

Status Report

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26 Dec. 2019

HK mPMT-Japan meeting

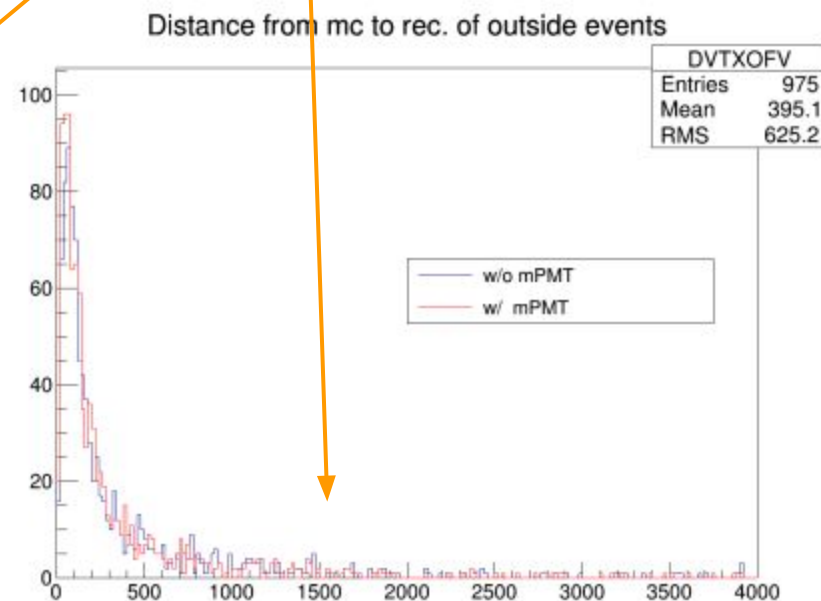
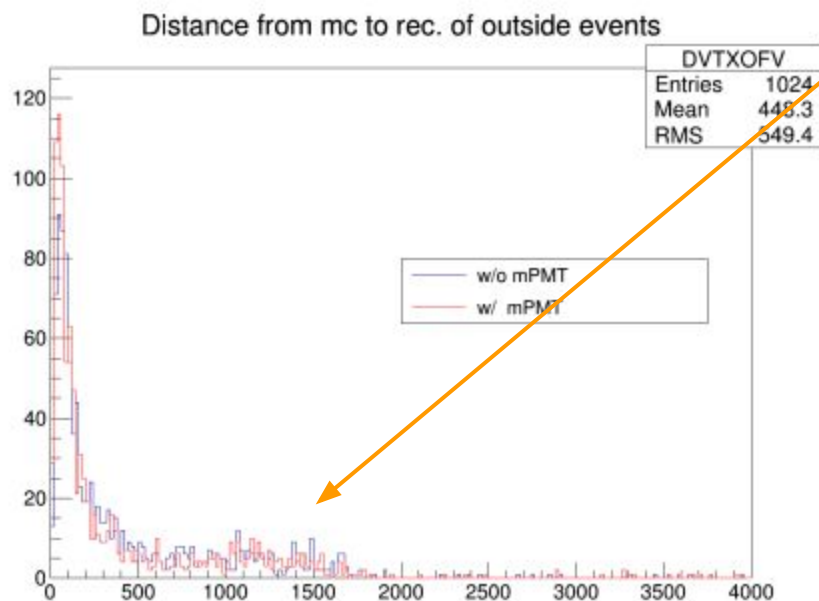
Updates

- mPMT different configuration
 - Fixed dark rate issue
- Todo (proposed at last meeting)
 - ~~Check D.R. setting etc. again~~ → fixed
 - ~~Generate MC~~ → done
 - ~~Calculate vertex resolution and miss-reconstructed fraction~~ → done
 - Organize the plots to compare easily ← now

$E=3$ MeV, 100 Hz (Left), 200 Hz (Right)

