

IWBS2004

**The optimization for the reduction
of the vacuum chamber vibration
via structure analysis**

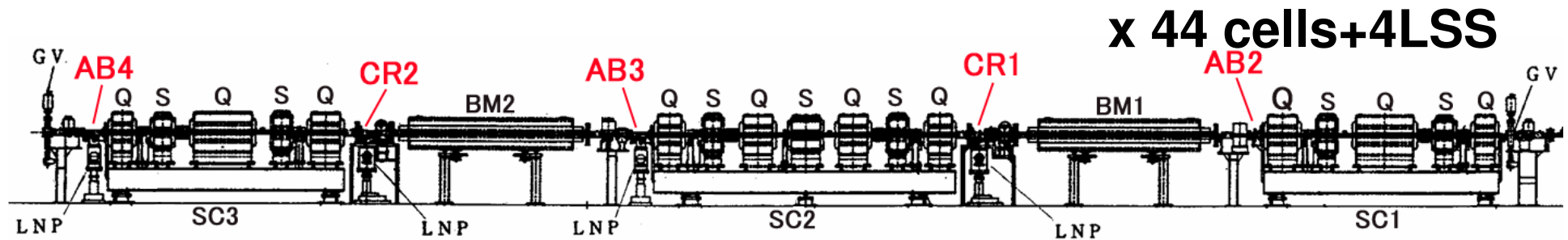
Tetsuhiko YORITA
JASRI/SPring-8



**Chamber vibrations are main source of beam fluctuation
at SPring-8 storage ring up to 200Hz region.**

What is the BEST way to reduce them?

Vacuum Chambers and Photon Absorbers



Photon absorbers are localized to keep U.H.V.
Crotches(CR1,2) @the end of Bending section
Absorbers(AB2,3,4) @the end of Straight section,

High heat load of photons

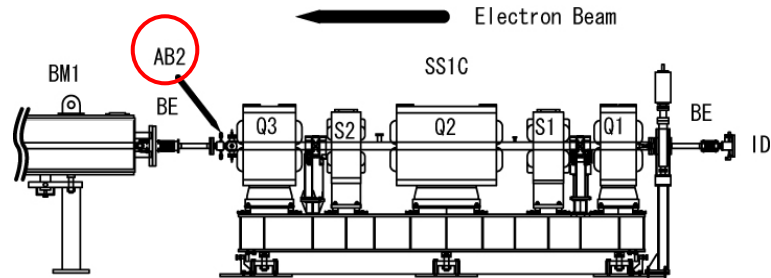
→ high speed water flow is needed

$$R \sim 1-2 \times 10^4 \gg 2000$$

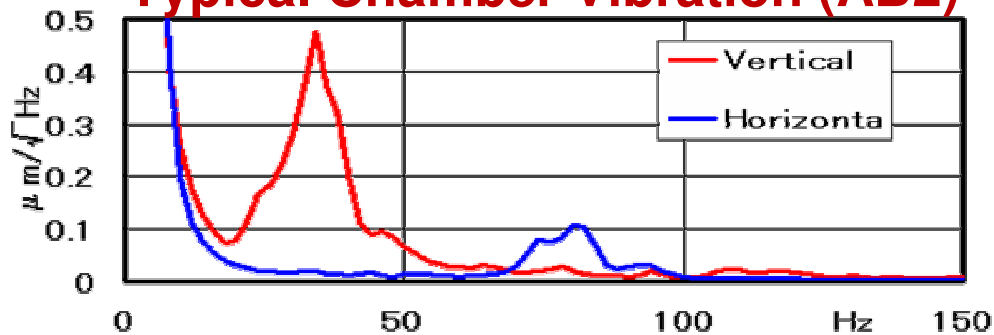
→ VIBRATION due to the water flow

Electron Beam Fluctuation due to the Chamber Vibration

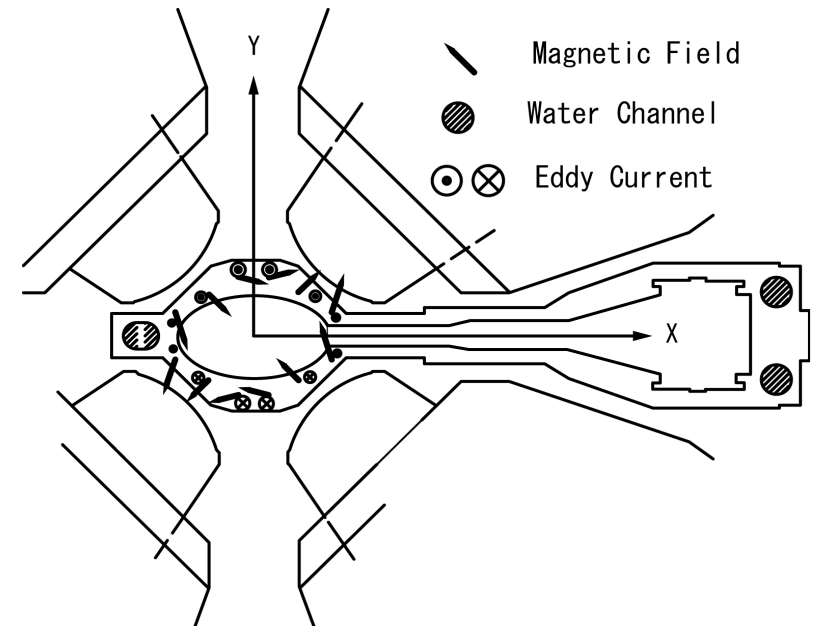
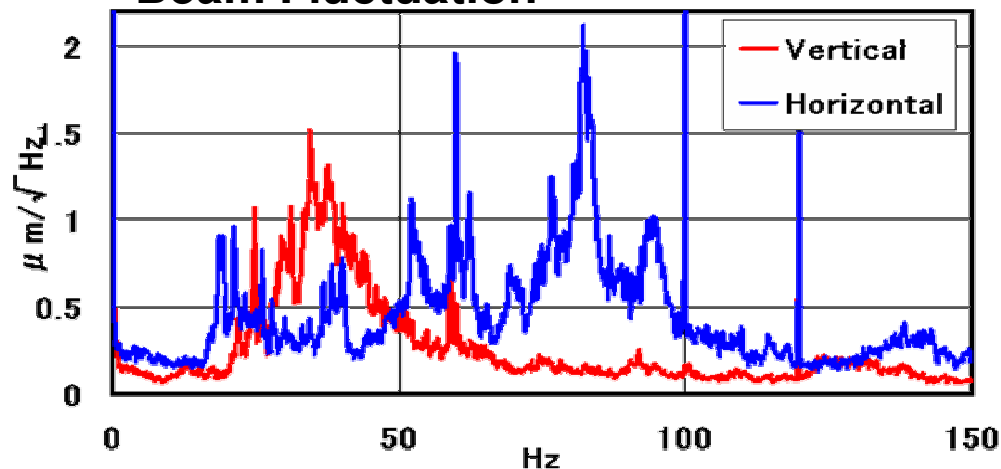
Reported at IWBS2002
(S. Matsui, et al.)



