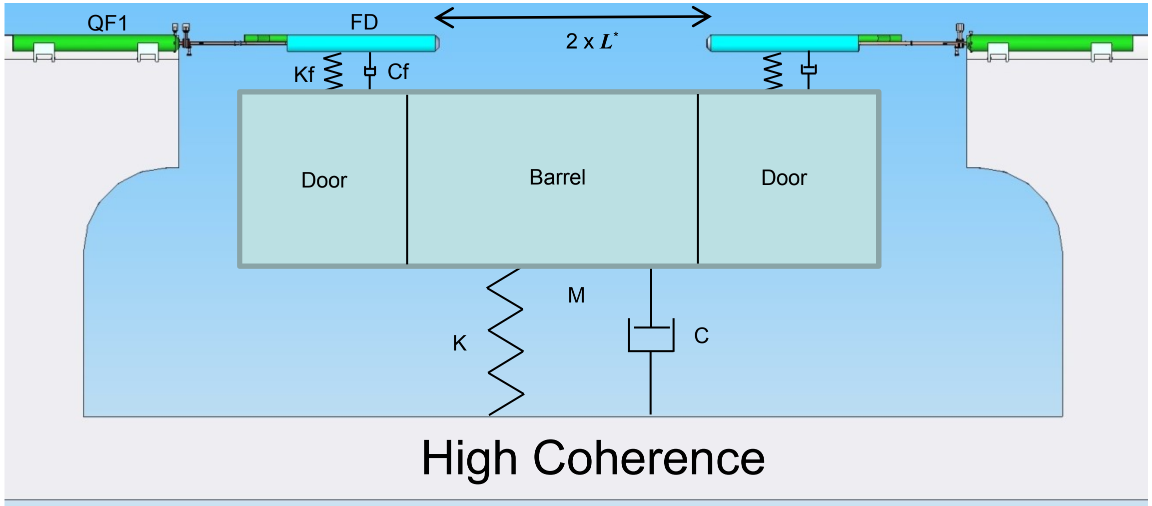
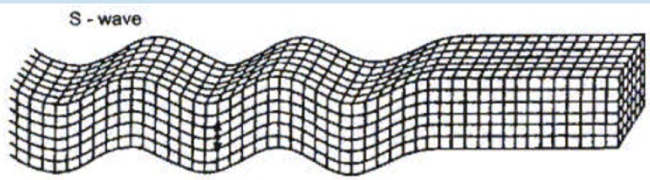
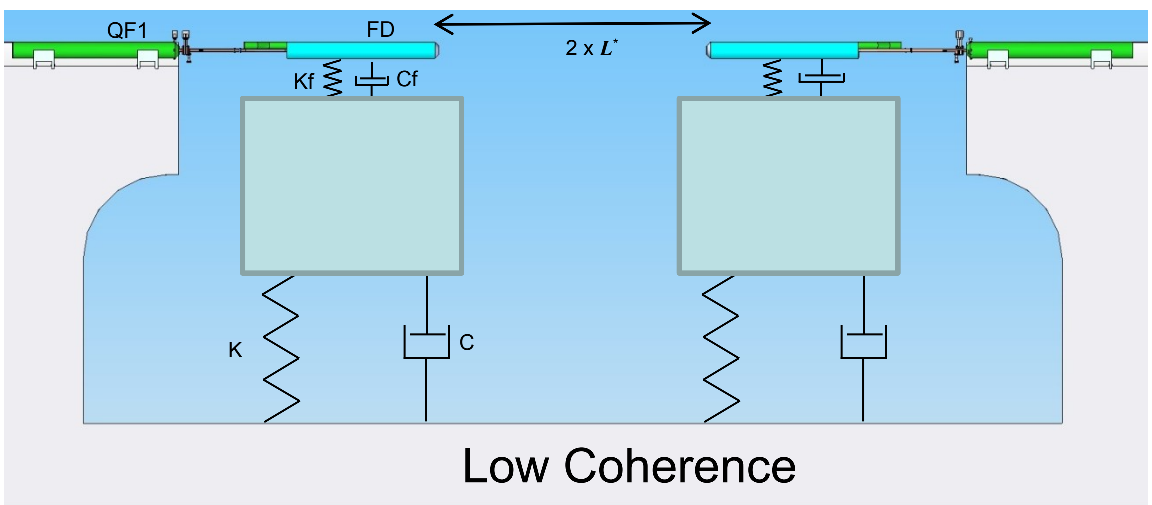


Figure 3: Measured (symbols) and modeling spectra $p(\omega)$ of absolute motion and $p(\omega, L)/2$ of relative motion for the 2 a.m. SLAC site ground motion model.