There are some inconsistency in the result w/o mPMT

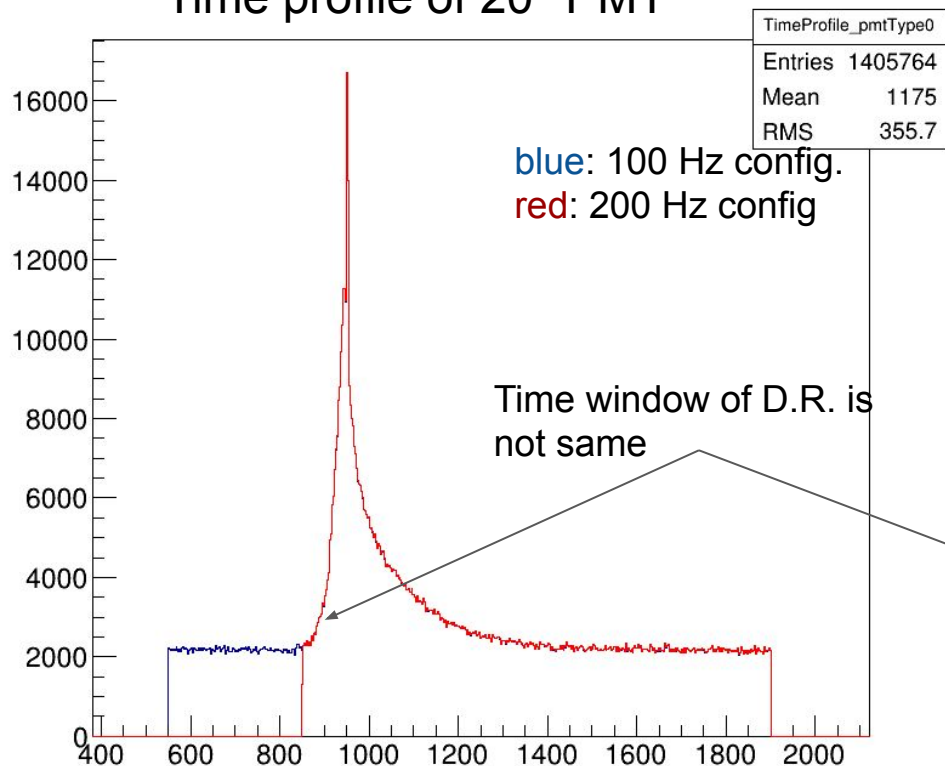
- Distance between rec. and MC vertex (unit = cm).
- Only events out of FV



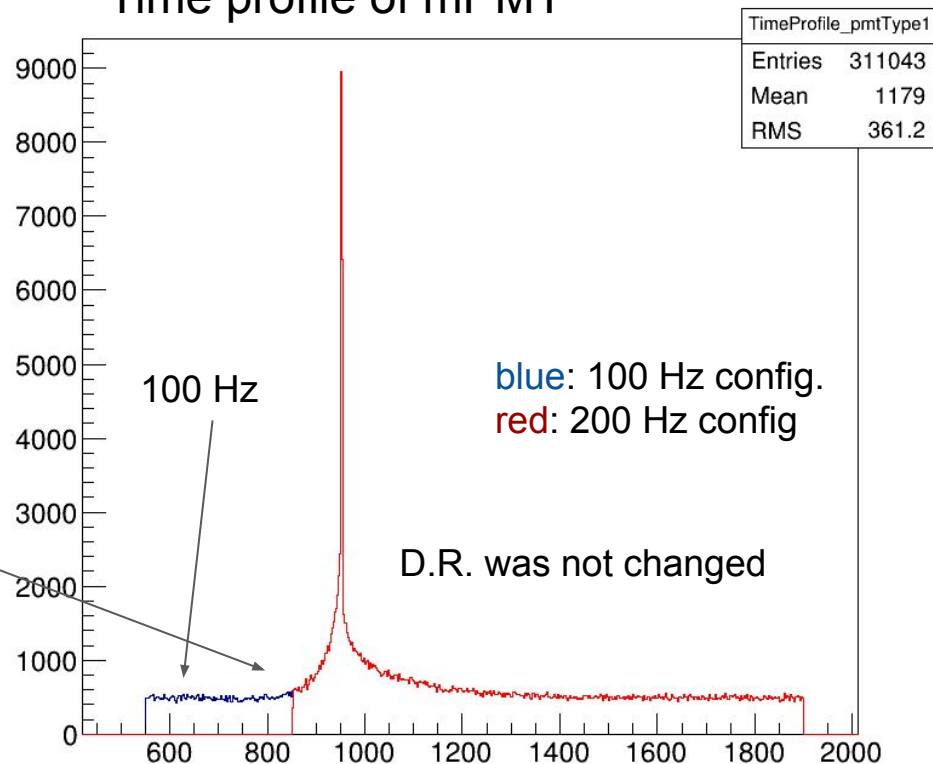
D.R. (100 / 200 Hz) (remind of last meeting)

