Effect of the Temperature Fluctuation of the Cooling Water on the Beam Orbit at the SPring-8 Storage Ring

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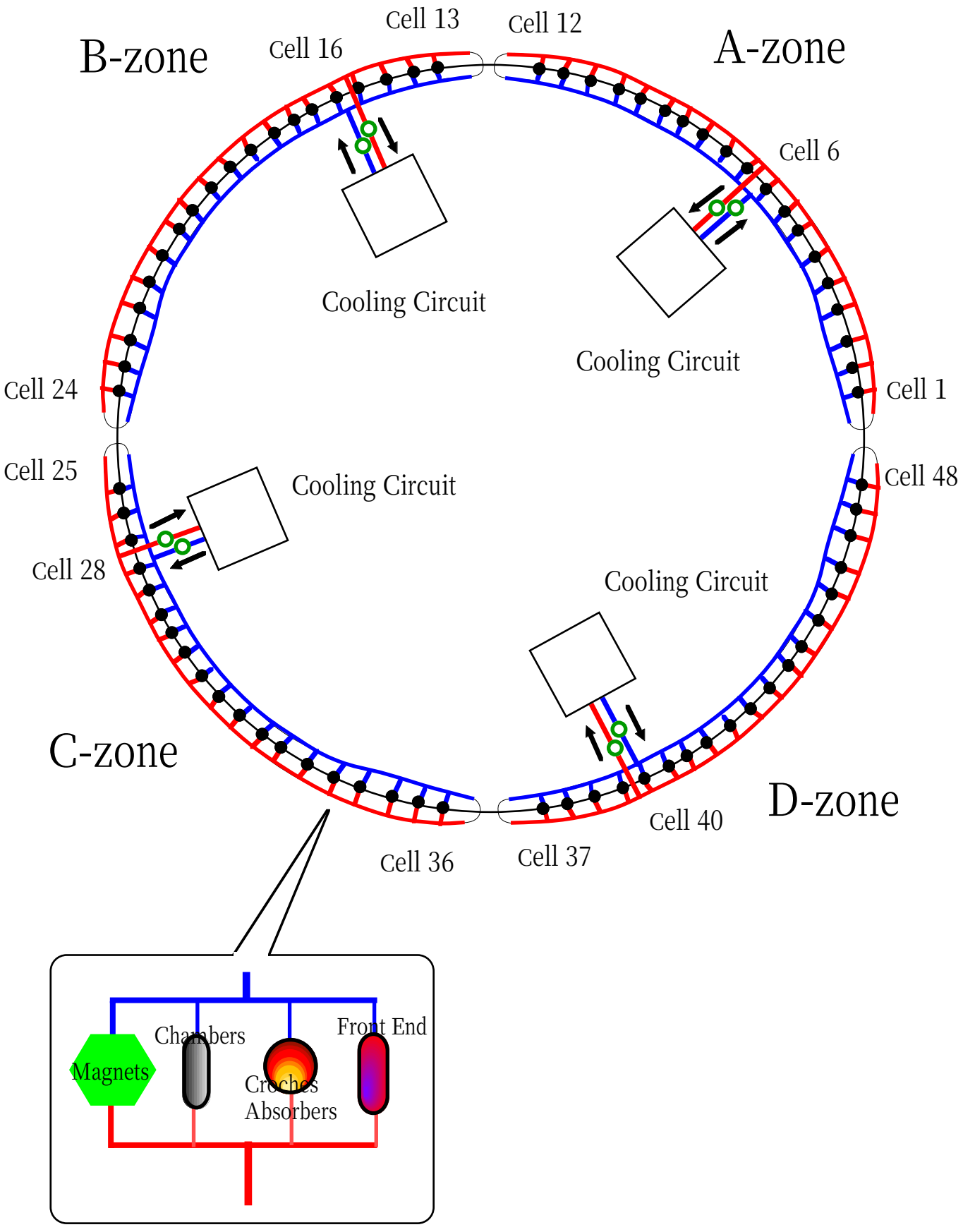
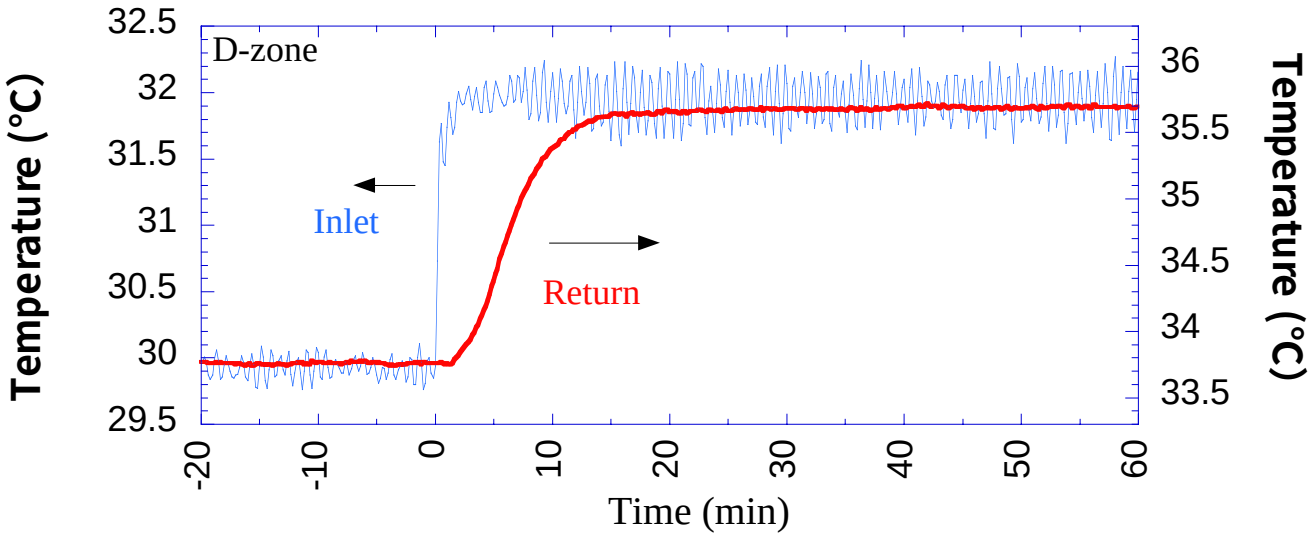
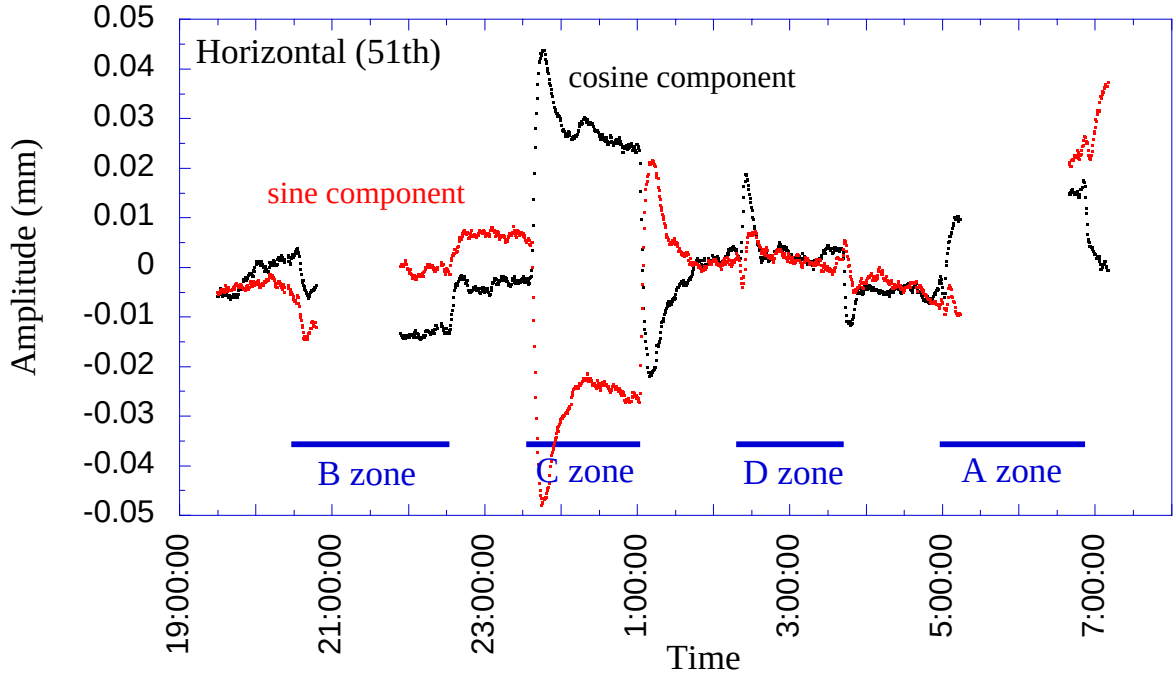
- Overview of the cooling water system of the storage ring
- Study about the effect of cooling water to the beam orbit
- Analysis of the study
- Experiments of an bending magnet behavior
- Comparison between analysis and experiments

