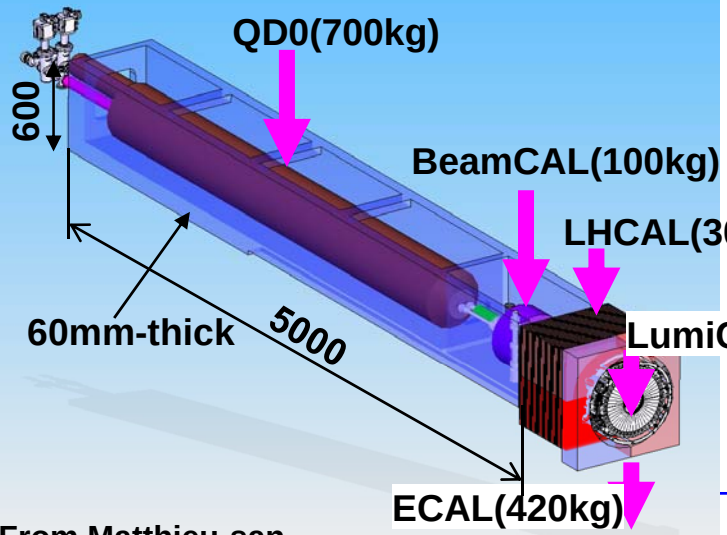
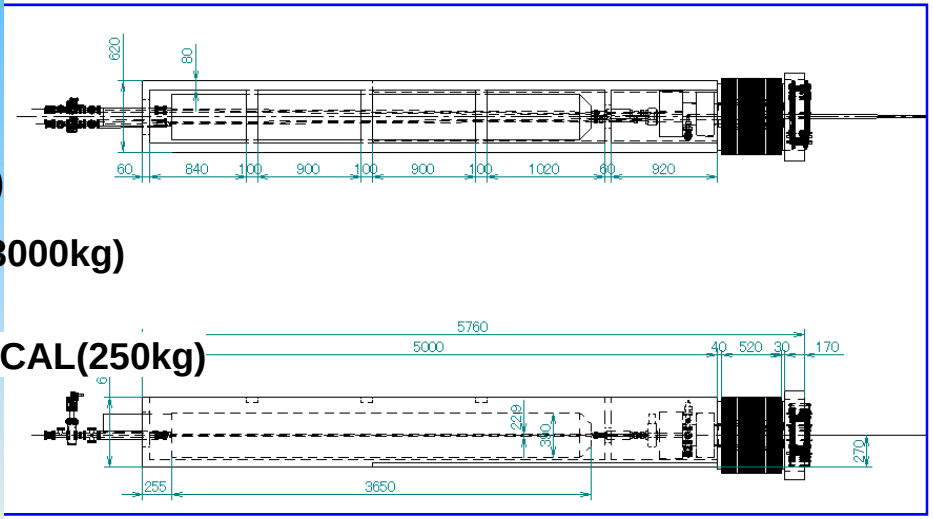
Status of Cylindrical Support tub studies

