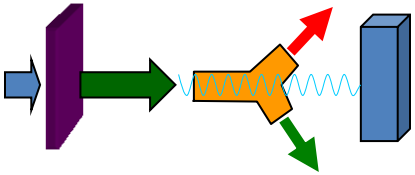


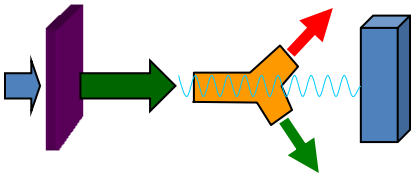
Status of Hybrid target R&D at KEK-LINAC

T.Takahashi

Hiroshima University

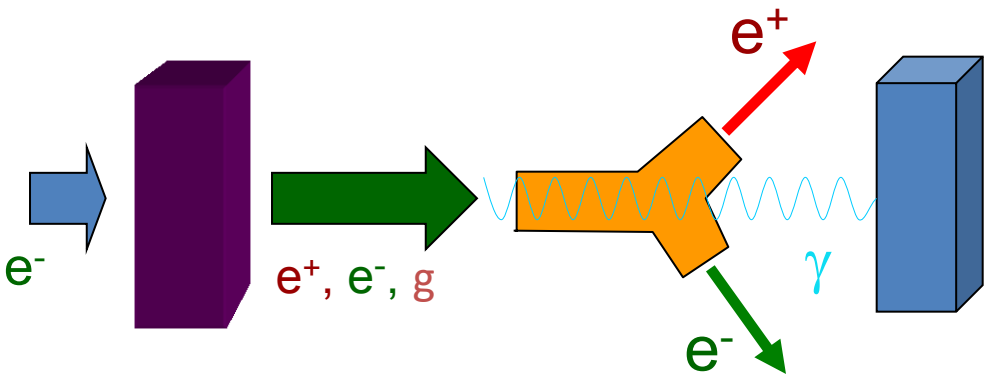
March 2011
ALPG11 Eugene

Collaborators:
V. Strakhovenko O. Dadoun, R. Chehab, A.Variola,
L. Rinolfi, O. Dadoun,T.Kamitani, T.Suwada, T.Omori,
J.Urakawa,K.Furukawa, K.Umemori,M.Satoh,T.Sugimura,
S.Kawada, T.Akagi, Y. Uesugi

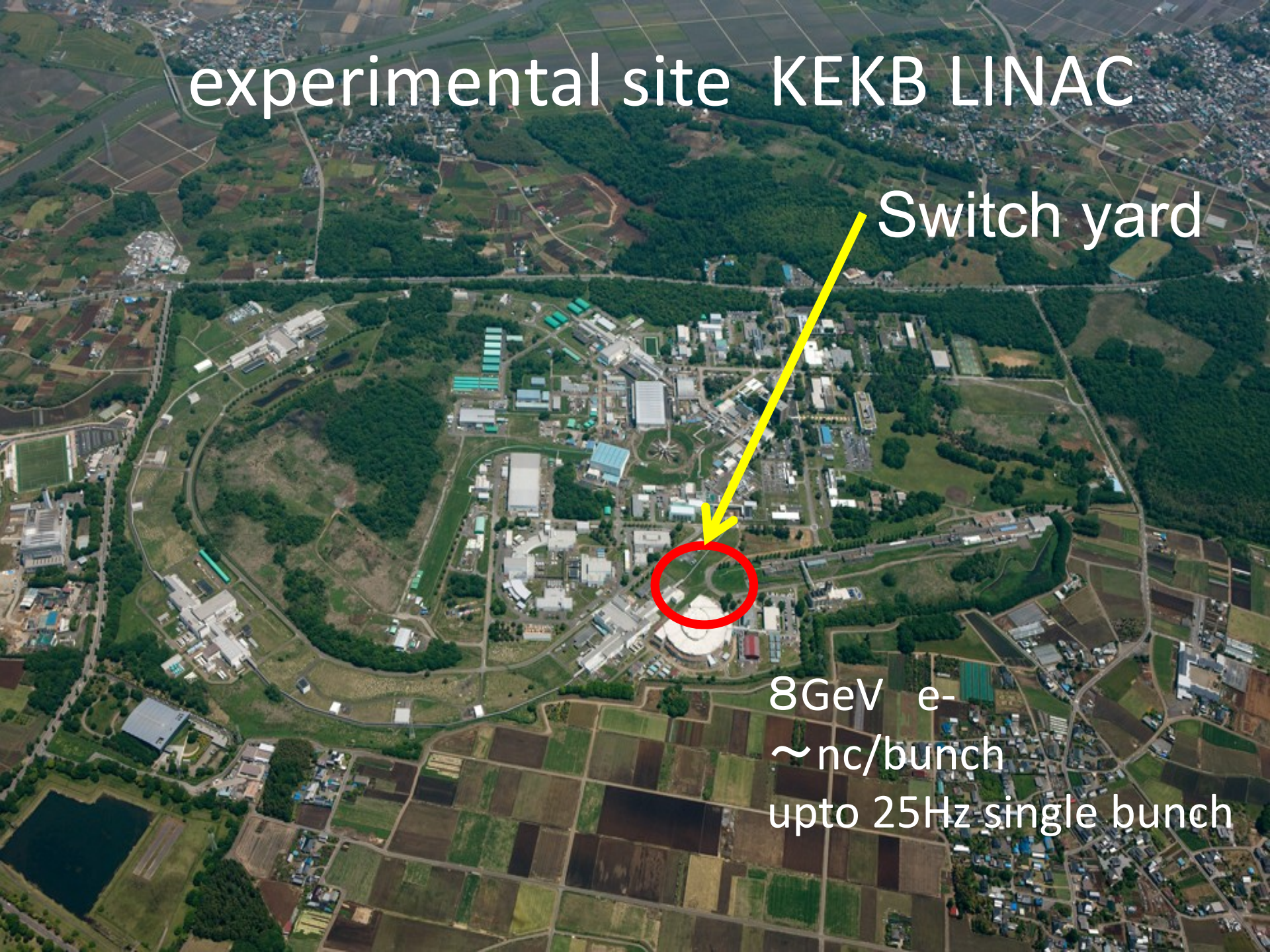


Hybrid target for positron source

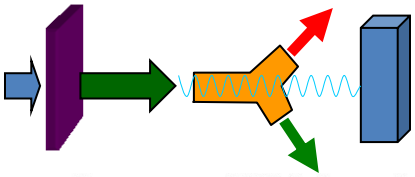
- Chehab, Variola, Strakhovenko Scheme for LC positron sources



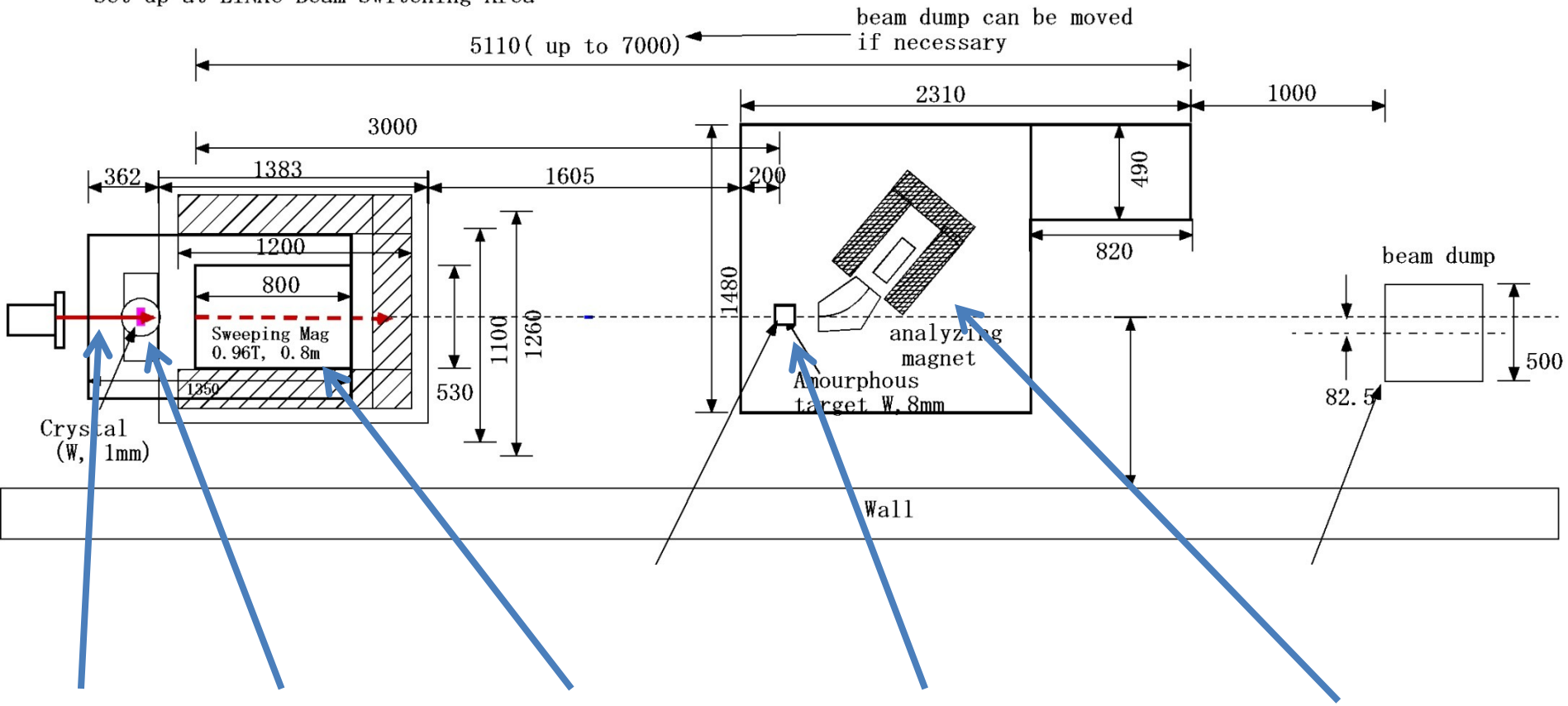
Experimental study for further development