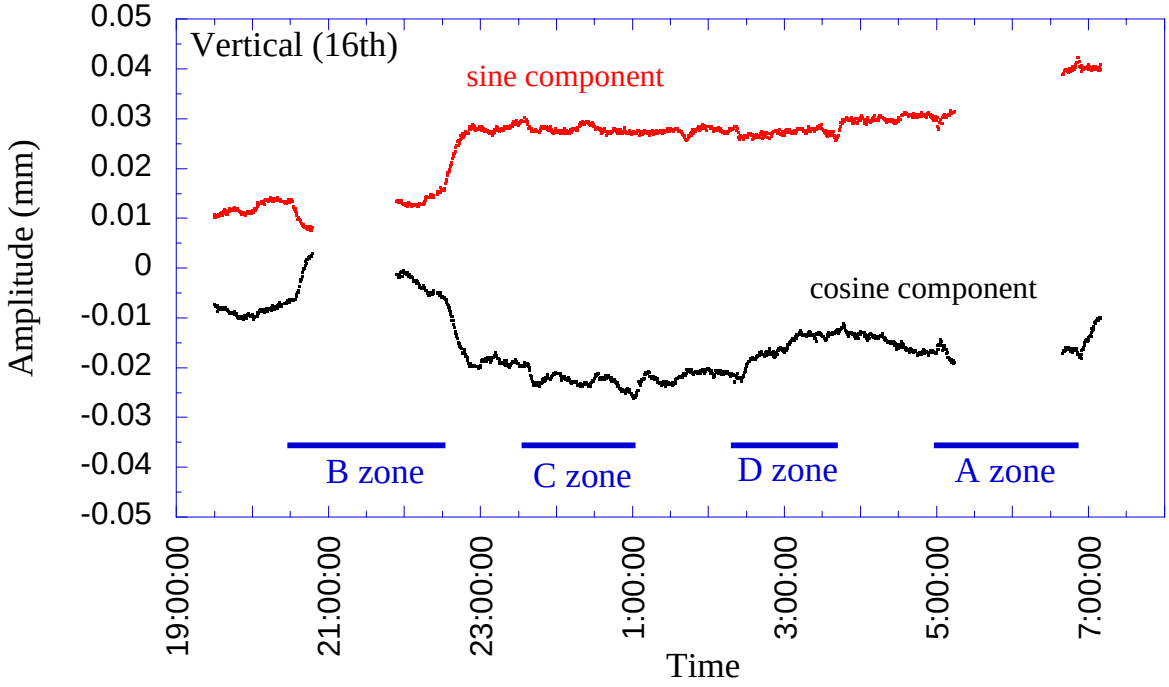
Diagram of Cooling System



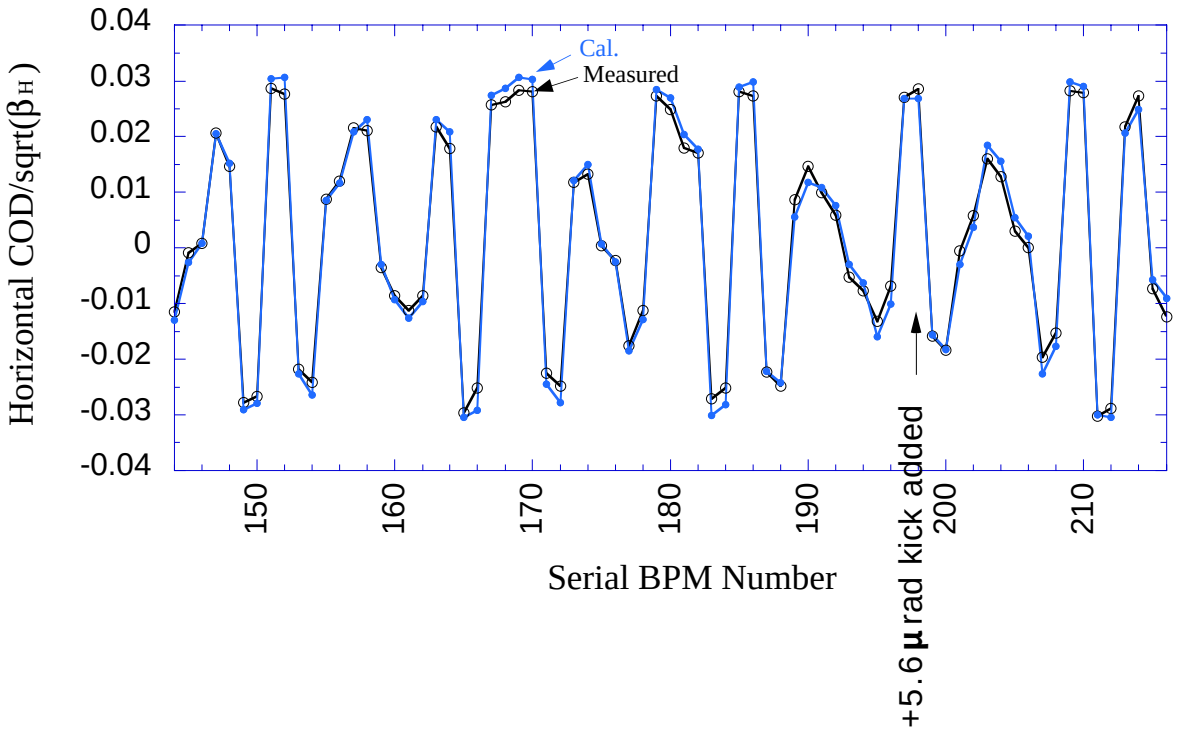


A typical time dependence of the tenperature rize of cooling water.(D-zone)
These are measured at the inlet and the outlet of each circuit.

