QD0 support and stability during the push-pull

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ILC Tokushin Kickoff Meeting

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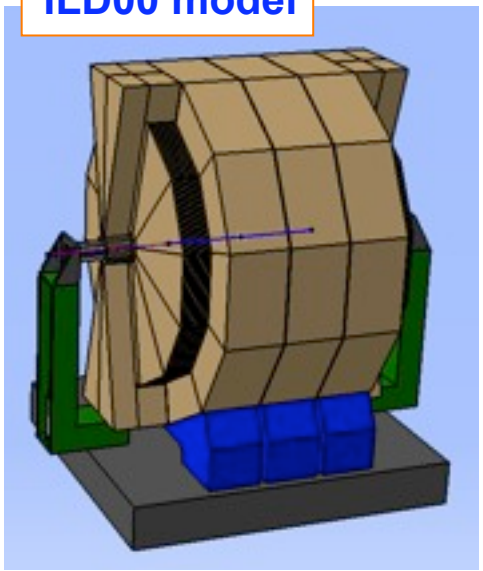
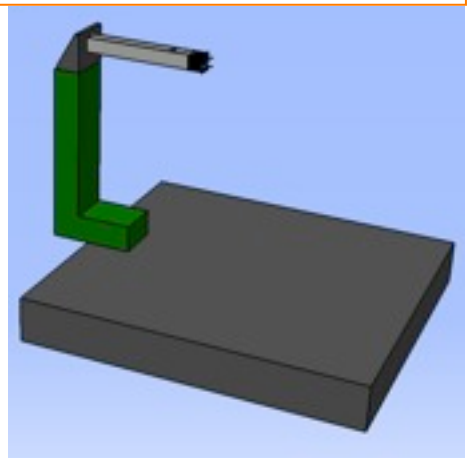
Introduction

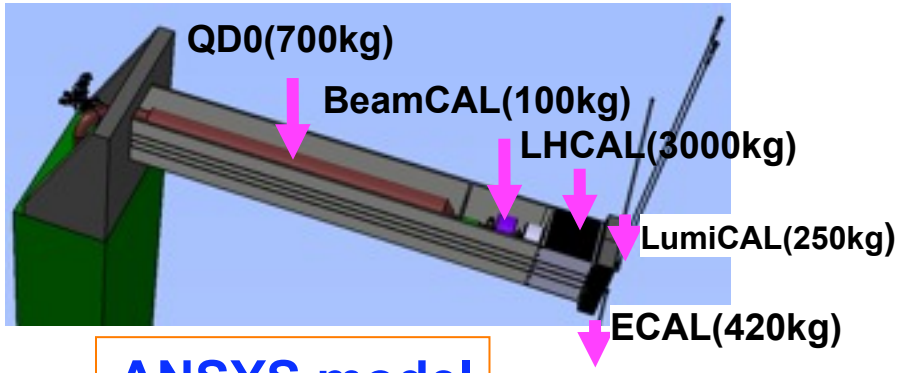
Vibration properties of the ILD QD0 support system has been studied.

ILD00 model

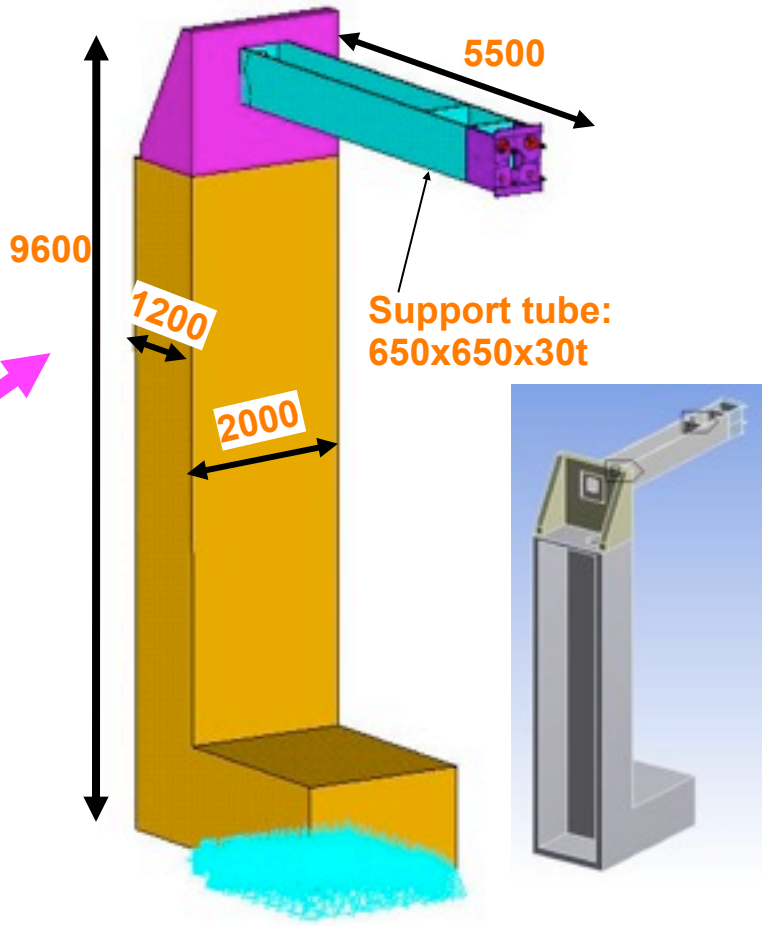


ILD QD0 support system



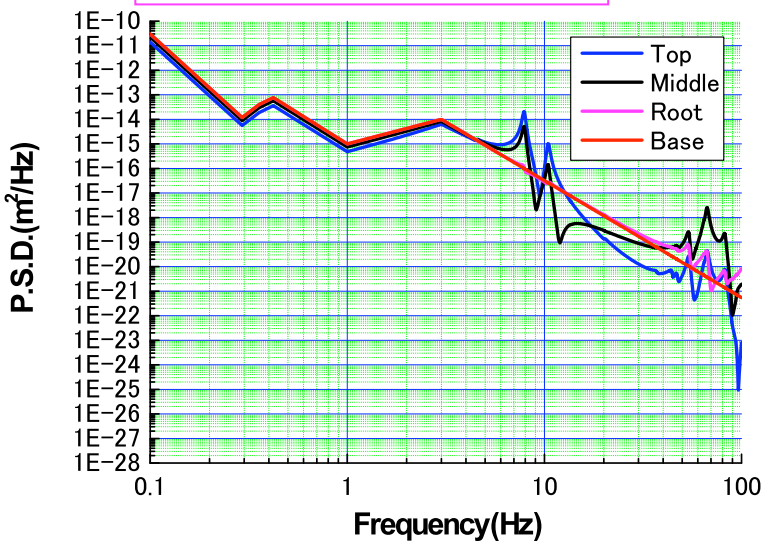


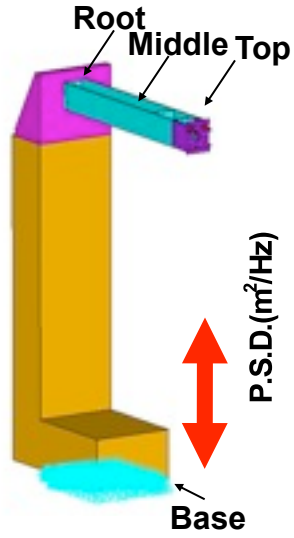
ANSYS model



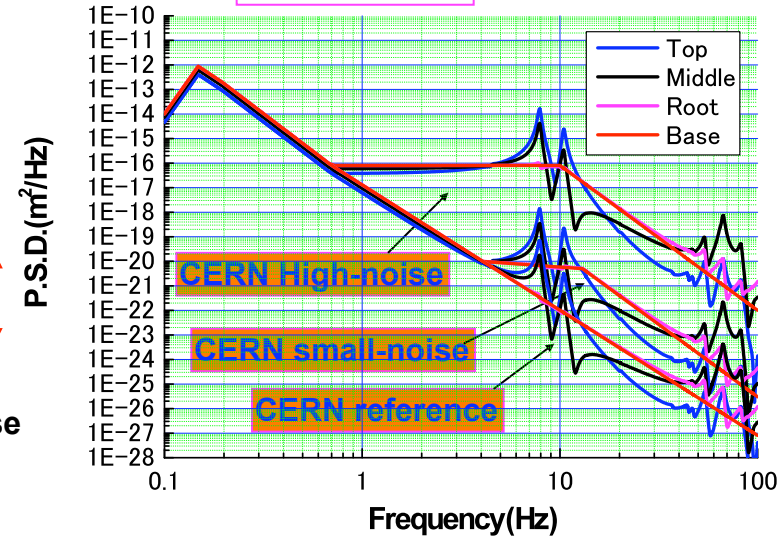
Calculation results: *Vertical direction*