Aug. 12 '08
KEK H. Yamaoka

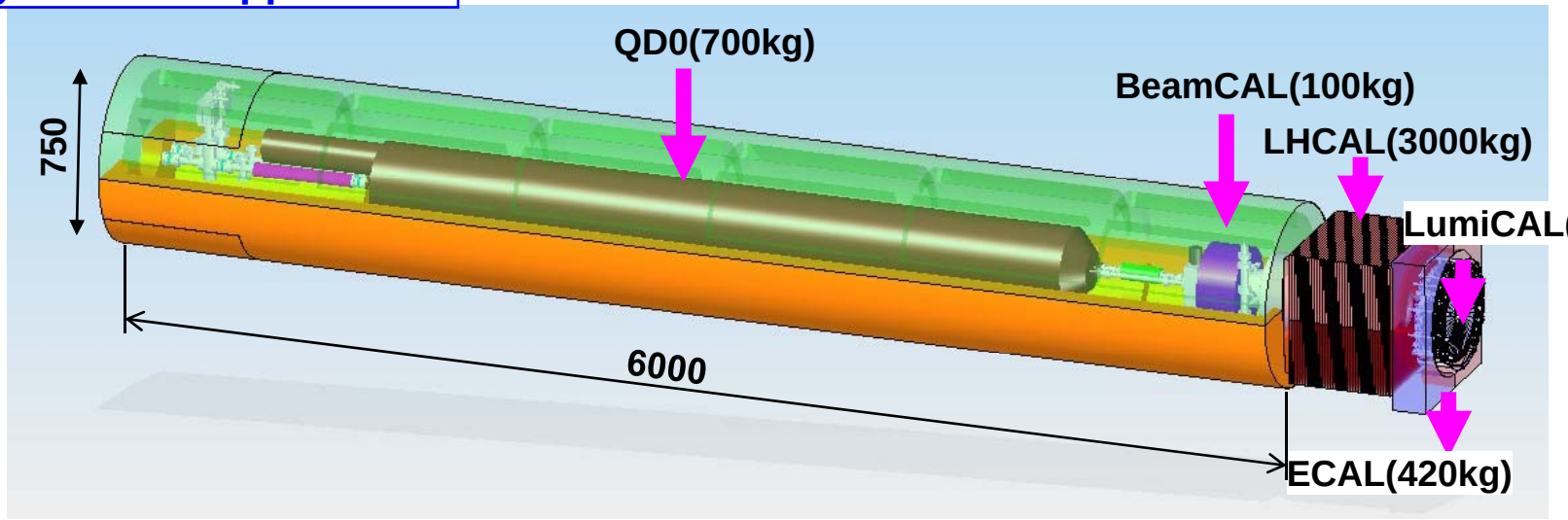
Square Support Tube





From Matthieu-san

Cylindrical Support Tube



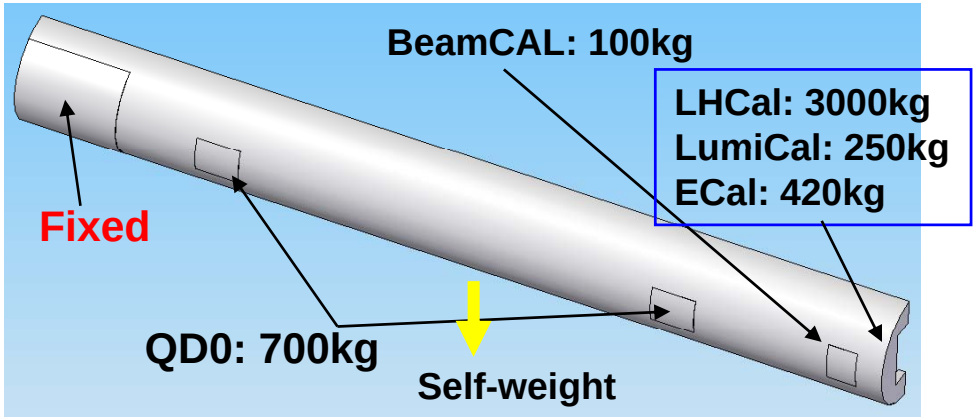
- Materials
  - -Stainless steel
  - -Aluminum
  - -CFRP(Not carried out)

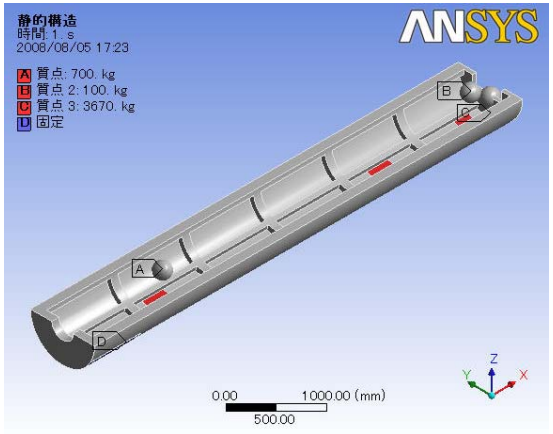
-Load condition
  See: right-upper

-Constraints
  - Only cylinder-end.
  - Not constraint on the middle position

-Models
  - Half-Cylinder
  - Full-Cylinder
  - Half-cylinder with reinforcement ribs

-Analyses
  - Static analysis
  - Modal analysis
  - Dynamic analysis due to grand motion

