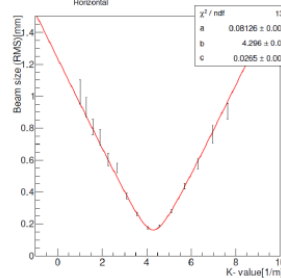# Effects of injector cavity offset

**Ji-Gwang Hwang, Eun-San Kim and Tsukasa Miyajima**

**KNU Accelerator Physics Laboratory**

# Motivation

➢ **As measuring in the injector beam line, the emittance growth is observed in a injector SC cavities by a factor of 2.**

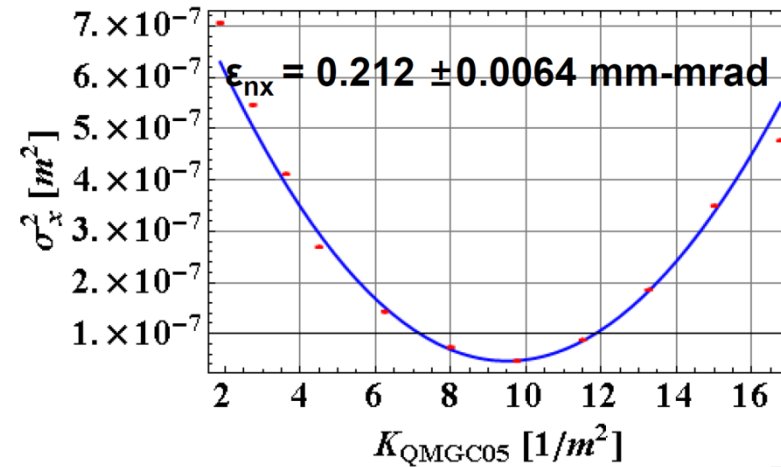電子銃下流でのエミッタンス(390 keV)
Solenoid-scan法で測定
規格化エミッタンス：**0.1 mm mrad**

Horizontal

| χ²/ndf | | 13/13 |
|---|---|---|
| a | 0.08126 ± 0.002738 | |
| b | 4.296 ± 0.01906 | |
| c | 0.0265 ± 0.001488 | |

カソードの初期エミッタンス
カソード材質：GaAs
kT = 120 meV
d = 0.8 mm

$$\varepsilon_n = \frac{d}{4}\sqrt{\frac{kT}{mc^2}}$$

= **0.097 mm mrad**

☐ カソードによって決まる初期エミッタンスと同程度であることが確認された
⇒輸送路でのエミッタンス増大は極めて小さい

$\varepsilon_{nx}$ = **0.212 ±0.0064 mm-mrad**

$\sigma_x^2 \ [m^2]$
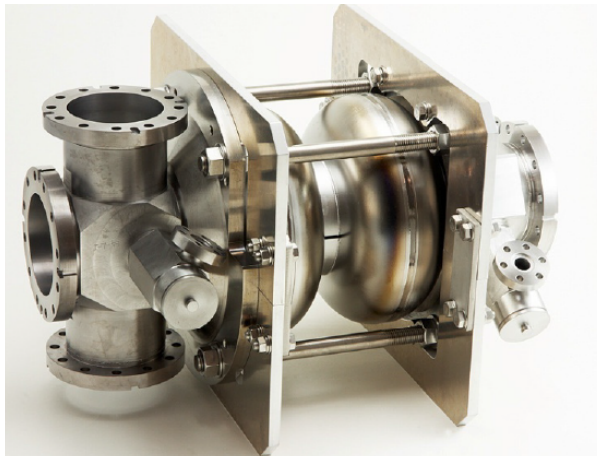
$K_{QMGC05} \ [1/m^2]$

➢ **In order to explain the growth of the emittance in this section, the study for estimation of effect of alignment errors of cavities is required.**

