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超伝導加速空洞アライメント検出

総合研究大学院大学
倉本綾佳

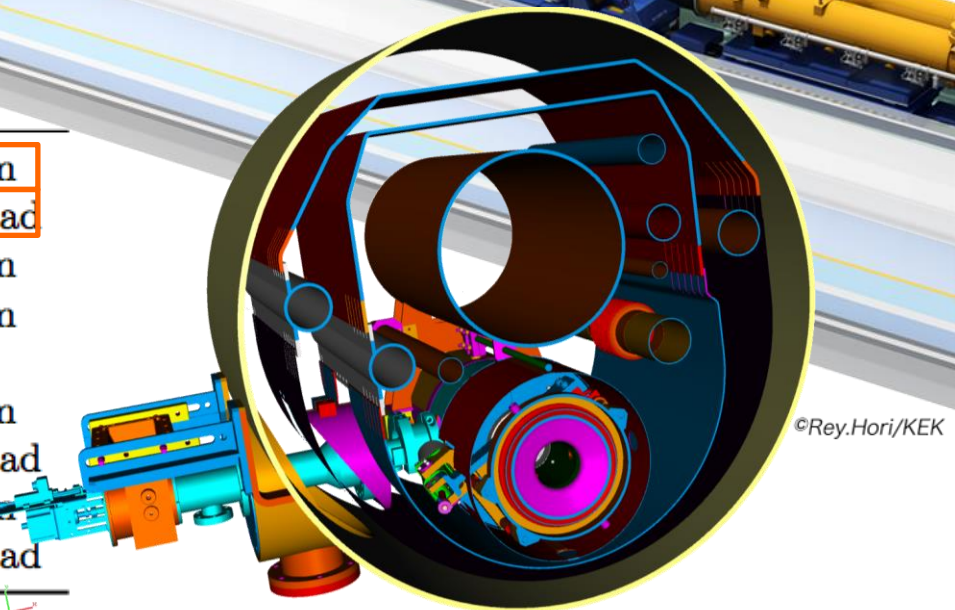
1. Alignment Tolerance
2. HOM & HOM Coupler
3. 高調波モードの測定
4. 測定結果
5. まとめ

