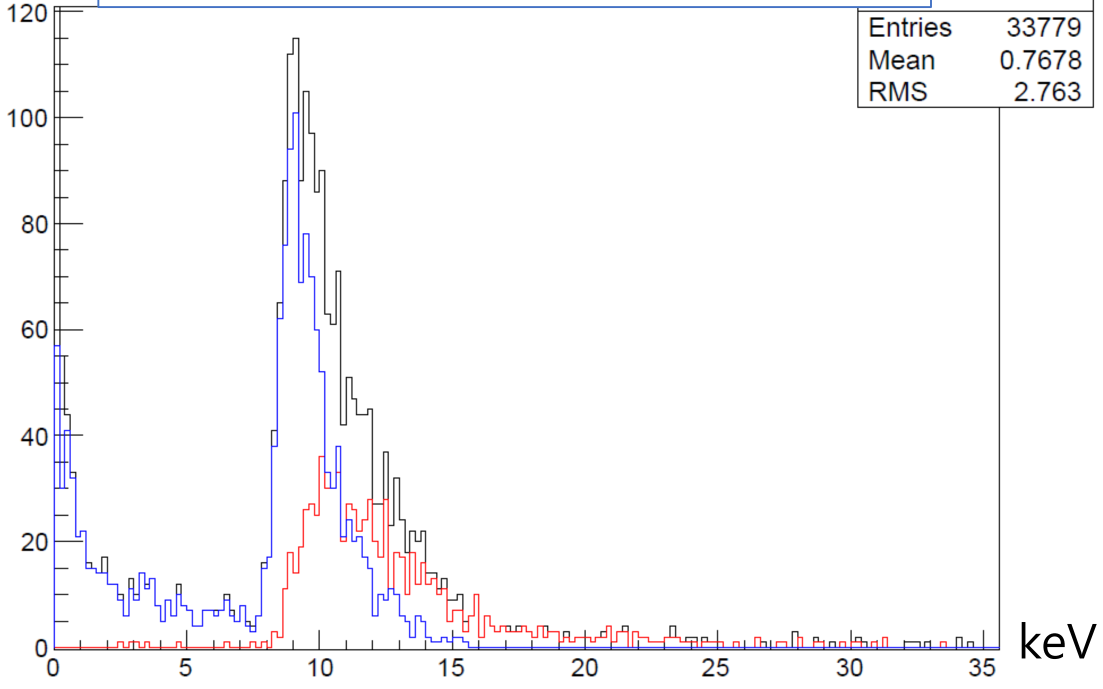
Positronium intensity measurement preparation (GBAR)

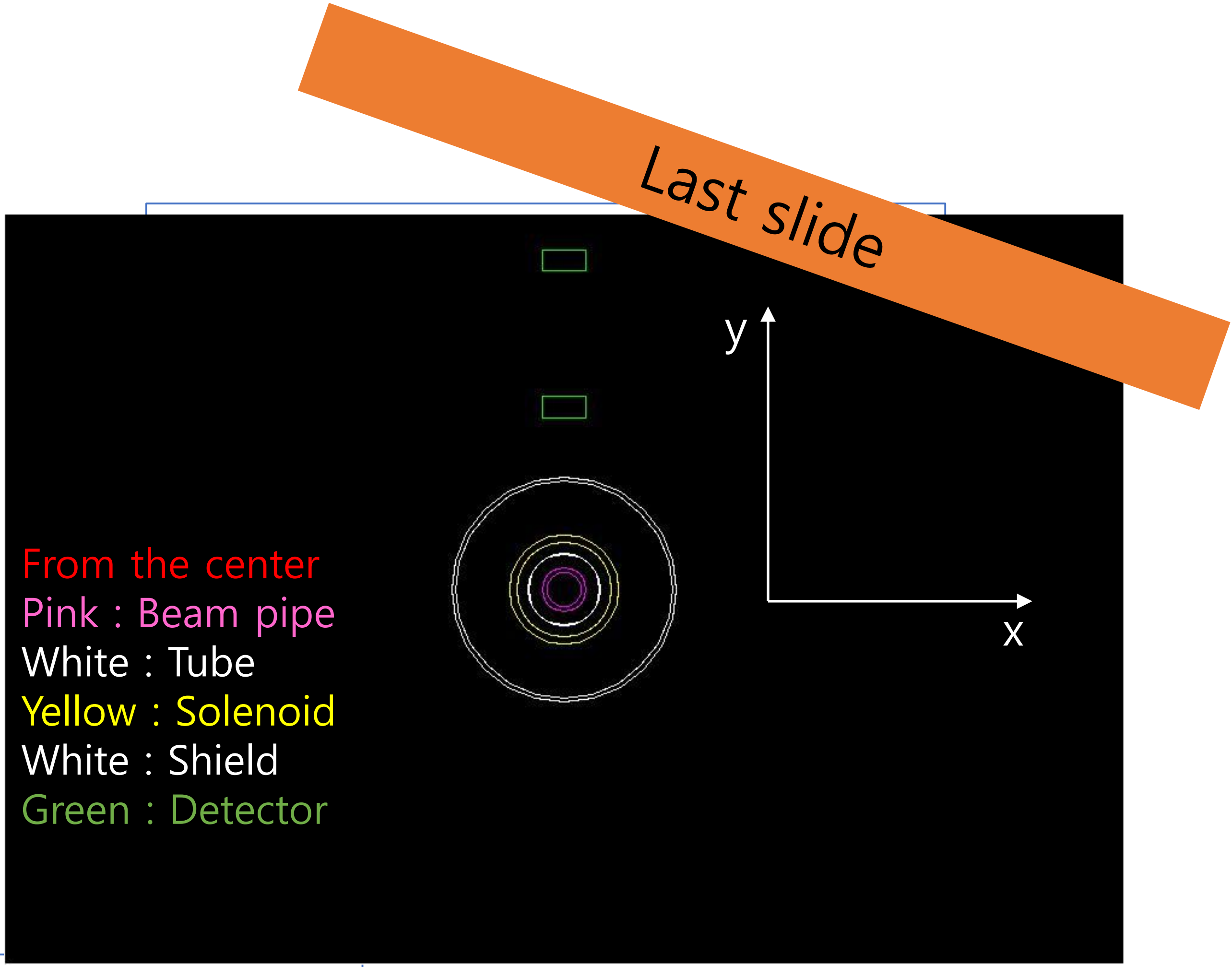
SNU

Bongho Kim

Anti-P tracker

Deposit E (1st detector)