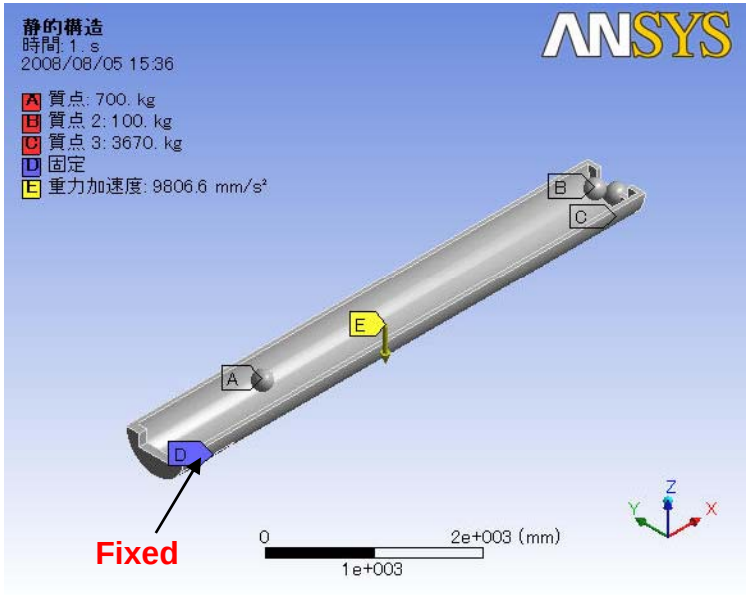


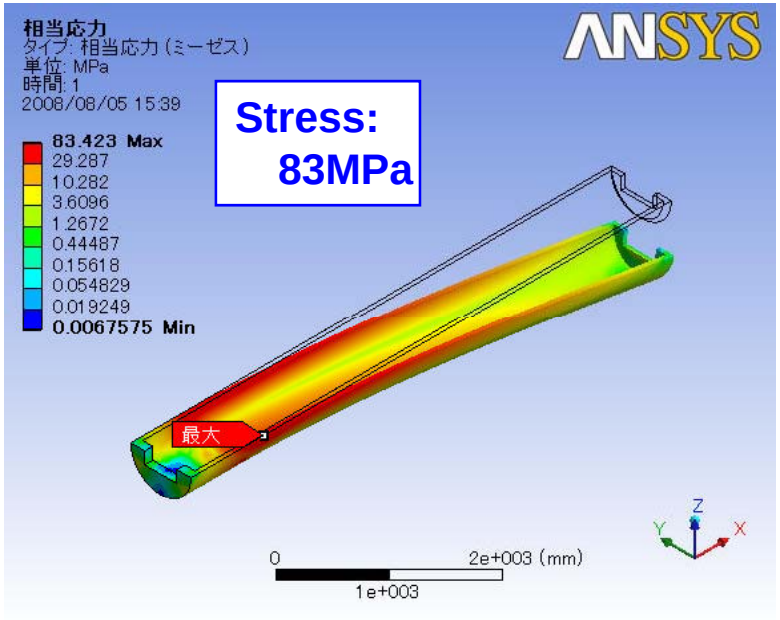


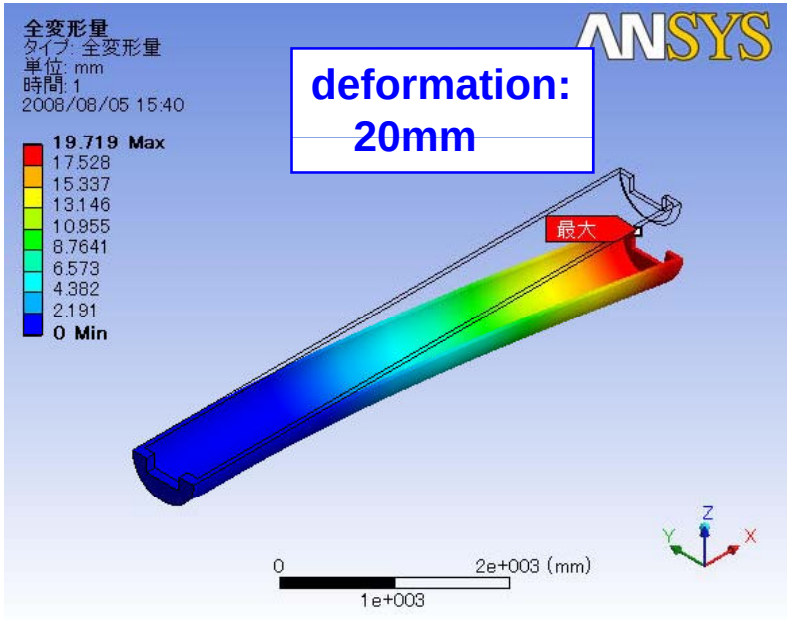
Results

