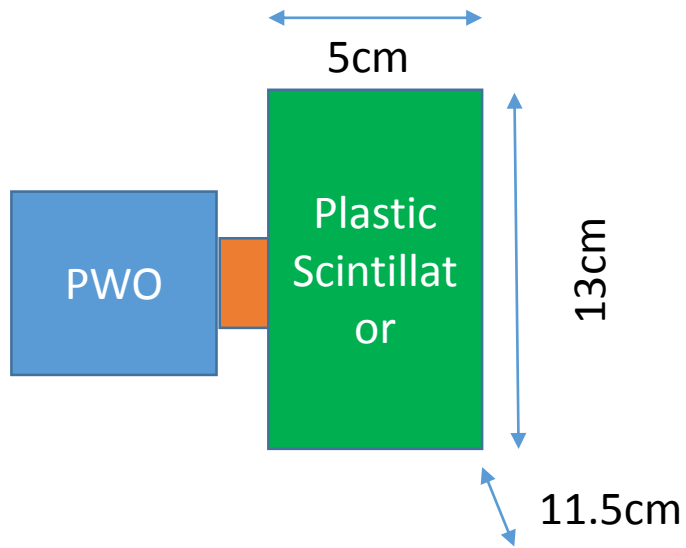


Positronium intensity measurement preparation (GBAR)

SNU

Bongho Kim

New setup for precision



- ^{22}Na source is in center of two scintillation materials
- ^{22}Na decay
 - 1.275MeV gamma(99%),
 - 0.543MeV beta+ (90%) ← will be annihilated inside source or surface of detector



Basic information

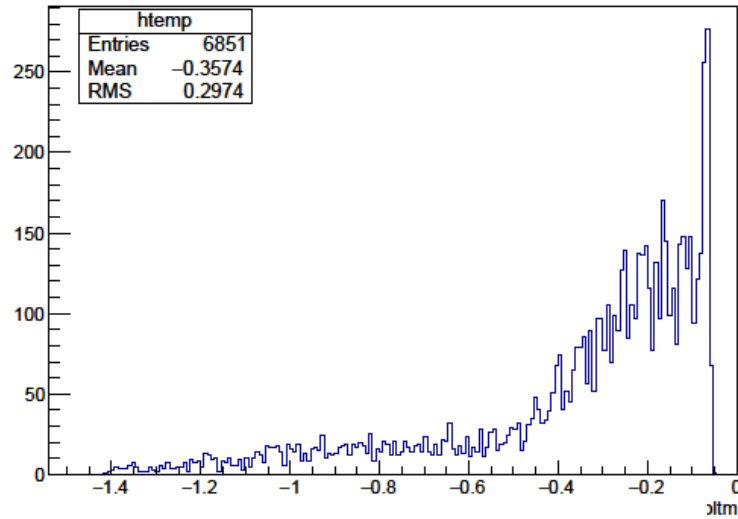
- Plastic scintillator + PMT(Xp2020) \leftarrow HV(-2kV)
- PbWO₄ crystal + PMT(H7195) \leftarrow HV(-2kV)

Counting rate (-29.5mV threshold)

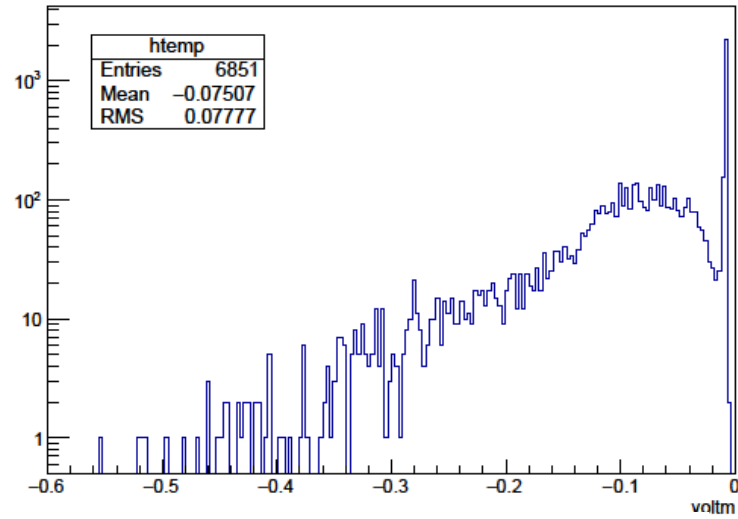
- PWO(no source) = 1327.5#/s
 - PWO(Na source) = 59916.6#/s
 - PS(no source) = 16957.8#/s
 - PS(Na source) = 130899.2#/s
- Random coincidence rate(trg for PS) = $5.99\text{E-}3$ (for 100ns gate)
- But really used trigger cut is $\text{peakH(PS)} < -42\text{mV}$