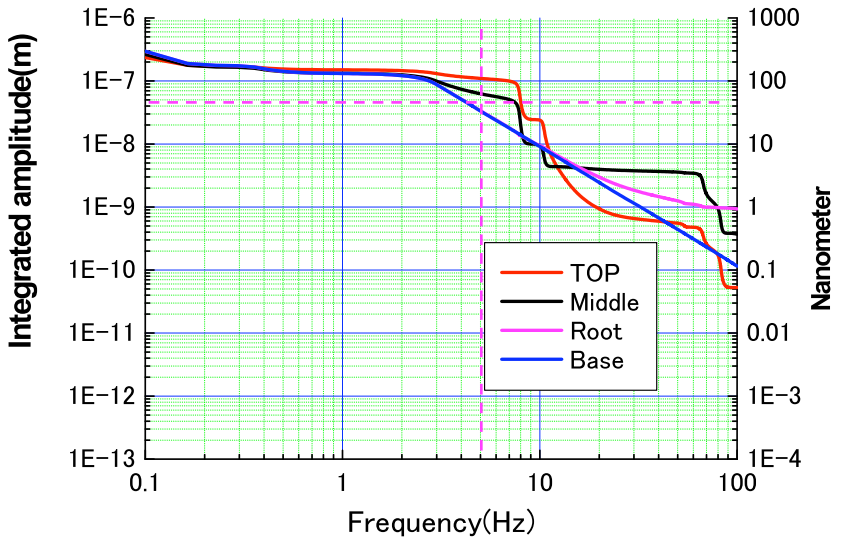
ATF-2004Feb10-17:00UD

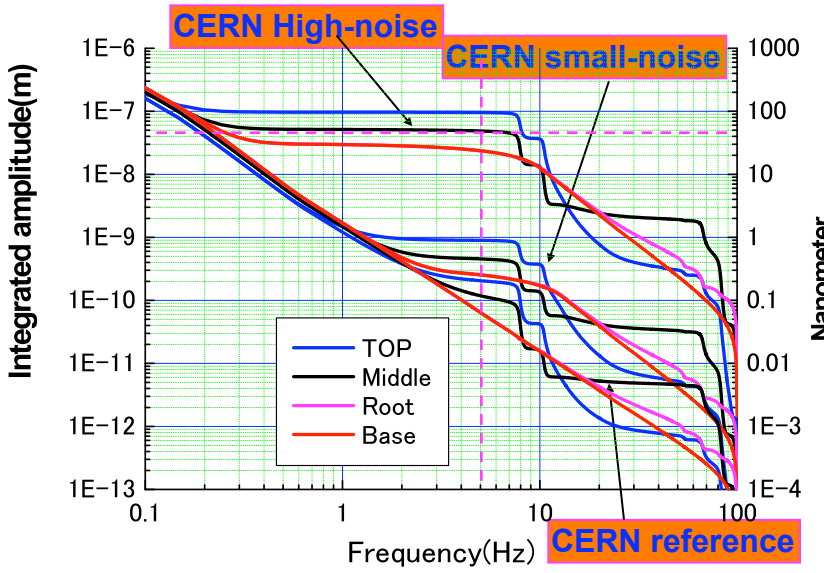




CERN-Data

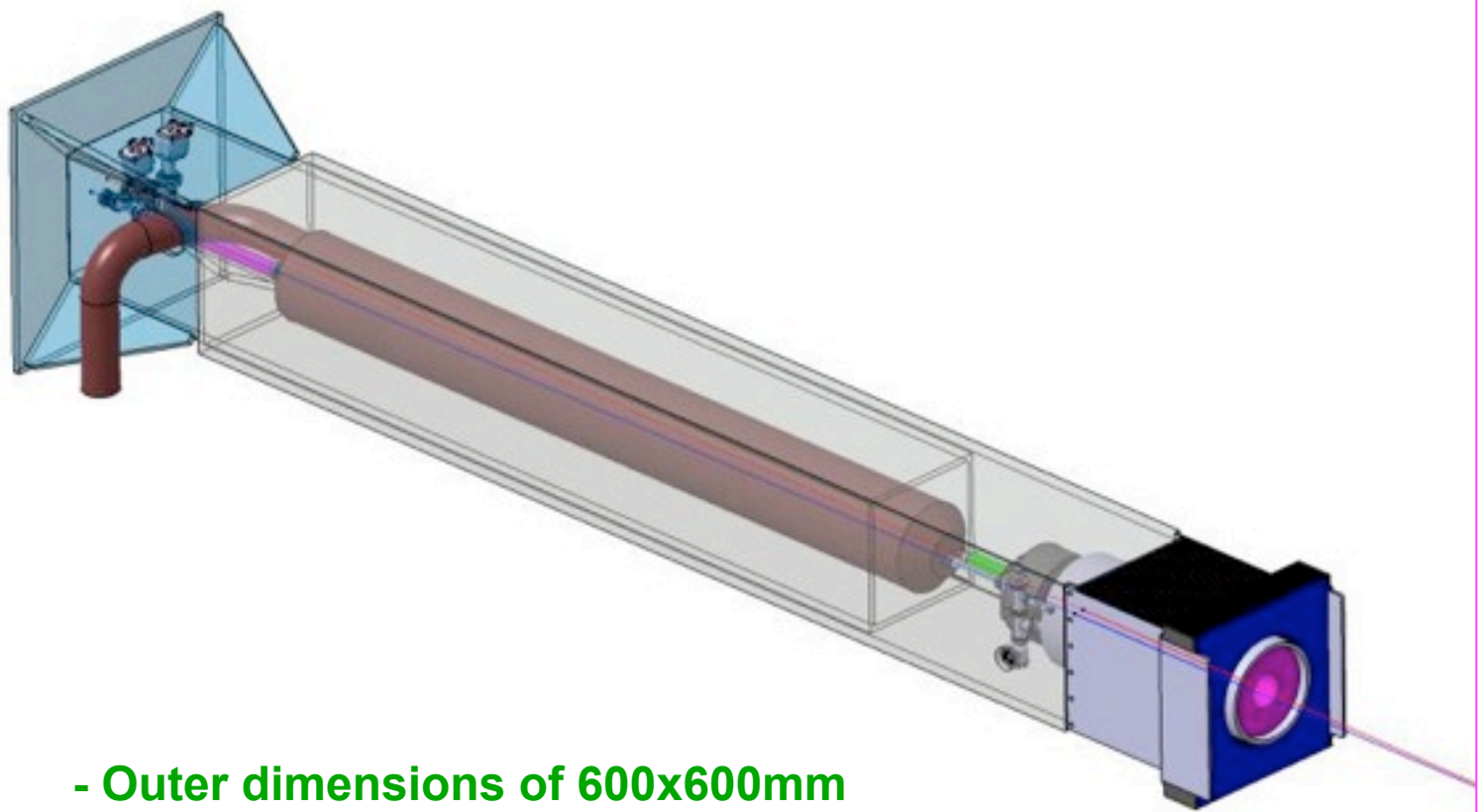






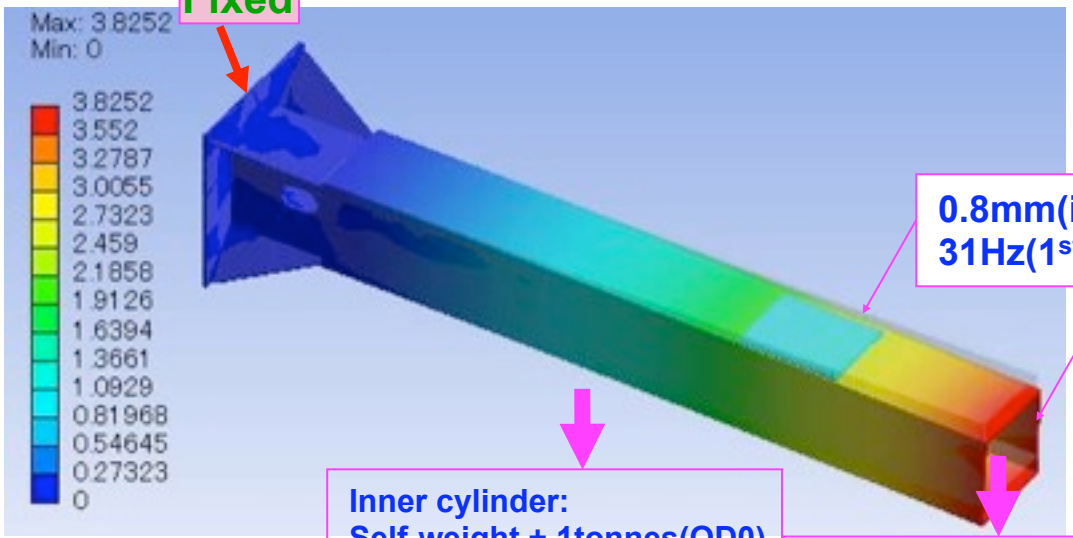
➔ **Integrated amplitude at 5Hz: Larger than 50nm.(ATF, CERN High)**
Much smaller than 50nm(CERN small, Reference)

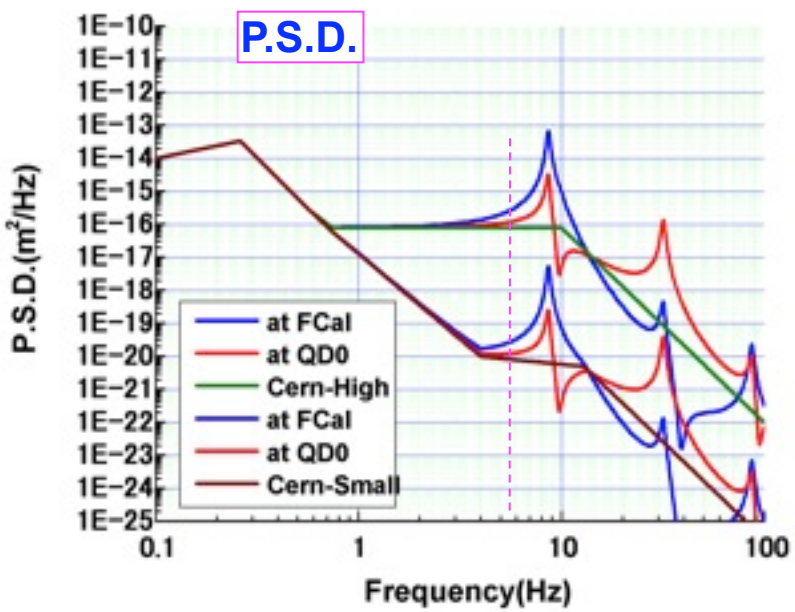
New configuration(Double tube type)

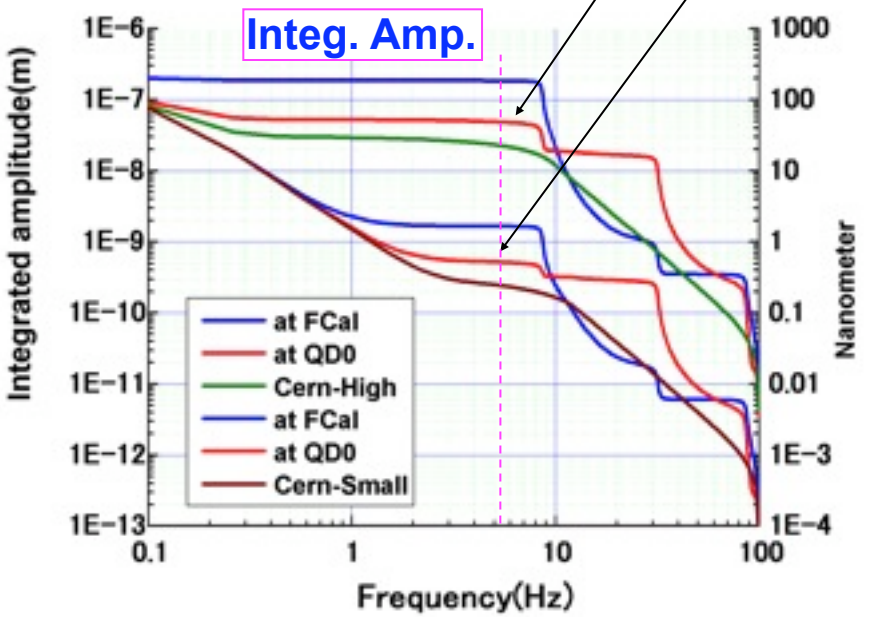


- Outer dimensions of 600x600mm
- 25mm thick

Calculation-1







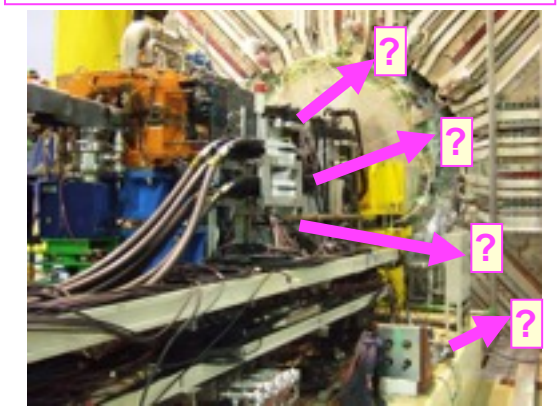
➔ If support tube is changed to double tube, it is possible to reduce amplitude less than ~50nm.