Static analysis

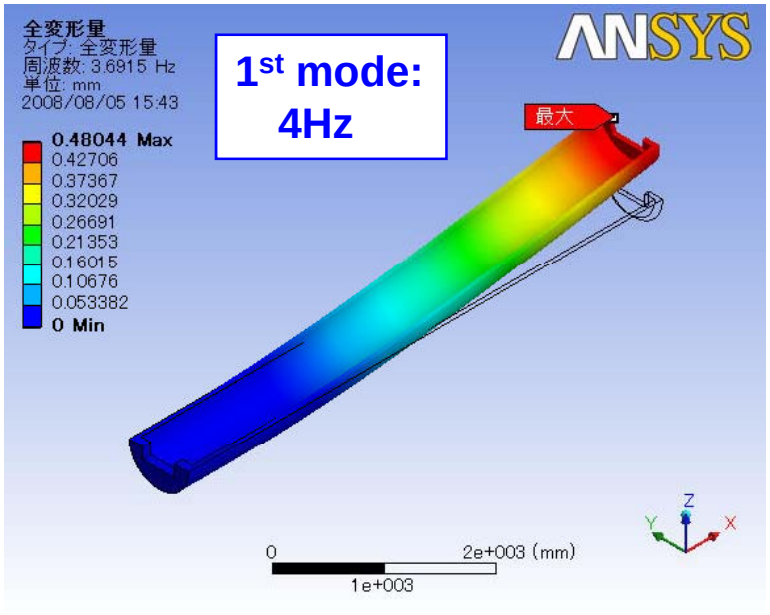
- Half-cylinder
- Stainless-steel
- 50mm-thick
- Each detector weight +Self-weight