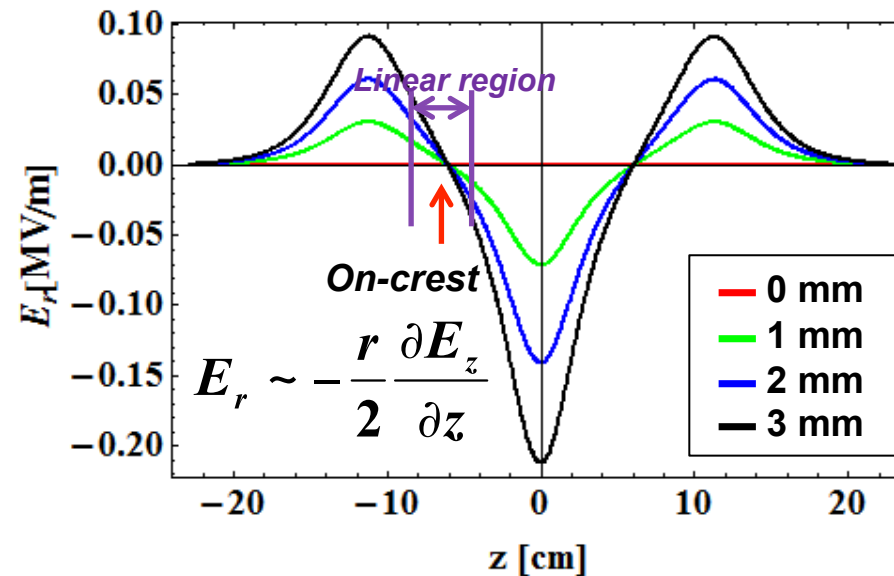**~ 0.1 mm-mrad**

**~ 0.2 mm-mrad**
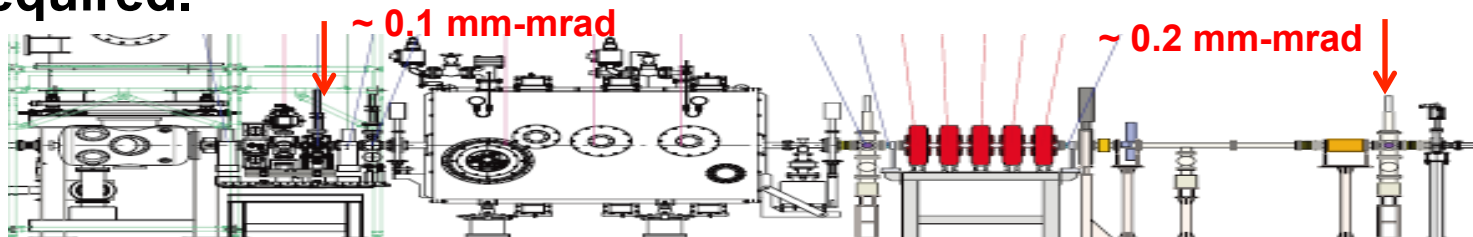
# Possible source of emittance growth

- **The transverse force provided by the cavity imparts a transverse momentum on the bunch which varies in time over the passage of the bunch.**
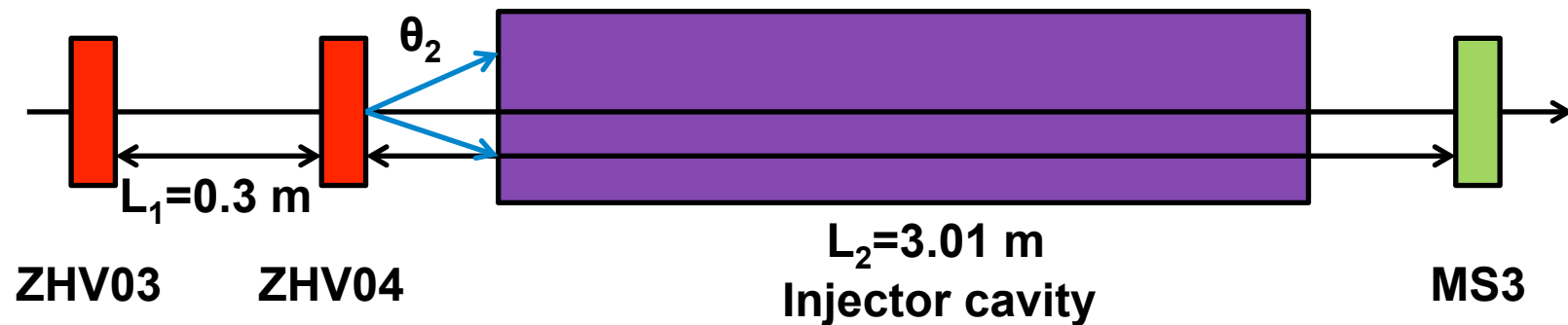