Alignment Tolerance

空洞はヘリウムジャケットに覆われ、クラ = 見えない。
イオモジュール内に設置。

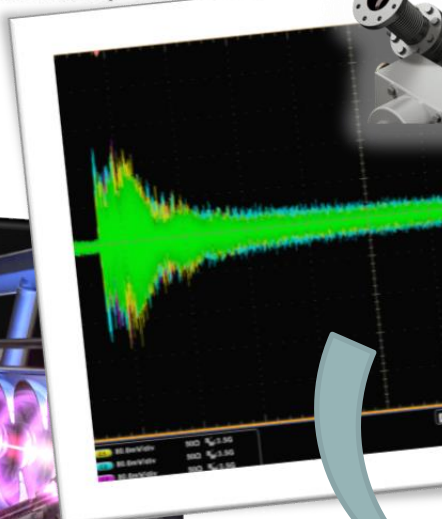
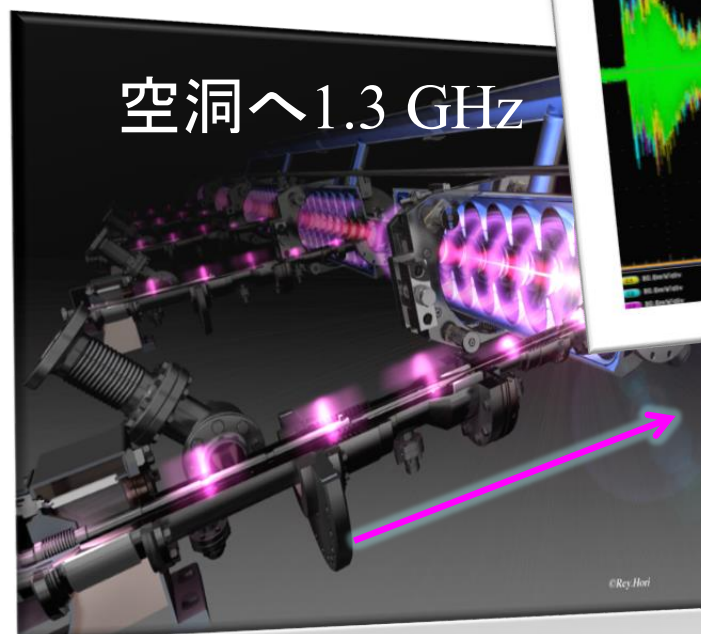
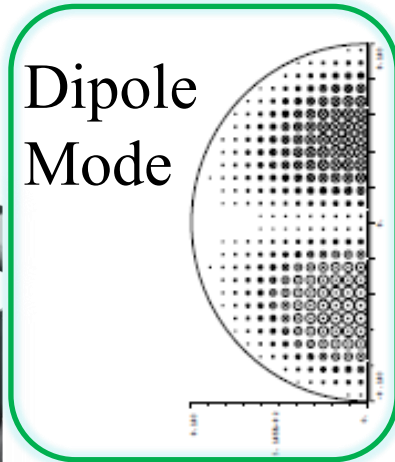
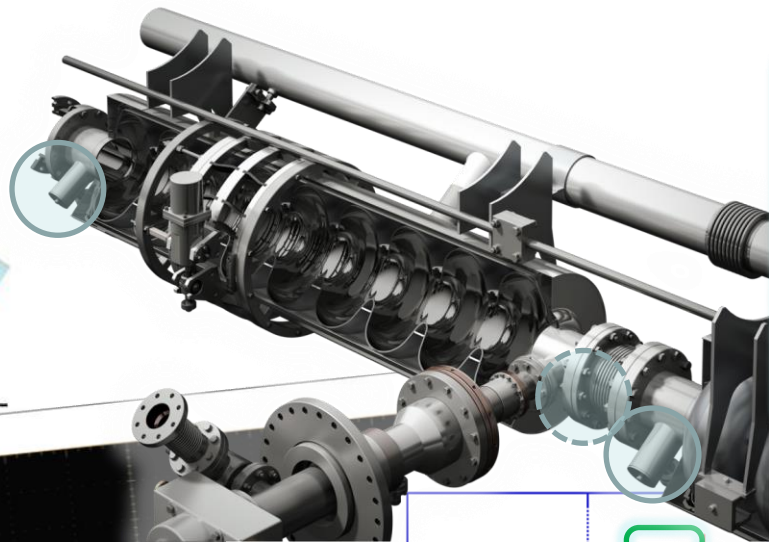
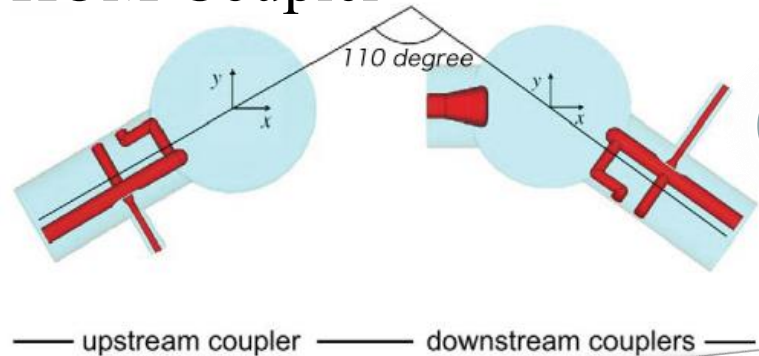
組み立て中や2Kまでの冷却中に生じた空洞の曲がり等の変形測定。

Error	with respect to	value
Cavity offset	module	300 μm
Cavity tilt	module	300 μrad
BPM offset	module	300 μm
BPM resolution		5 μm
BPM calibration		≤ 10 %
Quadrupole offset	module	300 μm
Quadrupole roll	module	300 μrad
Module offset	beamline reference	200 μm
Module tilt	beamline reference	20 μrad