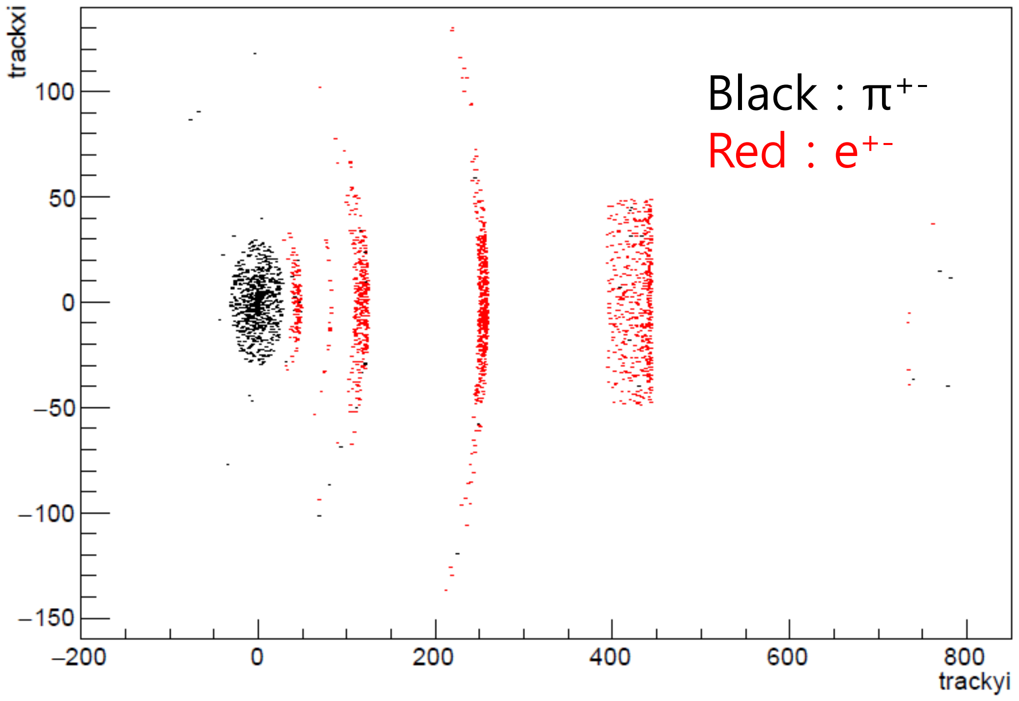
For 50,000 annihilation, 3.45#(π^{+-})/sample (acceptance ~2.3%)

Number of ₩ Iron shiel d	T (10mm)	T (20mm)	T (30mm)
Detected $\pi^{+\&-}$	795	695	584
Detected $e^{+\&-}$	1520	1220	973
S/N (above 8keV)	0.9(691/740)	1.0(595/571)	1.3(507/389)

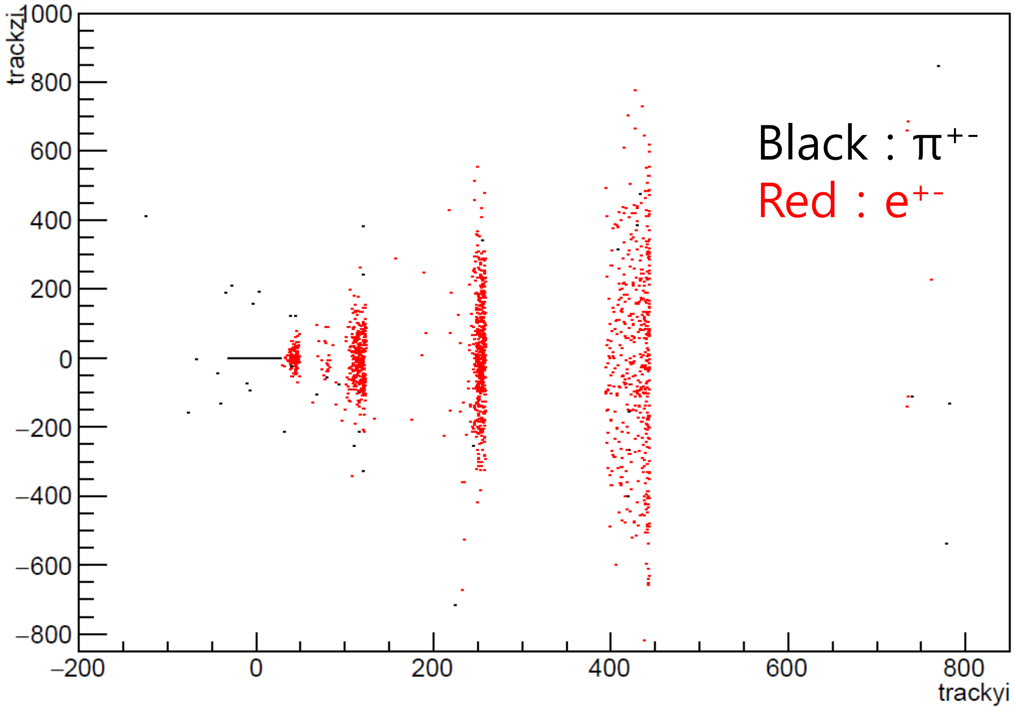
Anti-P tracker

Original position of detected signal

Y0 vs X0 (initial position for detected track)

