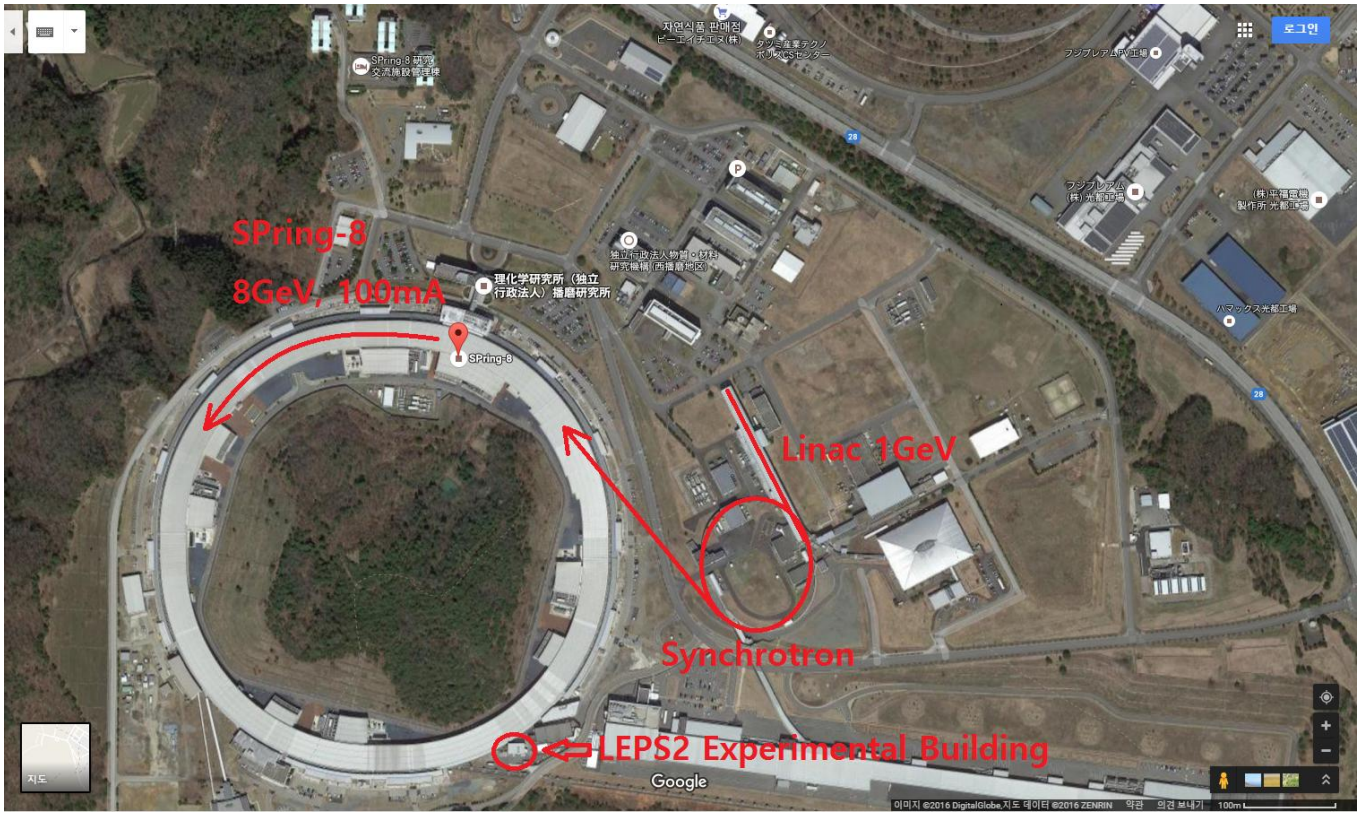
# LEPS2 Start Counter Test at Spring-8

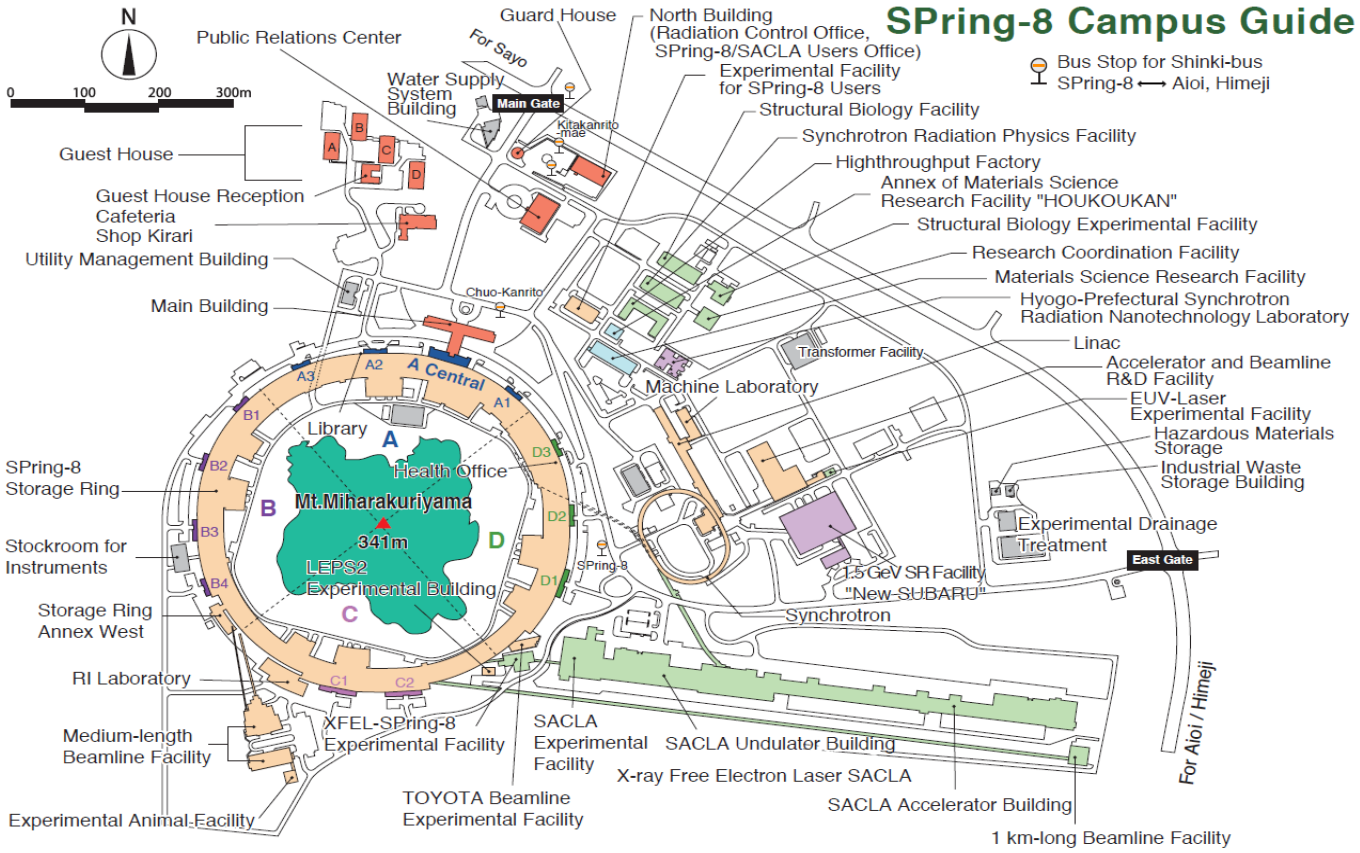
Jahmin Jo

Korea University

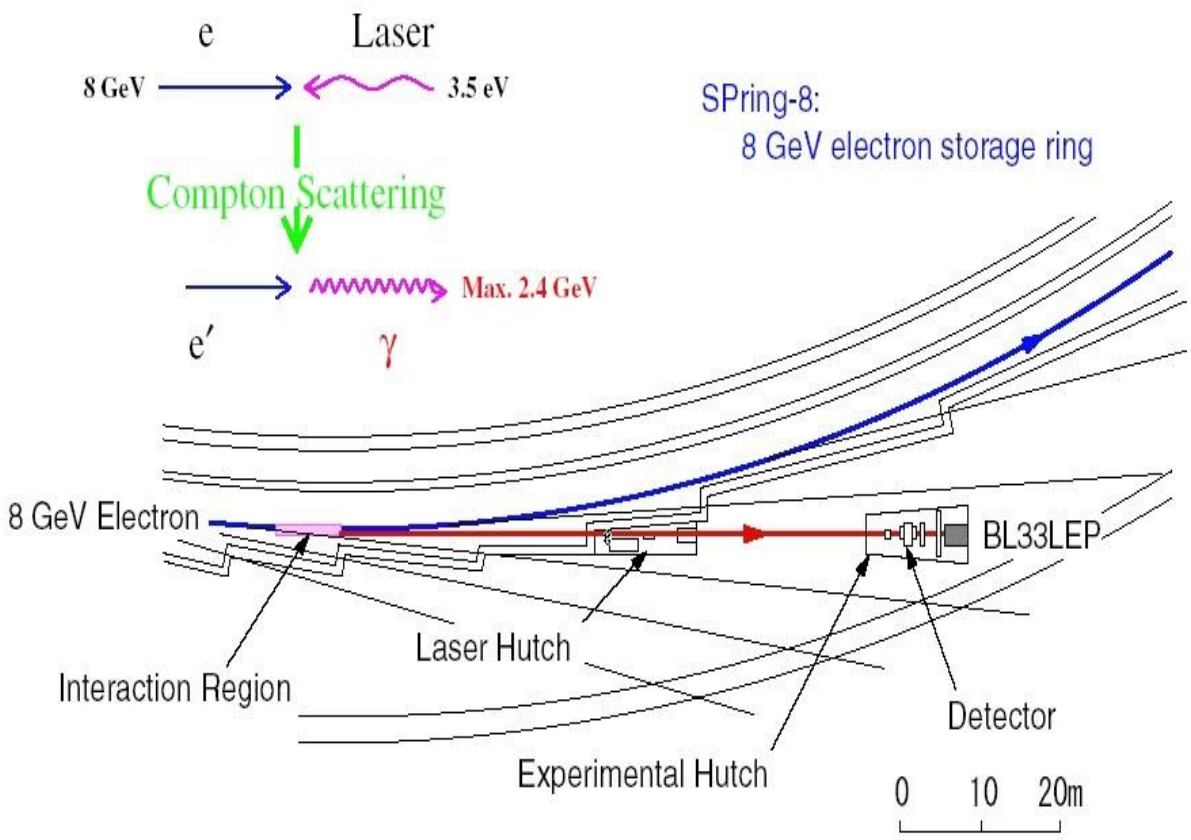
# Spring-8

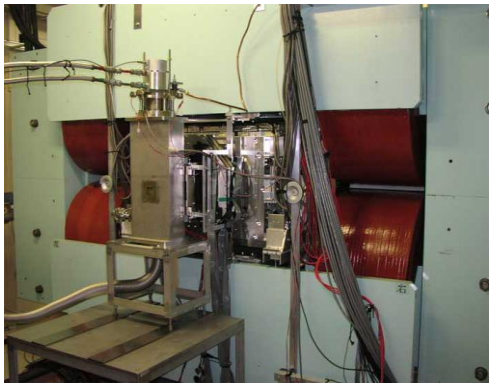

SPring-8
8GeV, 100mA
Linac 1GeV
Synchrotron
LEPS2 Experimental Building
Google

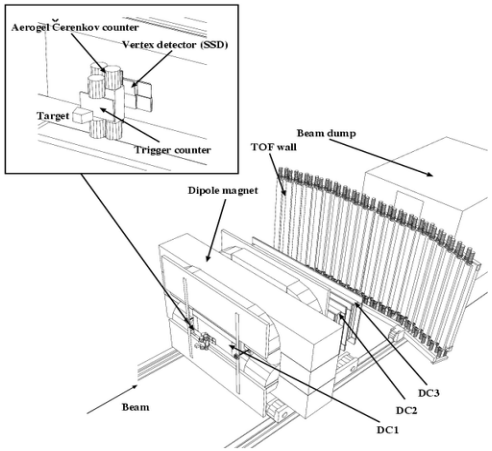
# Spring-8


SPring-8 Campus Guide
N
0 100 200 300m
Public Relations Center
Guard House
North Building
(Radiation Control Office,
SPring-8/SACLA Users Office)
Experimental Facility
for SPring-8 Users
Bus Stop for Shinki-bus
SPring-8 ⟷ Aioi, Himeji
For Sayo
Water Supply
System
Building
Main Gate
Kitakanrito mae
Structural Biology Facility
Synchrotron Radiation Physics Facility
Highthroughput Factory