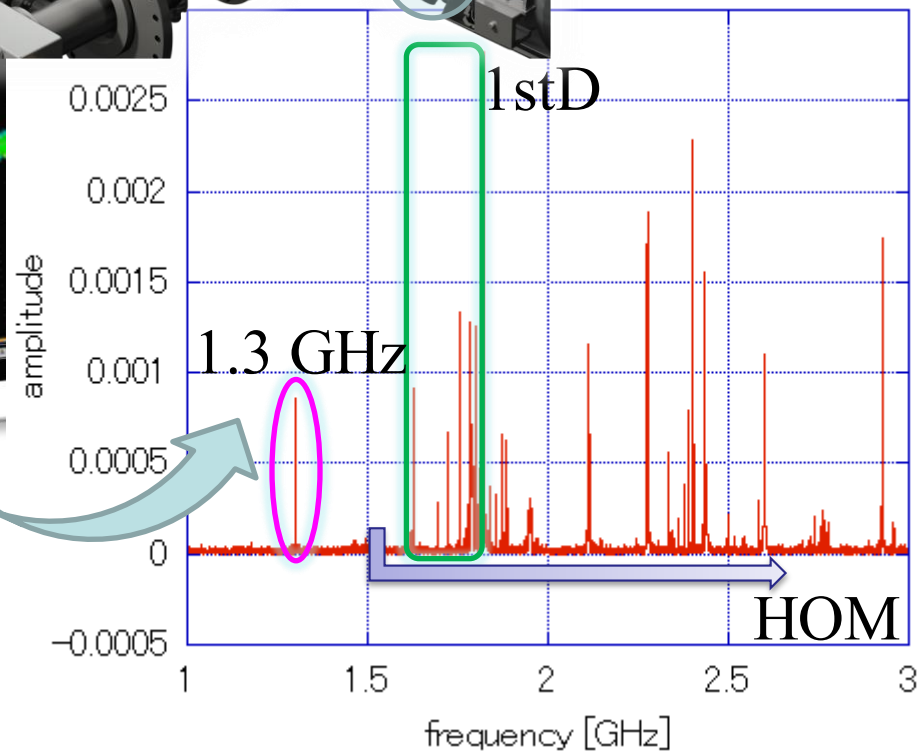


HOM (Higher Order Mode)

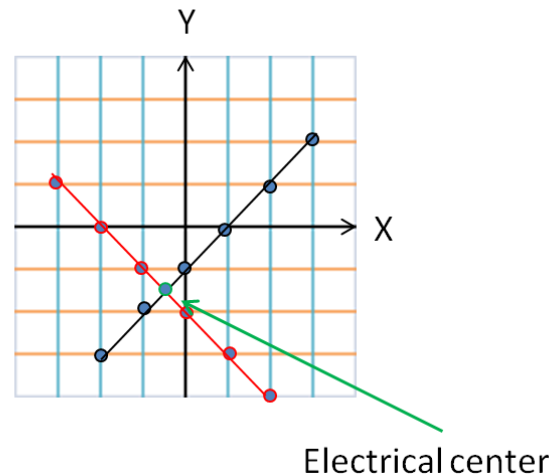
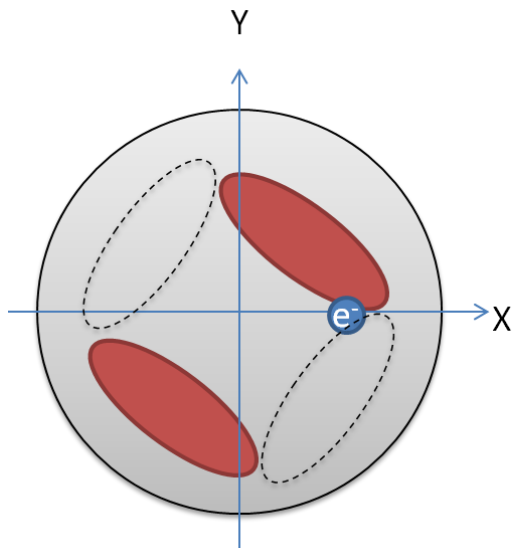
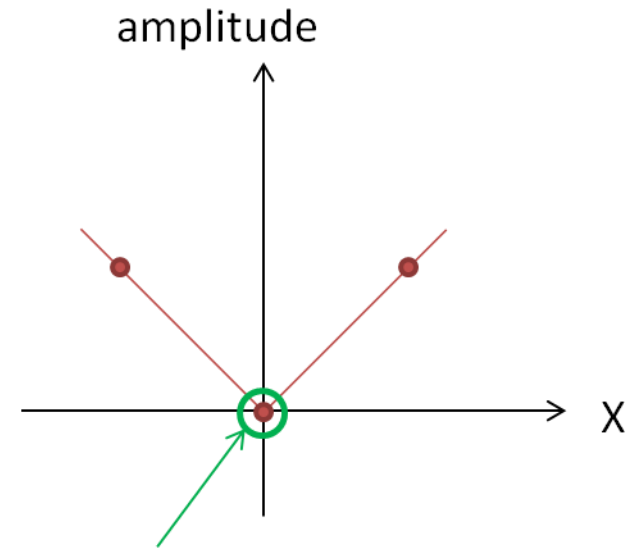
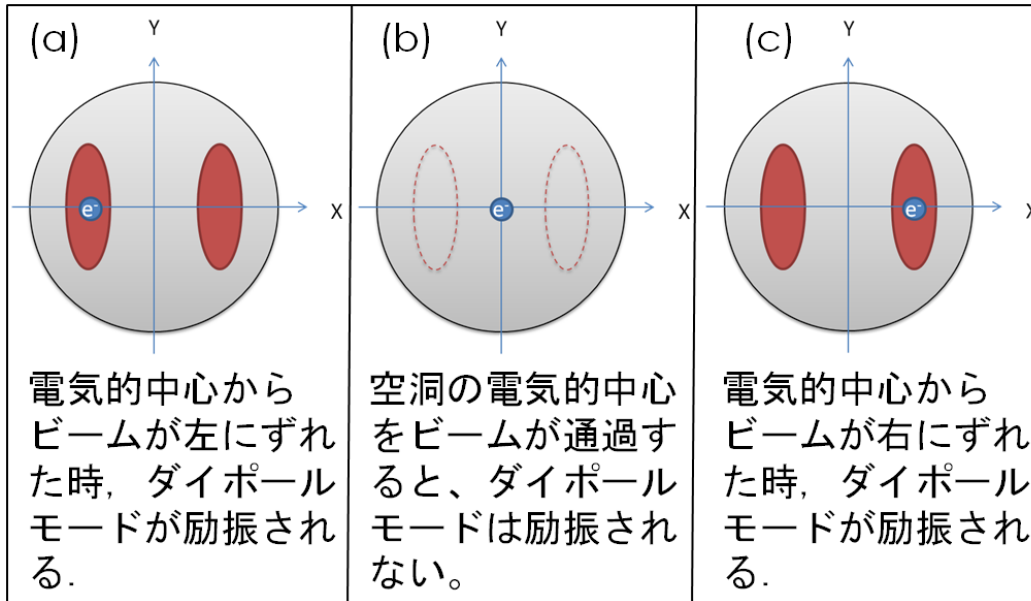
HOM Coupler



