

Positronium intensity measurement preparation (GBAR)

SNU

Bongho Kim

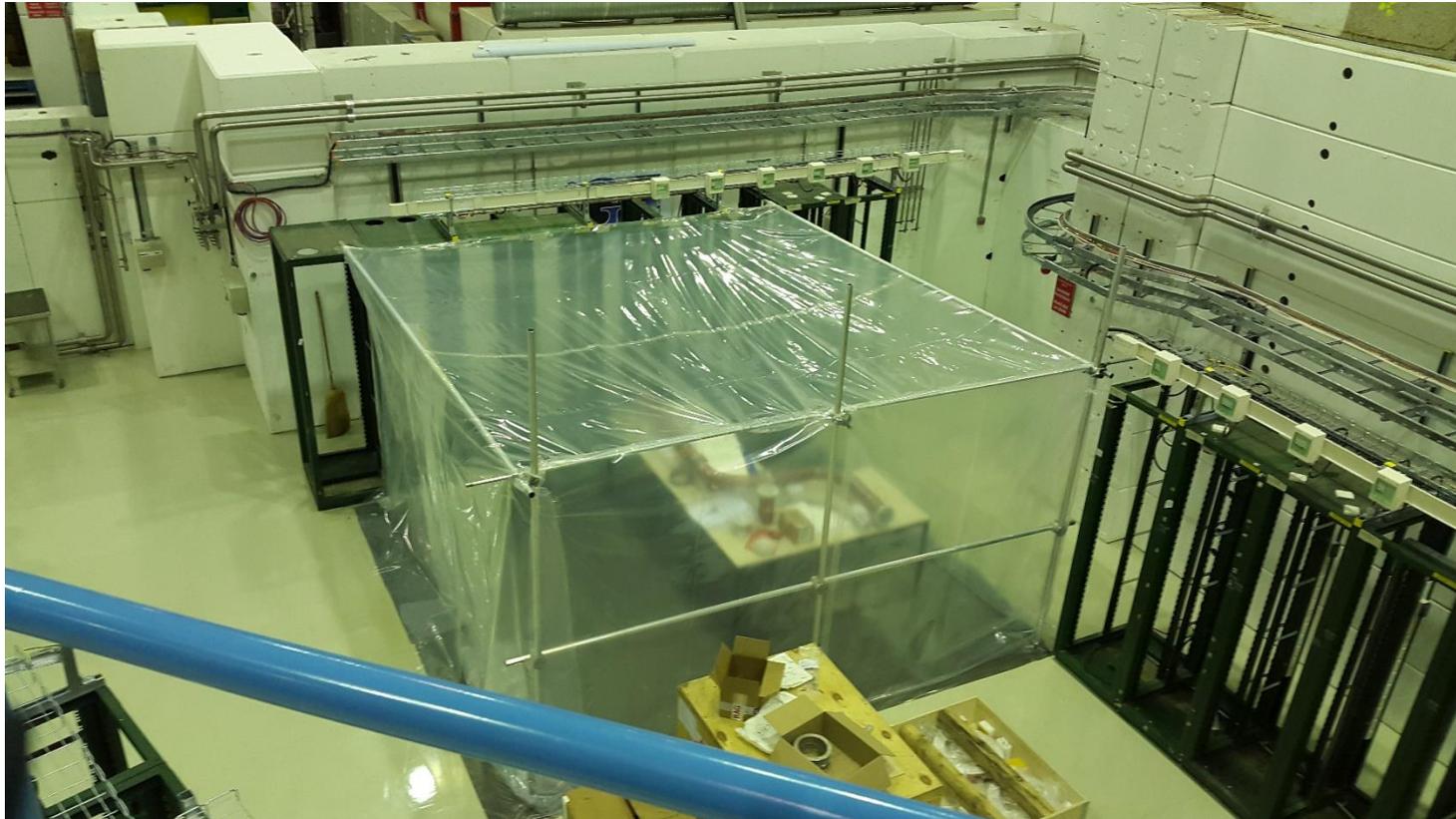
Simulation framework meeting

- We can share in “gbar-simu” project at [Gitlab.cern.ch](https://gitlab.cern.ch)
 - Sharing MM geometry and TOF geometry
 - Sharing detector data taking spec.
- Thickness of Chamber need to be changed 4mm(side),3mm(bottom).
- Chamber height is 600mm
- MM simulation has initial anti-H systematic errors(E,t,position,etc)
←This value may come from Pascal Debu (shared for all).
- Shaper simulation is not required in this stage.

Extra discussion

- MM needs trigger from us (time window is about 100ns)
 - ← Is there anything about trigger in simulation.
- Patrice will be in charged for chamber design and preparation.
 - ← Many steps are left for chamber preparation.
- 3 layer of MM will be prepared at July and we can test together.
 - ← Efficiency of MM will be lower than expectation by noises.

