

Estimation of the Number of Antiproton

Configuration of Time of Flight

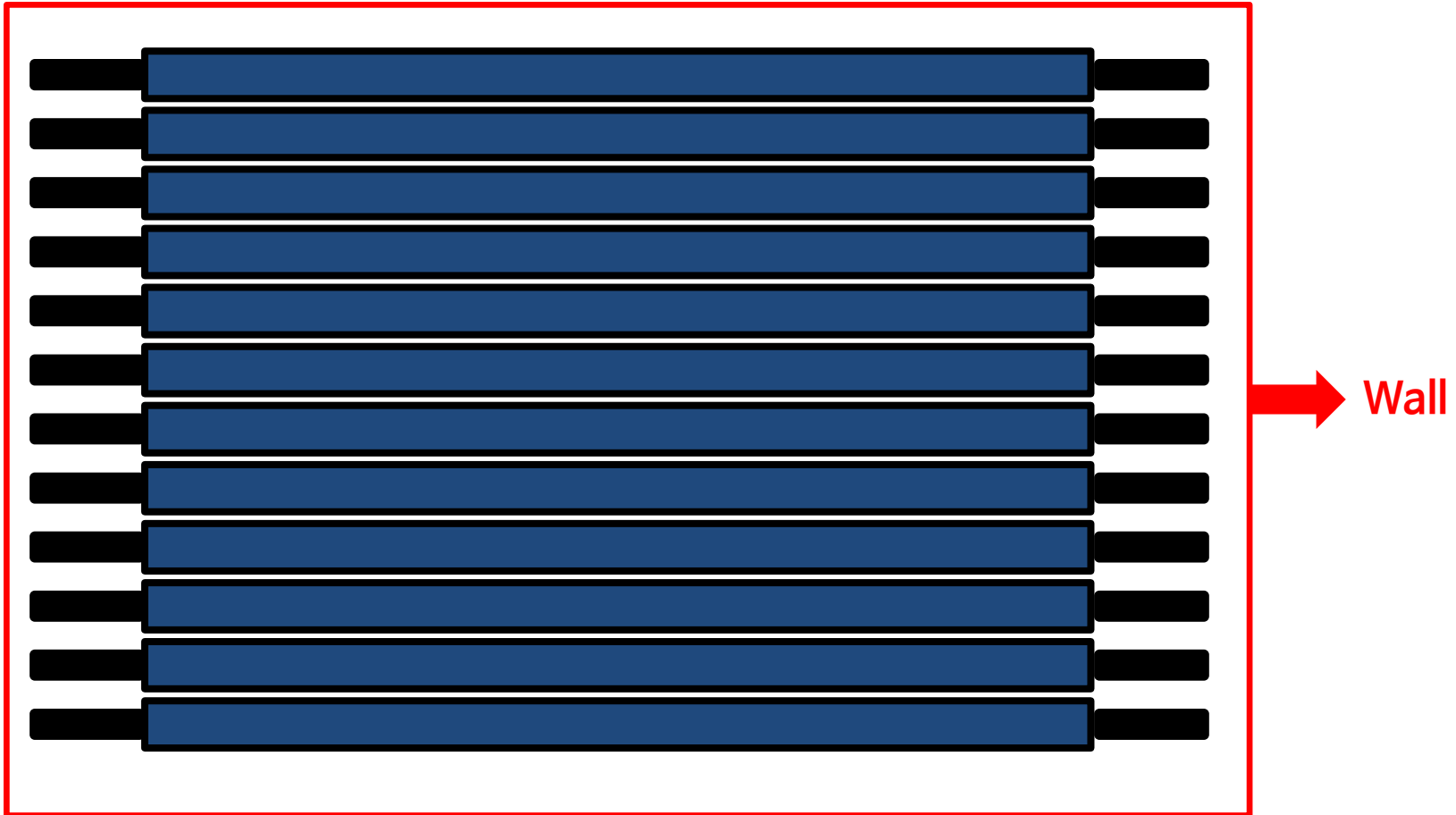


Scintillation counter

Plastic scintillator

photomultiplier tube
(PMT)

