

KEK Beam Test Facility Status and Plans



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for Fuji Test Beam Line Group



Test beam facility in KEK

- Proton Synchrotron (12GeV PS) was terminated Dec. 2005

Currently, there is no facility in KEK for the R&D efforts toward SuperB, ILC nor J-PARC experiments....

- J-PARC (Tokai : ~50km from KEK): test beam will be available not earlier than 2010.
- **A new facility, "Fuji Test Beam Line (FTBL)", is supposed to deliver a beam from Fall 2007.**

Where FTBL being built?

Fuji Xing

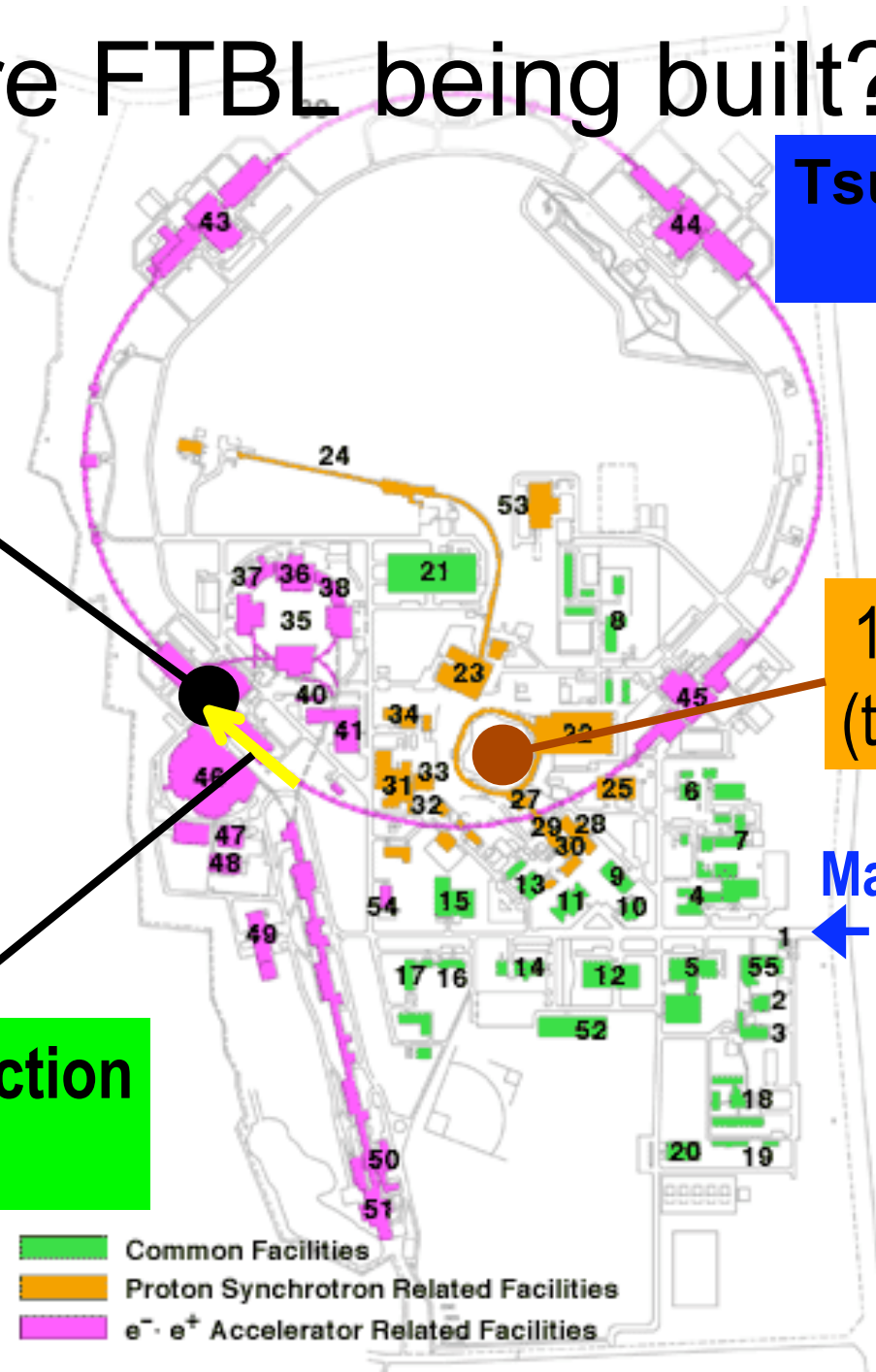
Tsukuba
IR

12 GeV PS
(terminated)

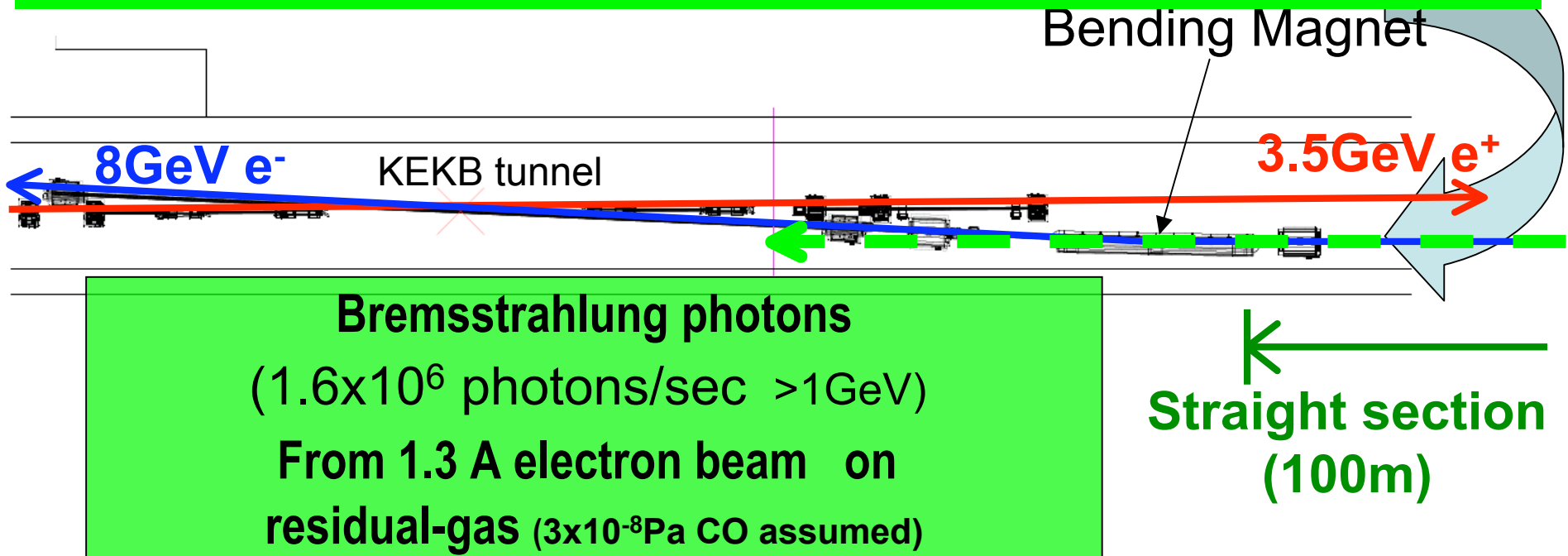
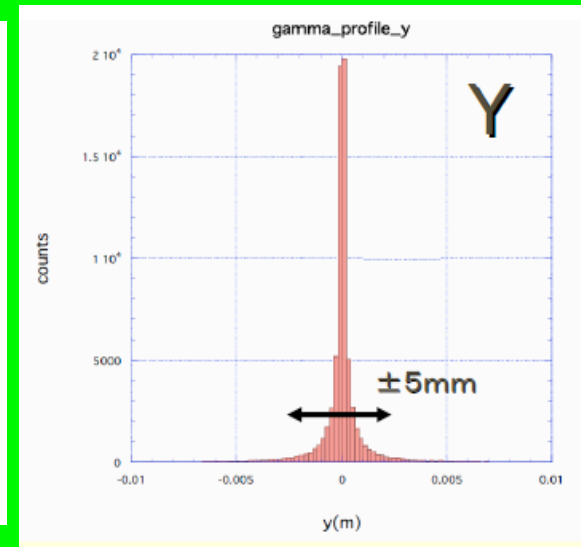
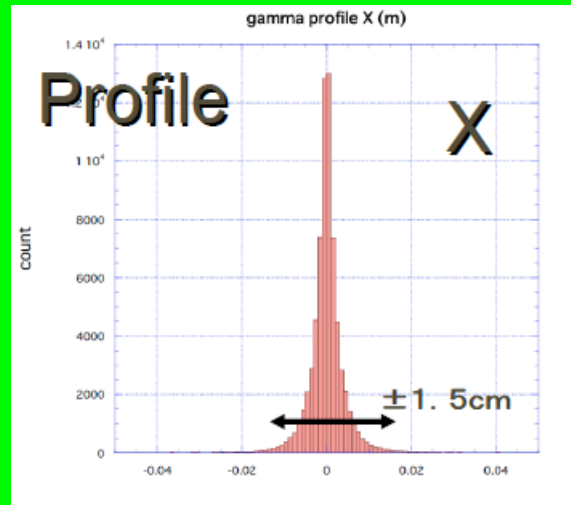
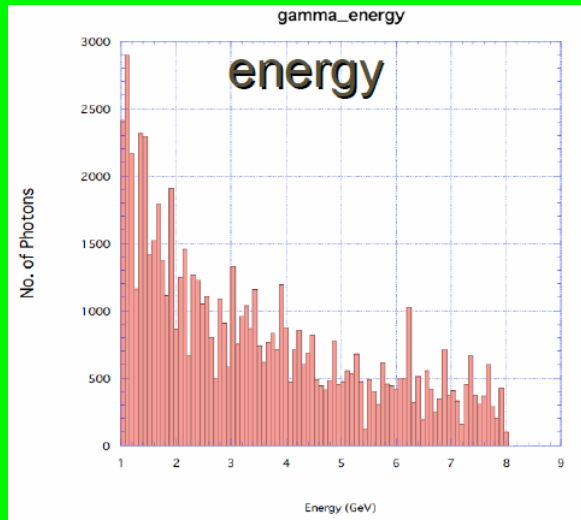
Main Entrance