Annex of Materials Science
Research Facility "HOUKOUKAN"
Structural Biology Experimental Facility
Research Coordination Facility
Materials Science Research Facility
Hyogo-Prefectural Synchrotron
Radiation Nanotechnology Laboratory
Guest House
Guest House Reception
Cafeteria
Shop Kirari
Utility Management Building
Main Building
Chuo-Kanrito
Transformer Facility
Linac
Accelerator and Beamline
R&D Facility
Machine Laboratory
EUV-Laser
Experimental Facility
Hazardous Materials
Storage
Industrial Waste
Storage Building
A Central
Library
Health Office
Mt.Miharakuriyama
341m
LEPS2
Experimental Building
SPring-8
Storage Ring
Stockroom for
Instruments
Storage Ring
Annex West
Experimental Drainage
Treatment
East Gate
1.5 GeV SR Facility
"New-SUBARU"
Synchrotron
RI Laboratory
Medium-length
Beamline Facility
XFEL-SPring-8
Experimental Facility
SACLA
Experimental
Facility
SACLA Undulator Building
X-ray Free Electron Laser SACLA
SACLA Accelerator Building
For Aioi / Himeji
Experimental Animal Facility
TOYOTA Beamline
Experimental Facility
1 km-long Beamline Facility

# LEPS

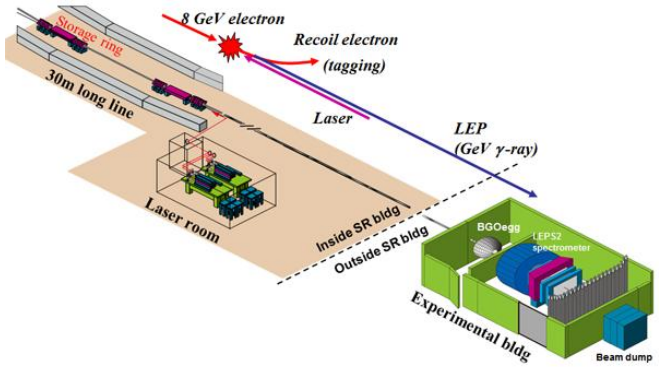

e
Laser
8 GeV
3.5 eV
Compton Scattering
Max. 2.4 GeV
e′
γ
SPring-8:
8 GeV electron storage ring
8 GeV Electron
BL33LEP
Laser Hutch
Interaction Region
Detector
Experimental Hutch
0 10 20m

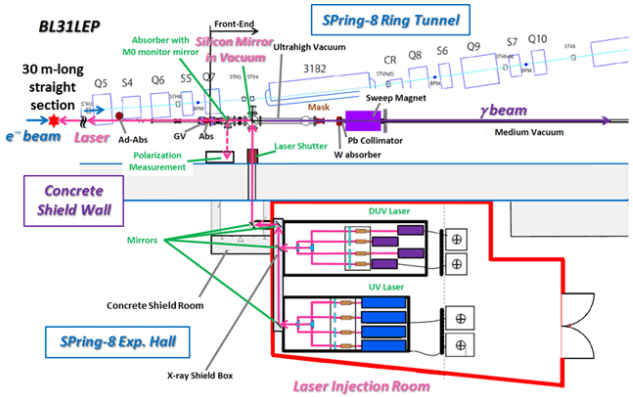


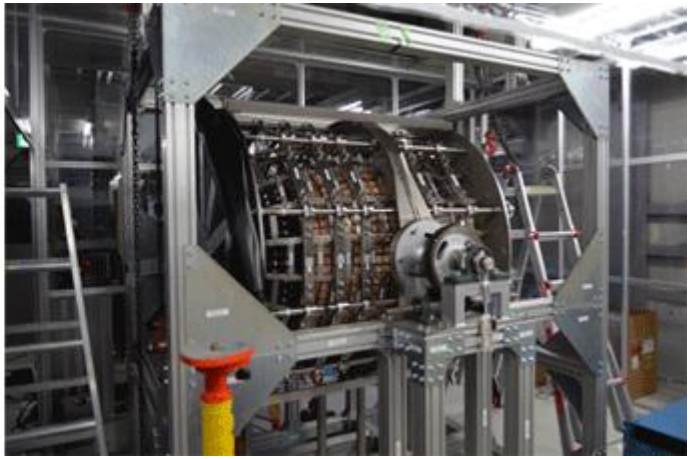

Aerogel Čerenkov counter
Vertex detector (SSD)
Target
Trigger counter
Beam dump
TOF wall
Dipole magnet
Beam
DC3
DC2
DC1