Configuration of Time of Flight



1 Wall = 12 Scintillation counter = 12 Plastic Scintillator = 24 PMT

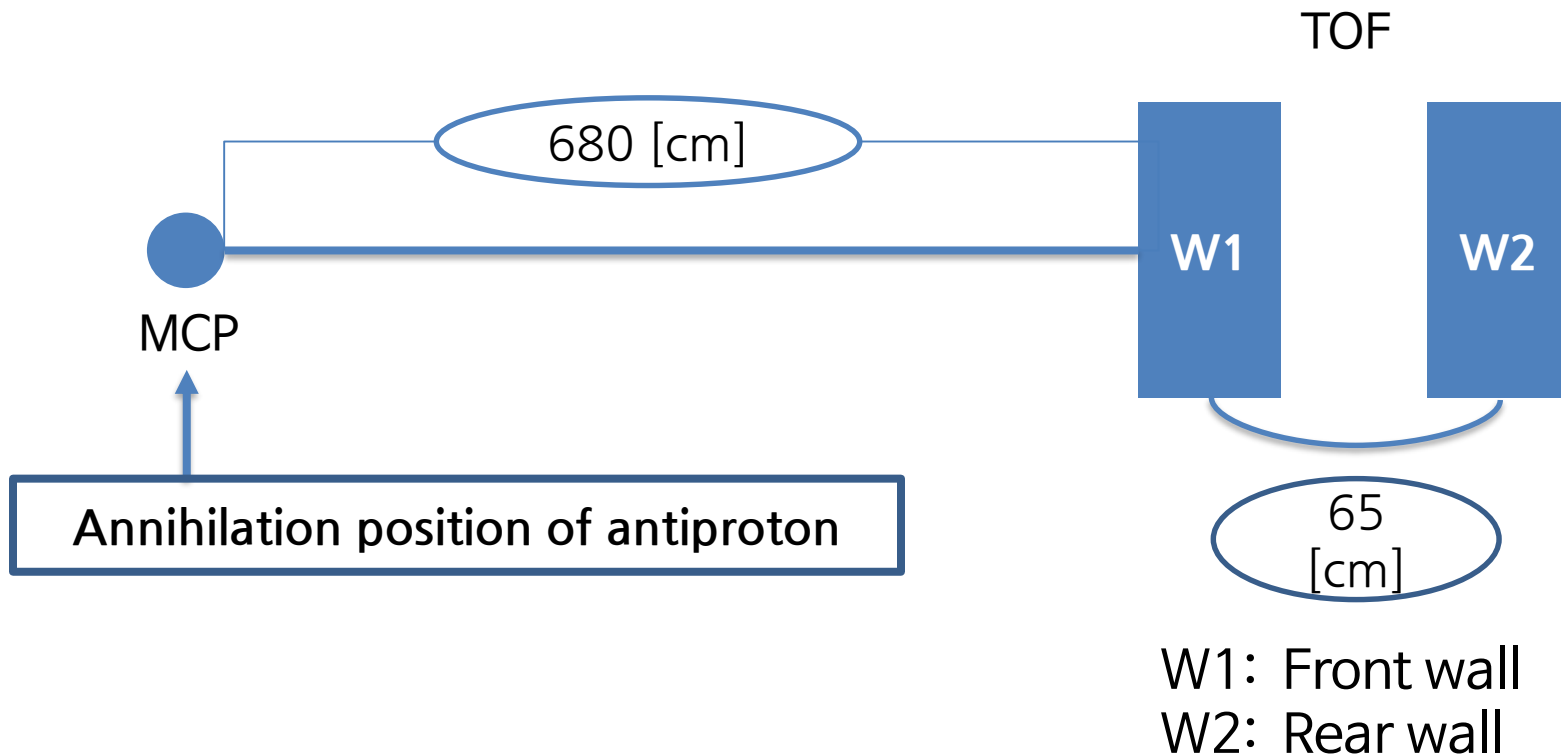
Configuration of Time of Flight



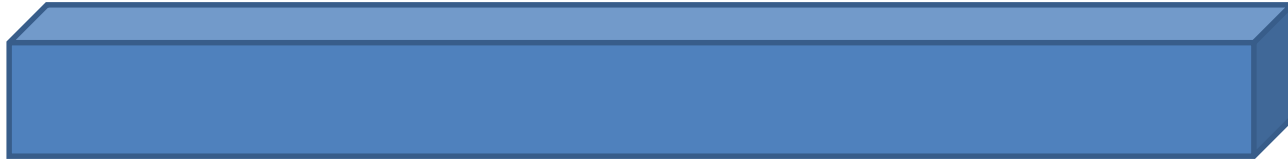
2 Wall installed in GBAR zone

Data Acquisition

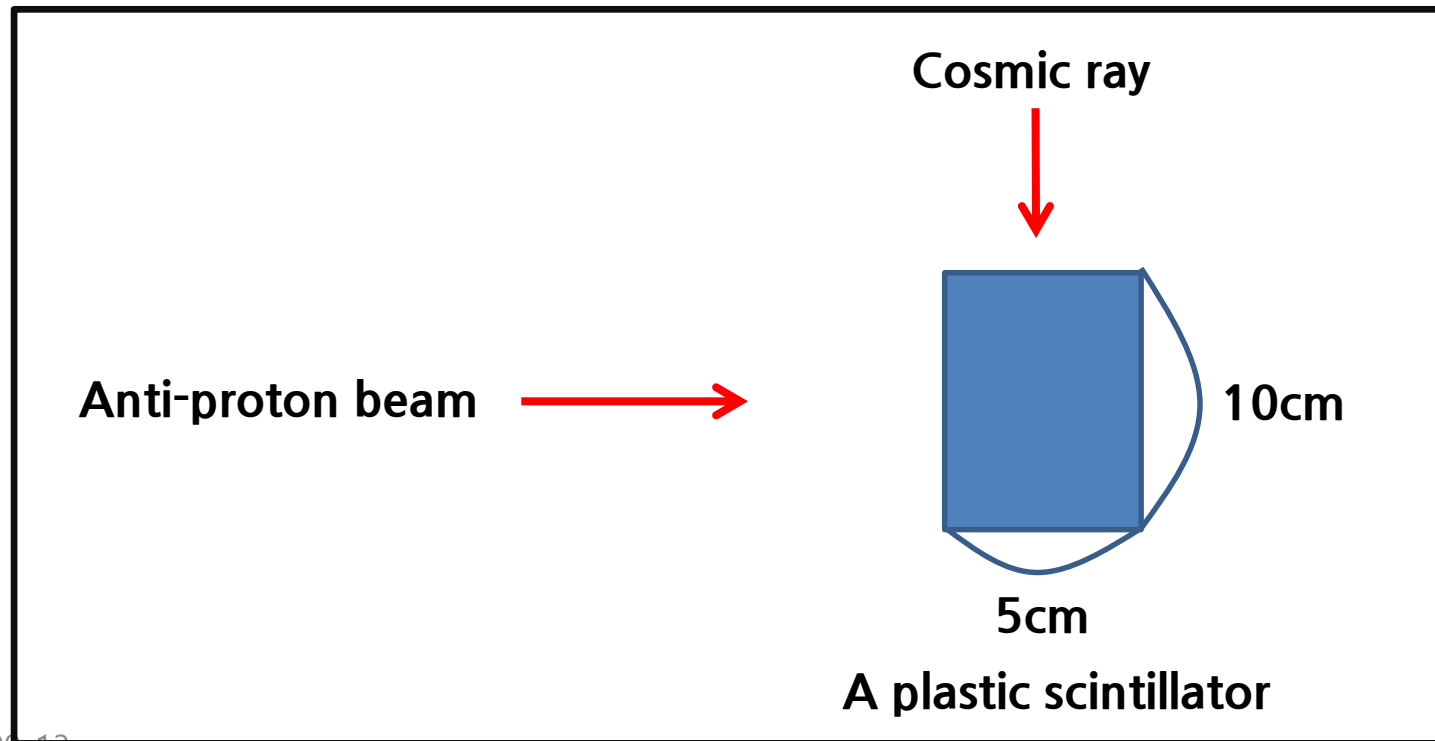
- Data on 08/10



Configuration of Time of Flight

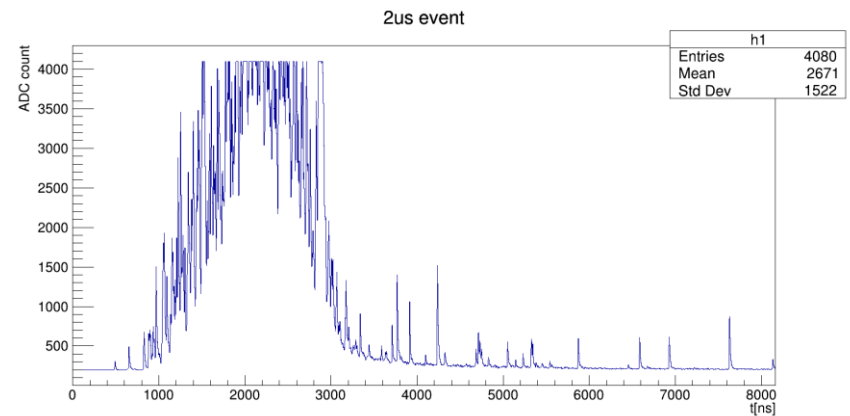
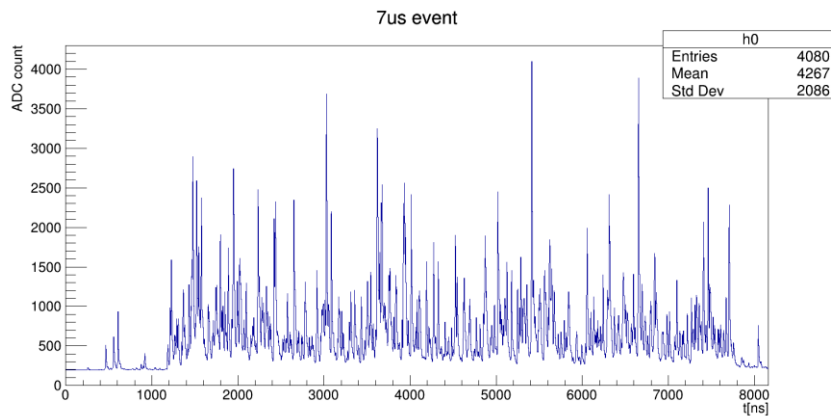


Size of a plastic scintillator : 170 cm * 10cm * 5cm



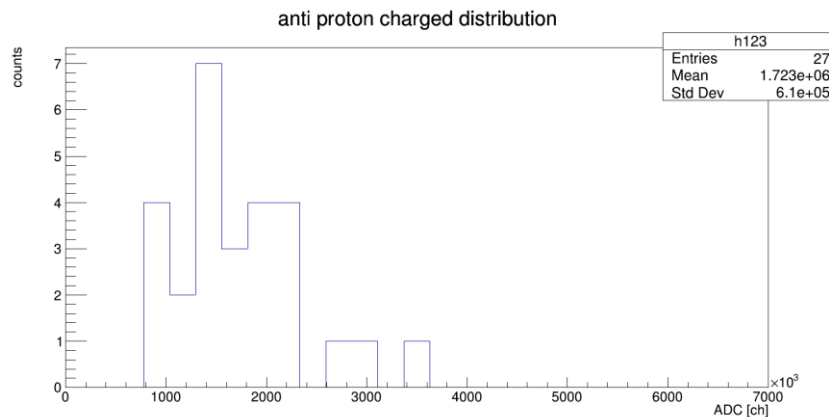