100 m straight section
for e^- 8 GeV

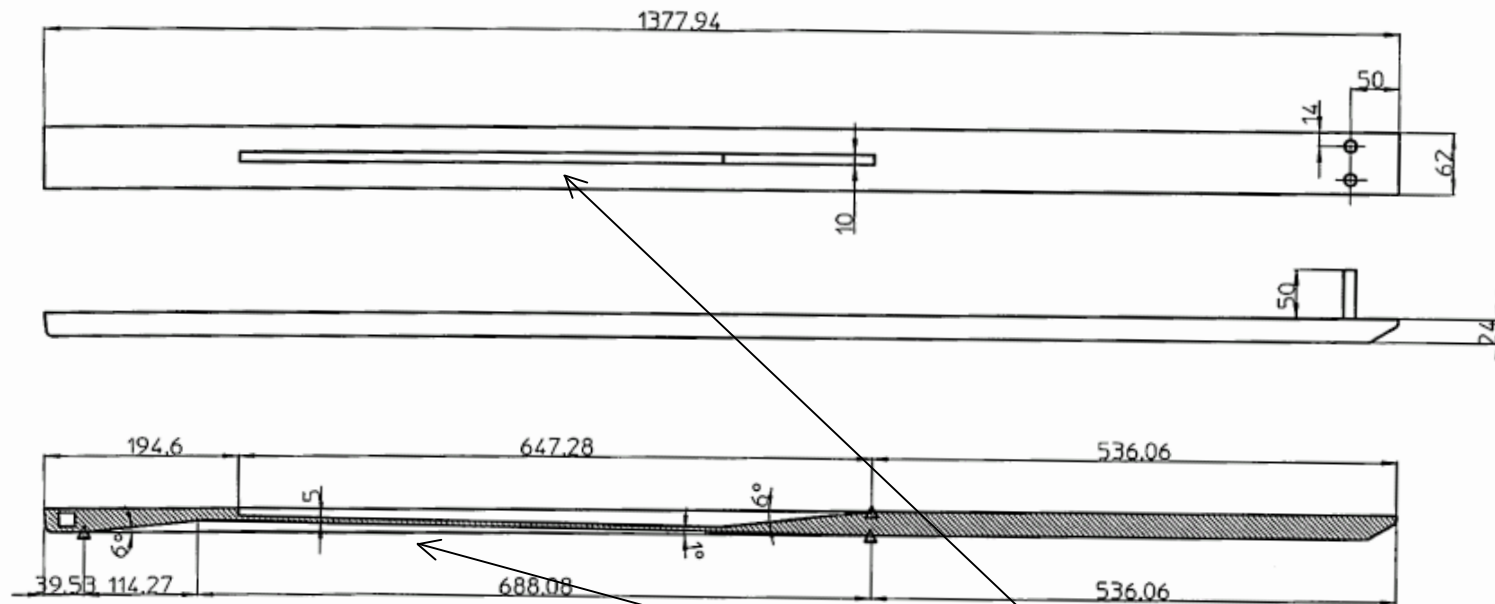
- Common Facilities
- Proton Synchrotron Related Facilities
- $e^- \cdot e^+$ Accelerator Related Facilities