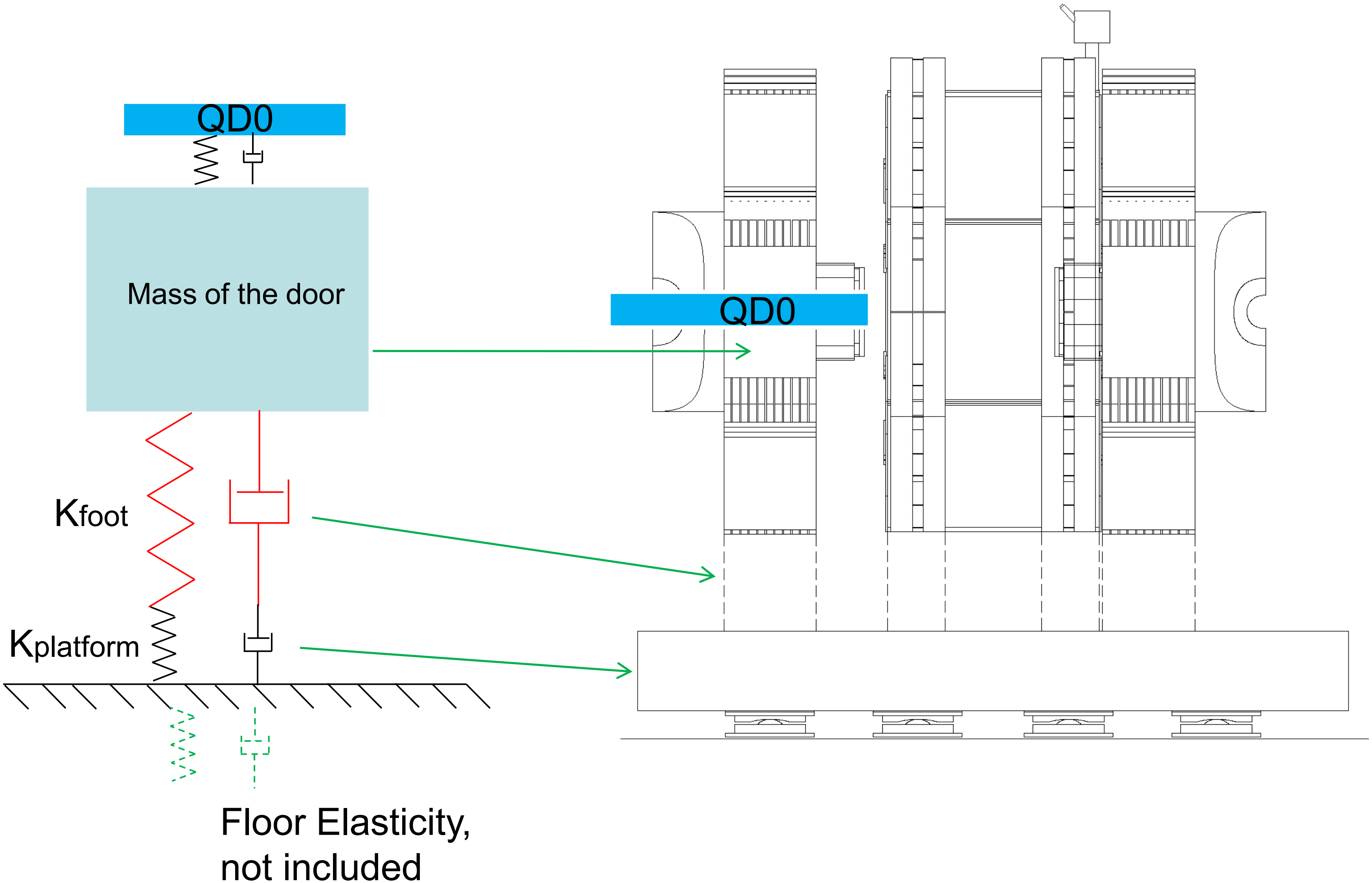
QD0 Supports



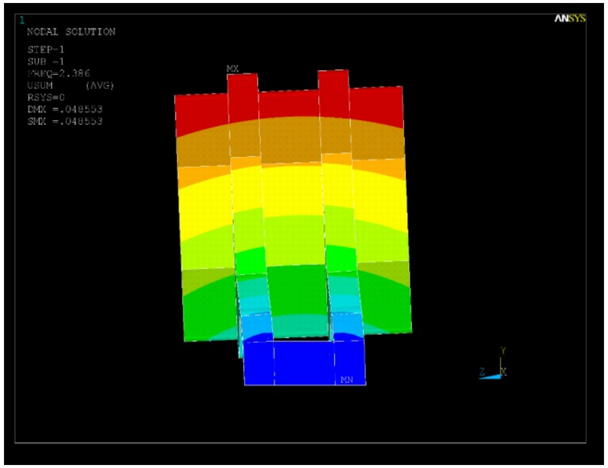




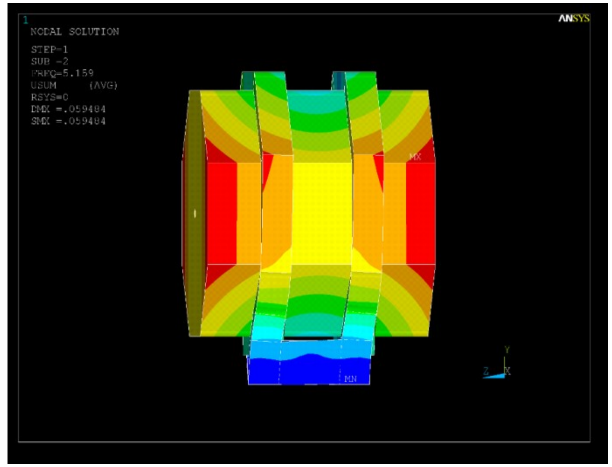
SiD Vibration Model : 1 degree of freedom M,K,C oscillator



