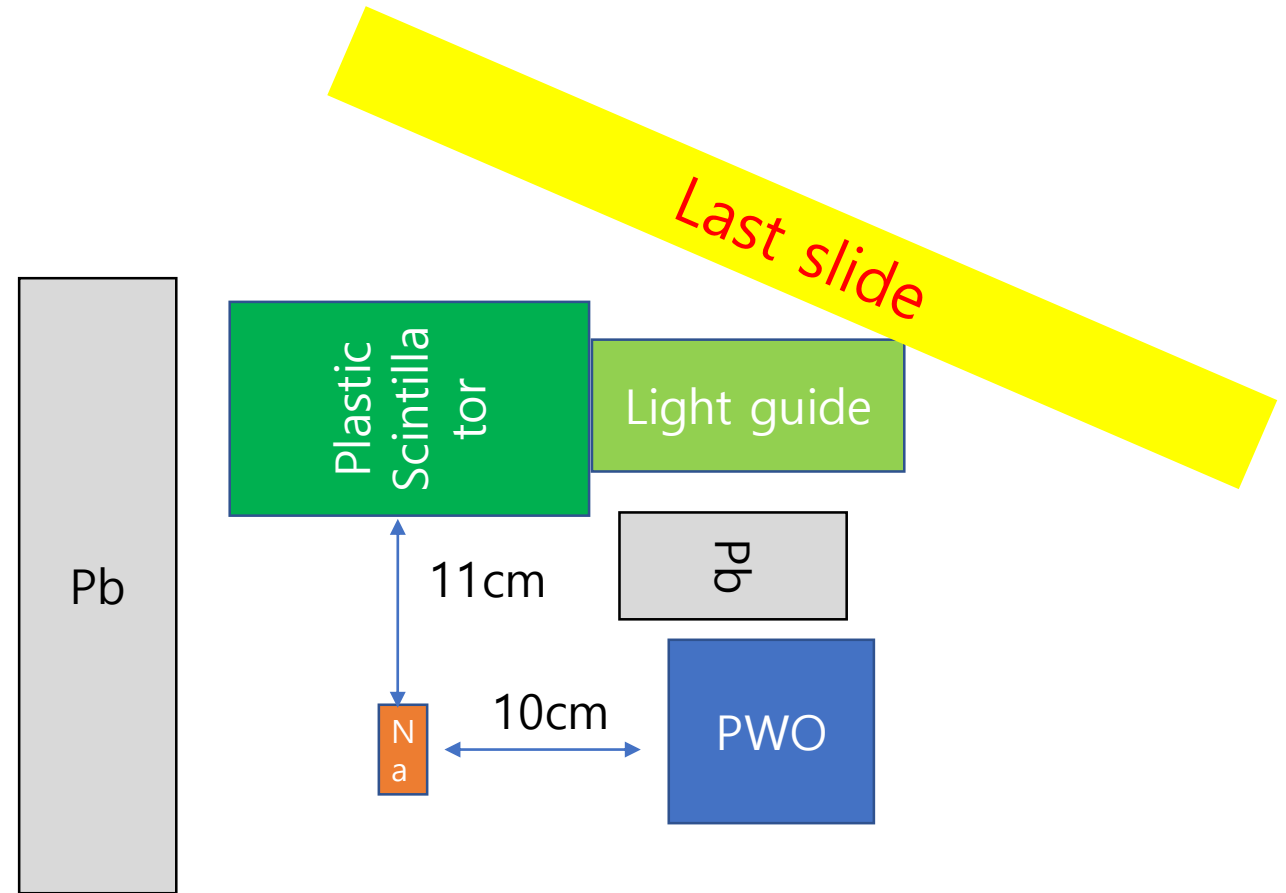
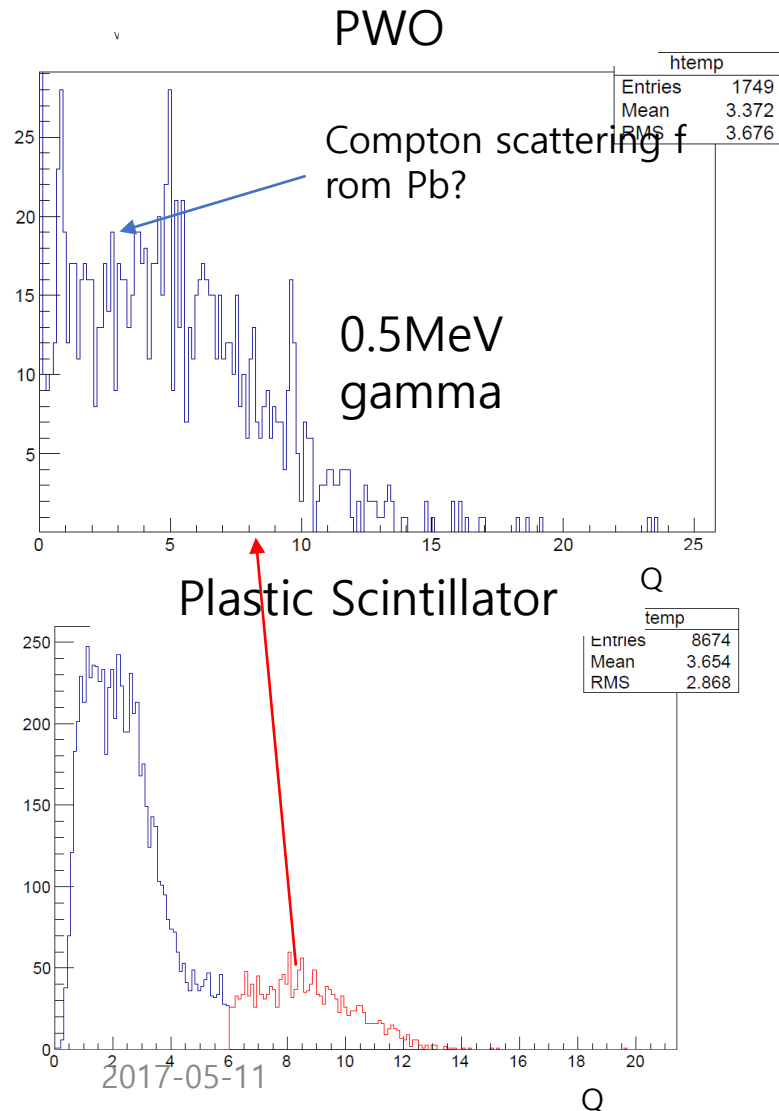