Typical Chamber Vibration (AB2)



Beam Fluctuation

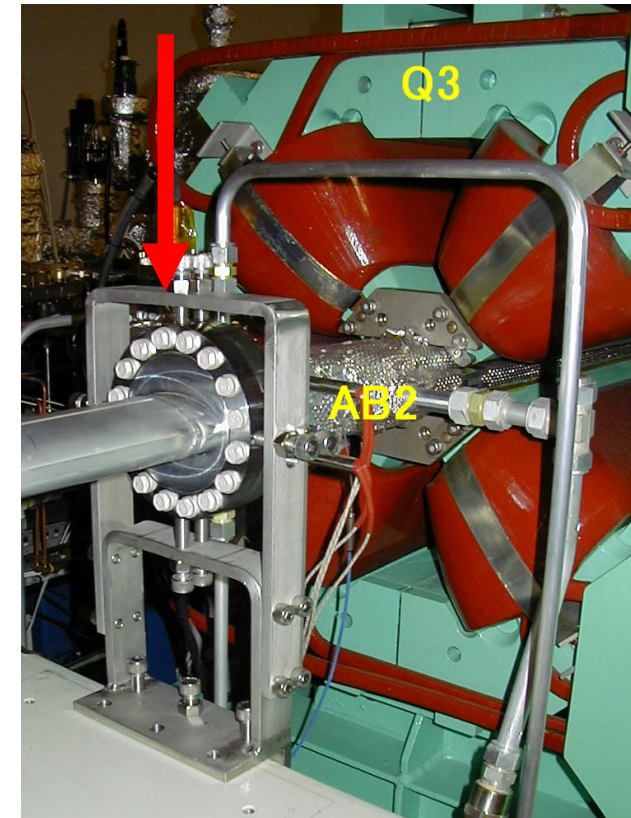
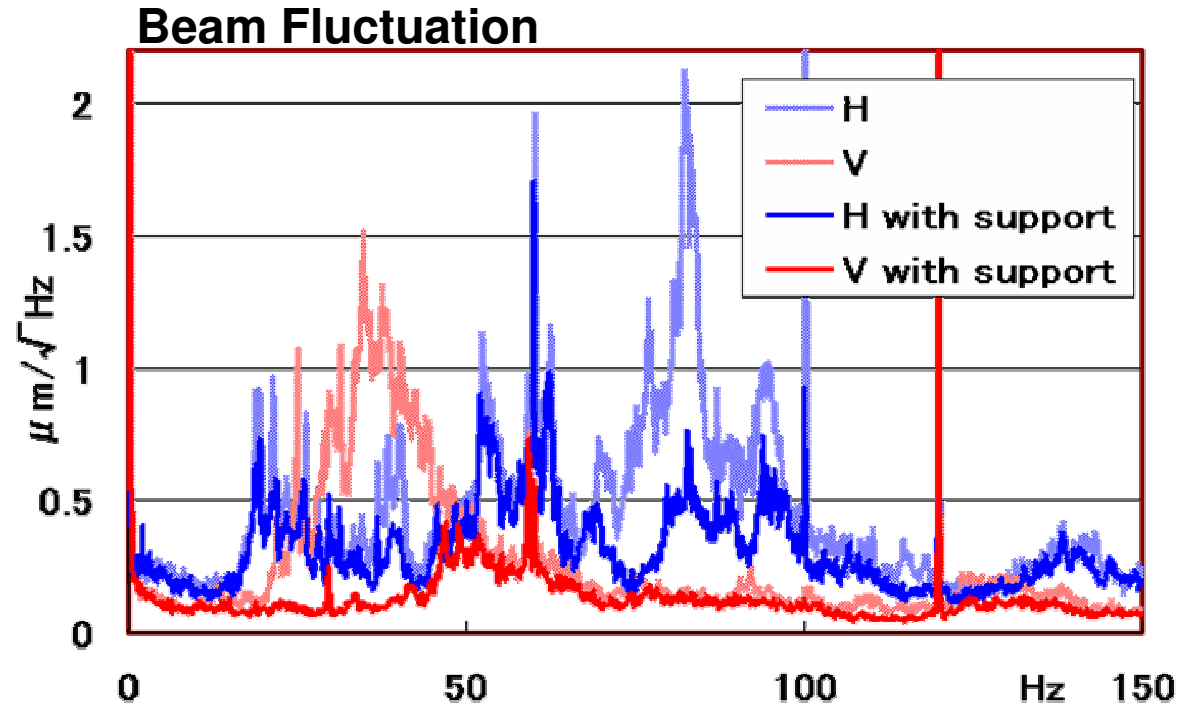
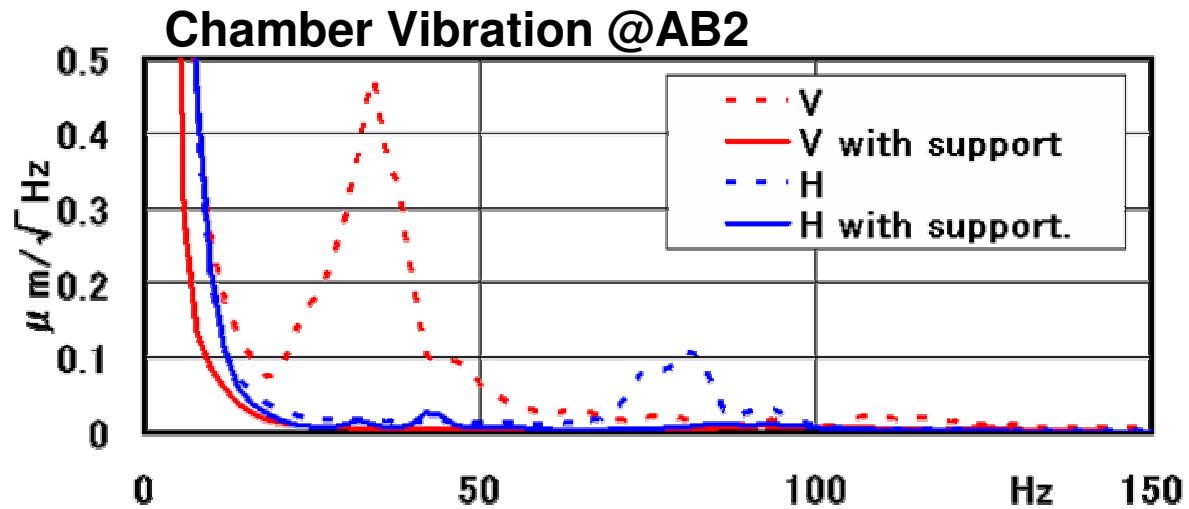


Eddy Current made by Q-mag. field kicks the electron beam.

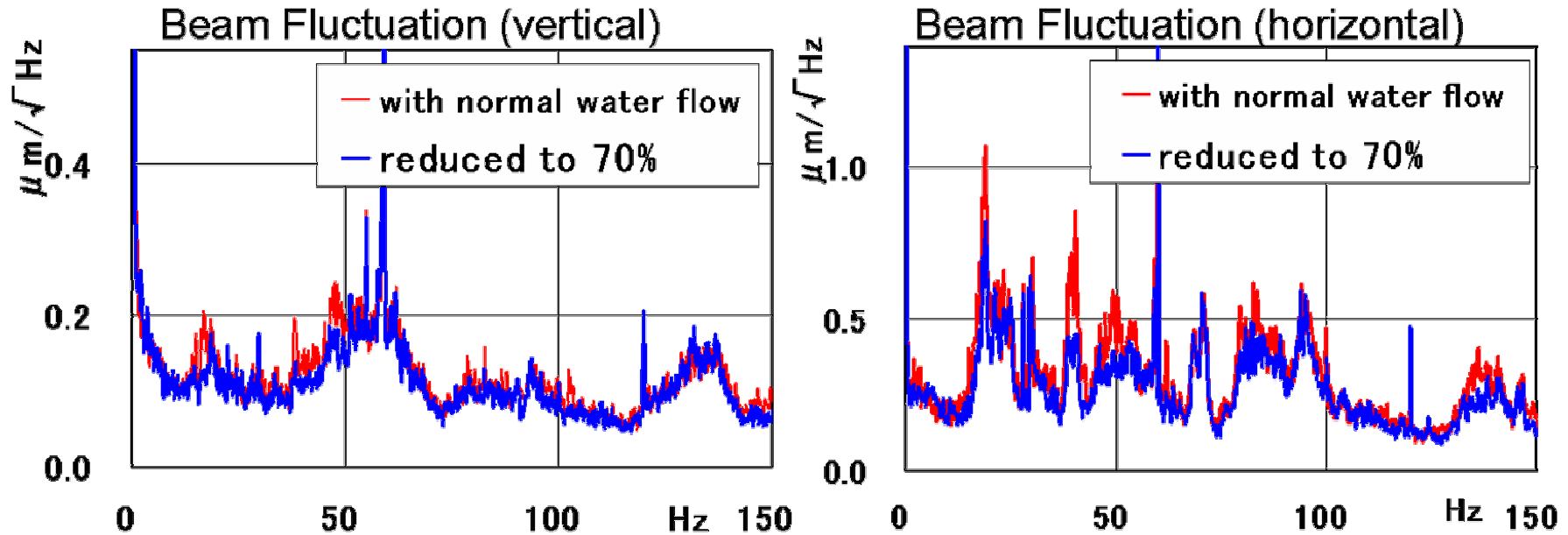
S. Matsui, et al. Jpn. J. Appl. Phys.
Vol. 42 (2003) pp.L338

Reduction with additional supports

Reported at IWBS2002
(M. Oishi, et al.)