- I found that dark rate was not generated correctly.
→ I will check the mac-file again and reproduce the MC
 - Chaged only “WCSimPMTObject.cc”

Time profile of 20" PMT

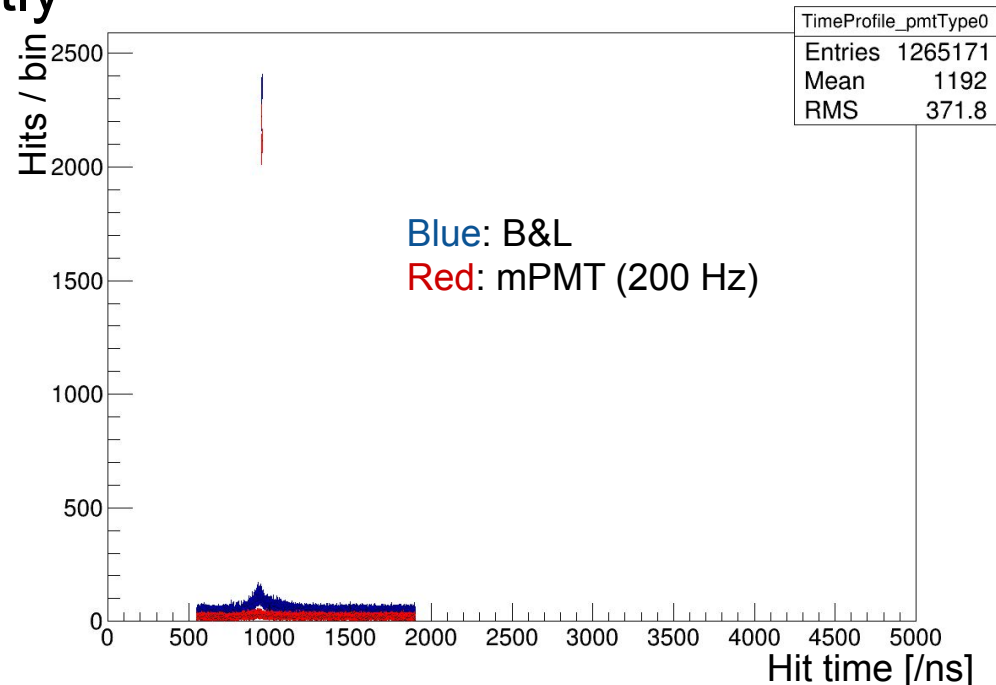


Time profile of mPMT



Modifications for DR issue

- Noticed from log that the pretrigger time window was set as -99 ns (should be -400 ns)
- Applied “/DAQ/TriggerNDigits/PreTriggerWindow -400” etc. explicitly in “macros/daq.mac”
 - These configurations are commented out in original WCSim(/_hybrid)
 - I have no idea of this reason...
- → DR is generated correctly
 - Right plot: time profile of 3 MeV electrons with DR of mPMT = 200 Hz