experimental site KEKB LINAC
Switch yard
8GeV e-
～nc/bunch
upto 25Hz single bunch

Setup



Set up at LINAC Beam Switching Area



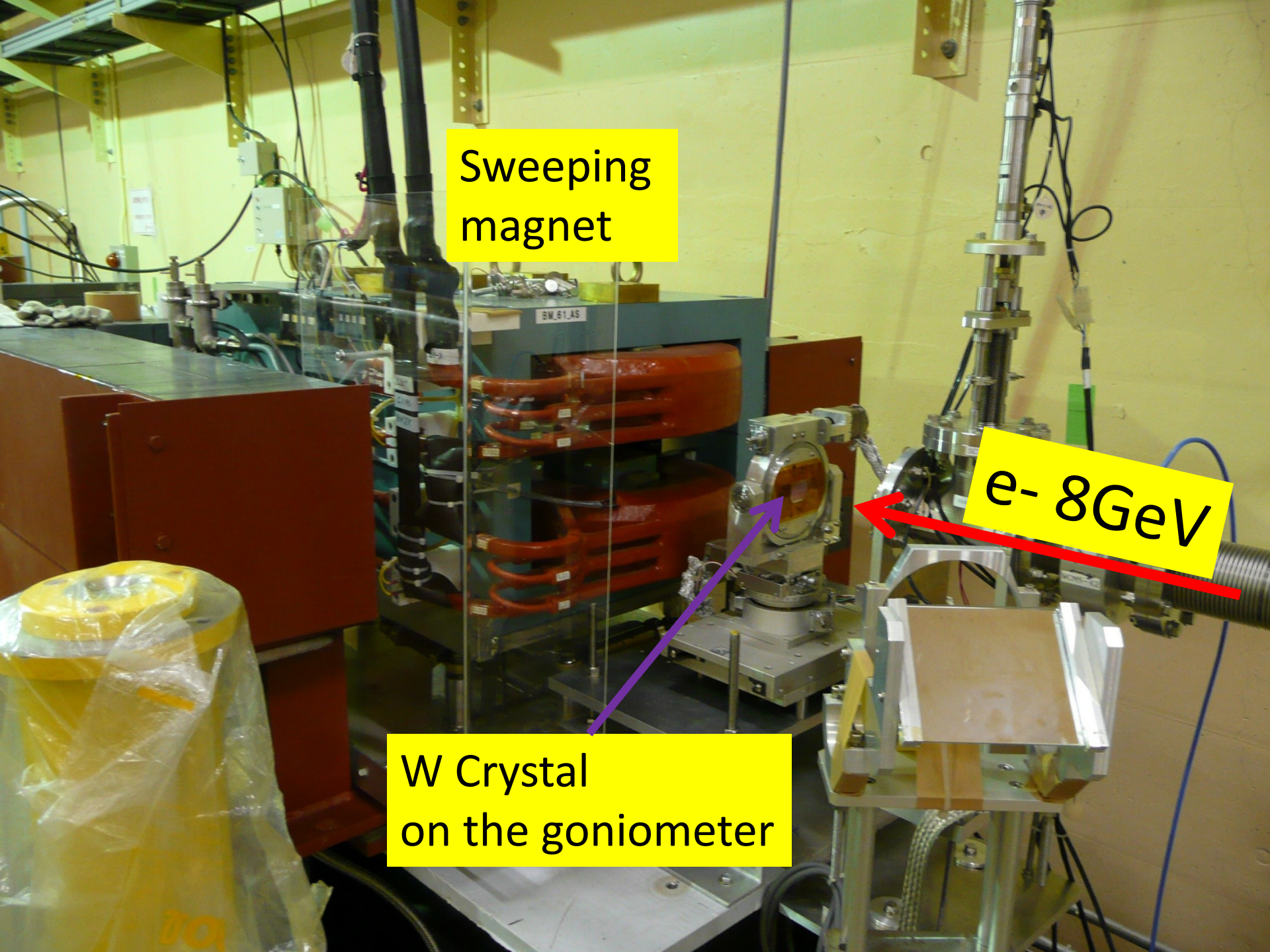
8GeV e-

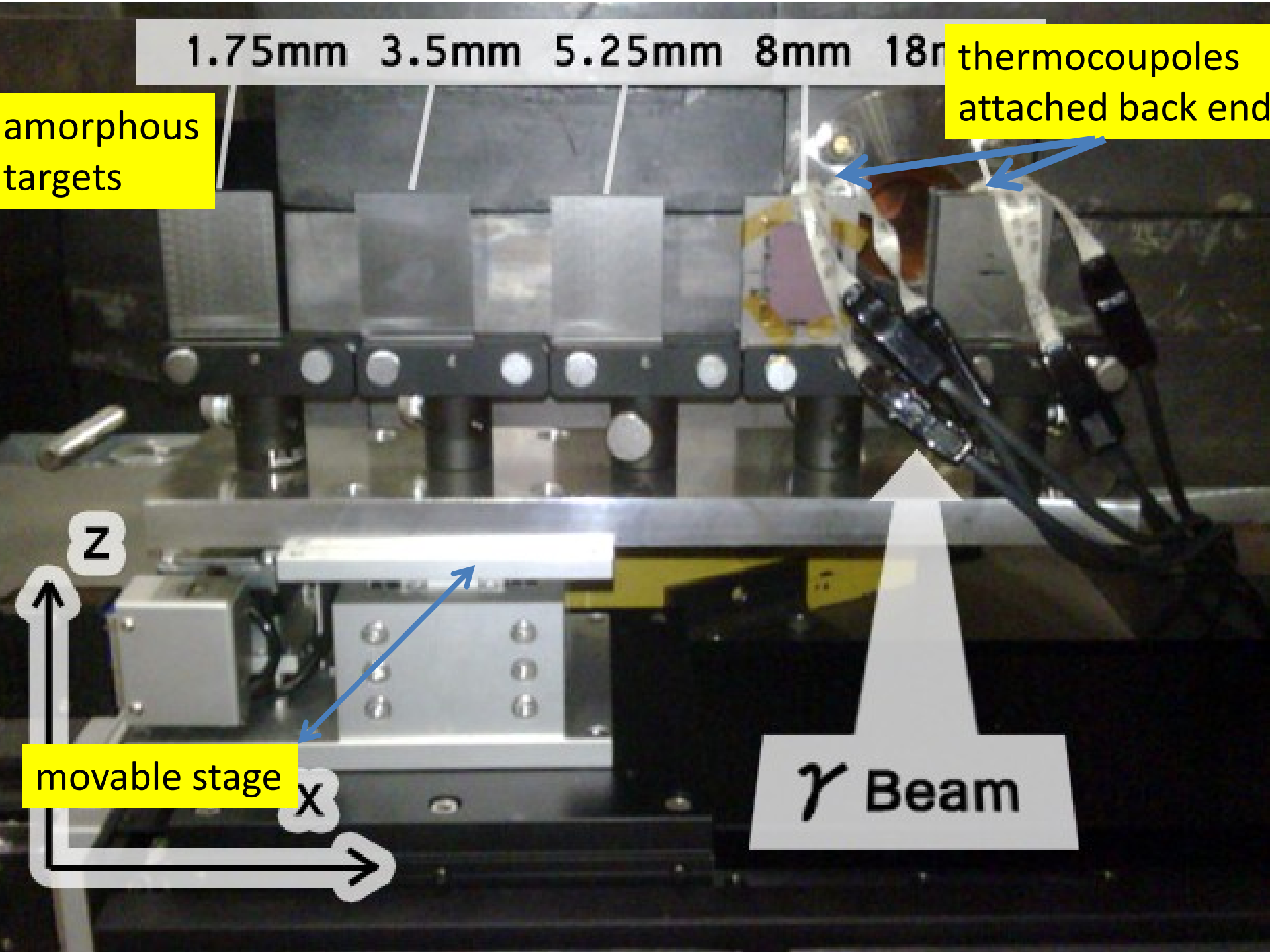
1mm
W crystal

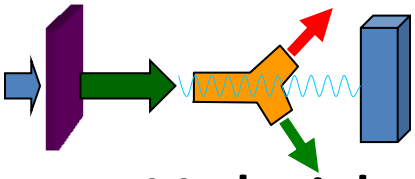
Sweeping Magnet
0.96T 0.75m

amorphous W
8 mm
18 mm

Analyzing magnet
5 ~ 30MeV


Sweeping
magnet
e- 8GeV
W Crystal
on the goniometer

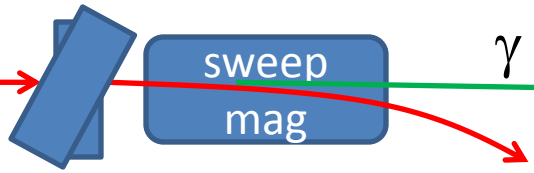

1.75mm 3.5mm 5.25mm 8mm 18r
amorphous targets
thermocoupoles attached back end
z
x
movable stage
γ Beam



The data

- Hybrid

e 8GeV



γ

1mm W Crystal
on axis (aligned to the beam)
off axis (not aligned to the beam)

- Conventional

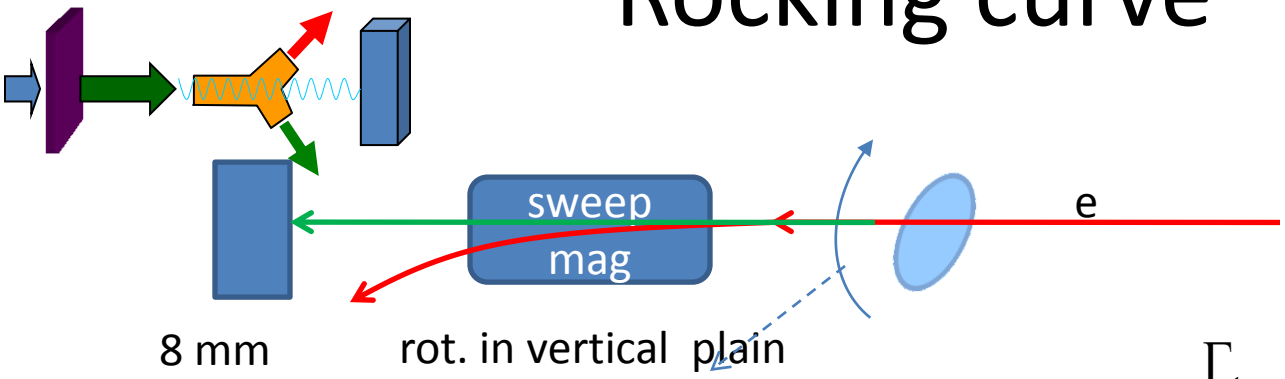
e 8GeV

amorphous W
1.75, 3.5, 5.25, 8, 18mm

positrons from the target momentum analyzed

temperature at the end of the targets by thermocouples and infrared camera

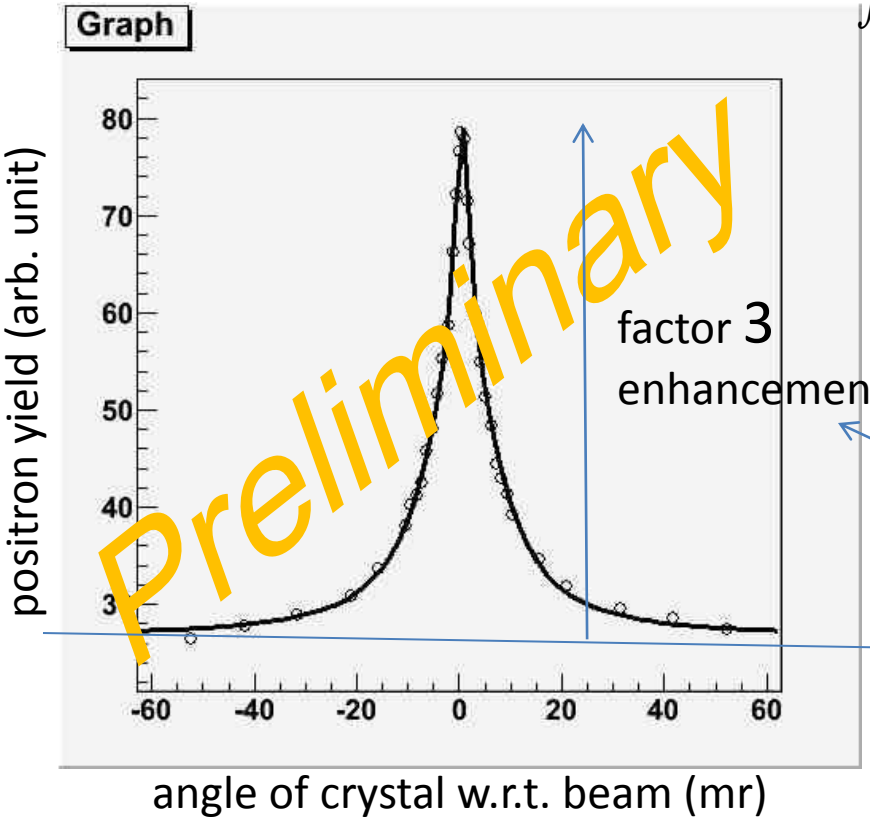
Rocking curve



$$f(\theta) = A\frac{\Gamma_1}{\left(\theta - \langle\theta\rangle\right)^2 + \Gamma_1^2} + B\frac{\Gamma_2}{\left(\theta - \langle\theta\rangle\right)^2 + \Gamma_2^2} + Const$$