*2 cell injector cavity*

$$E_r \sim -\frac{r}{2}\frac{\partial E_z}{\partial z}$$
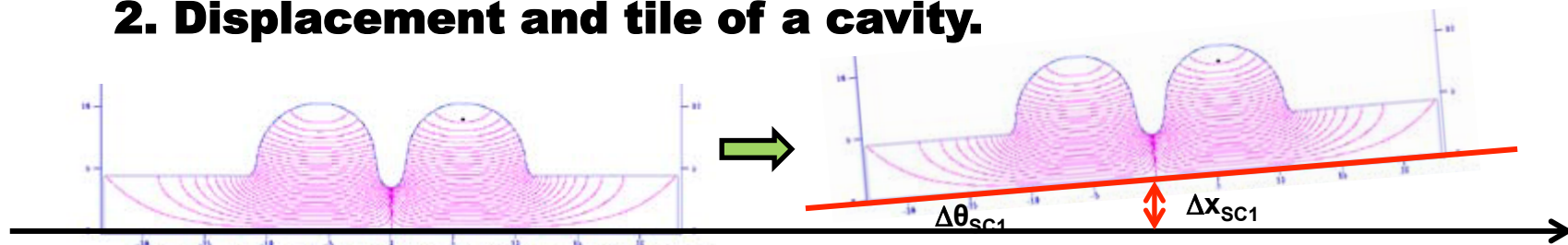
- **It can cause the growth of projected emittance.**

# Alignment error of cavities with beam angle

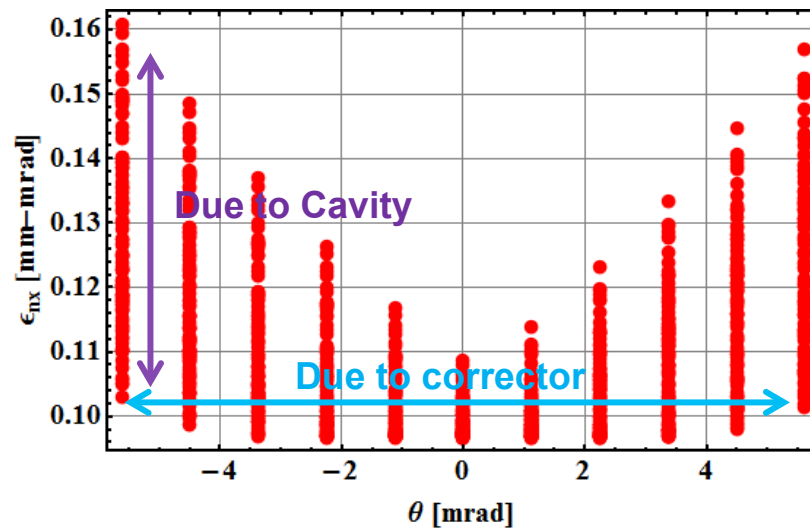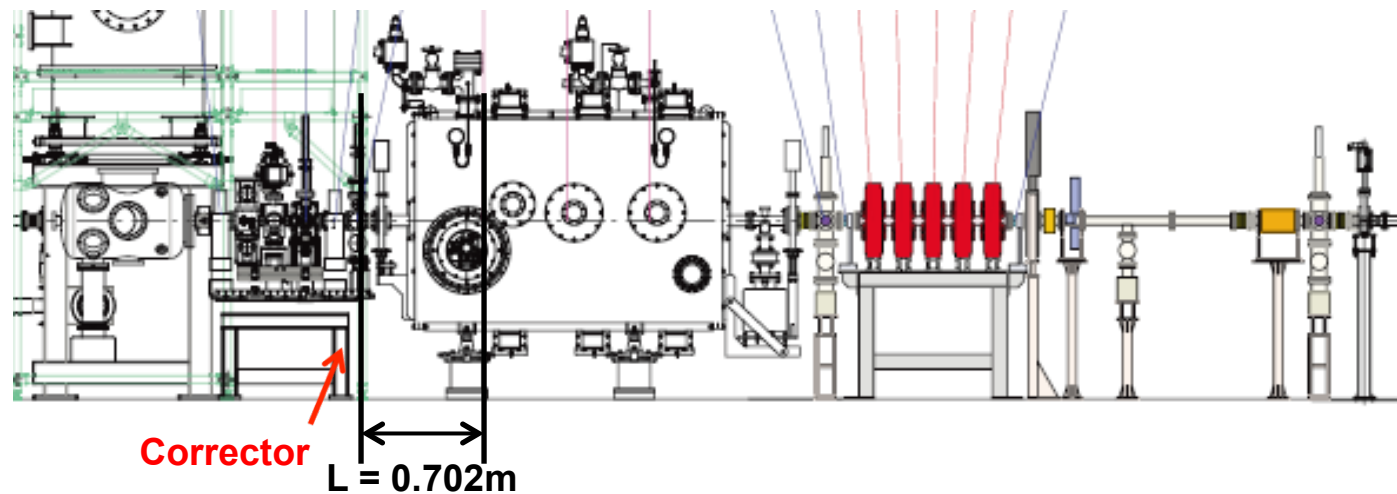**There has two kind of errors in the simulation.**