Currently

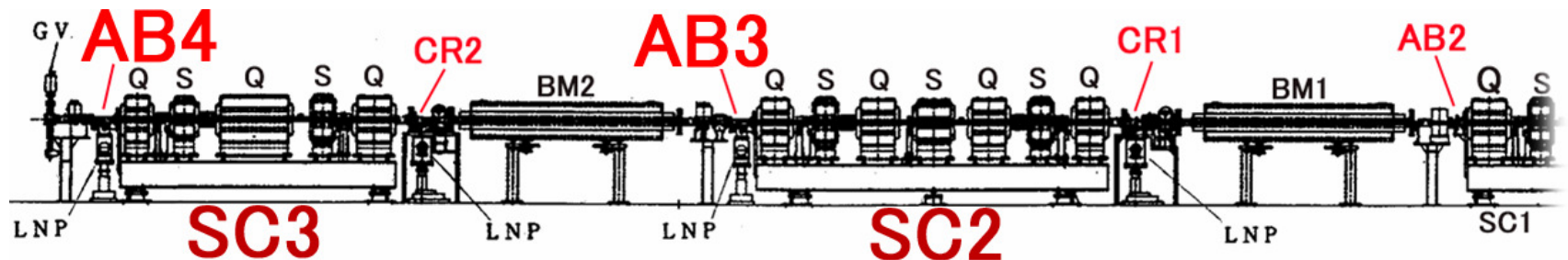


Confirmation with reduced water flow

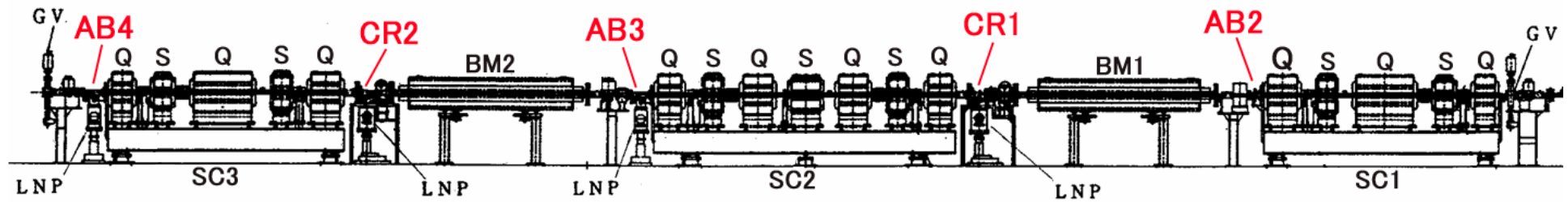
>>> The chamber vibration is still Main Source

especially **AB3,4** on **SC2,3** have much contribution

(confirmed by measurements with acceleration sensor)



What to do to reduce the vibration?



~~Separate the absorbers from chambers.~~

~~(Crotches are not so serious source because of separation by bellows.)~~

too late

See the detail of each vibration component
and reduce or modify

Chamber Vibration

= excitation force
(water flow)

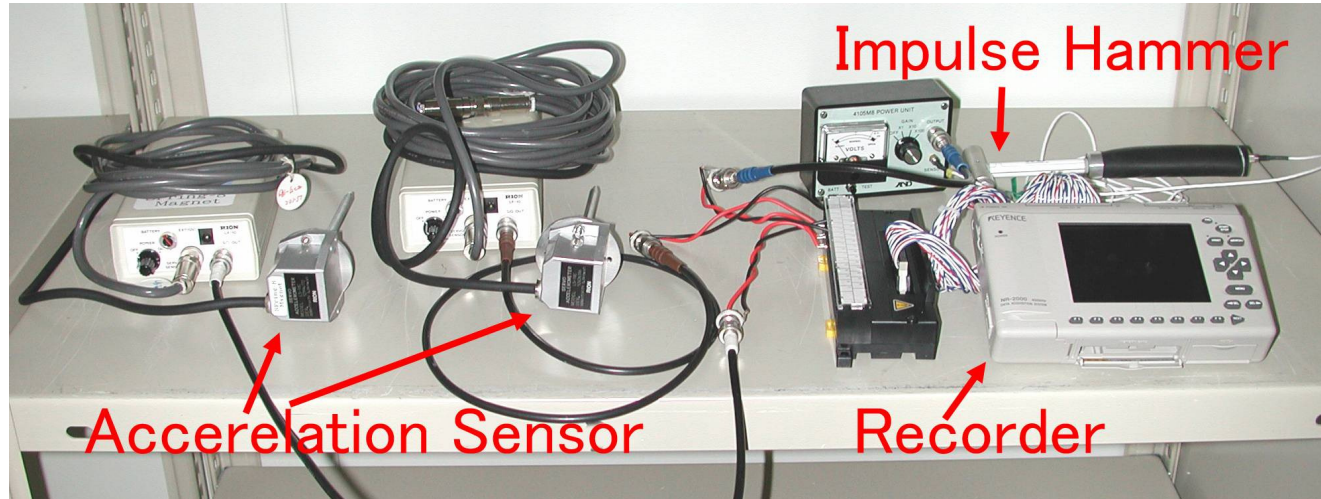
x

response function
(natural mode)

Modal Analysis

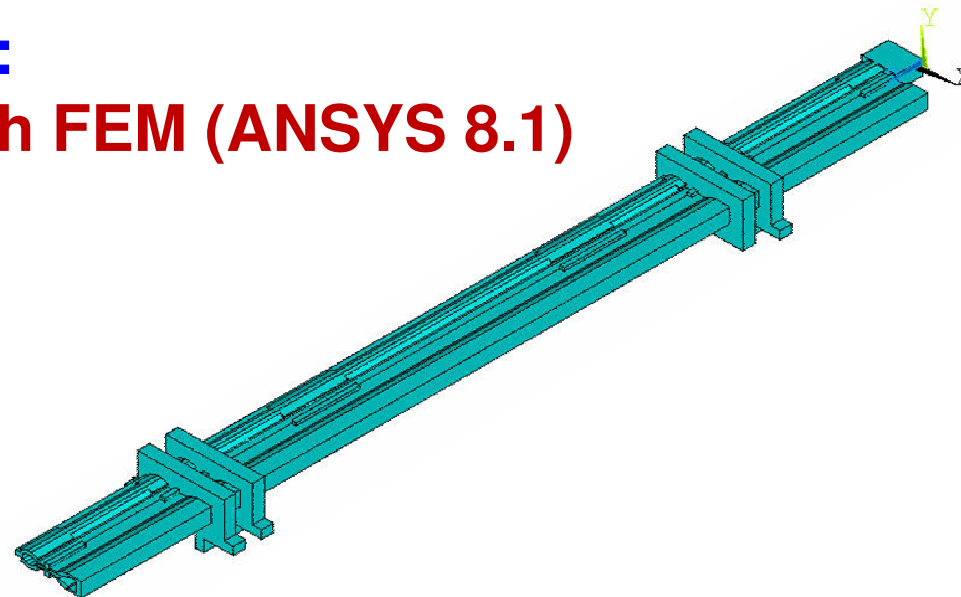
Modal Analysis

Measurement:

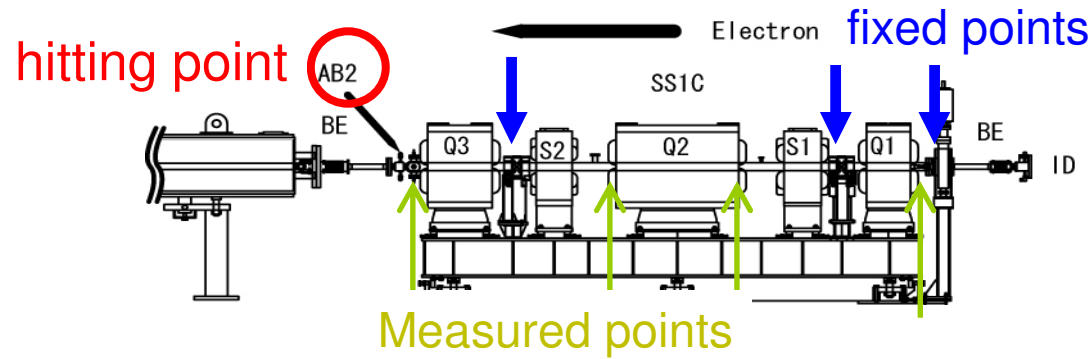


Calculation:

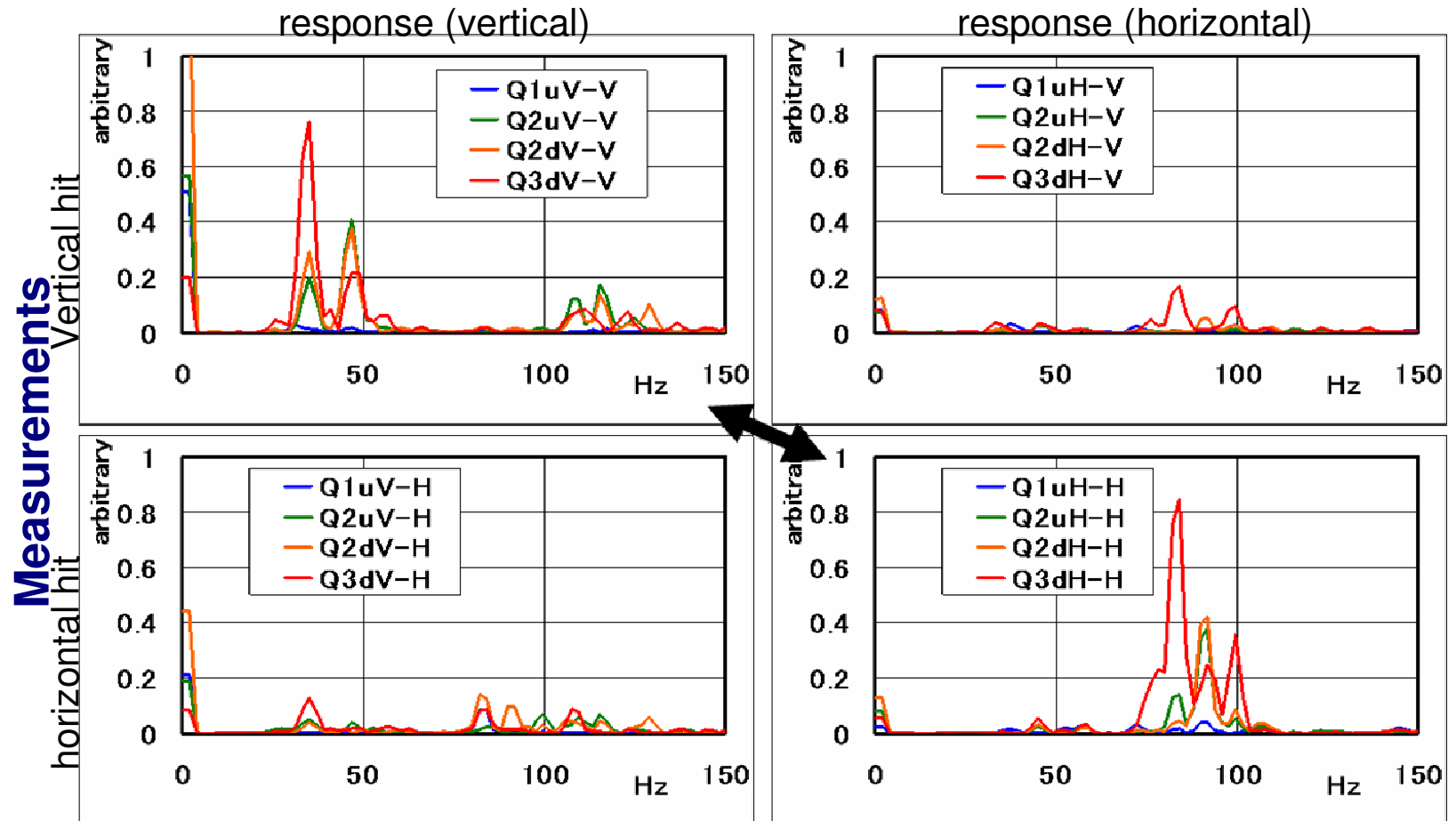
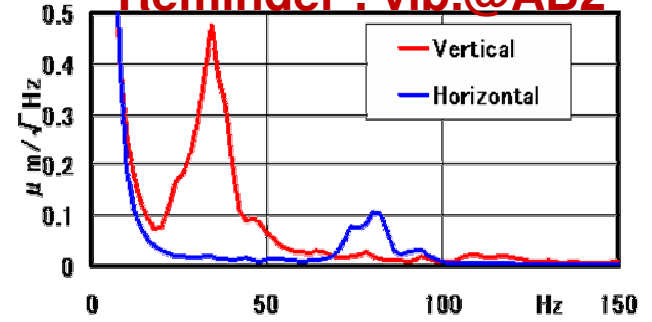
CAE with FEM (ANSYS 8.1)