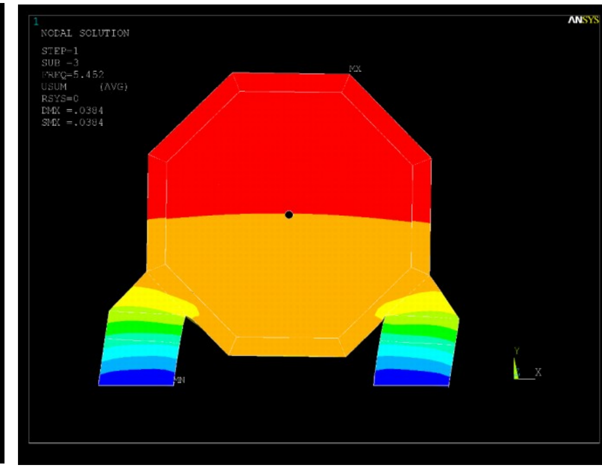
SiD Free Vibration Mode



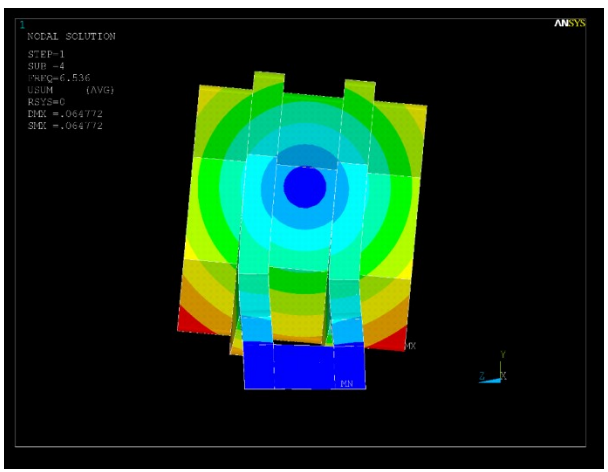
1st Mode, 2.38 Hz



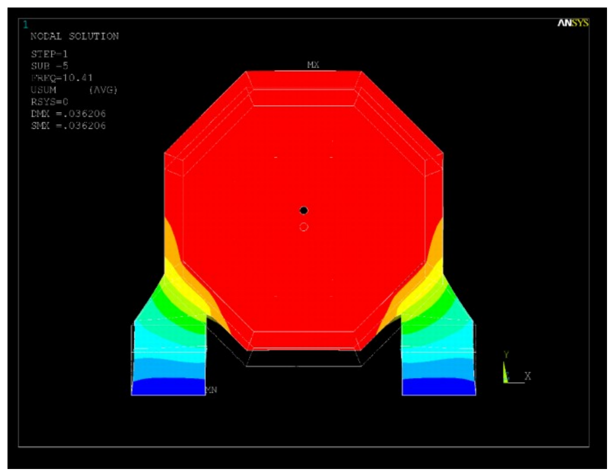
2nd Mode, 5.15 Hz



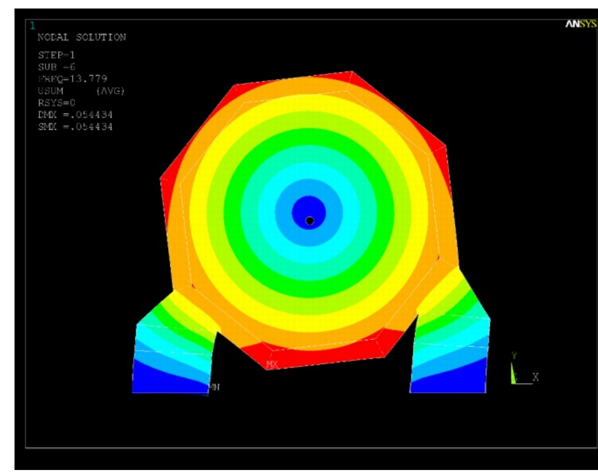
3rd Mode, 5.45 Hz



4th Mode, 6.53 Hz



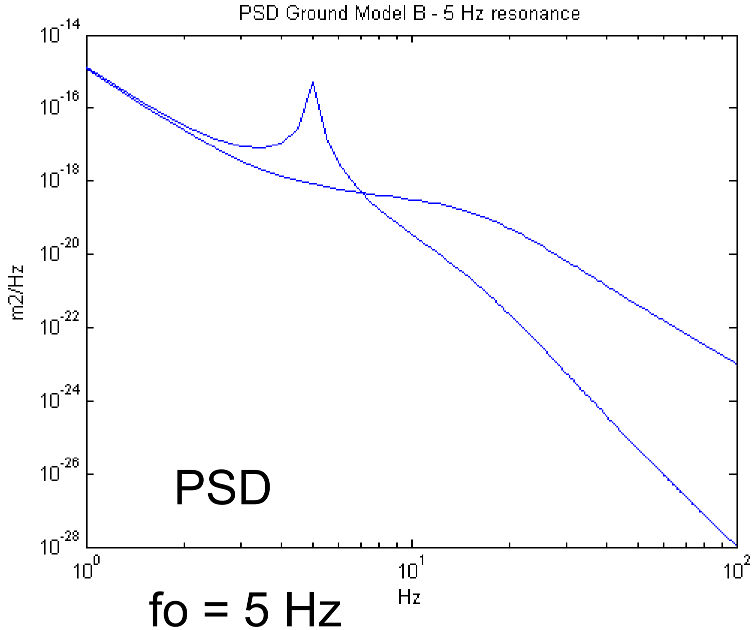
5th Mode, 10.42 Hz

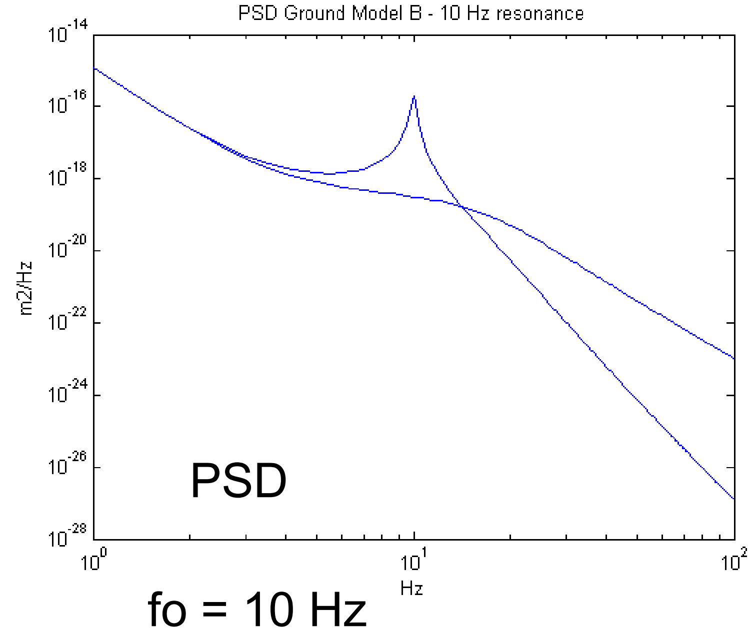


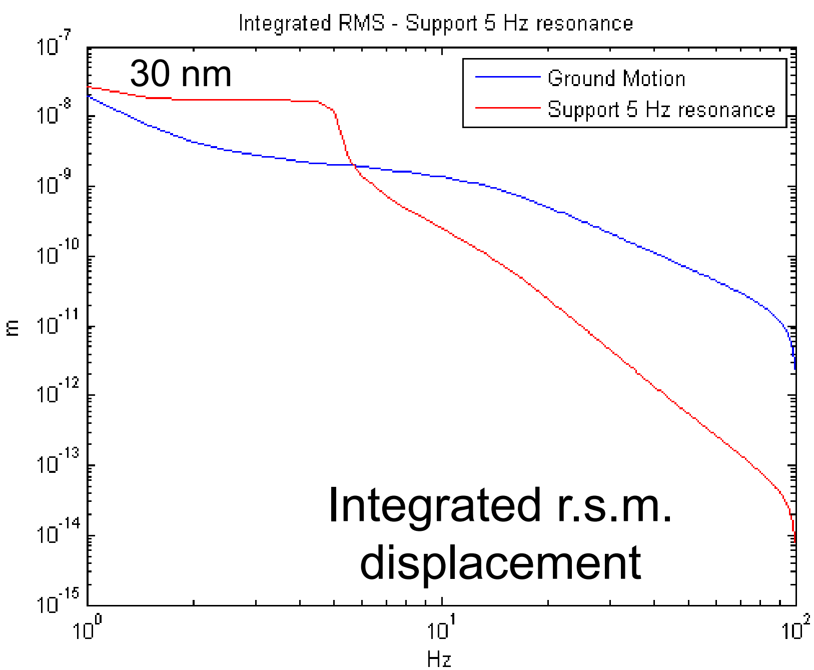
6th Mode, 13.7 Hz

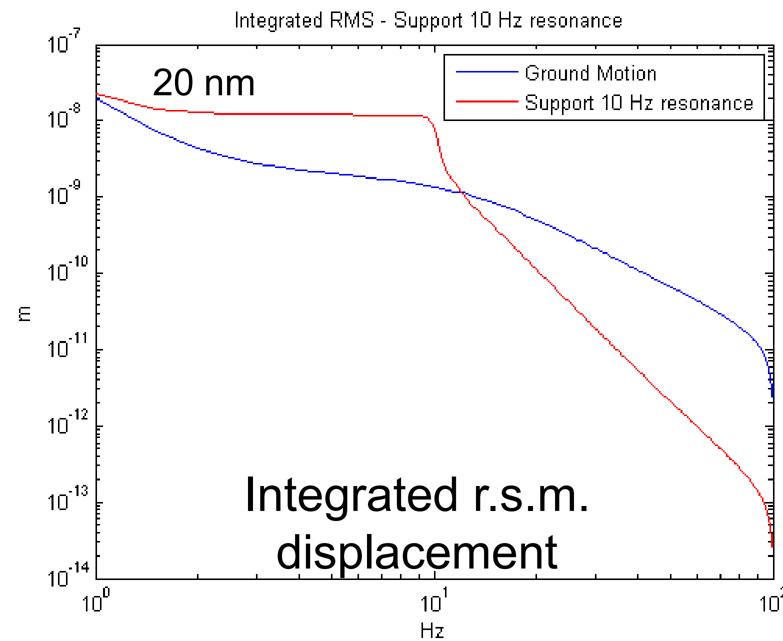
Vertical motion