Vibration measurement at KEKB

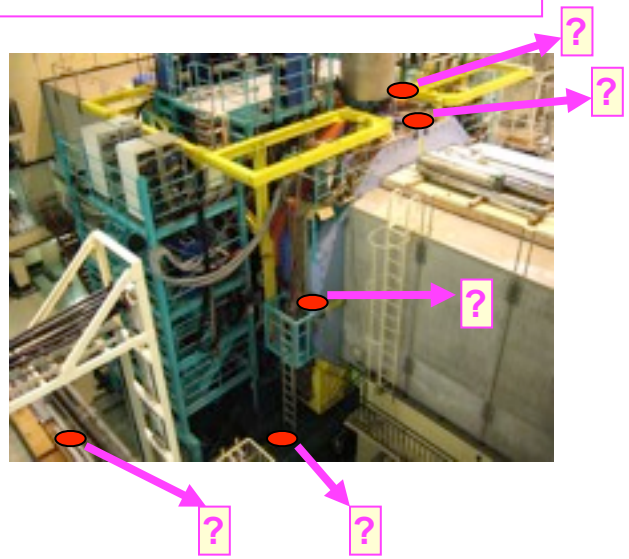
Investigation items

- Vibrations on each place
- Influence of air conditioner
- Coherency between both sides
- etc

Measure vibrations on KEKB

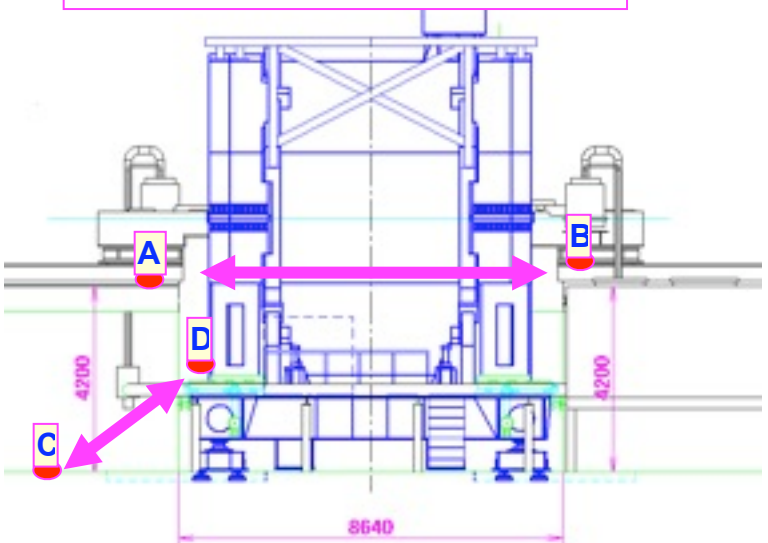


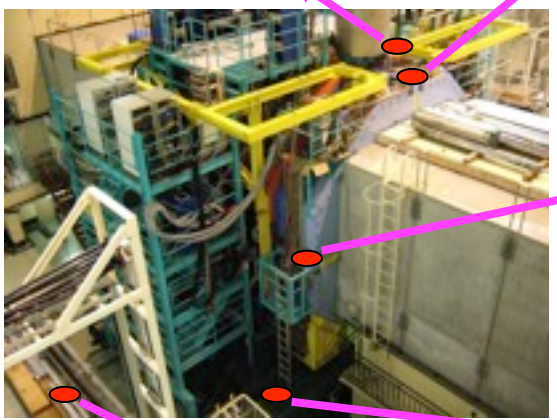
Measure vibrations on the Belle

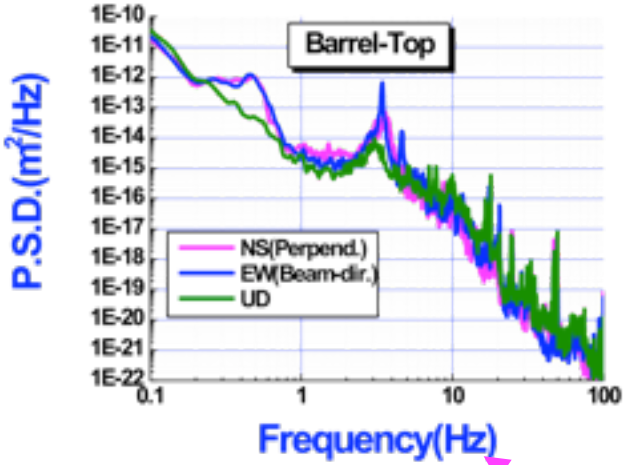


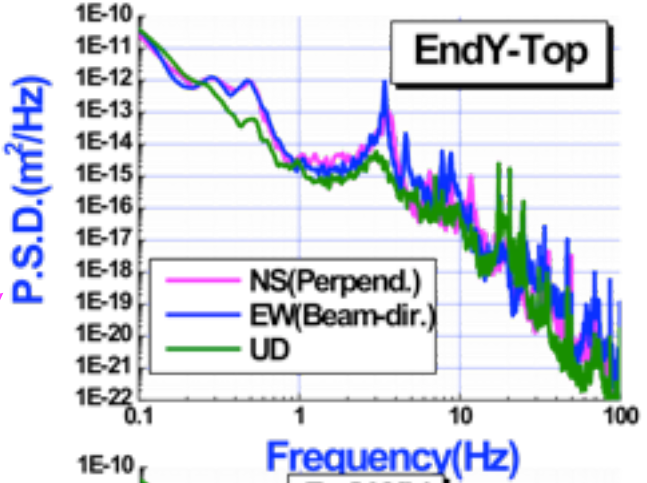
Influence of air conditions

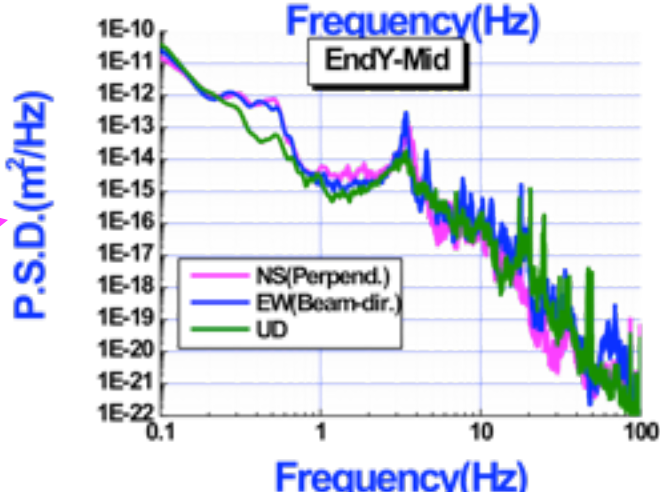
Coherency between A-B, C-D.

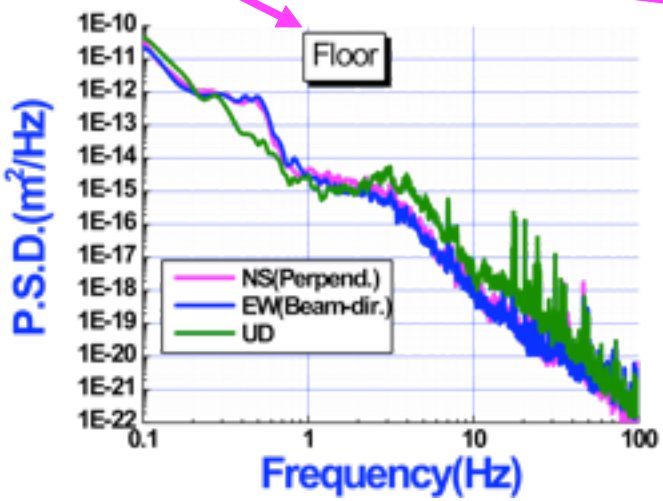


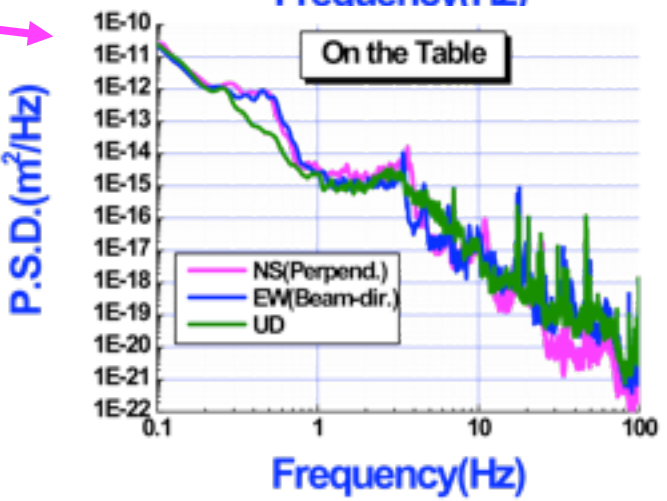



Barrel-Top
P.S.D.(m²/Hz)
Frequency(Hz)
NS(Perpend.)
EW(Beam-dir.)
UD


EndY-Top
P.S.D.(m²/Hz)
Frequency(Hz)
NS(Perpend.)
EW(Beam-dir.)
UD


EndY-Mid
P.S.D.(m²/Hz)
Frequency(Hz)
NS(Perpend.)
EW(Beam-dir.)
UD

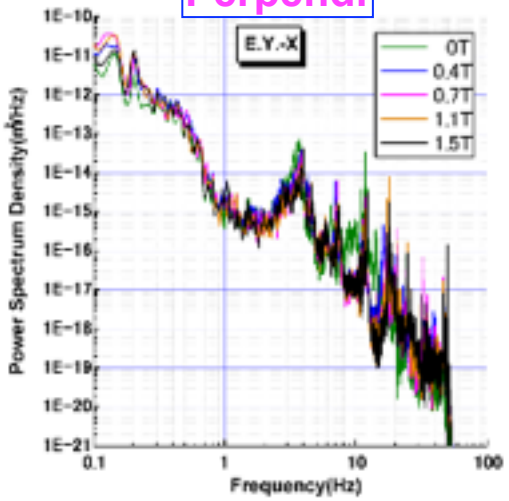

Floor
P.S.D.(m²/Hz)
Frequency(Hz)
NS(Perpend.)
EW(Beam-dir.)
UD


On the Table
P.S.D.(m²/Hz)
Frequency(Hz)
NS(Perpend.)
EW(Beam-dir.)
UD

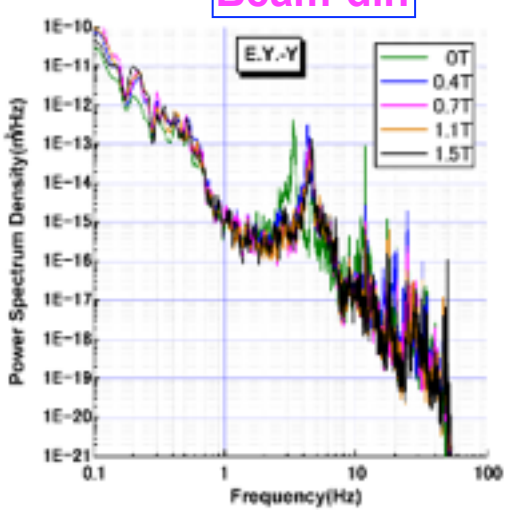
Vibration Measurements with magnetic field

End-yoke

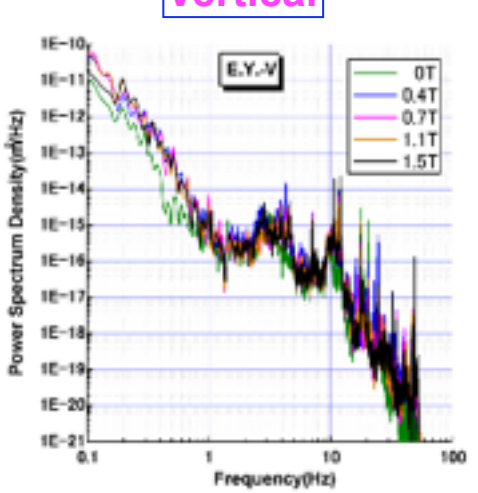
Perpend.