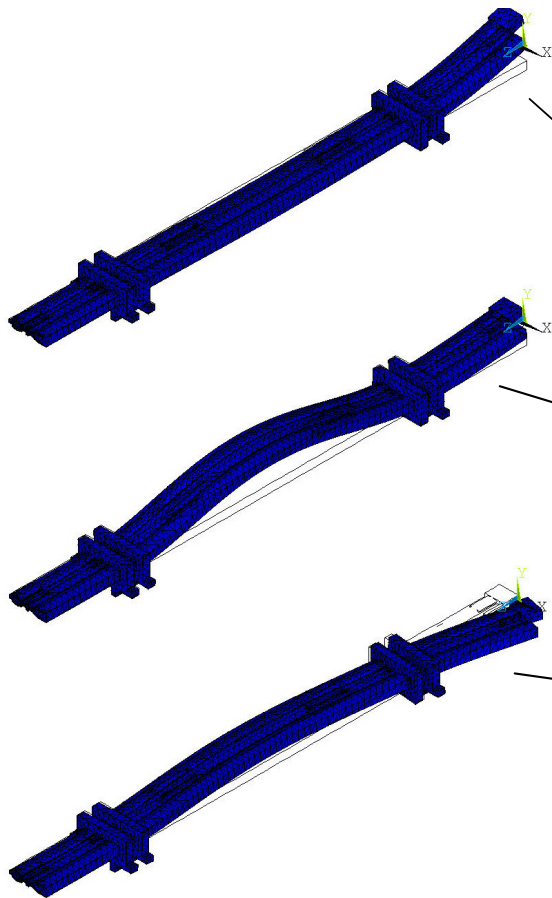
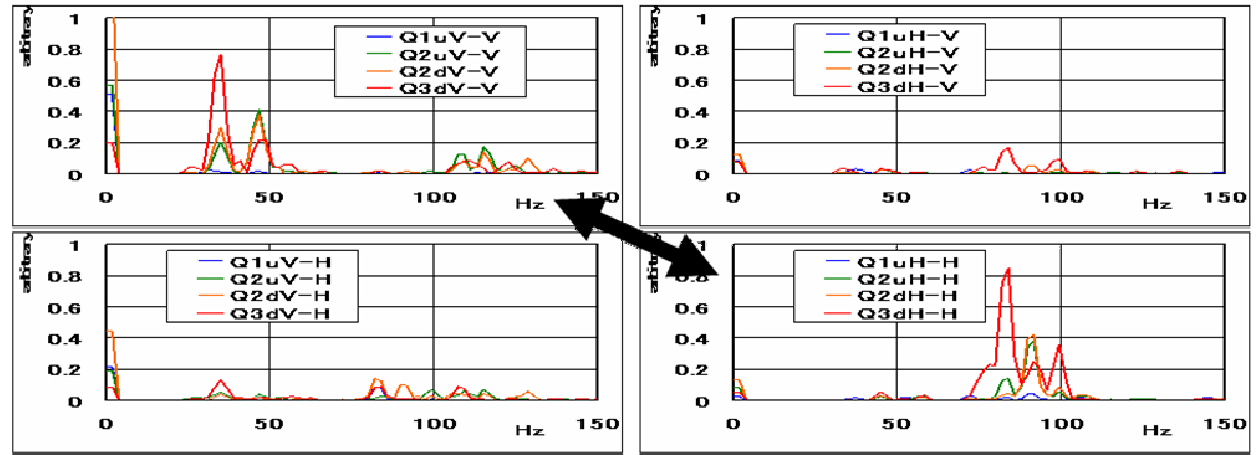
for SC1 consists with AB2



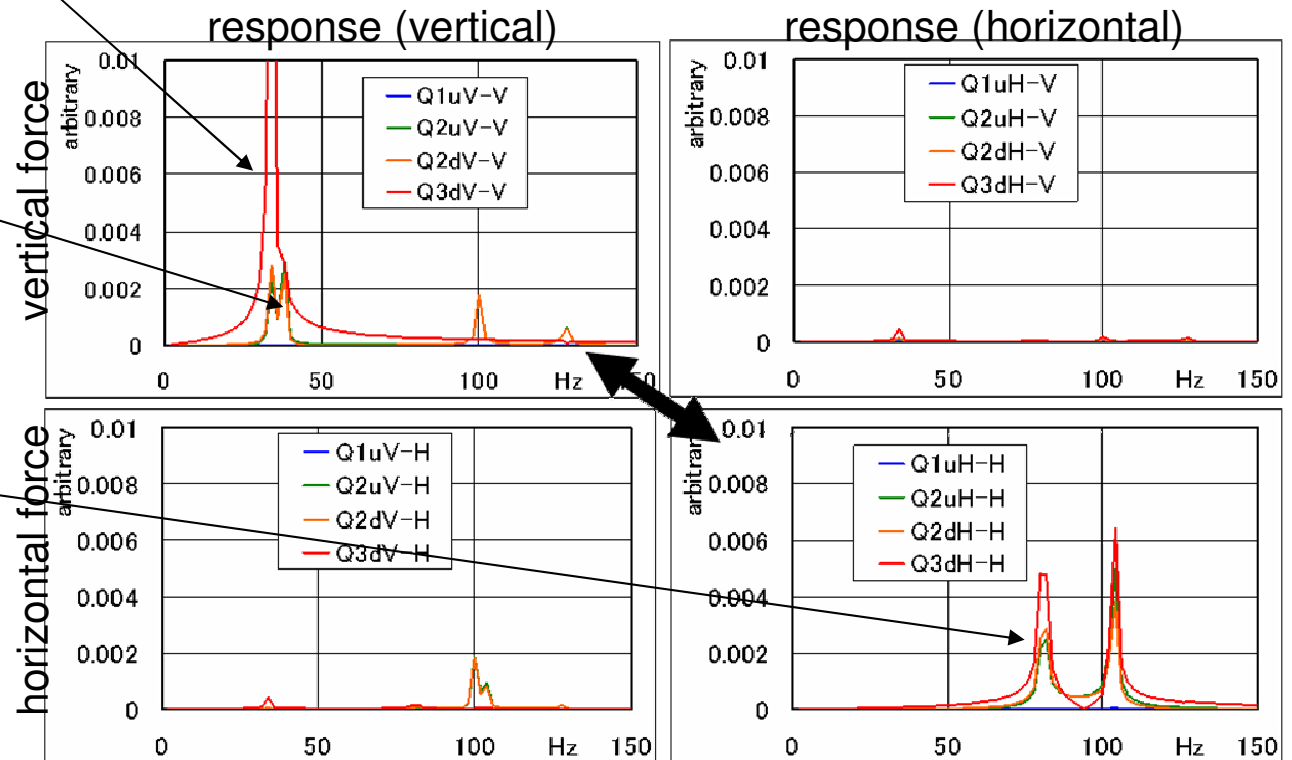
Reminder : vib.@AB2



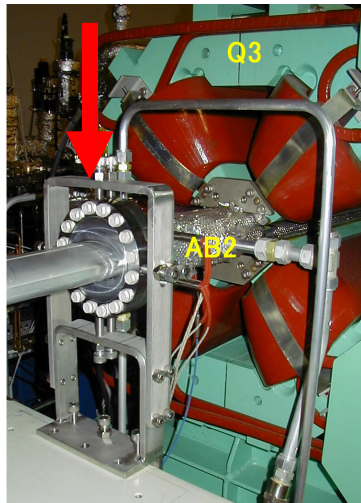
for SC1
consists with AB2



Calculations

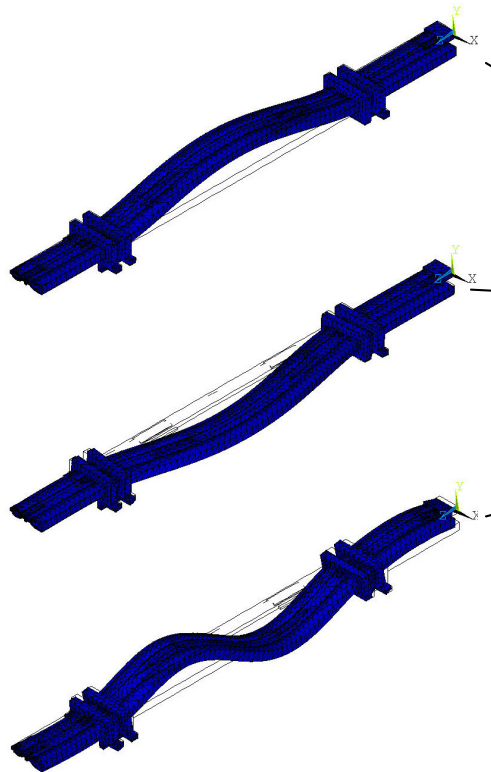
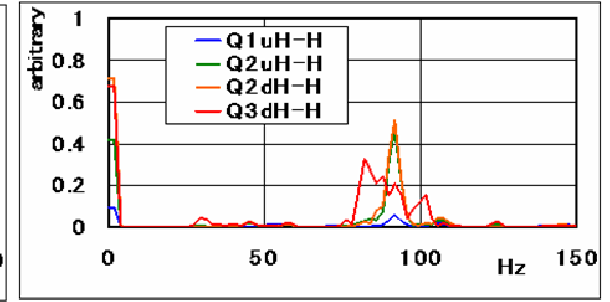
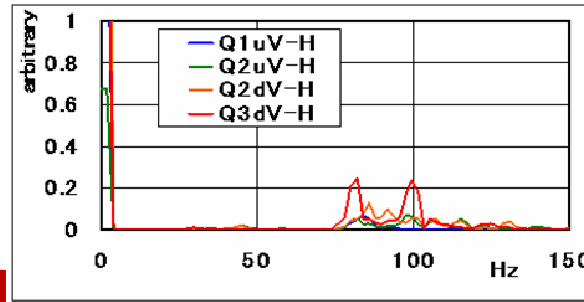
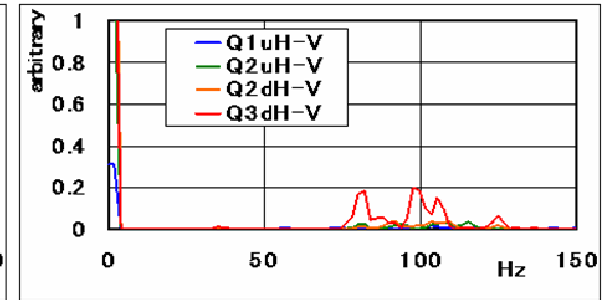
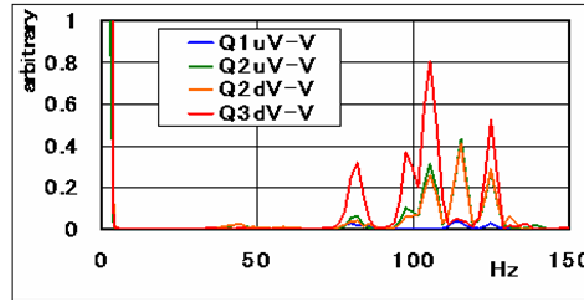