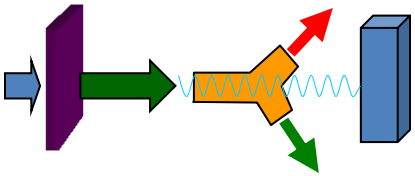
$$\Gamma_1 = 3.4 \pm 0.1$$

$$\Gamma_2 = 17.7 \pm 0.4$$

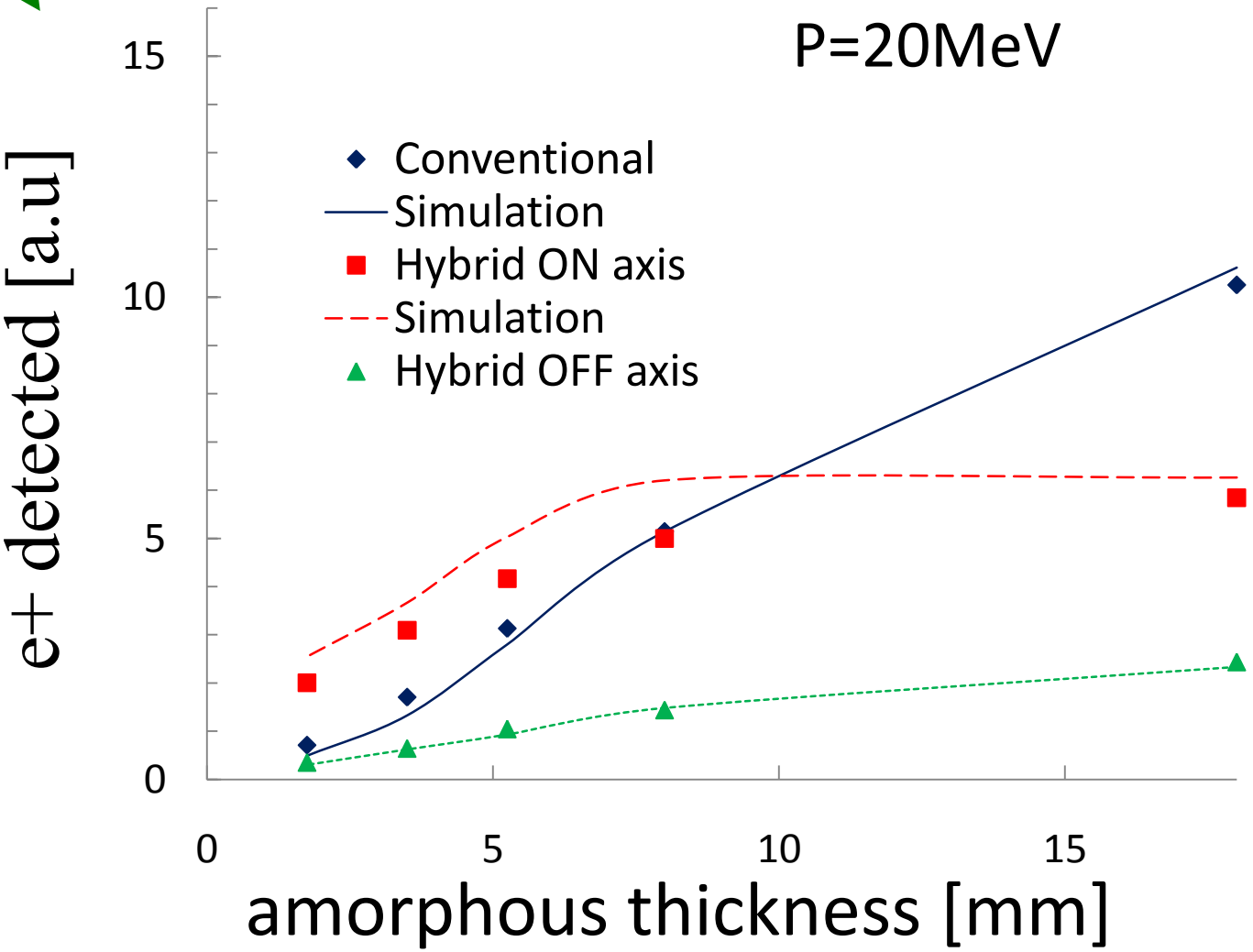


it was 1.2 in 2009 Sep data
we found the detector was
saturated in previous exp.

same for horizontal rotation

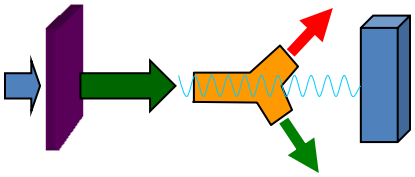


e+ yield



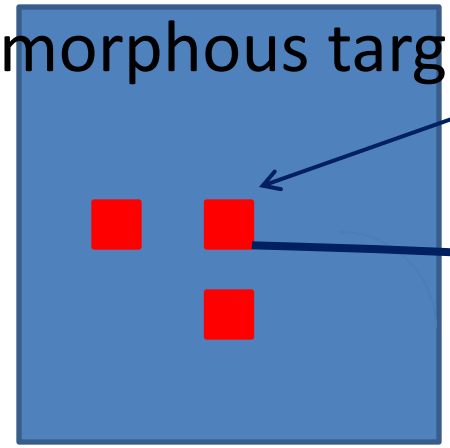
simulation and data normalized at 8mm

need to correct acceptance for precise analysis



Temperature measurement w/ thermocouples

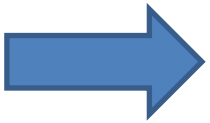
back plane of amorphous target



thermocouple approximately 1mm x 1mm

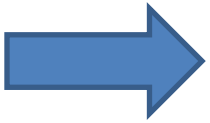
to fast data logger read temperature each 10ms