Beam-dir.

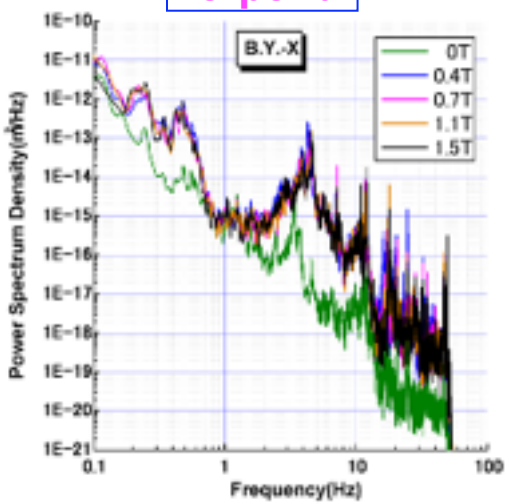


Vertical

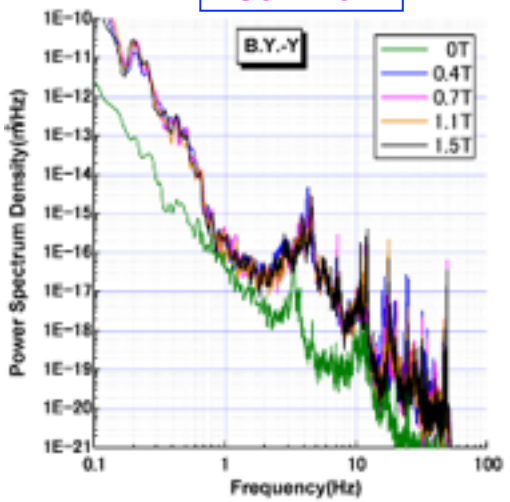


Barrel-yoke

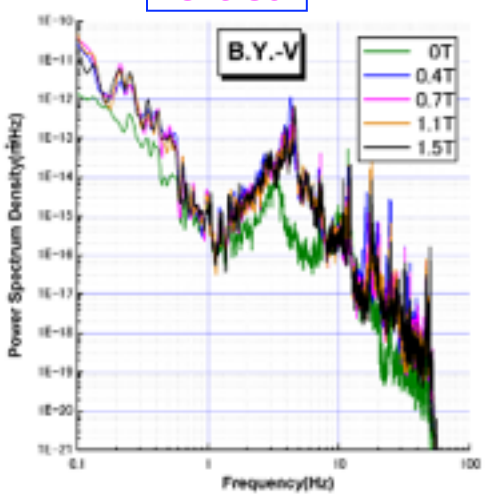
Perpend.



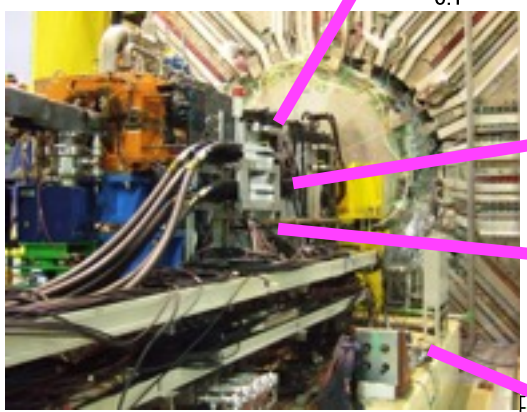
Beam-dir.