CERN Status



4/27/2017

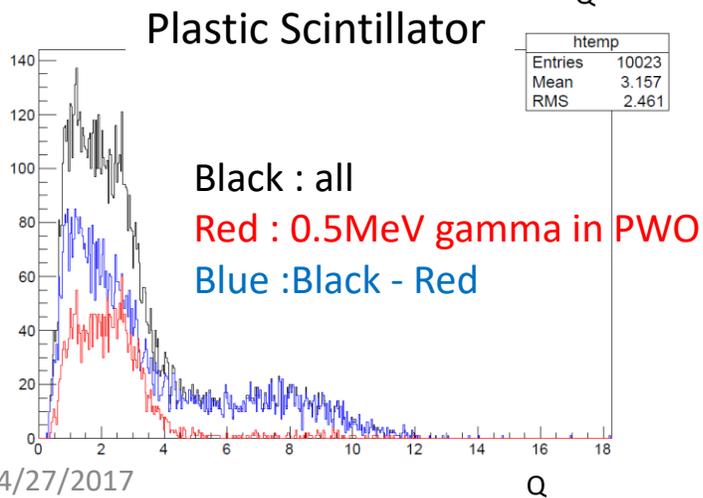
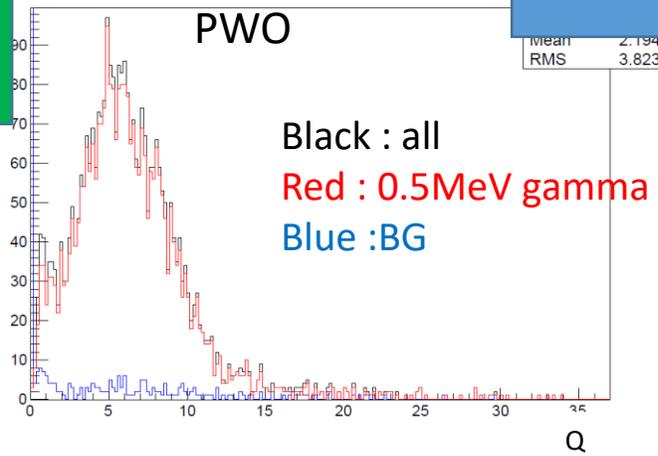
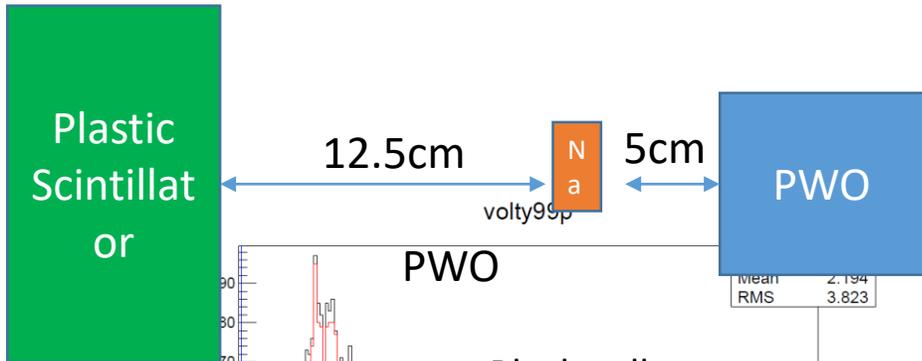
weekly meeting



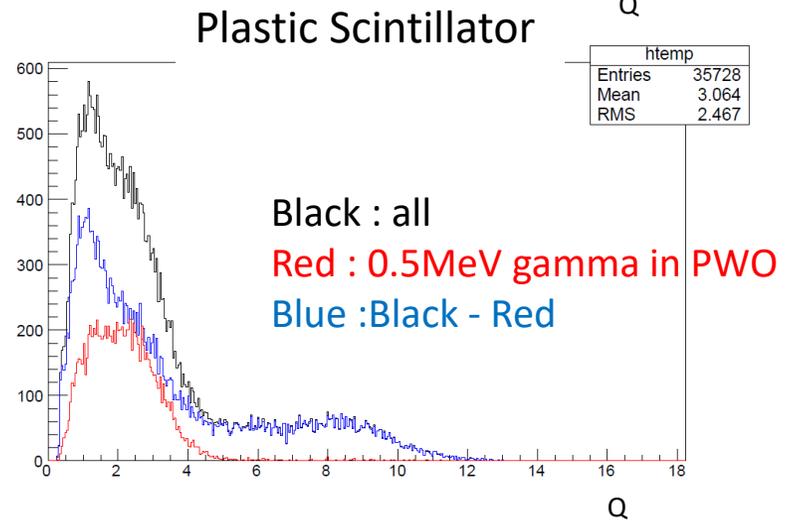
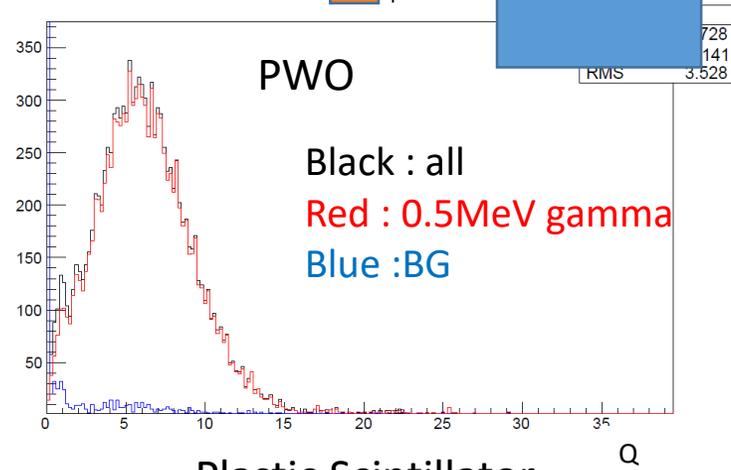
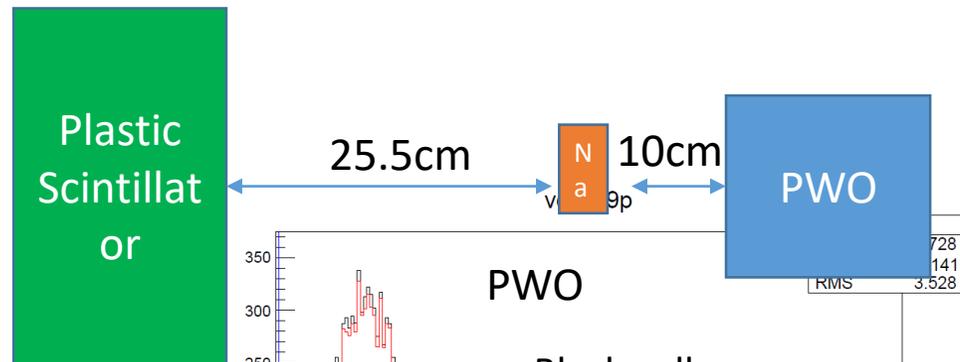
PWO preparation