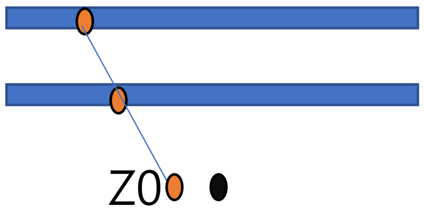


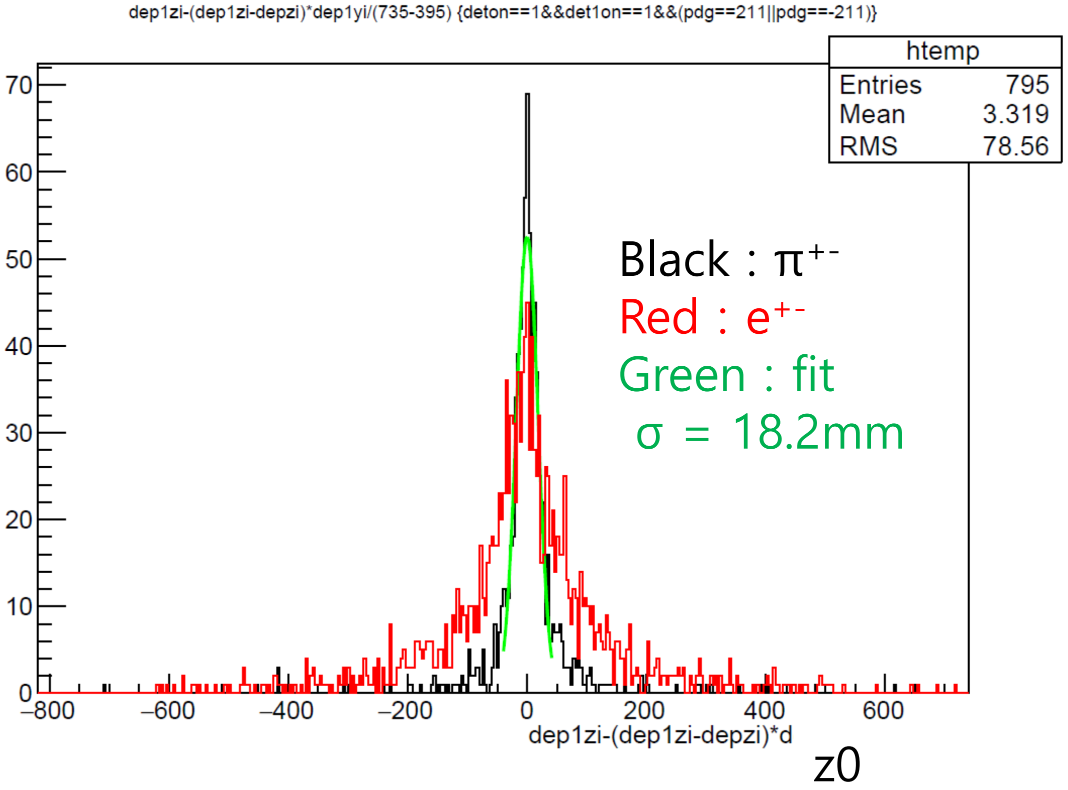
Y0 vs Z0 (initial position for detected track)

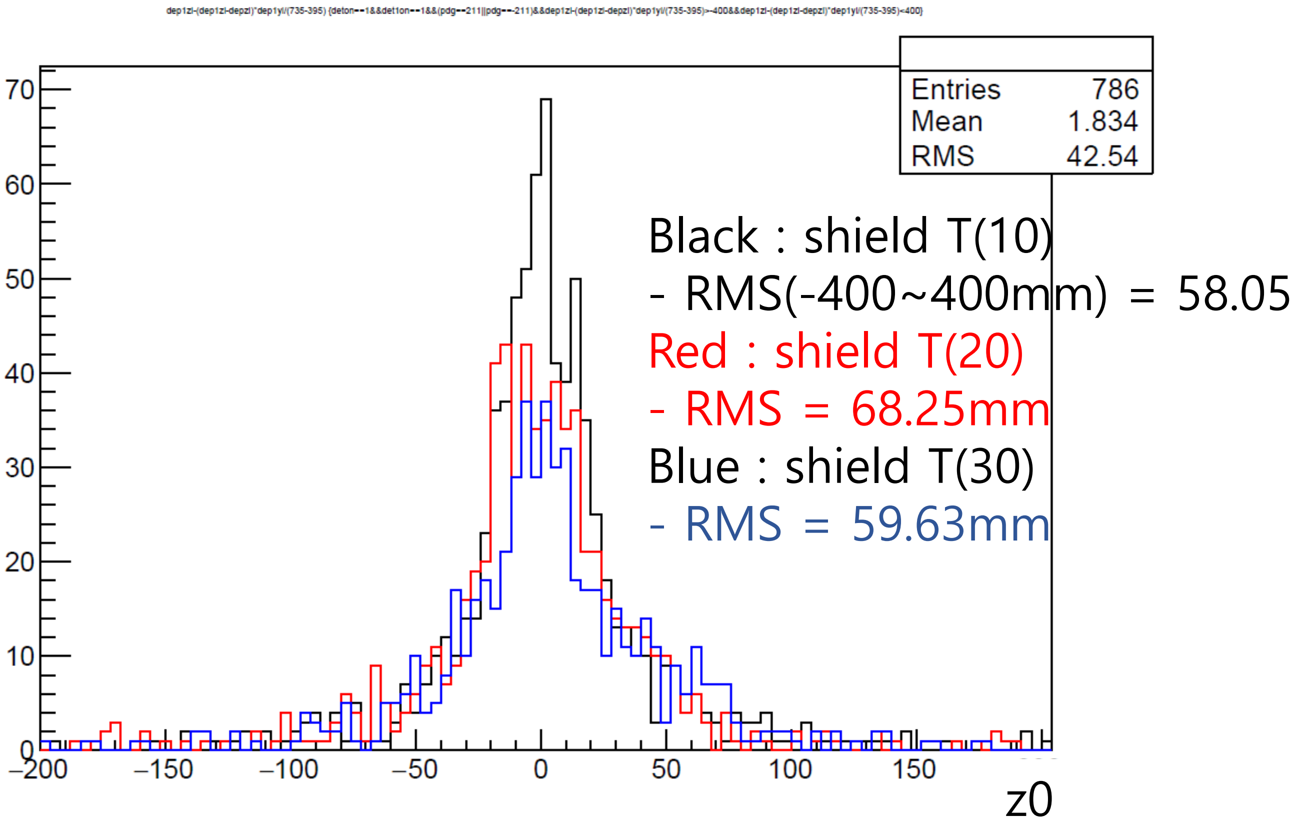


- In this simulation, positron&electron pair is generated by gamma's which hit the outside obstacles.
- Not only scattered pion but also this can ruin to reconstruct annihilation point but I need to study more for this effect.