Data Analysis

- 7us beam size events have less overflowed points than 1 ~ 3us events
- Select 7us beam events
- The number of 7us beam events: 27

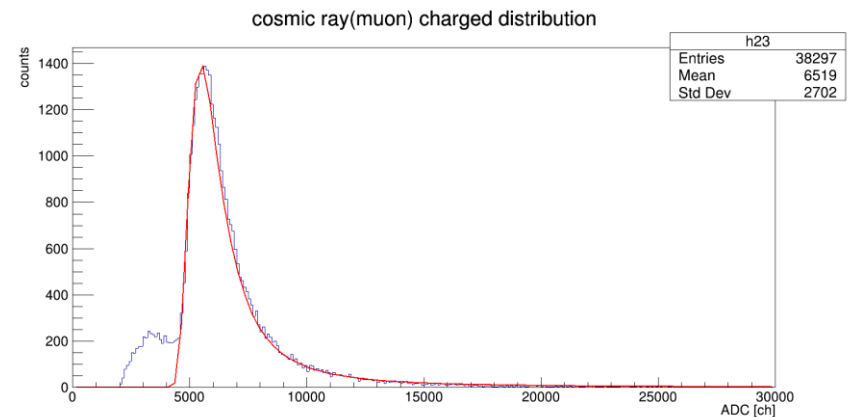


Data Analysis

- Sum of charged value from anti-proton beam each scintillation counter
- Figure out most probable value(MPV) of muon charged distribution from cosmic ray each scintillation counter



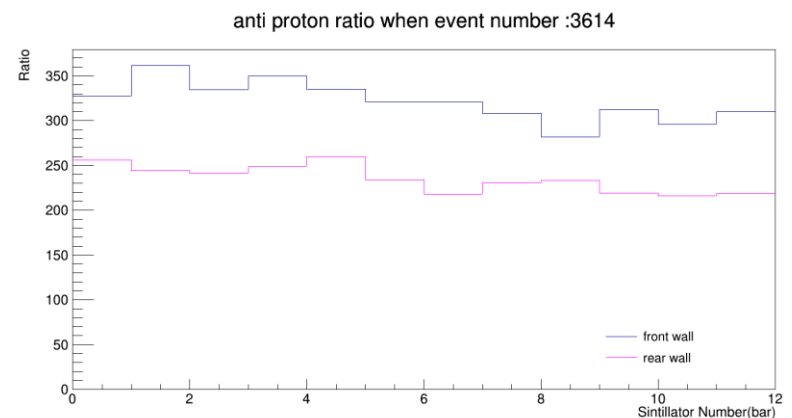
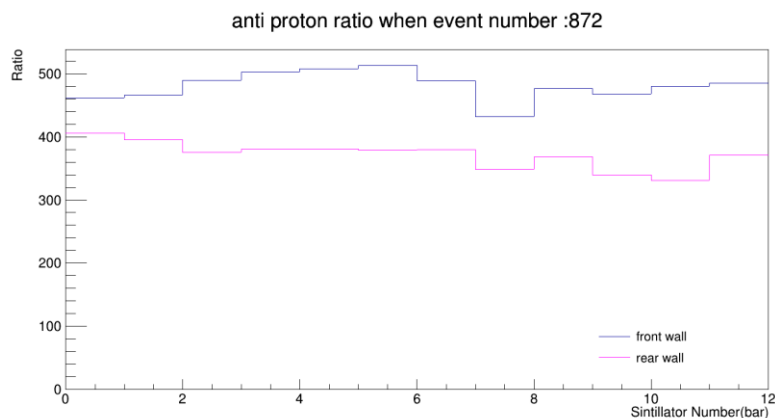
Sum charged value
Around $9.\text{e}+5 \sim 4.\text{e}+6$ [ch]