- Calibration issue
 - Rough efficiency $\sim 100\%$ (long before)
 - Source was too close with detector : more Compton scattering can happen
 - Last time, statistics was too low.
- Calibration is ongoing with 10cm distance (distance btw target &PWO)

Charge distribution

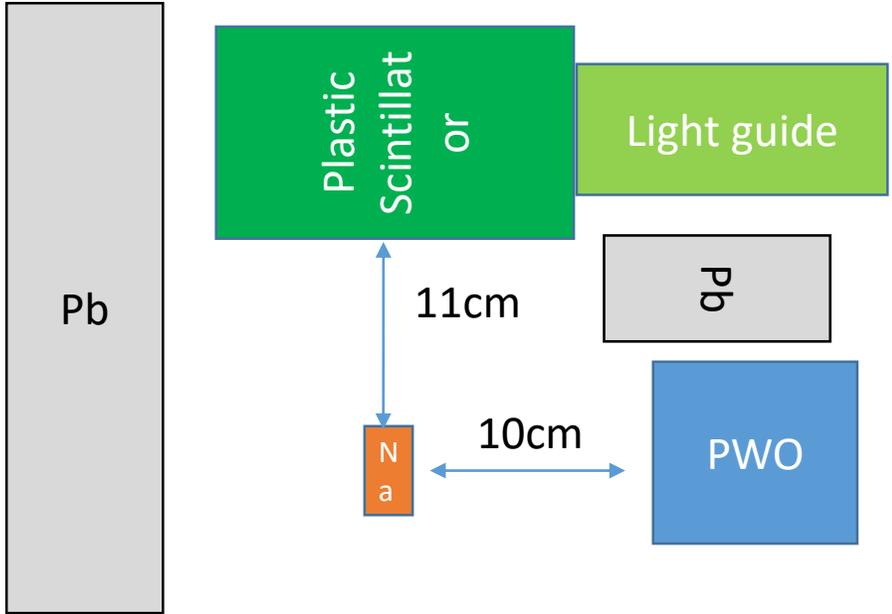
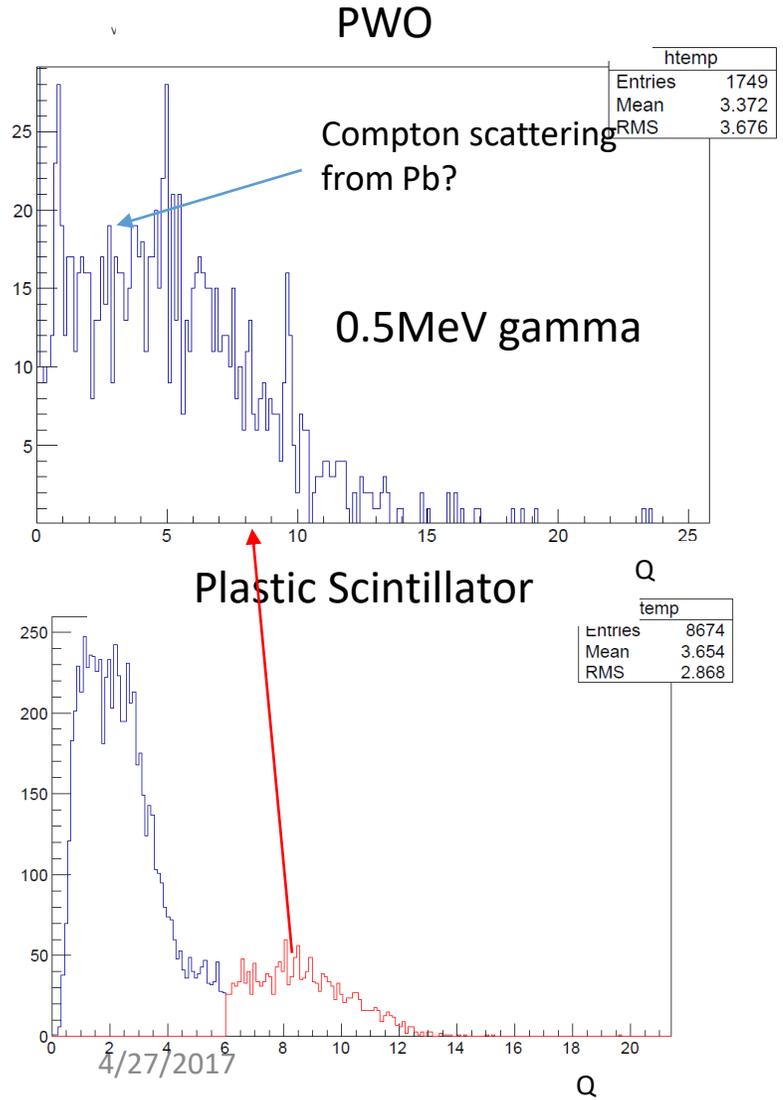