Random vibration Studies : SiD O.K. on the floor, no platform

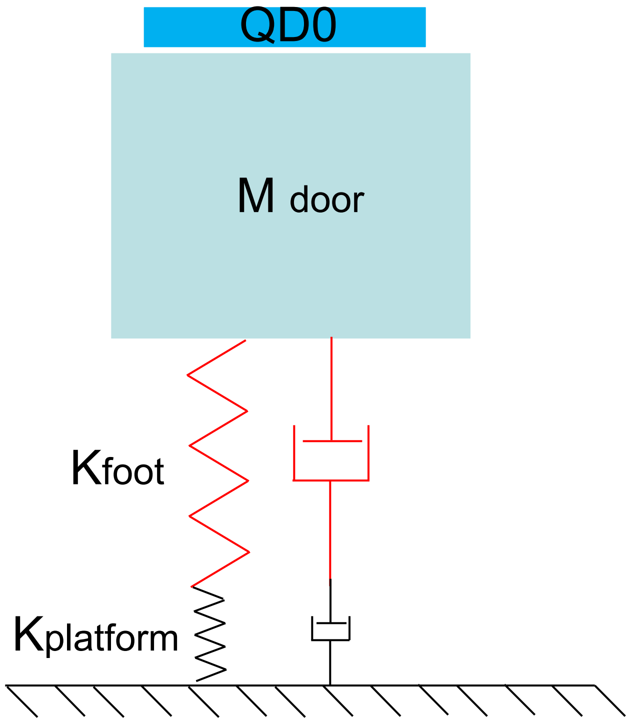








SiD Vibration Model : 1 degree of freedom M,K,C oscillator



$$f_n = \sqrt{\frac{f_f^2 f_p^2}{f_f^2 + f_p^2}}$$

1st mode system

f_f = 1st mode SiD foot

f_p = 1t mode platform

c = 2%

f_{foot} = 10 Hz from FEA,

$f_{platform}$ =

6 Hz, supported edges

15 Hz, int. support, door-on-platform

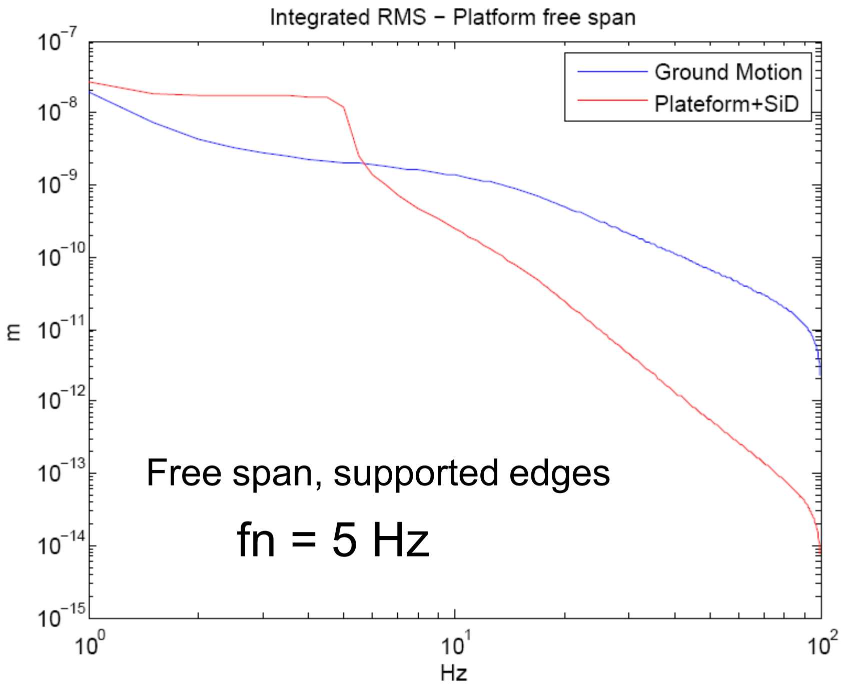
30 Hz, int.support, door-on-barrel

f_n =

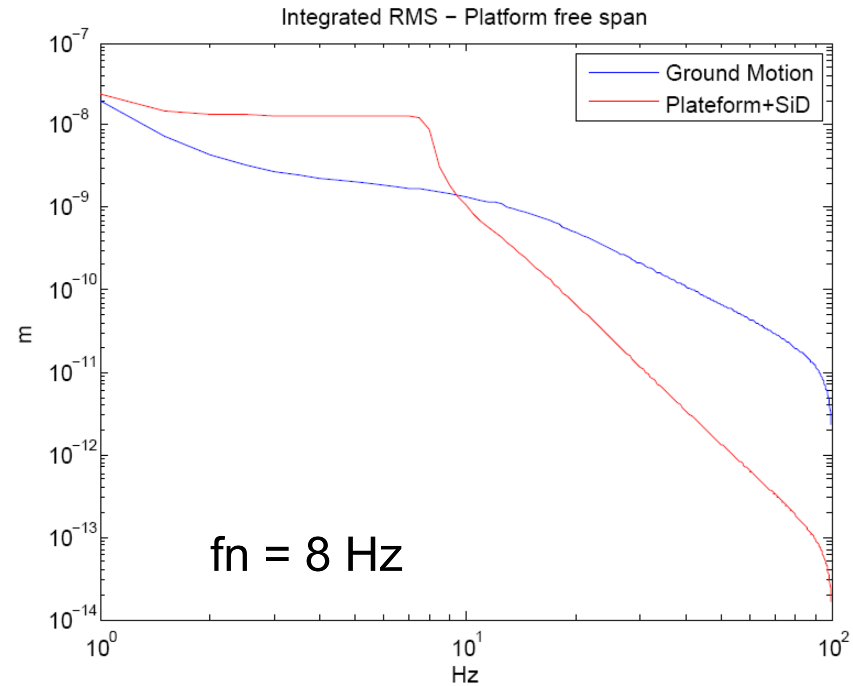