MPV of muon charged value
About $5.\text{e}+3$ [ch]

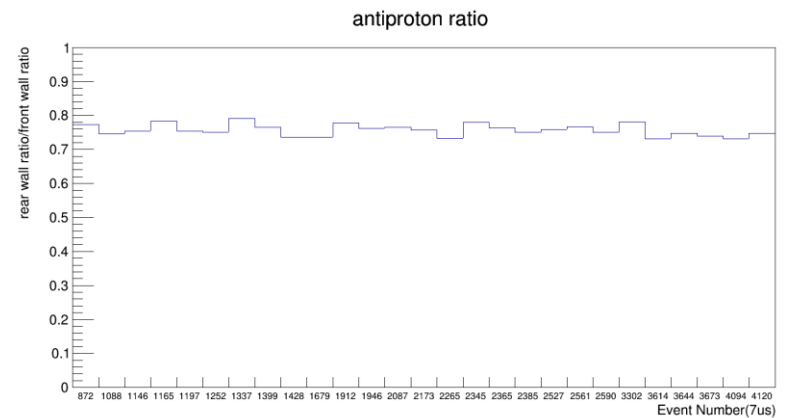
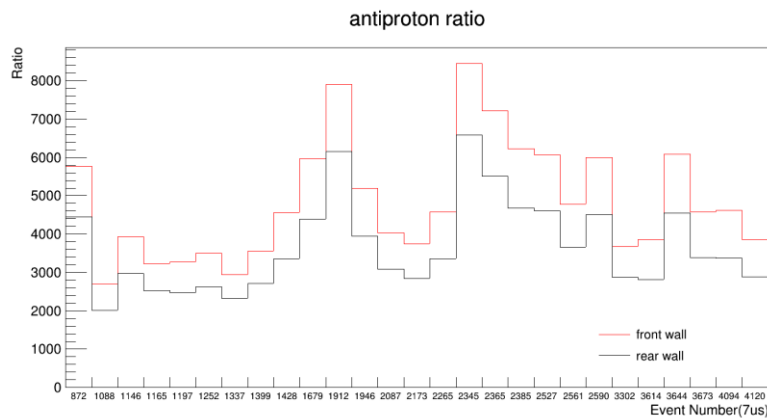
Data Analysis

- Normalization using MPV of muon charged value
- $$\text{Ratio} = \frac{\text{Sum of charged value from anti-proton beam}}{\text{MPV of muon charged value from cosmic ray}}$$
- Calculate ratio each scintillation counter
- If comparing ratio to simulation, we can estimate the number of antiproton each event

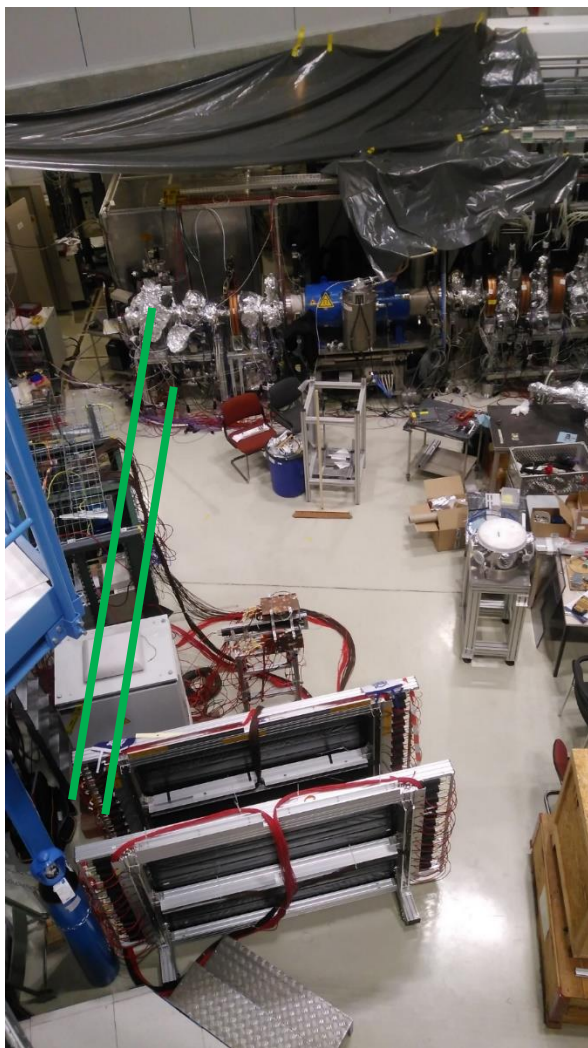


Data Analysis

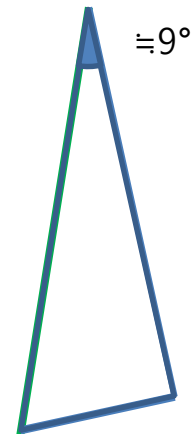
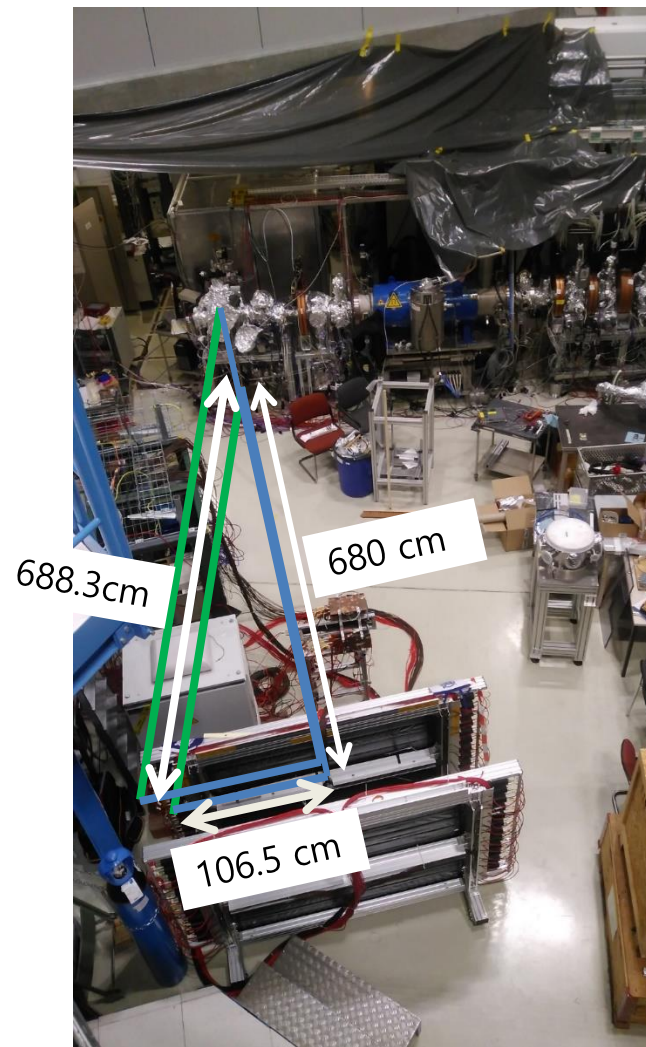
- The number of 7us beam events: 27
- Ratio of Wall = sum of ratio each scintillation (total 12 scintillations)
- Average of $\frac{\text{rear wall ratio}}{\text{front wall ratio}} = 75.6804 \text{ (\%)}$