“Turtle” simulation for Bremsstrahlung photon



Beam chamber at the bend to be replaced for gamma to exit efficiently

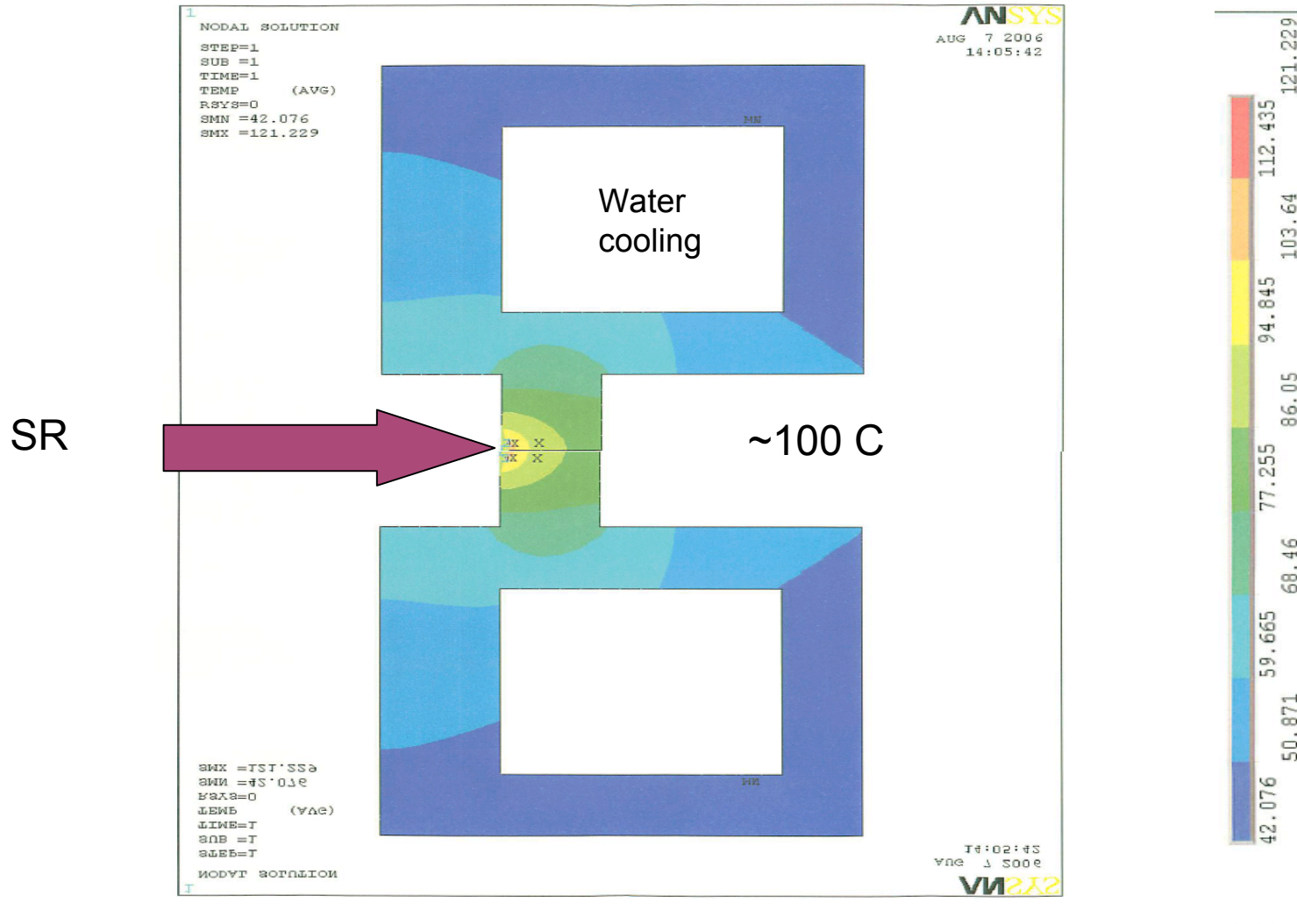


Effective thickness $\sim 5\text{mm}/\sin(7^\circ)$ (Cu) $\sim 3X_0$

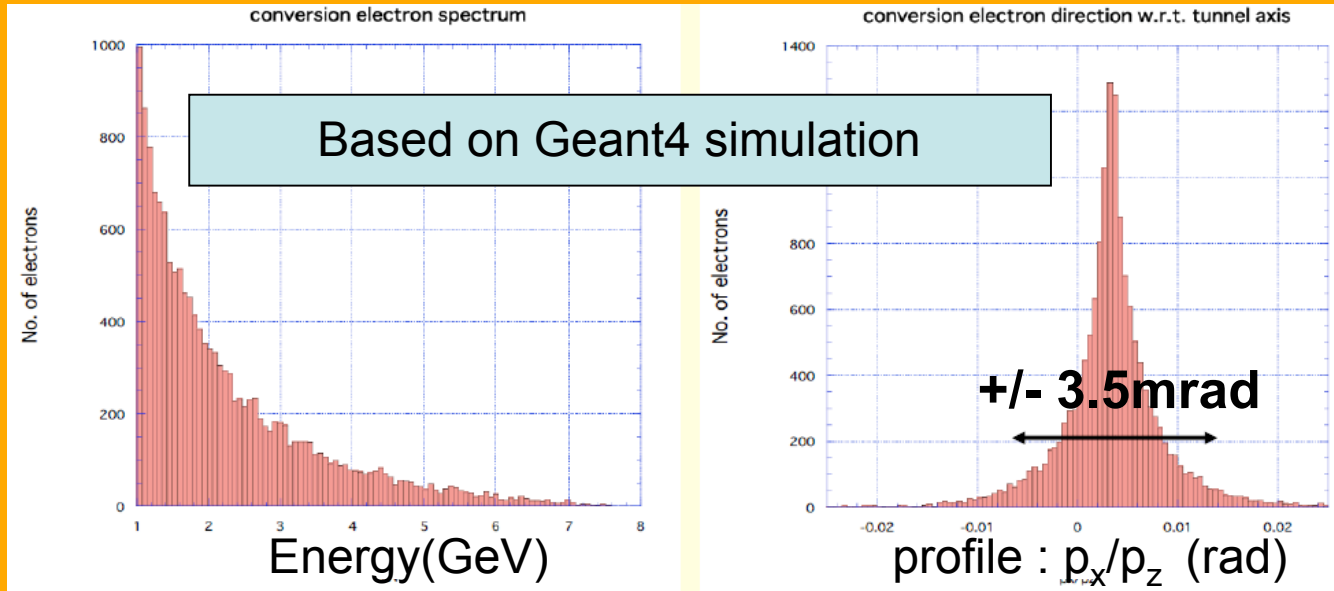
Photon exit window

10% photon will come out unconverted.

Temperature at the exit window

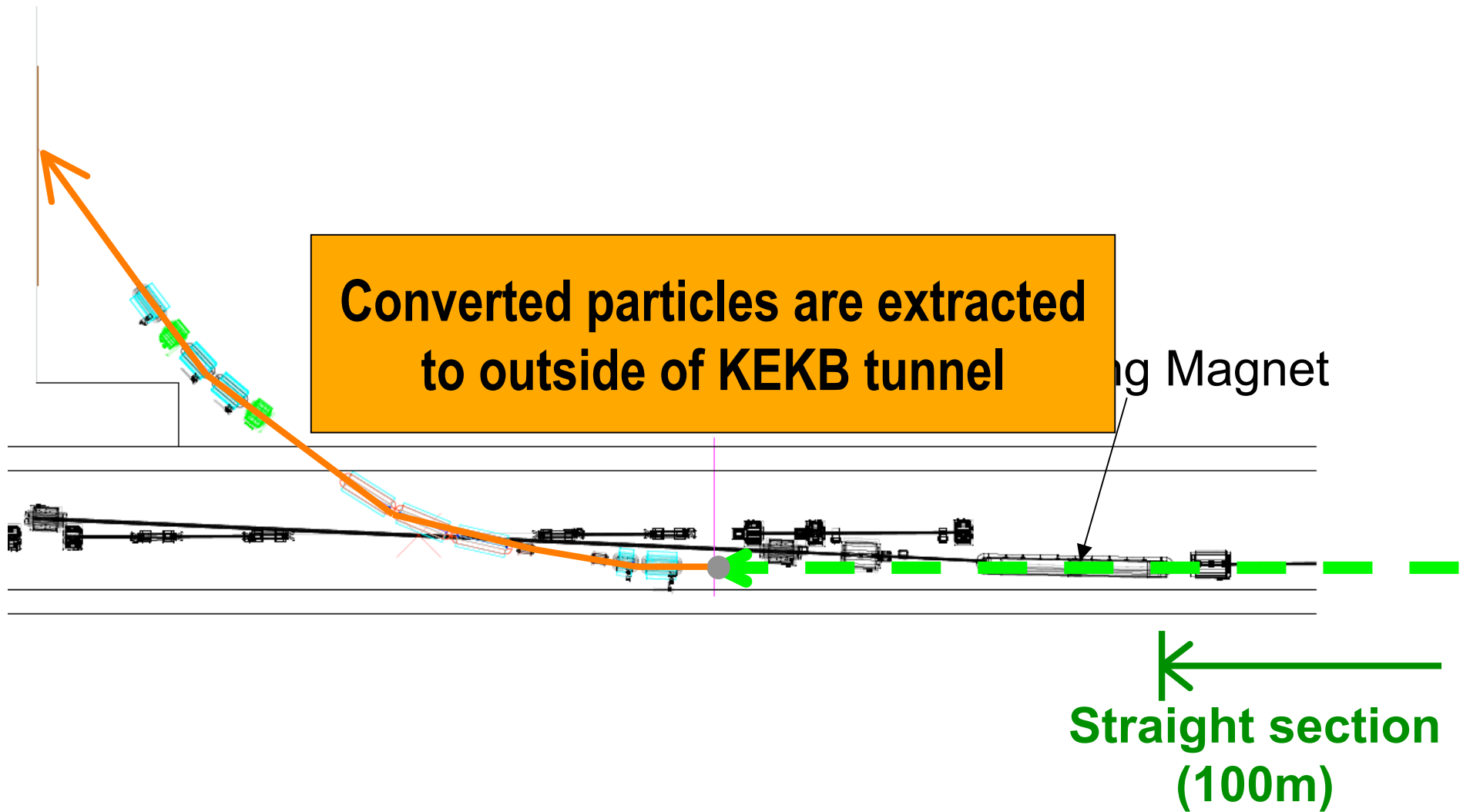


Generated electron



Charged particles (e^-/e^+)
from Brems. photon
(tungsten converter : 3mm \Leftrightarrow $\sim 1X_0$)