### 1. Displacement and angle due to corrector.



$\theta_2$

$L_1$=0.3 m

ZHV03     ZHV04

$L_2$=3.01 m
Injector cavity

MS3

### 2. Displacement and tile of a cavity.



$\Delta\theta_{SC1}$     $\Delta x_{SC1}$

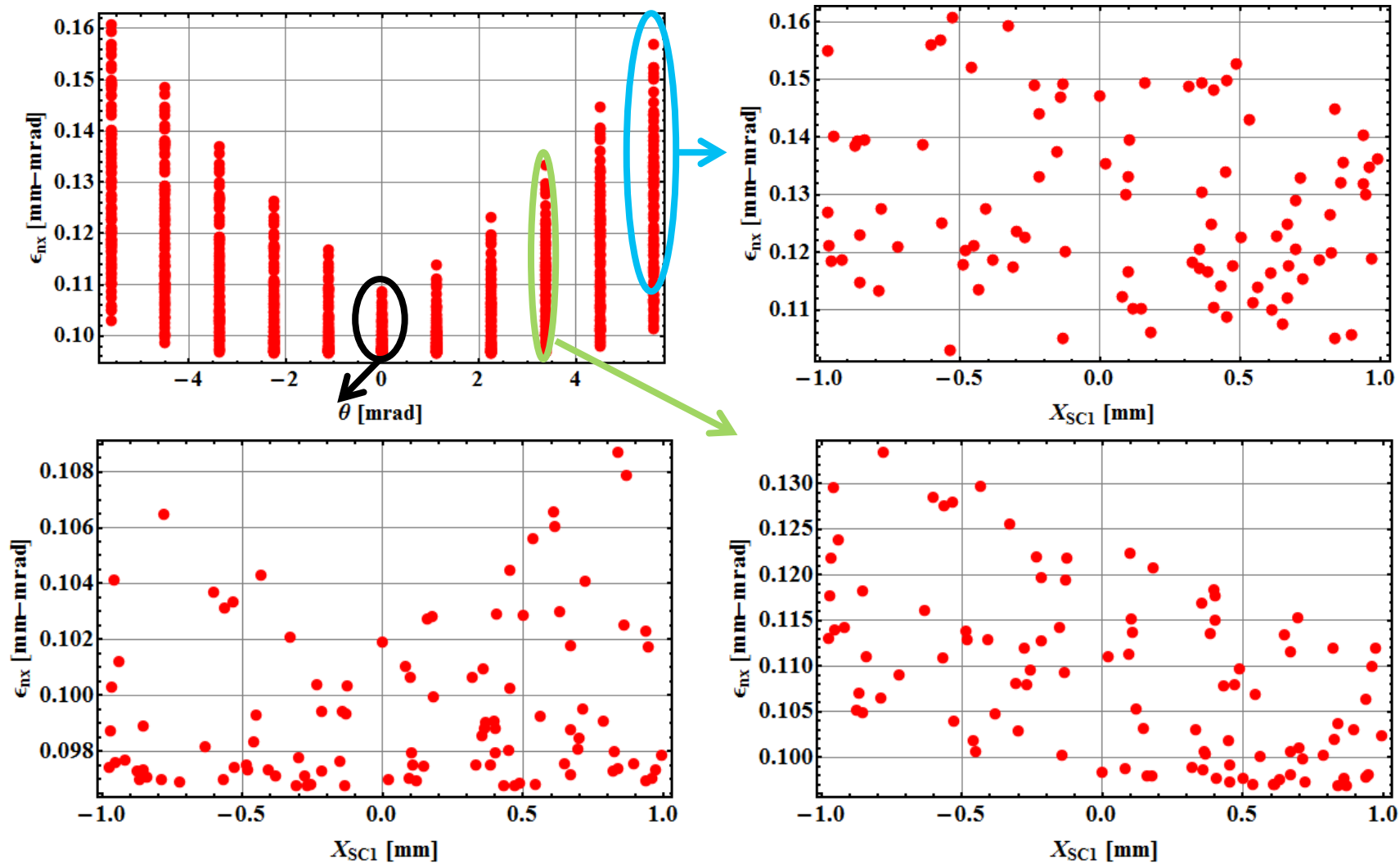# Alignment error of cavities with beam angle