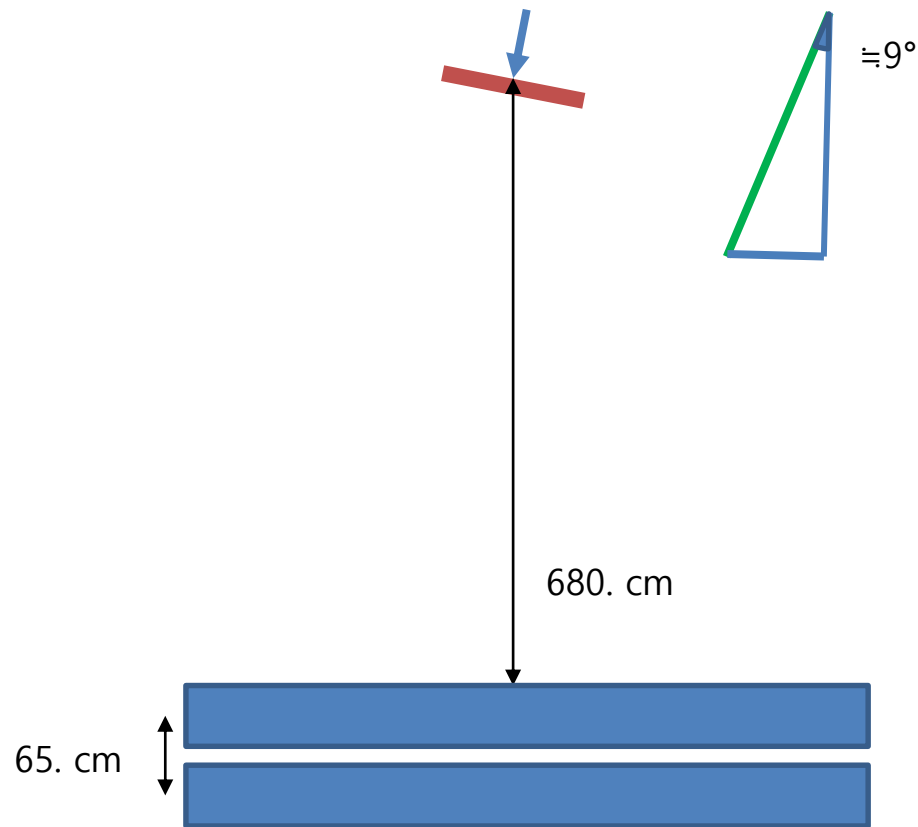








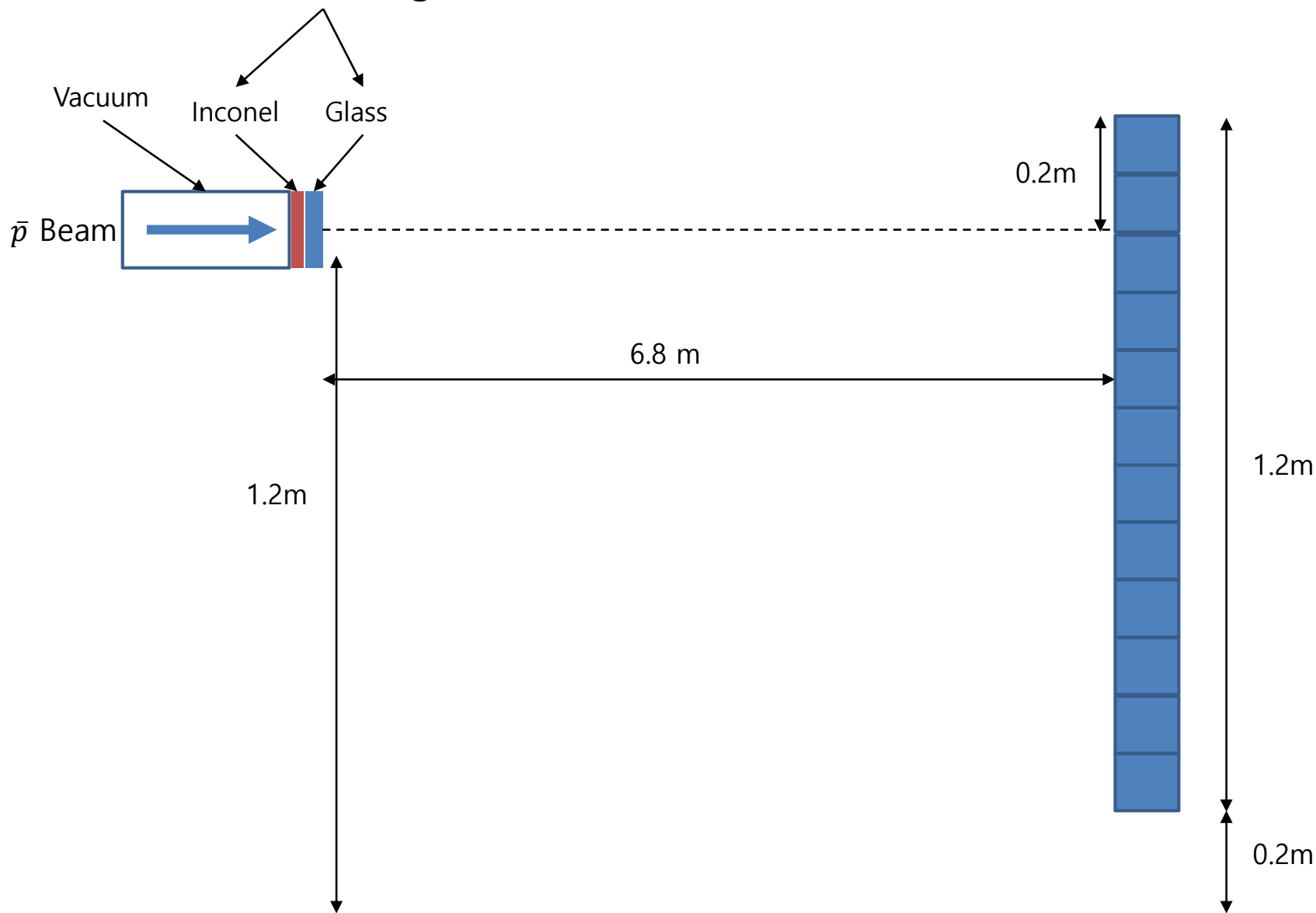




- Simulated $\bar{p}$ number: 10E+6