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Efficiency check

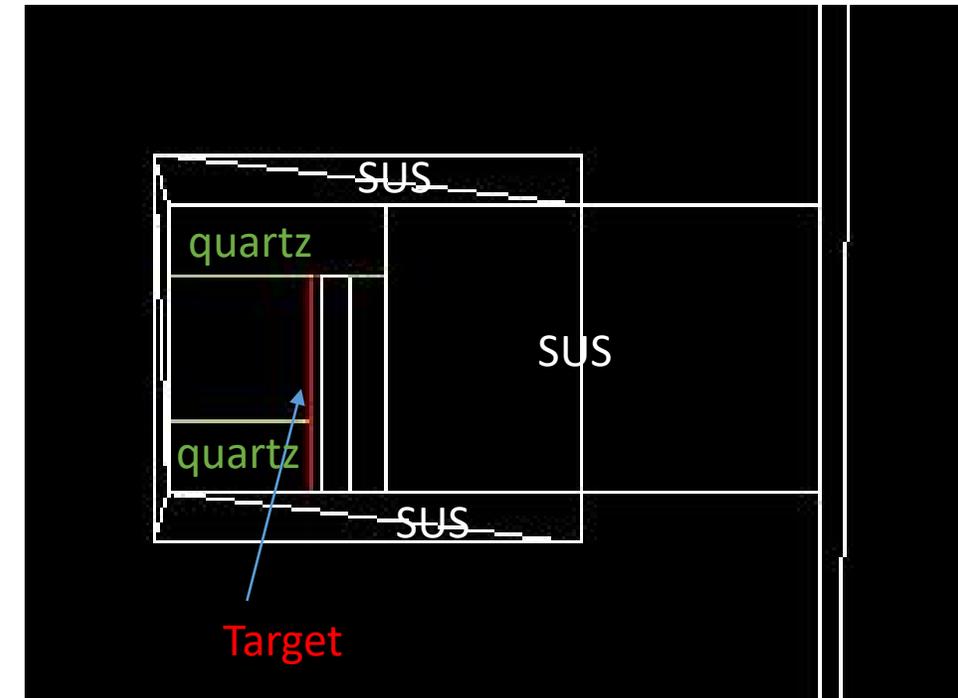


- If we assume all PWO signal comes from direct 0.5MeV gamma, efficiency is about 96%.
 - But if Compton scattered gamma by Pb gives signals, efficiency will be decreased
- Test will be done tomorrow with changing setup.

Positronium simulation

- In simulation, only 80% of positron can pass through film and only part of them hit target.
- Expected transmission rate is btw 80~90%.
- Physics library for positron is changed from standard to Penelope and transmission rate become ~90%.
- But current target is not good enough for current situation.

Target geometry

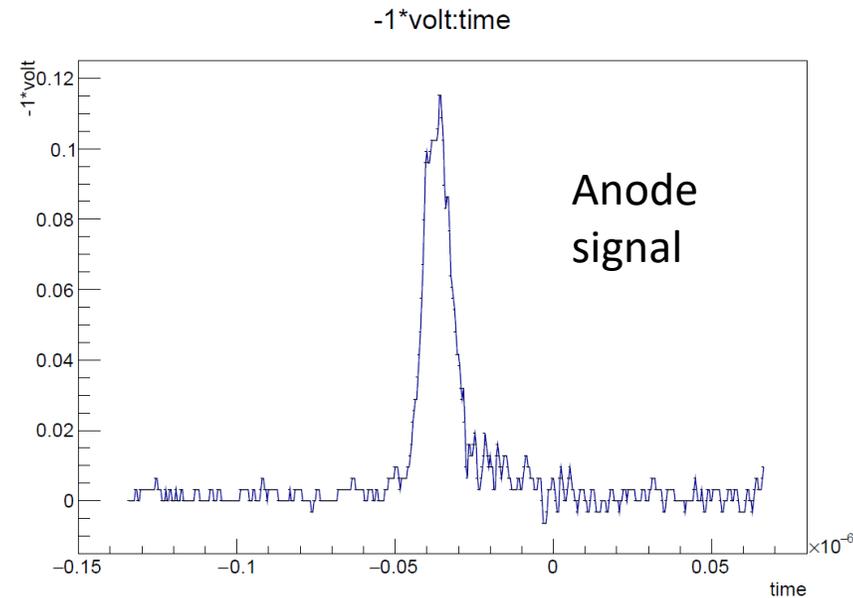
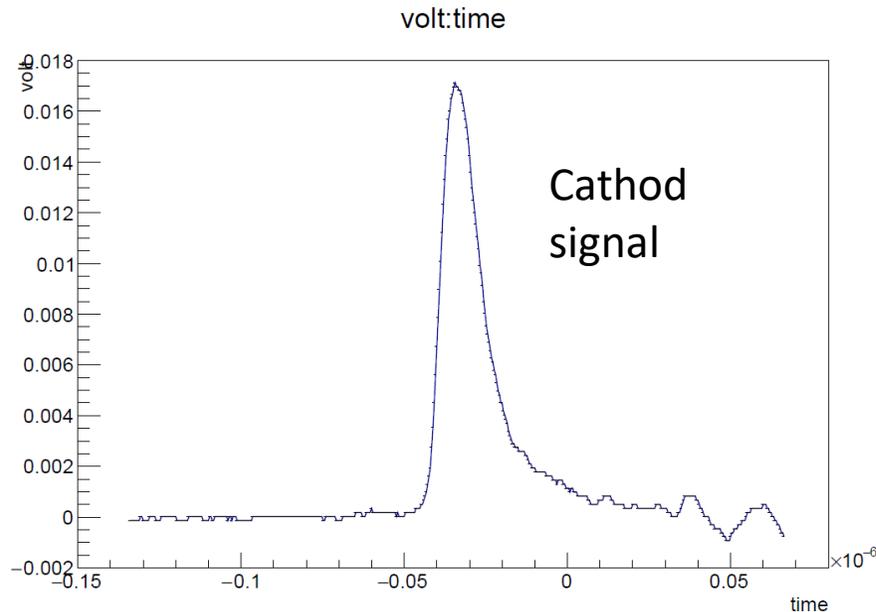


CEA status

- BG trap tuning is ongoing
- Positron lens is installed and HV test is ongoing.
- Positron buncher will be installed in this week or next week.
- Proton beam preparation still has problem...
← Davide from Orsay Univ. came and discussed with proton beam preparation. (many things left to do)
- Expected beam size is about ~cm order and it's too big for 2mm target cavity.