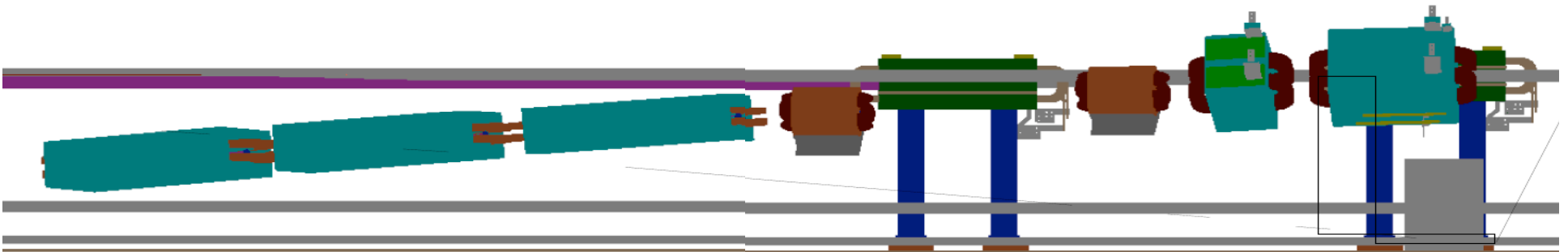
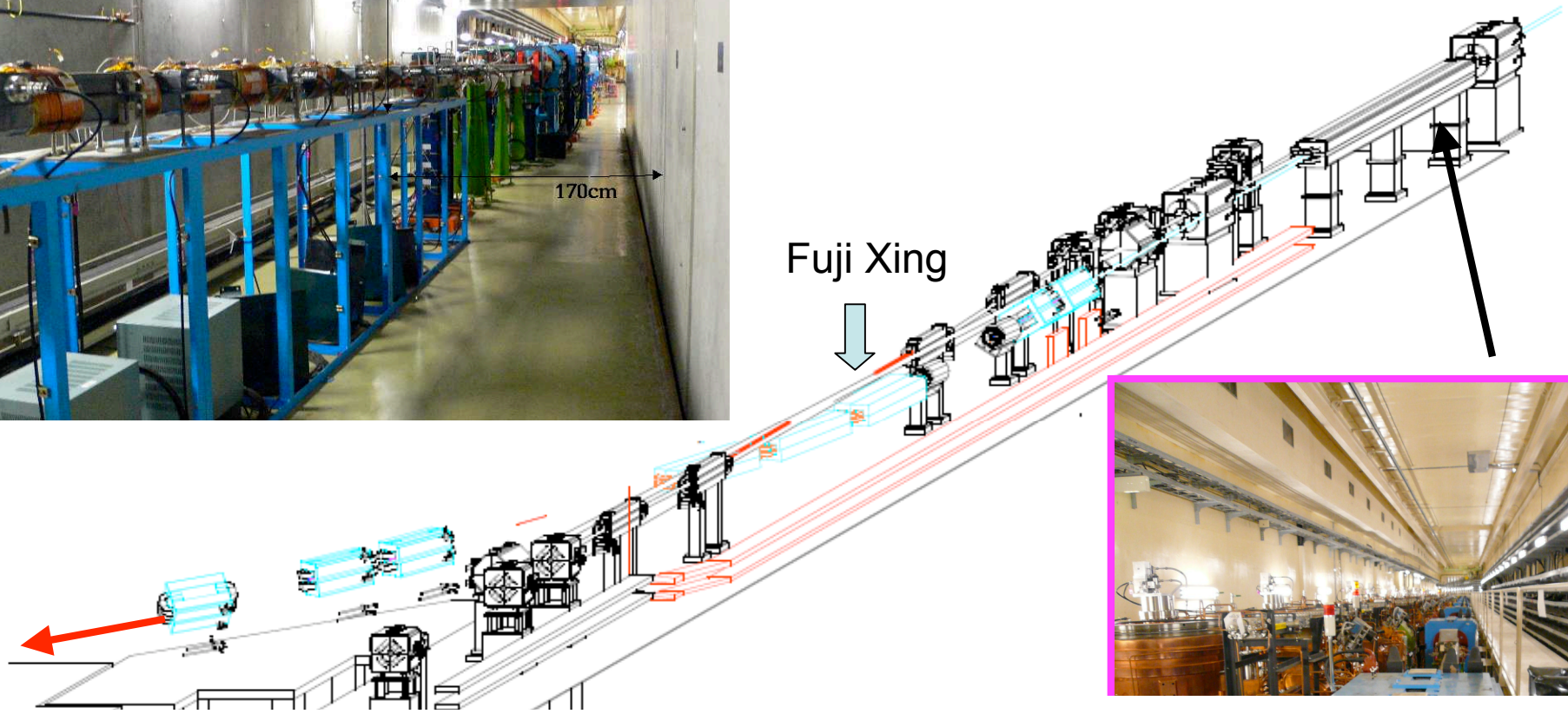
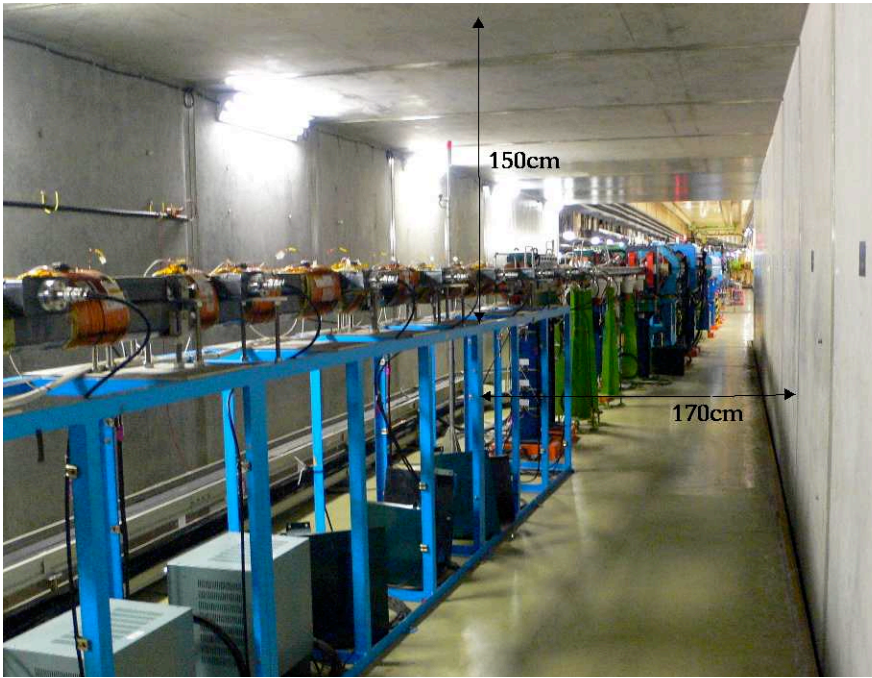
← Straight section
(100m)



Converted particles are extracted to outside of KEKB tunnel

Bending Magnet

**←
Straight section
(100m)**



Extraction line components

- **Aperture**

- **Bend** **Width 80mm (+sagitta 40mm)/ Height 40mm**
- **Q1,2I** $\varnothing 50$
- **Q13,4I** $\varnothing 166$ **LER spare**
- **Shield hole** $\varnothing 100$

- **Beam Line Parameters...**

<u>Bend</u>	<u>type</u>	<u>B(T)</u>	<u>L(cm)</u>	<u>PS</u>	<u>W</u>	
- B1L B1S	wiggler L+S	1.2	100+50	A	3400/2000	
- B2	BT model	1.2	160	B		new
- B3	BT model	1.2	160	B		new
- B4	BT model	1.2	160	B		new
- B5, 6, 7	wiggler L	1.2	100x2	A	3400 each	
<u>Quad</u>	<u>Max B</u>	<u>Max I</u>	<u>L(m)</u>	<u>Bore(m)</u>	<u>PS</u>	<u>W</u>
- Q1	16 T/m	50 A	0.525	0.052	C	390 kg
- Q2	16	50	0.525	0.052	C	390
- Q3	40.359	-0.276	0.584	0.166	A	2070
- Q4	27.505	0.317	0.584	0.166	B	2070

- **PS (Power supply)**

- **Type A: Beam channel 300A55V**
- **Type B: Beam channel 500A33V**
- **Type C: KEKB Vac. Group 60A 35V**