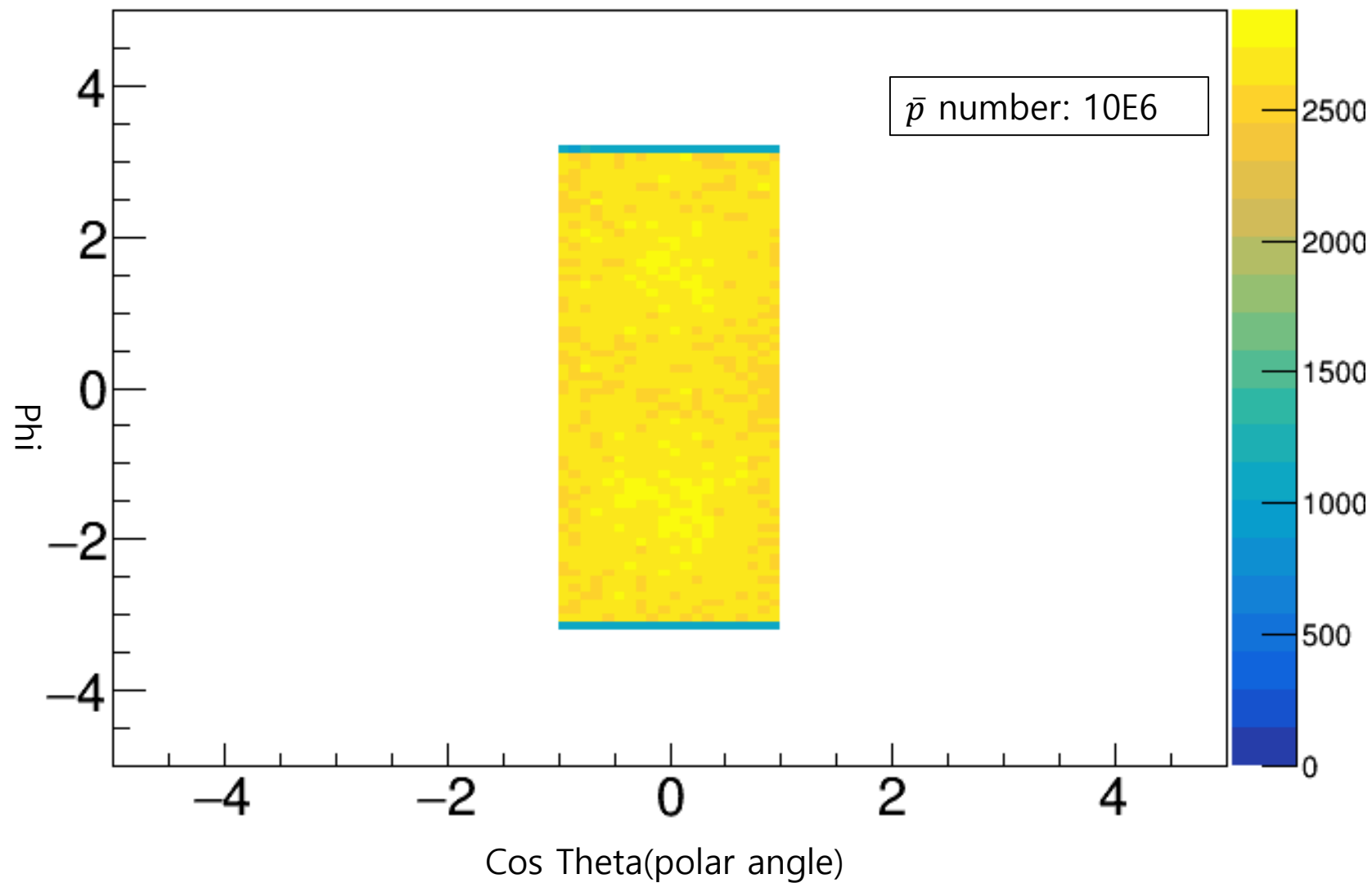
Front part of MCP:
Inconel coated glass

✕Not in scale