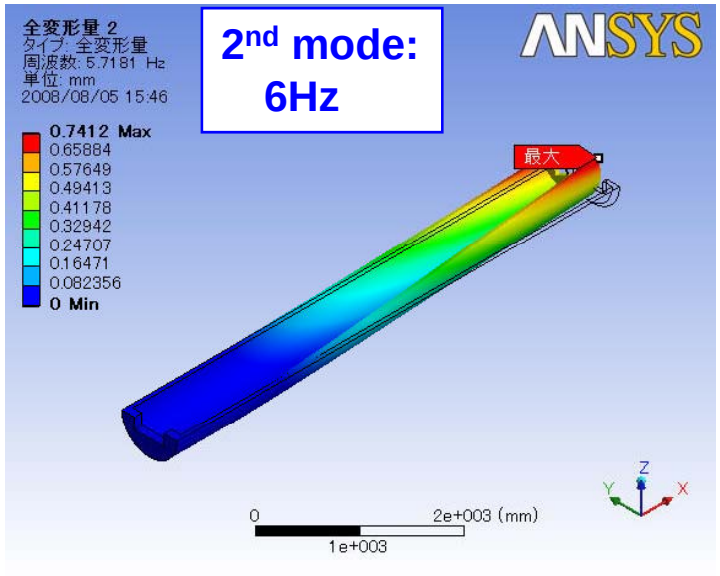


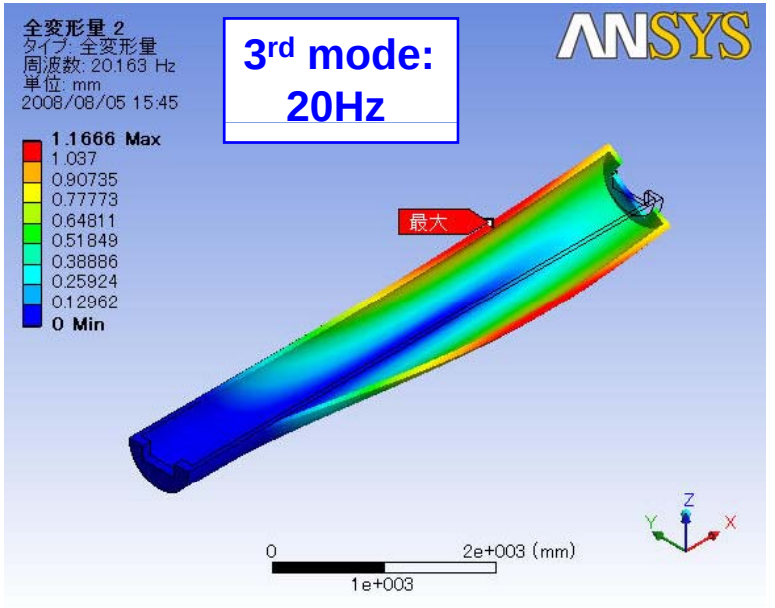




Natural frequencies

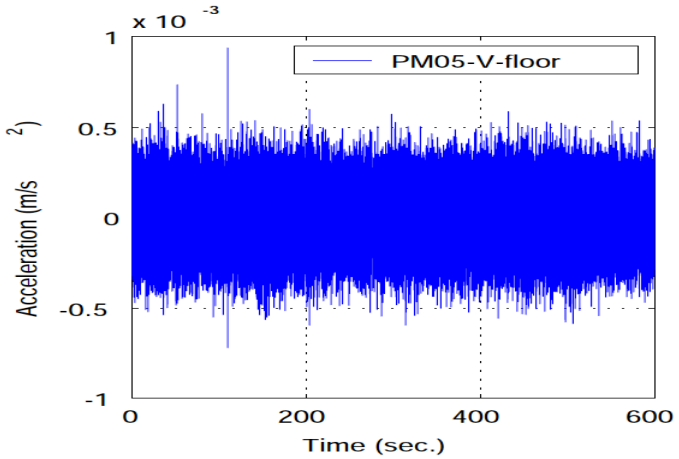




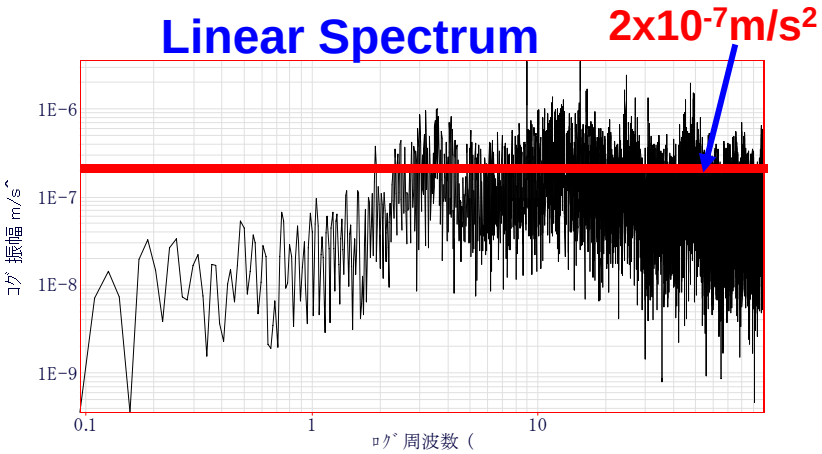


Amplitude of the support tube due to grand motion

Vertical-dir. @KEK: ATF(17:00 Feb. 10, 2004)



FFT



Input Acc. = 2×10^{-7}m/s^2

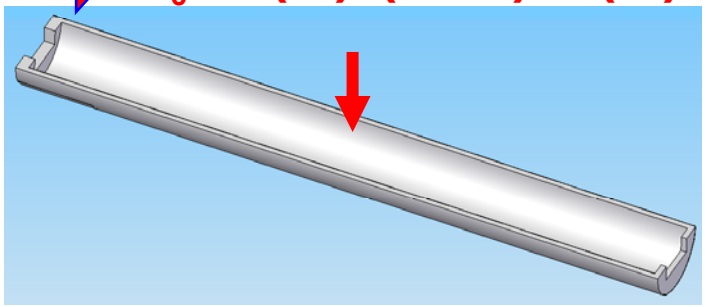
Mass=(2685.5+700+100+3000+250+420)/9.8[m/s^2]