Anti-P tracker (position recon test)

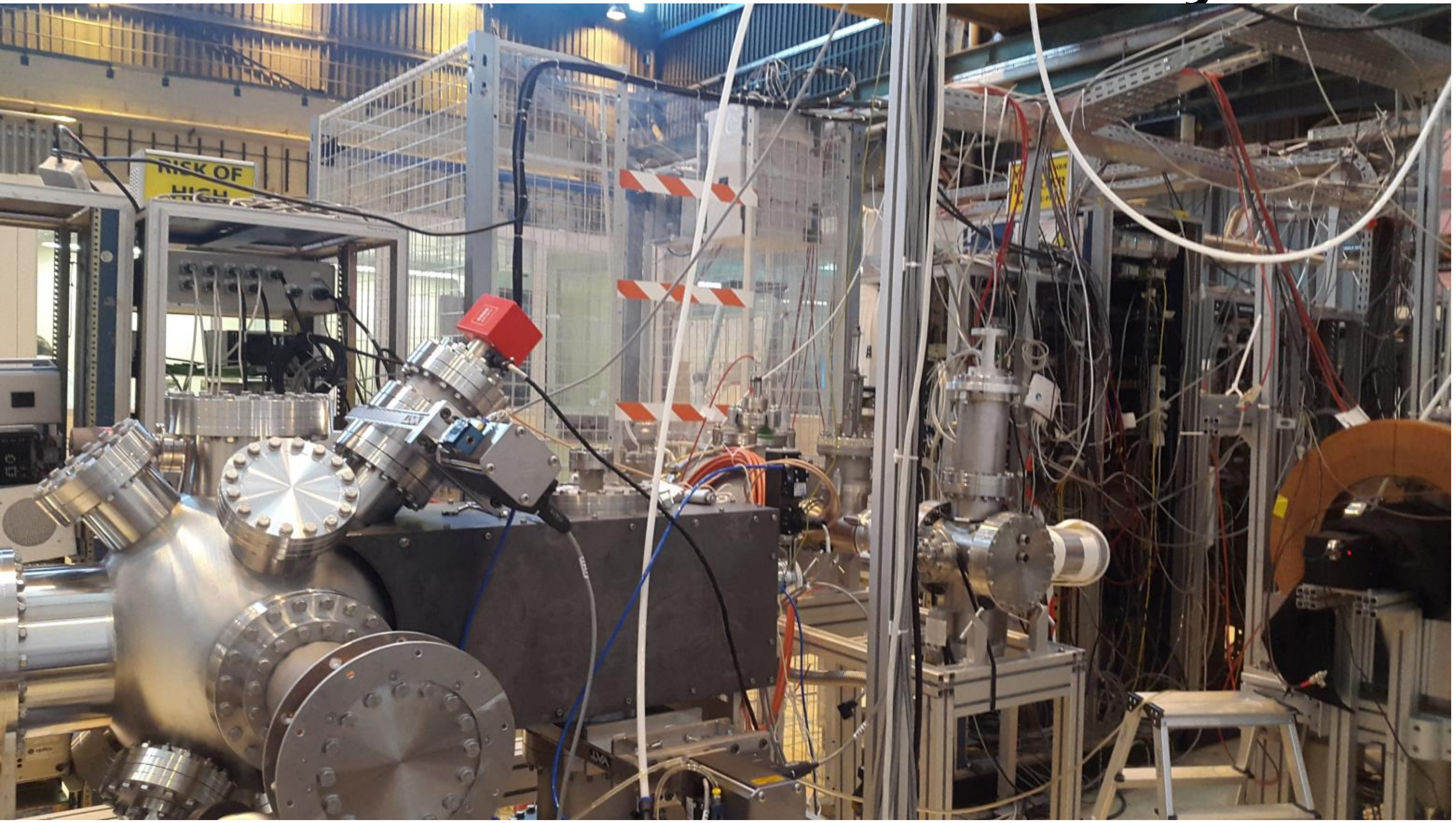






- Resolution changes by M shield Thickness will be checked.

Status in CEA Saclay



- Proton beam safety issue is almost solved : test can be started soon..
- Last part of BG trap (amplifier for rotating wall) is prepared and tunning is ongoing.
- Antion chamber flanges are changed and buncher will be tested soon.

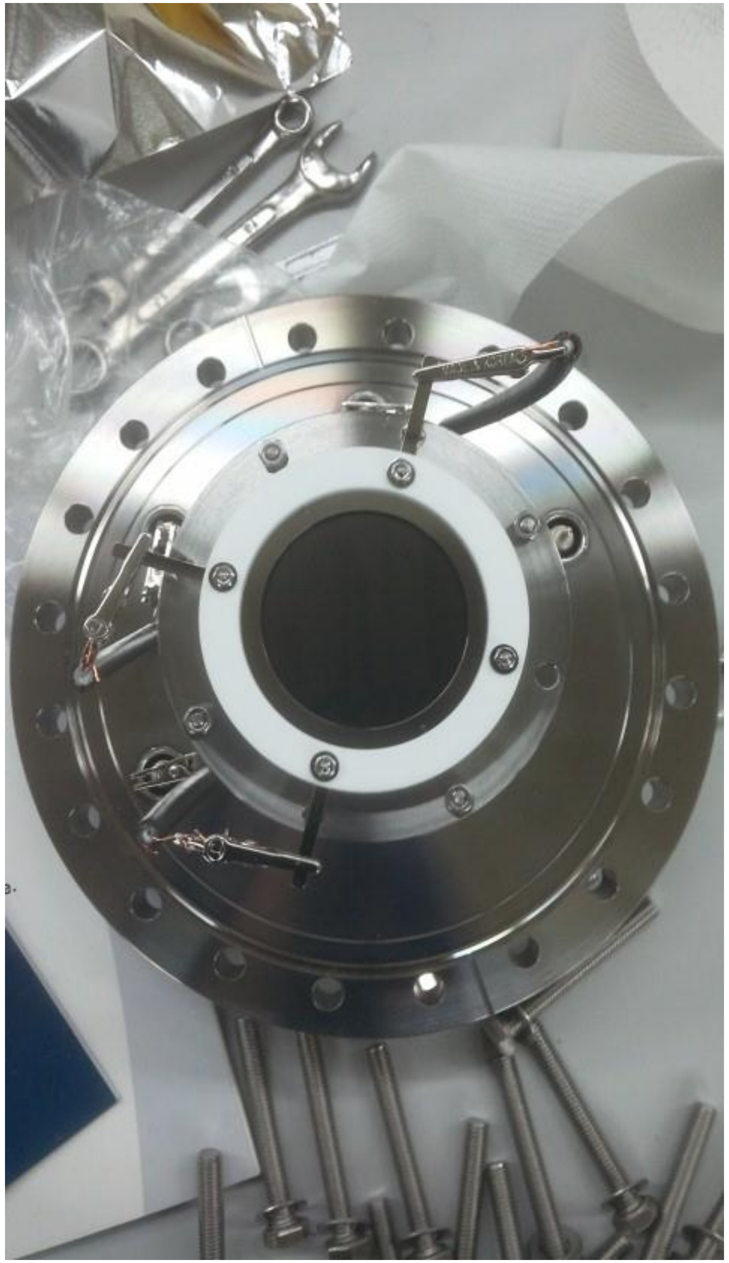
- Yesterday, Bertrand asked me about DAQ system of TOF and suggest to have meeting with others.