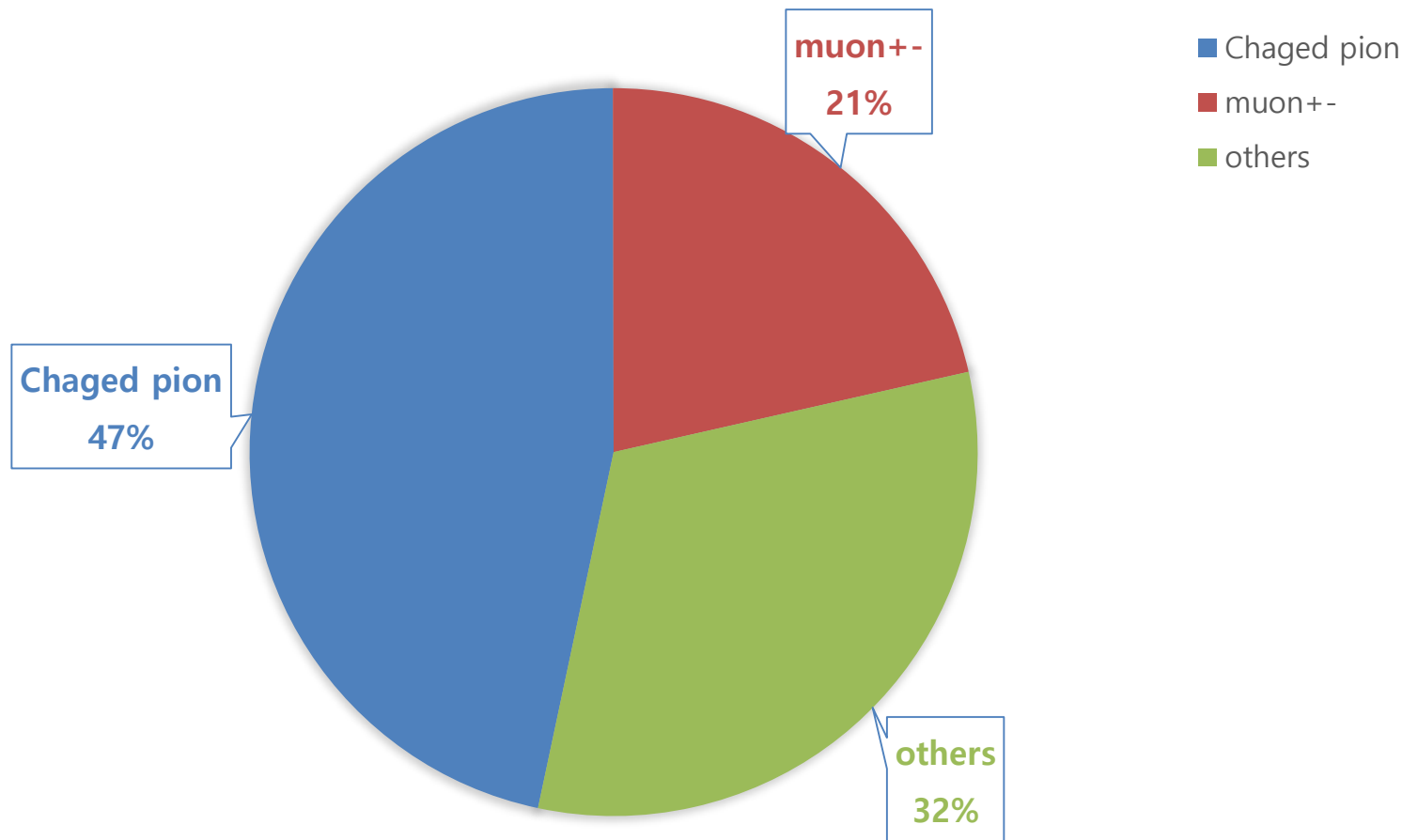


Ground

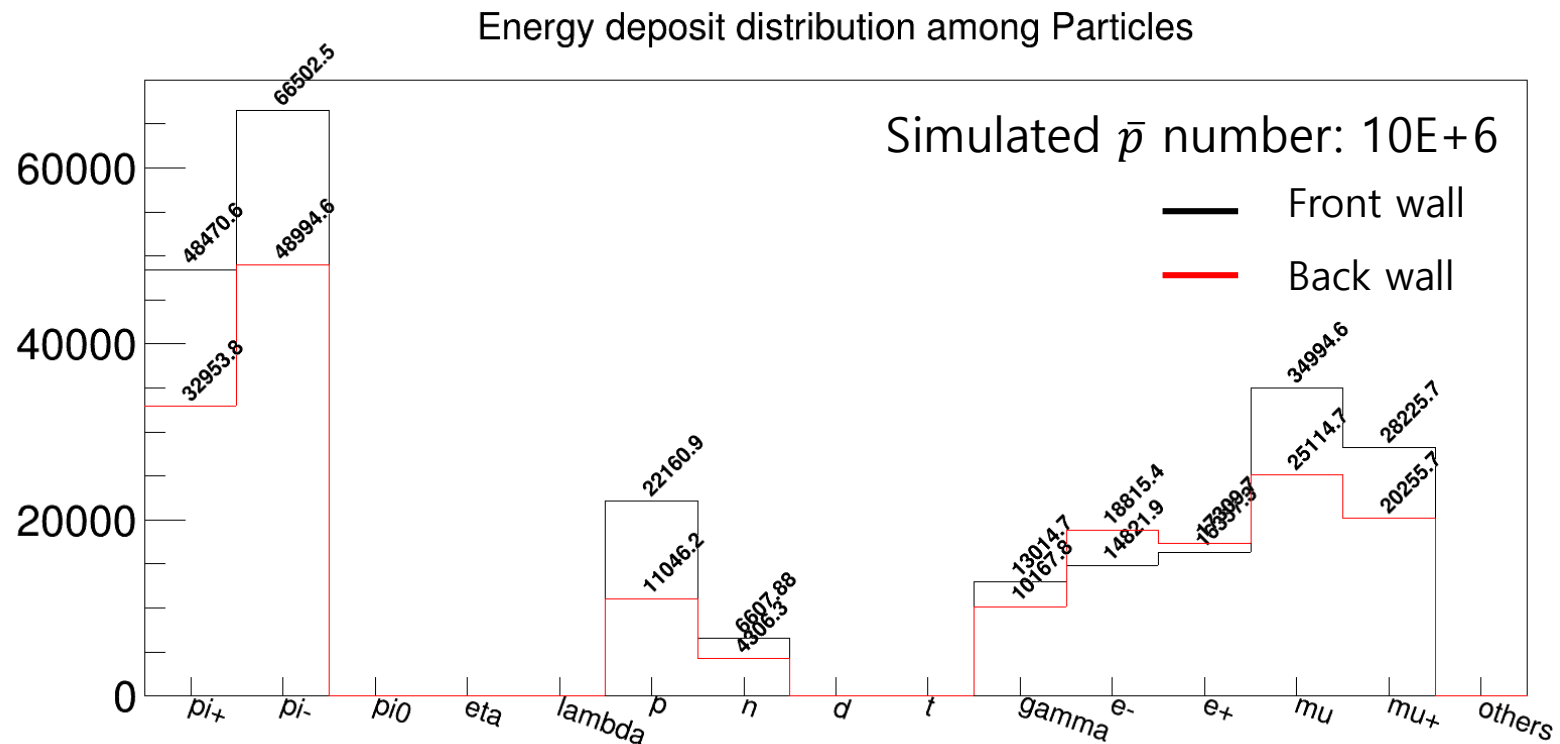
2D angle distribution of Produced Charged Pion