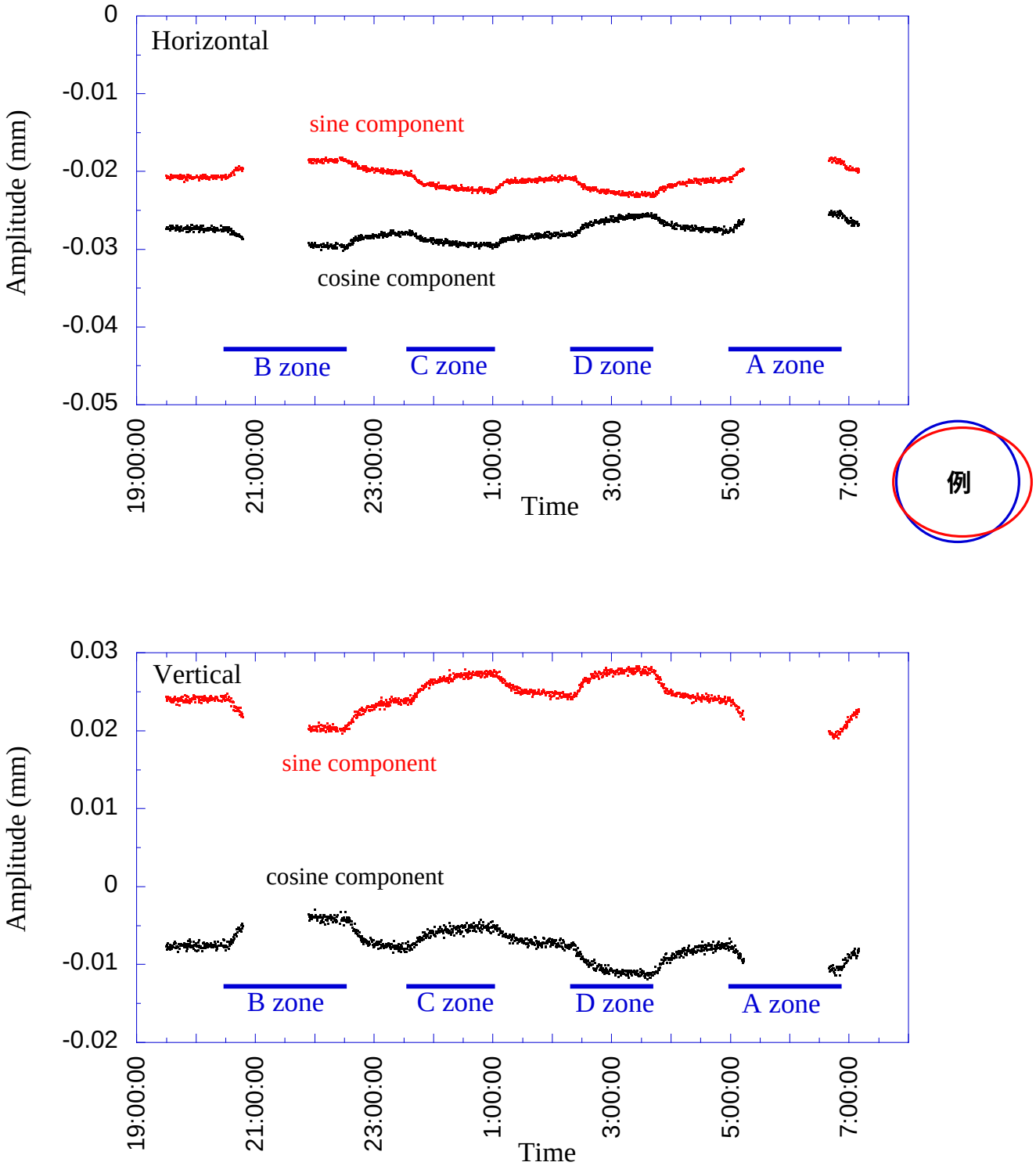




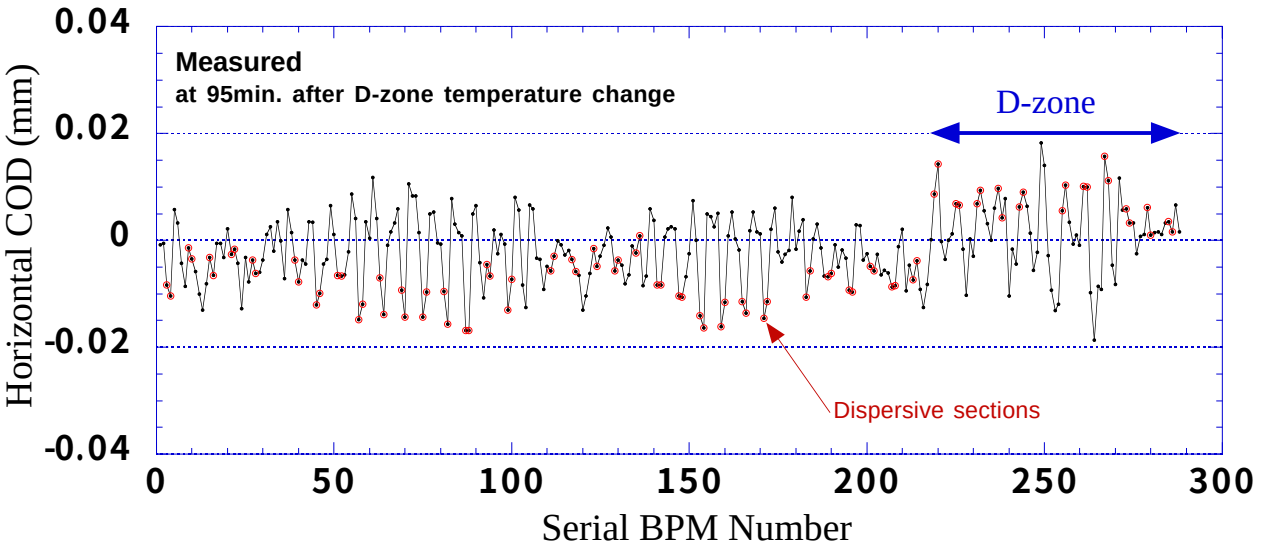
Amplitude of Fourier components of COD whose harmonic number is betatron tunes.