Positronium intensity measurement preparation (GBAR)

SNU

Bongho Kim

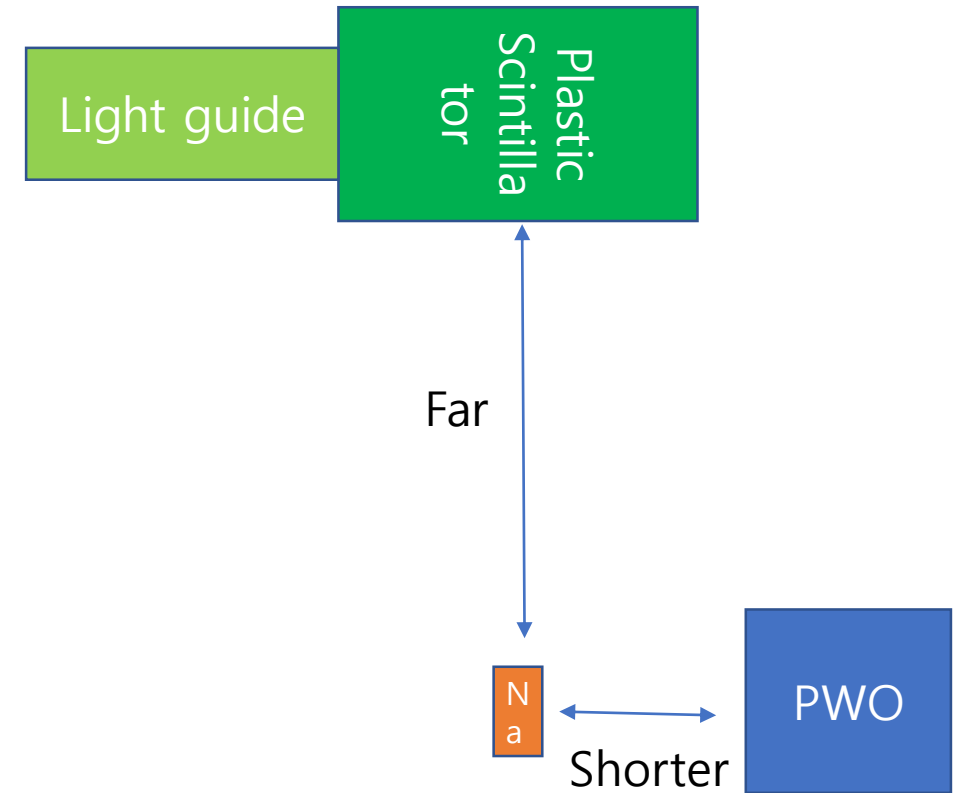
Efficiency check



- 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.

Efficiency check

- Pb block made some background (rejected)
- Short distance btw source and PWO detector has less BG.
- Longer distance btw source and PS detector has less BG.
- Cosmic ray count rate is checked.