Signal information

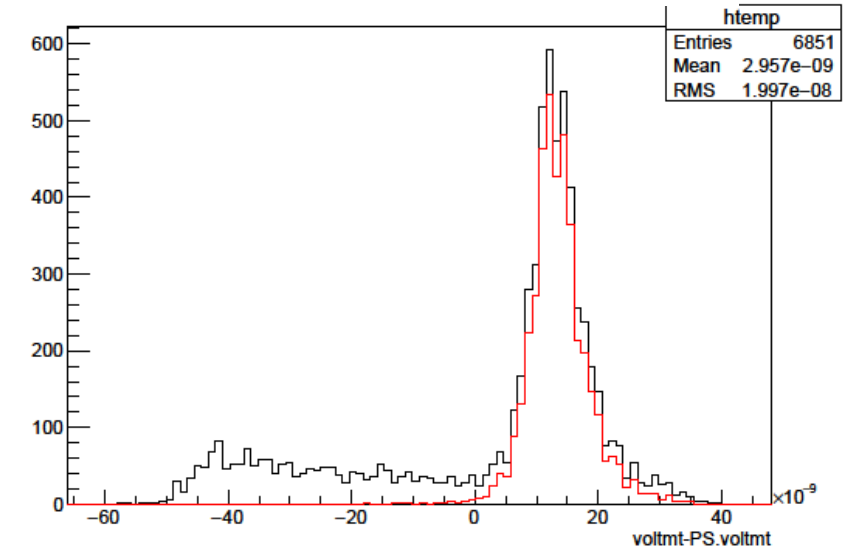
PS peak height distribution



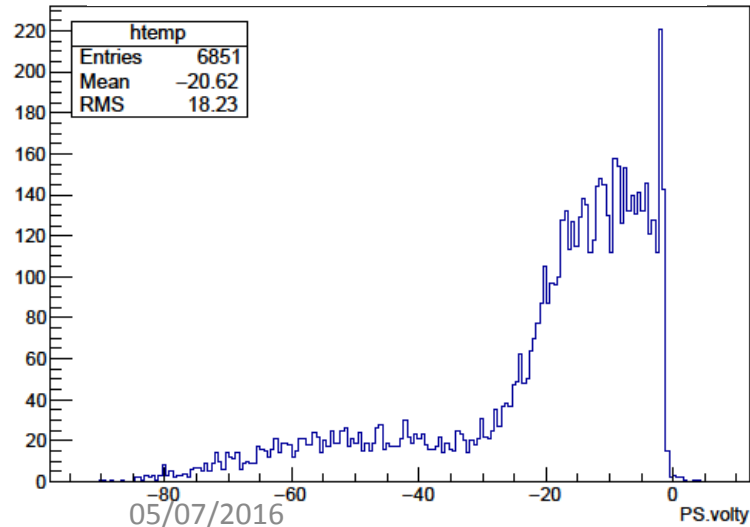
PS charge height distribution



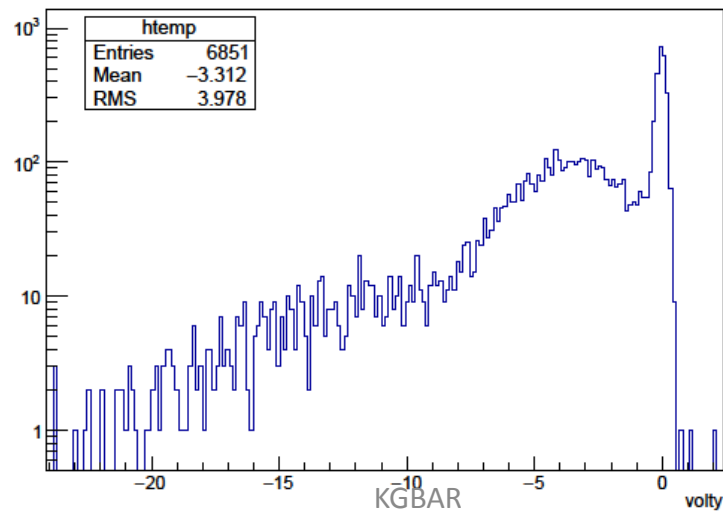
Δt distribution



PWO peak height distribution



PWO charge height distribution



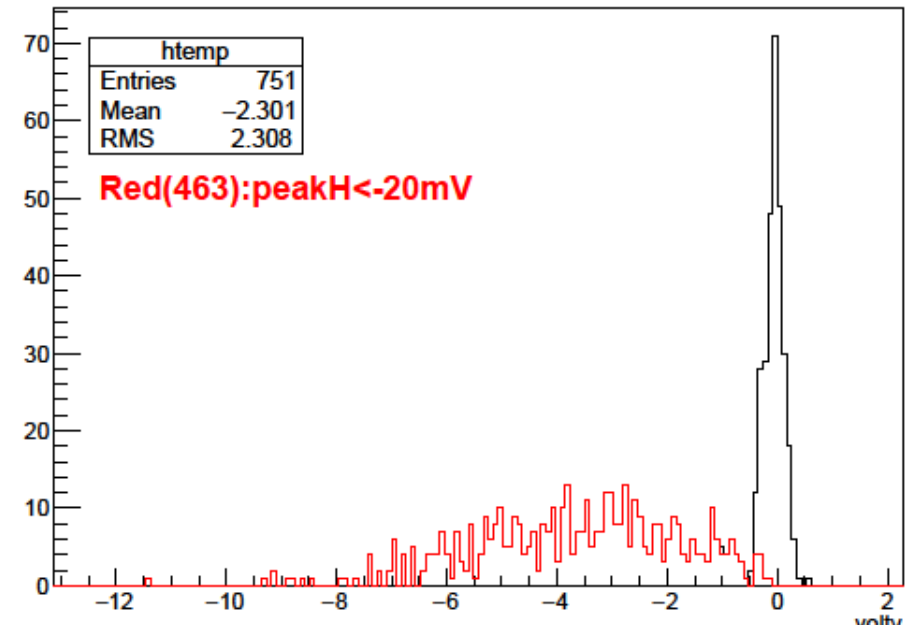