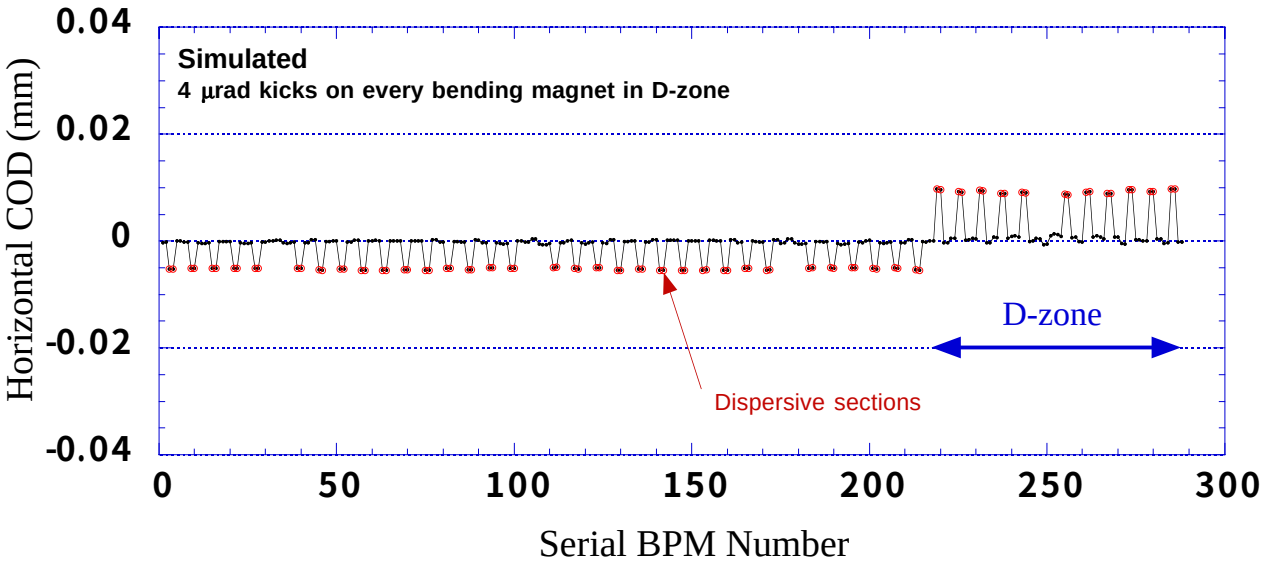


Measured and simulated orbit distortion.
+5.6 μrad kick corresponds to 8 μm movement of a quadrupole magnet.

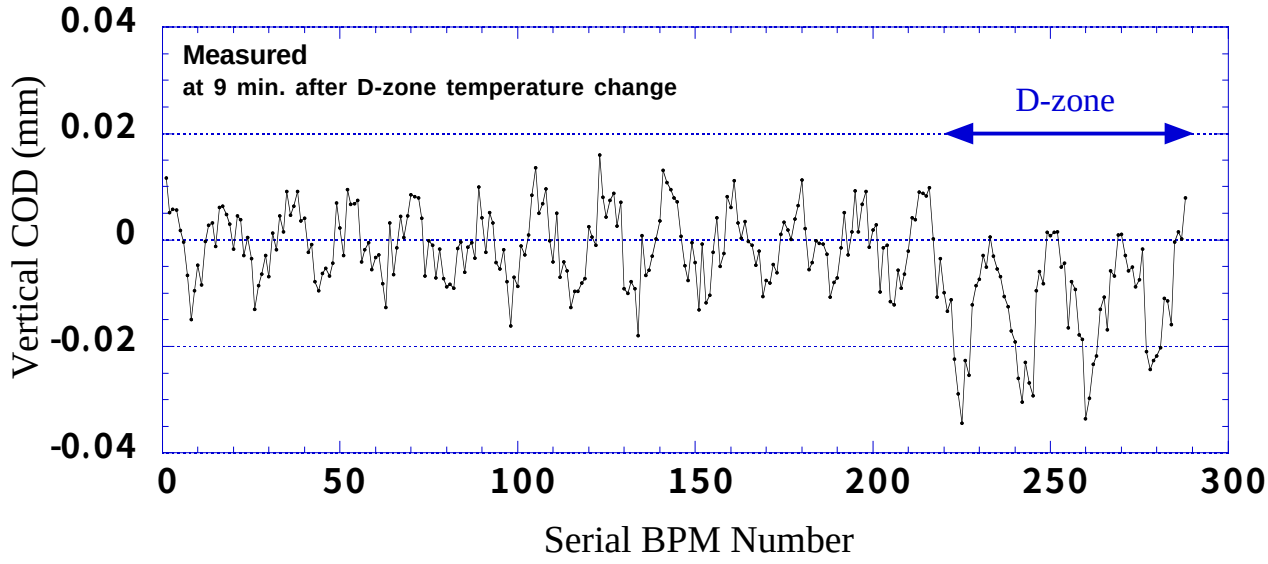


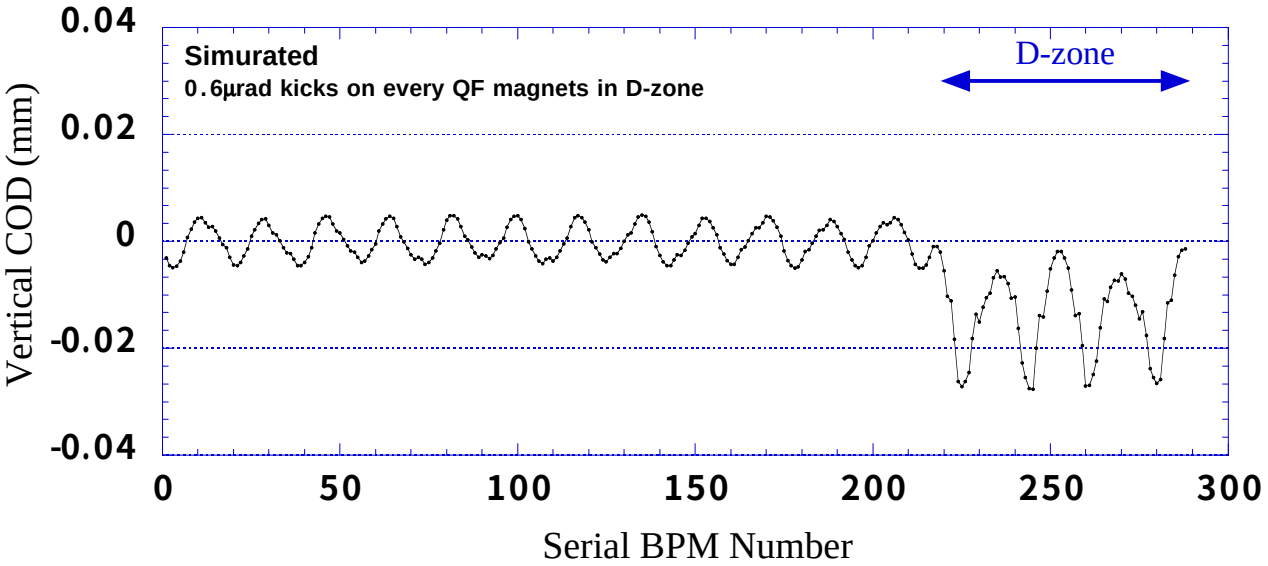
Amplitude of Fourier components of COD whose harmonic number is 1.

