



# Vibration Measurement of the Magnet & Floor in the Storage ring Tunnel

S.Matsui

- n Sensor
- n Measurement
- n Analysys
- n Preliminary Result

# Sensor Seismometer

## VSE-15T (Toukyou Sokusinn Co.)

- Servo type
- Output : Velocity 1kine(cm/s)=10V
- Record in the PC
- Sampling rate 1000Hz
- Collection 20 seconds

### 小型速度計

構造物・模型の  
振動測定用

微小地震  
測定用



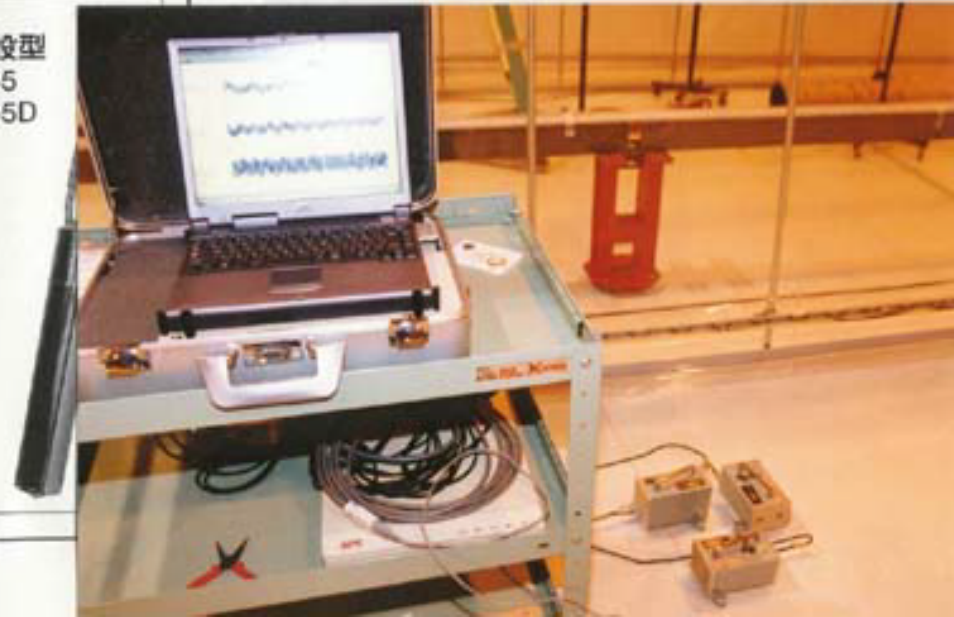
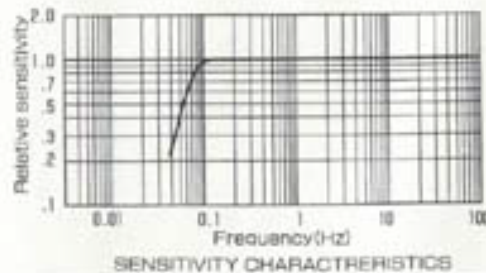
VSE-15



VSE-15D

測定周波数 0.07-100Hz(-3db)  
0.1-70Hz(±3%)  
測定範囲 100kine(100mV/kine)  
(感度) 10kine(1V/kine, 15D)  
2000gal(5mV/gal)  
ダイナミックレンジ 110db

地中埋設型  
VSE-355  
VSE-355D



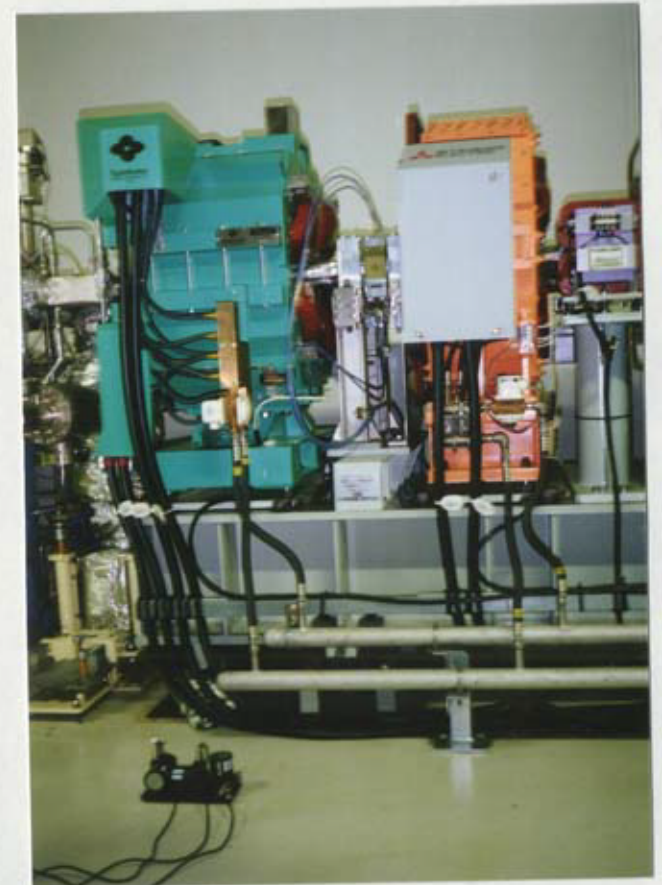
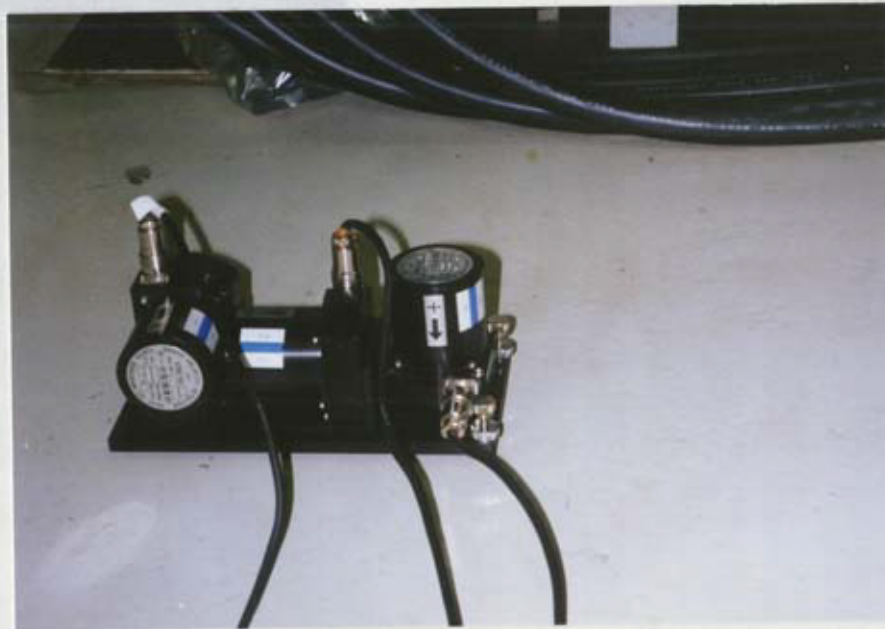
## Measurement      On the magnet and tunnel floor

2001 Summer 7/2~8/17 by 大久保、坪井、中西 (SES)

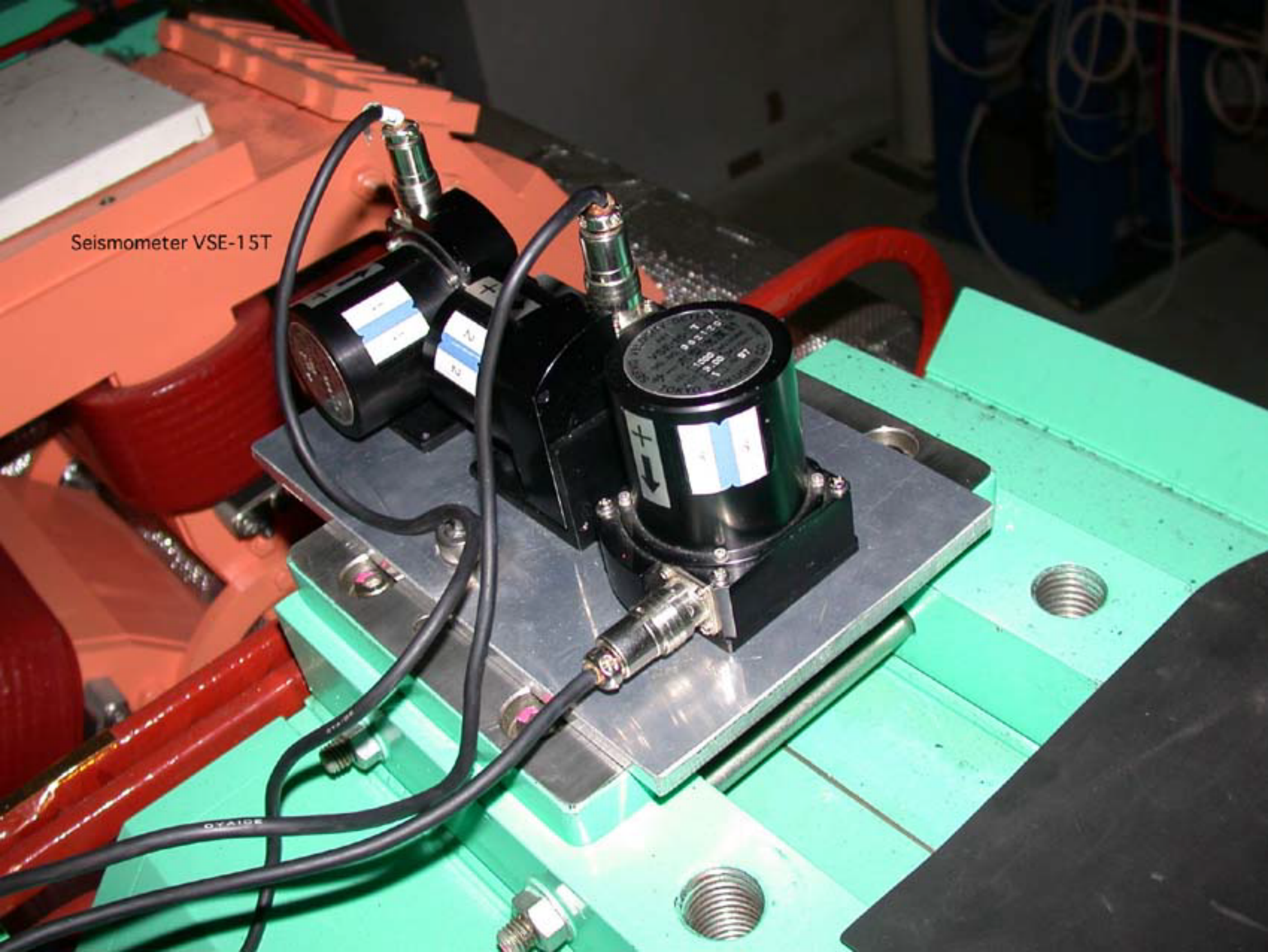
Magnet: Non Electric Power      ~500台

Cooling Water : Both Cases (Flow or Stop)

About 40 places per day      ~ 600台所(床)