Efficiency check

- $eff = \frac{\det(PWO\&PS)}{\det(PS) \times accept} = \frac{463 \pm 21.5}{751 \pm 27.4 \times accept}$
- $accept = 2 \times (0.289 \pm 0.050)$
- $eff = 106.66 \pm 29.23$

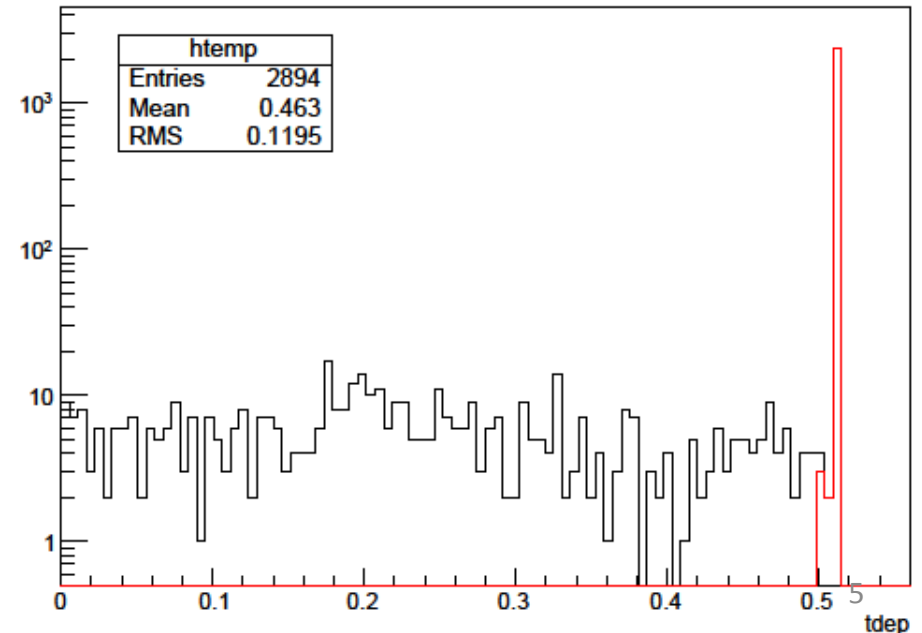
Too big error... How can we improve?
(depart source from detector)

→ Beam data will be used to improve.