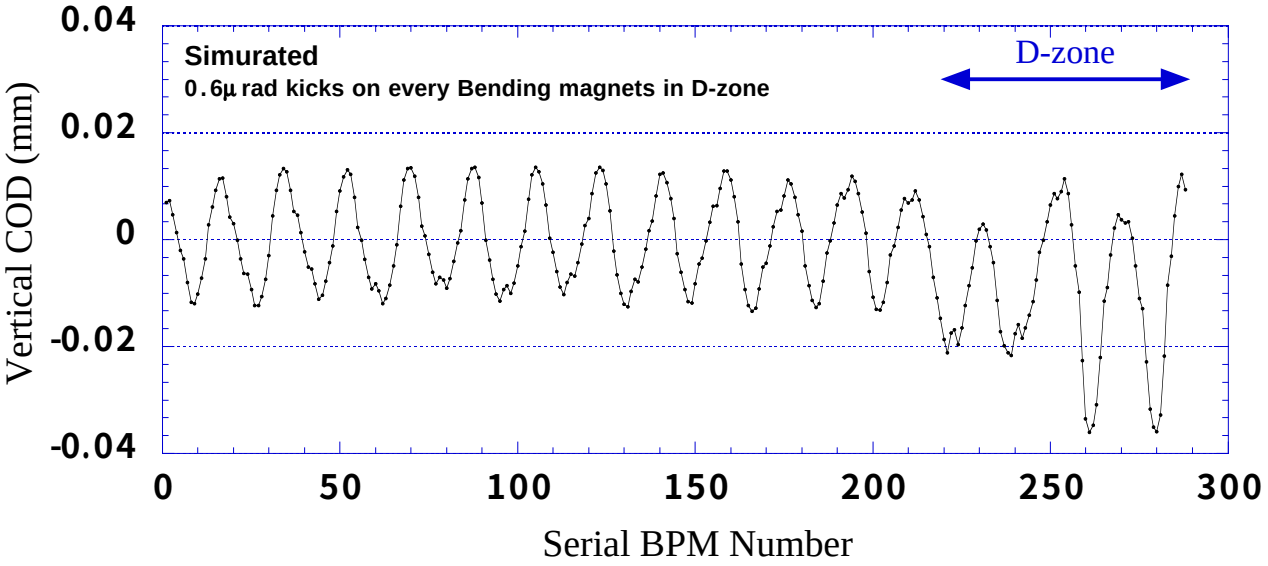




Measured and simulated horizontal COD distortion.

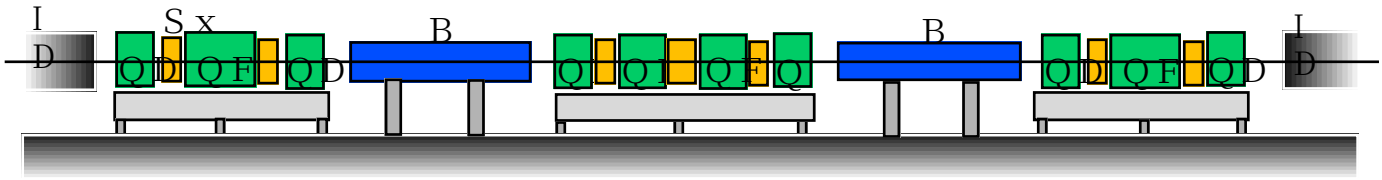




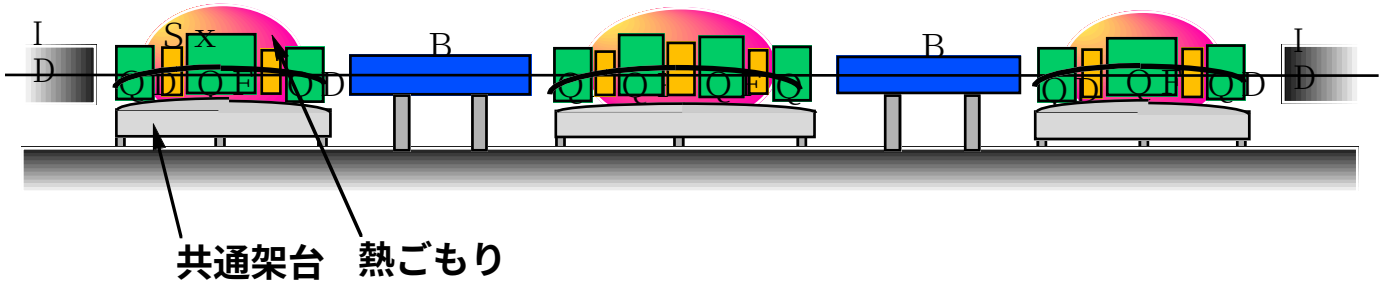


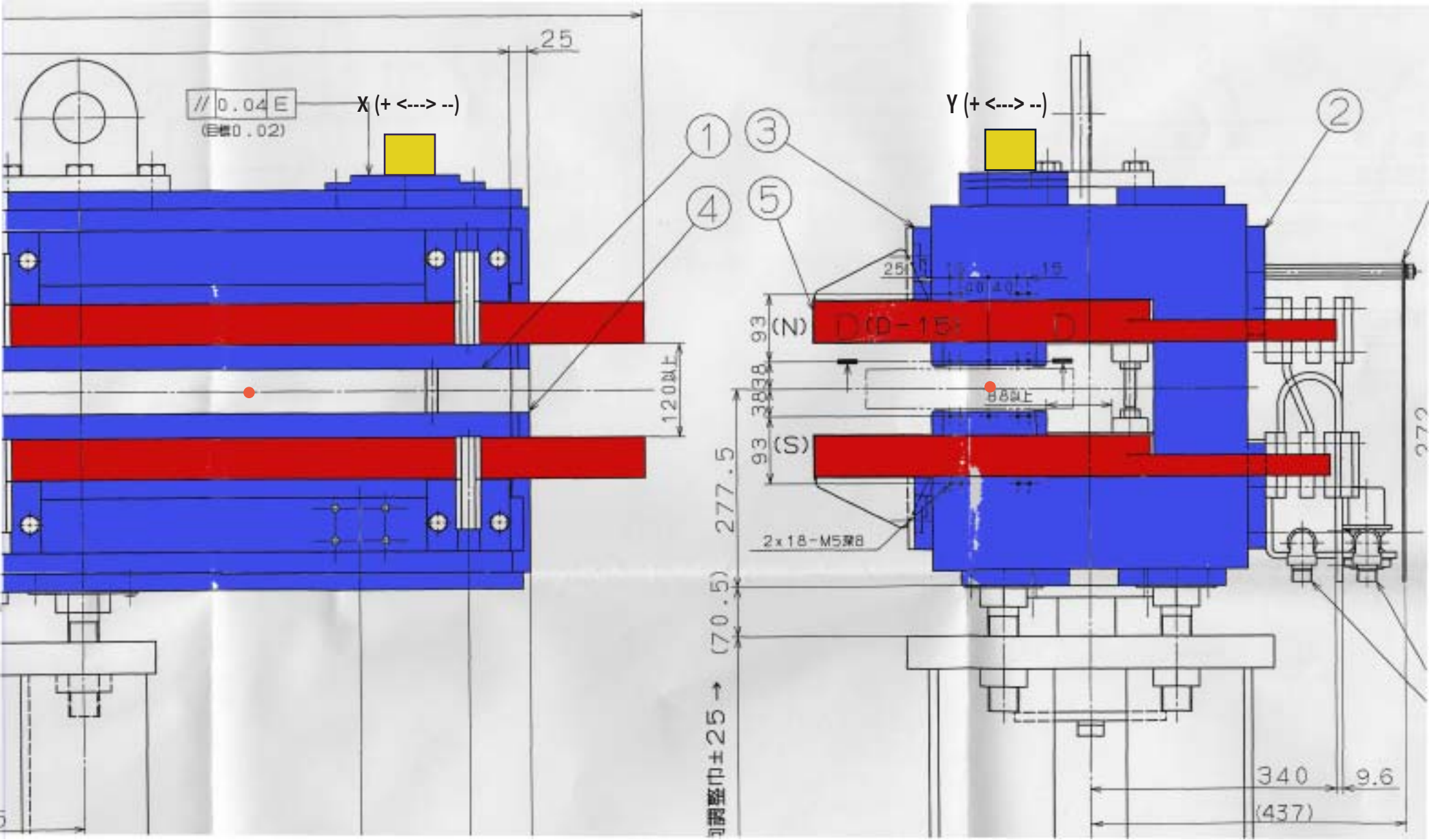
Measured and simulated vertical COD distortion