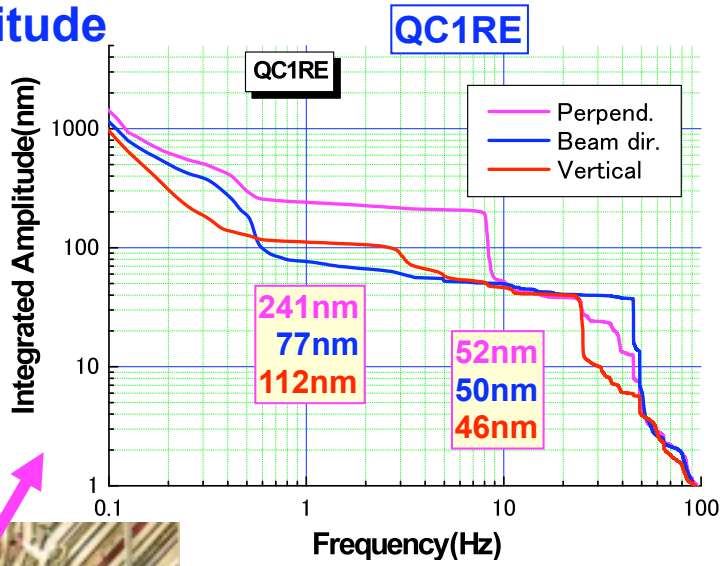


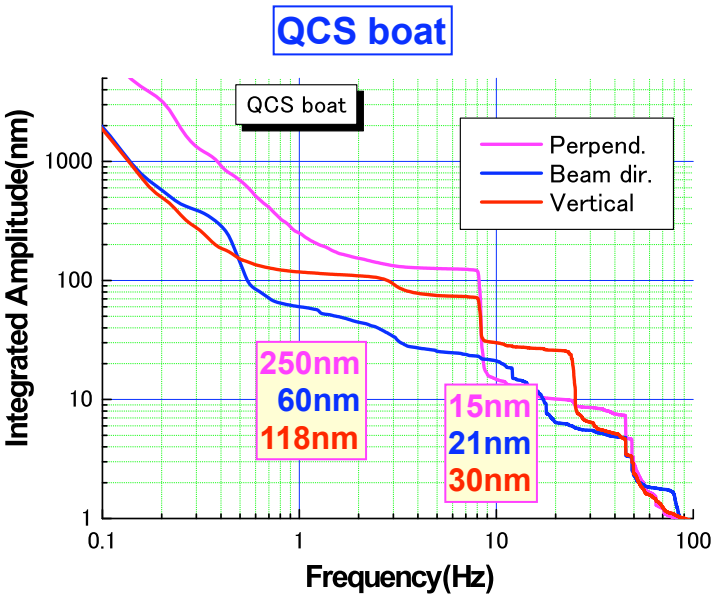
Vertical

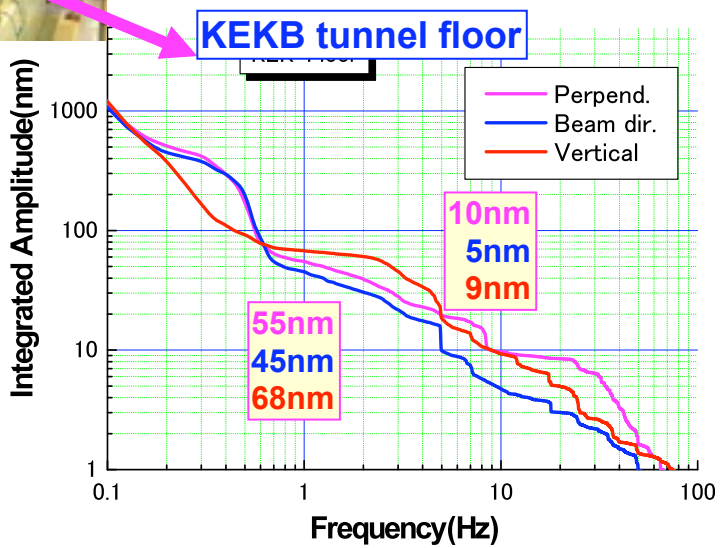


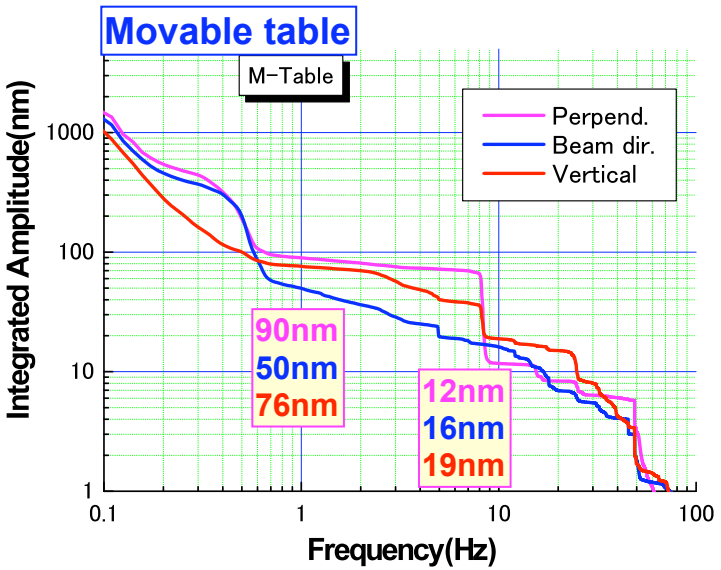
Integrated amplitude











Coherency measurement at KEKB-tunnel

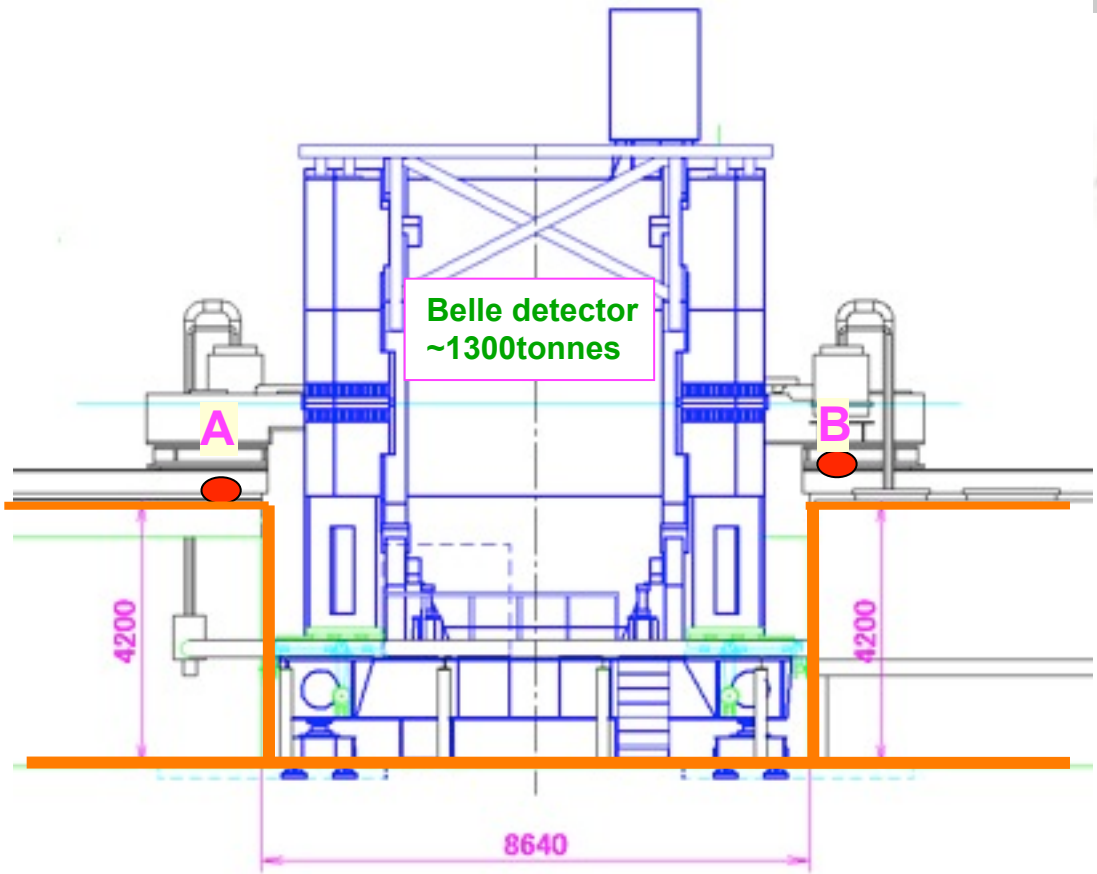
Measurement: A

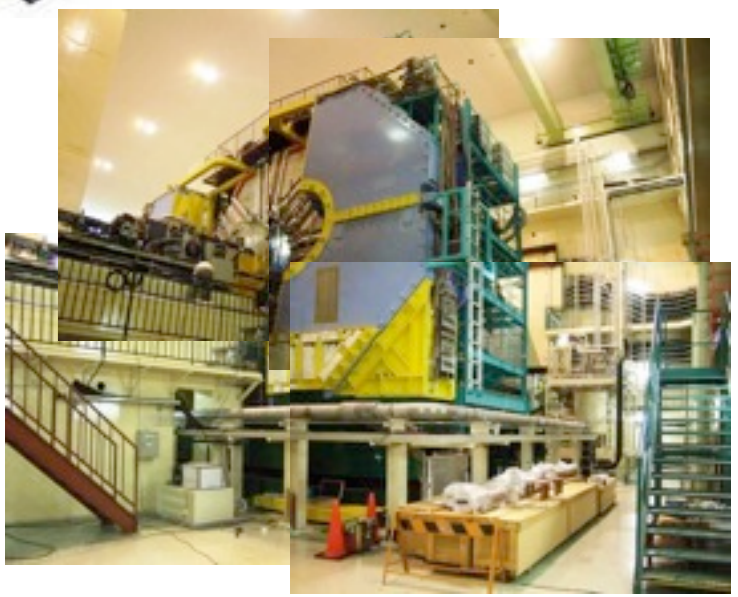
How is the coherency between the position-A and B?

These two points keep coherency??

Servo Accelerometer MG−102	Tokkyokiki Corp.
Size	40×40×50mm
Max. input	±2G
Resolution	1／10^6G

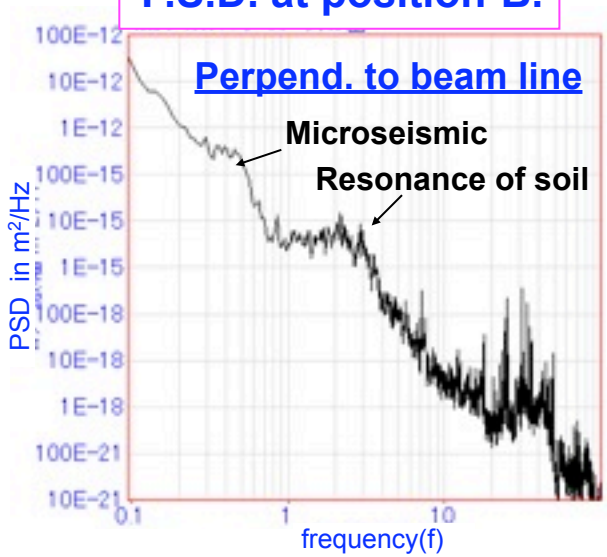
Acc. 0.1～400Hz
Acc. 60dB = 1gal/V

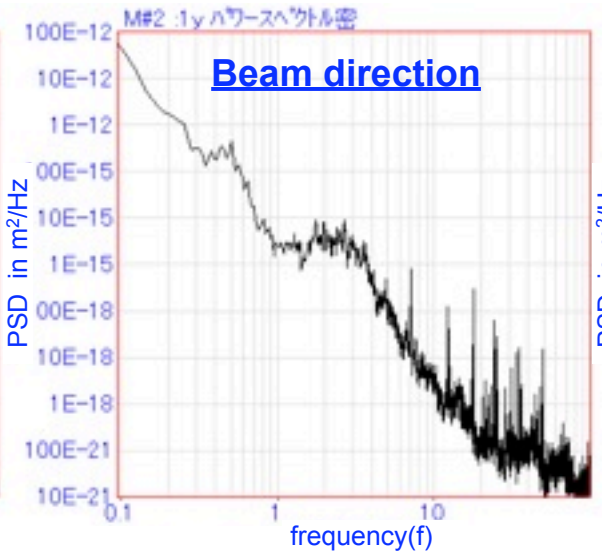


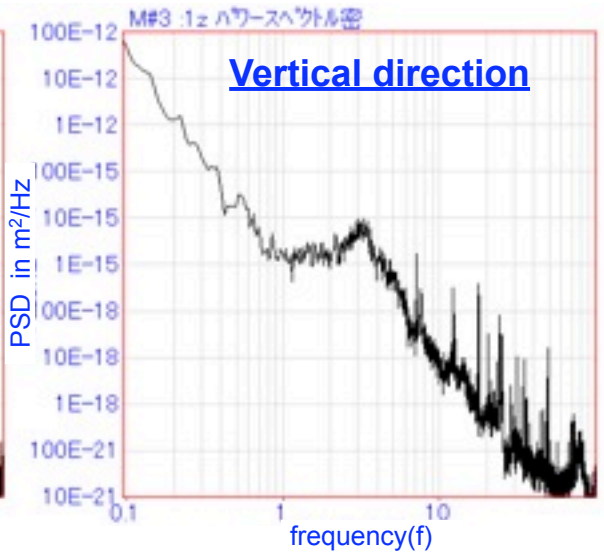


Results

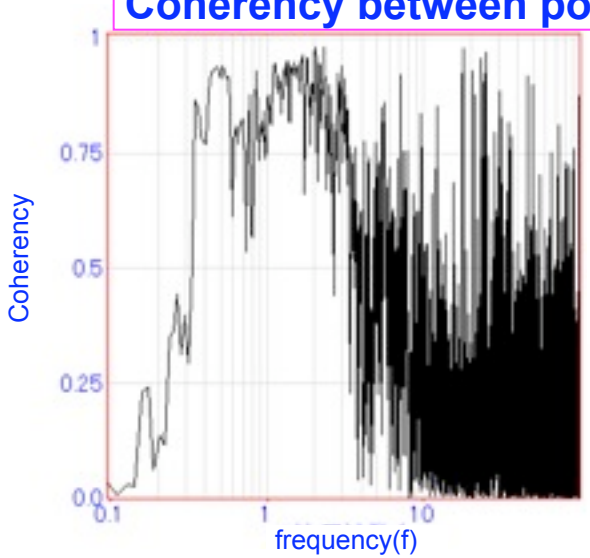
P.S.D. at position-B.

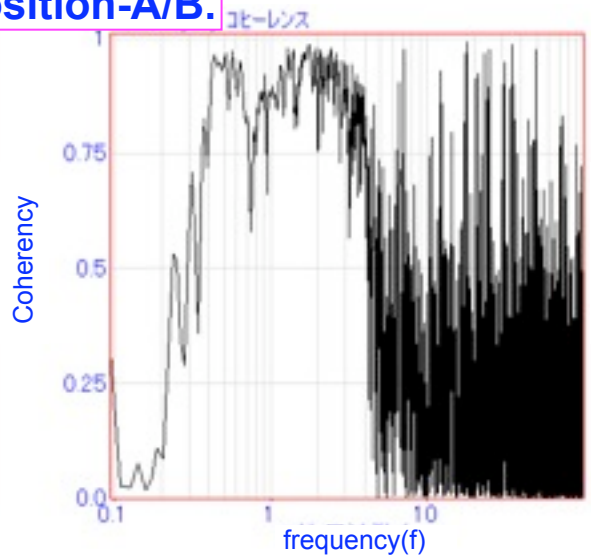


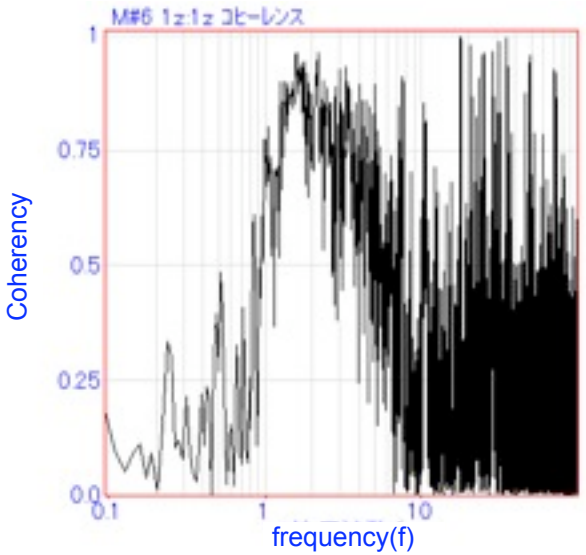




Coherency between position-A/B.







➔ It seems that there is no coherency between two positions at f > 3Hz.
Except for the frequency of microseismic(0.XHz) and resonance of soil(~3Hz).

Summary of vibration measurements

1. Power Spectrum Density

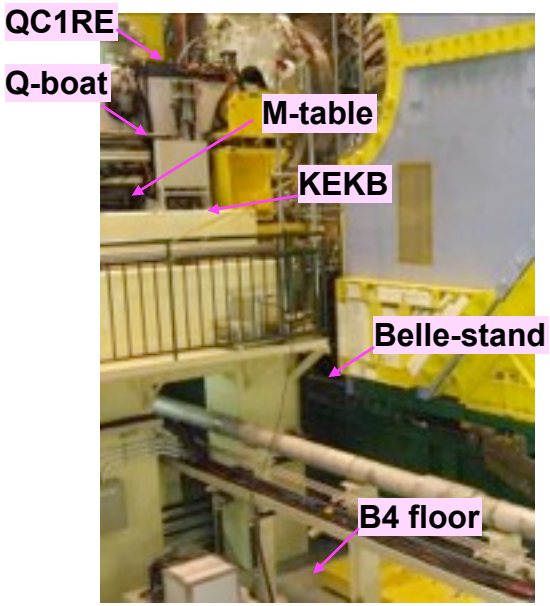
Tunnel: H-dir.→ ~0.3Hz（Micro-seismic）, ~3Hz(Resonance of soil)

V-dir.→ ~3Hz(Resonance of soil)

Q-table, magnet→ Peak around 8Hz was measured additionally.

2. Integrated amplitude →

Integrated amplitude(nm)						
	>1Hz			>10Hz		
	Perpend	Beam	Vertical	Perpend	Beam	Vertical
B4 floor	50	46	67	4	3	9
KEKB floor	55	45	68	10	5	9
Mag.-table	90	50	76	12	16	19
QCS-boat	250	60	118	15	21	30
QC1RE	241	77	112	52	50	46
Belle stand	105	69	71	13	11	13



3. Influence of Air conditioner

A small difference was measured around 1~3Hz

→ No obvious differences.

4. Coherency

(1) Both sides of KEKB-tunnel (Nikko-side ←→ Oho-side)

No coherency except for ~0.3Hz and ~3Hz.