5 Hz

8 Hz

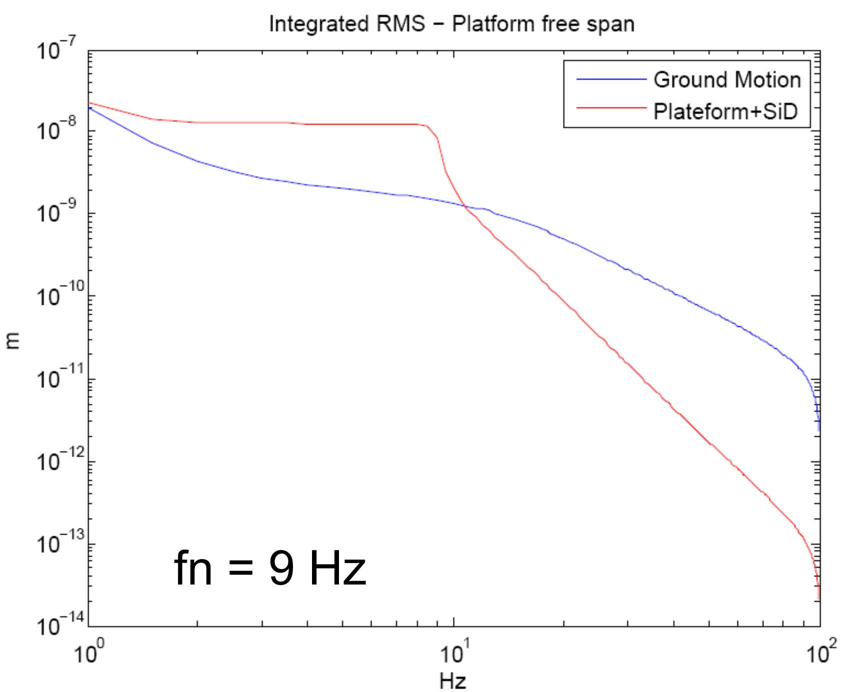
9 Hz



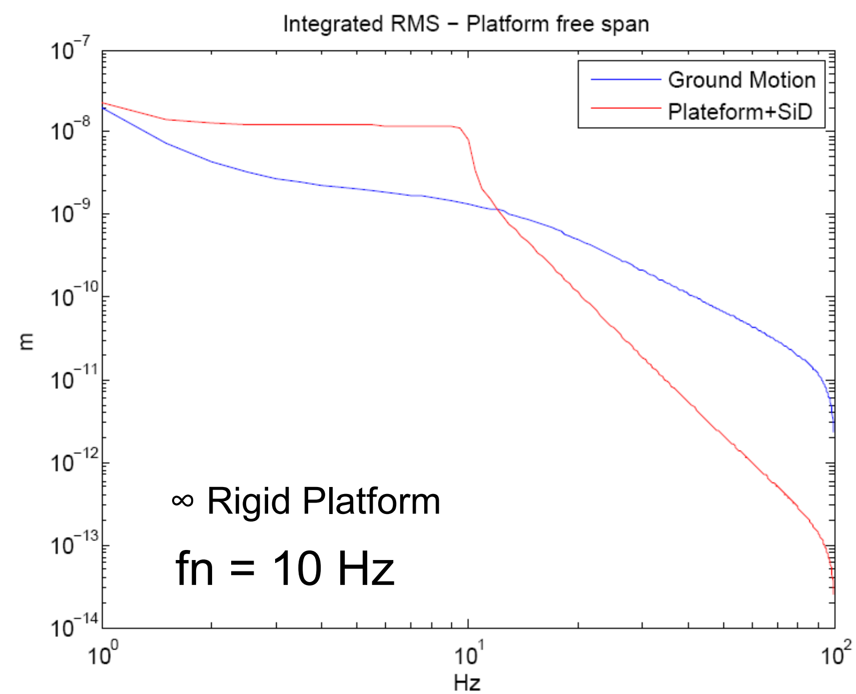
Integrated RMS – Platform free span
Ground Motion
Plateform+SiD
m
Hz
Free span, supported edges
fn = 5 Hz



Integrated RMS – Platform free span
Ground Motion
Plateform+SiD
m
Hz
fn = 8 Hz



Integrated RMS – Platform free span
Ground Motion
Plateform+SiD
m
Hz
fn = 9 Hz

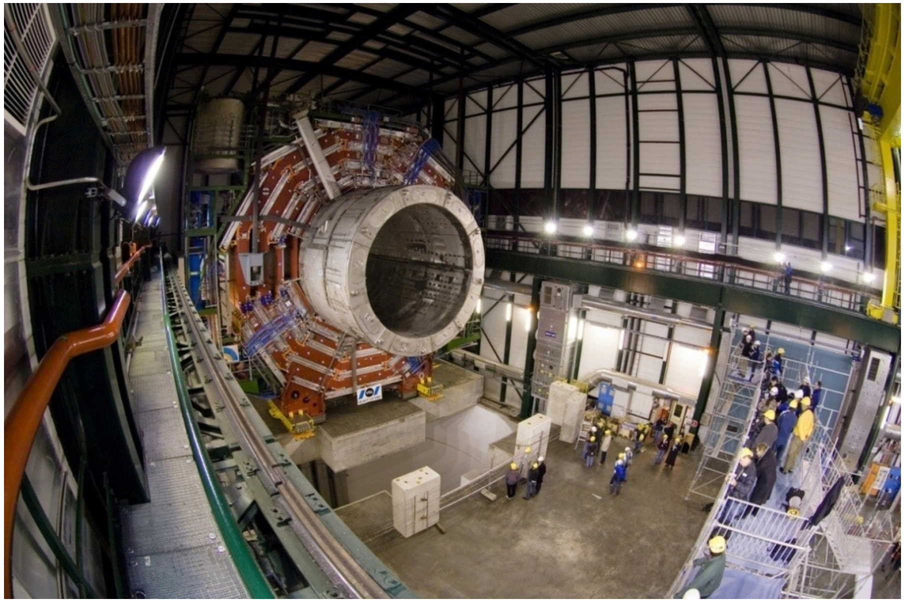


Integrated RMS – Platform free span
Ground Motion
Plateform+SiD
m
Hz
∞ Rigid Platform
fn = 10 Hz