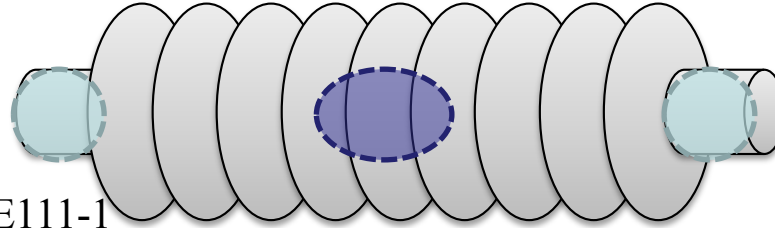
FFT



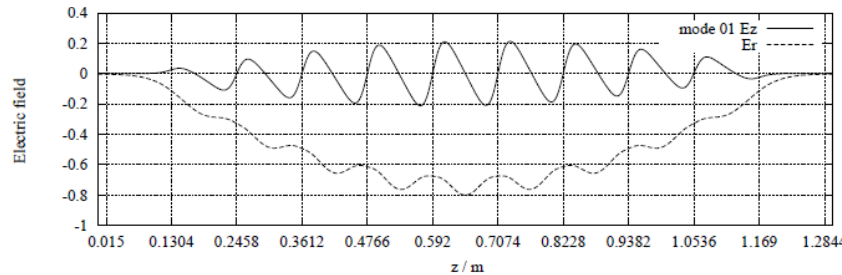
アライメント検出方法



TE111-1・Beam pipe mode



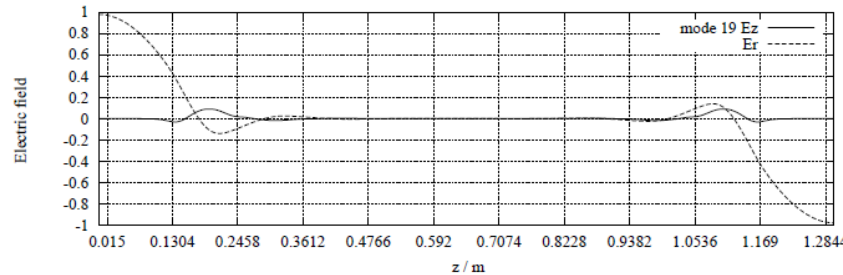
B.1.1 TE111-1



空洞長手方向中心で
振幅最大

Figure 85: Electric field ($3 \cdot E_z$ and E_r) at $r = 1$ cm versus z of mode: MM-01

B.1.3 Beam pipe modes



ビームパイプに局在

Figure 103: Electric field ($3 \cdot E_z$ and E_r) at $r = 1$ cm versus z of mode: MM-19