(2) Distance dependency

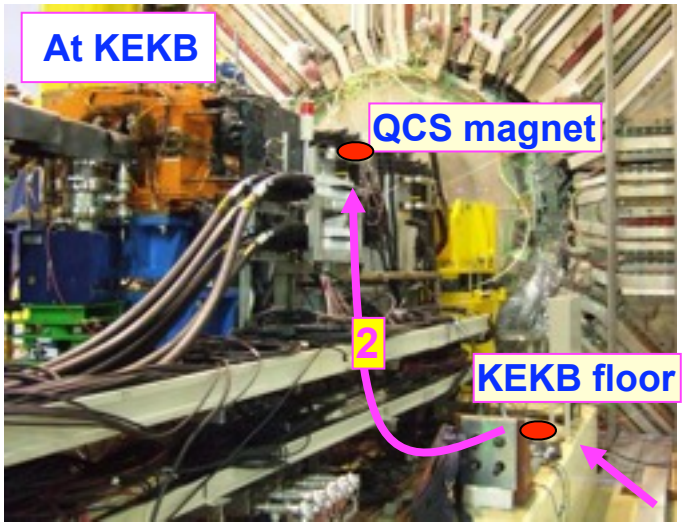
Frequency above 10Hz is getting worse.

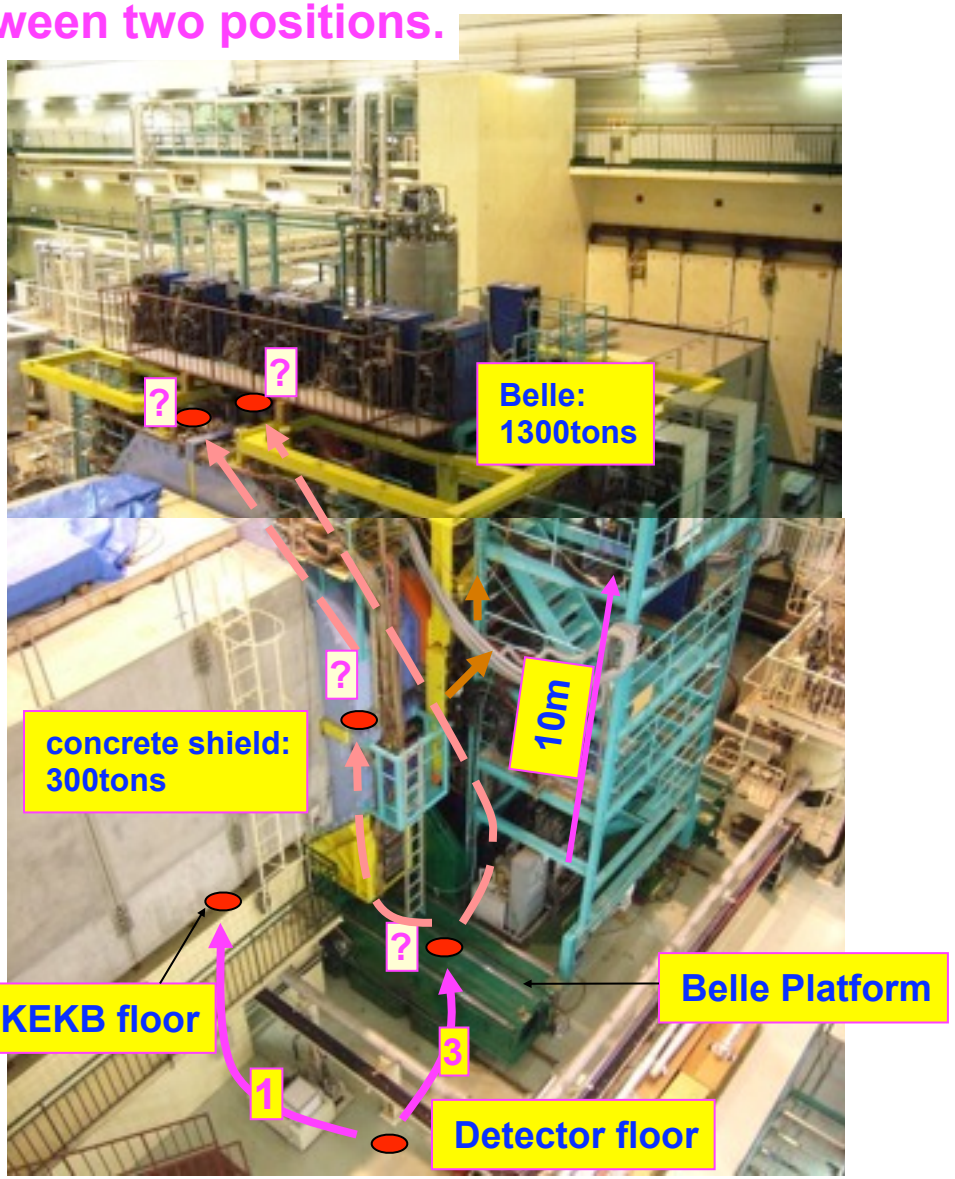
5. Modal test by hammering.

Resonance at 8Hz was measured and its mode shape was made.

Calculations

Respond vibration is calculated between two positions.





INPUT **OUTPUT**

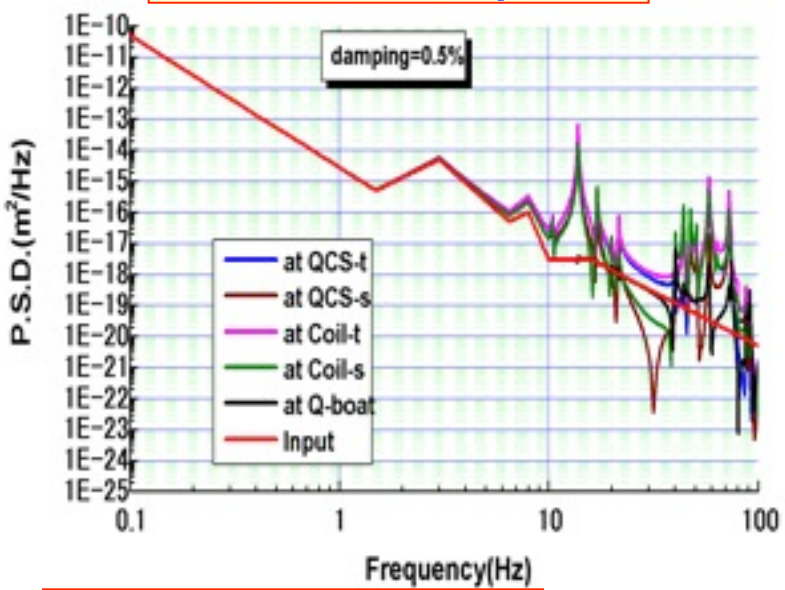
1. Detector floor → KEKB floor
2. KEKB floor → QCS magnet

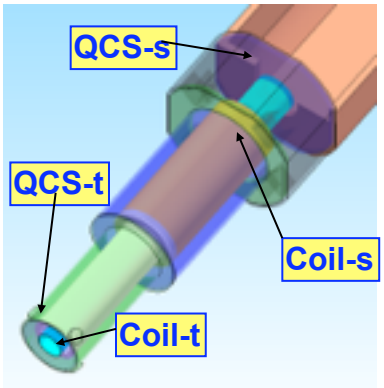
3. Detector floor → Belle platform

4. Belle platform → End cap/ Barrel yoke
(Not yet: Sorry)
→ Needs special technique due to large model.

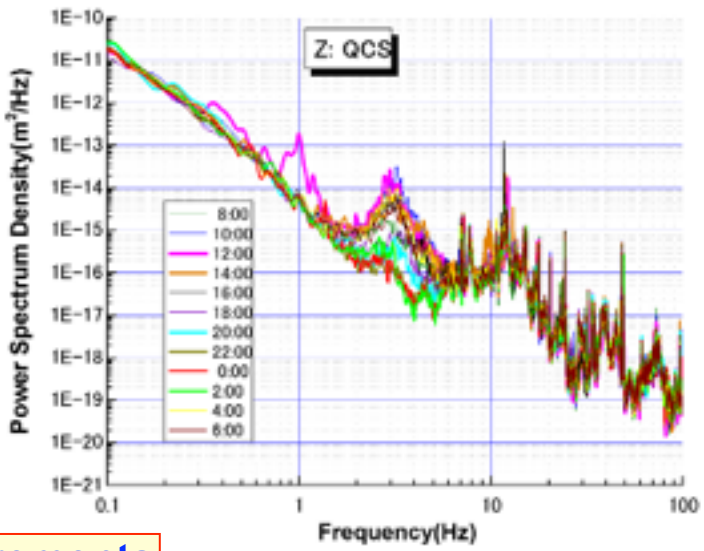
Response amplitude (*Vertical direction*)