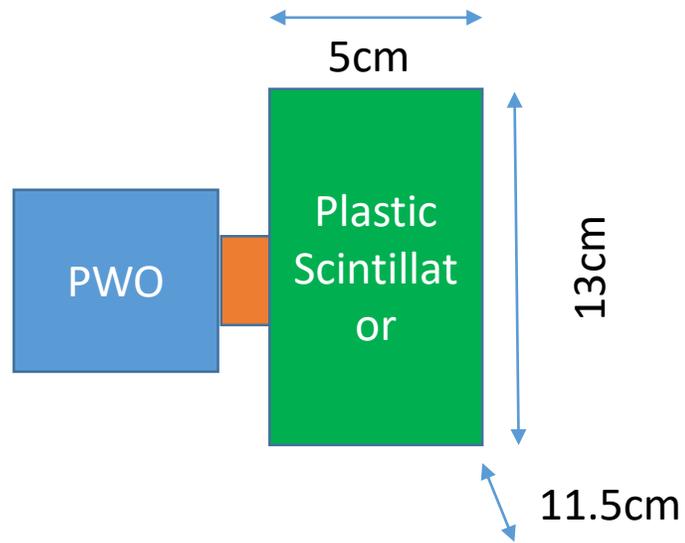
Test with Cherenkov detector

- At last week, I helped student from Calipso experiment to measure positron beam by Cherenkov detector in GBAR.
- Tomorrow, I will test PWO detector with her detector to compare



Backup

New setup for precision

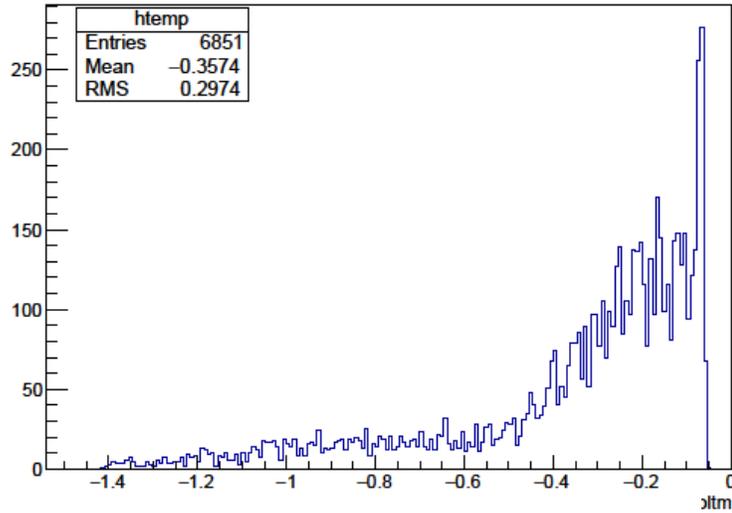


- ^{22}Na source is in center of two scintillation materials
- ^{22}Na decay
 - 1.275MeV gamma(99%),
 - 0.543MeV beta+ (90%) ← will be annihilated inside source or surface of detector