Background from Compton scattering

Integral distribution

Yello : Far detector
Blue : near detector
Pink : back to back

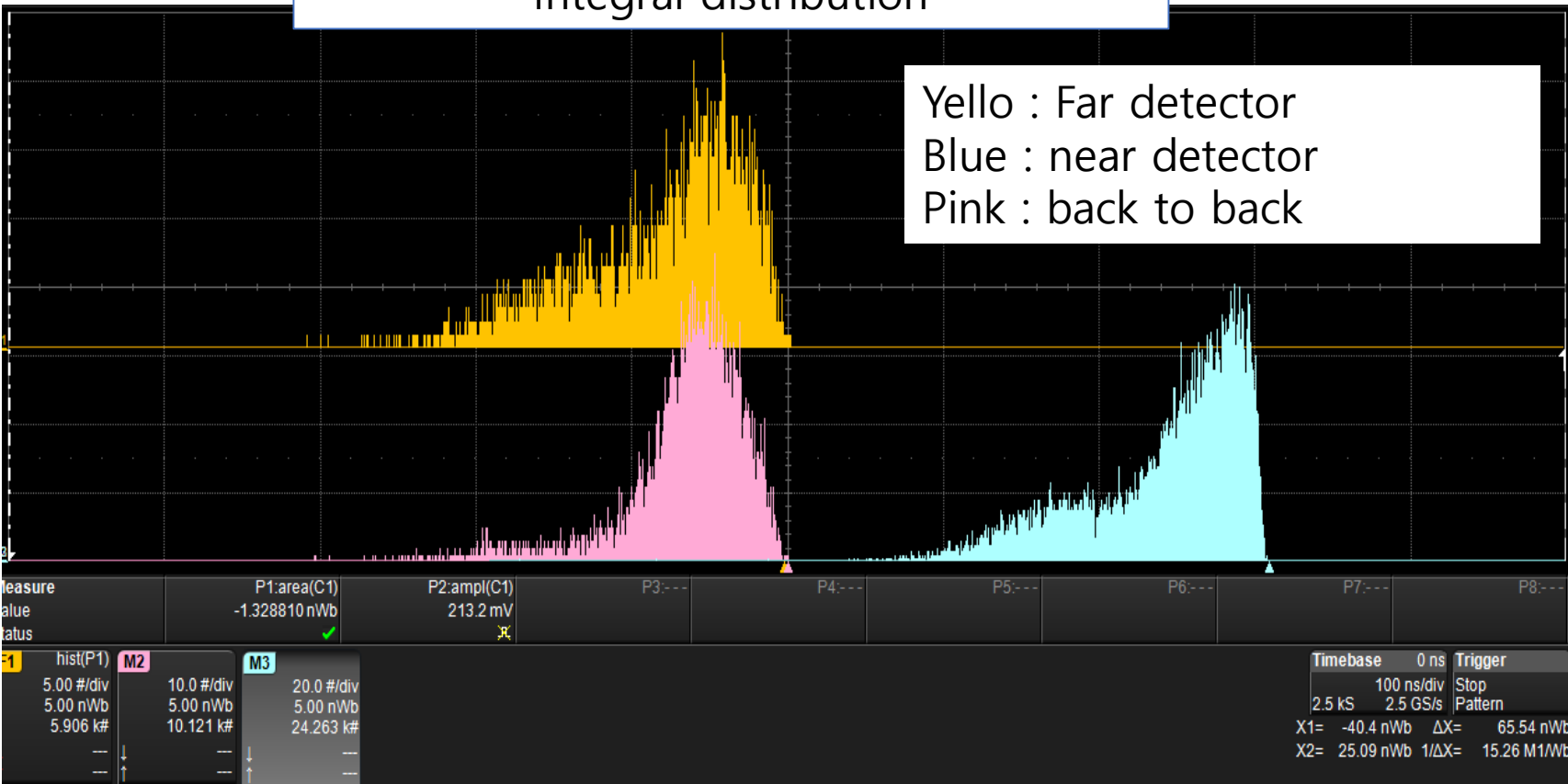
Plastic
Scintillator

5cm → 55cm

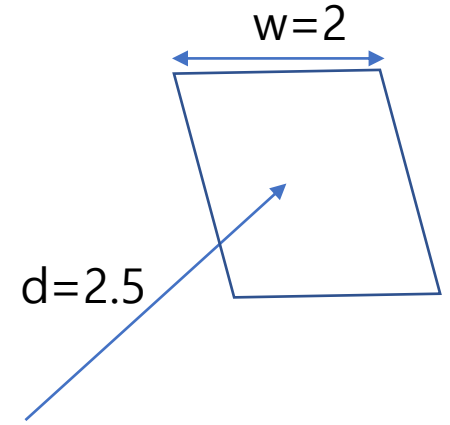
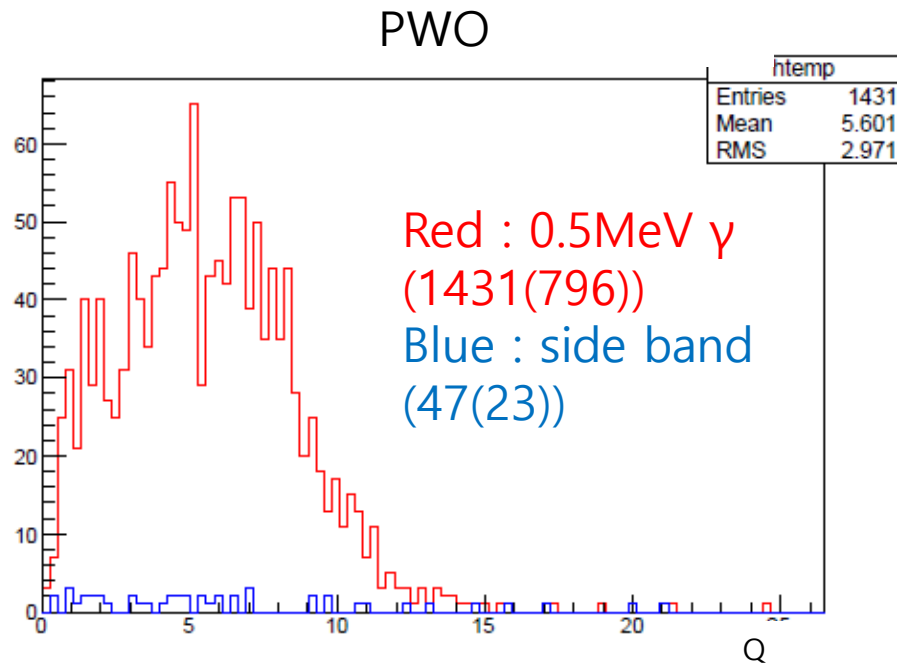
Na