temperature at equilibrium

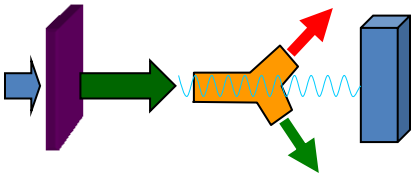


total energy deposit

bunch by bunch temperature variation

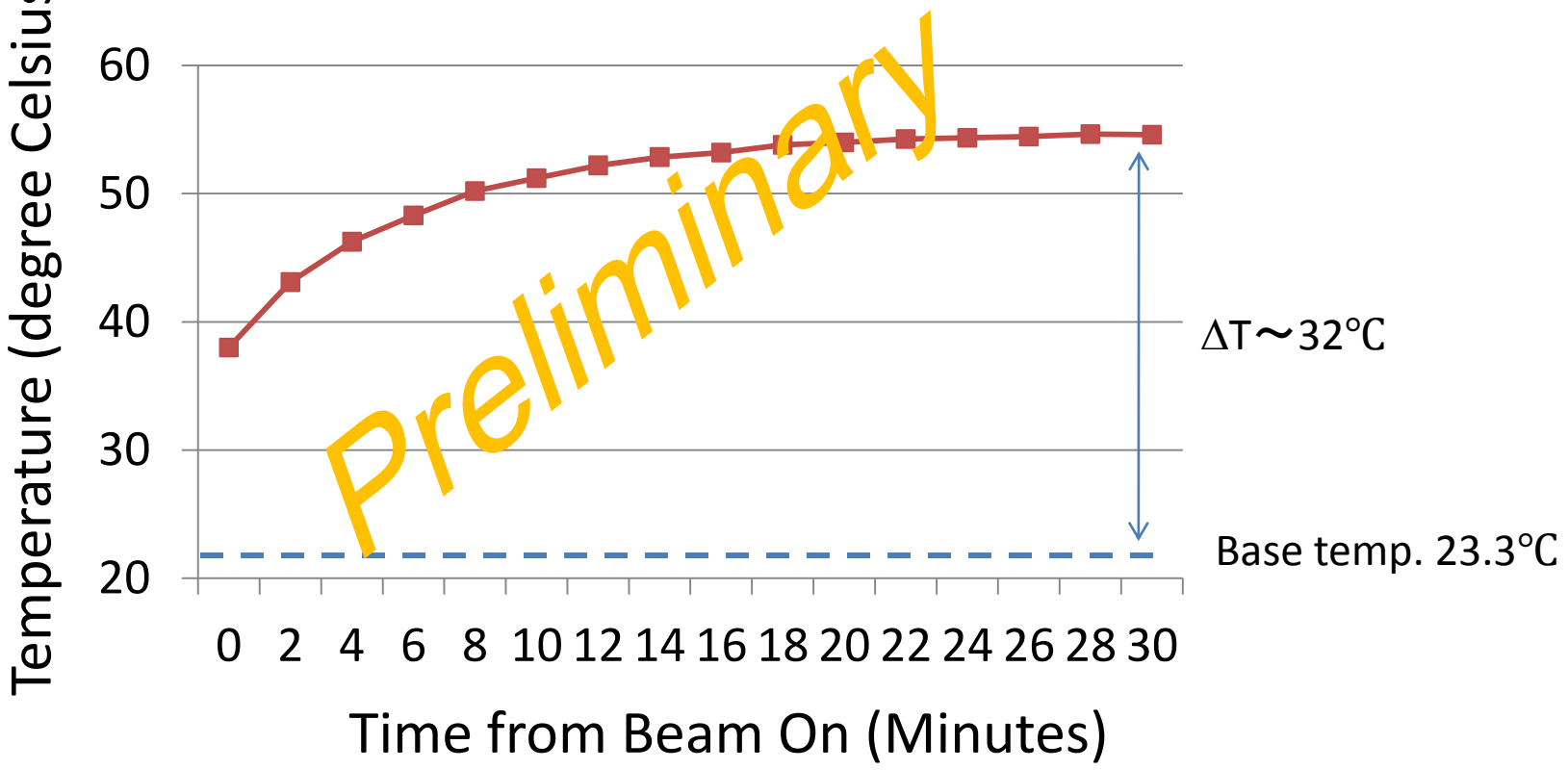


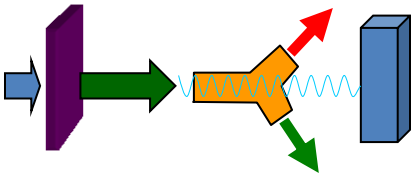
PEDD information by thermocouple



Example of Temperature Measurement

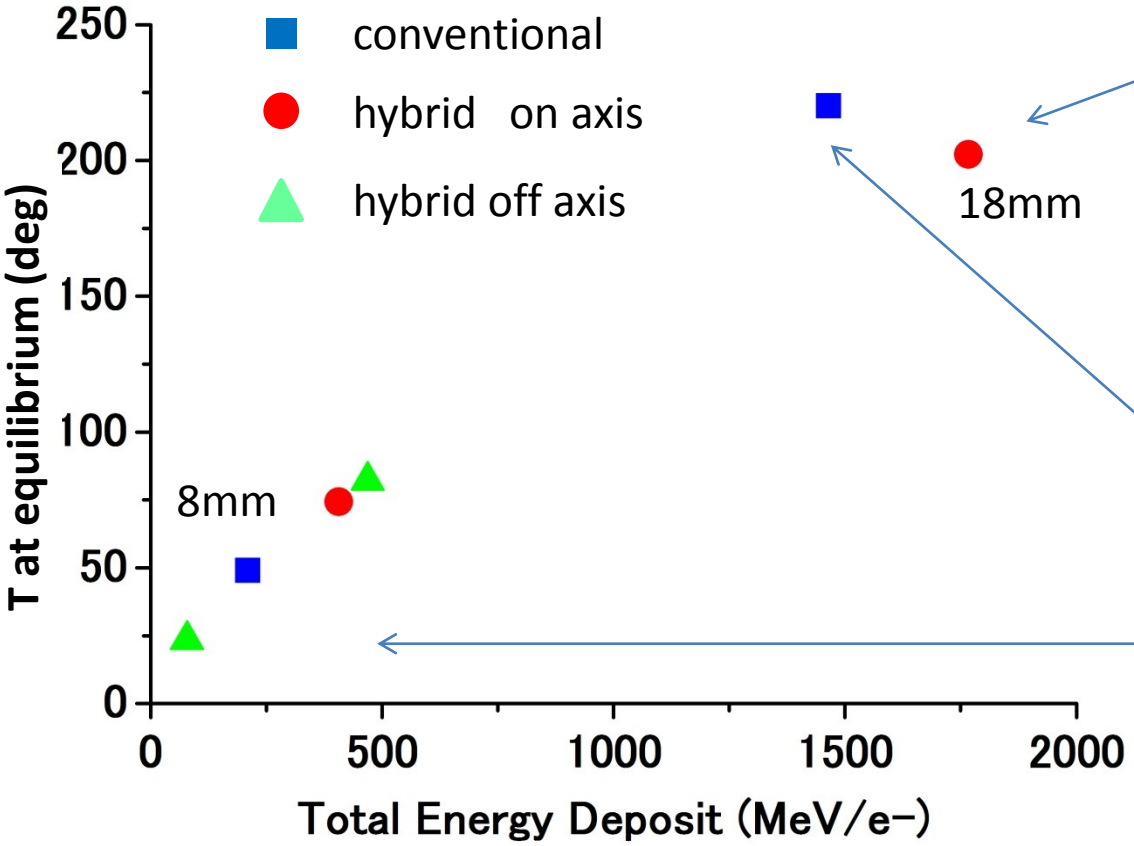
Temperature of the 8mm amorphous target for the hybrid case