# LEPS2


# LEPS2


8 GeV electron
Recoil electron
(tagging)
Storage ring
30m long line
Laser
LEP
(GeV γ-ray)
Laser room
Inside SR bldg
Outside SR bldg
BGOegg
LEPS2 spectrometer
Experimental bldg
Beam dump


BL31LEP
SPring-8 Ring Tunnel
Front-End
Absorber with M0 monitor mirror
Silicon Mirror in Vacuum
Ultrahigh Vacuum
30 m-long straight section
Q5 S4 Q6 S5 Q7
31B2
CR Q8 S6 Q9 S7 Q10
Sweep Magnet
Mask
γbeam
Medium Vacuum
e⁻beam
Laser
Ad-Abs
GV
Abs
Pb Collimator
W absorber
Laser Shutter
Polarization Measurement
Concrete Shield Wall
DUV Laser
Mirrors
UV Laser
Concrete Shield Room
SPring-8 Exp. Hall
X-ray Shield Box
Laser Injection Room

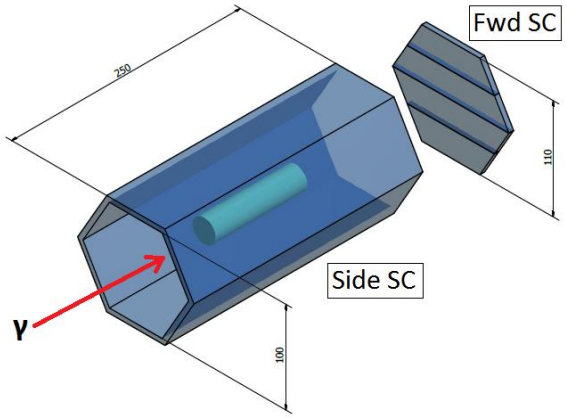


# LEPS2 SC test

- Purpose
  - Time resolution measurement of LEPS2 SC (Requirement : σ < 300 ps)

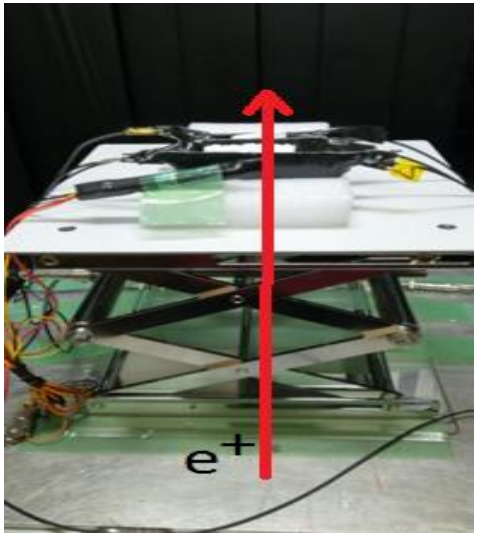
- Date/Place
  - Sept. 28 ~ Sept. 29 / Downstream DC at BL33 LEPS hutch

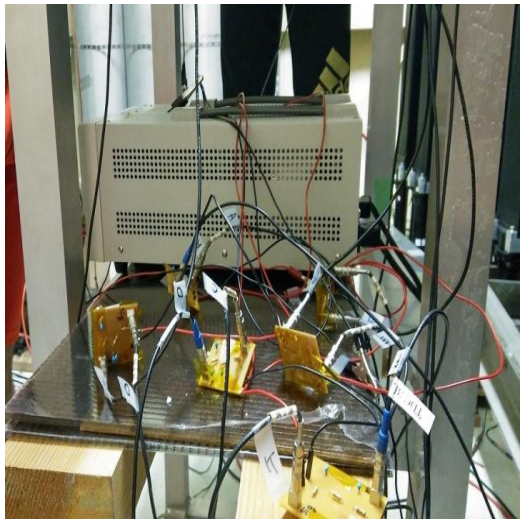
- Time requested
  - 2h (check) + 10h (beam exposure) = 12h

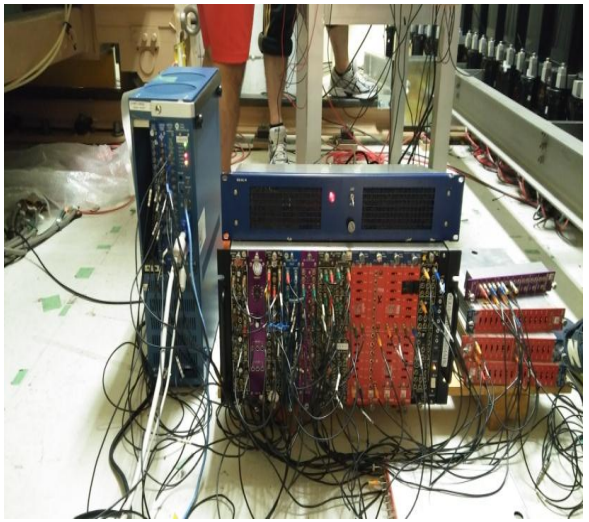



- Side-SC(6module)
- Fwd-SC(4moudule)
- Scintillator(EJ-212)
- Both-side MPPC (S12571-010P)