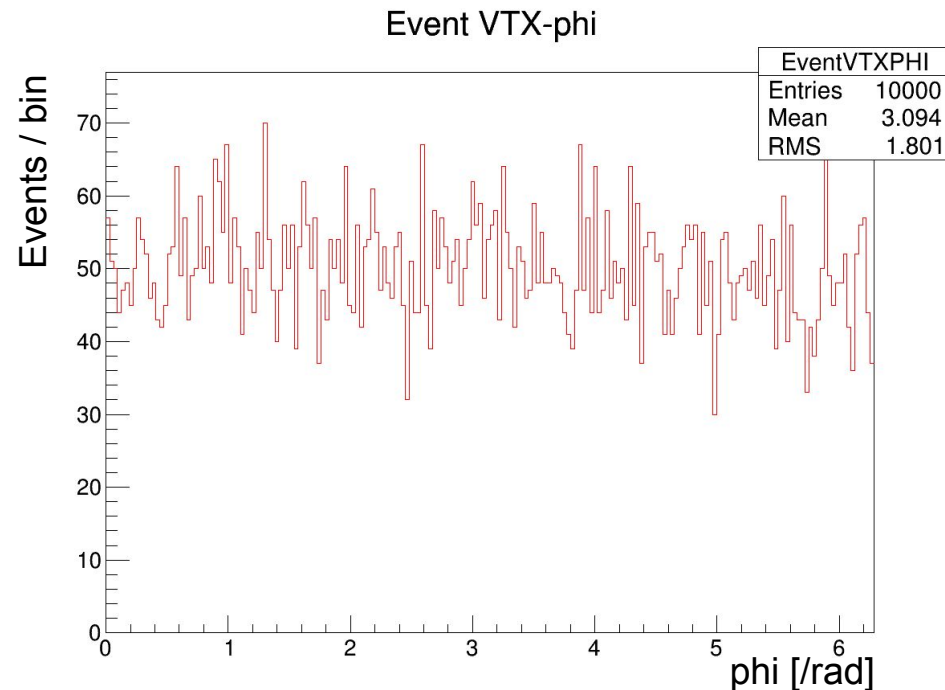
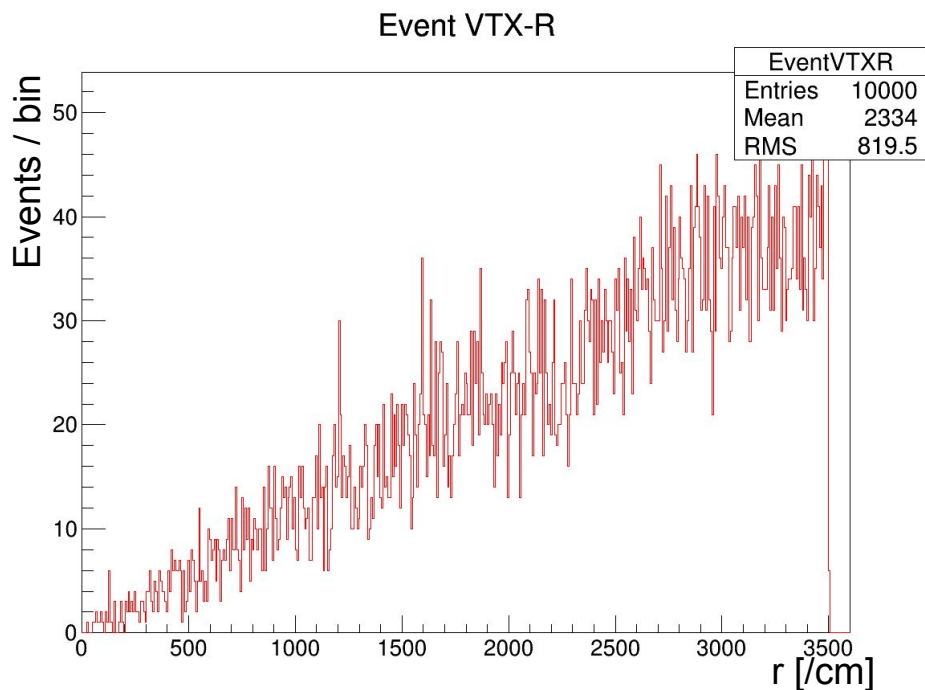
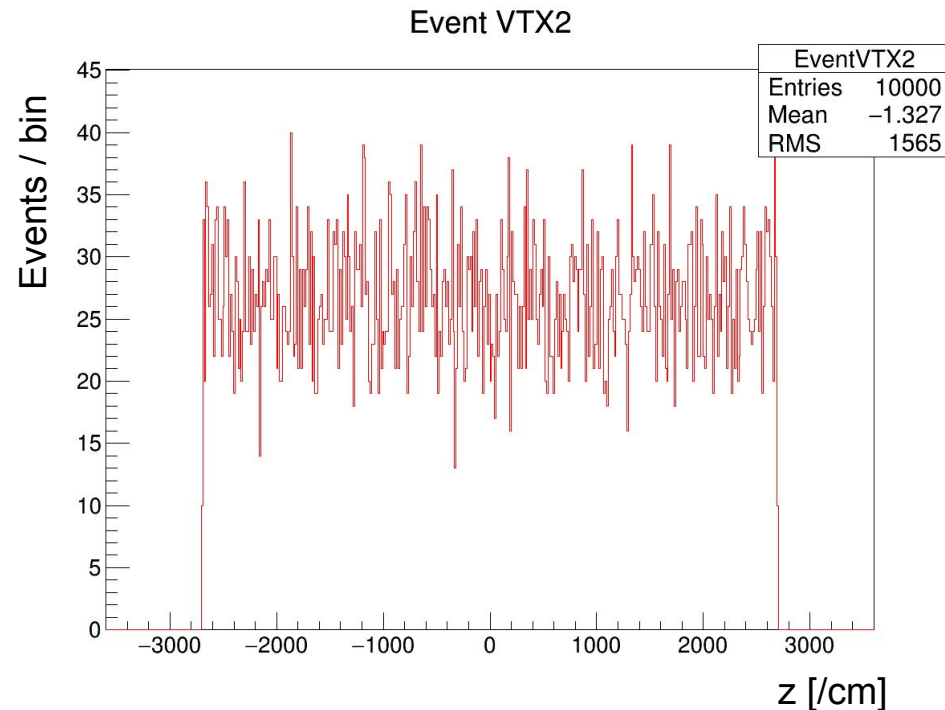