Delivered Beam

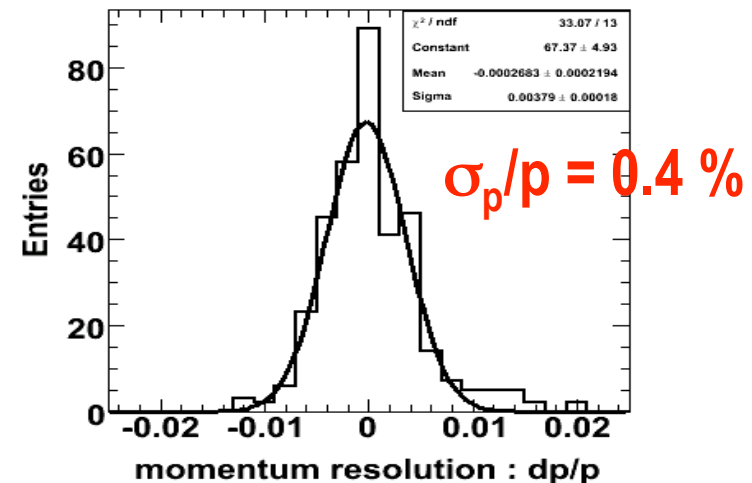
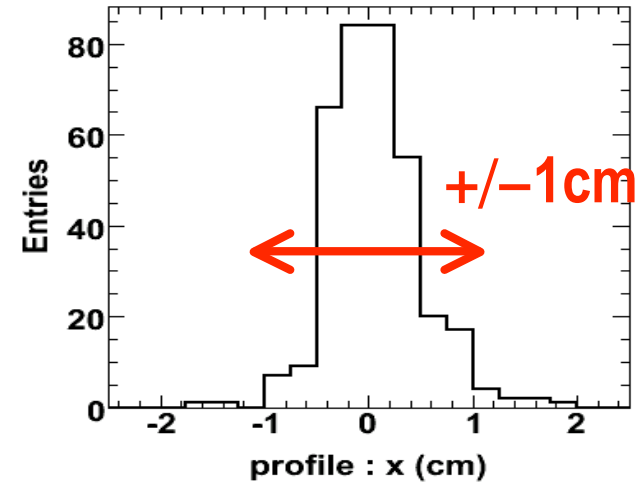
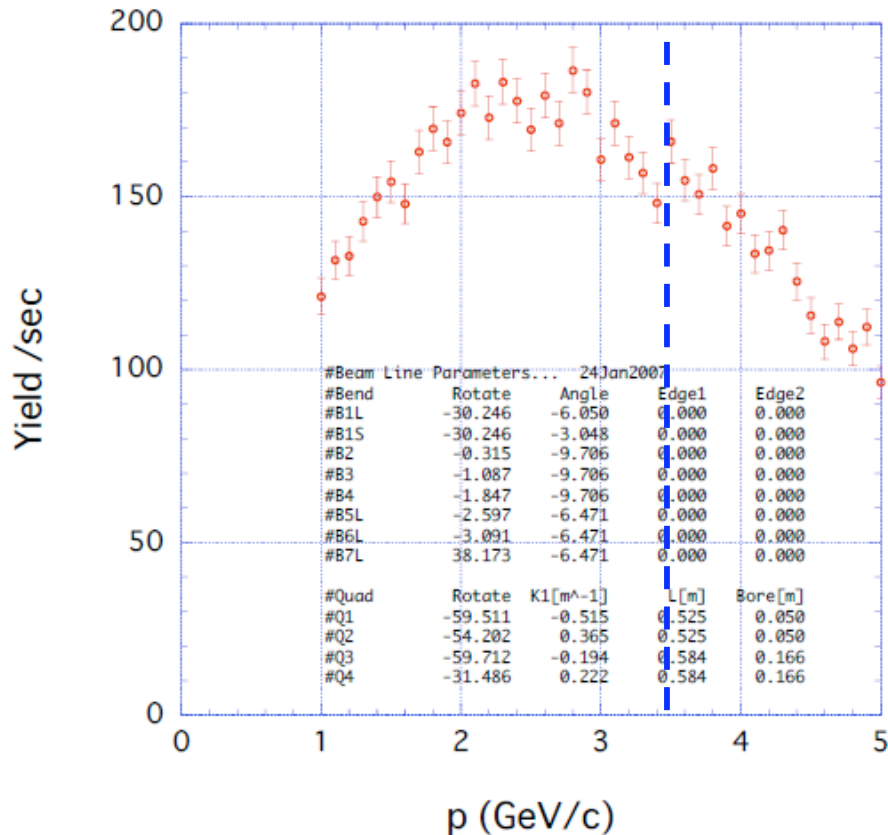
“SAD” simulation
by A. Morita (KEKB)

~200 electrons/sec (DC)