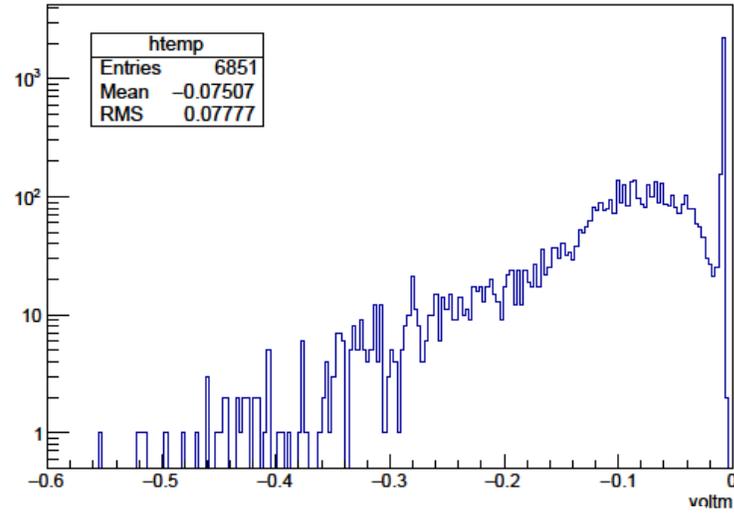


Signal information

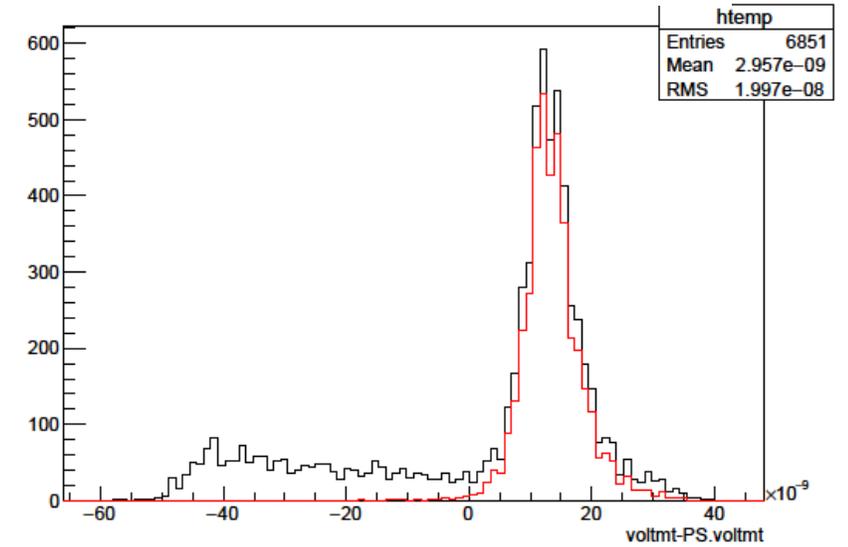
PS peak height distribution



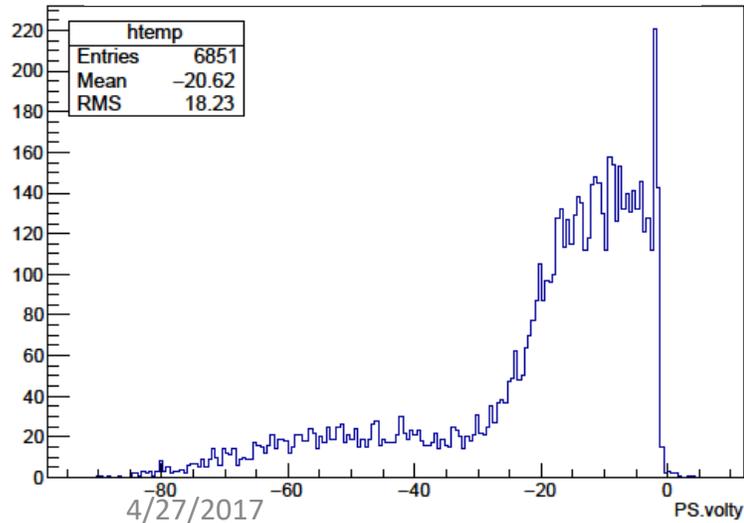
PS charge height distribution



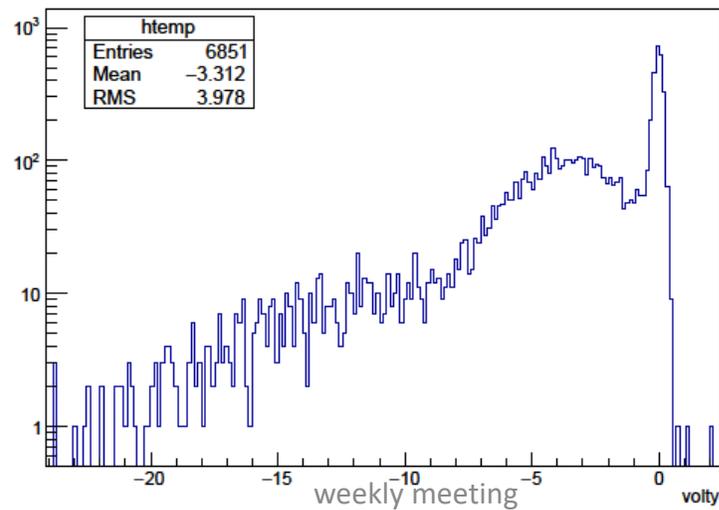
Δt distribution



PWO peak height distribution



PWO charge height distribution



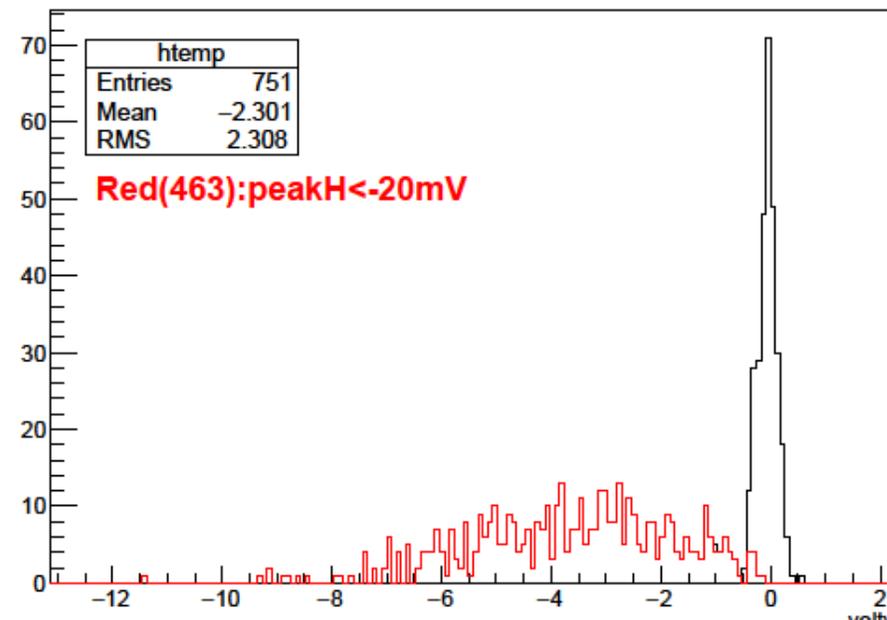
Efficiency check

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

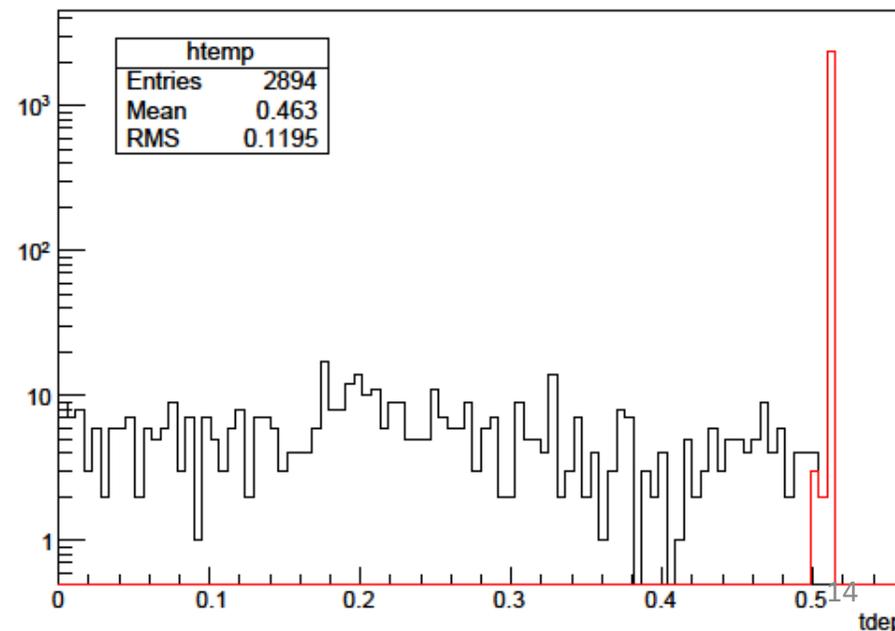
Too big error... How can we improve?

(depart source from detector)

→ Beam data will be used to improve.