Self-weight(half-cylinder)

$F_0\cos(\omega t)=(m \cdot a)\sin(\omega t)$

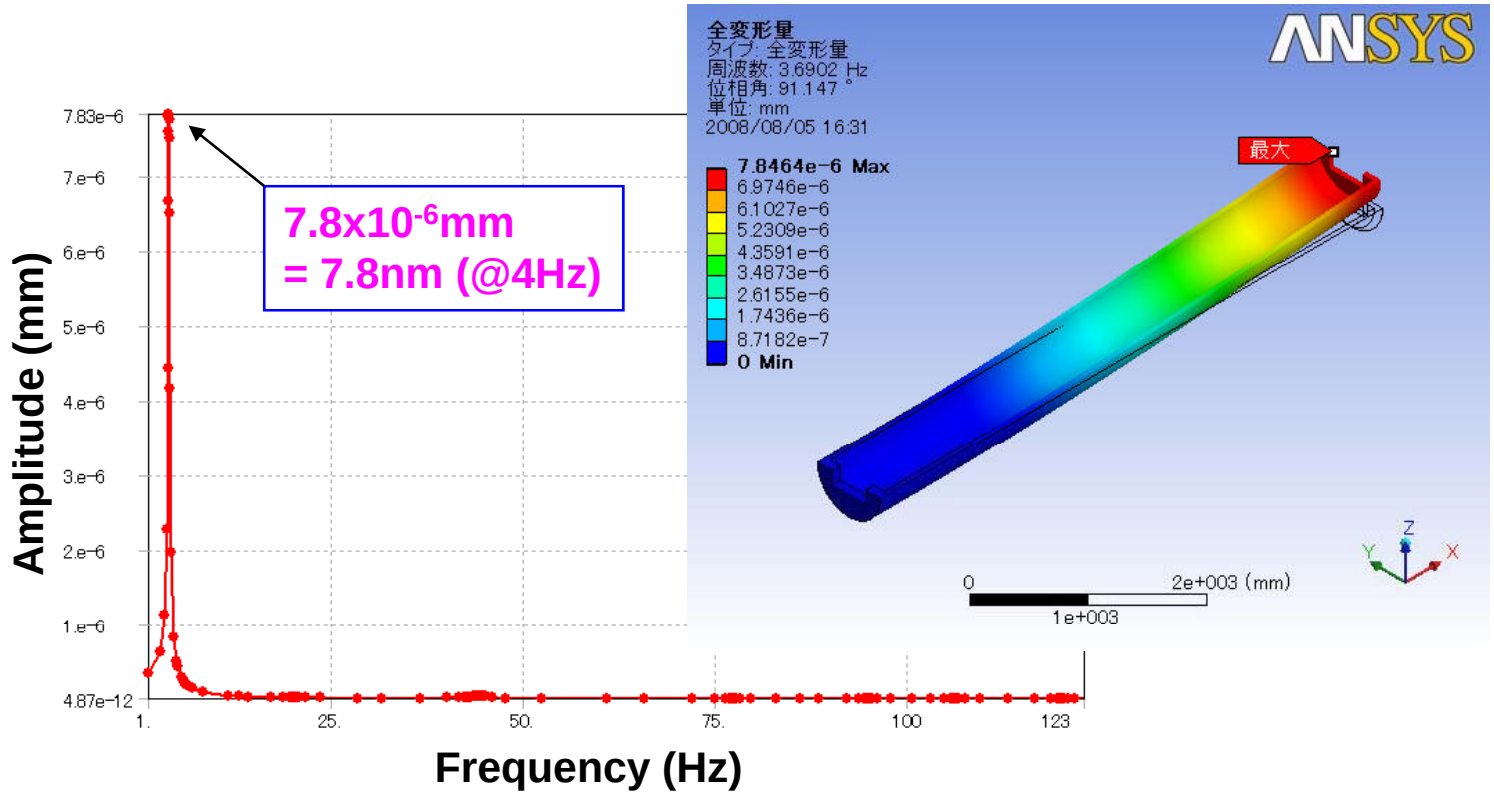
$F_0=2\times10^{-3}$N

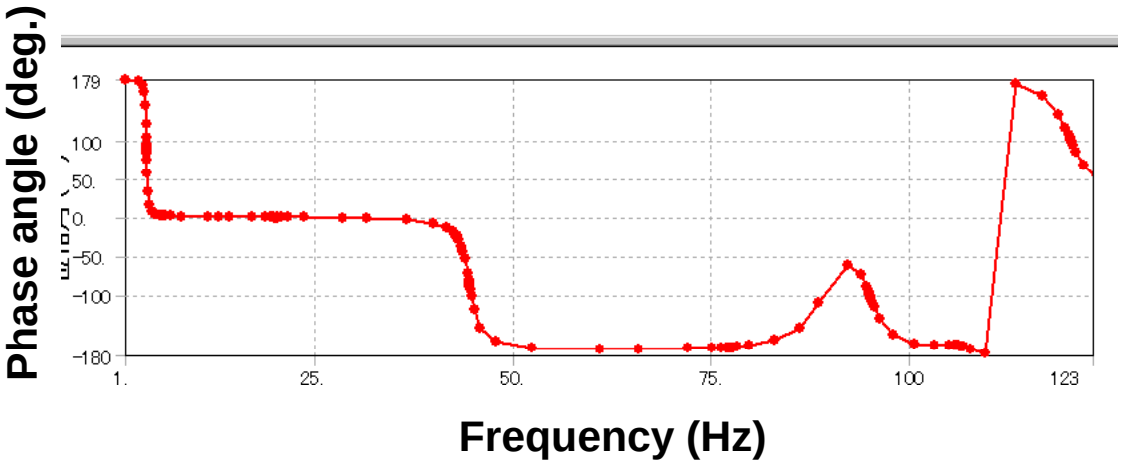
ω= 0 – 1000Hz



- **Input value is measurement data at ATF in KEK.**
- **Input data is assumed to harmonic vibration.**