PWO

2.5cm



Efficiency check



- Solid angle

$$\frac{\Omega}{2\pi} = 4 \cdot \arcsin\left(\sin\left(\arctan\left(\frac{w}{2d}\right)\right)^2\right)$$

$$= 0.255$$

Count rate(trigger (PS)) $\sim 3(^{22}\text{Na}) : 1(\text{cosmic})$

$$F_{\text{corr}} = 0.57$$

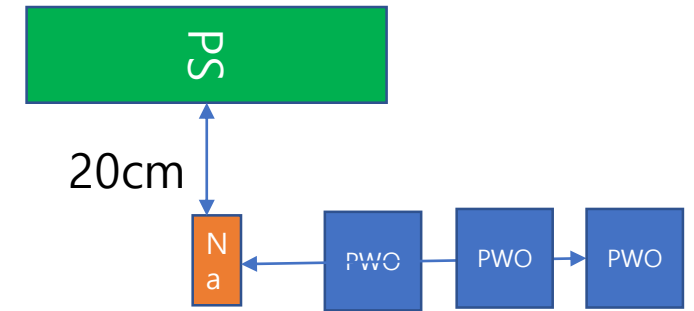
- For 1.2MeV events in Plastic scintillator : 13662

$$Eff = \frac{(796 - 23)/0.57}{13662 * 0.255 * 0.75} = 51.9\% \pm > 2\%$$

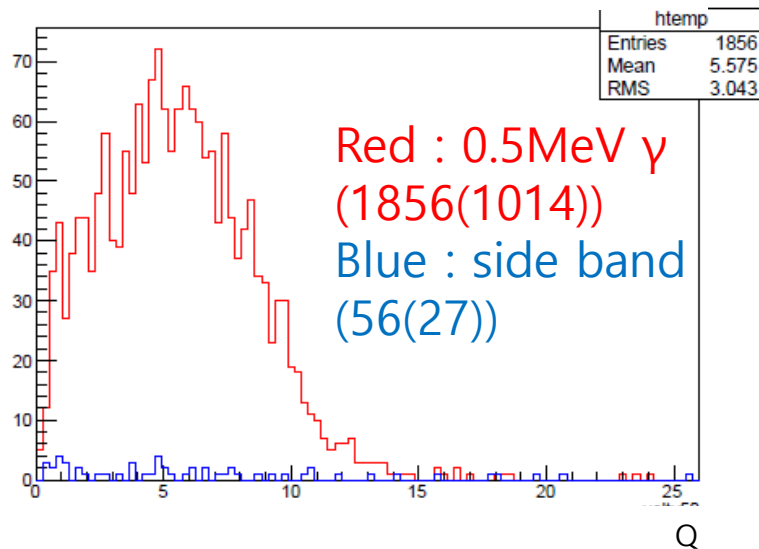
- Lower than expectation : Need to check with longer distance

← Because detector is too near to source, many gamma hit edge of crystal and expected energy loss is less.

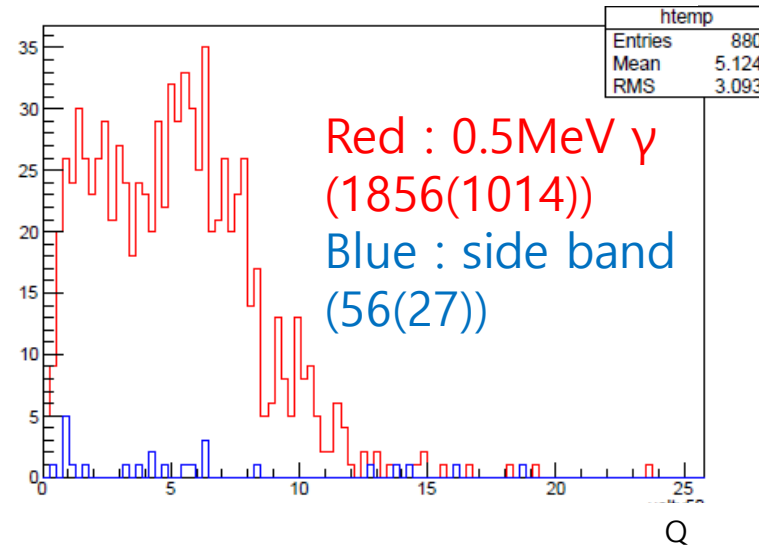
Efficiency check



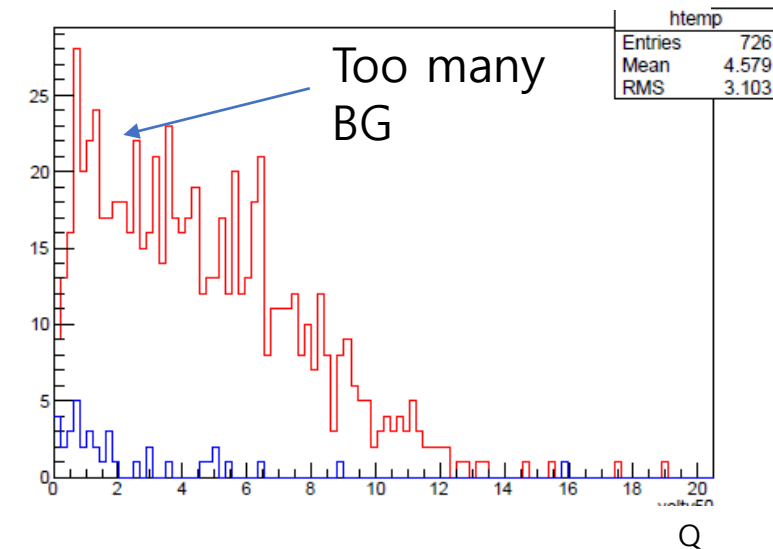
PWO (2.5cm)