Charge distribution



Deposit E distribution (simulation)

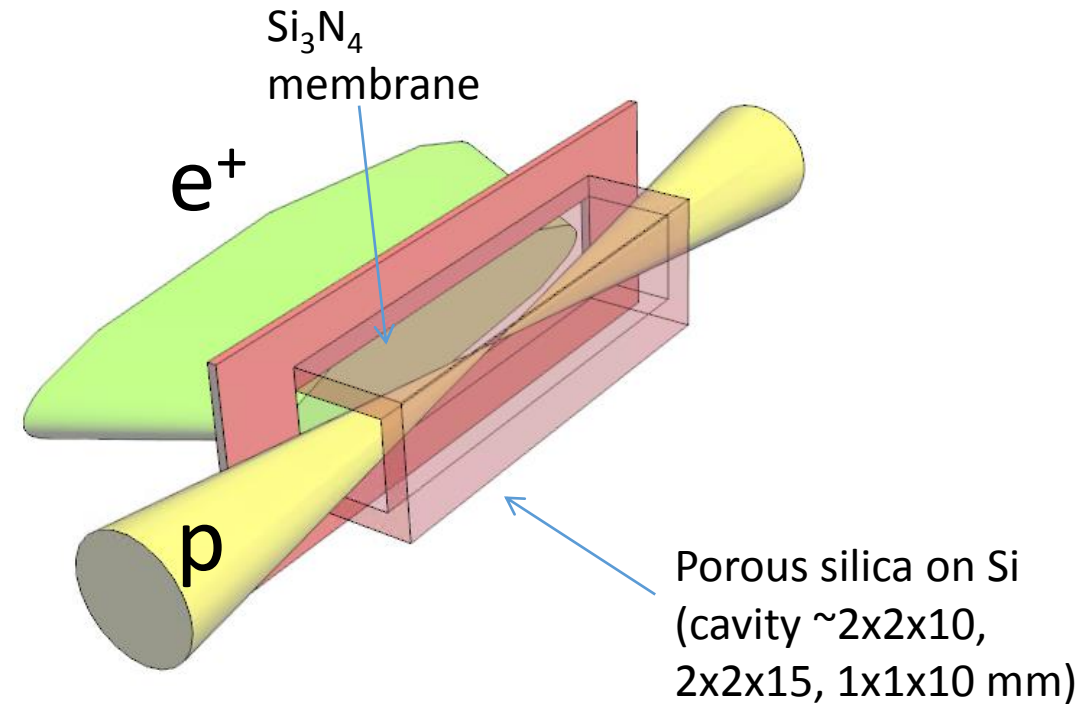


PWO calibration issues

- Raw signal fitting
- Precise efficiency check
- Time resolution check
 - With plastic scintillator, we can measure time resolution from back to back gamma(e^+ beam annihilation) event.
- Saturation effect
 - Expect total charge of signal and if necessary check by LED

Simulation preparation

- Aim of the simulation is the estimation of
 - Positron rate passing through membrane and target
 - Positronium rate and position in- and out-side of cavity
 - Phys Rev A81, 012715 (2010)
- In this month, I will try to develop simulation (vacation season)