Deposit E distribution (simulation)

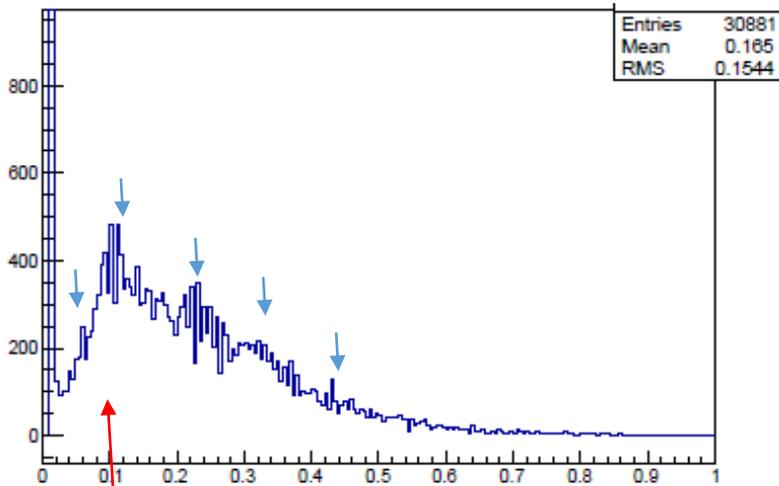


Test with high gain

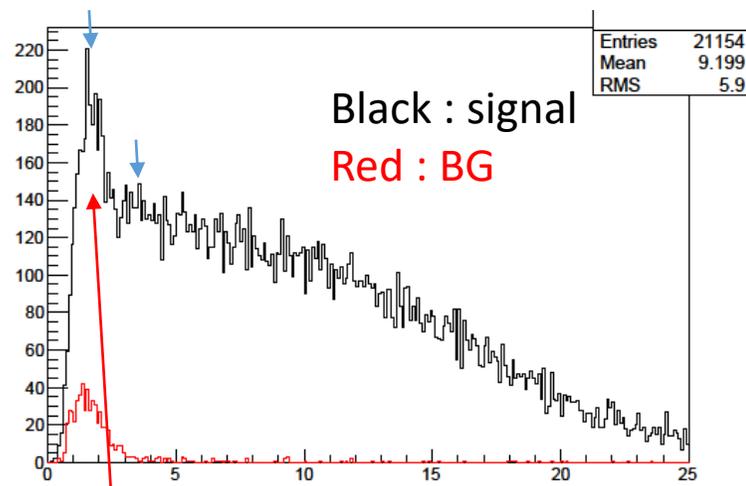
- HV changed from -2kV to -2.3kV

→ Gain increase 2.5 times from $8e^6$ to $2e^7$

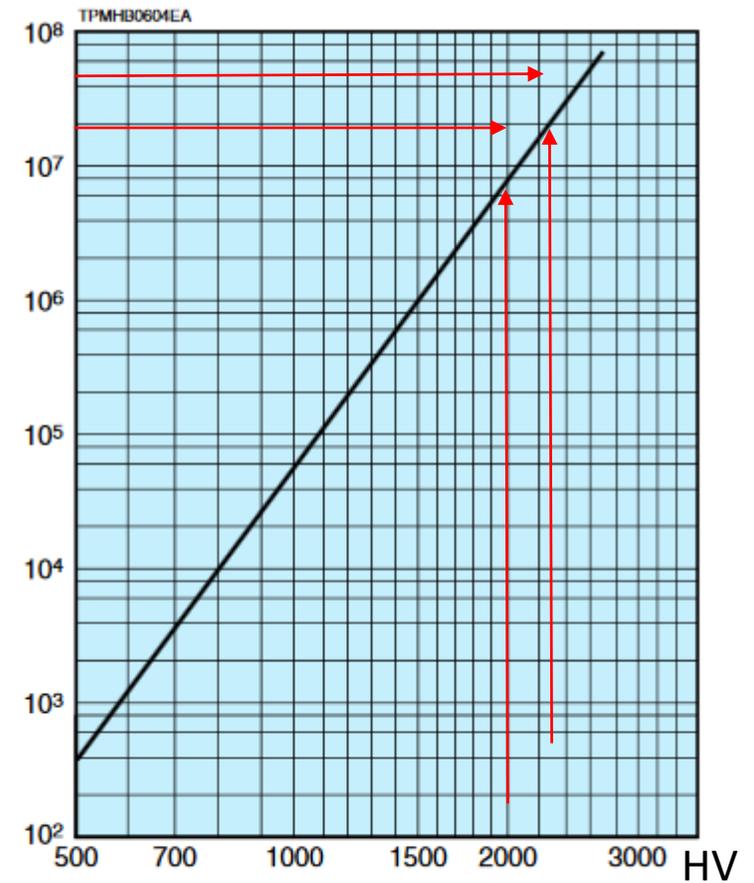
peak height distribution(-2.3kV)



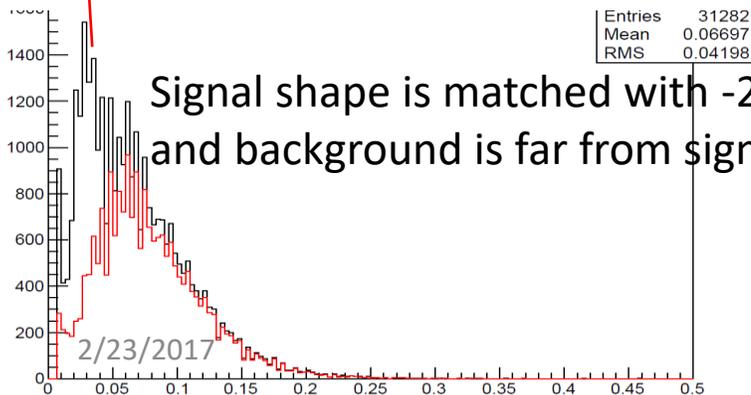
peak charge distribution (-2.3kV)