← Patrice asked posdoc in CEA to handle master daq for GBAR

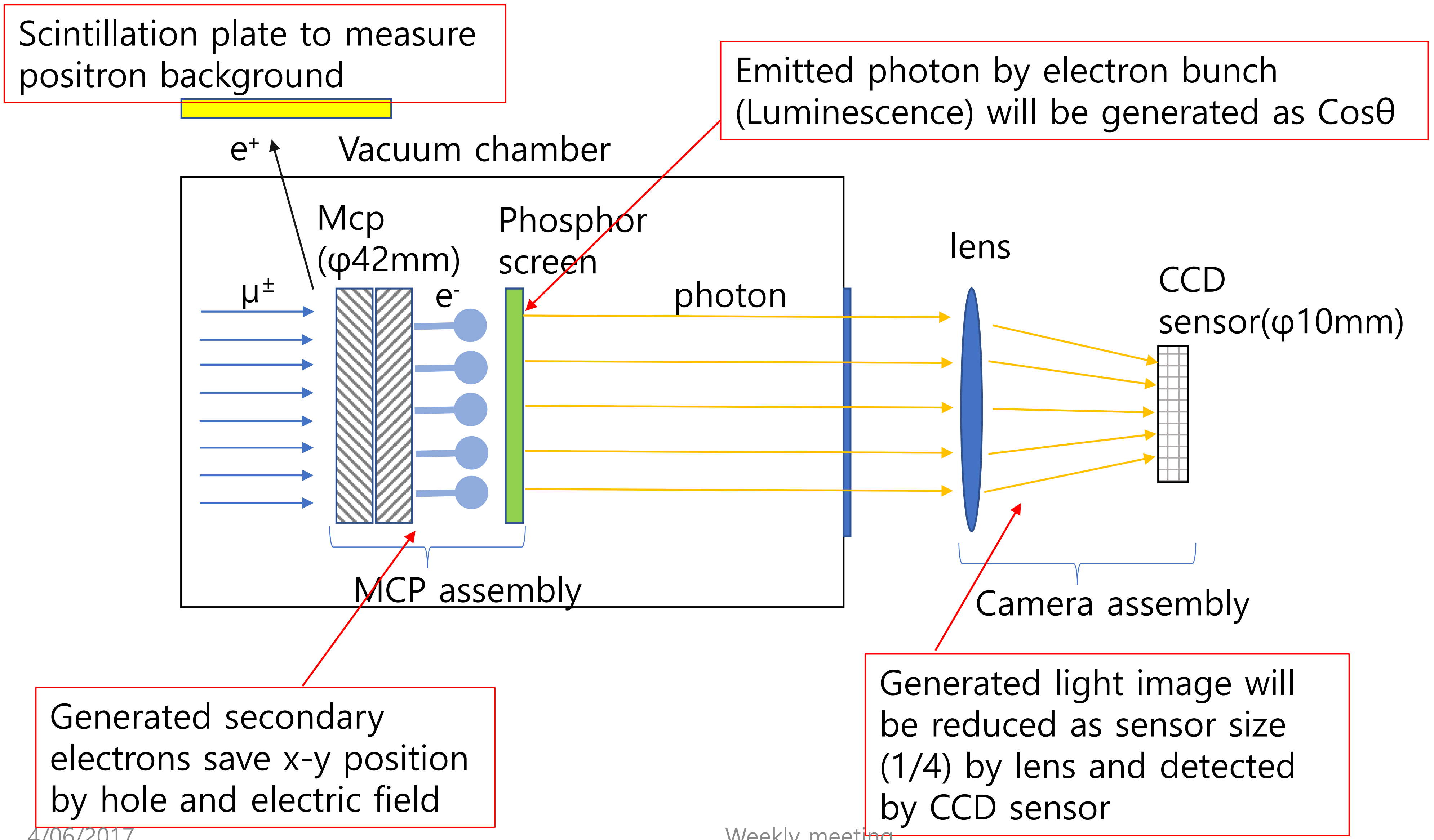
- Next week or later, I will meet to Balint and Patrice at CERN to discuss about simulation frame work.