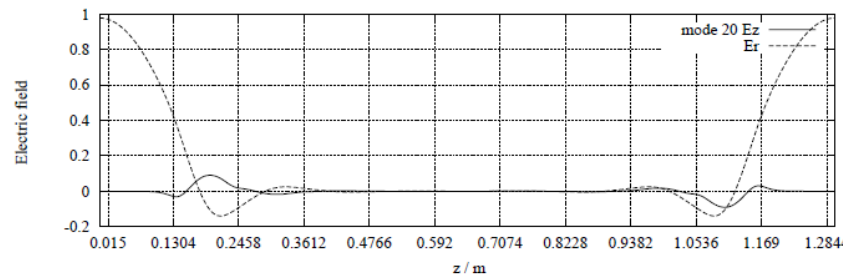
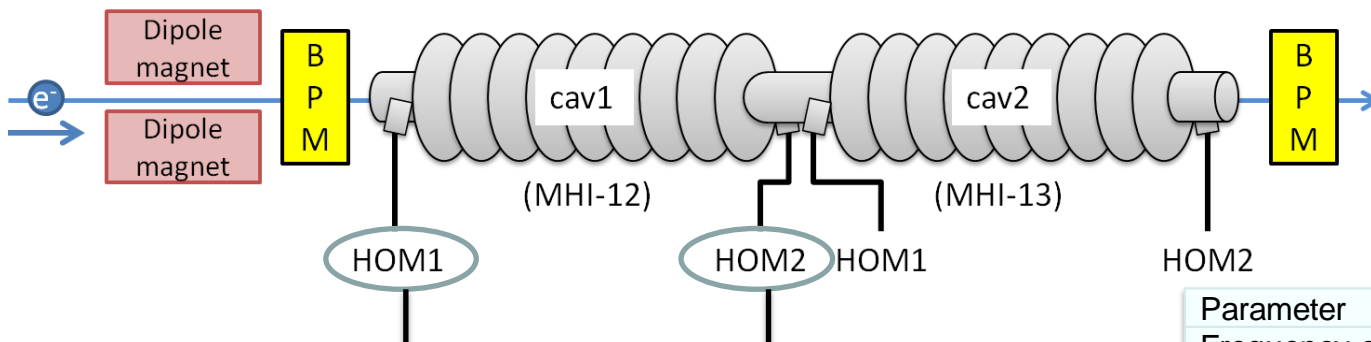


Figure 104: Electric field ($3 \cdot E_z$ and E_r) at $r = 1$ cm versus z of mode: MM-20

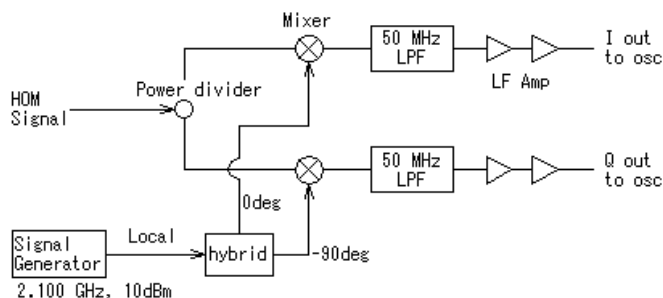
STF加速器-測定セットアップ-



TE111-1測定時

- 2 × HPF (Mini-Circuits VHF-1500+)
- band pass filter (1.590 to 1.802 GHz)

Beam pipe mode測定時

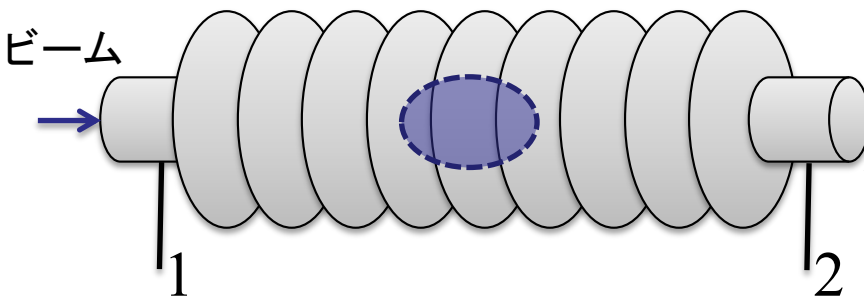
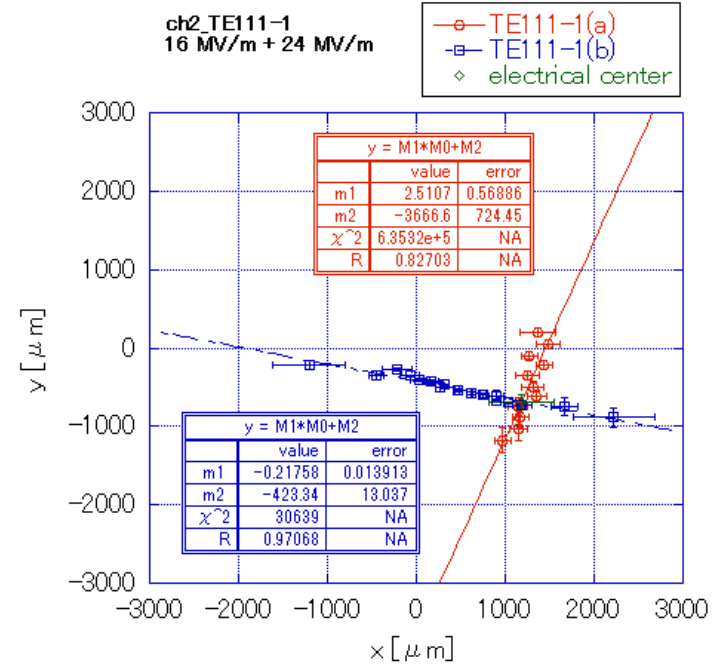
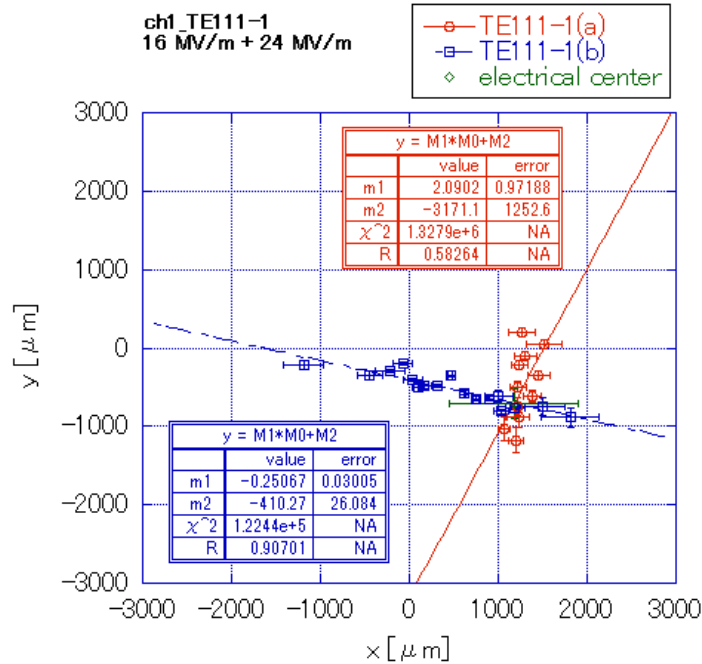