Seismometer VSE-15T



SPC  
2001 07/09 16:16:30

C48Q8

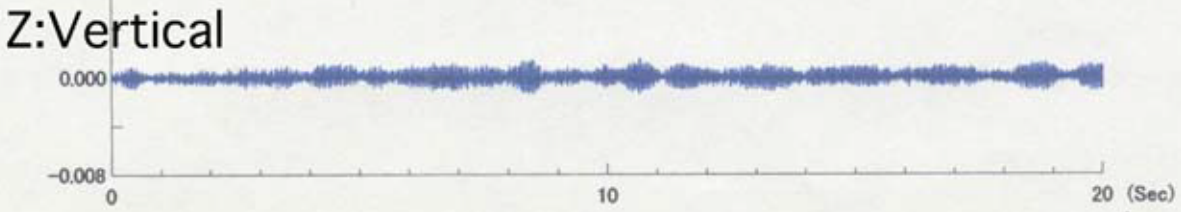
CH01:CH-1  
Max. = 0.008 (kine)  
Min. = -0.008 (kine)



CH02:CH-2  
Max. = 0.002 (kine)  
Min. = -0.002 (kine)



CH03:CH-3  
Max. = 0.002 (kine)  
Min. = -0.001 (kine)



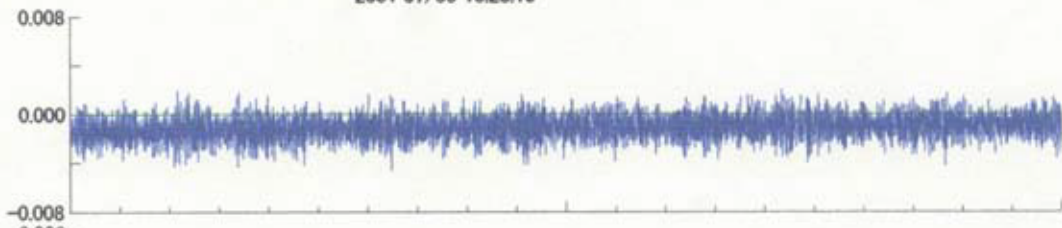
Data

20#15

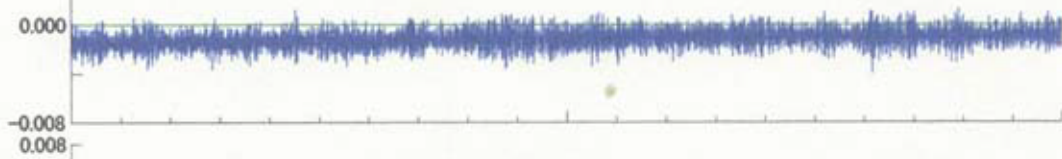
C48Q7

SPC  
2001 07/09 16:28:15

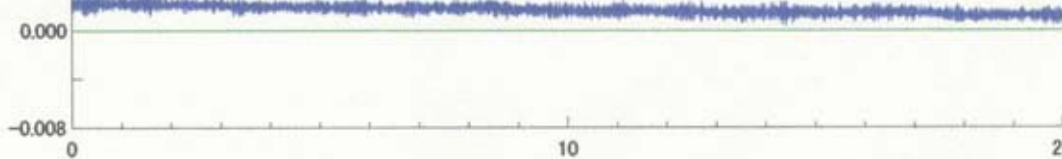
CH01:CH-1  
Max. = 0.002 (kine)  
Min. = -0.005 (kine)



CH02:CH-2  
Max. = 0.001 (kine)  
Min. = -0.004 (kine)



CH03:CH-3  
Max. = 0.003 (kine)  
Min. = 0.000 (kine)



# MathCad

v1 :=

 D:\7\_9\fc48q8m~1.txt

v2 :=

 D:\7\_9\fc48q8m~2.txt

v3 :=

 D:\7\_9\fc03q8m~3.txt

fs := 1000 a1 := mean(v1) n := last(v1)

in1 := 0

en1 := 0.00

$$ti1 := \frac{(in1 - en1)}{n}$$

Velocity  
↓  
Displacement

$n = 2 \times 10^4$

i := 1..n

$$x1_i := in1 \quad x1_{i+1} := x1_i + v1_i \cdot 0.01 - a1 \cdot 0.01 - ti1$$

← Displacement

j := 1..n

$$f_j := \frac{j}{n} \cdot fs$$

$$k := 1.. \frac{n}{2}$$

$$fv1 := cfft(v1)$$

$$fx1 := cfft(x1)$$

FFT

q := 1..300

$$sfv1_q := \sum_{p=q20+1}^{q20+20} fv1_p$$

$$safv1_q := \sum_{p=q20+1}^{q20+20} |fv1_p|$$

$$sfx1_q := \sum_{p=q20+1}^{q20+20} fx1_p$$

$$xm_{q,1} := \sum_{p=q20+1}^{q20+20} |fx1_p|$$

a2 := mean(v2)

in2 := 0.0

en2 := 0

$$ti2 := \frac{(in2 - en2)}{n}$$

$$fv2 := cfft(v2)$$

x2\_i := in2

$$x2_{i+1} := x2_i + v2_i \cdot 0.01 - a2 \cdot 0.01 - ti2$$

$$fx2 := cfft(x2)$$

q := 1..300

$$sfv2_q := \sum_{p=q20+1}^{q20+20} fv2_p$$

$$safv2_q := \sum_{p=q20+1}^{q20+20} |fv2_p|$$

$$sfx2_q := \sum_{p=q20+1}^{q20+20} fx2_p$$

$$xm_{q,2} := \sum_{p=q20+1}^{q20+20} |fx2_p|$$

$$xm_{q,0} = q$$

a3 := mean(v3)

in3 := 0

en3 := 0

$$ti3 := \frac{(in3 - en3)}{n}$$

$$fv3 := cfft(v3)$$

x3\_i := in3

$$x3_{i+1} := x3_i + v3_i \cdot 0.01 - a3 \cdot 0.01 - ti3$$

$$fx3 := cfft(x3)$$

q := 1..300

$$sfv3_q := \sum_{p=q20+1}^{q20+20} fv3_p$$

$$safv3_q := \sum_{p=q20+1}^{q20+20} |fv3_p|$$

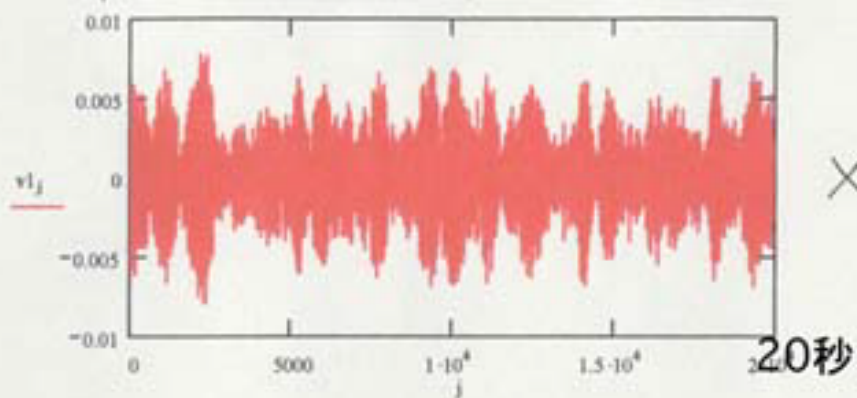
$$sfx3_q := \sum_{p=q20+1}^{q20+20} fx3_p$$

$$xm_{q,3} := \sum_{p=q20+1}^{q20+20} |fx3_p|$$

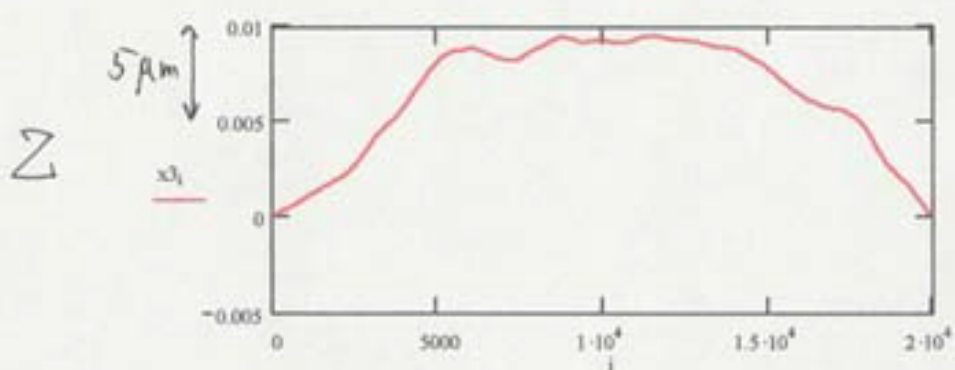
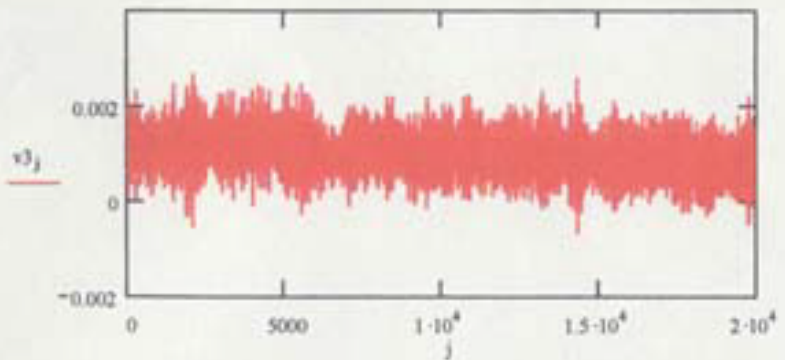
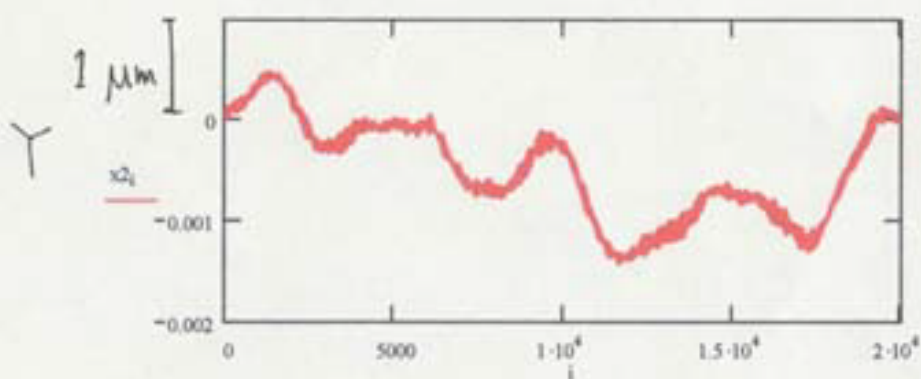
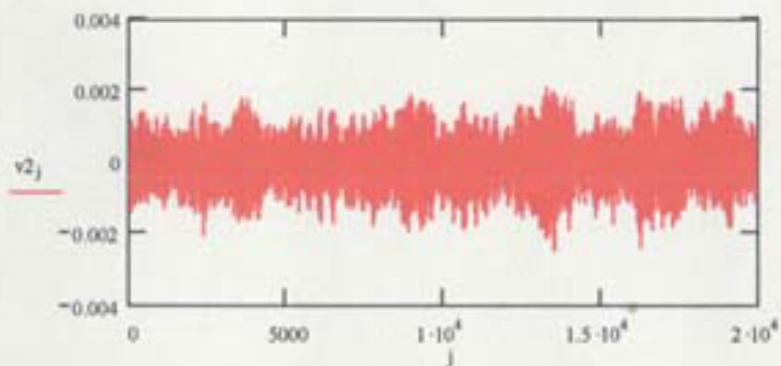
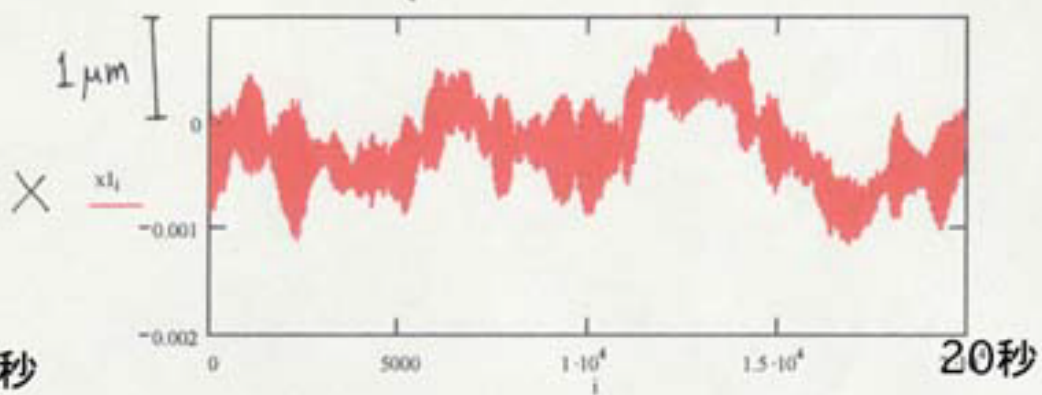
用波数母の括中