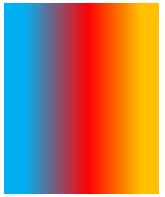


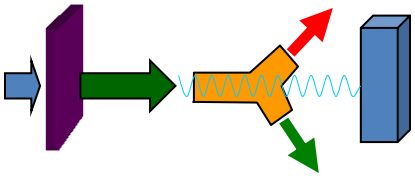
T vs total energy deposit

T at equilibrium has information for
total energy deposit except for 18mm hybrid



target is thicker than shower max

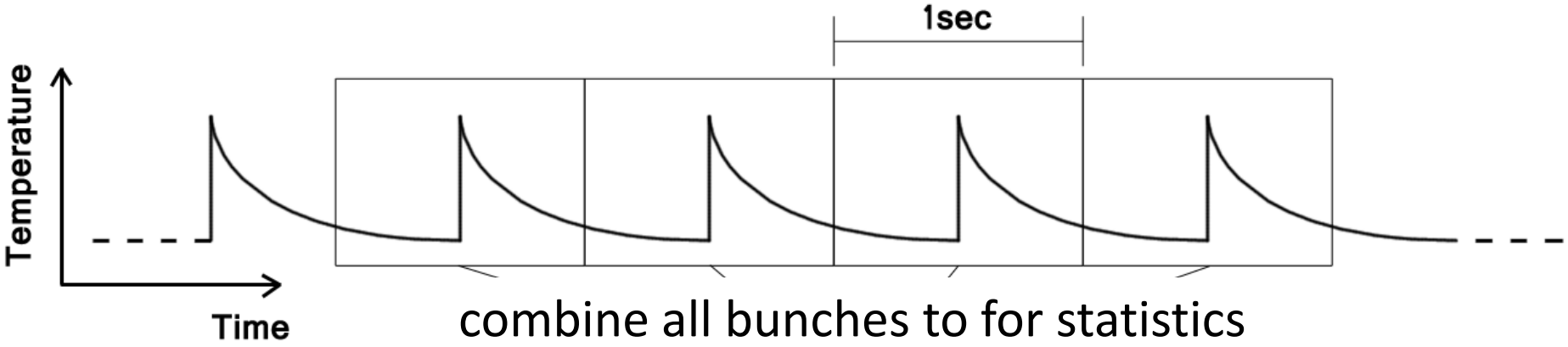




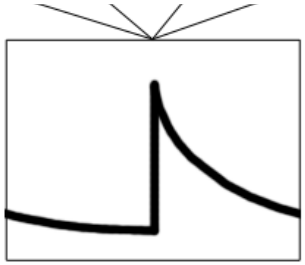
bunch by bunch temperature rise

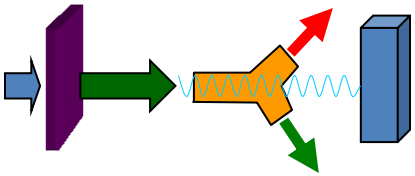
- bunch repetition 1Hz

~ 60 pulses for one data set

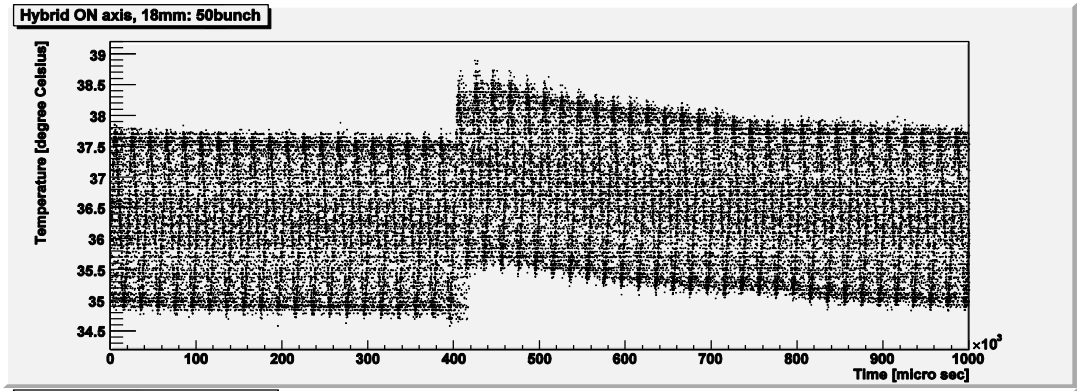


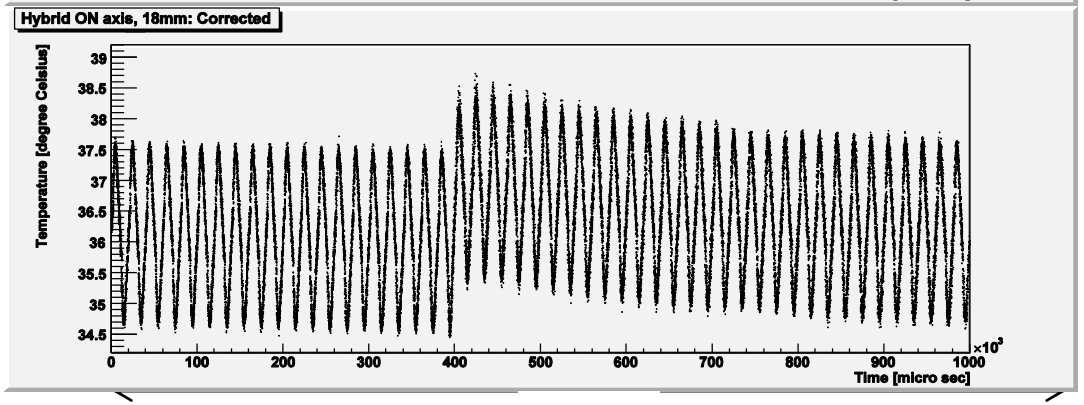
combine all bunches to for statistics



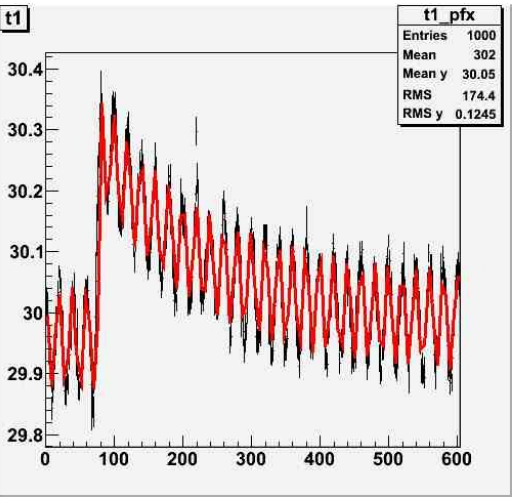


time , base T. adjustment

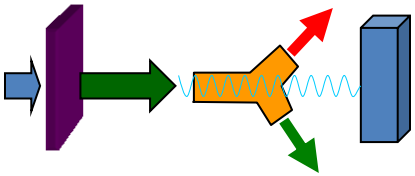




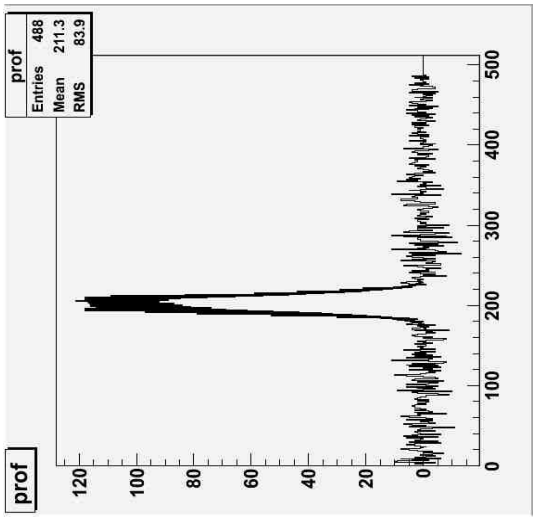