MC production

- Reproduced MC after the modification
- Configuration: HK mPMT hybrid
 - B&L: DR = 4.2 kHz, # = 20 k
 - mPMT: DR = 50 / 100 / 200 Hz, # = 10 k
- Particle: electron
 - Energy: 3 / 4 / 5 / 6 / 8 / 10 / 15 MeV
 - Vertex: uniform in the tank (cylinder of 54 m height and 35 m diameter)
 - Direction: isotropy

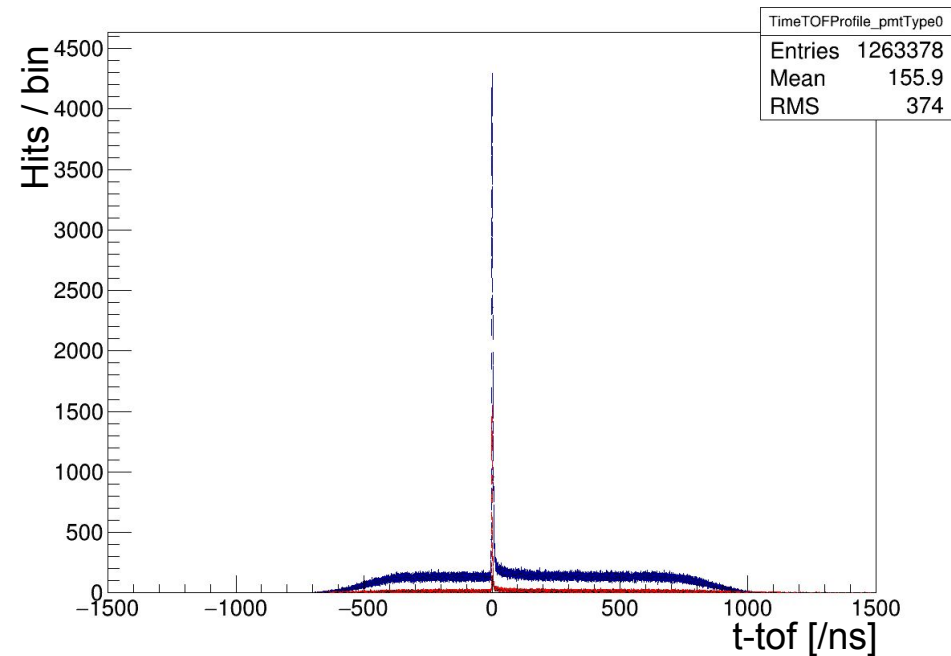
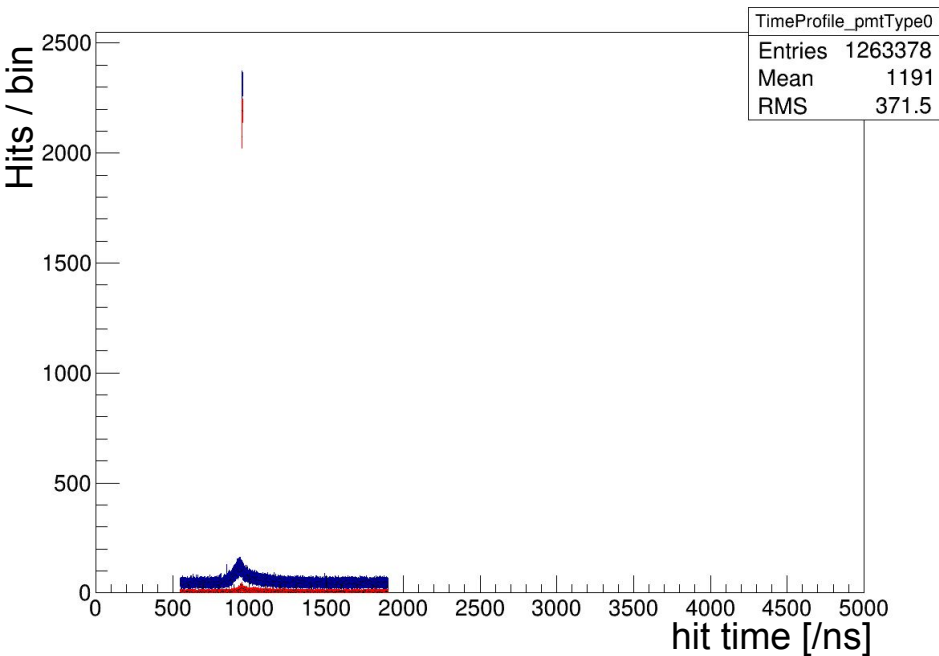
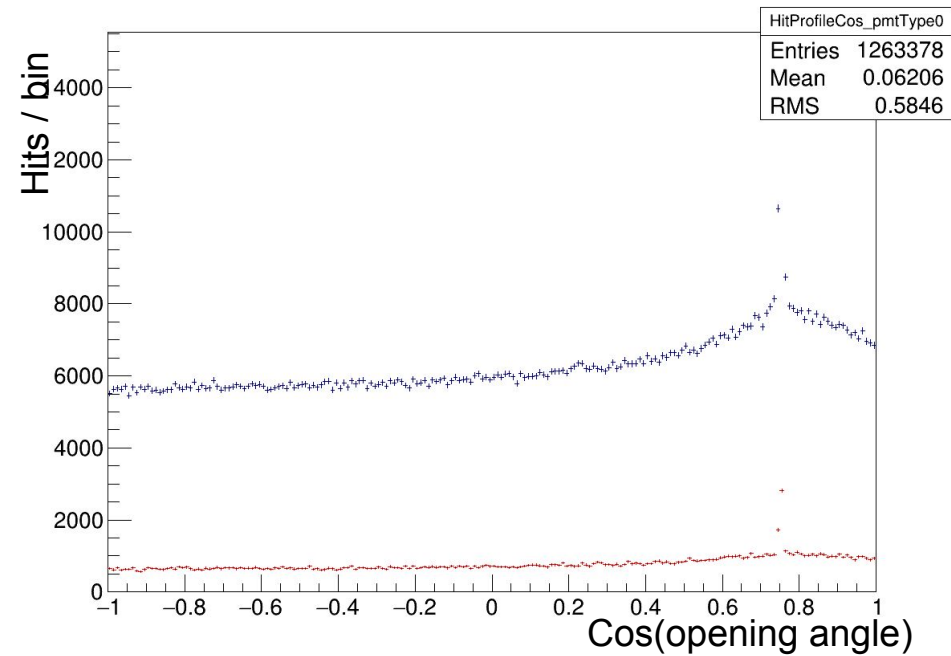
Vertex distribution