Calculation: damp=0.5%

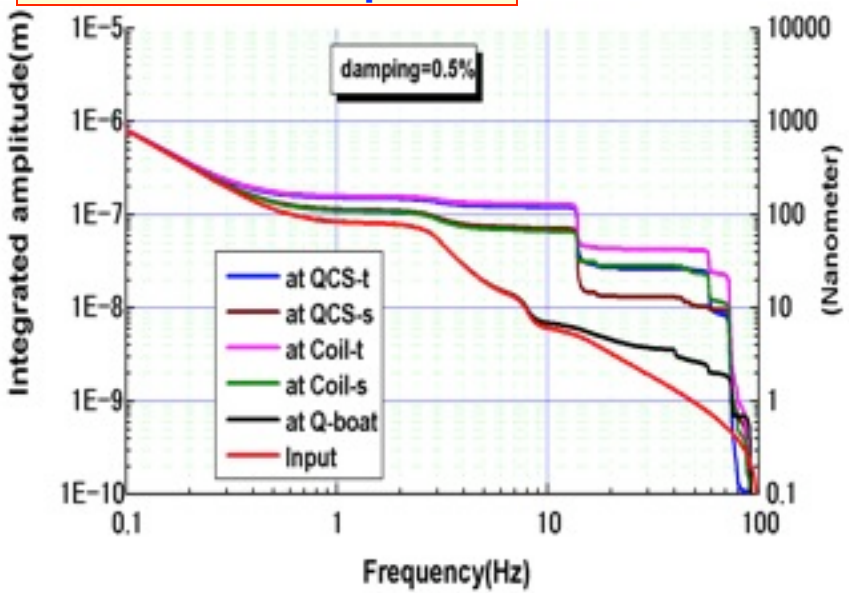




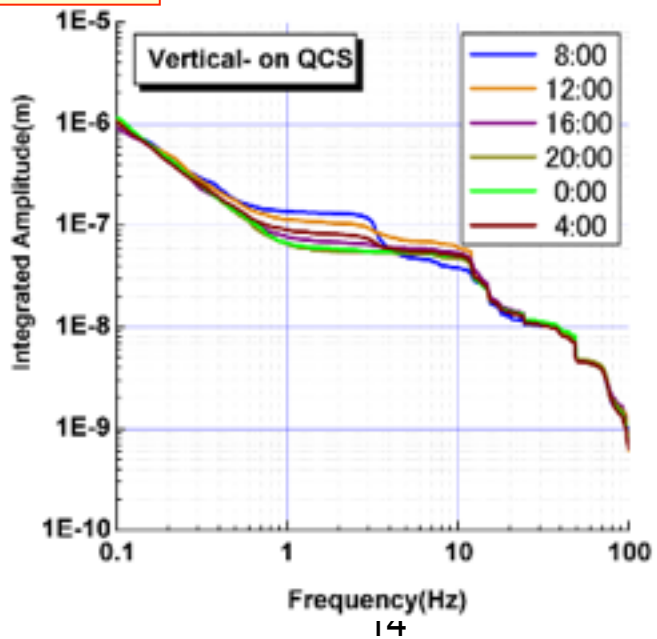
Measurements



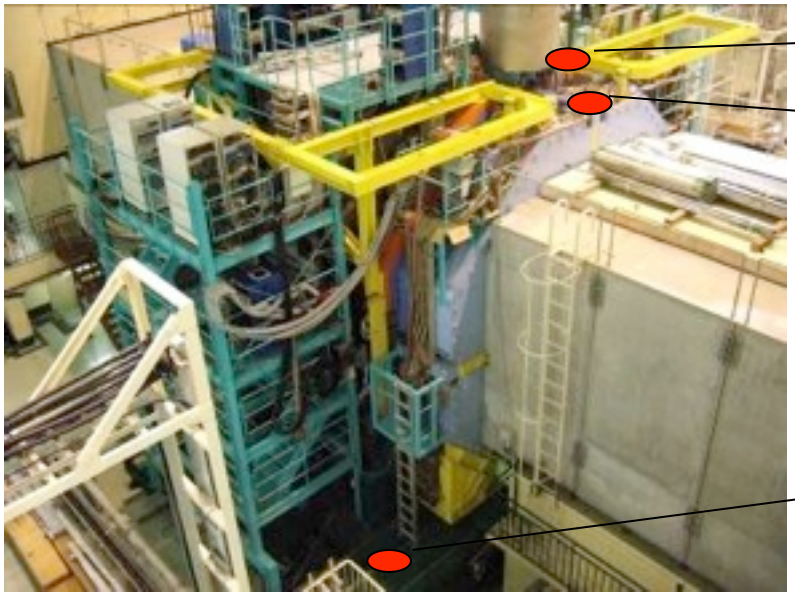
Calculation: damp=0.5%

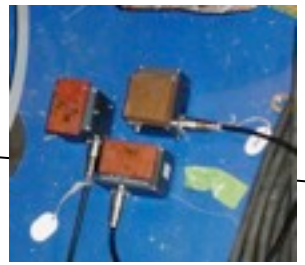


Measurements

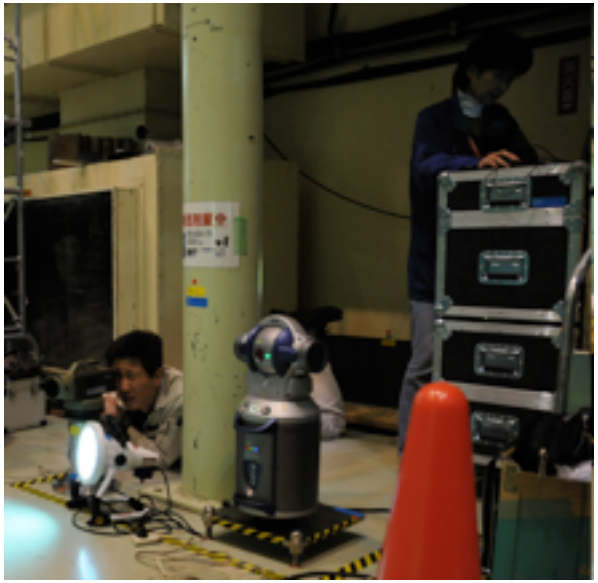


Vibration measurement during Belle roll-out

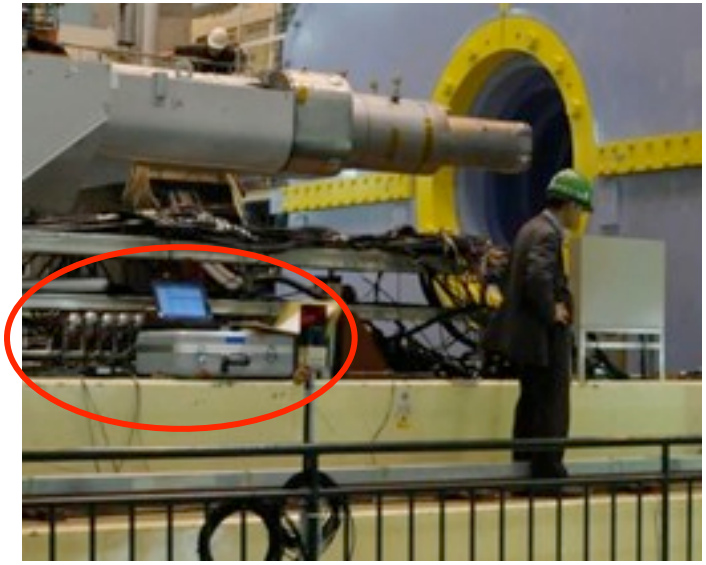




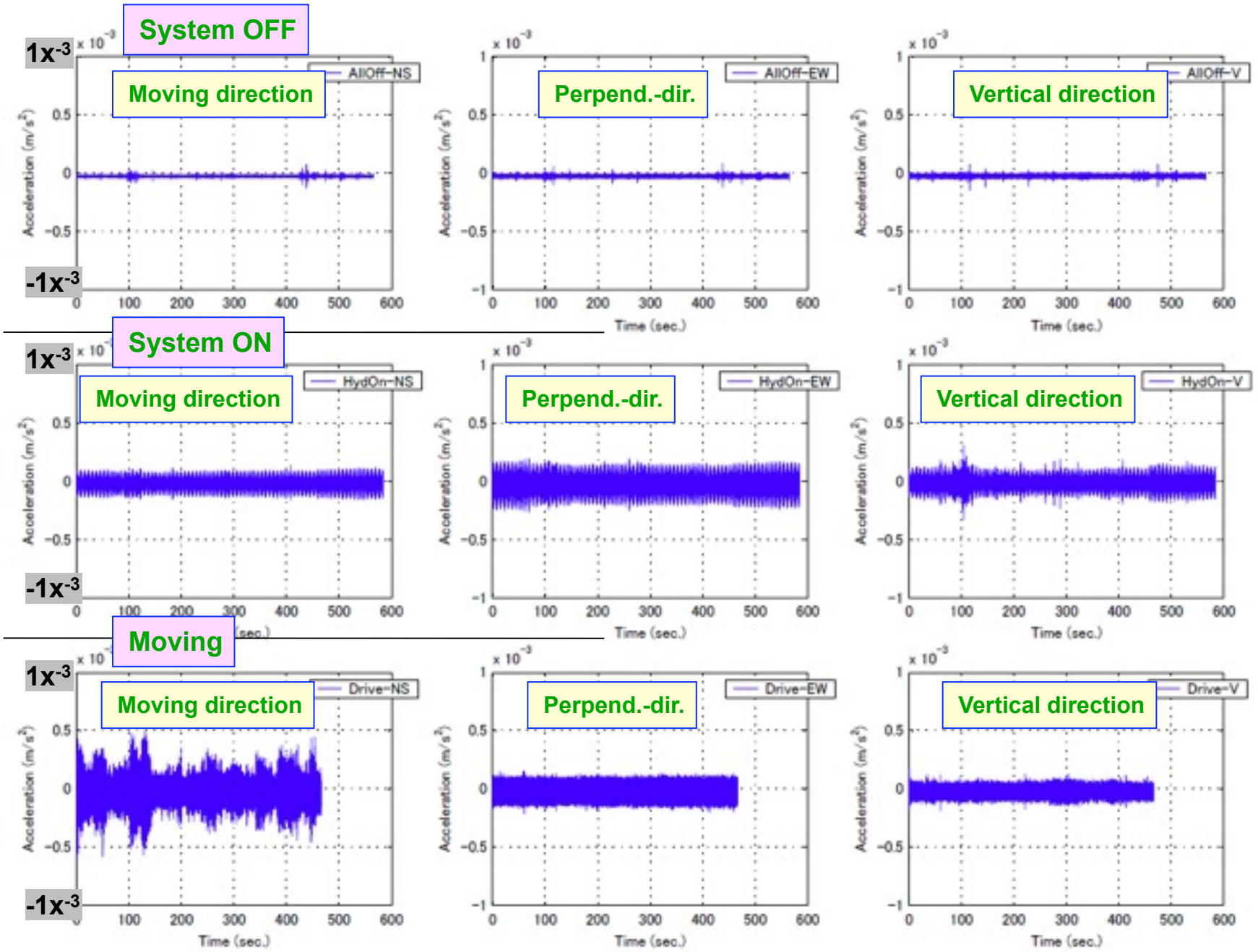
Measurement of floor motion



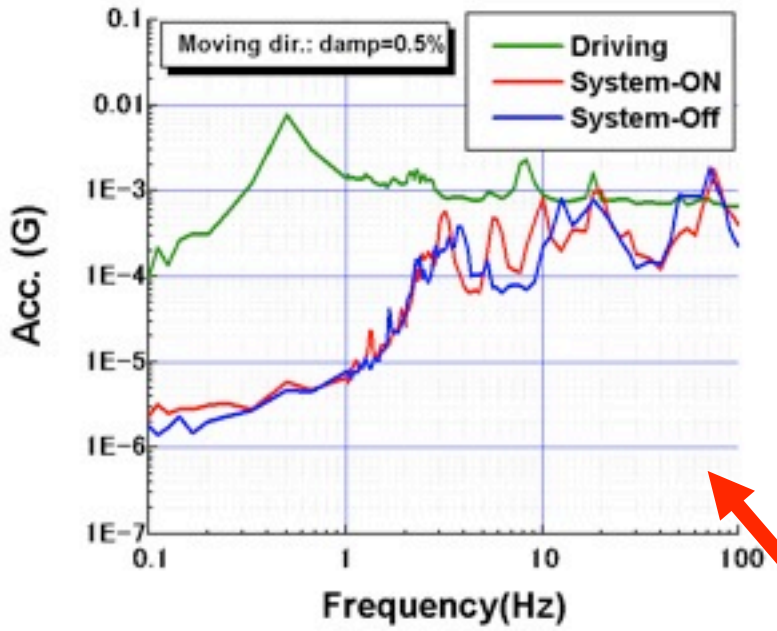
Measurement of floor tilting

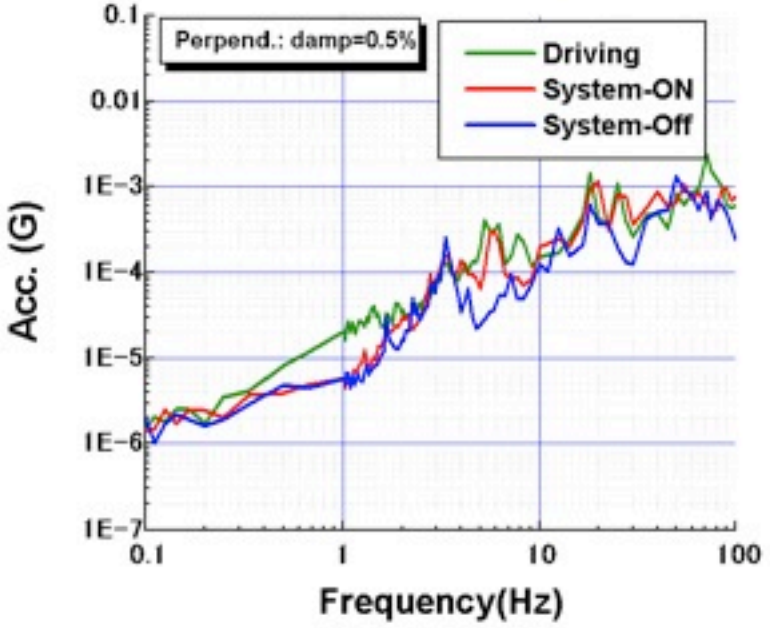


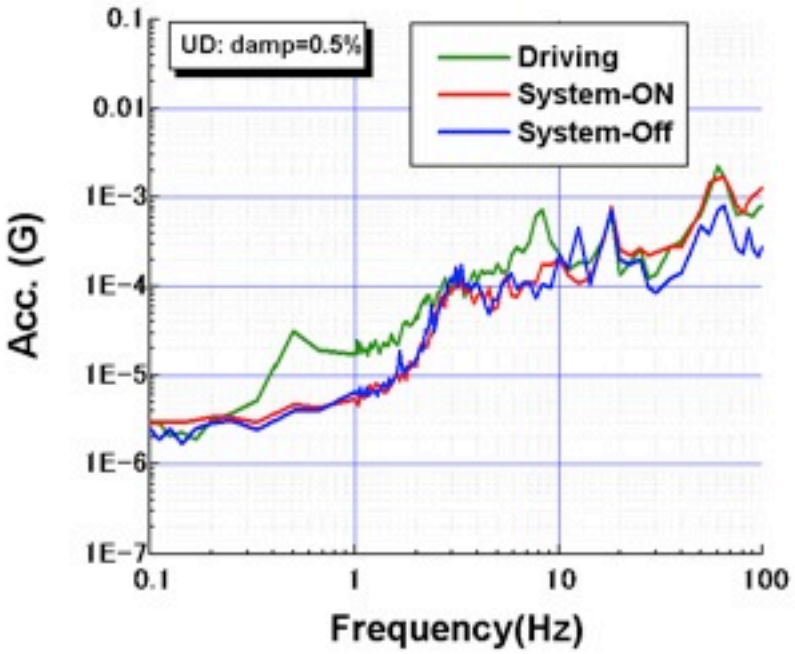
Vibrations：On the platform



Response acceleration @platform







Response acceleration ➔ ~0.01G

Seismic criteria for the Belle detector

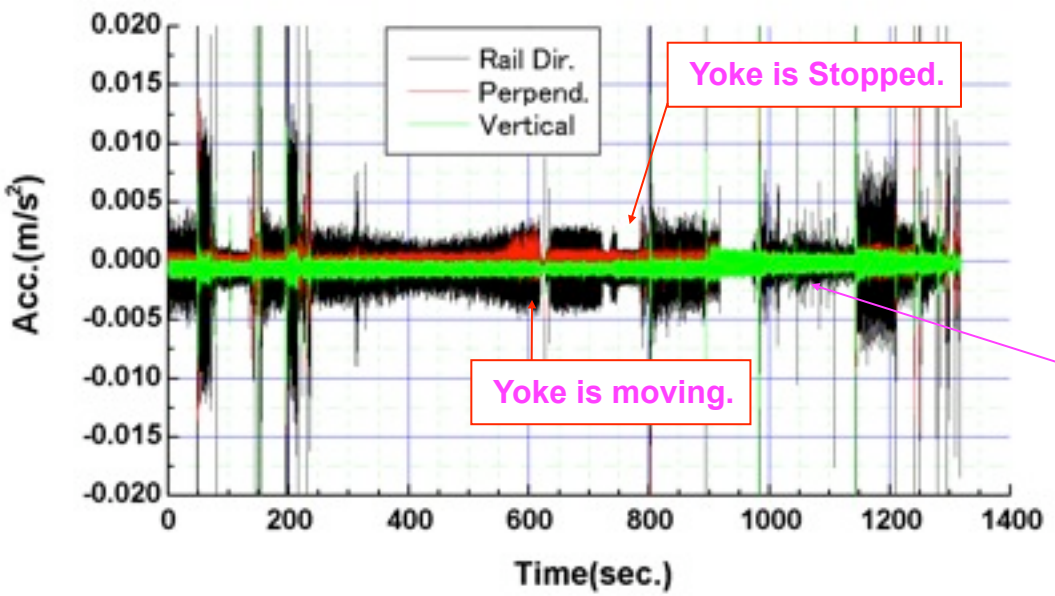
➔ 0.2G

→ 0.01G of Acc is very small.

➔ This seismic level is safe enough.

Compare response acc. to the other moving system

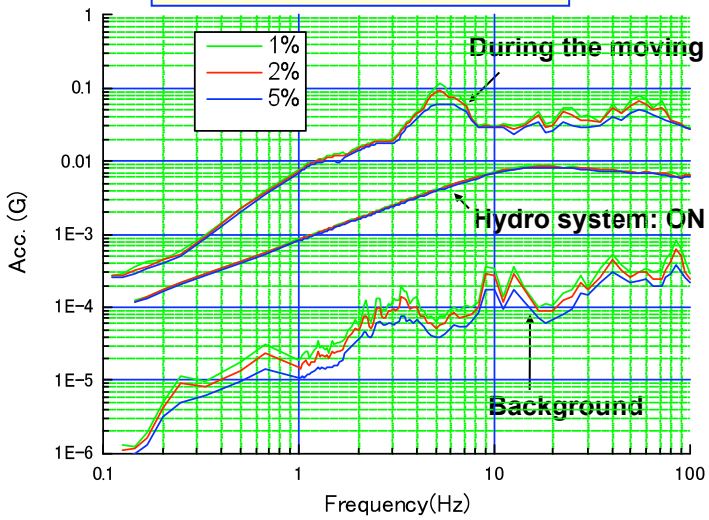
ND280@J-Parc



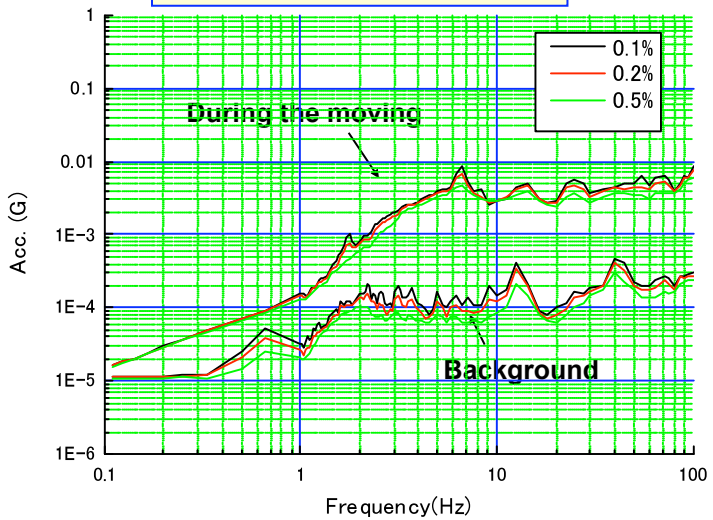
Arms are being extended
Yoke is pushing by the mover.

Response acceleration@ND280

On the roller: Rail dir.



On the roller: Vertical



Response acceleration ➔ ~0.1G