PWO (5cm)



PWO (10cm)



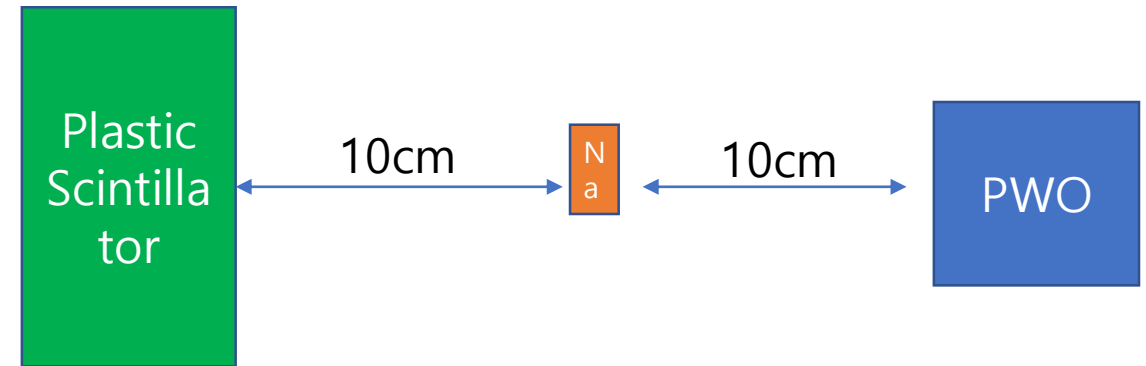
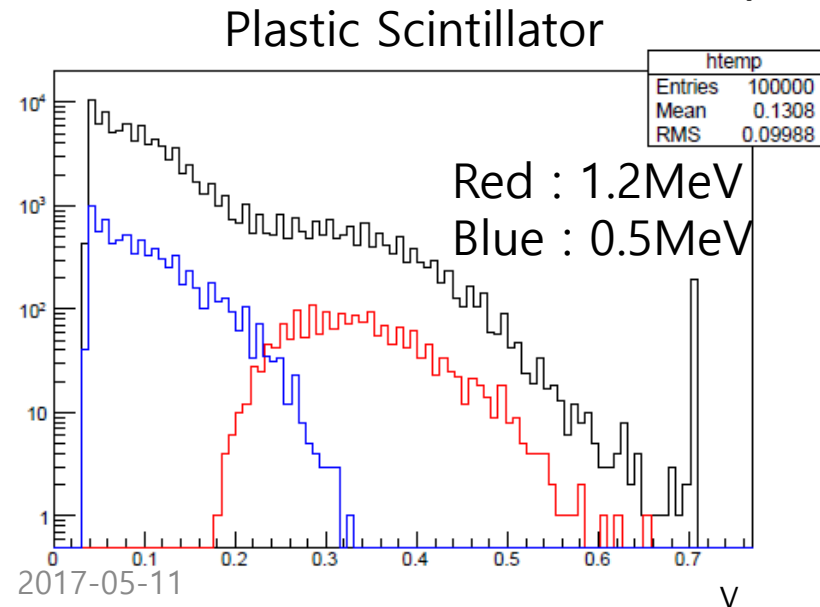
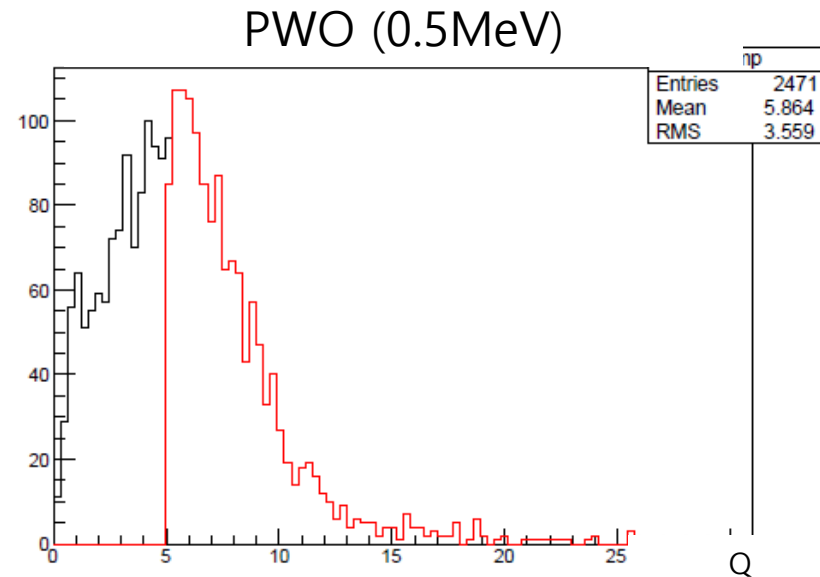
- d(PS-source) : 20cm, d(PWO-source) : 2.5cm, 5cm, 10cm

- $Eff(2.5cm) = \frac{1014 - 27/0.57}{13625 * 0.255 * 0.943} = 52.9\% \pm > 1.8\%$

- $Eff(5cm) = \frac{(441 - 12)/0.57}{13607 * 0.08809 * 0.943} = 66.6\% \pm > 3.2\%$