Positron EM process

What is used before in positronium simulation in GBAR

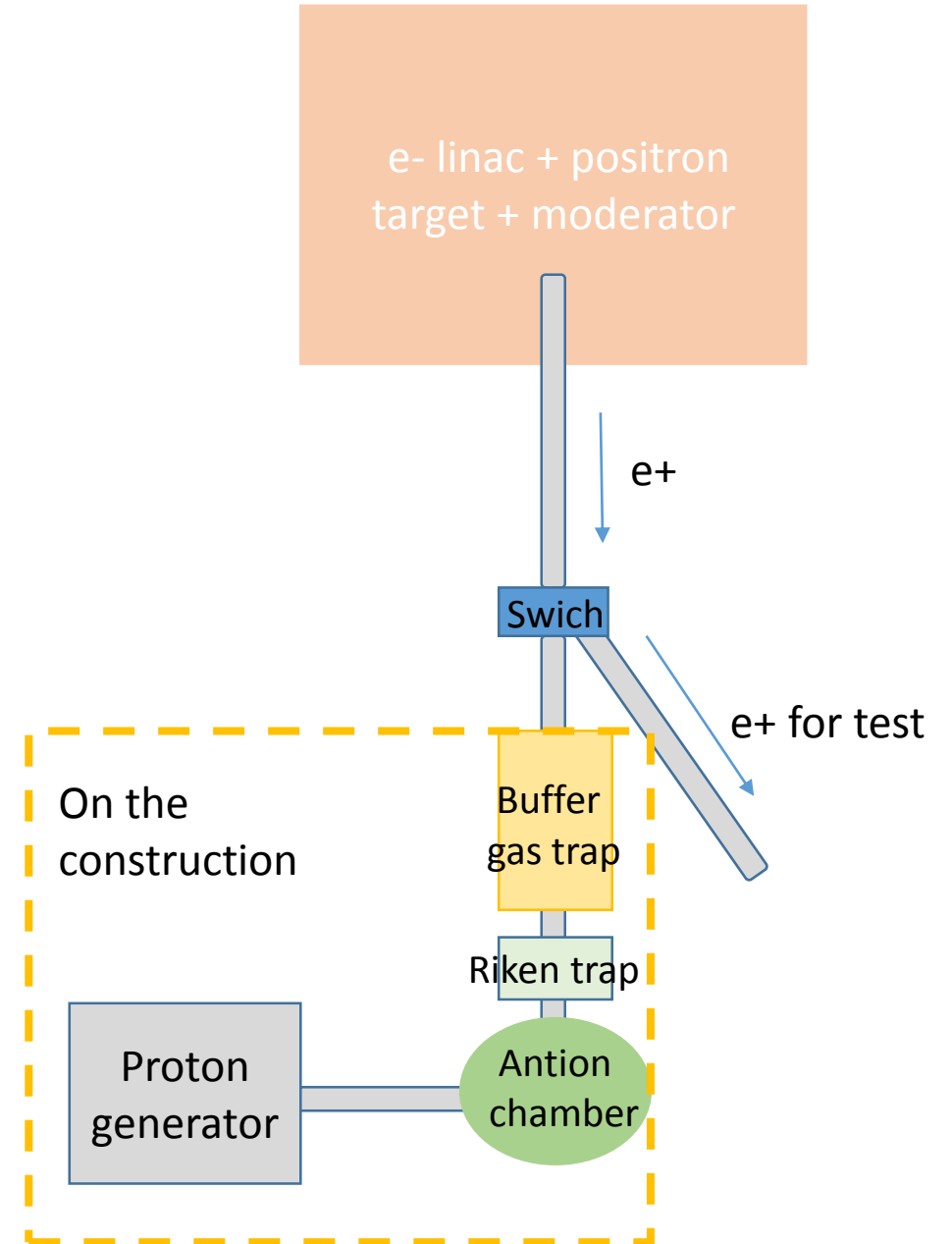
- Ps formation
- Multiple scattering
- Bremsstrahlung
- Annihilation

← Which is optimized for High energy physics

→ **Penelope** library need to be checked (electrons, positrons and photons (250ev ~ 1GeV))