About beam profile monitor

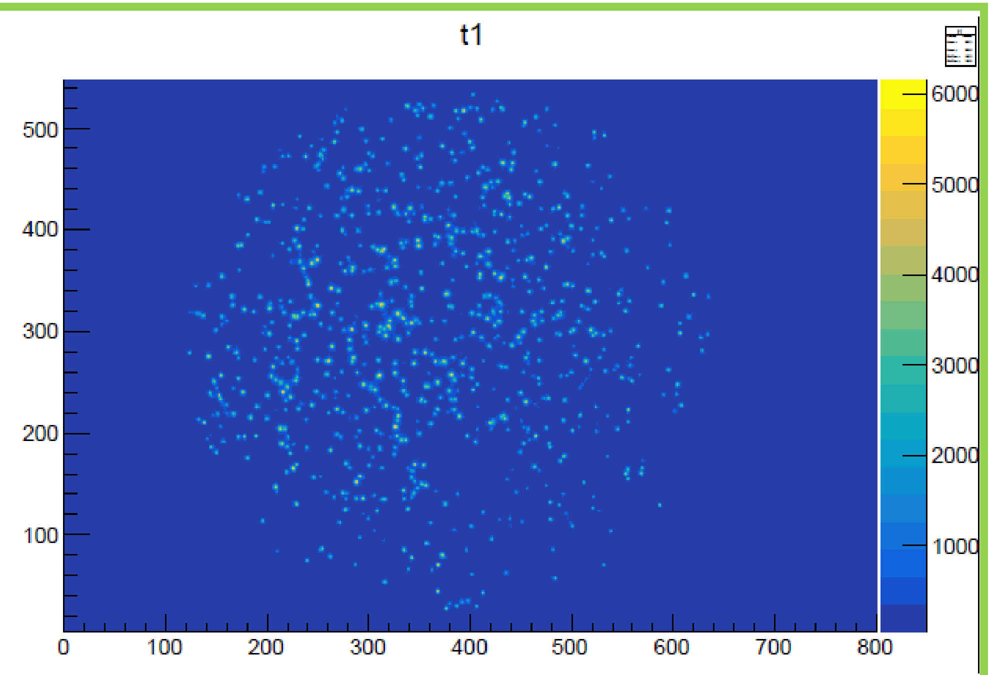
- A few pages from my old slides



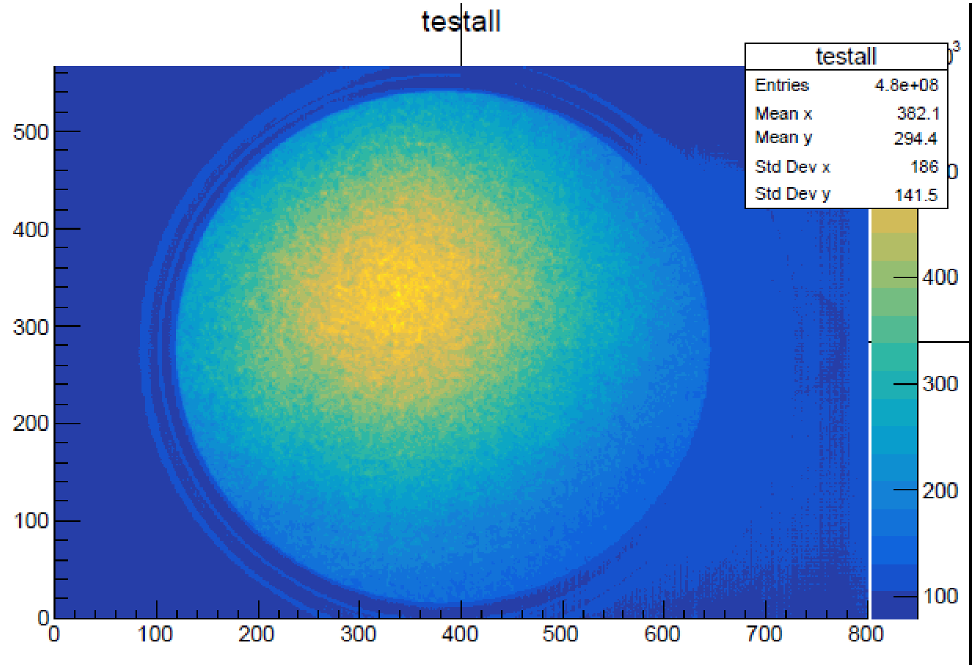
Layout of MCP+CCD assembly



Muon beam data sample



Picture for 1 bunch of μ with D10mm hole size.

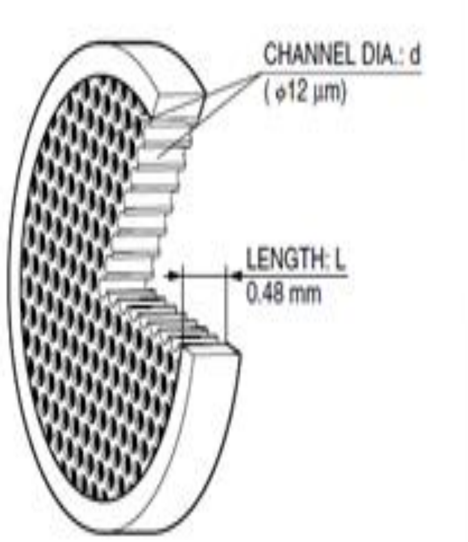


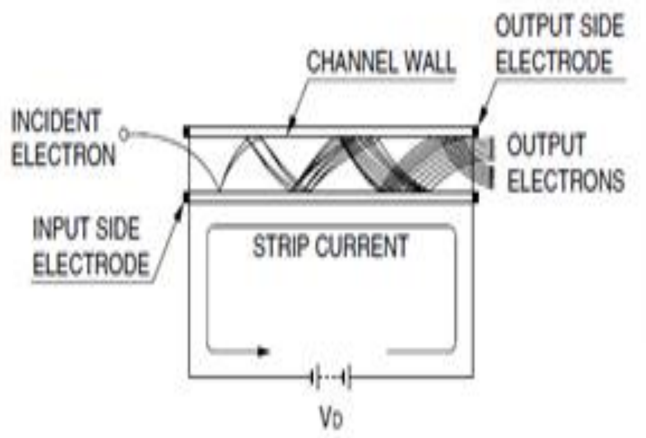
Combined Picture for 10,000 pictures of μ with D10mm hole size.

- 4 different hole size collimator & several slit changed data was taken for beam time.
- By chaning trigger time of BPM, Beam background and positron decay background data was also taken.

4-1)MCP

- Secondary electron emission from channel wall + acceleration by ΔV.
- **10^6 Max gain** for chevron-type(2-stage) make signal cleaner.
- But multiflier generated when secondary electron emitted with **efficiency** as next page.
- Secondary emission depends on particle momentum and type.
- Spatial resolution **~100μm** for 2-stage.
- Dark count only 3 [count/s/cm^2]