# Set up condition

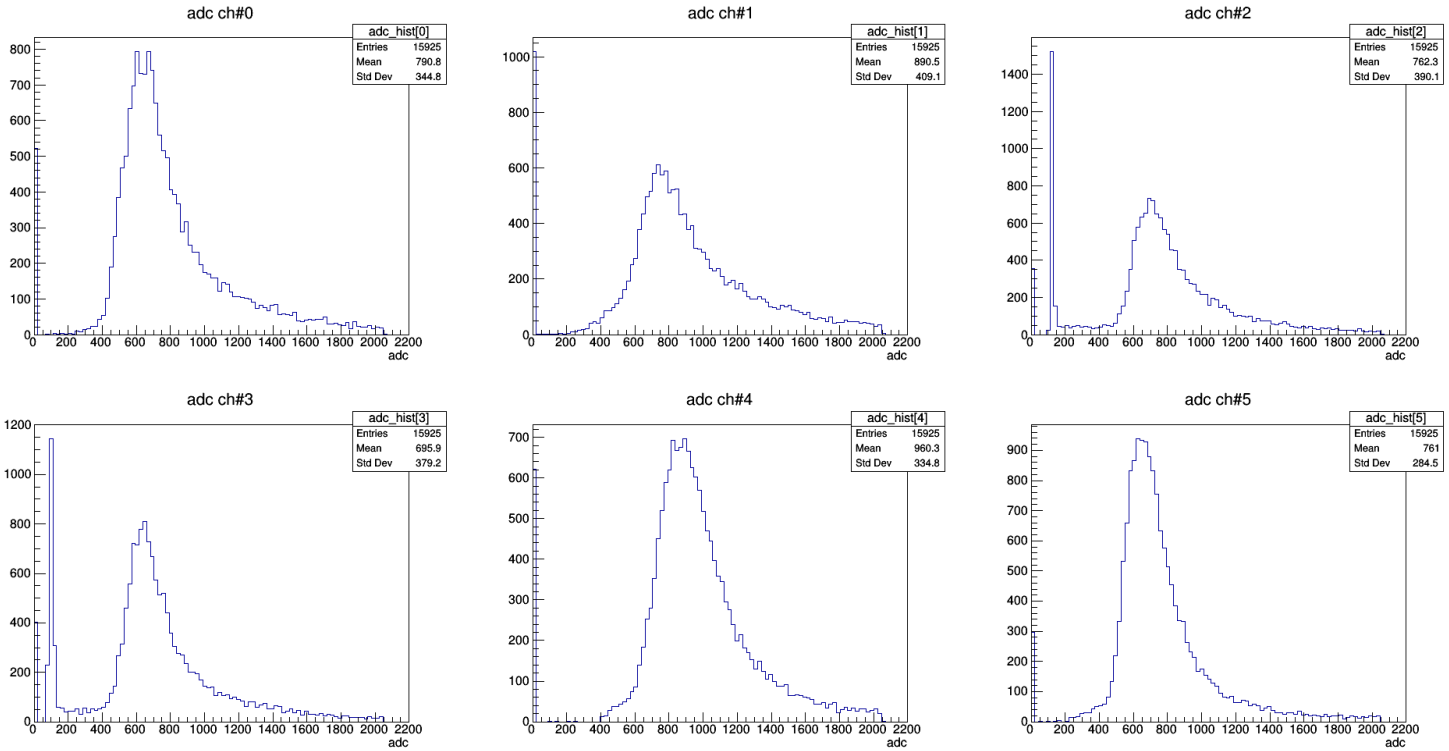




- Beam time
  - DAQ check
  - Side SC (6), Forward SC (4)
  - Position dependence : Middle, right, left
  - Angle dependence : 0°, clockwise, anti-clockwise