1sec

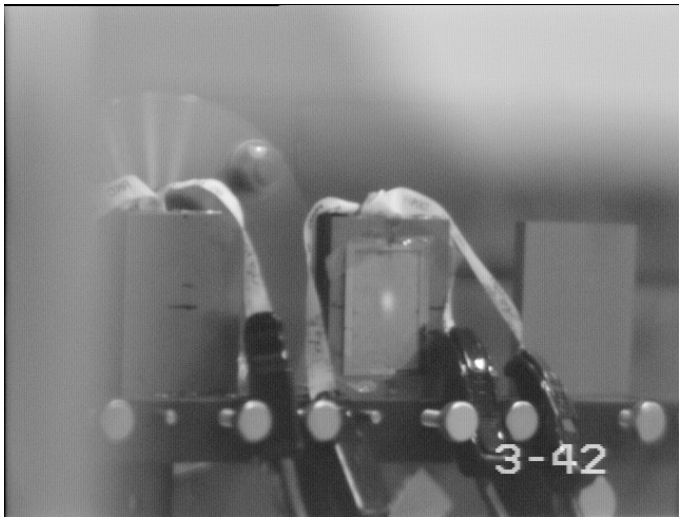


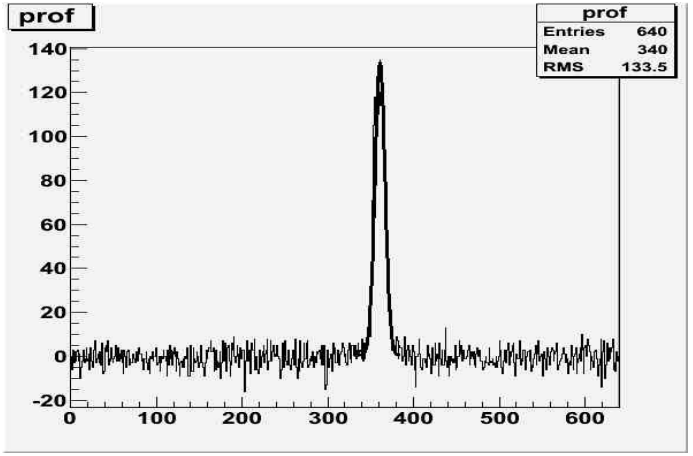
$$T(t) = T_0 + ae^{-(t+\delta-t_0)/\tau_1}\left(1-e^{-(t+\delta-t_0)/\tau_2}\right)$$
$$+b\sin(2\pi f(t+\delta))$$



Beam profile on amorphous

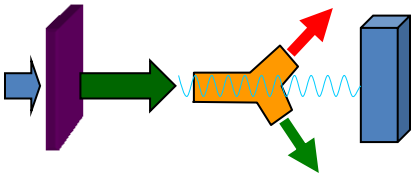






σx=2.0mm

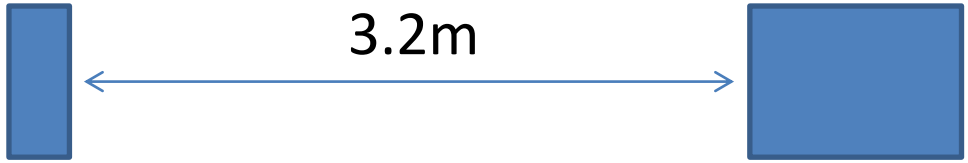
σy=2.3 mm

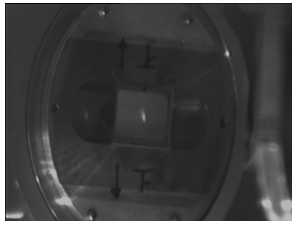


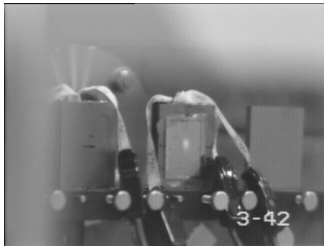
beam profiles

crystal

amorphous





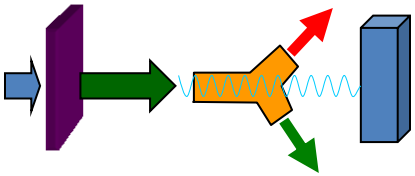


σx=0.42mm
σy=1.54mm

σx=2.0mm
σy=2.3 mm

beam divergence
θx～0.5mr
θy～0.24mr

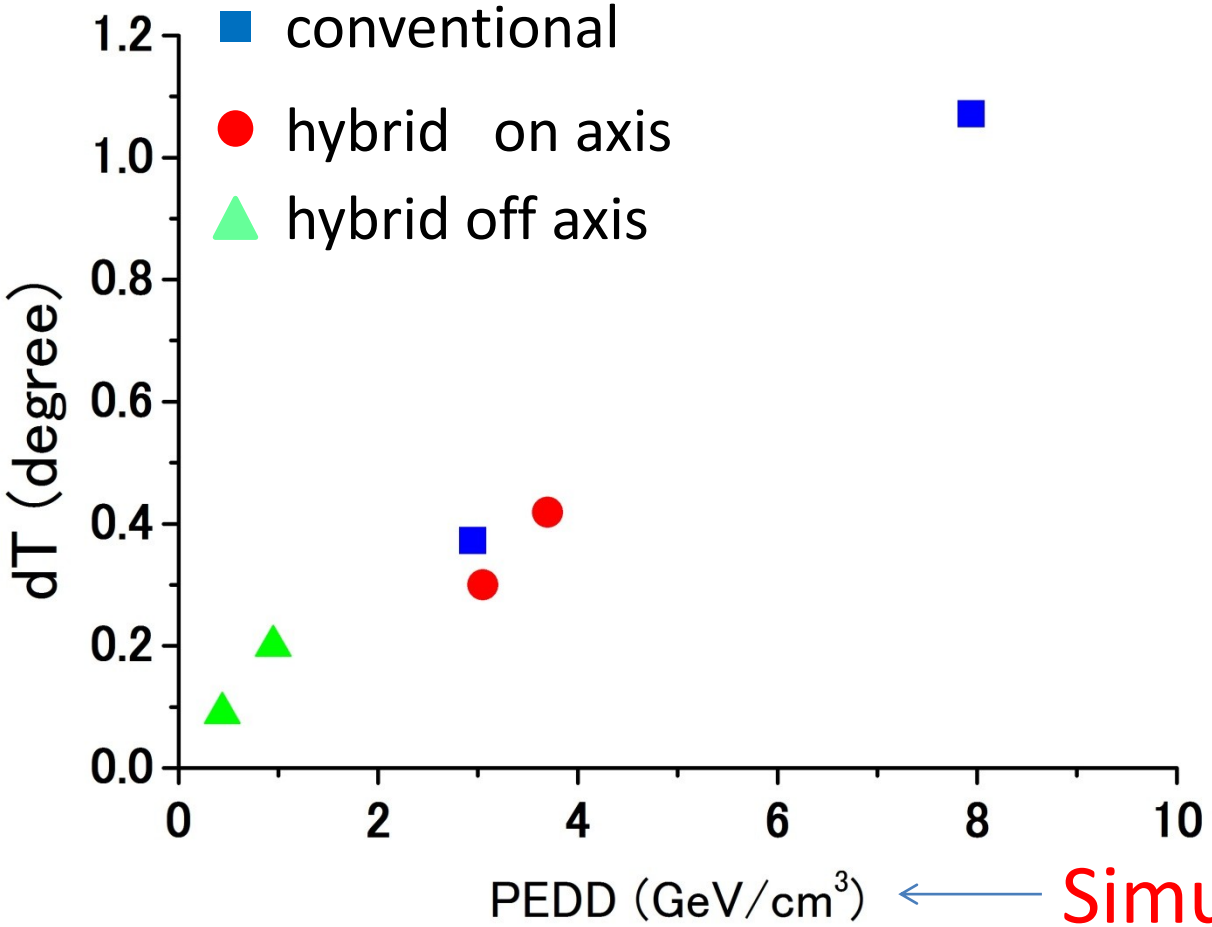
PEDD estimation



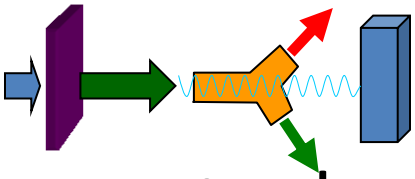
bunch by bunch temp.