 D:\7\_9\fc48q8m  
xm

(cm/s) Velocity

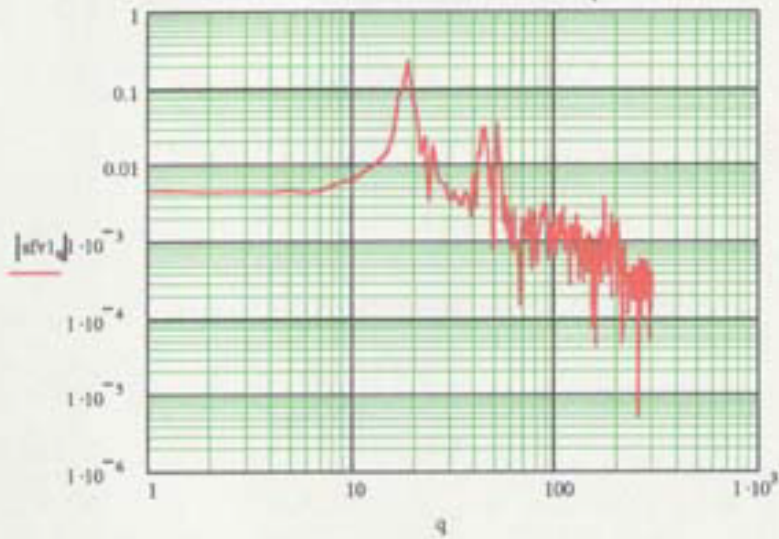


Displacement

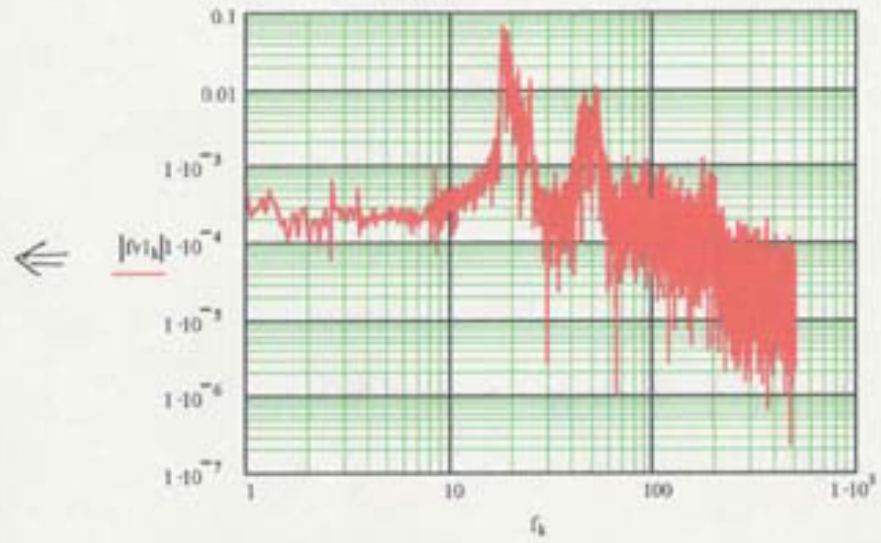


# Smoothing

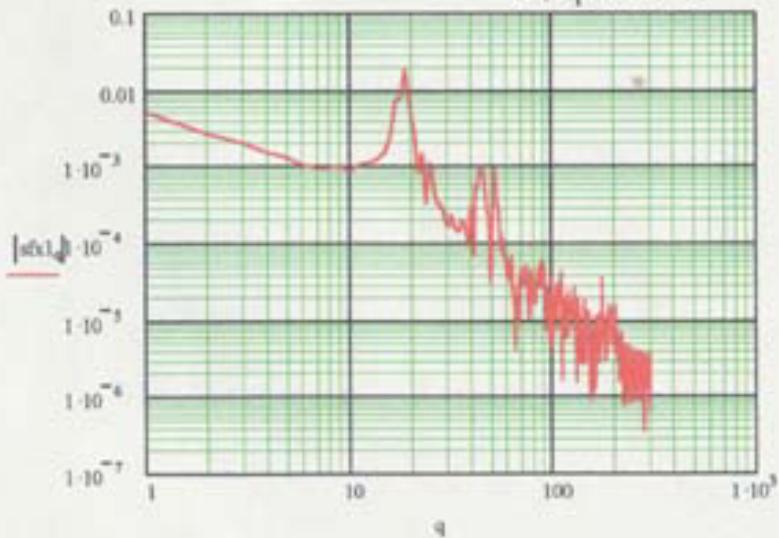
Velocity



Velocity

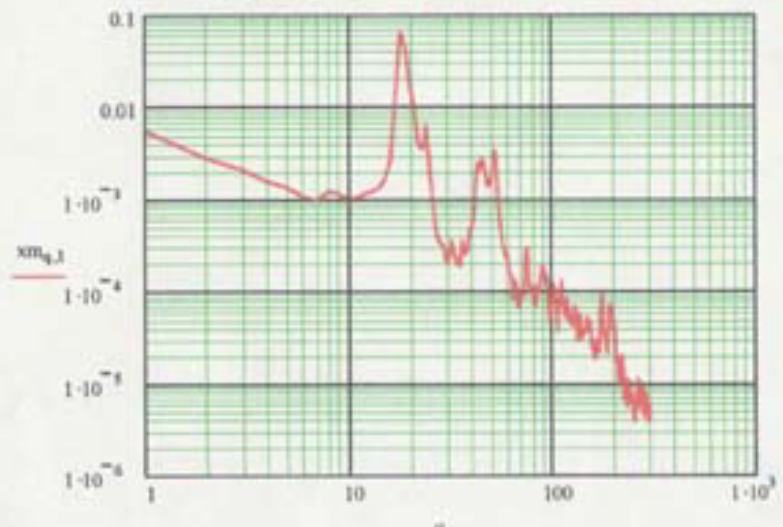


Displacement



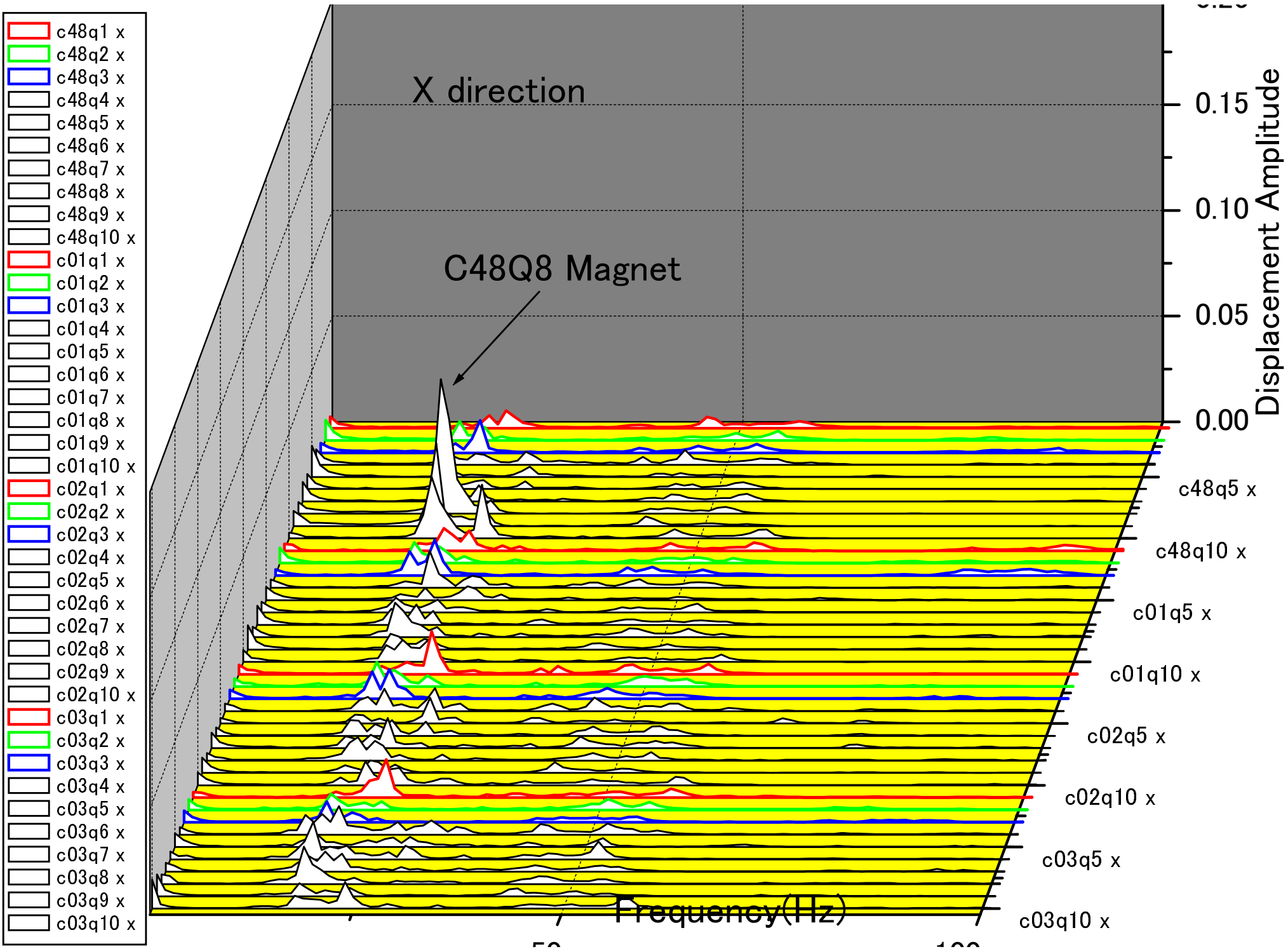
$0.05 \text{ Hz}$

Displacement



$1 \text{ Hz}$





X direction

C48Q8 Magnet

Displacement Amplitude

Frequency(Hz)