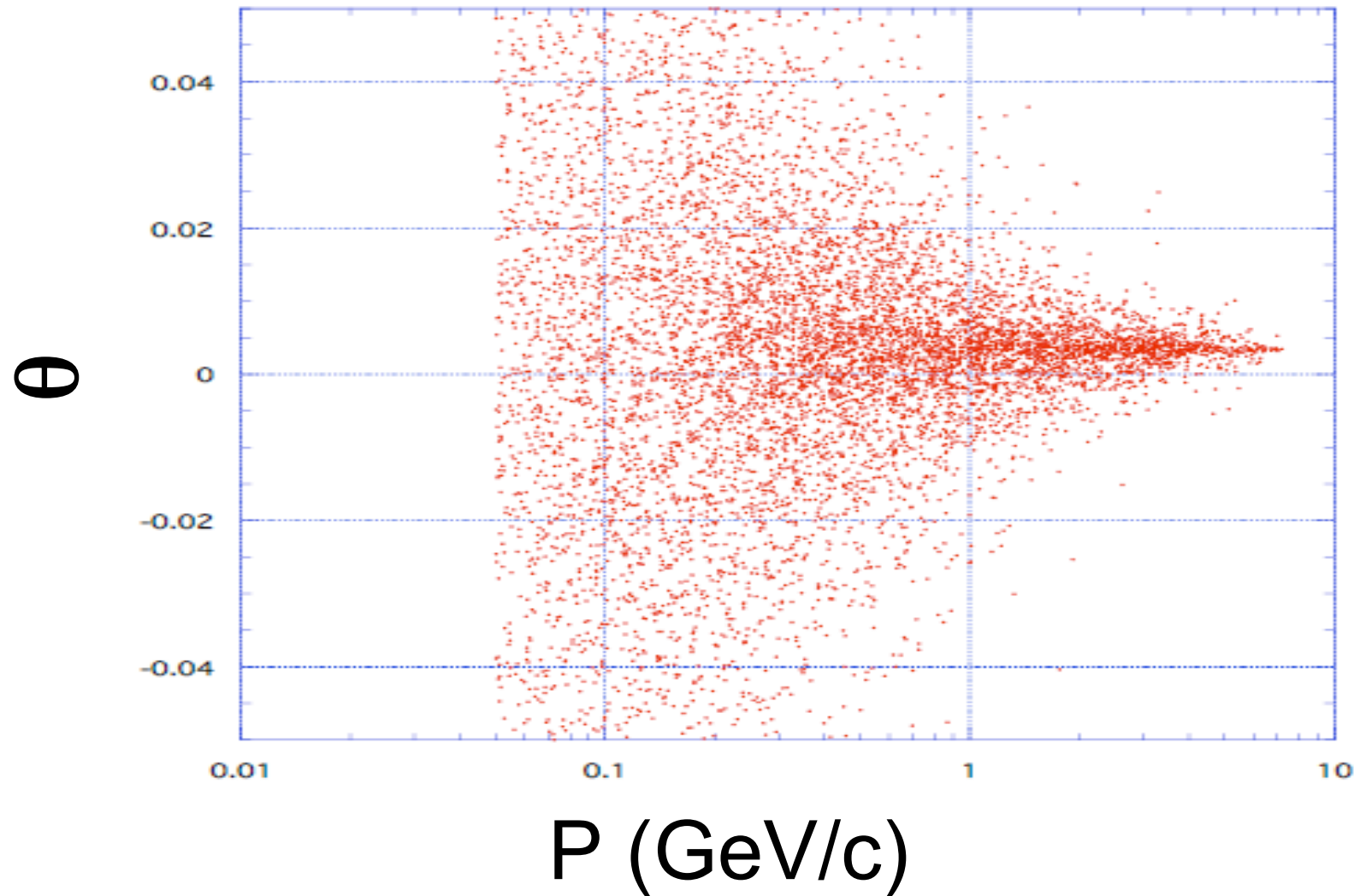
$p = 0.5 \sim 3.4$ GeV/c

$\sigma_p/p \sim 0.4\%$

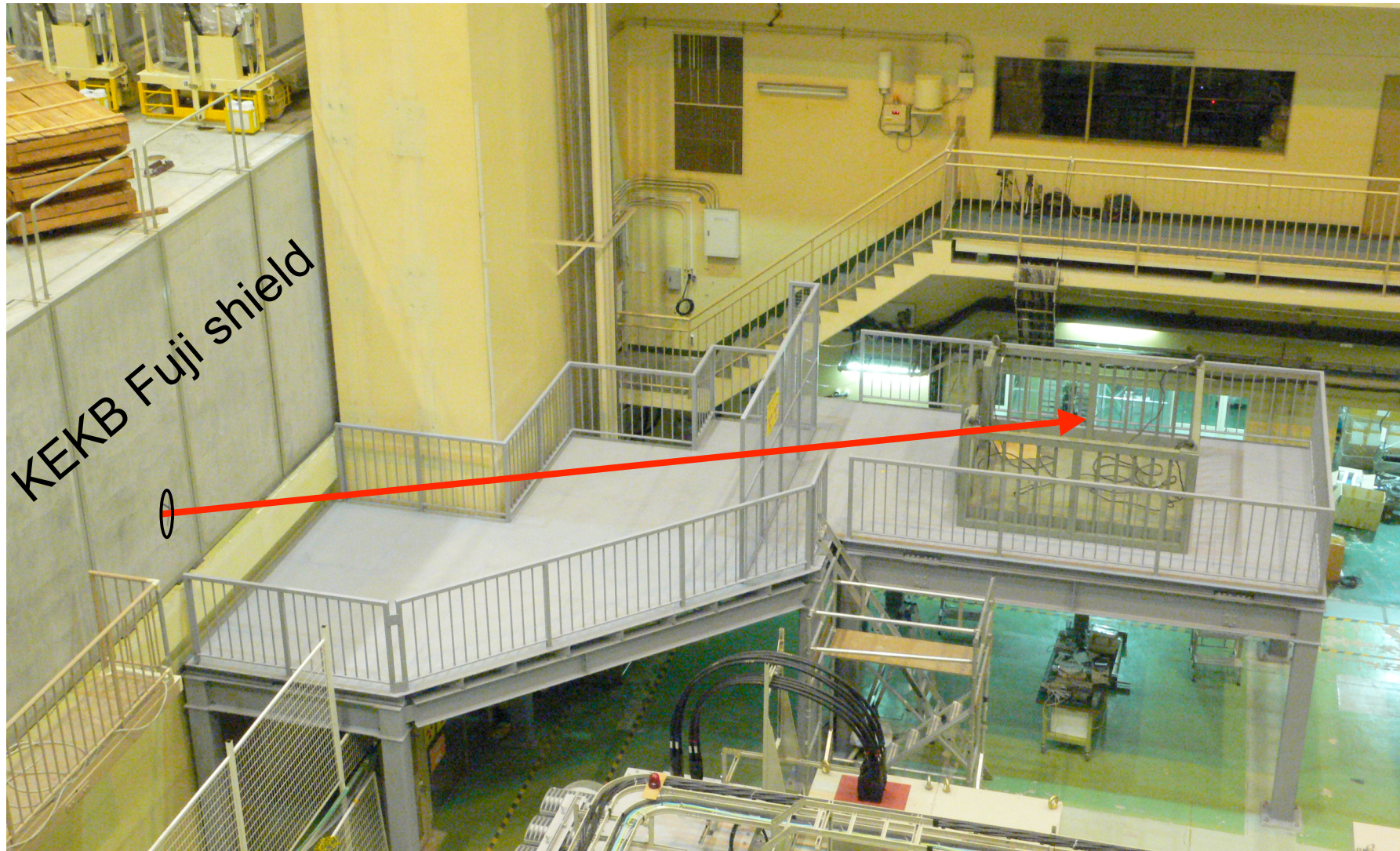
spot size ± 1 cm



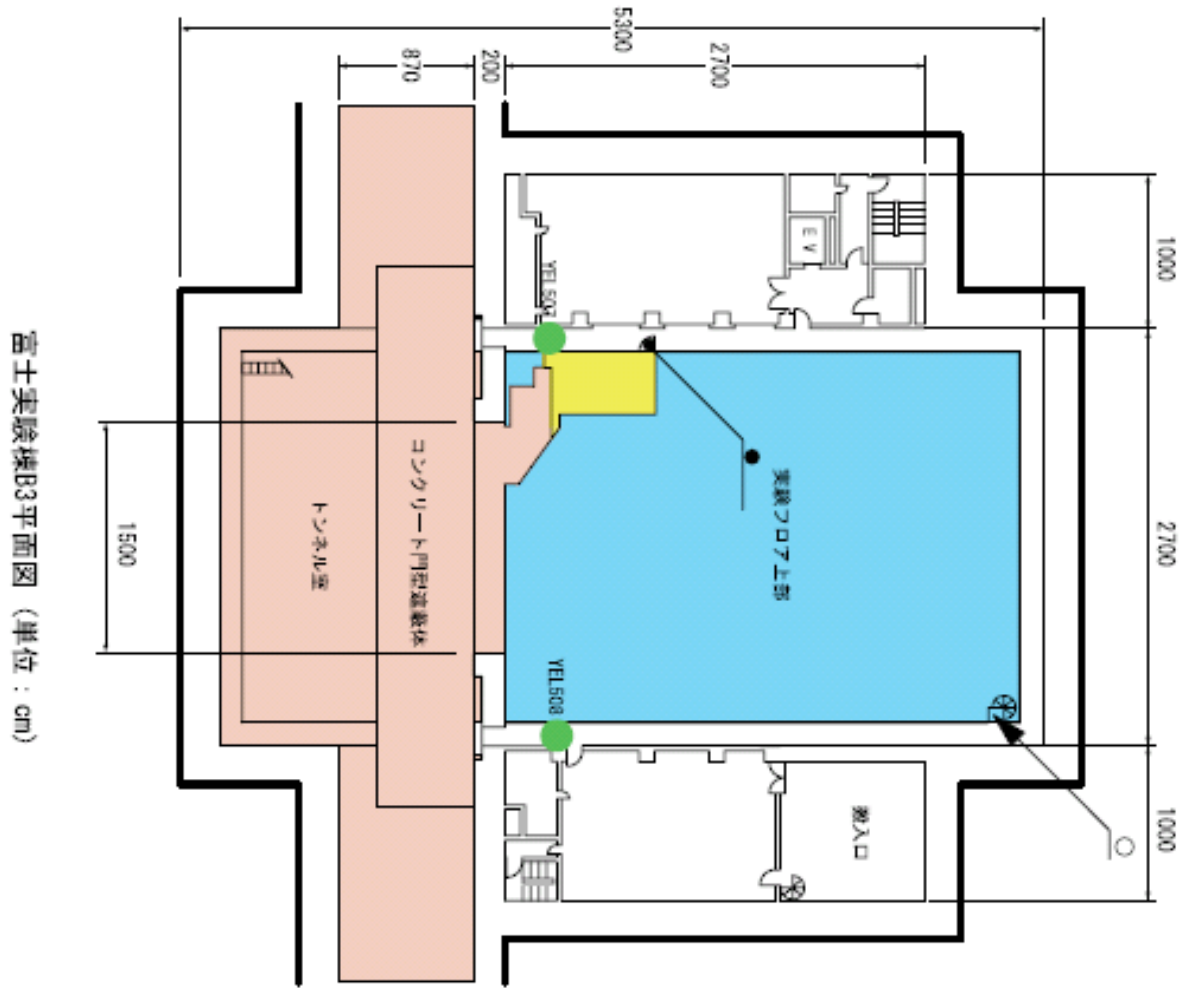
Angular dispersion after converter



Beam line stage constructed in Fuji hall