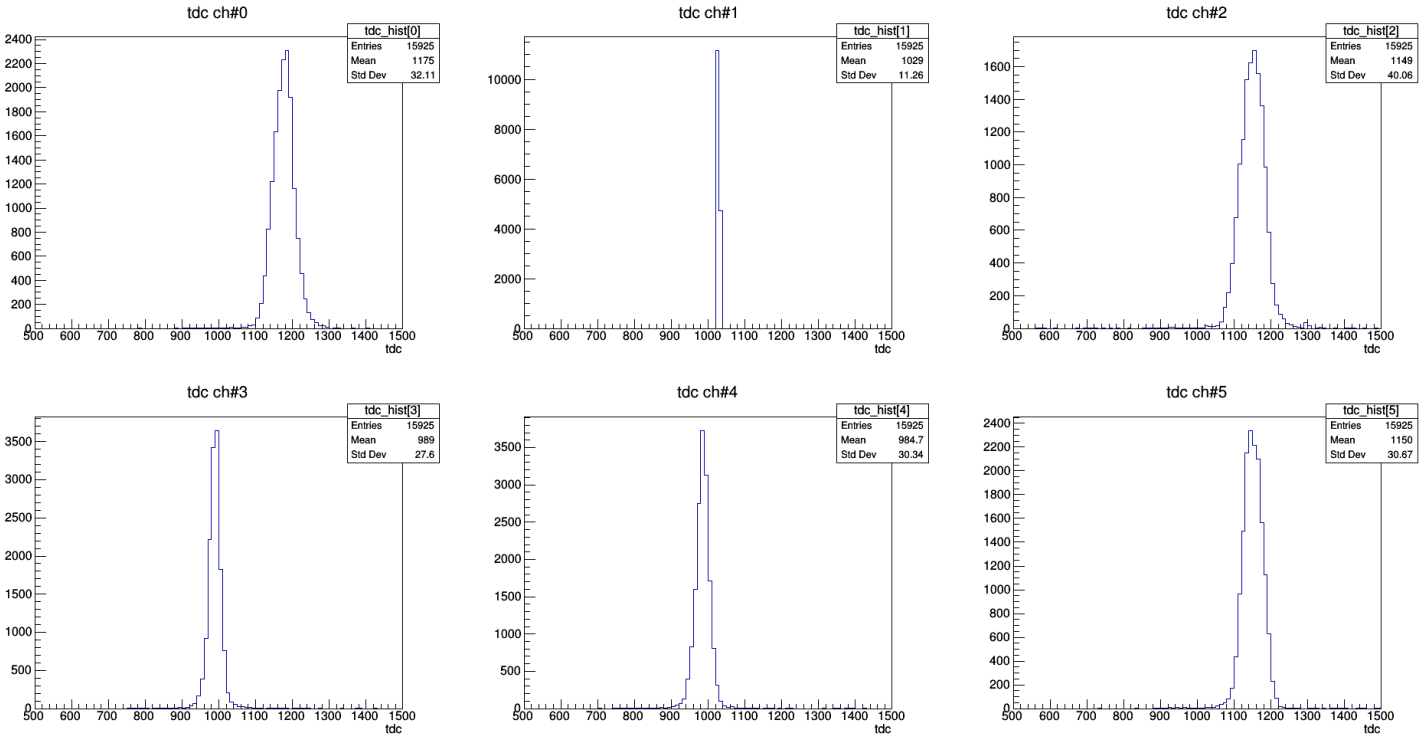
# ADC & TDC




- Forward scintillators (3), middle, 0°
- Data file : sc0120.dat (30000 number of event)
- HV : 67.4V