**Corrector**

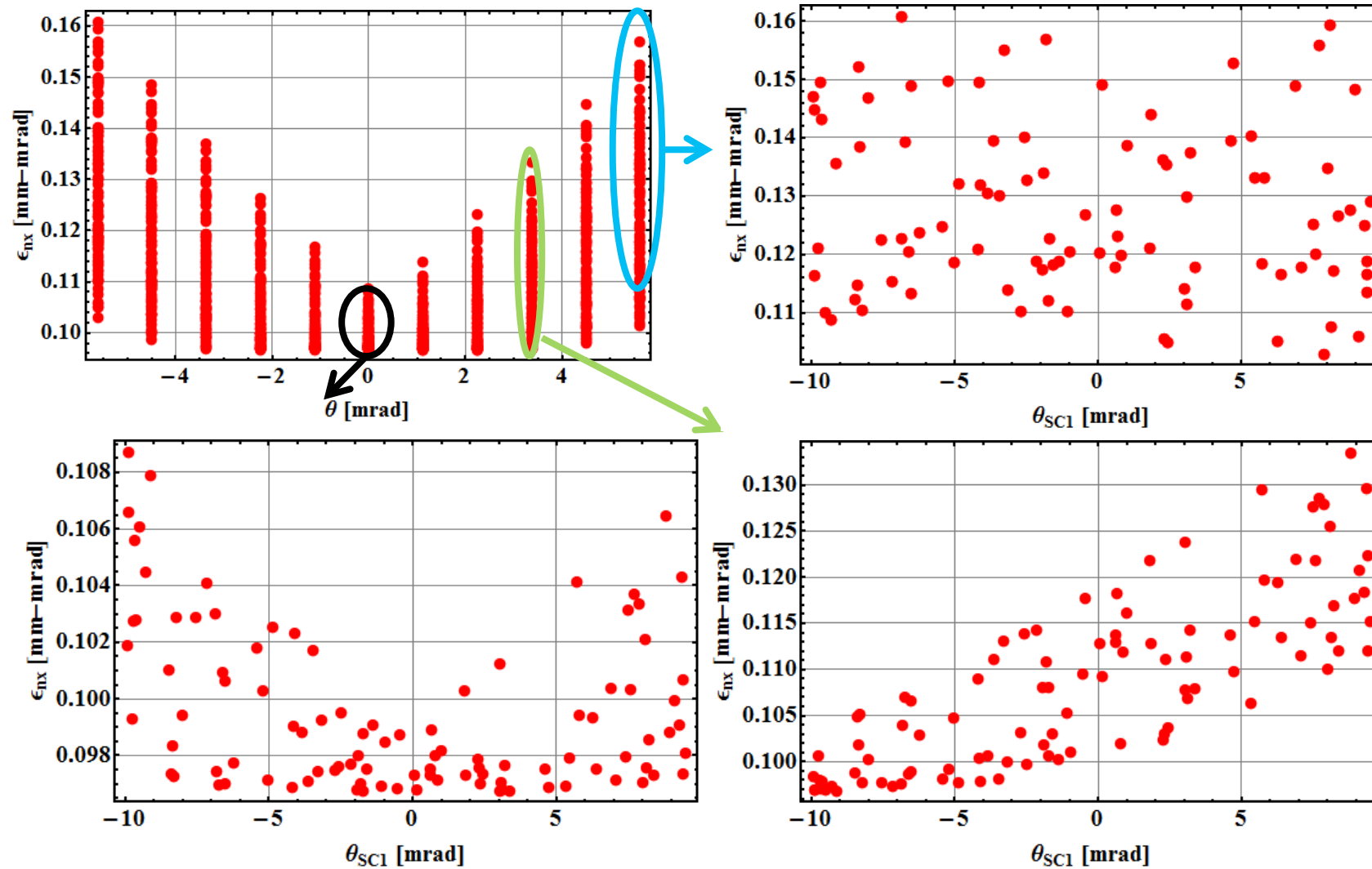L = 0.702m



Due to Cavity

Due to corrector

When the displacement of the central orbit with beam angle was given by one corrector is installed just before a cavities, the growth