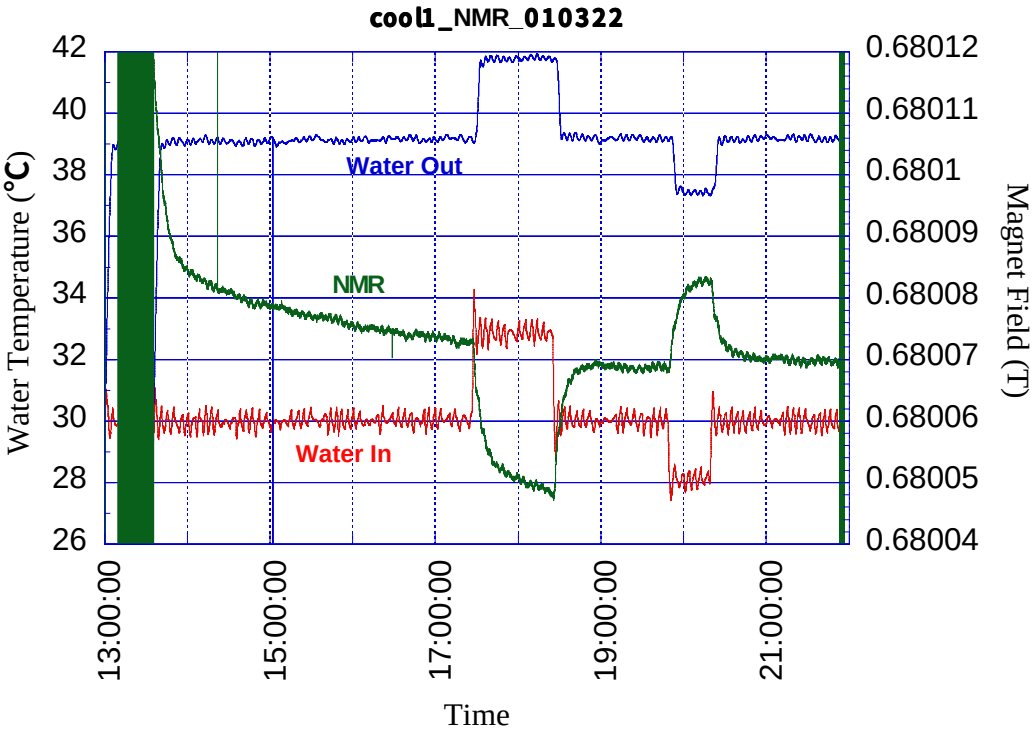
Layout of 1 cell

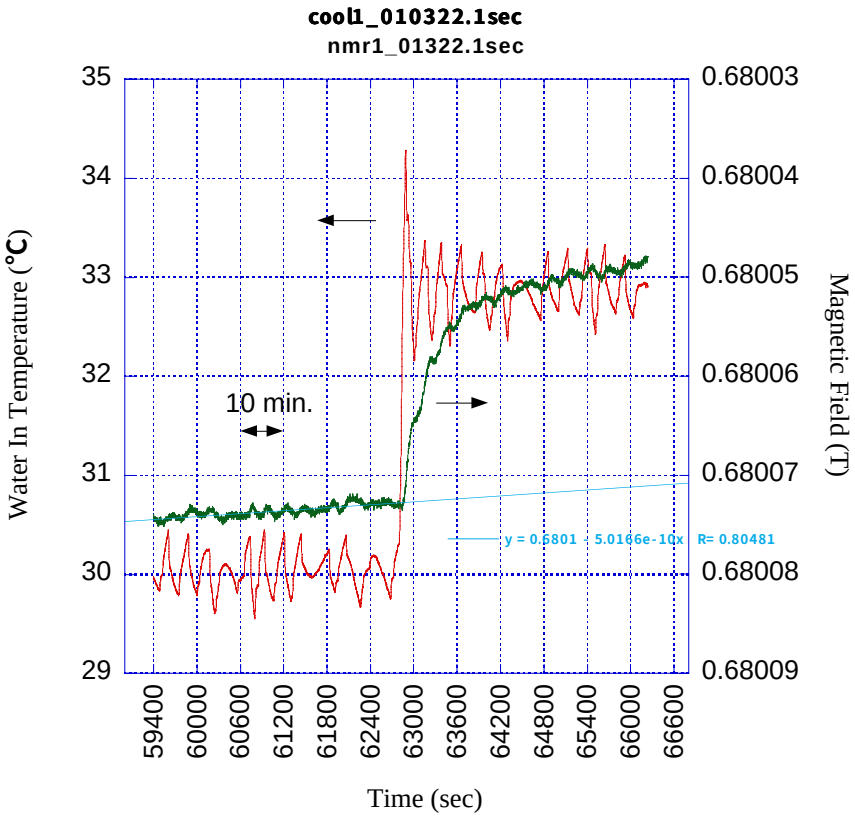


冷却水の温度を上げると、共通架台の中心部の温度が相対的に高くなり、
ＱＦ電磁石の位置が上がる。

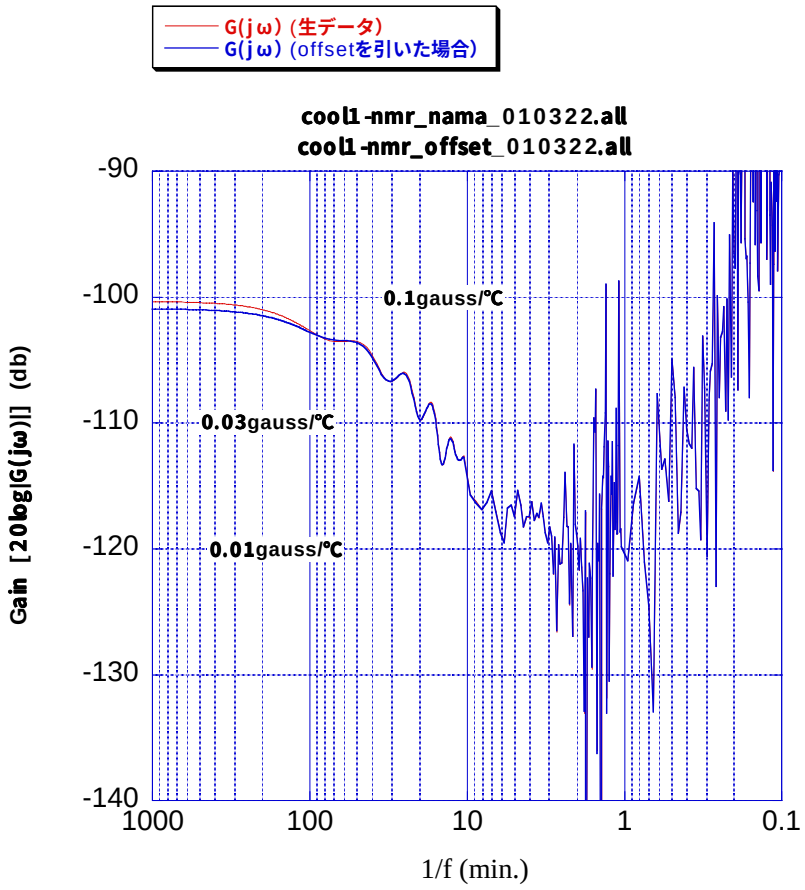


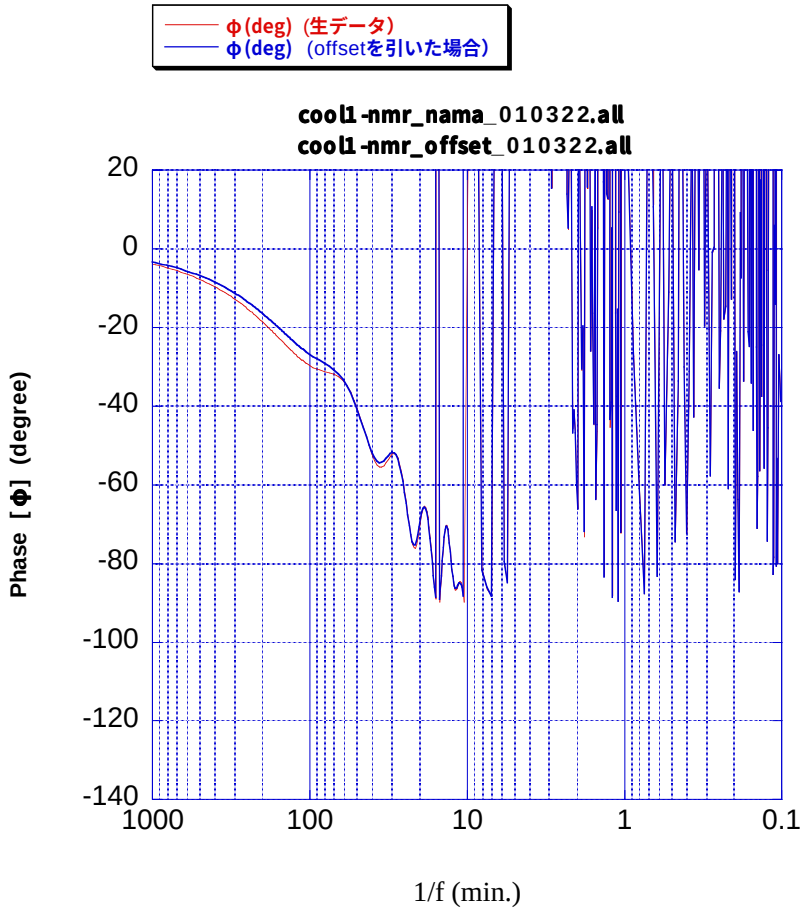

25
// 0.04 E
(⊟0.02)
X (+ <---> --)