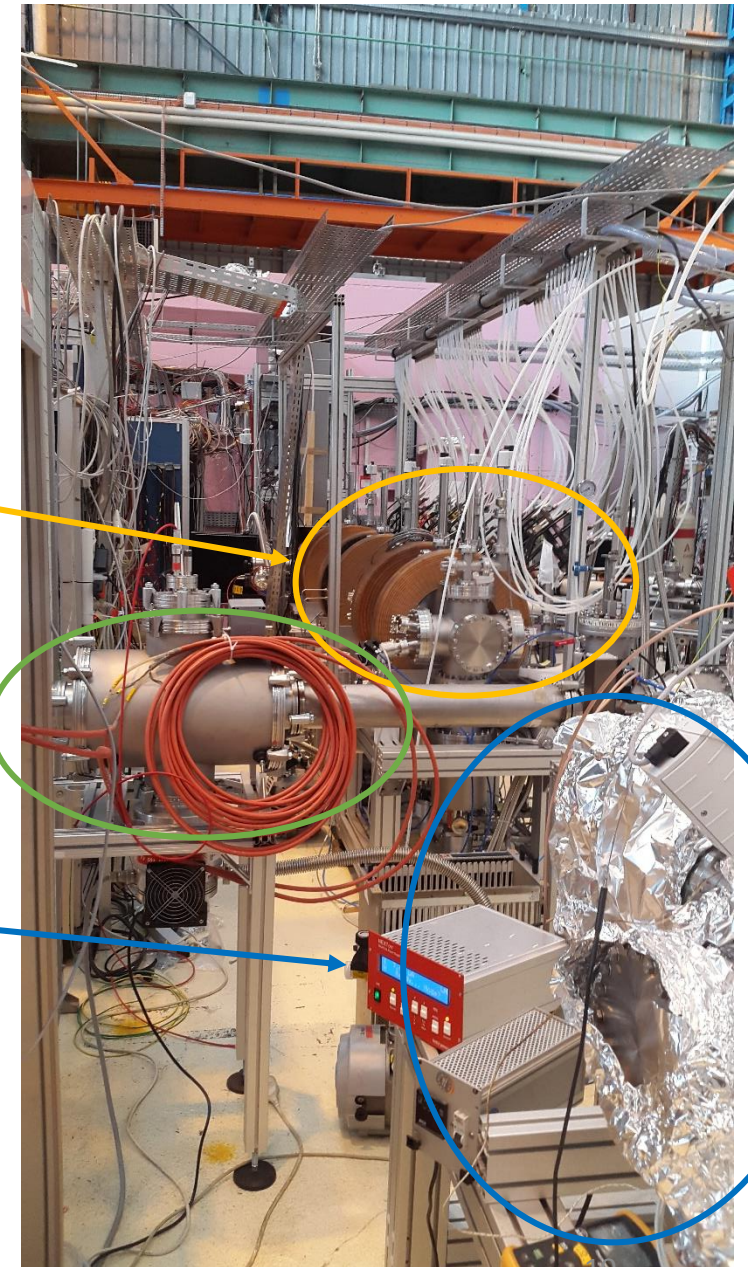
Status in Saclay

- There's several things which need to be done before real beam test..
- Proton generation is done but need to connect HV for lens, etc..
- Buffer gas trap preparation is ongoing but need more time..
- Riken trap will be tested soon..
- Antion chamber is ready but no precise information for source, etc..



Status in Saclay

- There's holiday season from middle of July
- Buffer gas trap preparation
 - Cabling is ongoing for controller and power
 - Gold plated electrode ready in this week
- Proton beam preparation
 - Almost done(?)
- Antion preparation
 - Chamber has baked
 - Focus will be tested with e^- gun
- Riken trap
 - Can it be tested from next week?