- $Eff(2.5cm) = \frac{(299 - 5)/0.57}{27381 * 0.02449 * 0.943} = 81.6\% \pm > 4.8\%$

Corrections



- Fraction (red/all) = $(1402-5)/(2471-24)=0.57$

Signal rate : 0.943

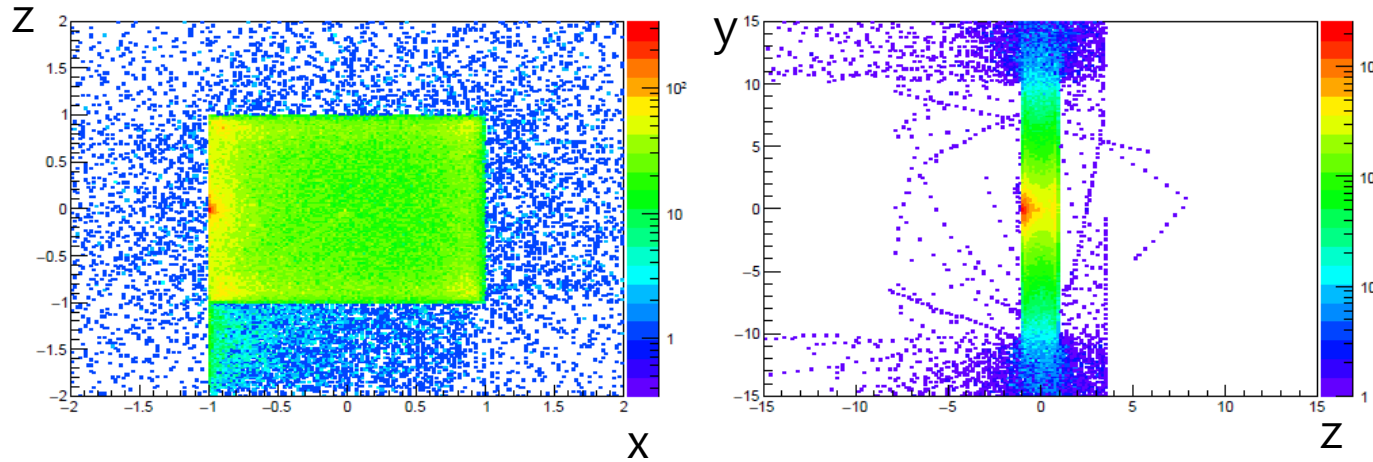
← Count rate

- 75.76#/s for 1.2MeV (height>0.3V)

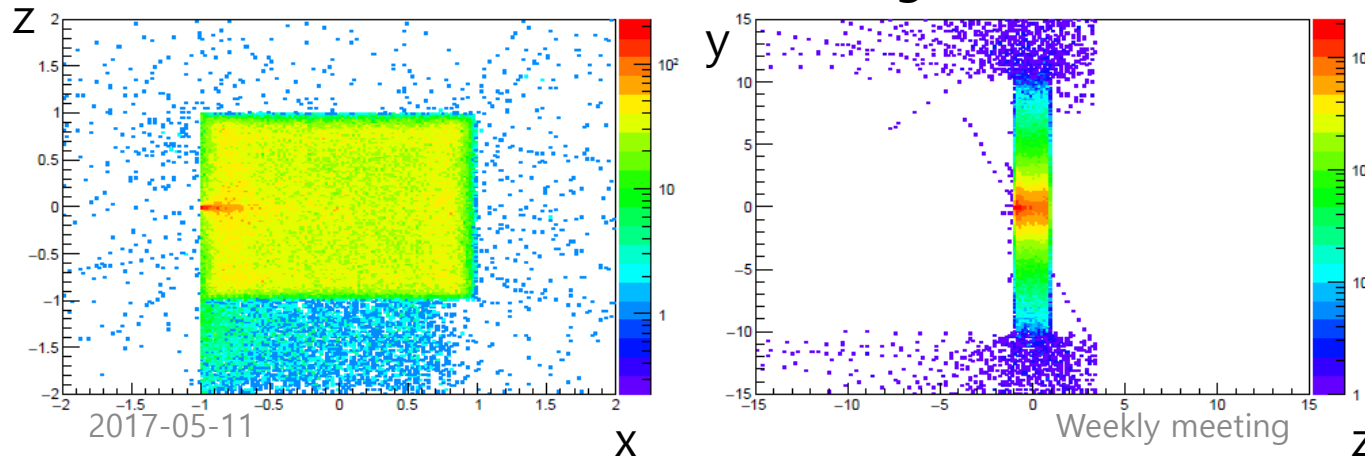
- 4.55#/s for no source

Positronium simulation

Isotropic scattering



Lambert scattering



- Timing distribution had problem and it's solved
- In isotropic scattering, many positroniums are stuck at edge.
- In Cosine (lambert) case, more positroniums stay in target and shows uniform x-z distribution.

CERN & CEA status

- CERN
 - Linac may start, Likan trap packing from June
 - Test with target from July
- CEA
 - Proton source test soon
 - Antion chamber and BG trap connection in next week.

To do list

- PWO efficiency is btw 60~90% but more study is required.
 - ← Larger distance to see efficiency be stable
 - ← More statistics for 10cm with less noise
- Antion chamber will be connected to BG trap next week (water cut in CEA)
- Upload simulation in Gitlab.