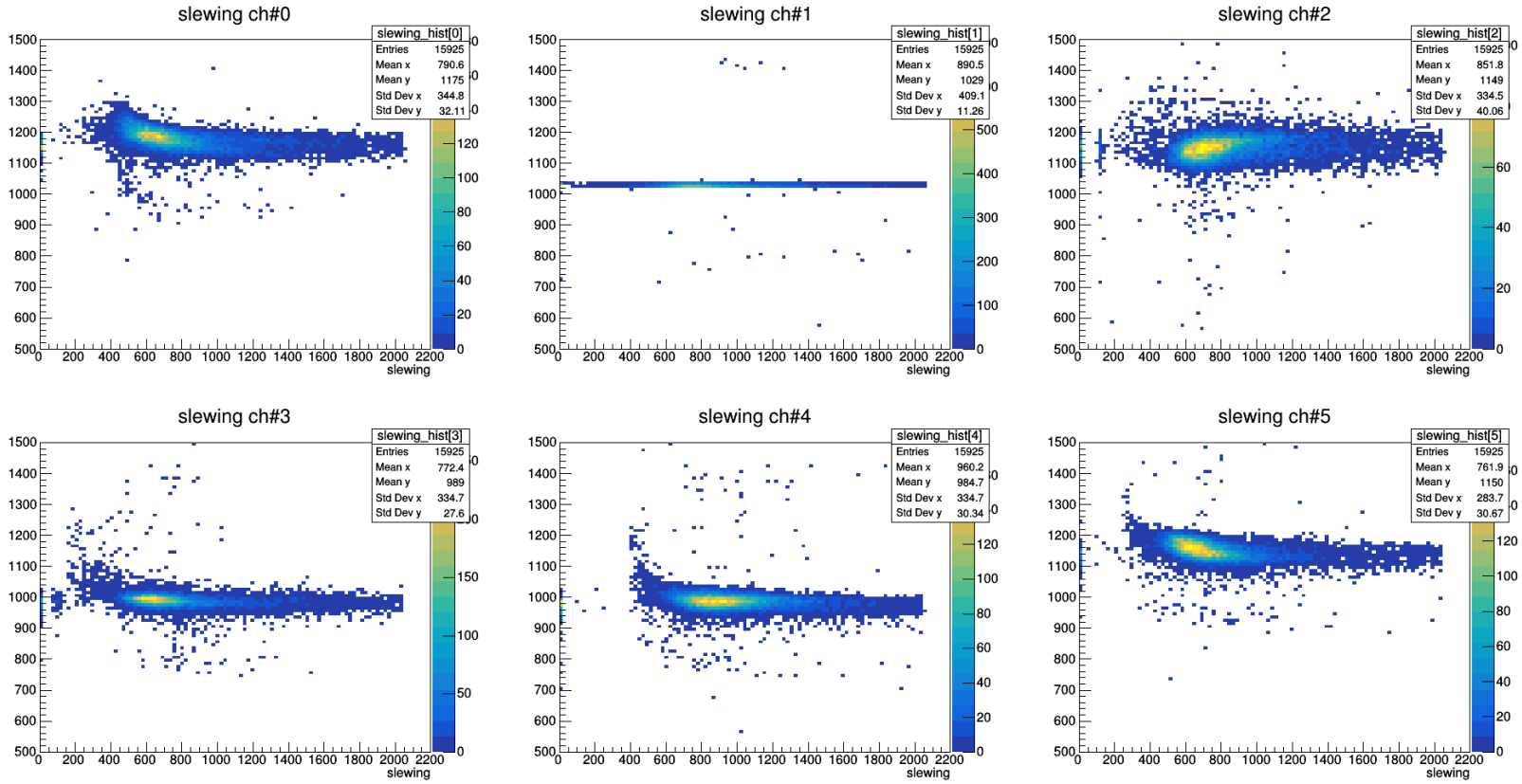
ADC : Ch1 ~ Ch6

# ADC & TDC



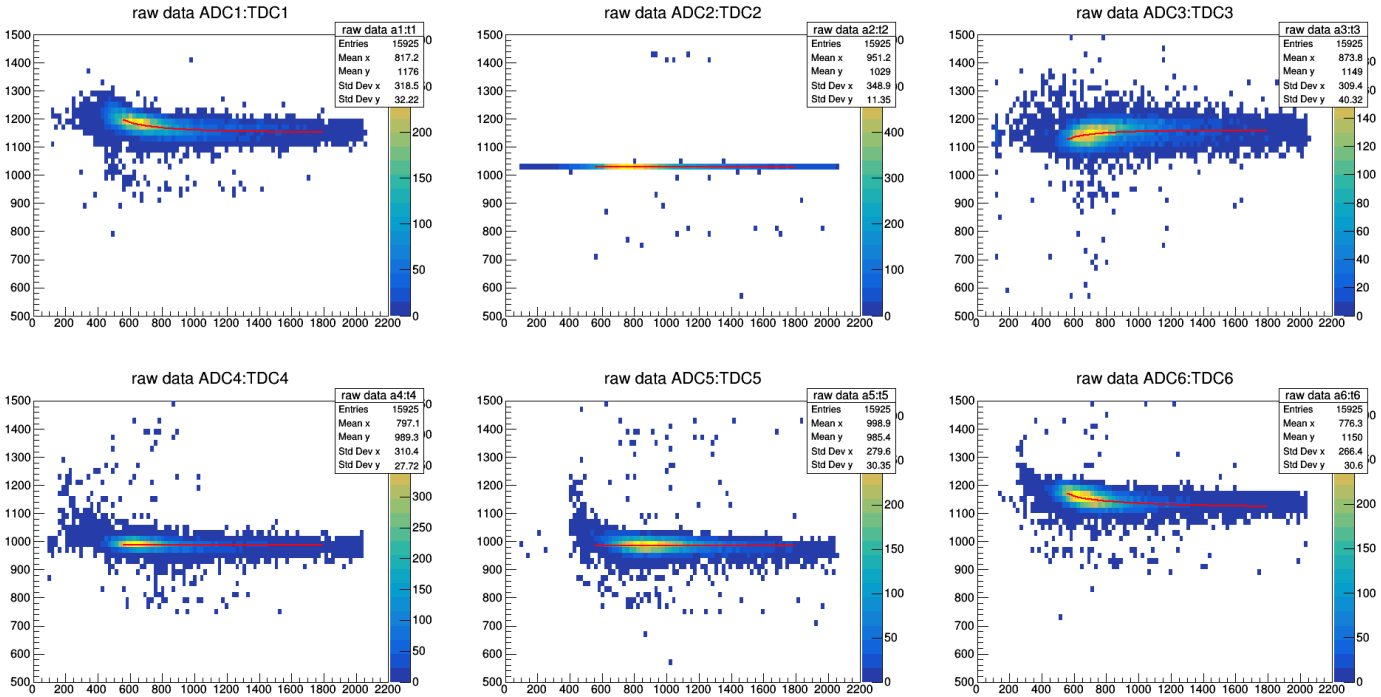

TDC : Ch1 ~ Ch6

# Slewing effect



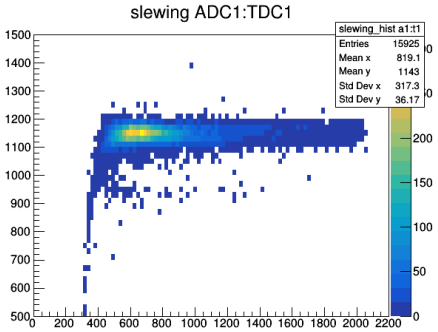

ADC vs TDC : Ch1 ~ Ch6

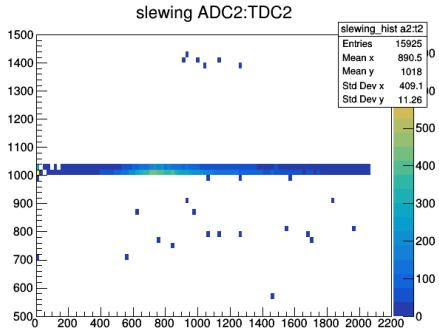
# Slewing correction

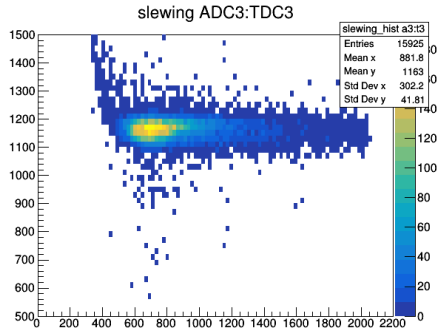


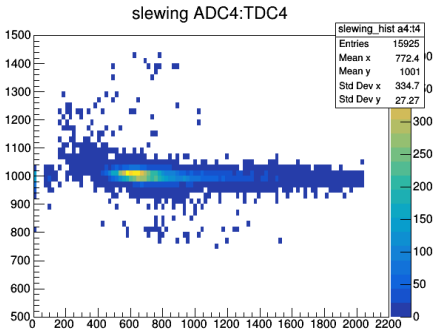

- Fitting function : $f(x) = a(x-b)^{-c} + d$ (typically used function) [1]
  - b : asymptote of x value of the fitting function
  - d : typical TDC value at high ADC
  - a, c : slope of the fitting function (c usually 0.5 ~ 0.8)