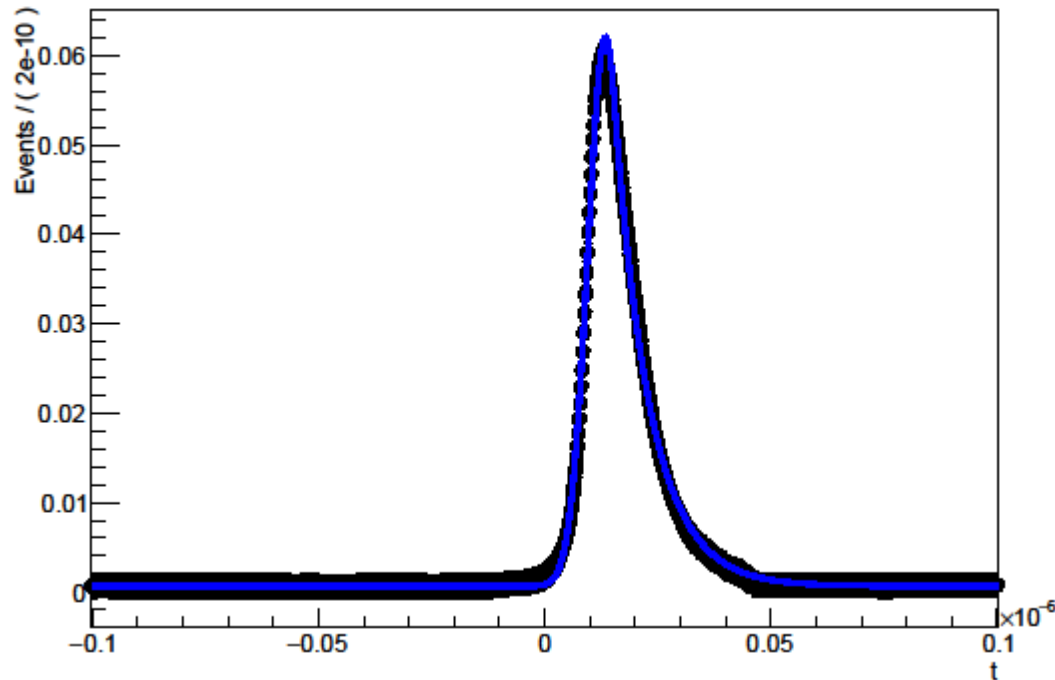
To do list

- Positron & positronium simulation development
- Toy MC preparation (Raw signal fitting first)
- Eventually, we need to find way to measure positronium distribution in and out of target cavity.
- After vacation season, I will try to measure efficiency of PWO crystal with positron beam.

Backup

Raw signal fitting

A RooPlot of "t"



- PDF : Crystal ball PDF +poly(0)
- Chisq : 201. (not good..)
- Bin error: $0.001333(\Delta^2/12)$
- Can I use this PDF as signal?

Mean : $1.3\text{E-}8 \pm 4.2\text{E-}11$

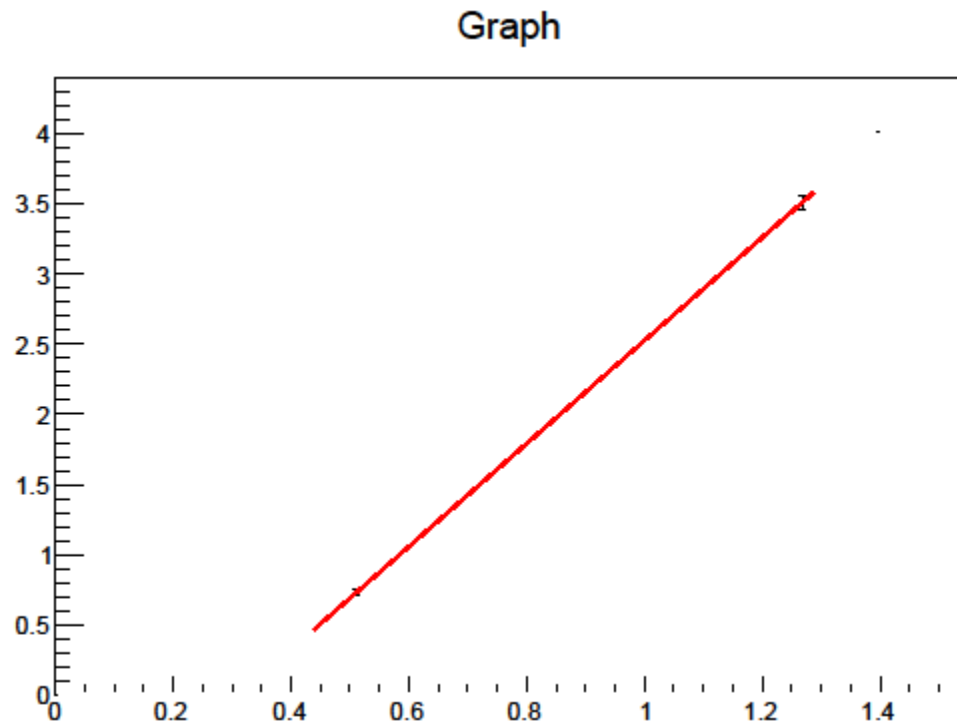
Sigma : $3.9\text{E-}9 \pm 4.3\text{E-}11$