GAIN



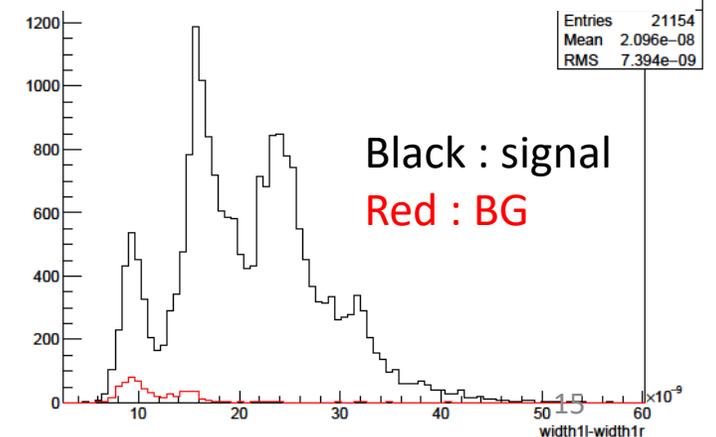
peak height distribution (-2kV)



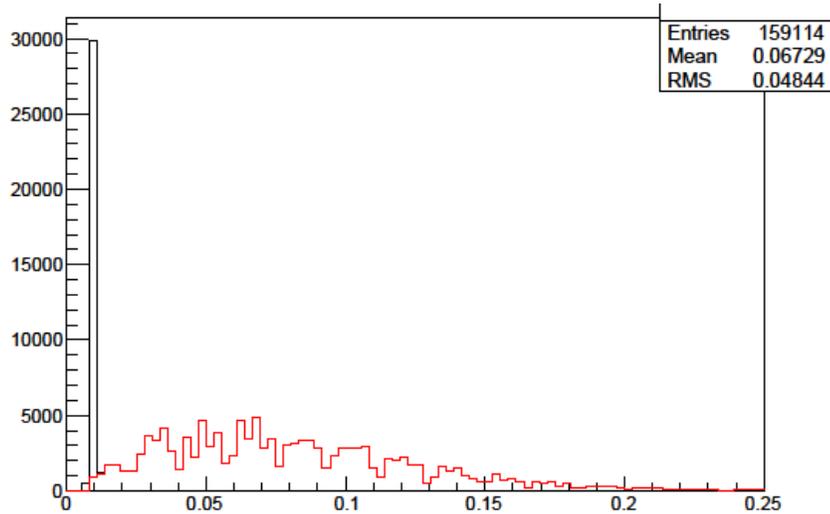
peak charge distribution (-2.kV)



peak width(99%) distribution (-2.3kV)

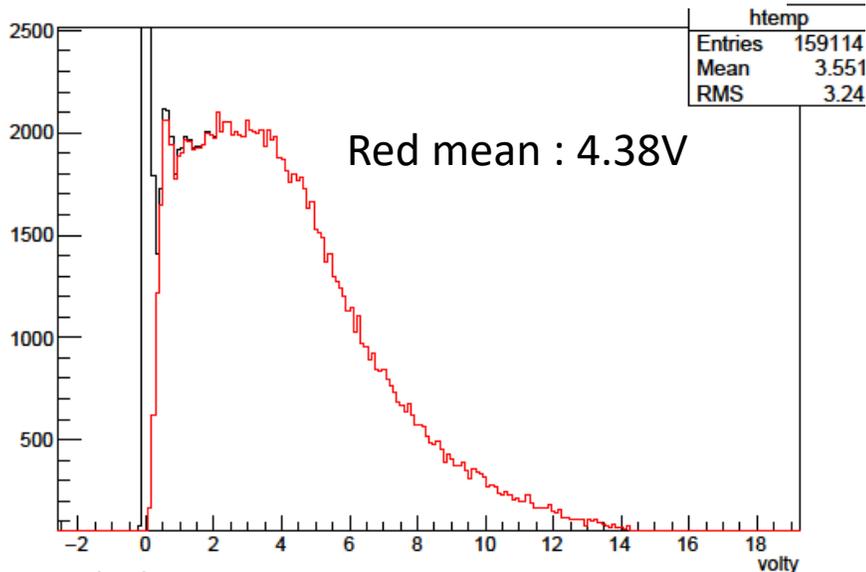


peak height distribution (-2kV)



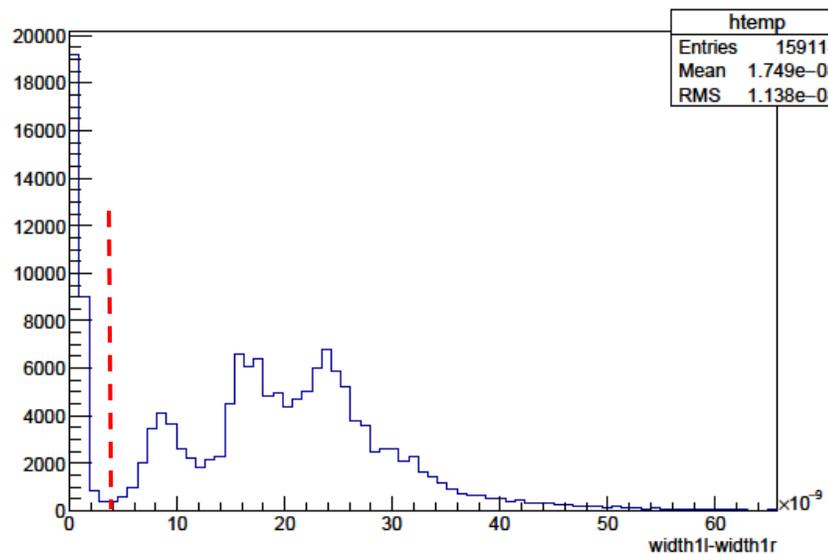
- Intensity($6.1\mu s < t < 10.4\mu s$) = 50.54V
 - Acceptance(ϵ_{acc}) : $16 / (4\pi * 42^2) = 1/1200$.
 - $f_{corr} = \text{mean } V / (\# \text{ of } \gamma) = 4.38V/\#$
 - Positron # = intensity/ ϵ_{acc} /2(back to back)/ f_{corr}
= $6.92e+3$ (other detection : ~ 5500)
- Roughly matched.

peak charge distribution (-2.kV)



2/23/2017

peak width(99%) distribution (-2.kV)



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