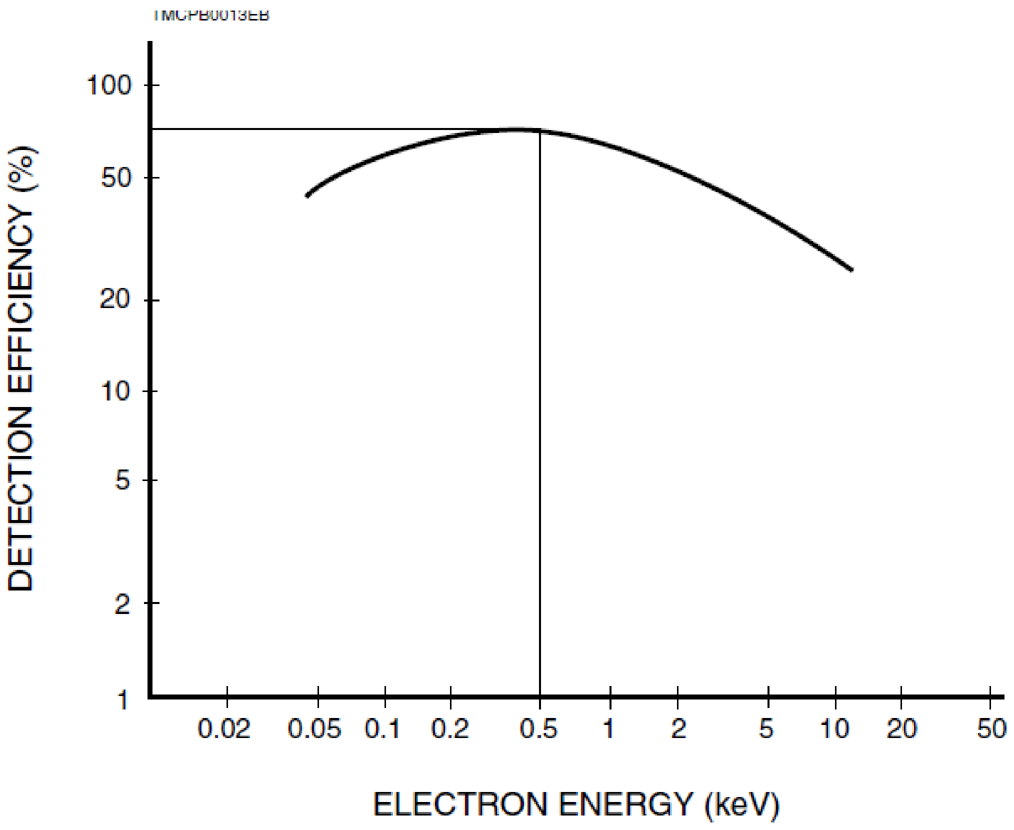




MCP efficiency

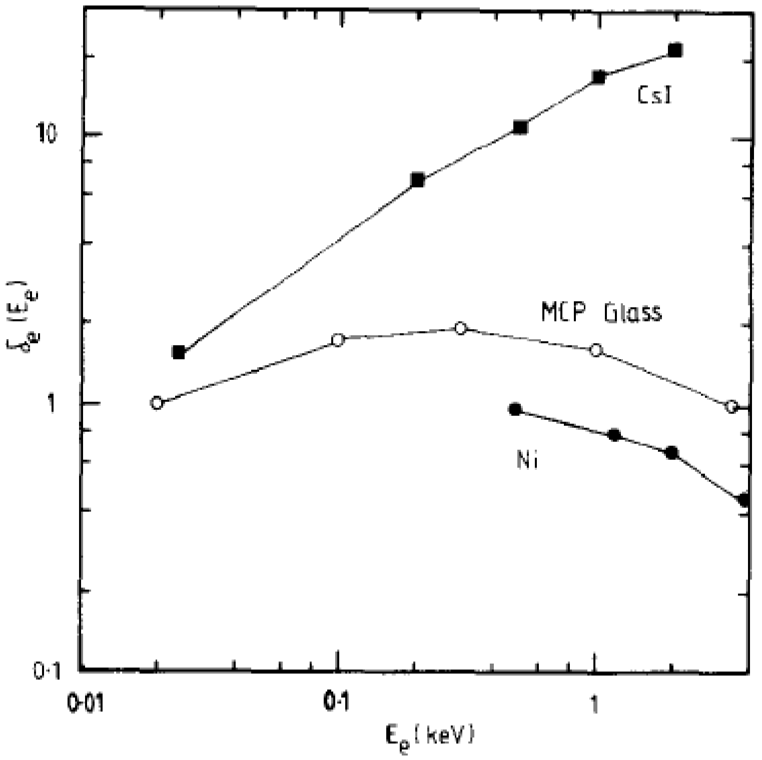
Table 3: Detection Efficiency of MCP

Types of Radiation	Energy or Wavelength	Detection Efficiency (%)
Electron	0.2 keV to 2 keV	50 to 85
	2 keV to 50 keV	10 to 60
Ion (H^+, He^+, Ar^+)	0.5 keV to 2 keV	5 to 58
	2 keV to 50 keV	60 to 85
	50 keV to 200 keV	4 to 60
UV	300 Å to 1100 Å	5 to 15
	1100 Å to 1500 Å	1 to 5
Soft X-ray	2 Å to 50 Å	5 to 15
Hard X-ray	0.12 Å to 0.2 Å	to 1
High energy particle (ρ, π)	1 GeV to 10 GeV	to 95
Neutron	2.5 MeV to 14 MeV	0.14 to 0.64



MCP surface

- Basic electrode : Inconel (nickel based)
- MgO, CsI,or aluminum can be coated ←high secondary electron yield and escape length.
- Because Electrode has short escape length as 20Å compared with CsI 215Å, coating will give more escaped secondary electron from surface→ higher efficiency.

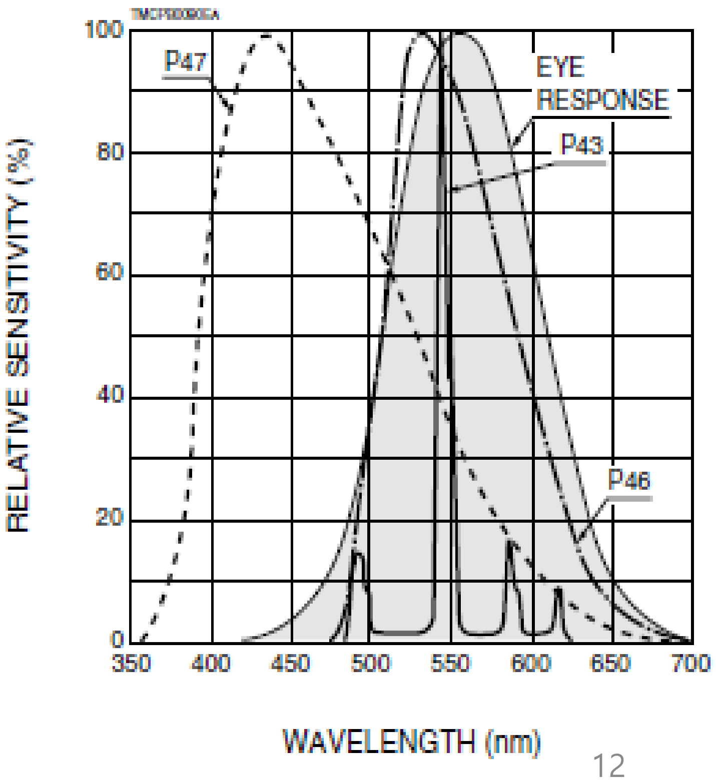


4-2)Phosphor screen

Types of Phosphor Screen	P43	P46	P47
Peak Emission Wavelength (nm)	545	530	430
Emission Color	Yellowish Green	Yellowish Green	Purplish Blue
Relative Power Efficiency Ⓐ	1	0.3	0.3
Decay Time 10 %	1 ms	0.2 µs to 0.4 µs Ⓑ	0.11 µs
Remarks	Standard	Shorter decay time	Shorter decay time