c48q5 x

c48q10 x

c01q5 x

c01q10 x

c02q5 x

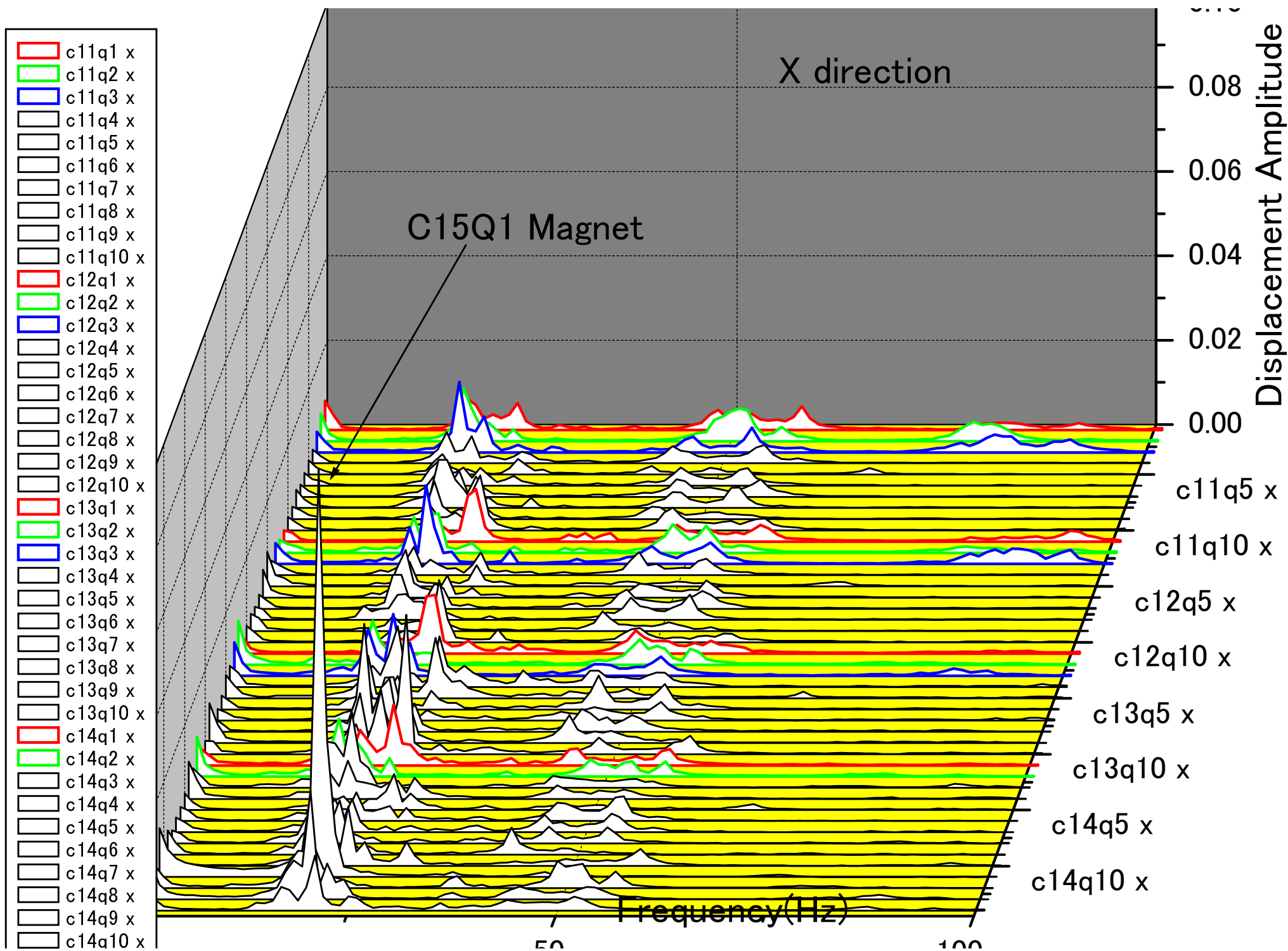
c02q10 x

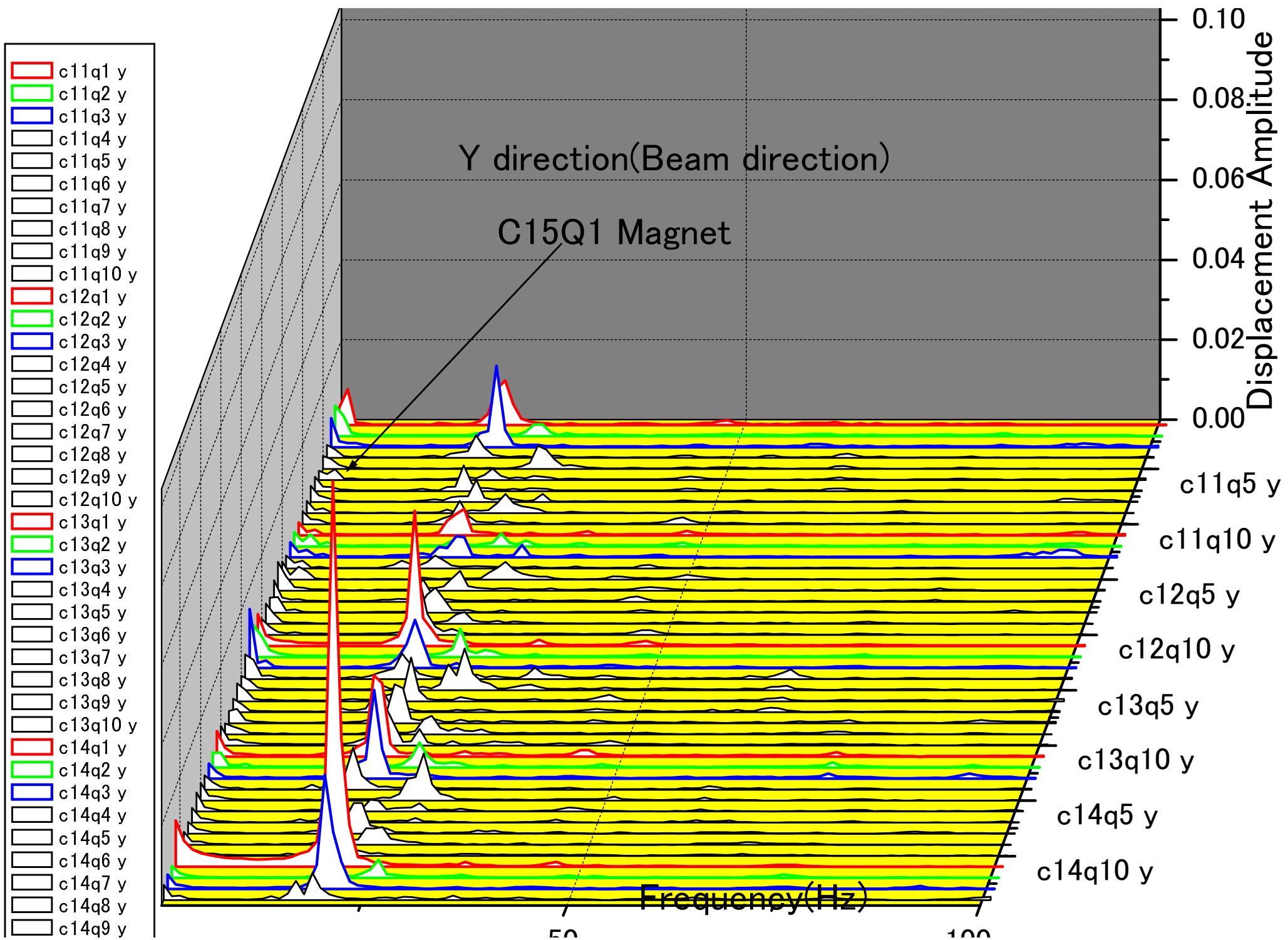
c03q5 x

c03q10 x

50

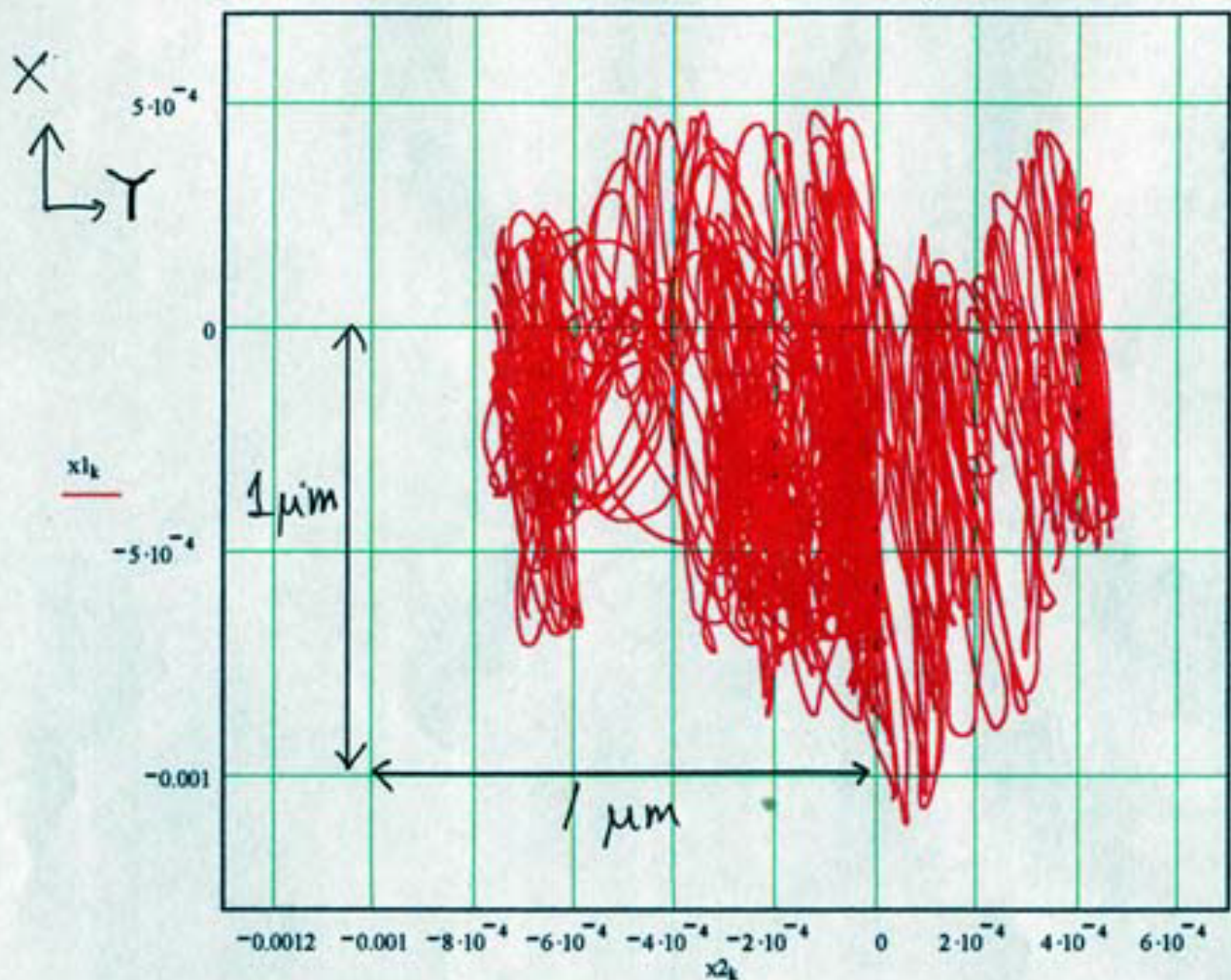
100





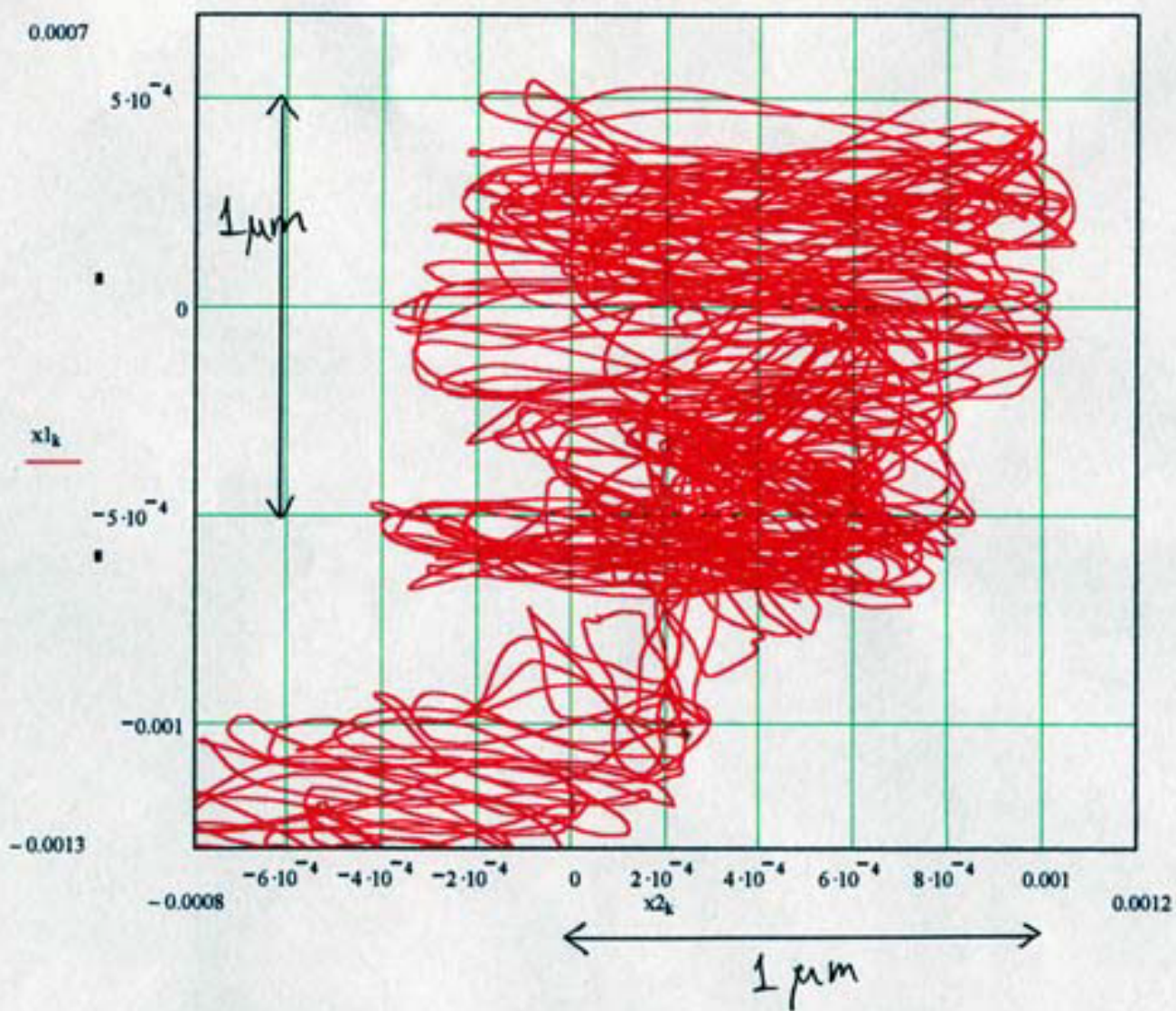