for SC1 with support



The mode of ~40Hz disappeared

Measurements

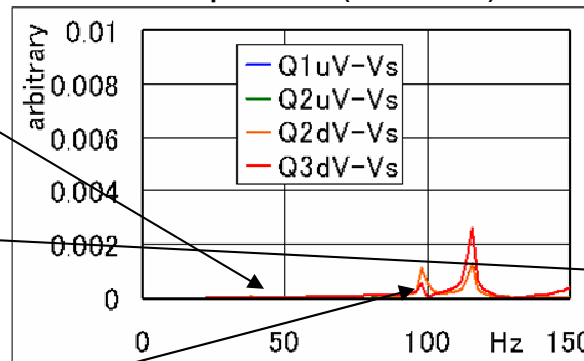


Calculations

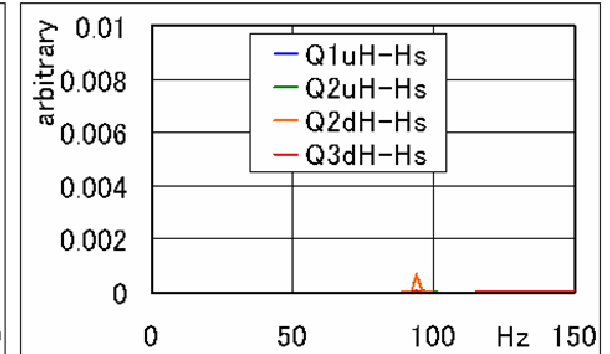
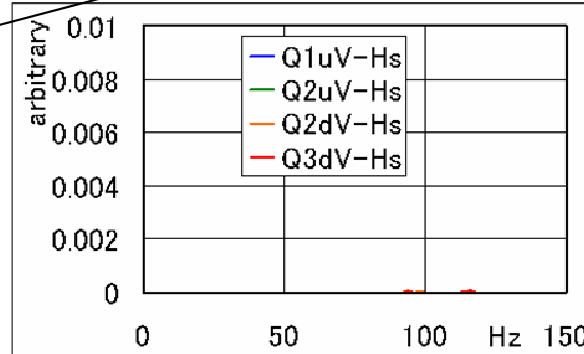
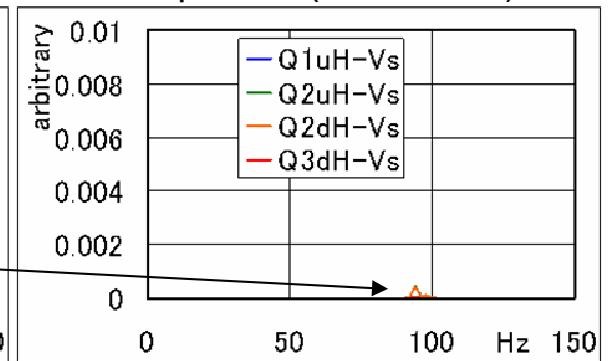
vertical force

horizontal force

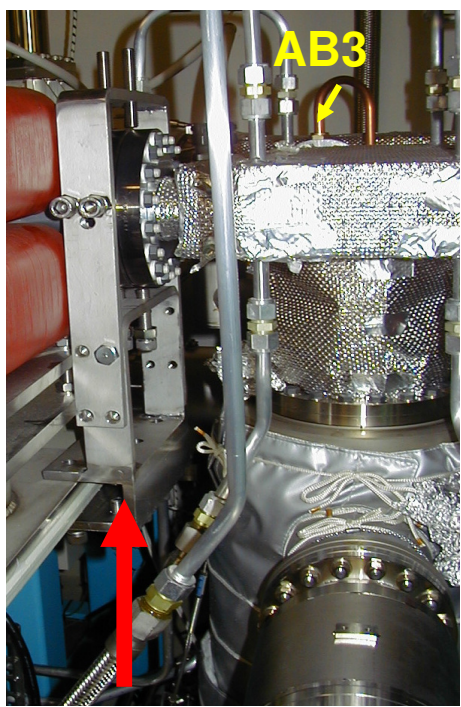
response (vertical)



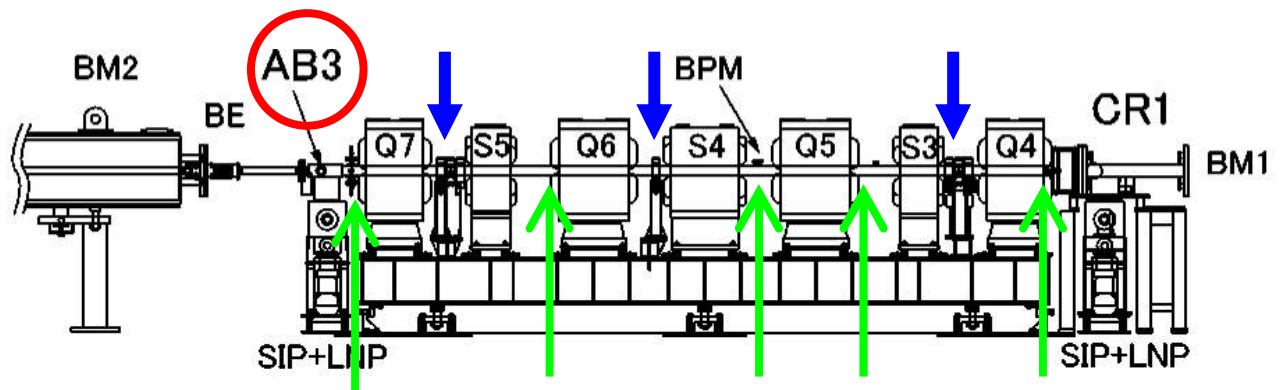
response (horizontal)