Platform Simulation

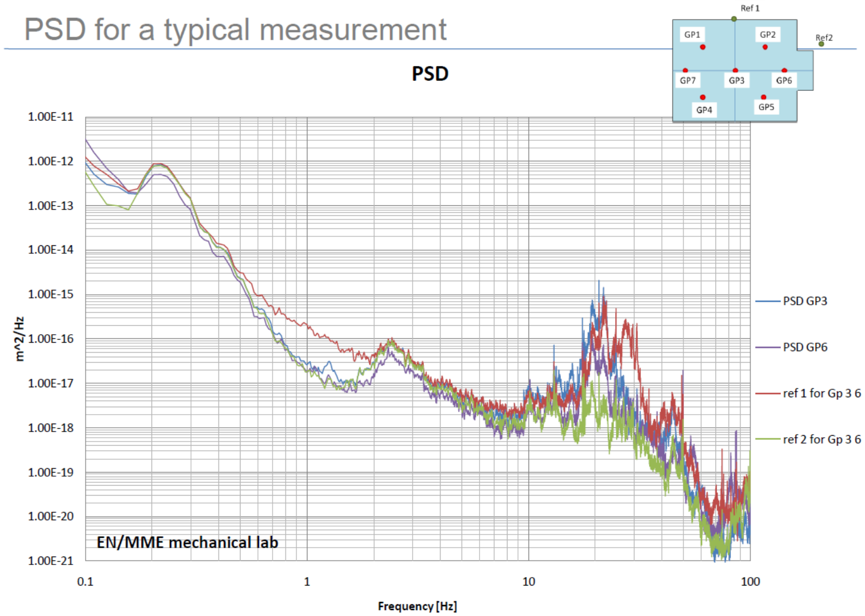
Benchmark with exp.data

The CMS Plug

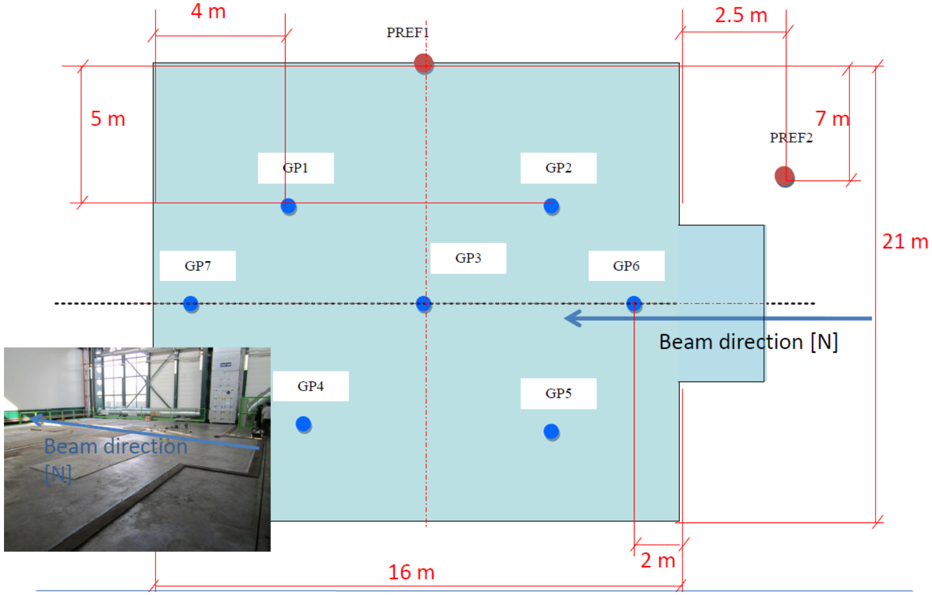


Experimental Vibration measurements – CMS Plug

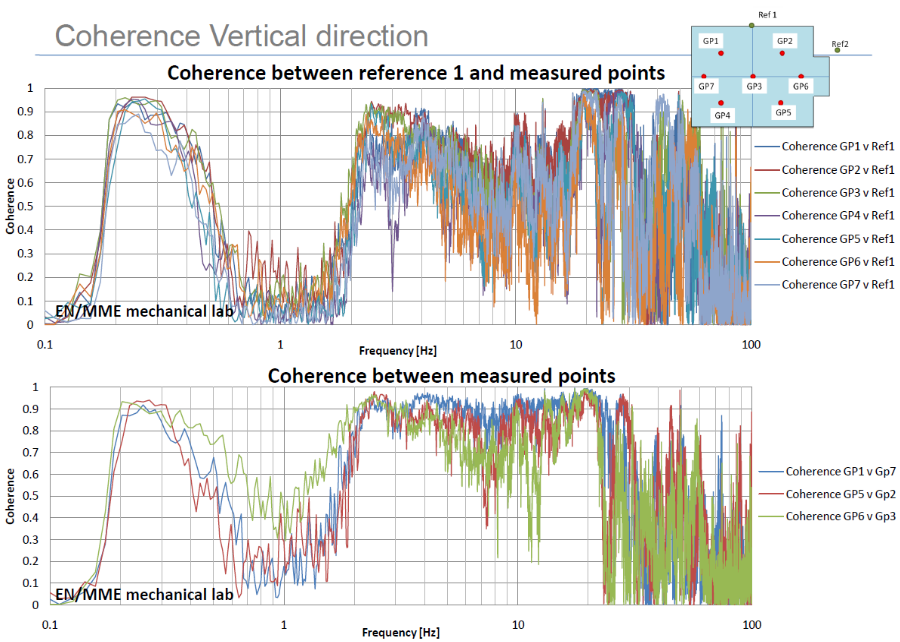
PSD for a typical measurement



Sensor position

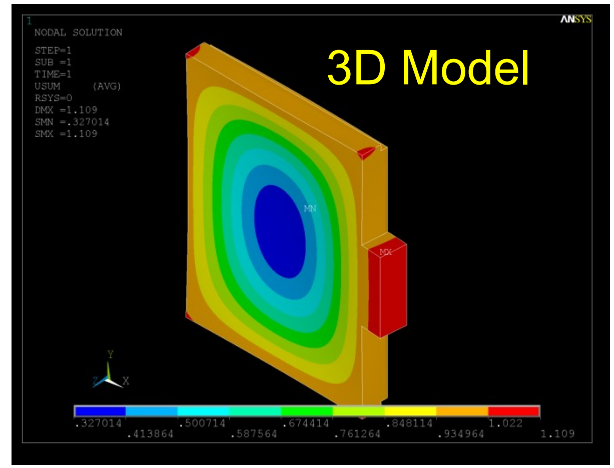


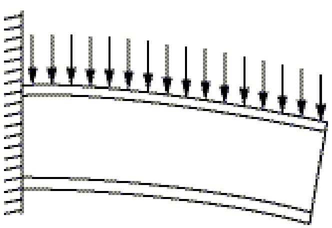
Coherence Vertical direction



Finite Element Model, 3D vs. 2D

CMS Platform





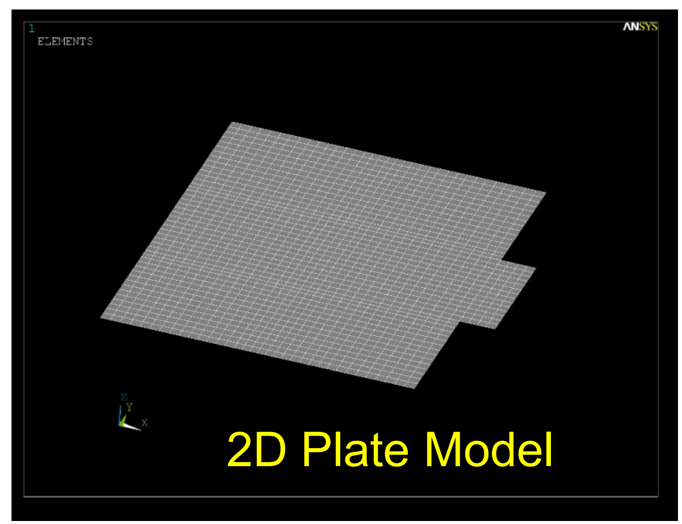
Deformed shape without
sandwich option

iron re-bars (equivalent th. 25 mm)

Concrete th. 2150 mm

Iron re-bars (equivalent th. 25 mm)

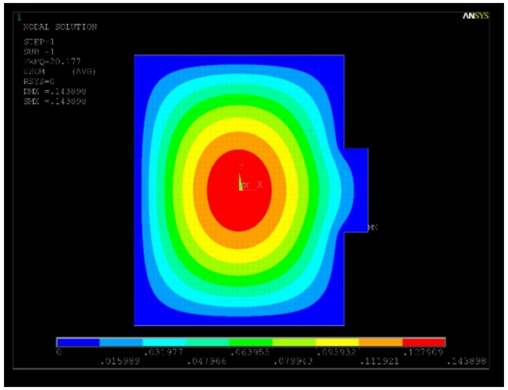
Total thick. 2.2 m



Free modes

Mode	FREQ
1	20.17
2	41.12
3	53.24
4	72.76
5	73.28
6	95.85

1



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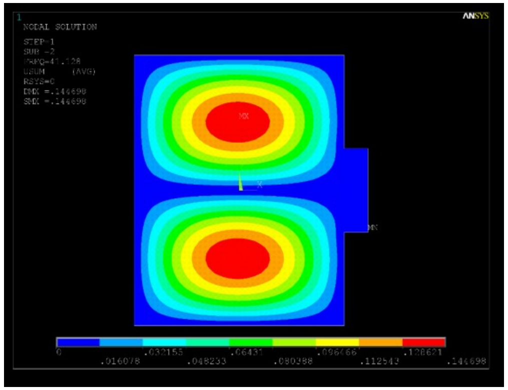

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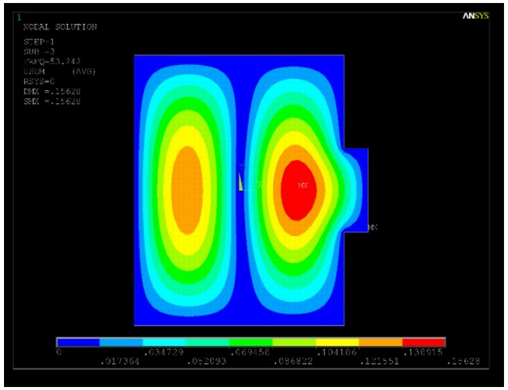