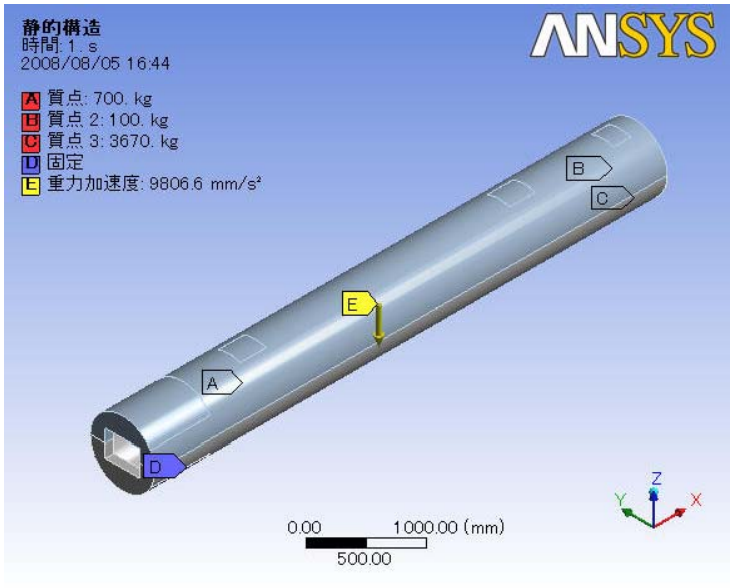
Calculation results





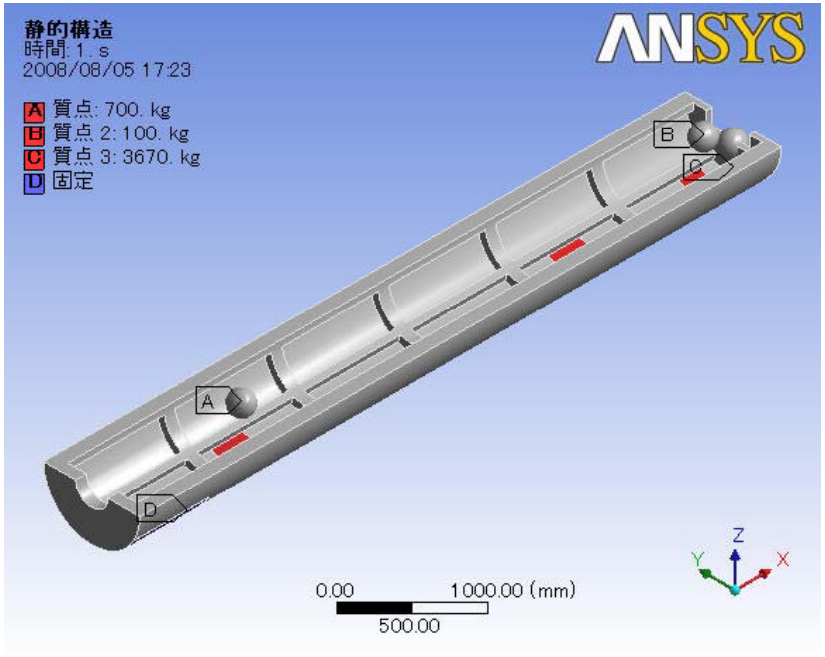
The maximum amplitude:
8×10^{-6}mm = 8nm
@ 4Hz(1st mode)

B. Full-cylinder, SUS, 50mm-thick



- Staic
  - Def. : 3.2mm
  - Stress: 38MPa
- Natural freq.
  - 1st : 10Hz
  - 2nd : 79Hz
  - 3rd : 122Hz
- Harmonic
  - Amp.: 3nm

C. Half-cylinder, SUS, Reinforcement ribs



- Staic
  - Def. : 8.5mm
  - Stress: 54MPa
- Natural freq.
  - 1st : 6Hz
  - 2nd : 8Hz
  - 3rd : 28Hz
- Harmonic
  - Amp.: 3nm

Summary

	Configuration	Half Cyl.	Full Cyl.	Half Cyl.	Full Cyl.	With Ribs	With Ribs
	Material	SUS	SUS	Al	Al	SUS	Al
Size	Thickness(mm)	50.0	50.0	50.0	50.0	50.0	50.0
	Length(mm)	6000	6000	6000	6000	6000	6000
	Rib size(mm)					75(H)x60(W)	75(H)x60(W)
Load conditions	QD0(kg)	700.0	700.0	700.0	700.0	700.0	700.0
	BeamCAL(kg)	100.0	100.0	100.0	100.0	100.0	100.0
	LHCAL(kg)	3000.0	3000.0	3000.0	3000.0	3000.0	3000.0
	LumiCAL(kg)	250.0	250.0	250.0	250.0	250.0	250.0
	ECAL(kg)	420.0	420.0	420.0	420.0	420.0	420.0
	Self-Weight(kg)	2685.5	5371.0	960.0	1920.0	4528.3	1597.9
Static analysis	Stress(MPa)	83.4	38.4	71.2	28.0	53.5	41.2
	Deformation(mm)	19.7	3.2	46.9	6.7	8.5	19.5
Natural Frequency	1st mode(Hz)	3.7	9.5	2.3	6.3	5.7	3.7
	2nd	5.7	78.9	3.7	64.9	7.6	4.9
	3rd	20.2	122.5	16.5	91.1	27.5	23.4
Harmonic analysis	Inp. force (N)	2.0E-03	2.0E-03	2.0E-03	2.0E-03	2.0E-03	2.0E-03
	Amp.(nm)	7.8	2.7	15.3	3.0	3.1	8.6
	Resp. freq.(Hz)	3.7	9.5	2.3	6.3	5.7	3.7
	Phase Ang.(deg.)	91.1	91.1	91.1	91.1	91.1	91.1

- Half-cylinder is too large deformation/stress.
  - It should be full-cylinder → Cylinder must be halved. → Configuration??
- Stainless steel is the best material for support tube??
  - Smaller deformation/stress than aluminum case.
  - CFRP, tungsten is not realistic??
- Additional support is not necessary??
  - Amplitude due to grand motion is acceptable?? → a few nm.

End