Backup

Charge distribution

Plastic Scintillator

12.5cm

Na

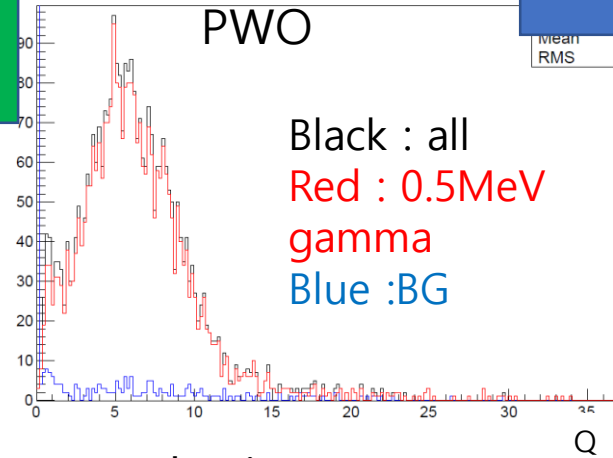
5cm

PWO

PWO

Mean	2.194
RMS	3.823

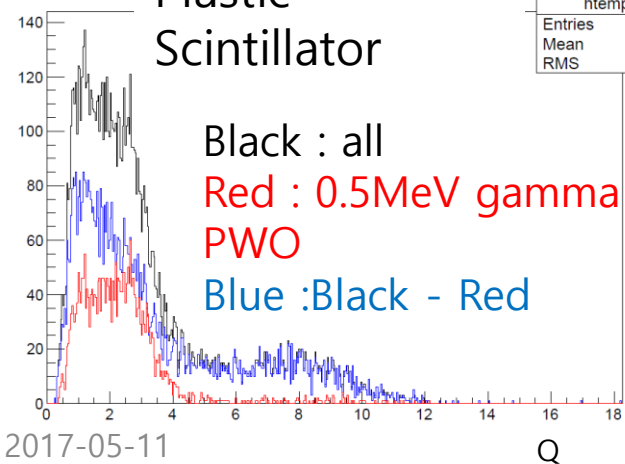
Black : all
Red : 0.5MeV gamma
Blue : BG



Plastic Scintillator

htemp	
Entries	10023
Mean	3.157
RMS	2.461

Black : all
Red : 0.5MeV gamma in PWO
Blue : Black - Red



2017-05-11

Plastic Scintillator

25.5cm

Na

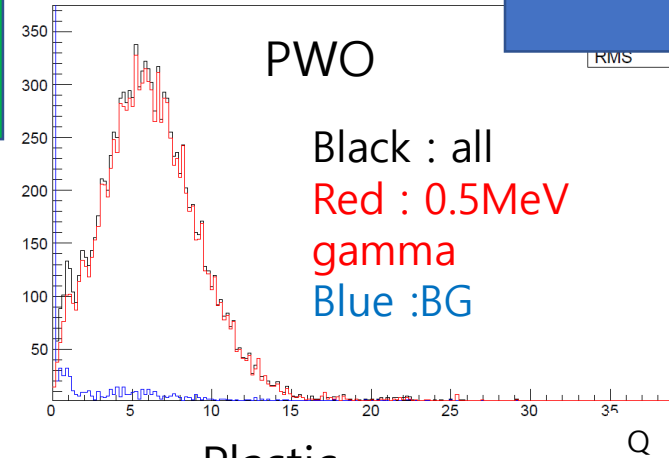
10cm

PWO

PWO

Mean	2.728
RMS	3.528

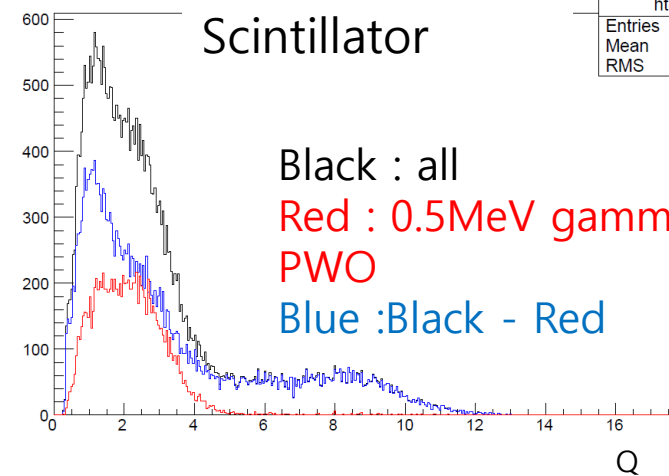
Black : all
Red : 0.5MeV gamma
Blue : BG