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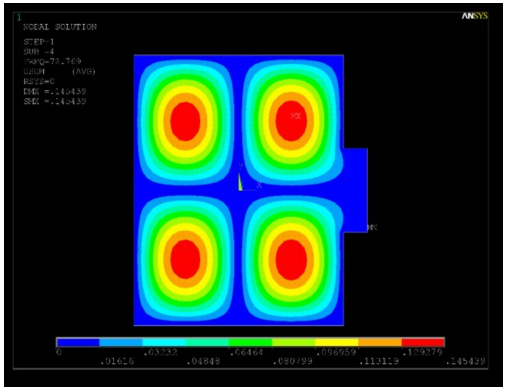

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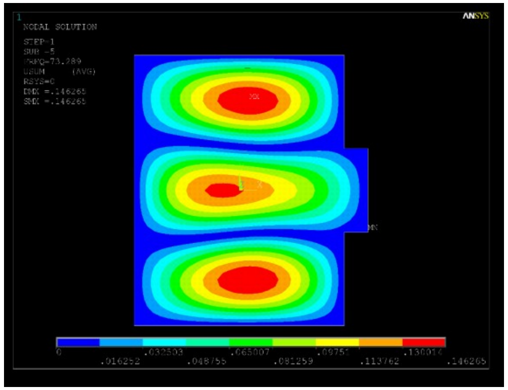
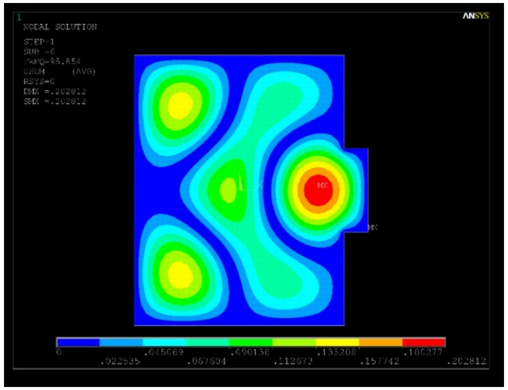
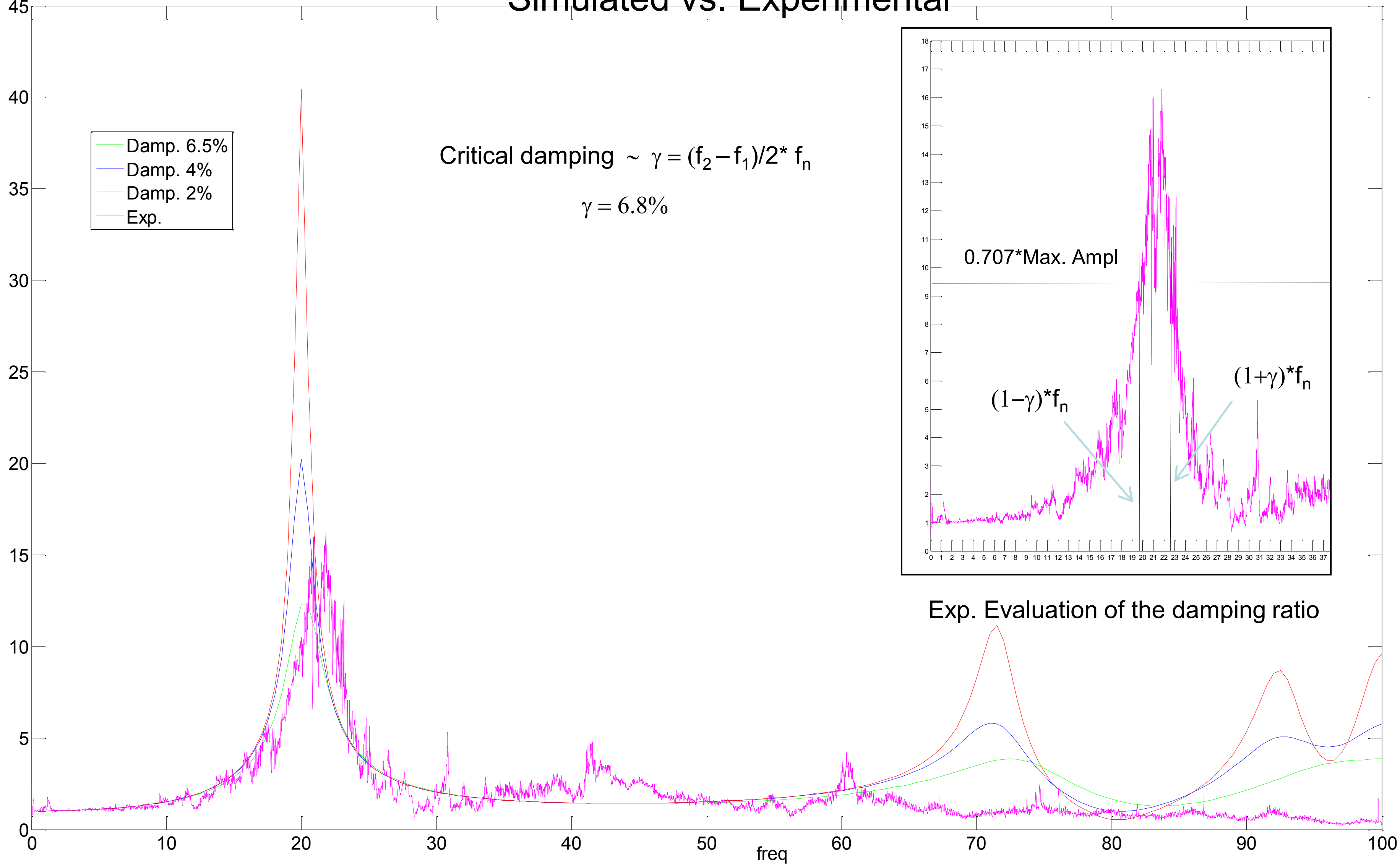