Y (+ <---> --)
①
②
③
④
⑤
120以上
93
(N)
(D-15)
38
38
93
(S)
88以上
277.5
(70.5)
2×18-M5深8
調整巾±25
340
9.6
(437)



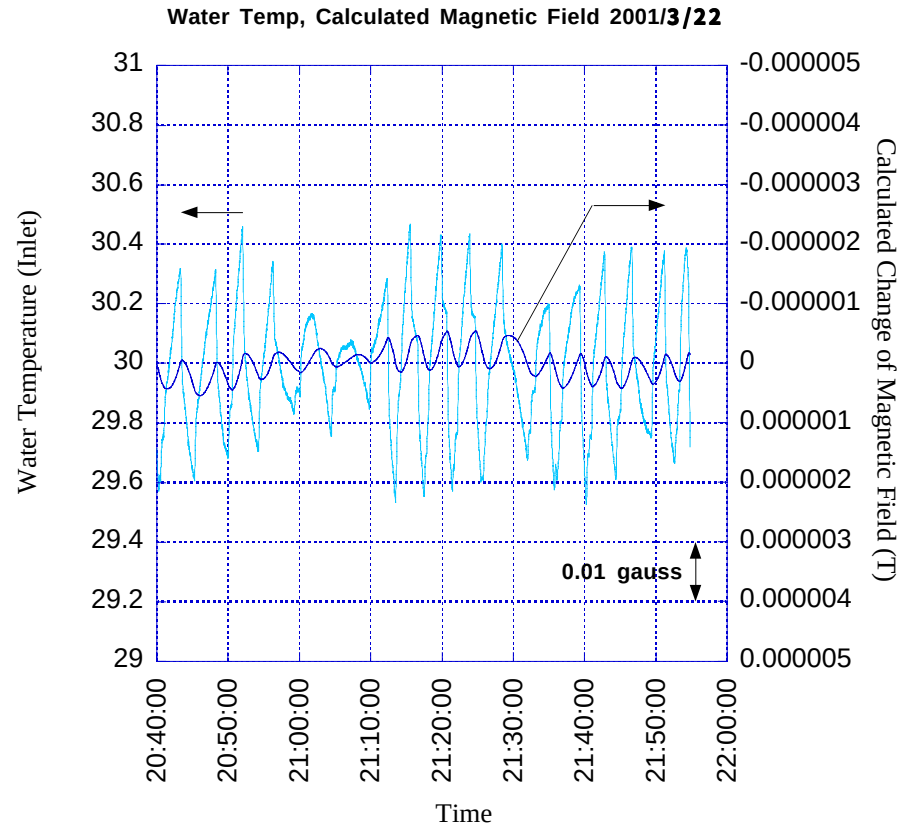


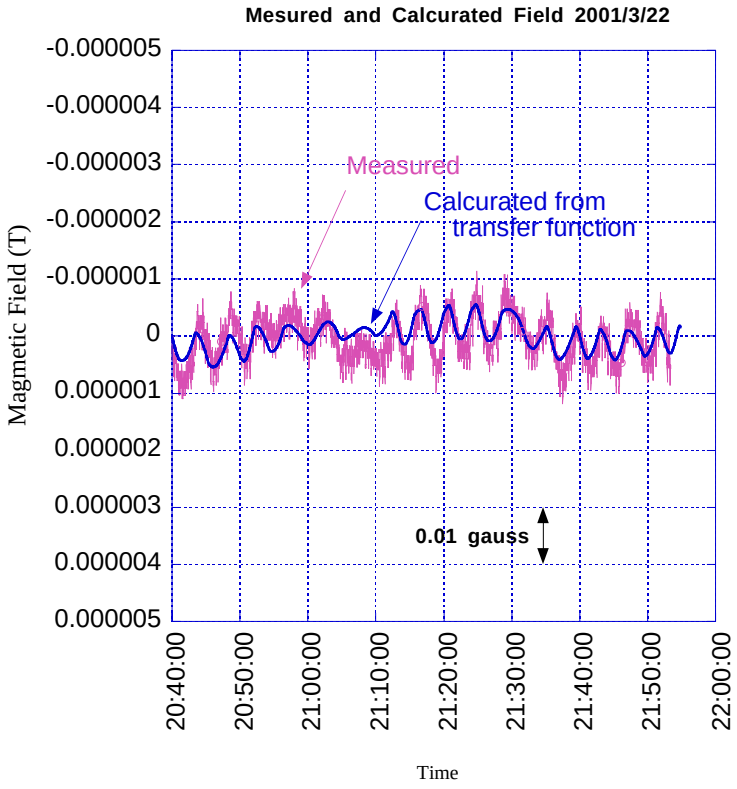
Response of the field of an bending magnet to the cooling water temperature change