Seismic criteria for the ND280

➔ 0.5G

→ 0.1G of Acc is less than the criteria.

➔ But 10 time bigger than the Belle moving system.

Conclusions

Vibration studies for the ILD QD0 support system have been studied.

- P.S.D. calculations of QD0 support system(Support tube).

- Vibration measurements at KEKB.

- Consistency of vibration calculation to the measurement data.

- Measurements of response accelerations during the Belle/ND280 moving.

Further studies

- Study;

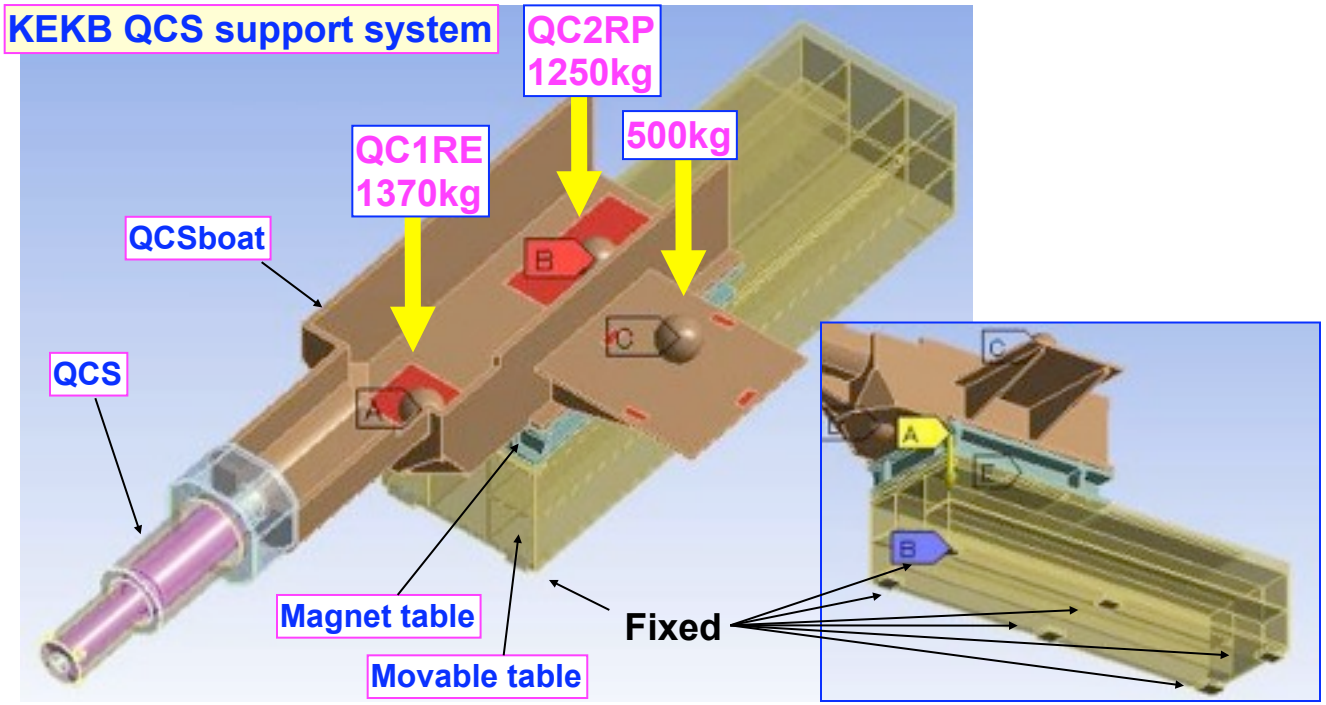
- Transportation plan of iron yokes/solenoid from the ground to the experimental hall.

- Assembly/installation plan of iron yoke and solenoid.

- Aliment system of heavy components to the particular position.

- Quick/smooth moving system during the push-pull.

➔ Respond amplitude was calculated and ***check consistency btwn calc. and meas.***



1. Loads
- Self-weight
- QC1RE: 1370kg
- QC2RP: 1250kg
- Box: 500kg

2. Materials
Cryostat: SUS
Coil: Cu
Supp.-rod: Ti-alloy
QCS table: SS400

3. Thread bolts
→ 10-M30
6-M24
Pre-tension: Not defined

4. Support-rods(Backward)
→ Spring elements
k=6171kg/mm per rod

5. Support-rods(Forward)
→ Spring elements
k=12521kg/mm per rod