6

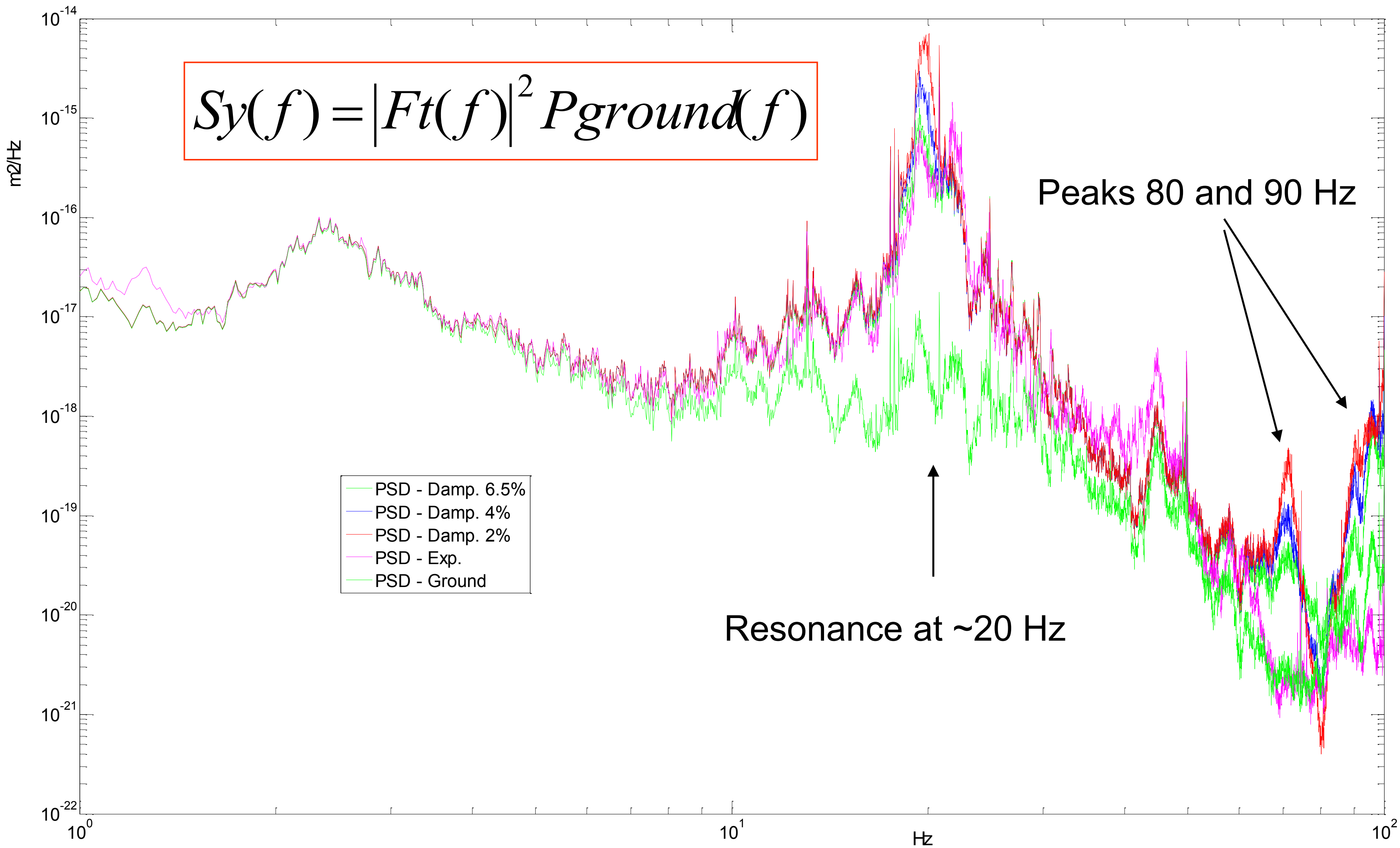


Transfer Functions - Middle Point (Geophone N.3)

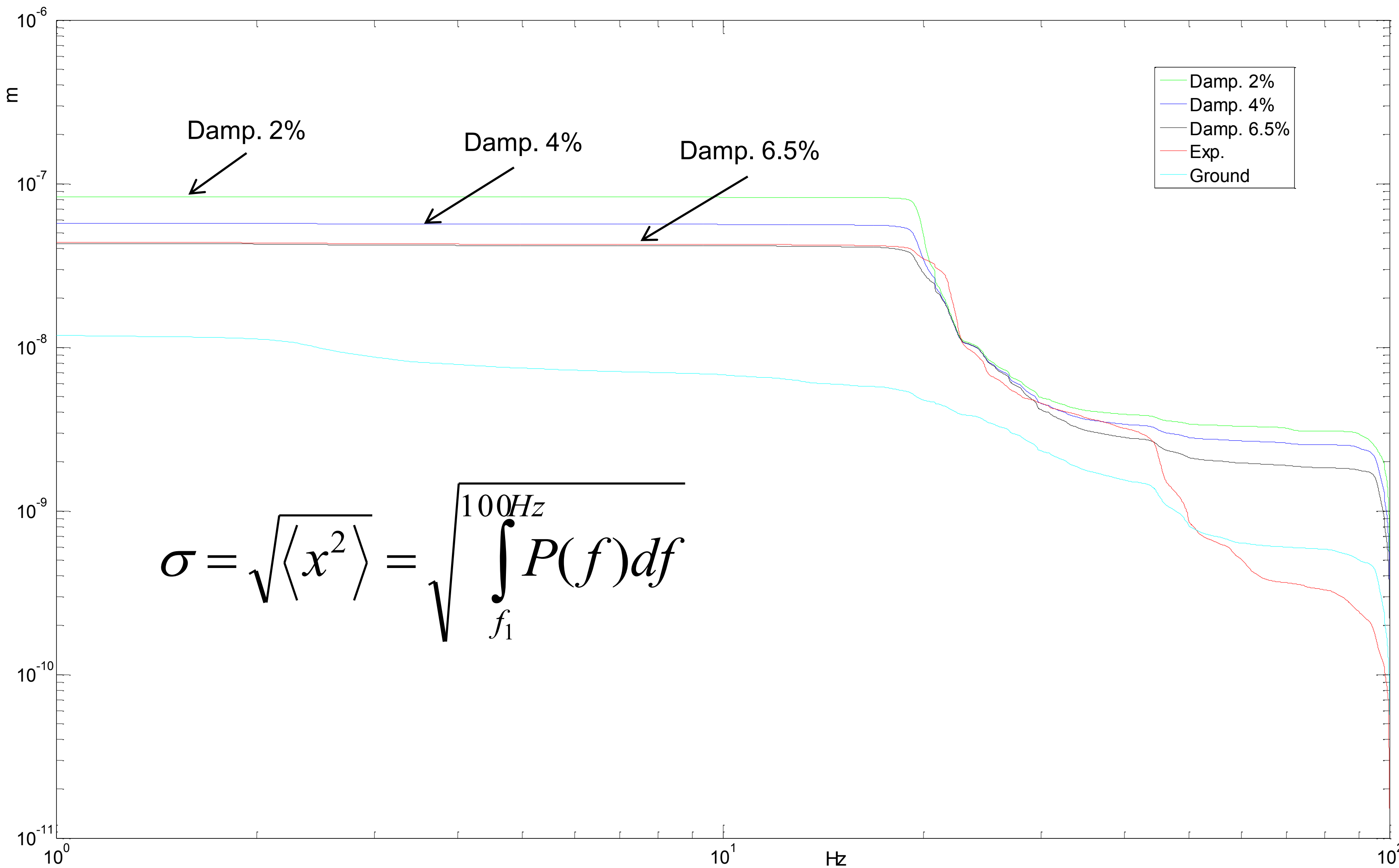
Simulated vs. Experimental



Simulations vs. Measured Power Spectra (Platform Center)



Integrated Displacement (r.m.s.)



$$\sigma = \sqrt{\langle x^2 \rangle} = \sqrt{\int_{f_1}^{100Hz} P(f)\,df}$$

Summary

SiD is designed with the QD0’s supported from the doors

SiD can be moved without a platform, ILD can’t. The Platform is the only compatible solution, which does not require modification in the design of both detectors

➡ SiD will move on a platform upon condition it meets functional requirements : dimensions, static, vibration, floor, etc

➡ With these requirements, we expect the platform designed by the CFS group. The two platforms do not need to be identical.

The effects of vibrations on beam stability remain a subject which need more studies

New set of experimental vibration data available for the CMS Pug/platform

The data have been used to benchmark FEA with positive results.

Experimental characterization of the dynamic properties of reinforced concrete structure is underway (See K.Bertsche talk today)