- dT provides a measure of PEDD

Measured



Simulation



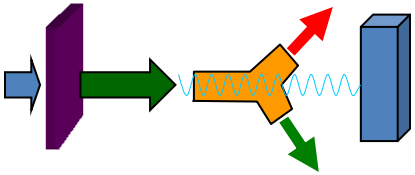
summary

- we took systematic data for hybrid target R&D
  - yield from various target thickness
  - momentum 5, 10, 20 MeV
  - energy deposit/temperature
    - at equilibrium
    - single bunch variation
    - beam profile

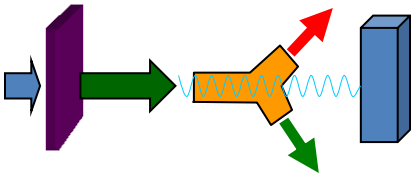
Data analysis → Done

- Correction for detector acceptance
  - hopefully next a couple of months

→ Evaluation of the hybrid scheme as a positron source



supplements



momentum dependence

hybrid on axis

conventional

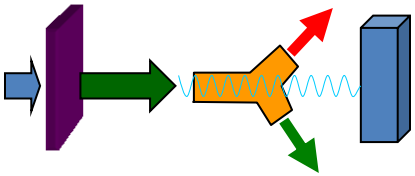
e+ detected [a.u.]

0
5
10

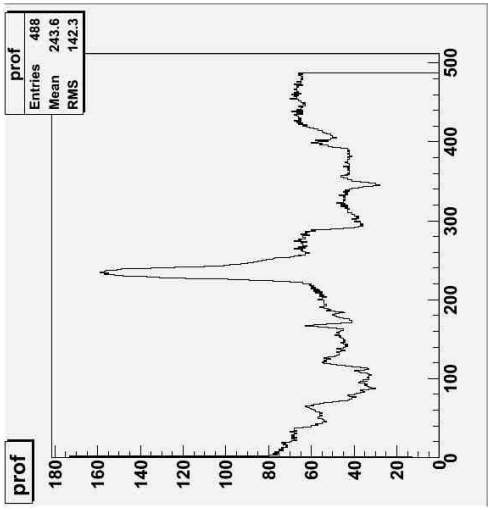
0
5
10
15
20

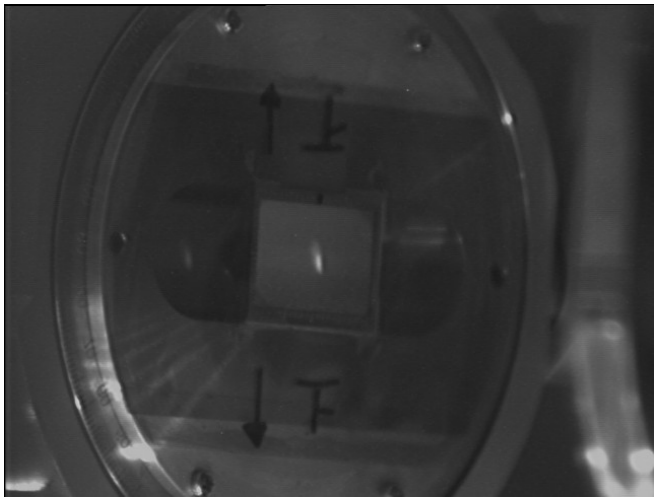
18mm
8mm
5.25mm
3.5mm
1.75mm

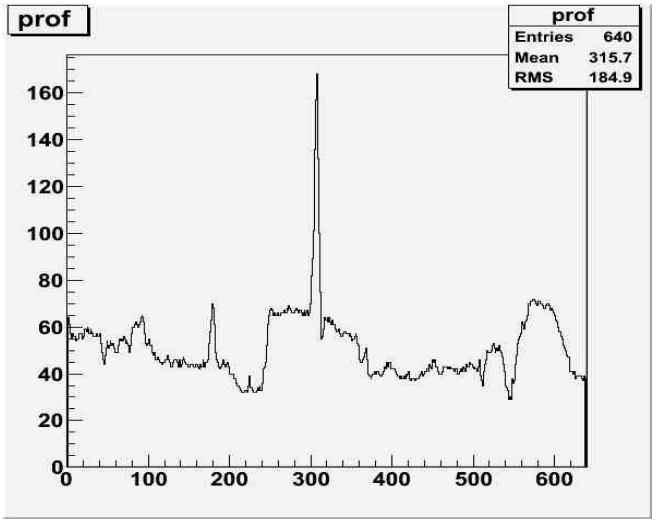
e+ momentum[MeV]