of the emittance is strongly depend on the alignment error and angle.
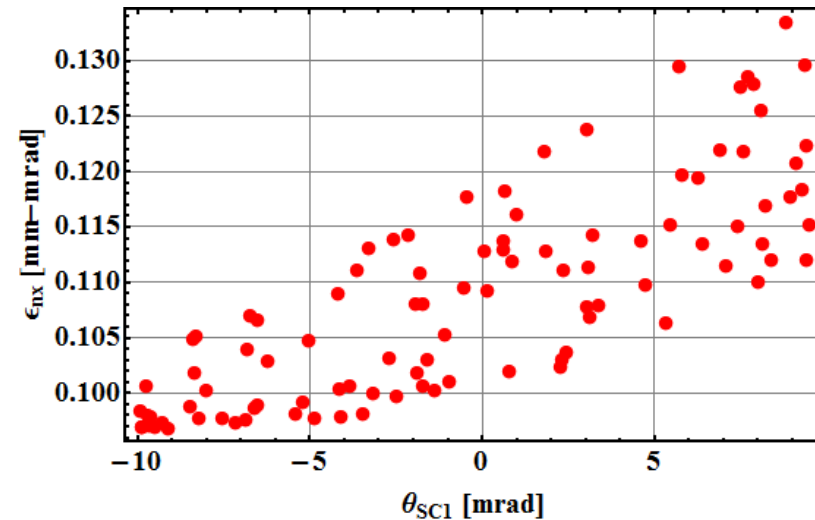
$\Delta\theta_{corr} = \pm 5.61$ mrad
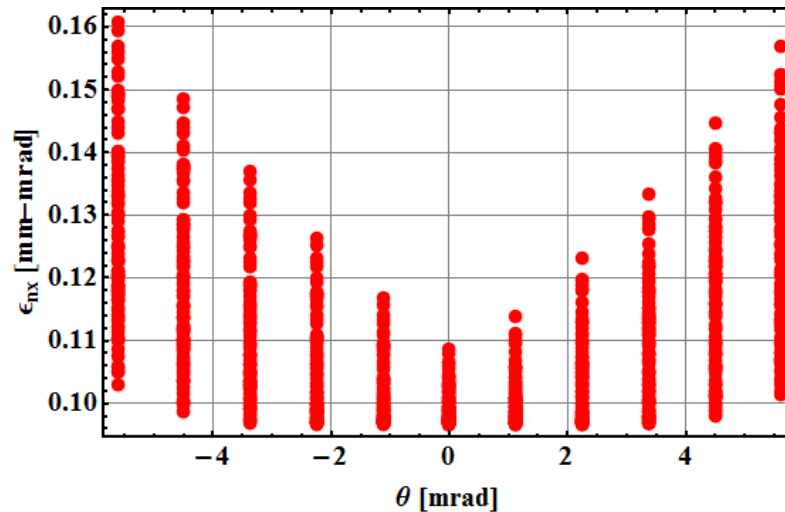
# Alignment error of cavities with beam angle