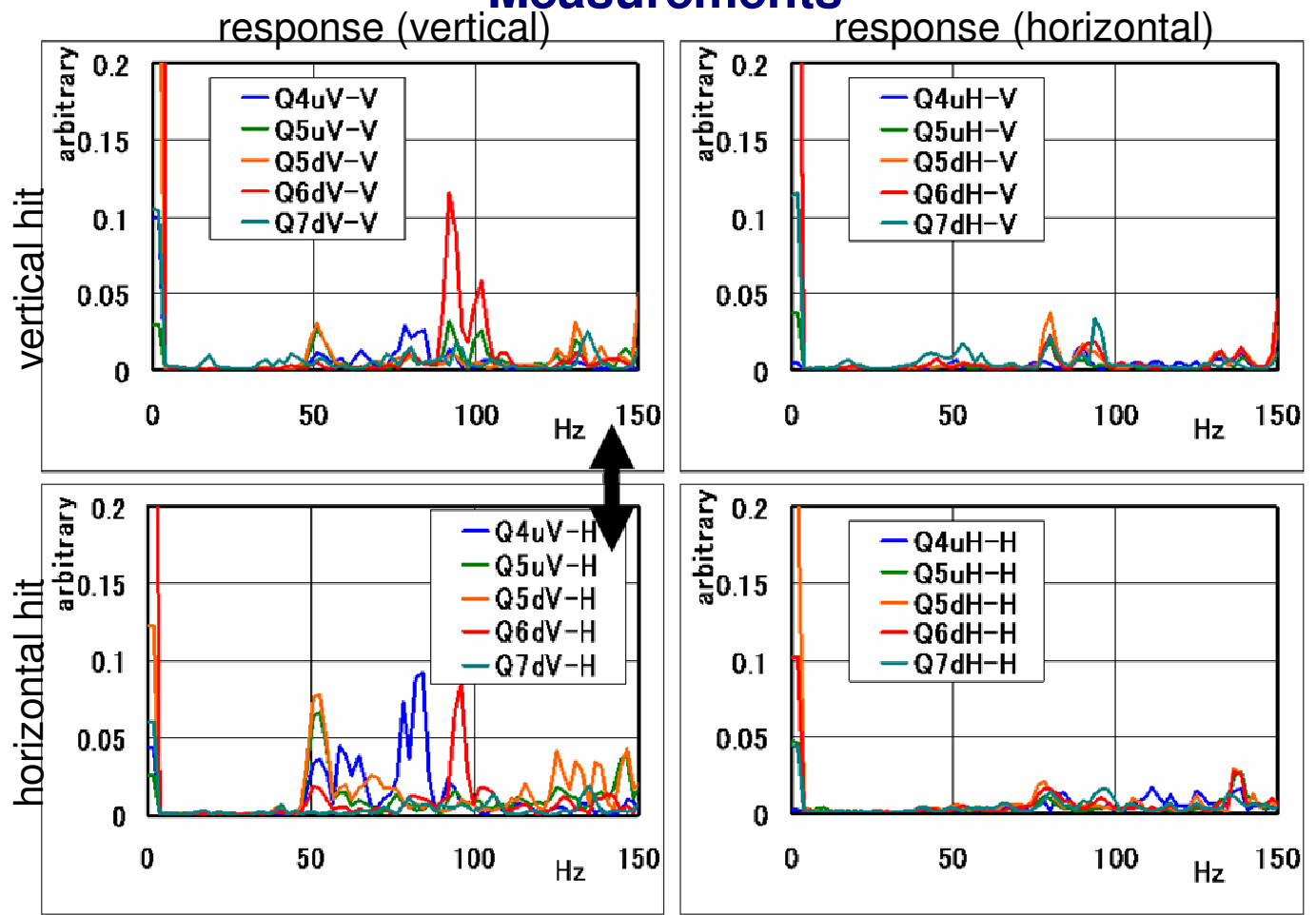
for SC2
consists with AB3

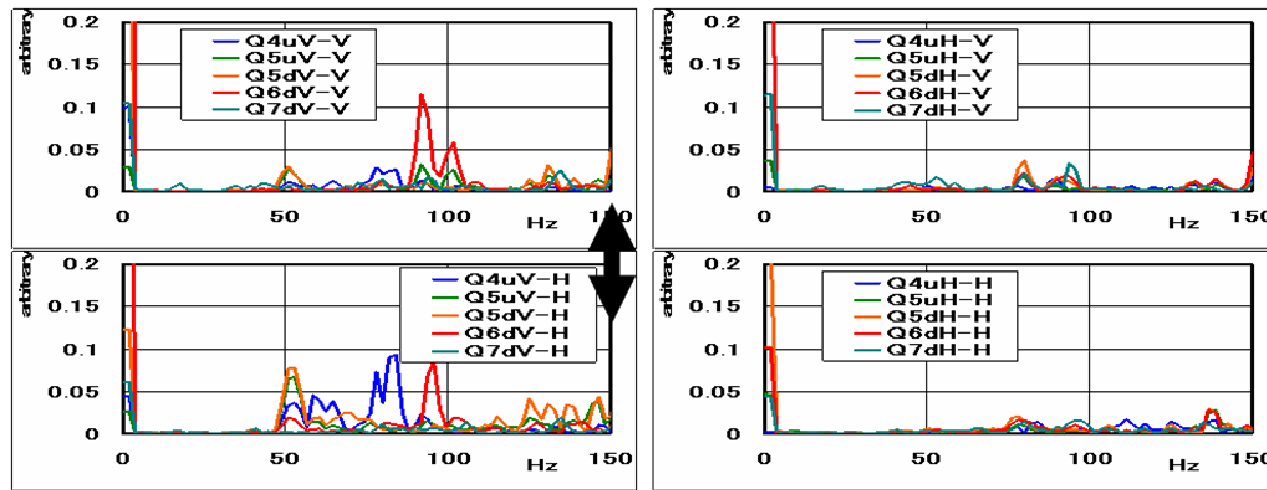
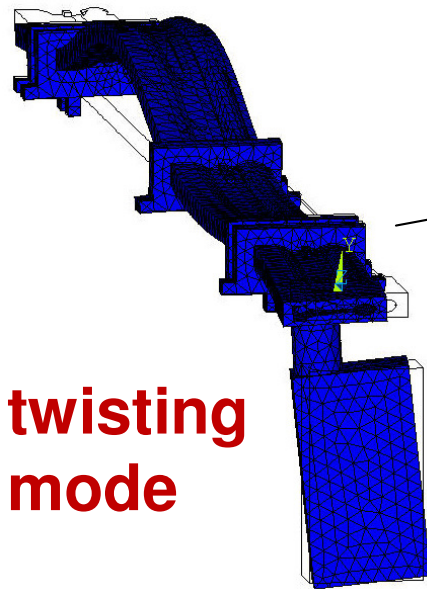


This type
support
doesn't
work !!