Agilent Technologies
DSO9404A

Parameter	
Frequency of accelerator	1.300 GHz
Number of beam bunches	28
Bunch spacing	6.15 ns
Bunch charge	~50 pC
Repetition	5 Hz
Gradient of RF Gun	40 MV/m
Gradient of cav1	16 MV/m
Gradient of cav2	24 MV/m



TE111-1 16 MV/m +24 MV/m



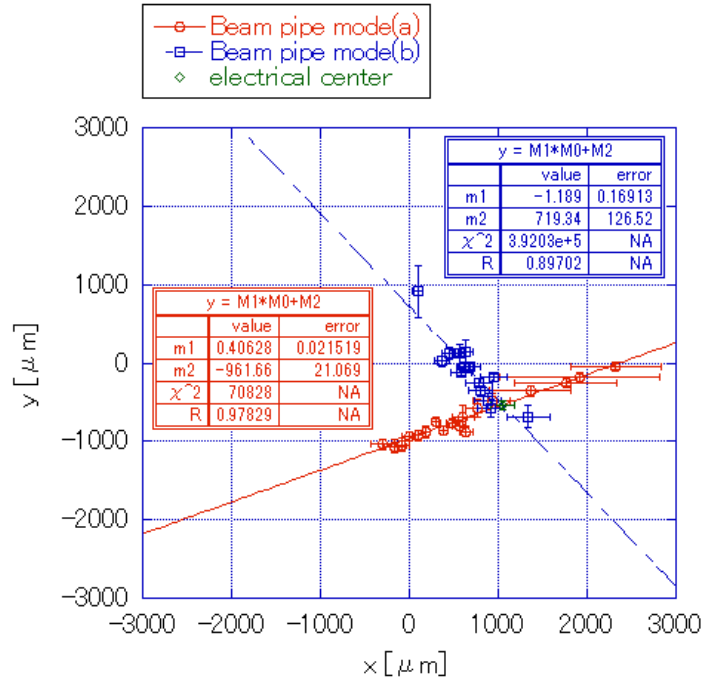
<TE111-1から導出されたelectrical center>

	Frequency [GHz]
a	1.6087
b	1.6096

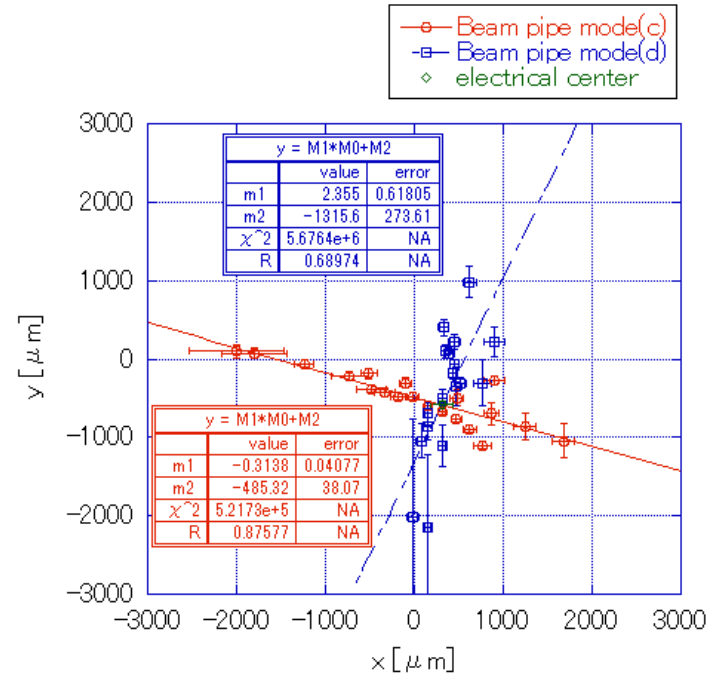
	ch1	ch2
x [μm]	1179 ± 725.6	1189 ± 363.4
y [μm]	-705.9 ± 186.0	-682.0 ± 82.63