C48Q8

Vibration of Reference plane



Beam direction

C15Q1



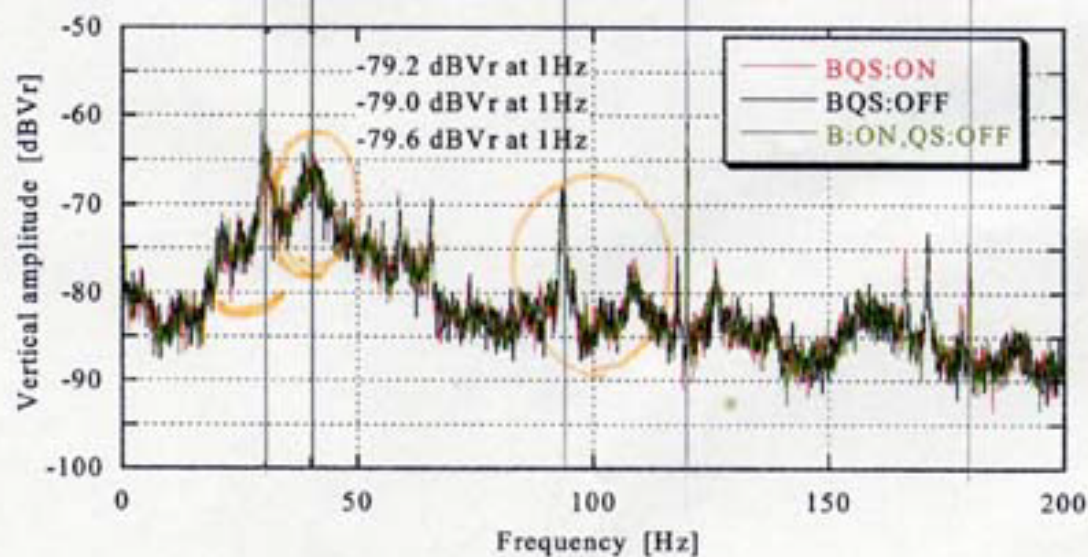
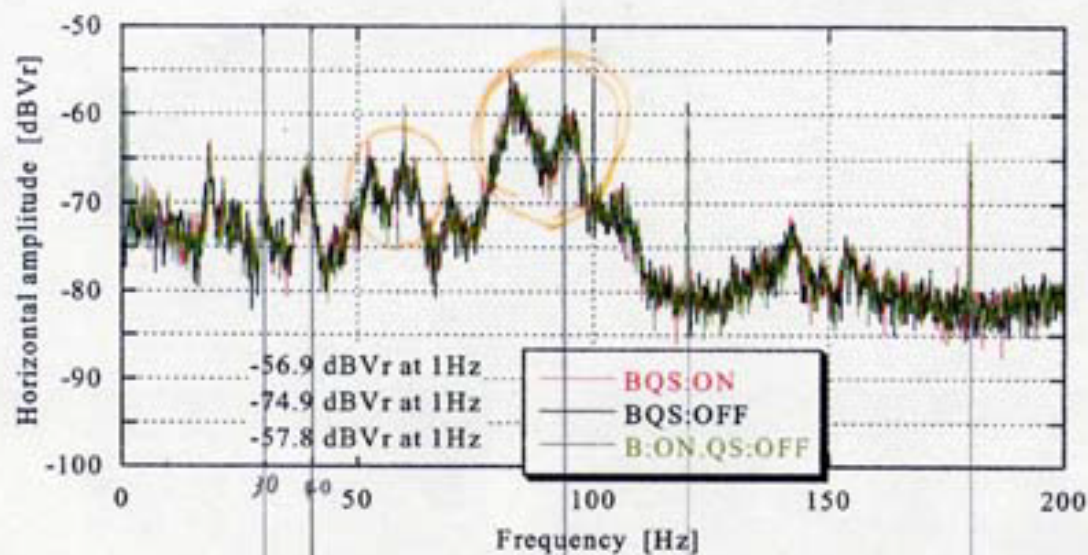
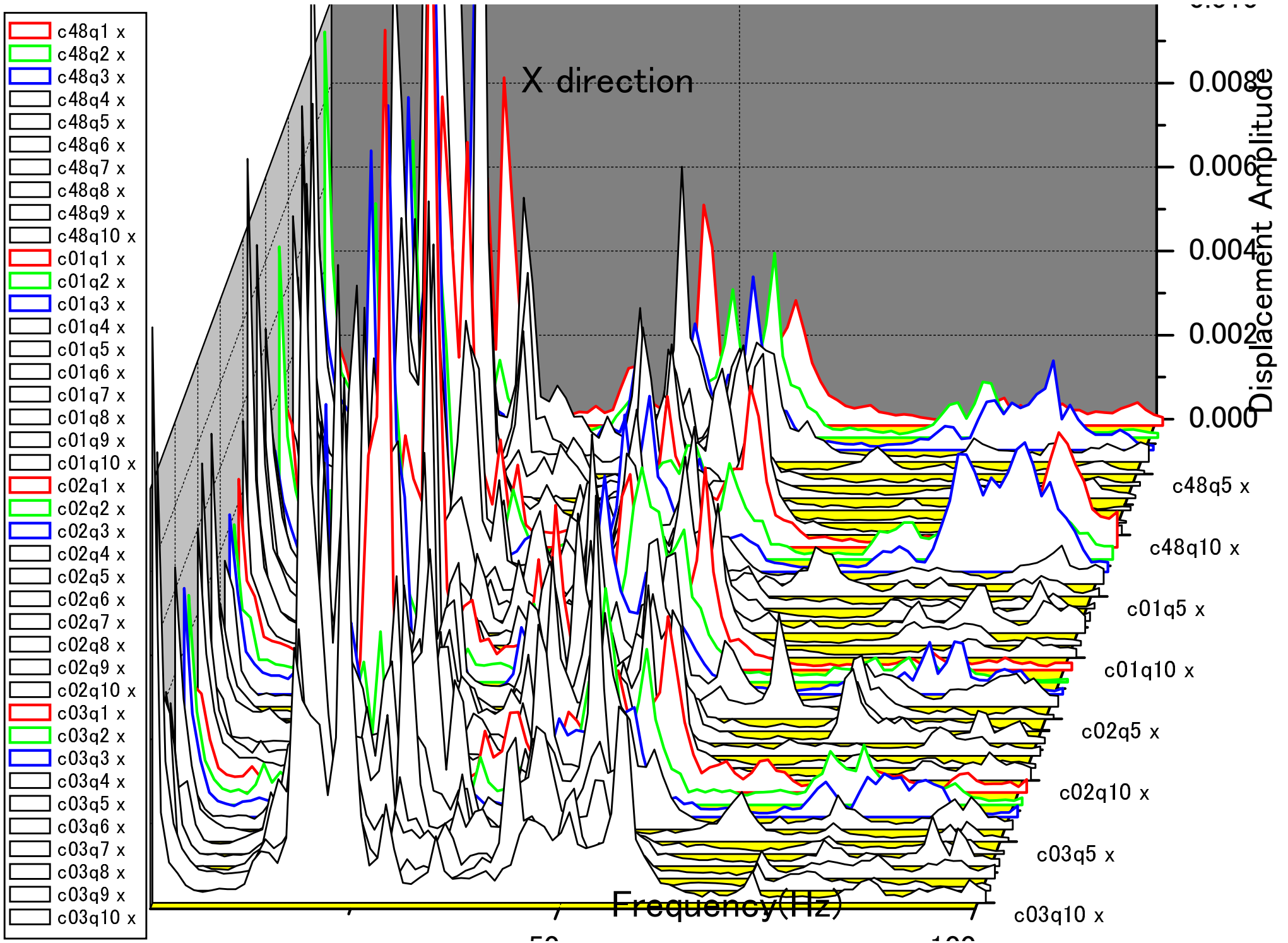
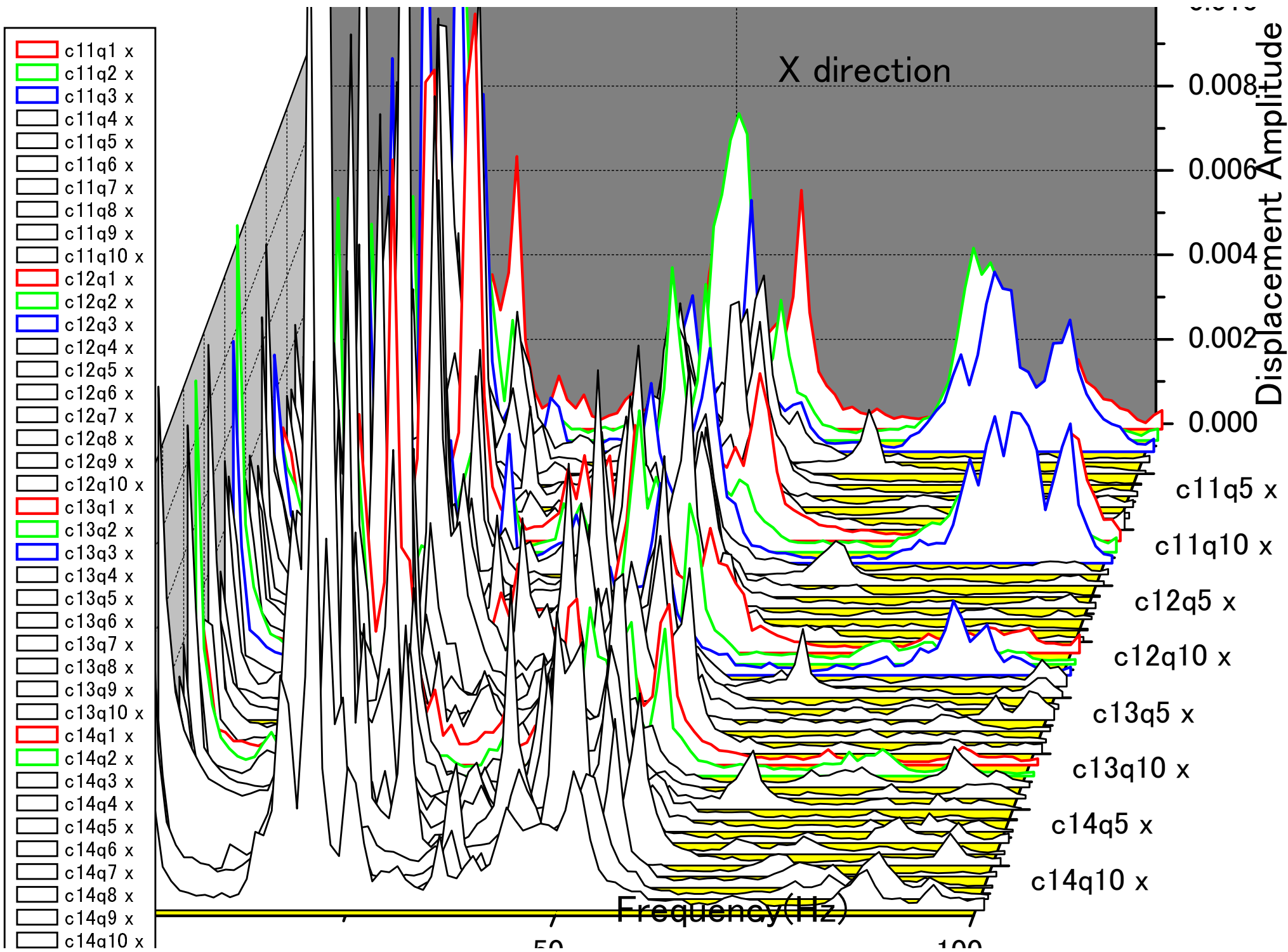