# Alignment error of cavities with beam angle

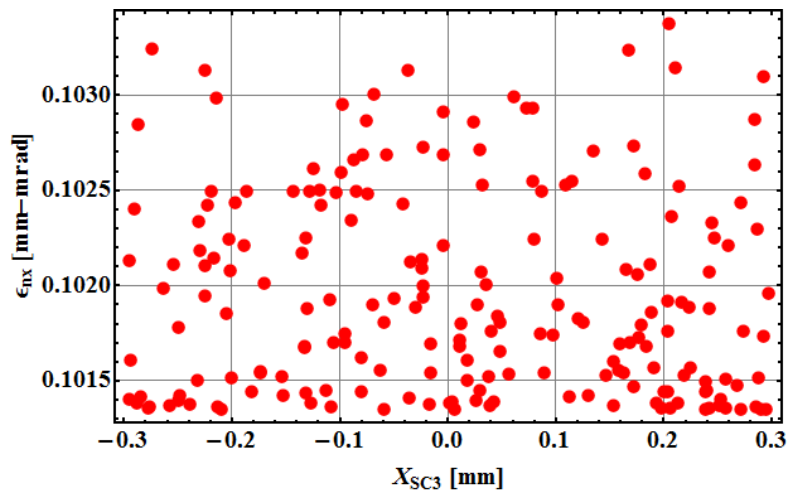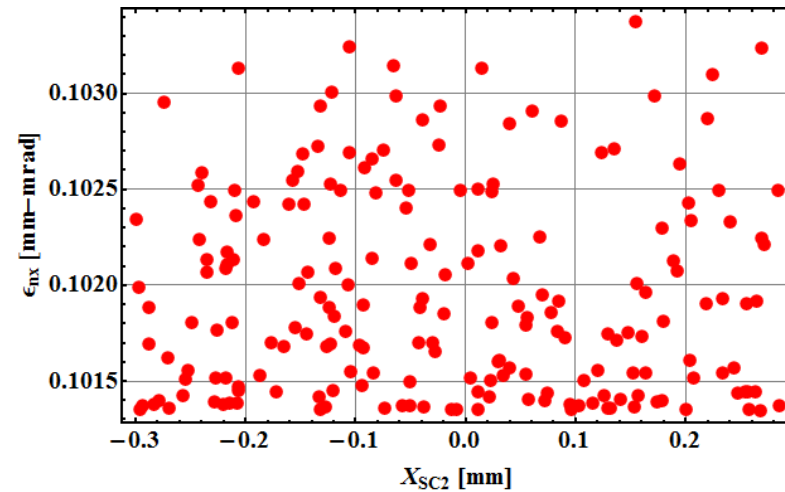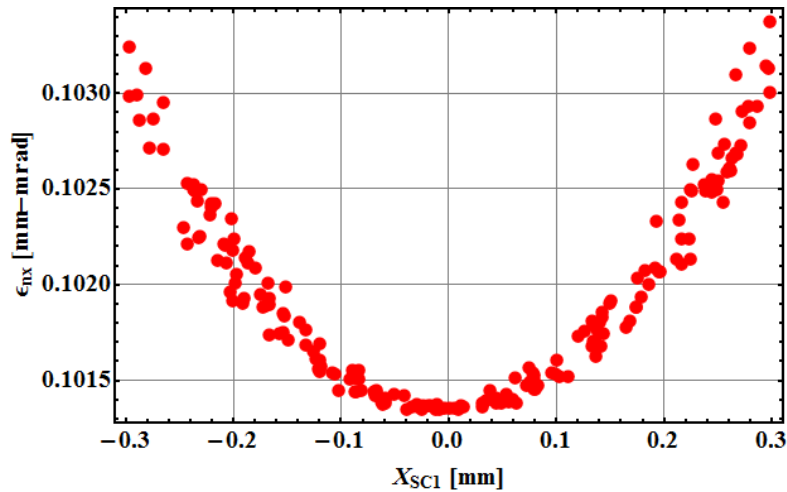# Discussion

- **The effect of the displacement and angle due to the corrector h as more strong effect than the displacement and tilt of a cavity.**



- **The incident angle of the beam at the cavity is main source of t he emittance growth.**

# Alignment error of cavities



The uniform distributed alignment error was given for three cavities.

$$\Delta x = \pm\ 0.300\ mm$$

When only alignment error of three cavities was given, the growth of the emittance is strongly depend on the alignment error of 1st cavity.