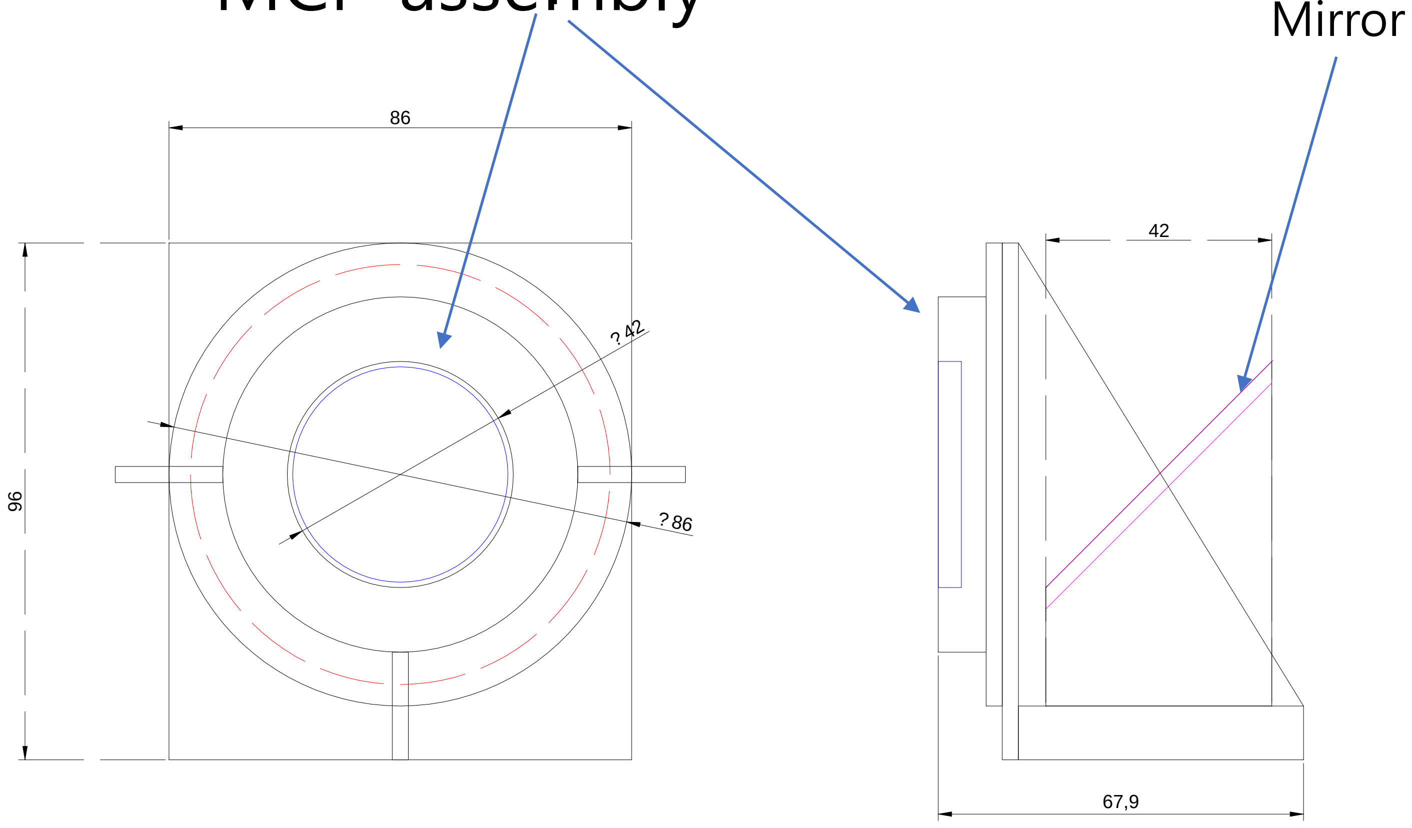
NOTE: ⒶAt supply voltage of 6 kV. Relative value with 1 being the output from P43.
ⒷDepends on the input pulse width.

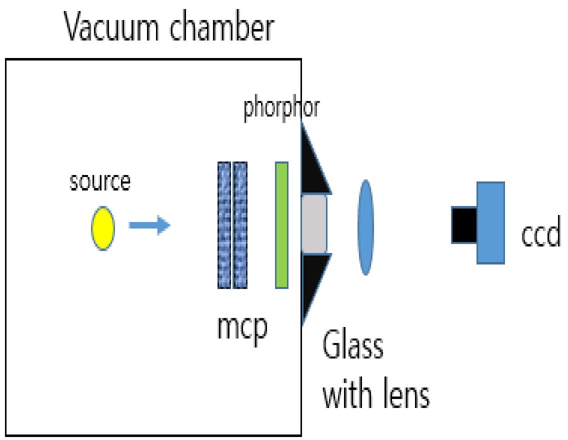
- luminescence photon emission from phosphor material by electron collision.
- Accelerated electron by ΔV between MCP and phosphor aluminum layer.
- Light emitted with Lambert cosine distribution which save spatial distribution.
- Decay time and yield will be issue.
- To separate positron background from signal, short decay time will be preferred. (P46, P47)

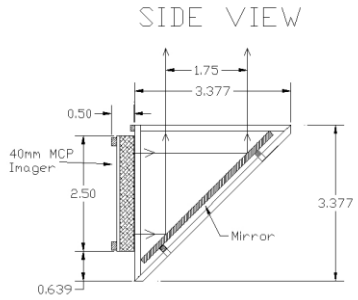


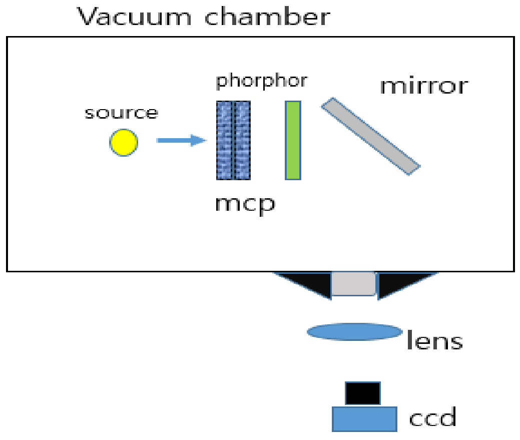
Overview

- MCP assembly









Assembly

Device	Company		Price
MCP	Hamamatsu	2stage (with MgO coating?)	$8,900
Phosphor screen	Hamamatsu	P47(0.11μs decay time)	
CCD camera	PCO	Pco1600 or others..	$20,000
Lens, Mirror	Edmund		
Grid	Trying to check		
Voltage Gate module	Photek?		

PCO1600 : Above 500ns only

Signal example