Deposit energy distribution



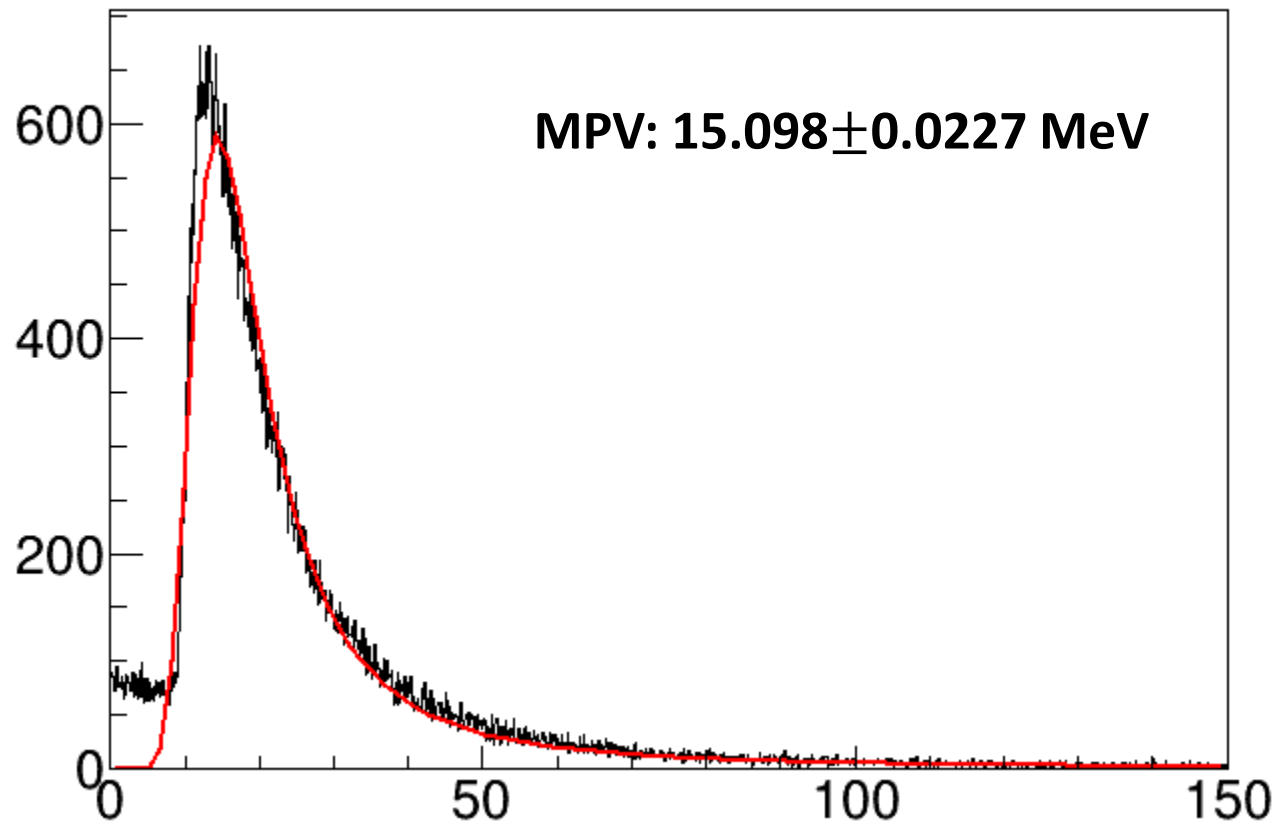
Deposit energy distribution



Deposit energy distribution

- Total Energy deposit
 - Front wall: 251623 MeV
 - Back wall: 189225 MeV

Deposit energy distribution of cosmic muon



$\bar{p}$ Number Estimation

- For event #872 front wall-Bottom bar
- Total count: 2866519.9
- Muon count MPV: 6216.0
- Ratio: 461.2
(Total count/muon count)

In the same manner,

- Ratio for front wall is 4454.6

$\bar{p}$ Number Estimation

- For event #872
Front wall-Ratio: 4454.6
- Simulated Ratio: 16666
($10\text{E}+6 \bar{p}$)
- $\bar{p}$ number: $(5766/16666)*(10\text{E}+6)=3.46\text{E}+5$

Event Number	Front wall	Back wall	Back wall/Front wall	Estimated Pbar Number	
872	5766.59	4454.63	0.7725	3.46E+05	3.55E+05
1088	2698.51	2014.47	0.7465	1.62E+05	1.61E+05
1146	3932.29	2966.66	0.7544	2.36E+05	2.37E+05
1165	3224.63	2522.32	0.7822	1.93E+05	2.01E+05
1197	3274.4	2469.01	0.7540	1.96E+05	1.97E+05
1252	3500.16	2626.25	0.7503	2.10E+05	2.10E+05
1337	2941.08	2326.13	0.7909	1.76E+05	1.86E+05
1399	3551.8	2718.46	0.7654	2.13E+05	2.17E+05
1428	4564.81	3362.98	0.7367	2.74E+05	2.68E+05
1679	5965.11	4391.4	0.7362	3.58E+05	3.50E+05
1912	7909.68	6152.9	0.7779	4.75E+05	4.91E+05
1946	5187.97	3952.64	0.7619	3.11E+05	3.15E+05
2087	4030.03	3084.72	0.7654	2.42E+05	2.46E+05
2173	3752.33	2841.14	0.7572	2.25E+05	2.27E+05
2265	4577.37	3356.14	0.7332	2.75E+05	2.68E+05
2345	8444.96	6590.94	0.7805	5.07E+05	5.26E+05
2365	7208.91	5509.75	0.7643	4.33E+05	4.40E+05
2385	6226.59	4674.96	0.7508	3.74E+05	3.73E+05
2527	6074.44	4610.33	0.7590	3.64E+05	3.68E+05
2561	4776.41	3662.26	0.7667	2.87E+05	2.92E+05
2590	5999.89	4499.57	0.7499	3.60E+05	3.59E+05
3302	3673.94	2871.01	0.7815	2.20E+05	2.29E+05
3614	3859.15	2819.61	0.7306	2.32E+05	2.25E+05
3644	6076.17	4545.73	0.7481	3.65E+05	3.63E+05
3673	4580.27	3388.15	0.7397	2.75E+05	2.70E+05
4094	4621.62	3376.81	0.7307	2.77E+05	2.69E+05
4120	3855.36	2880.49	0.7471	2.31E+05	2.30E+05
Average	4824.9804	3654.424	0.7574	2.90E+05	2.92E+05
Simulated ratio	16666.313	12533.37	0.7520	1.00E+06	1.00E+06

• Estimated $\bar{p}$ Number :

	Front wall	Back wall
Max	5.07E+05	5.26E+05
min	1.62E+05	1.61E+05
Average	2.90E+05	2.92E+05