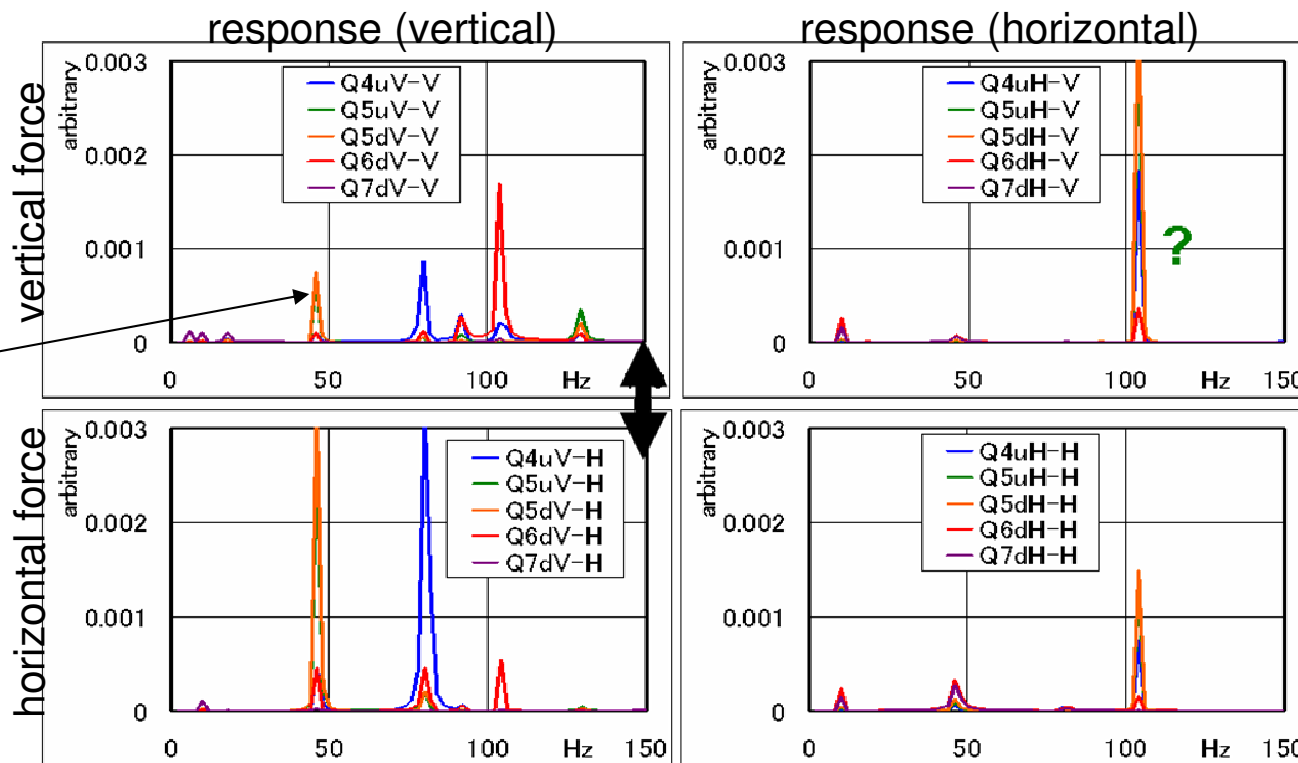


Measurements

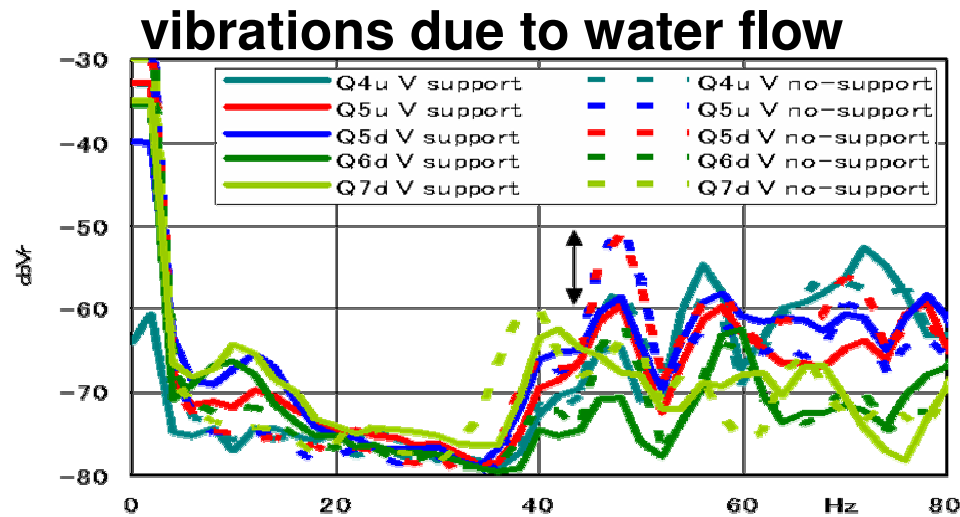
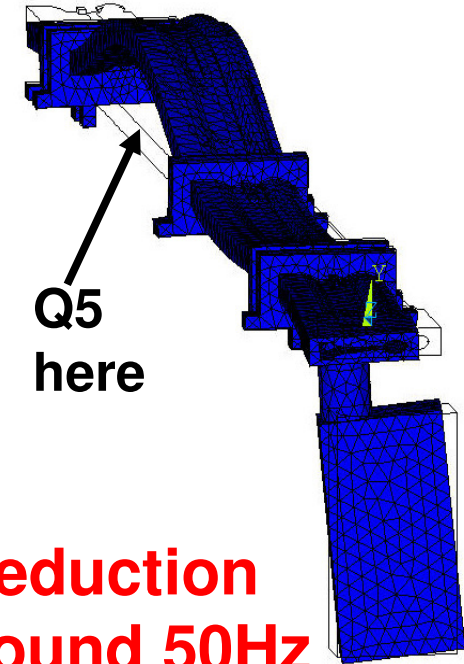
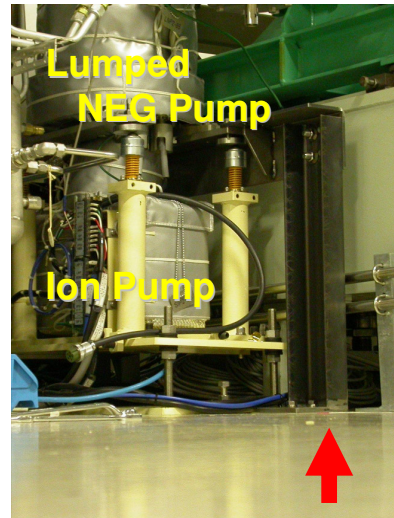
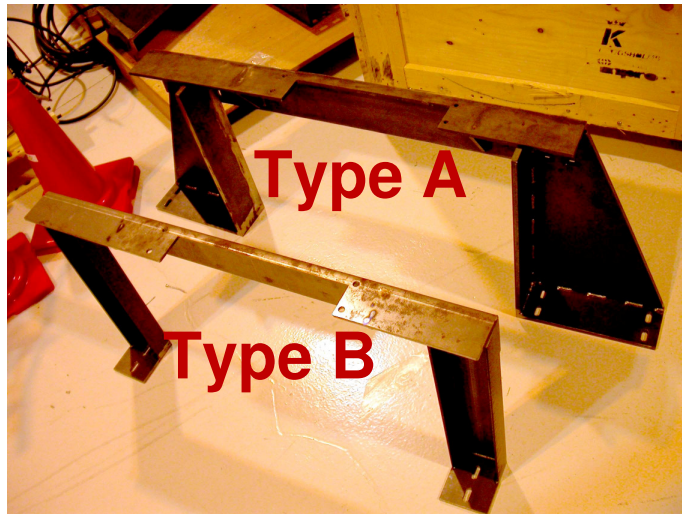




Calculations

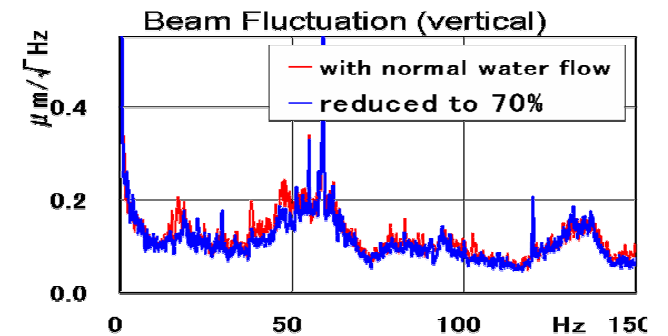


New support test for reduction of the twisting motion



type A : reduction around 50Hz

type B : no effect



One of good candidates for the entire modification

Summary

- . Photon absorbers are localized to keep U.H.V.
high heat load of photons
→ **high speed water flow is needed**
VIBRATION due to the water flow
- . **Electron beam fluctuation is caused by the chamber vibration**
- . **Some chamber supports work for the vibration reduction, and some don't.**
- . **To see the detail of the chamber response function, the Modal Analysis has been done.**
A solution appeared

- . **We can see details for the other candidates and optimize the way of the vibration reduction taking account of their costs.**