Radiation restricted area

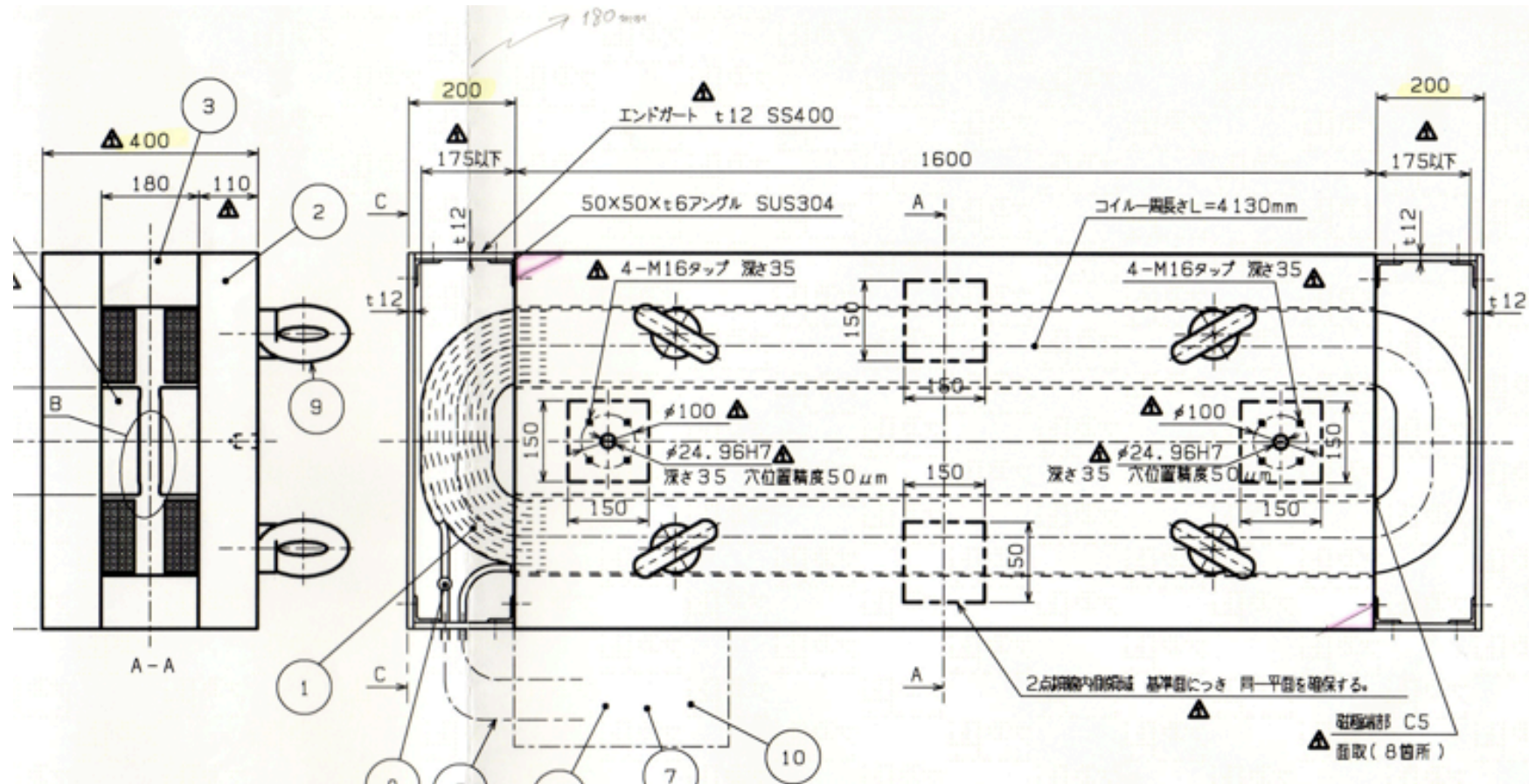


Components collected everywhere



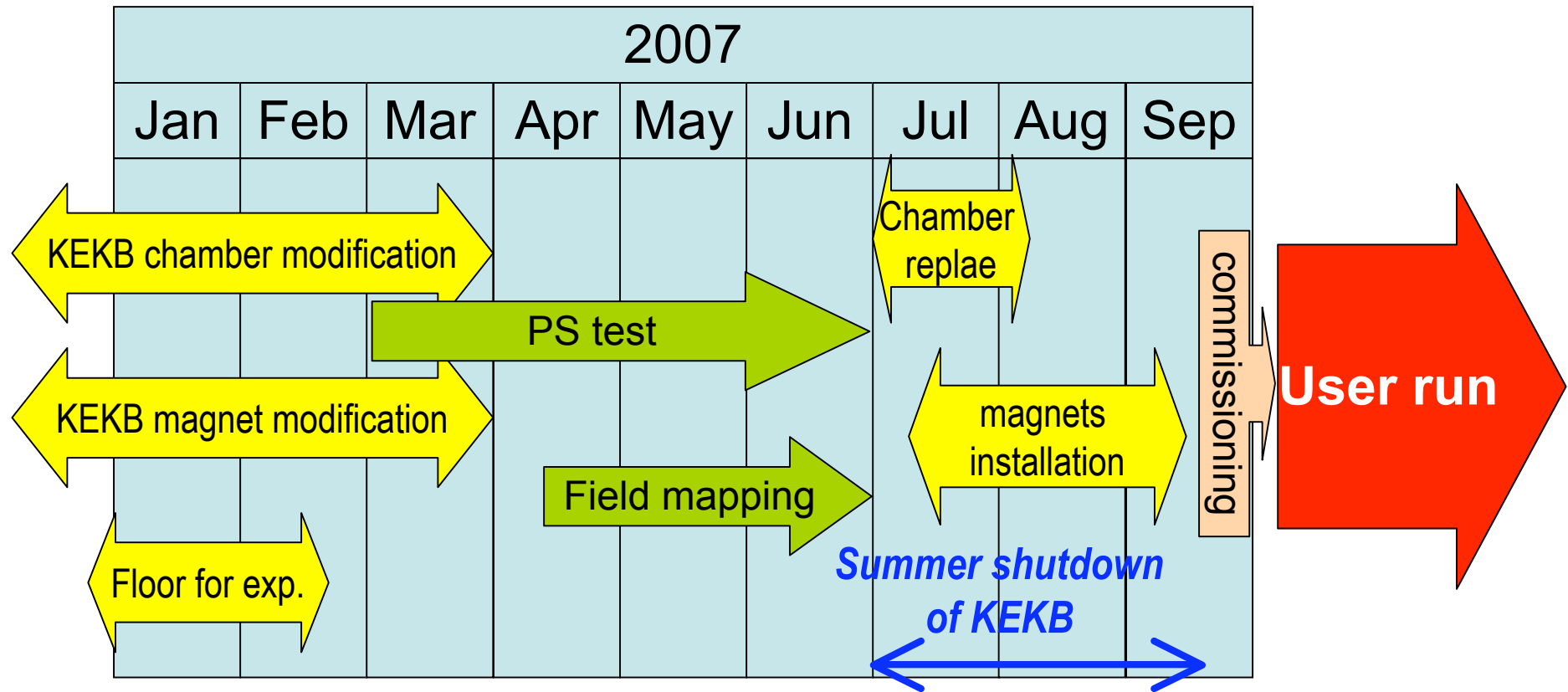
Most of the magnets,
all the power-supplies
and the beam shutter are
recycled from
the past experiments