Beam pipe mode 16 + 24 MV/m

upstream



downstream



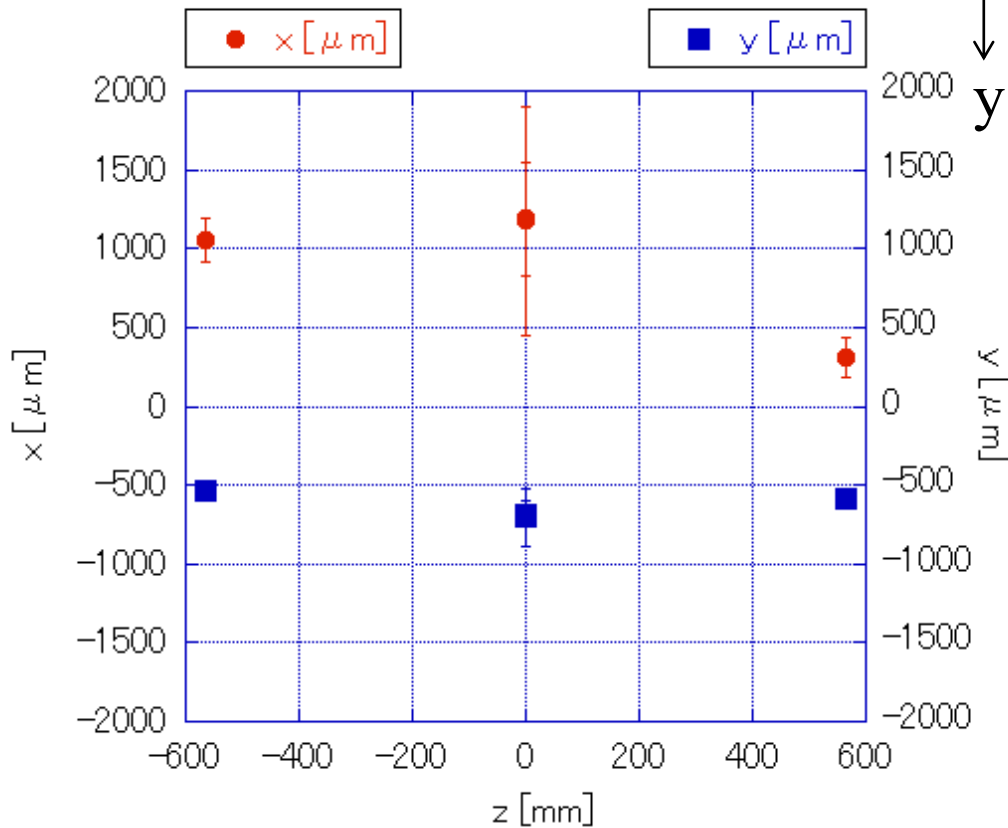
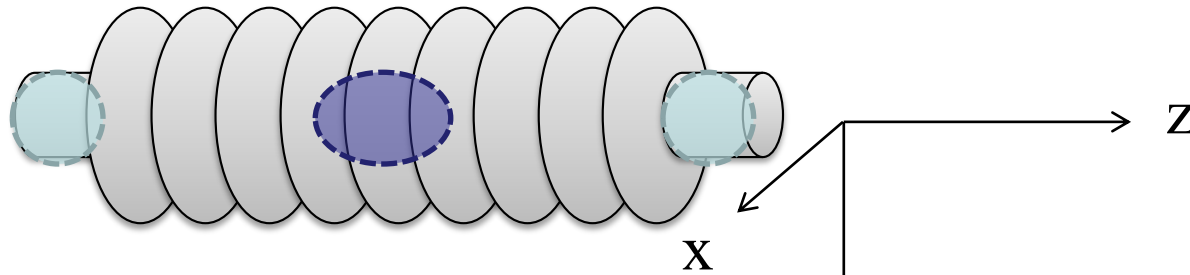
Δ Frequency [GHz]
from 2.100 GHz