Beam profile on the cryltal

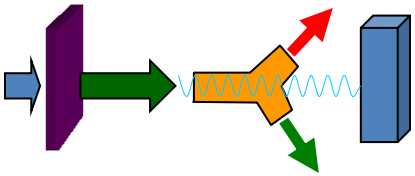






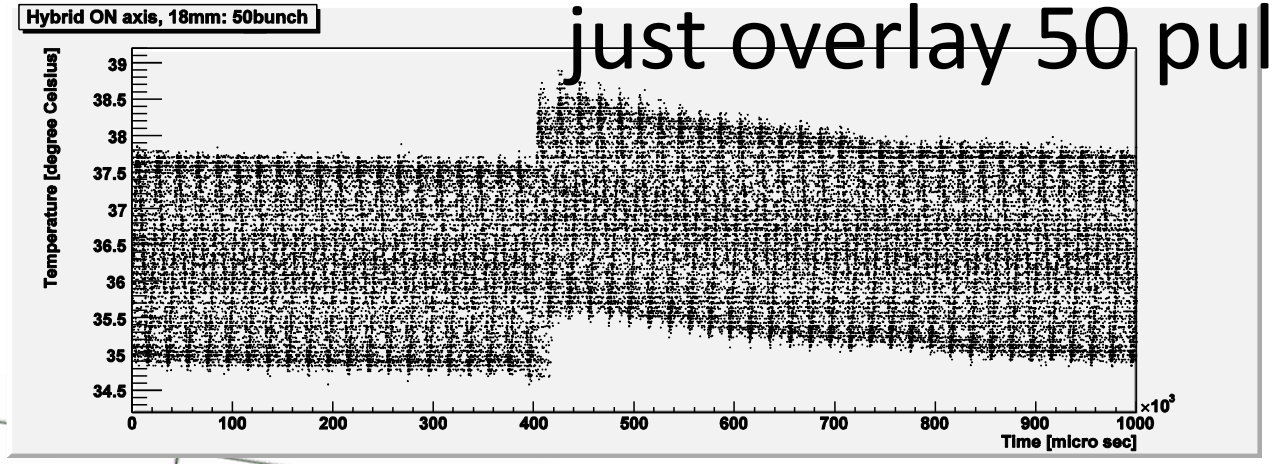
σx=0.42mm

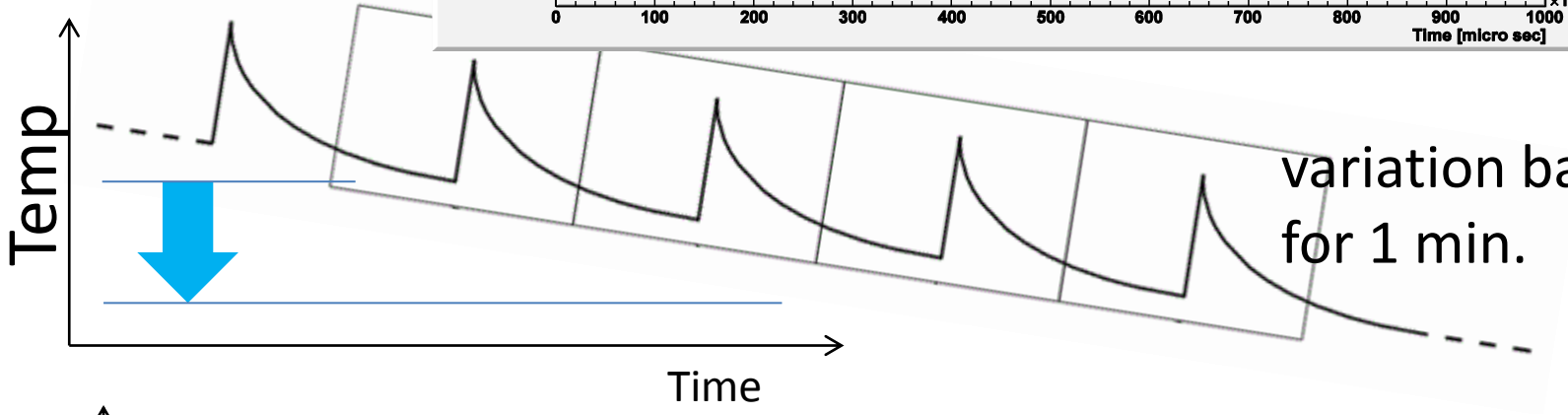
σy=1.54mm



adjust time and base line

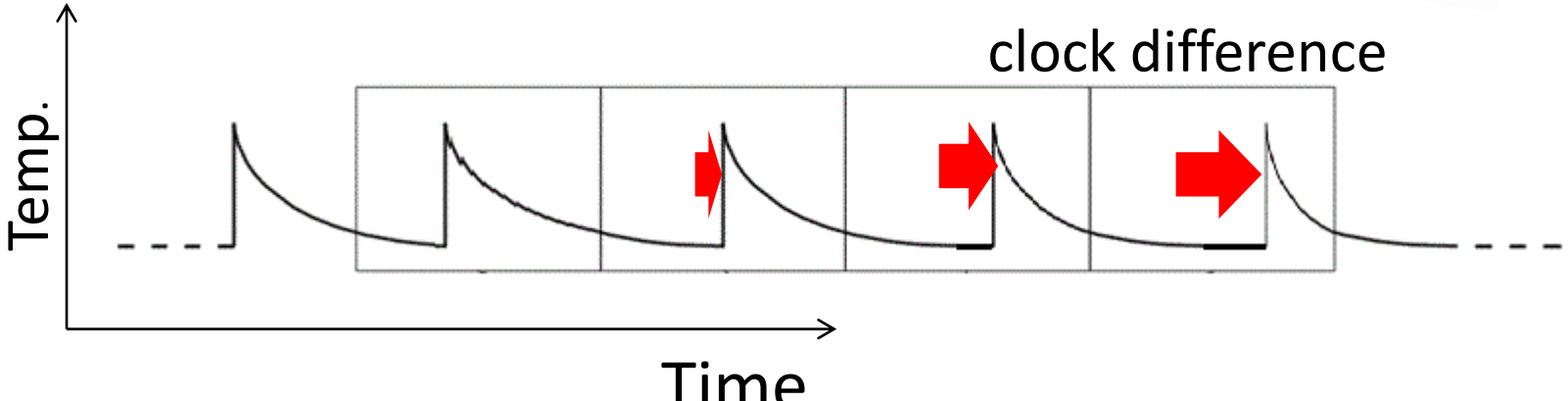
just overlay 50 pulses

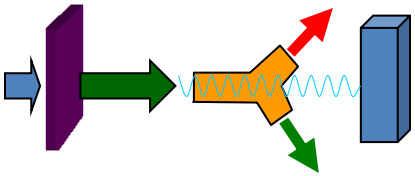




variation base temp.
for 1 min.

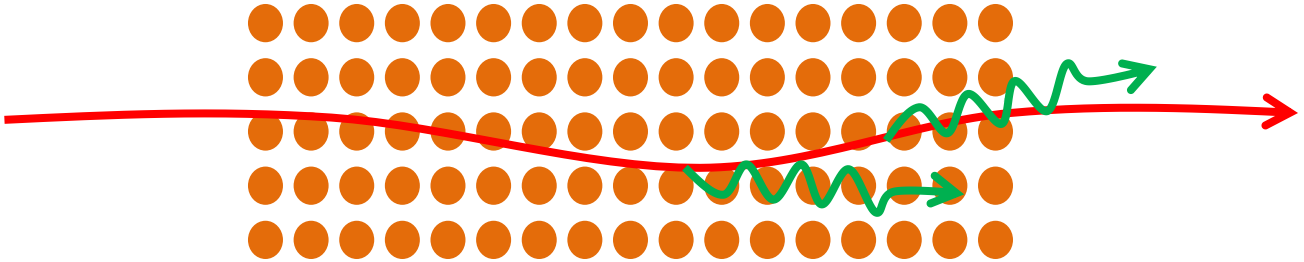
clock difference



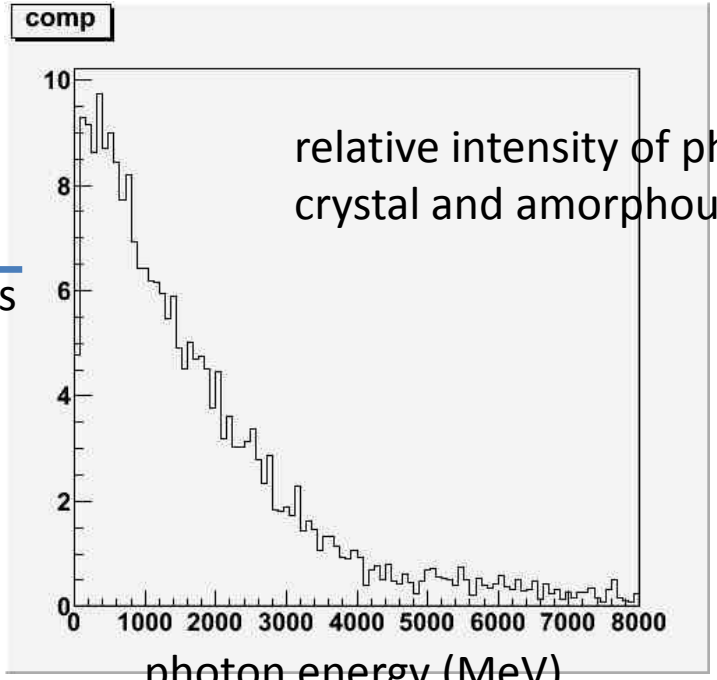


Channeling Radiation

e-

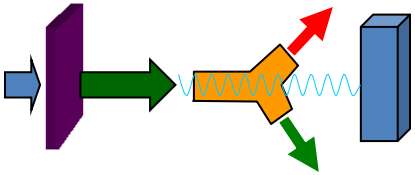


$\frac{\#\gamma \text{ crystal}}{\#\gamma \text{ amorphous}}$



relative intensity of phtons from crystal and amorphous tungsten

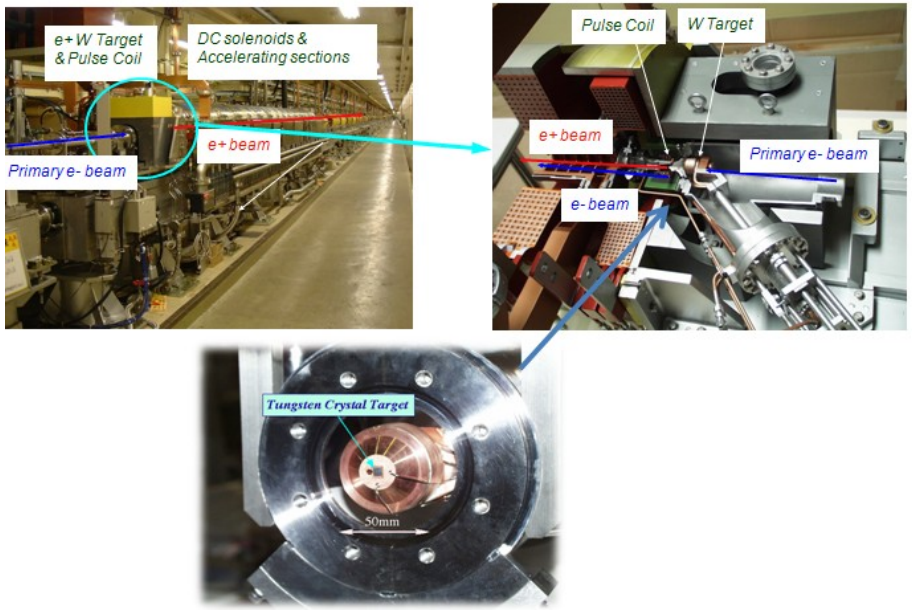
Crystals: converter from high energy electrons to low energy photons



KEKB LINAC

- KEKB LINAC
  - E(beam) : 8GeV Bunch Charge: ~nC

Experiences with crystal targets for KEKB



- Ideal for R&D for hybrid target