Three new compact magnets to be installed under Xing



Designed by Egawa

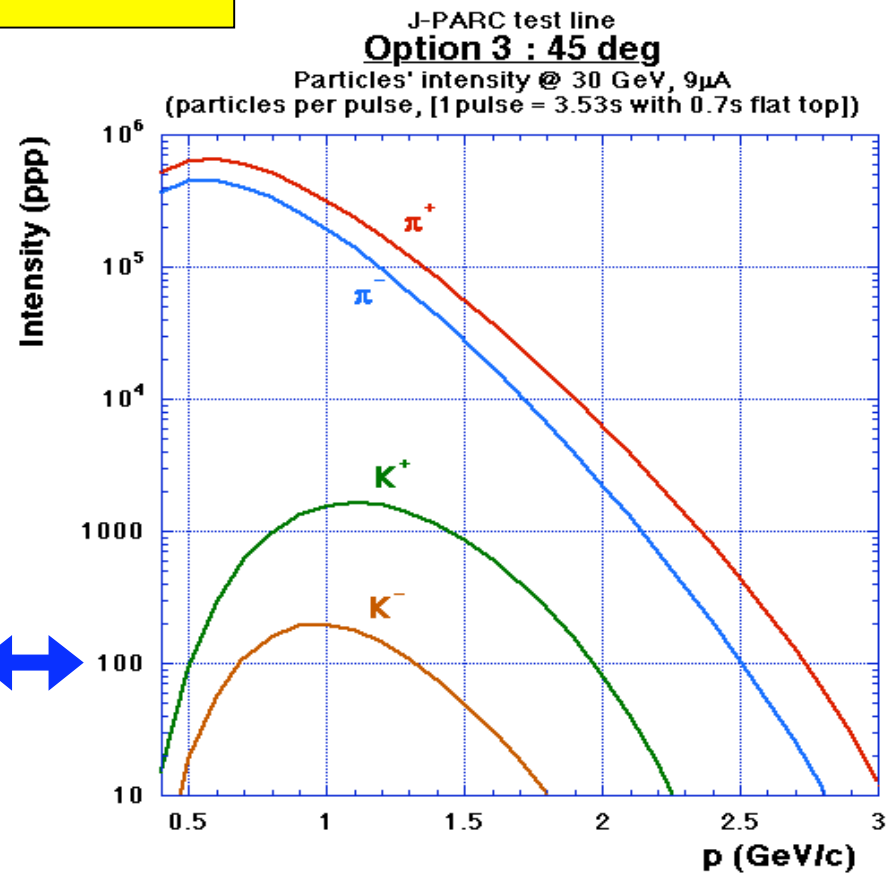
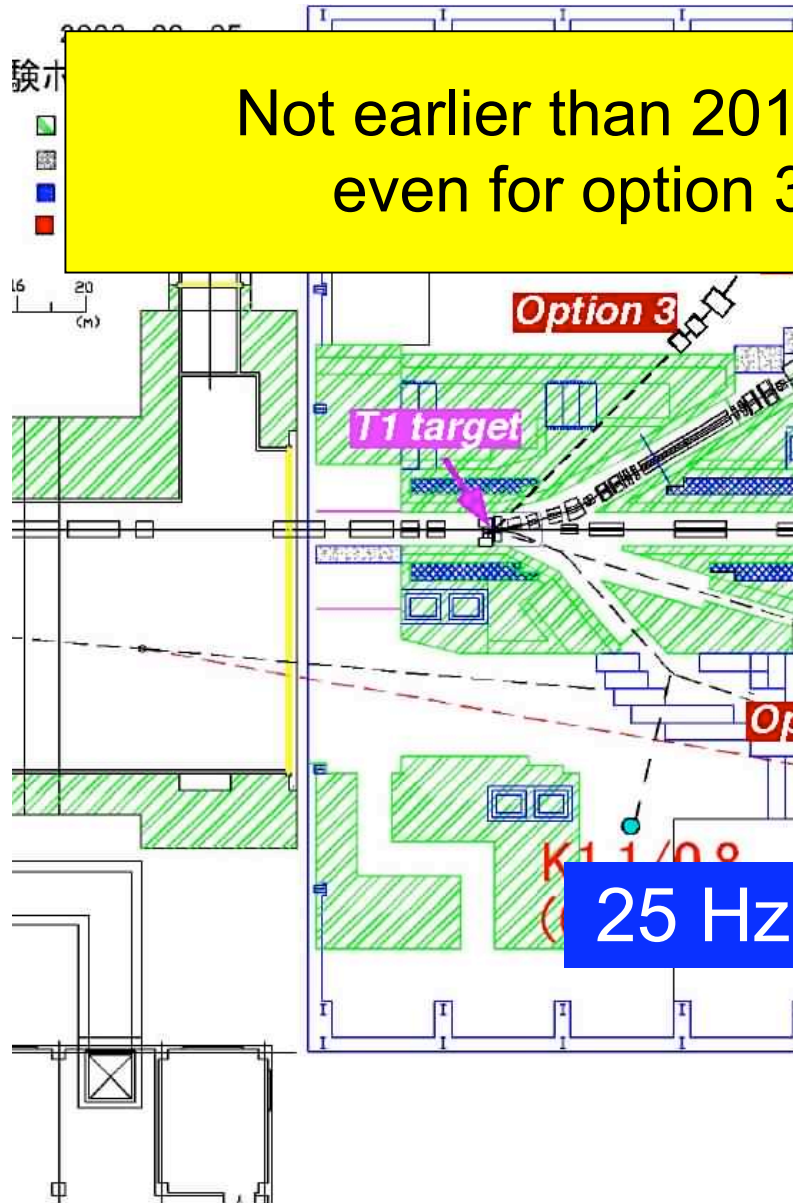
Fuji Test Beam Line : Schedule



Run time ↔ KEKB operation

J-PARC Test Beam Line (Phase-1)

Not earlier than 2010 ~,
even for option 3.



Summary

- New Test Beam Facility in KEK,
“Fuji Test Beam Line (FTBL)”,
will deliver a beam **from Sep 2007**
- Electron (positron) beam
Rate ~ 200 Hz (continuous, no bunch structure)
 $p = 0.5 \sim 3.4$ GeV/c, $dp/p = 0.4\%$

*Conversion of bremsstrahlung photon without
any performance degradation in KEKB*



Backup

フォトン数見積もり

$$N_{\gamma} = \frac{d}{X_0} \left[\frac{4}{3} \ln \left(\frac{k_{\max}}{k_{\min}} \right) - \frac{4(k_{\max} - k_{\min})}{3E} + \frac{(k_{\max} - k_{\min})^2}{2E^2} \right]$$

$$\frac{d}{X_0} = \frac{12.5 \text{ g/cm}^2 \cdot p(\text{atm})}{36 \text{ g/cm}^2} \approx 1 \times 10^{-13}$$

for residual gas of CO @ $p = 3 \times 10^{-8} \text{ Pa} = 3 \times 10^{-13} \text{ atm}$
in 100 m long straight section.

$$N_{\gamma} = 2 \times 10^{-13} / \text{electron (1~8 GeV/c)}$$

$$N_{\text{electron}}(\text{HER}=1.3\text{A}) = 8.1 \times 10^{18} \text{ (1/sec)}$$

$$\underline{\text{フォトン数}} = \underline{1.6 \times 10^6 / \text{秒}}$$

電子数の見積もり

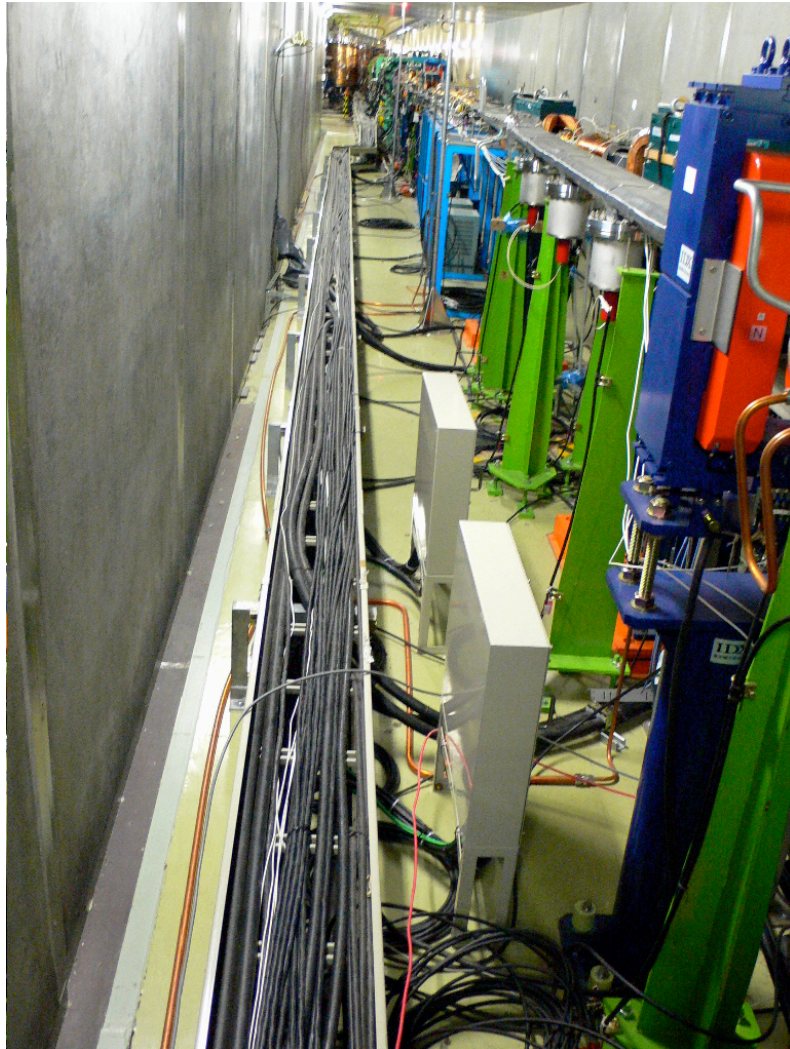
- * ビームパイプ取り出し窓厚さ(銅: 3 radiation length を仮定)これによるコンバージョンロスは、

- $$X_c = \frac{9}{7}(X_o) \quad \text{より、} 3.0 / (9 / 7) = 2.33 \text{ conversion length}$$

$$N_\gamma (NC) = N_\gamma * \exp(-2.33) = 1.6 \times 10^5 \text{ /秒}$$

TURTLEによるHERビームのシミュレーションにより、Bremsstrahlungの生成、Geant4によりコンバージョン電子の生成を行う。

周辺の現状



ステップ・リフターの設置で
往來に配慮