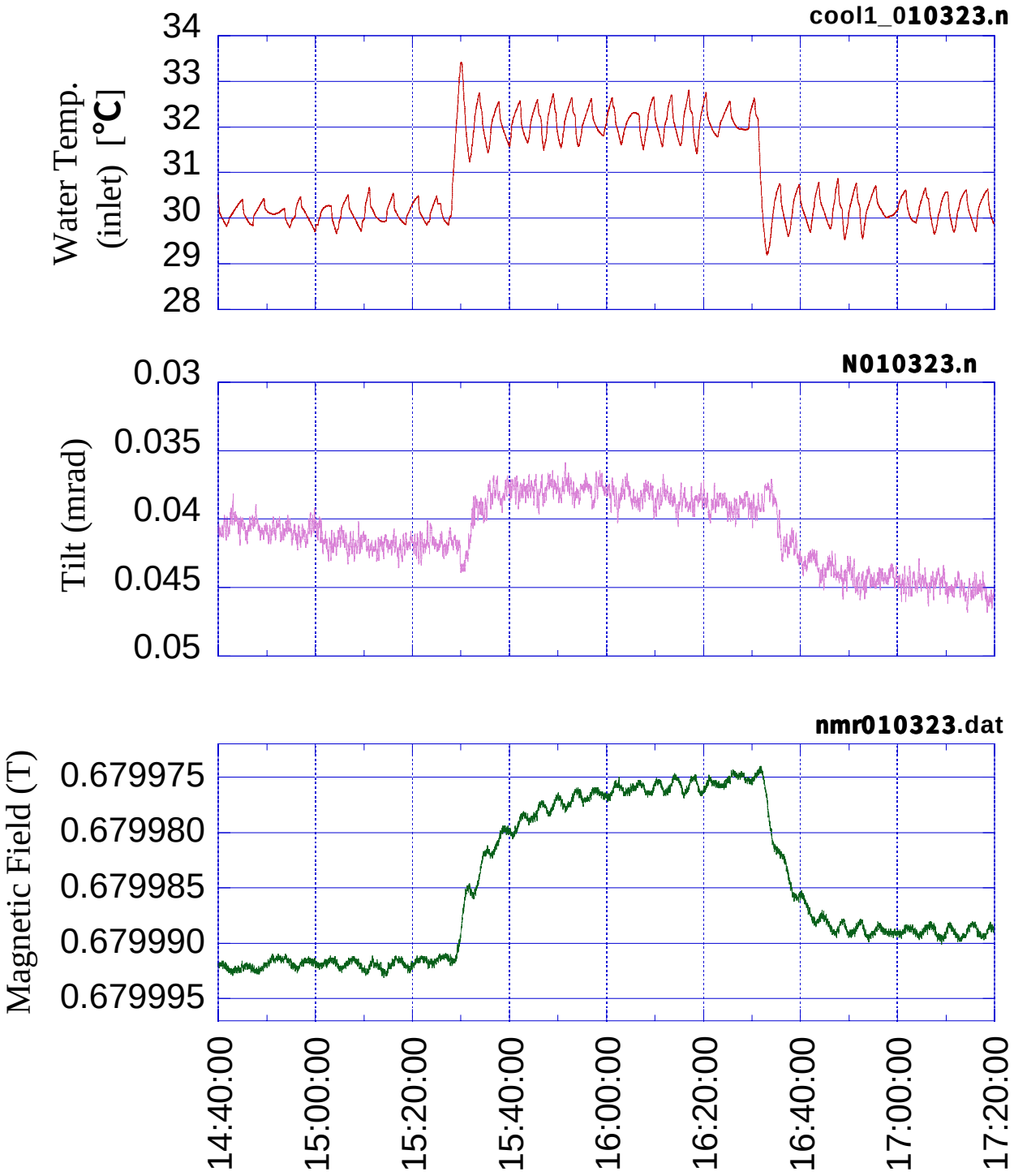


Frequency response of magnetic field





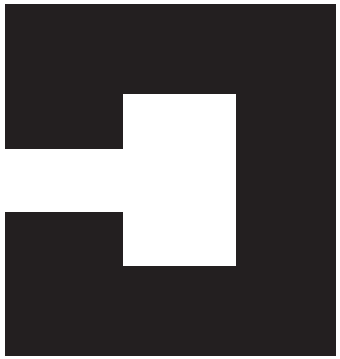
Comparison between maesured and reconstructed field variation from transfer function



Time variation of water temp., tilt of bending magnet and its magnetic field

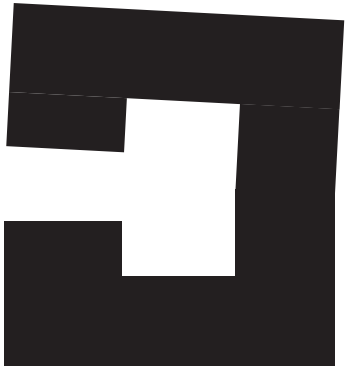
Deformimg process of bending magnet

1



kick-x : 71 mrad
(∵ By = 6790 gauss)
kick-y ～0

2 (in 5min.)

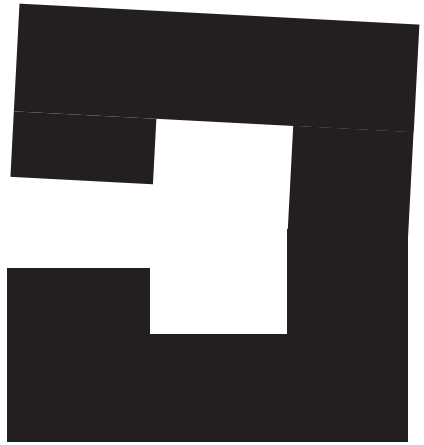


Tilt of upper yoke : 2.5 μ rad/°C

Δ kick-x : 0.5 μ rad/°C
(∵ Δ By～0.05 gauss/°C)

Δ kick-y : 0.05 μ rad/°C
(∵ Δ Bx～1/10 Δ By)

3



Thermal expansion const.
: 1.2e-5/°C
Δ kick-x : 0.86 μ rad/°C (cal.)
--> Δ By～0.08 gauss/°C

It will compensated with increase
of the length of the magnet !?

Results

	Estimated from COD variation	Estimated from bending magnet measurements	Other
Horizontal 51th COD amplitude	10μm/°C	4 μm/°C/1 magnet ×$\sqrt{}$n	
Vertical 16th COD amplitude	-	0.64 μm/°C/1 magnet ×$\sqrt{}$n	
Horizontal systematic COD distortion (1th)	2 μrad/°C kicks on every bending magnet in a zone.	0. 5 μrad/°C kicks on every bending magnet +α ?	How can we treat the thermal expansion ?
Vertical systematic COD distortion (1th)	<0.3μrad/°C kicks on every bending magnet in a zone. (AND/OR) <0.3 μrad/°C kicks on every QF magnet in a zone.	0.05 μrad/°C kicks on every bending magnet +α ?	0. 3 μrad/°C kick QF magnets are 0.6μm taller than QD magnets in a zone.