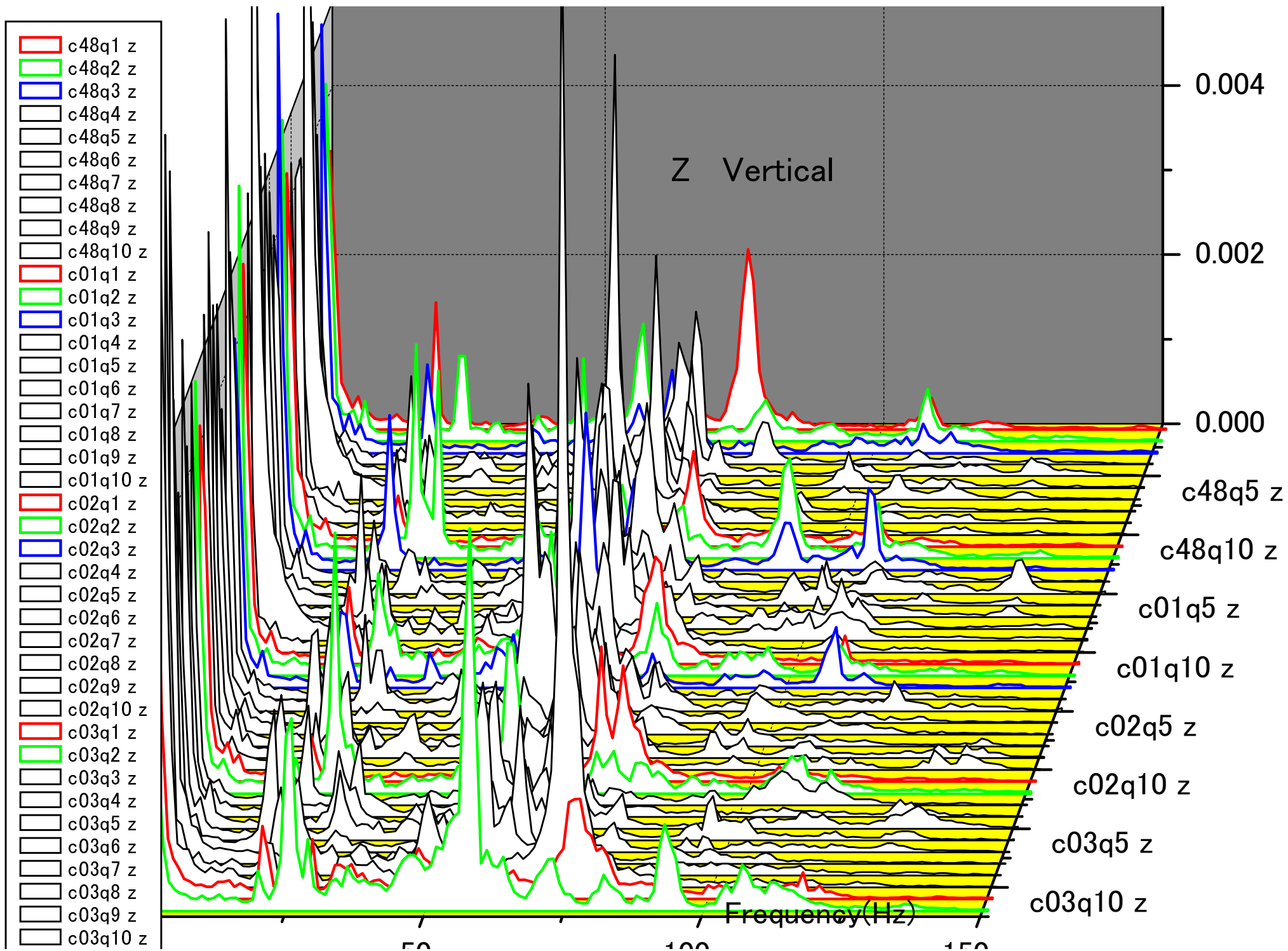
図3. シンクロトロン運転の有無におけるビームの振動 (at 15-cell, 0~200Hz)