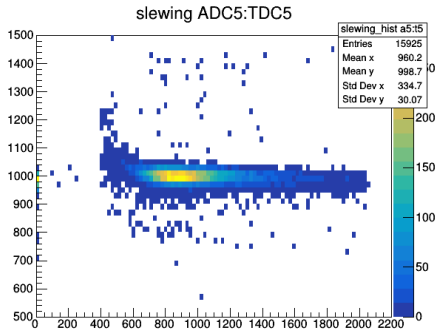
# Slewing correction

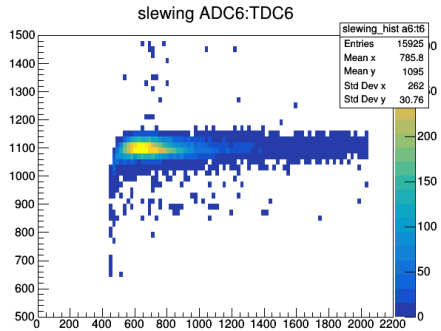


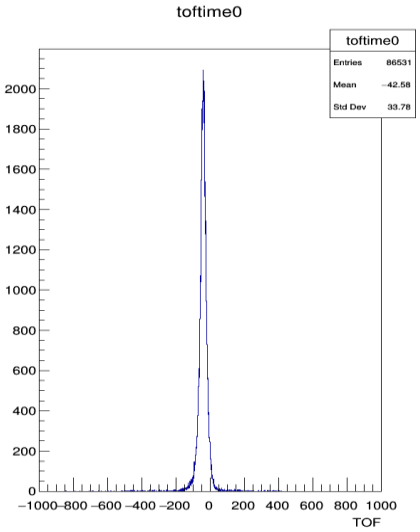



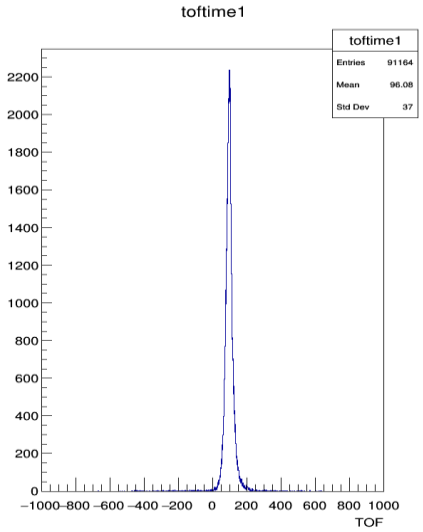



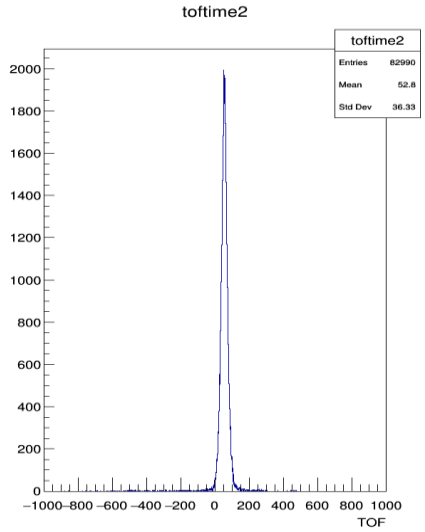



# Time of flight




$$TOF1 = \left| \frac{T_{cor}1 + T_{cor}2}{2} - \frac{T_{cor}3 + T_{cor}4}{2} \right|$$

$$TOF2 = \left| \frac{T_{cor}3 + T_{cor}4}{2} - \frac{T_{cor}5 + T_{cor}6}{2} \right|$$

$$TOF3 = \left| \frac{T_{cor}1 + T_{cor}3}{2} - \frac{T_{cor}5 + T_{cor}6}{2} \right|$$

$T_{cor}1 \sim T_{cor}6$
corrected TDC
(by slewing correction)

$$\sigma_{TOF1} = \sqrt{\sigma 1^2 + \sigma 2^2} \approx 14.91$$

$$\sigma_{TOF2} = \sqrt{\sigma 2^2 + \sigma 3^2} \approx 14.63$$

$$\sigma_{TOF3} = \sqrt{\sigma 1^2 + \sigma 3^2} \approx 15.65$$

# Timing resolution

$$\sigma 1^2 = \frac{\sigma_{TOF1}{}^2 - \sigma_{TOF2}{}^2 + \sigma_{TOF3}{}^2}{2} \approx 126.6 \qquad \sigma 1 \approx 11.25 \qquad 281.25 ps$$

$$\sigma 2^2 = \frac{\sigma_{TOF1}{}^2 + \sigma_{TOF2}{}^2 - \sigma_{TOF3}{}^2}{2} \approx 95.71 \Rightarrow \sigma 2 \approx 9.78 \Rightarrow 244.5 ps$$

$$\sigma 3^2 = \frac{-\sigma_{TOF1}{}^2 + \sigma_{TOF2}{}^2 + \sigma_{TOF3}{}^2}{2} \approx 118.32 \qquad \sigma 3 \approx 10.88 \qquad 271.9 ps$$

if TDC resolution 25ps

# Reference


- [1] W. Braunschweig et al, Nucl. Instr. and Meth. in Phys. Research 134 (1976) 261-266