HOM1	a	0.0327
HOM1	b	0.0331
HOM2	c	0.0202
HOM2	d	0.0208

<Beam pipe modeから導出されたelectrical center>

	HOM1 (upstream)	HOM2 (downstream)
x [μ m]	1054 \pm 138.4	-533.5 \pm 60.25
y [μ m]	311.1 \pm 126.2	-582.9 \pm 52.91

アライメント検出

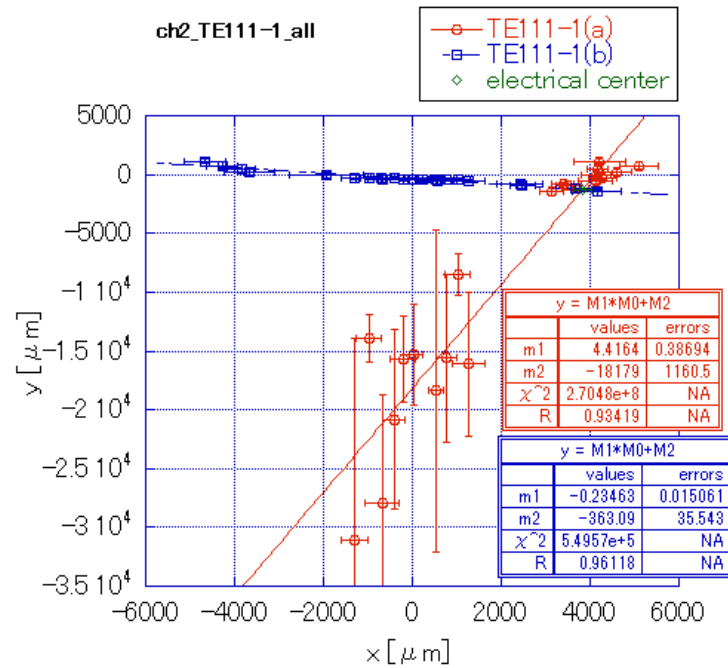
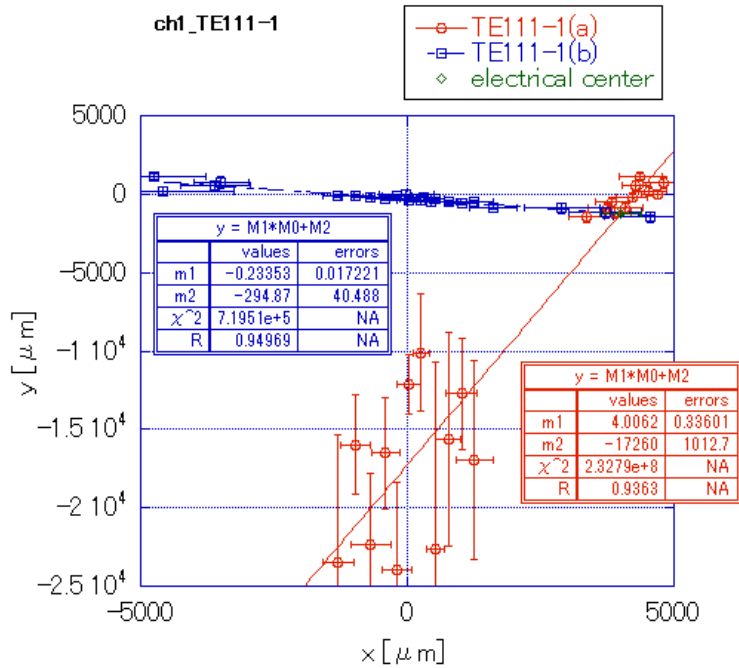


- カプラーによるビームキックの影響
- 電気的中心と機械的中心の関係付け

	Beam pipe (upstream)	Middle cell	Beam pipe (downstream)
x	1054 ± 138.4	1179 ± 725.6 1189 ± 363.4	311.1 ± 126.2
y	-582.9 ± 52.91	-705.9 ± 186.0 -682.0 ± 82.63	-533.5 ± 60.25

(単位 μm)

TE111-1 0 MV/m + 0MV/m



	x [μm]		y [μm]	
	ch1	ch2	ch1	ch2
0 +0 MV/m	4001 \pm 397.5	3831 \pm 209.0	-1229 \pm 119.6	-1262 \pm 80.82
16 +24 MV/m	1179 \pm 725.6	1189 \pm 363.4	-705.9 \pm 186.0	-682.0 \pm 82.63

- STF加速器にてHOMの測定を行った.
- TE111-1およびビームパイプモードを見つけることができ、それぞれのモードから電気的中心を求めることができた.
- カップラーキックの影響を考慮する必要がある.
- 電気的中心と機械的中心の位置関係を今後測定する.

ご清聴ありがとうございました。