by 深見

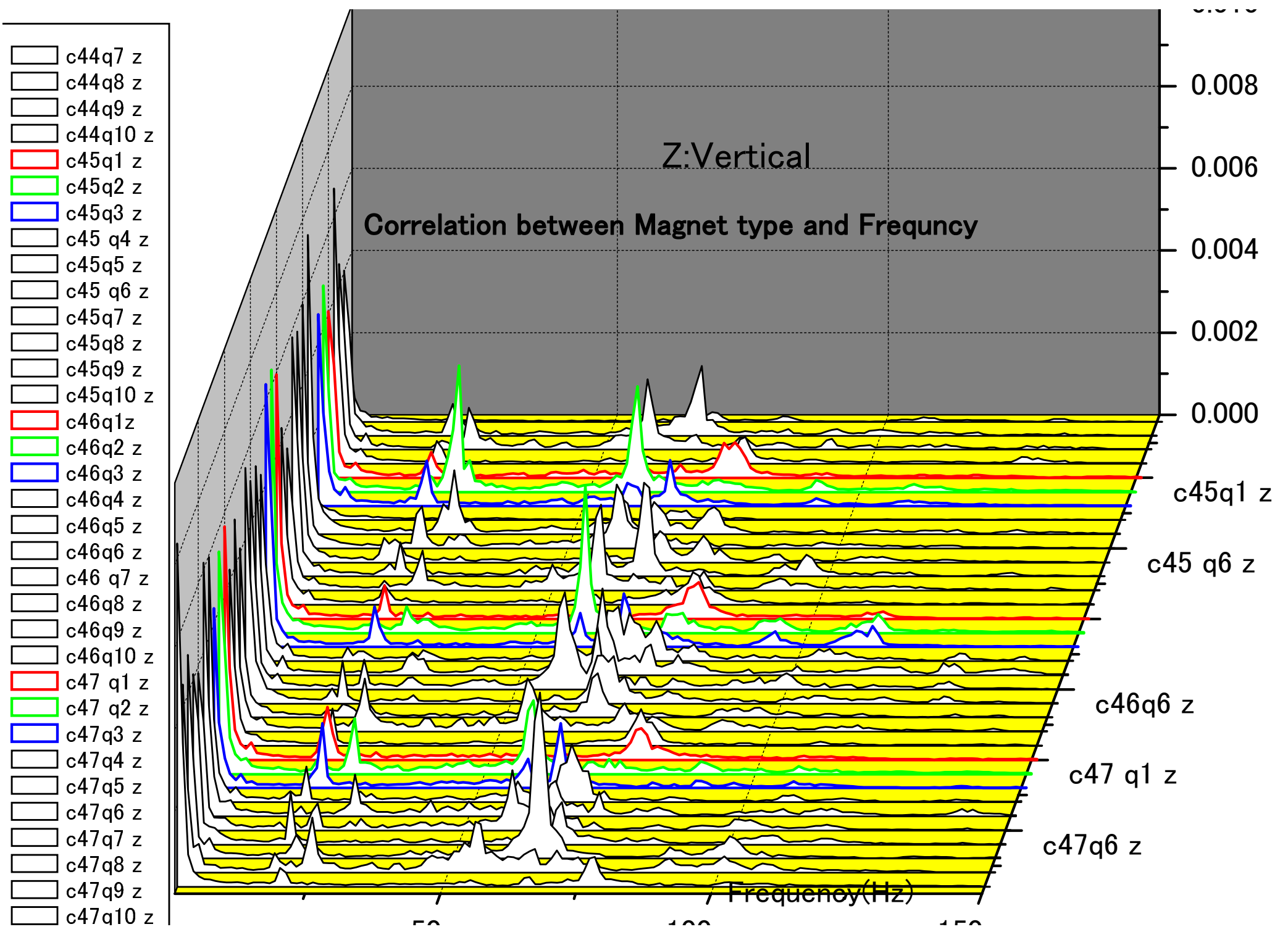
2001年9月測定

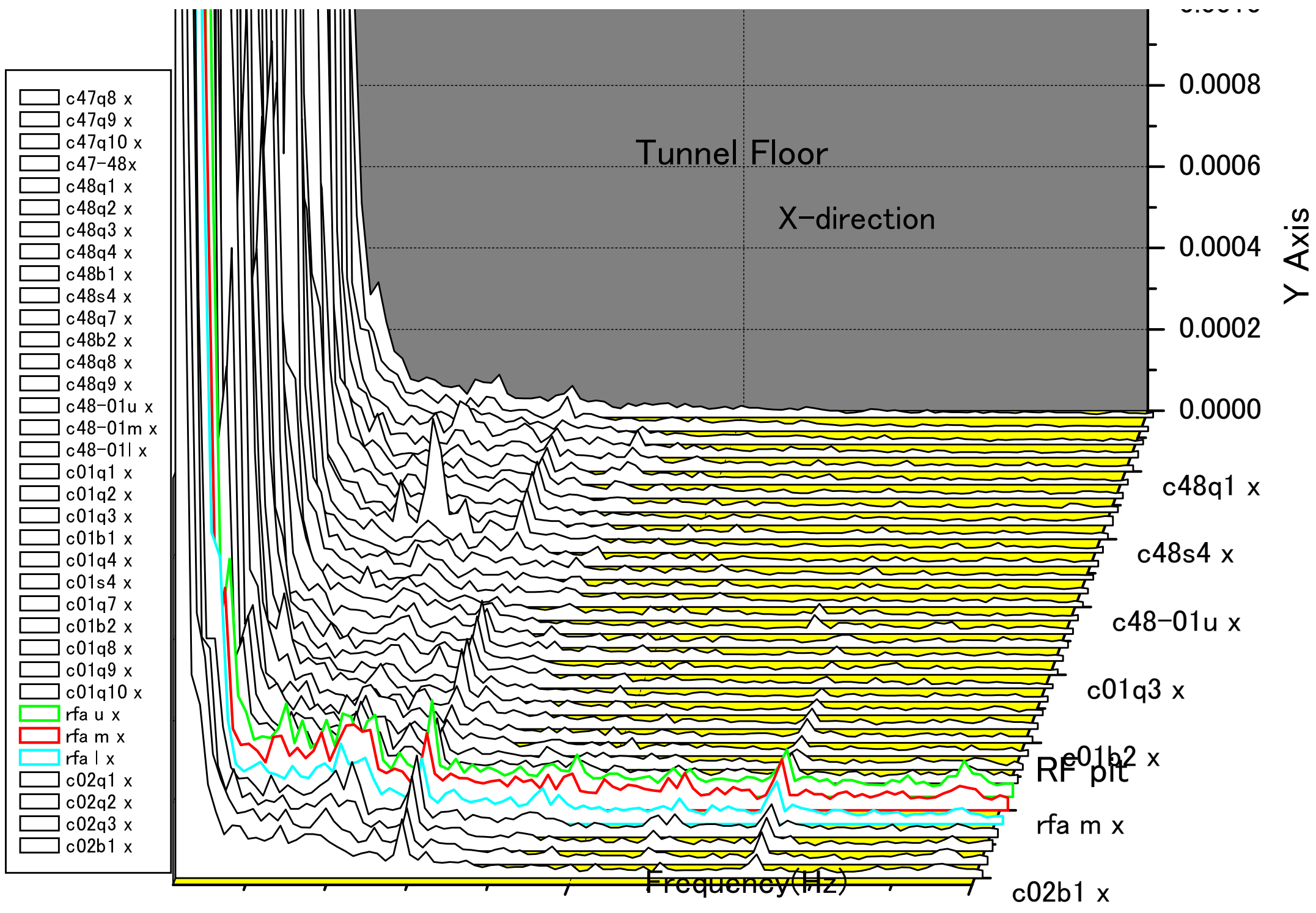












- c47q8 x
- c47q9 x
- c47q10 x
- c47-48x
- c48q1 x
- c48q2 x
- c48q3 x
- c48q4 x
- c48b1 x
- c48s4 x
- c48q7 x
- c48b2 x
- c48q8 x
- c48q9 x
- c48-01u x
- c48-01m x
- c48-01l x
- c01q1 x
- c01q2 x
- c01q3 x
- c01b1 x
- c01q4 x
- c01s4 x
- c01q7 x
- c01b2 x
- c01q8 x
- c01q9 x
- c01q10 x
- rfa u x
- rfa m x
- rfa l x
- c02q1 x
- c02q2 x
- c02q3 x
- c02b1 x

Tunnel Floor

X-direction

Y Axis

Frequency(Hz)