Alpha : $-5.0\text{E-}1 \pm 8.9\text{E-}3$

N : 126 ± 1.7

FWHM : 11.8ns

Linearity for Plastic Scintillator

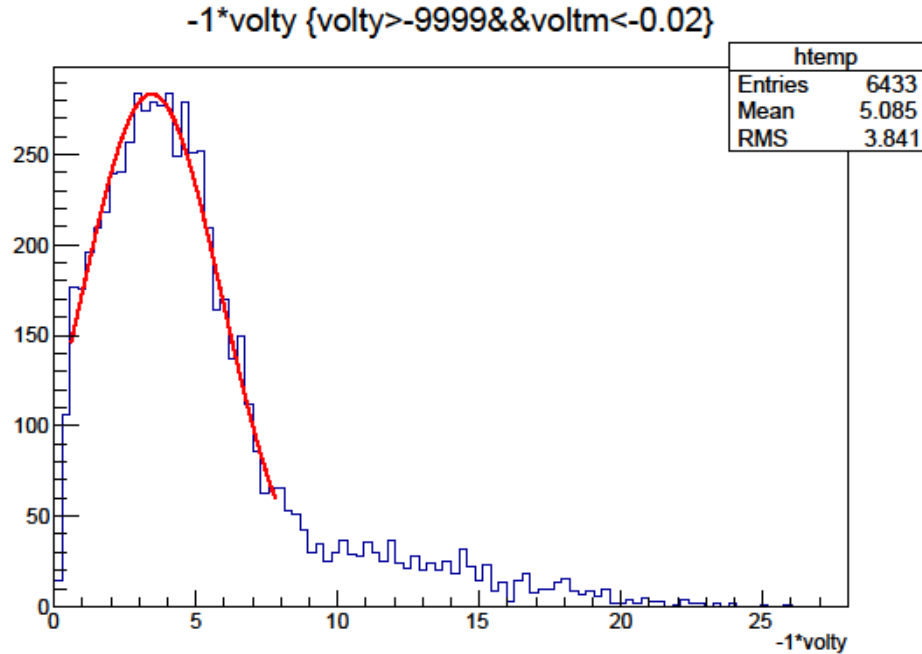


- Not from 0,0

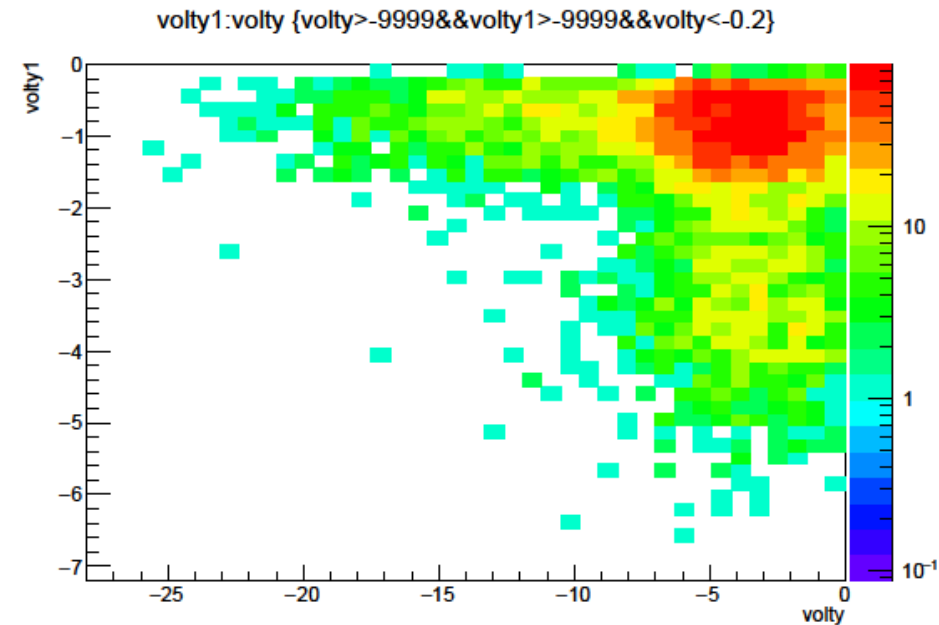
$$Y = 3.67(\pm 0.07) * X - 1.15(\pm 0.05)$$

→ Does it make sense?

Simple fitting with single gaussian of PWO



- Mean : 3.441 ± 0.056
 - Sigma : 2.472 ± 0.062
- To fitting second peak, better modelling required.



Last day setup



28/06/2016



KGBAR

16