Plastic Scintillator

htemp	
Entries	35728
Mean	3.064
RMS	2.467

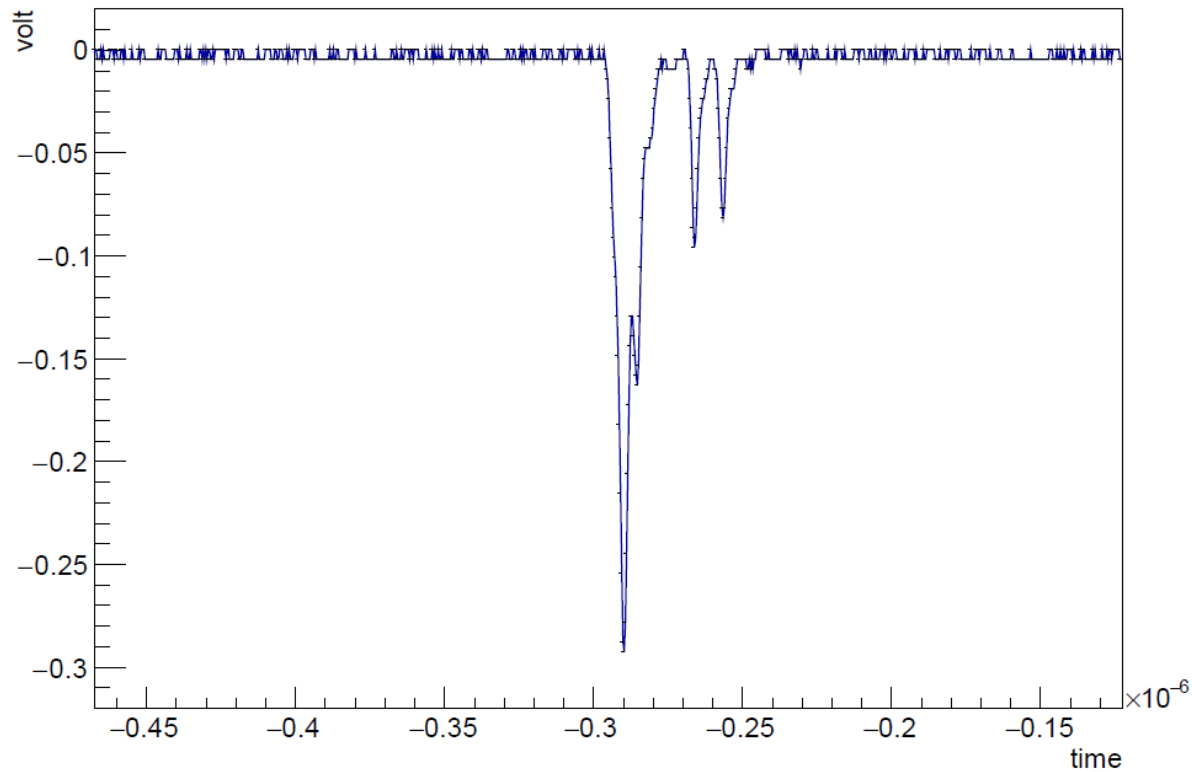
Black : all
Red : 0.5MeV gamma in PWO
Blue : Black - Red



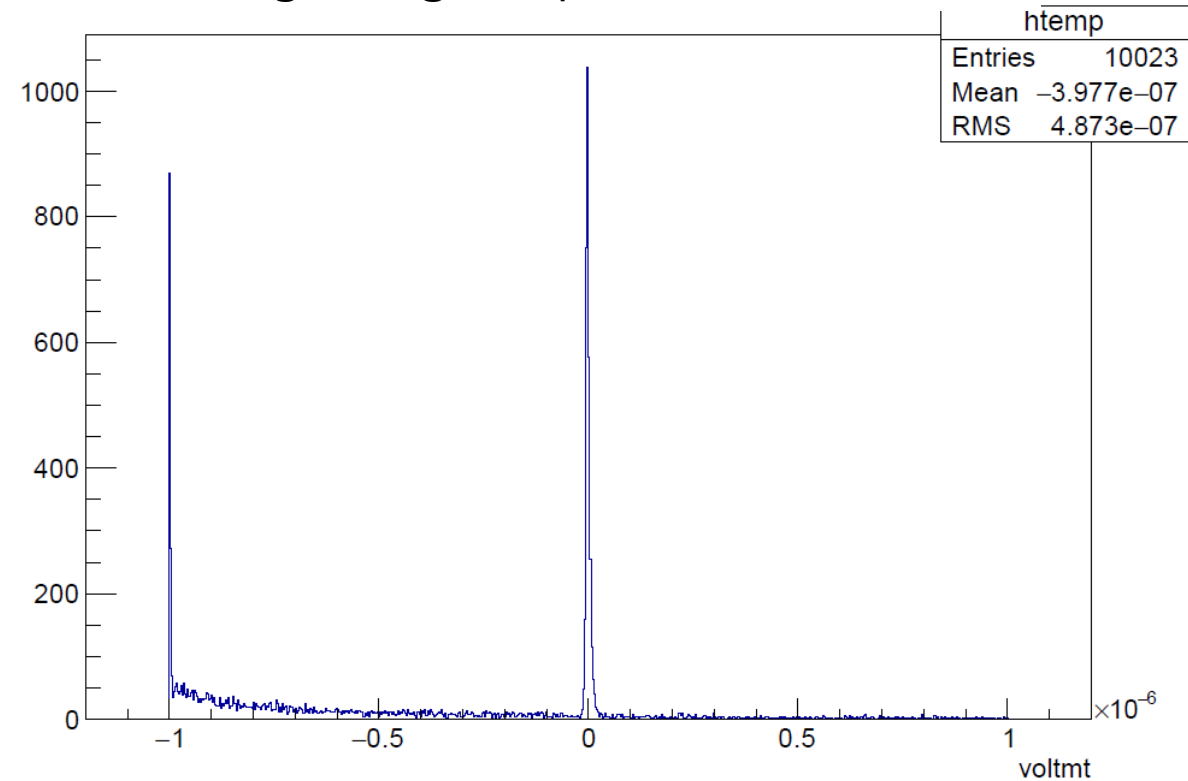
Weekly meeting

12

Raw signal example



Signal(highest peak) time in PWO



- Trigger : Plastic Scintillator only