c48q1 x

c48s4 x

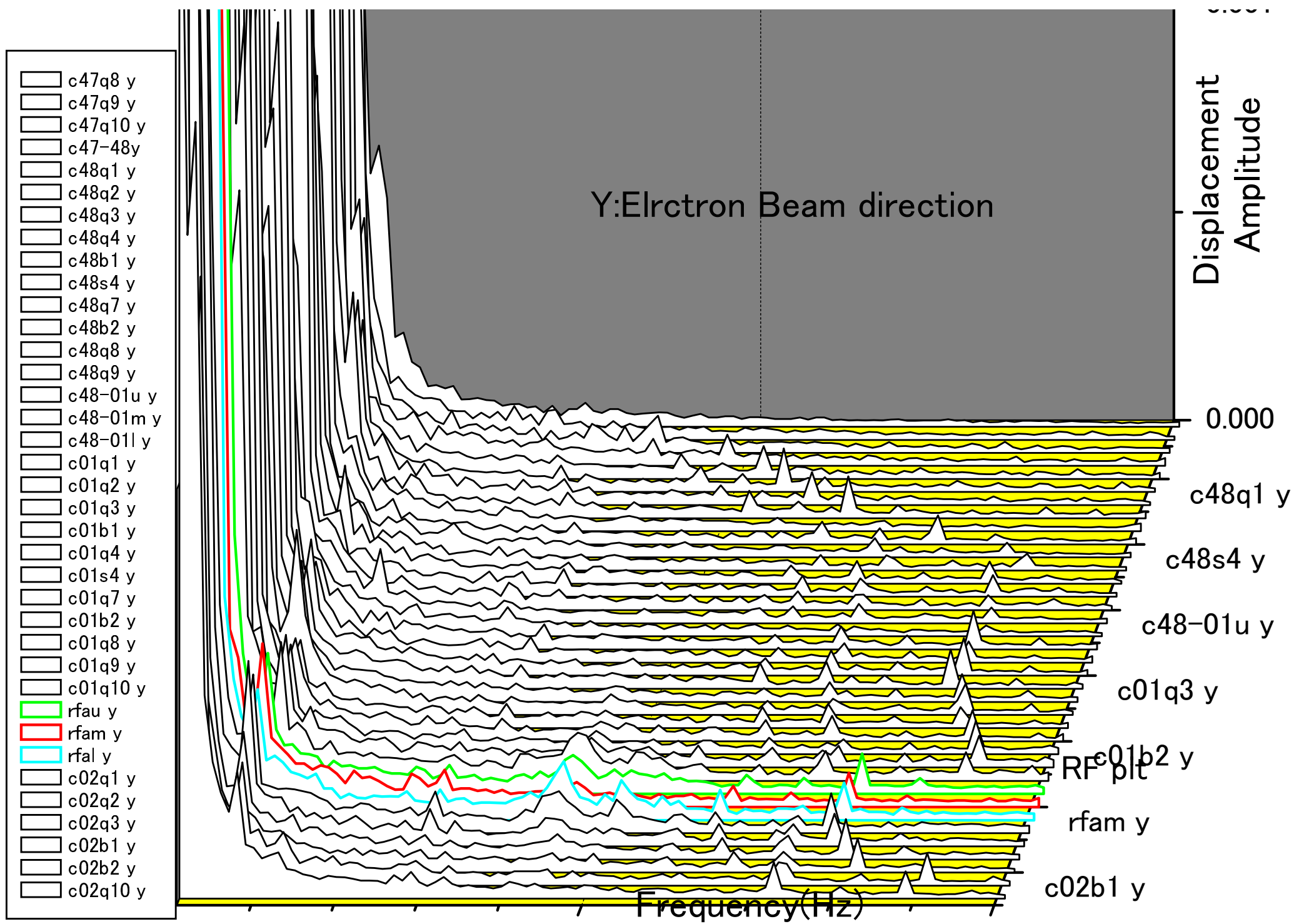
c48-01u x

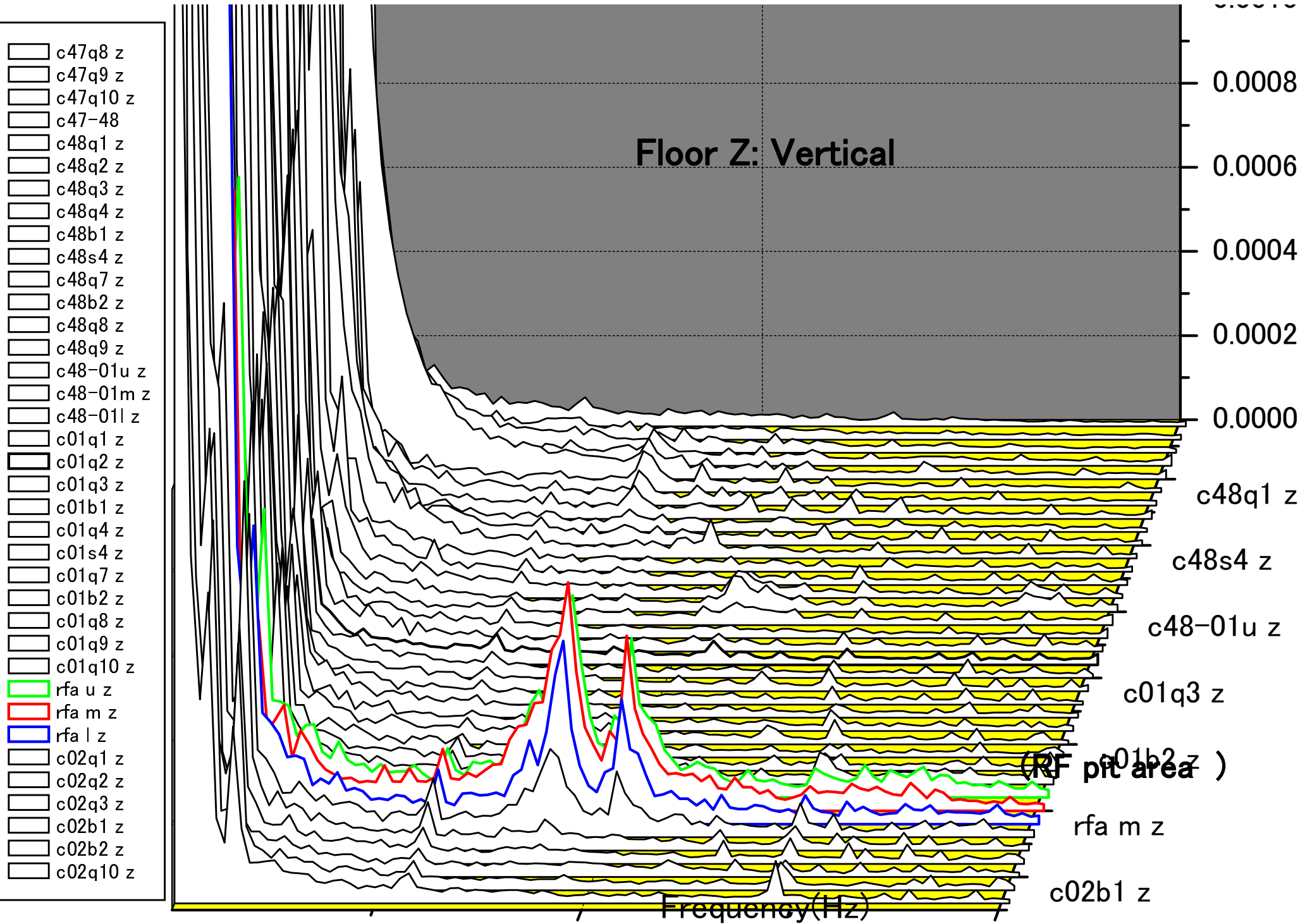
c01q3 x

rfa l x

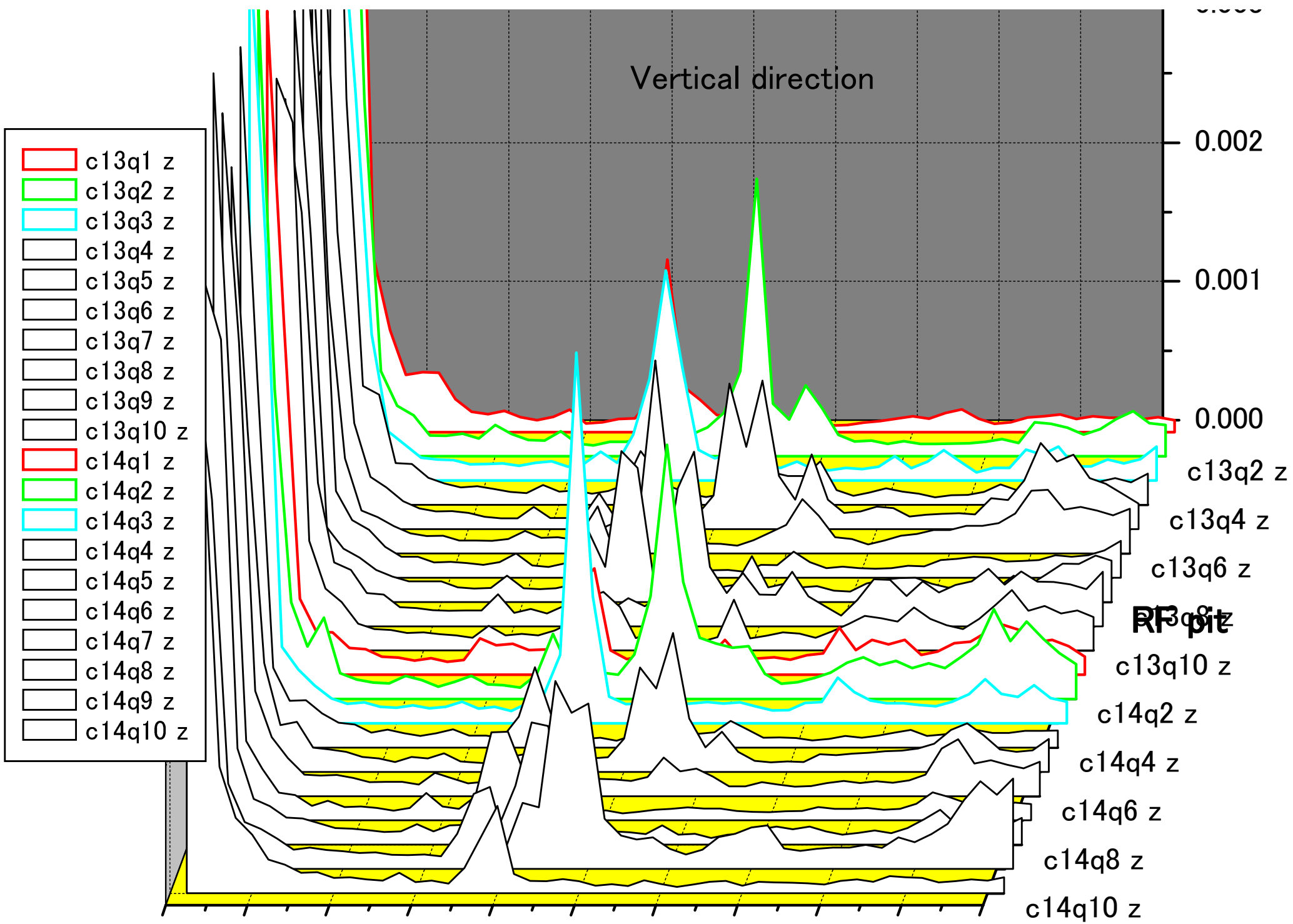
rfa m x

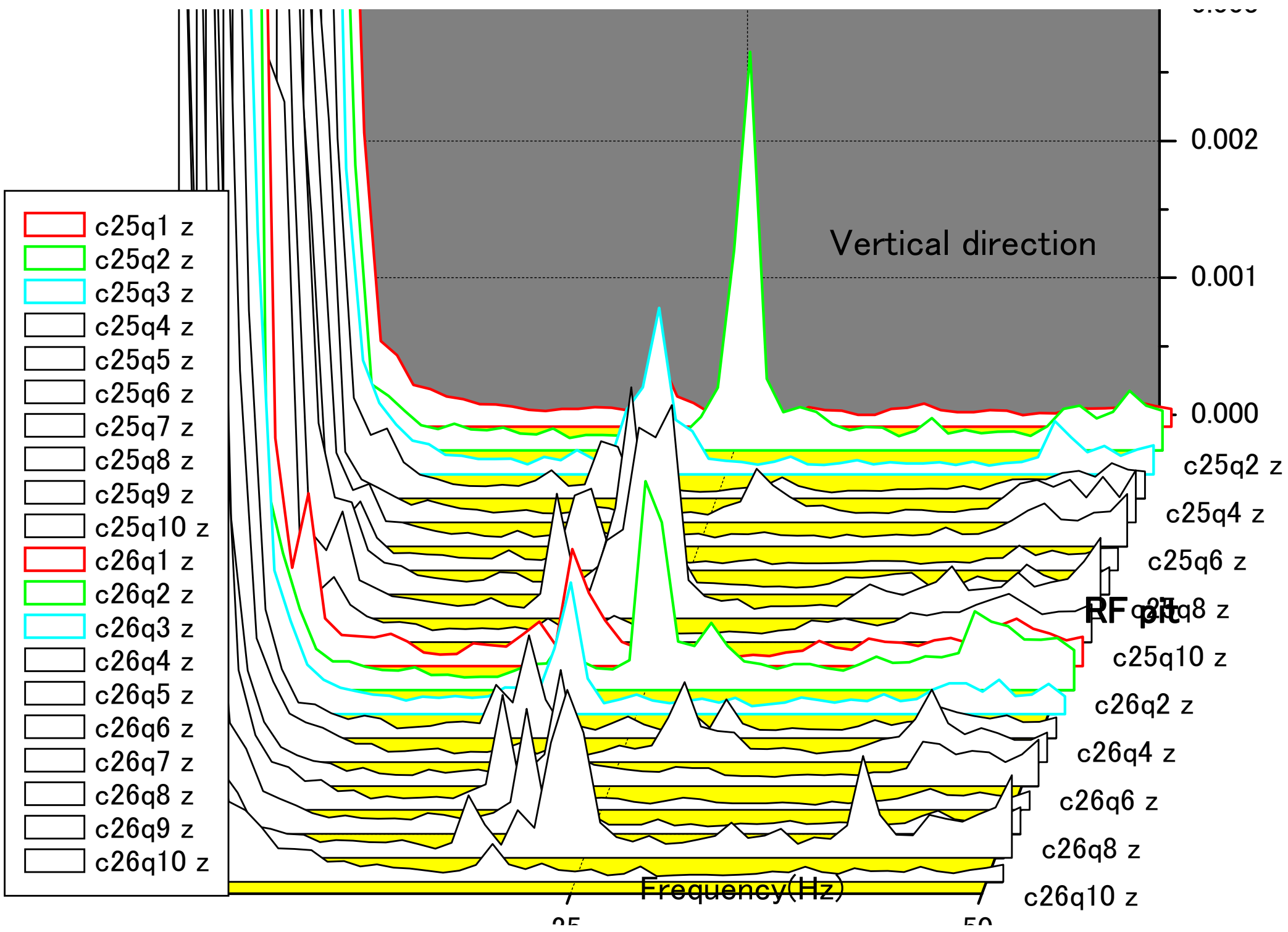
c02b1 x





- c47q8 z
- c47q9 z
- c47q10 z
- c47-48
- c48q1 z
- c48q2 z
- c48q3 z
- c48q4 z
- c48b1 z
- c48s4 z
- c48q7 z
- c48b2 z
- c48q8 z
- c48q9 z
- c48-01u z
- c48-01m z
- c48-01l z
- c01q1 z
- c01q2 z
- c01q3 z
- c01b1 z
- c01q4 z
- c01s4 z
- c01q7 z
- c01b2 z
- c01q8 z
- c01q9 z
- c01q10 z
- rfa u z
- rfa m z
- rfa l z
- c02q1 z
- c02q2 z
- c02q3 z
- c02b1 z
- c02b2 z
- c02q10 z





# Concluding Remark

- n いくつかのピークの原因の推定
- n 特に大きく振動している磁石がある
- n システムティックな評価ができるようになってきた
- n 床面などまだ未整理なところについては 解析を続ける
- n ランダムな振動ではない部分を次に目標にする