- $E = 3 \text{ MeV}$
- $DR = 50 \text{ Hz}$



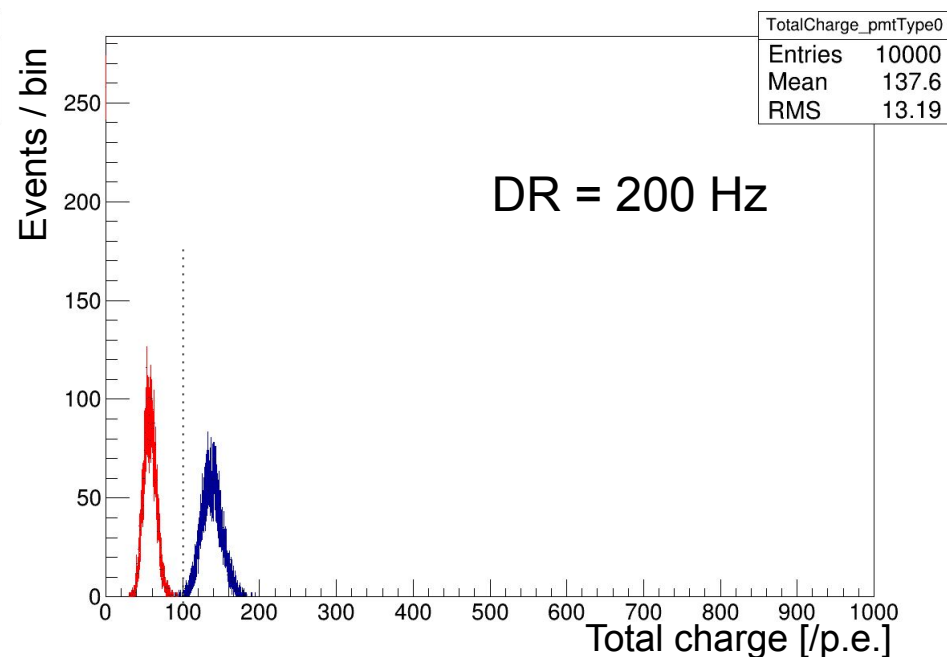
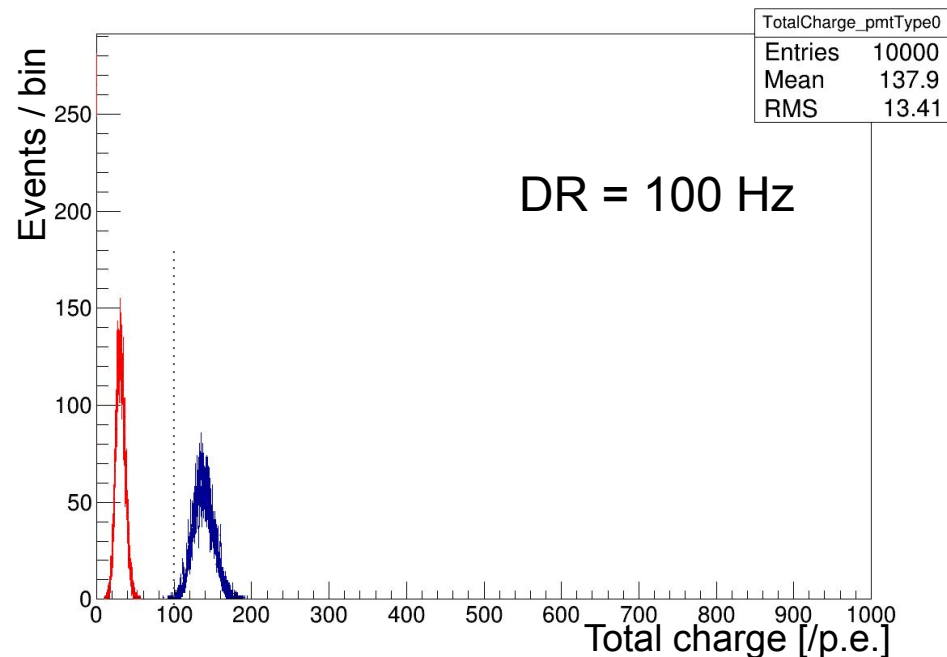
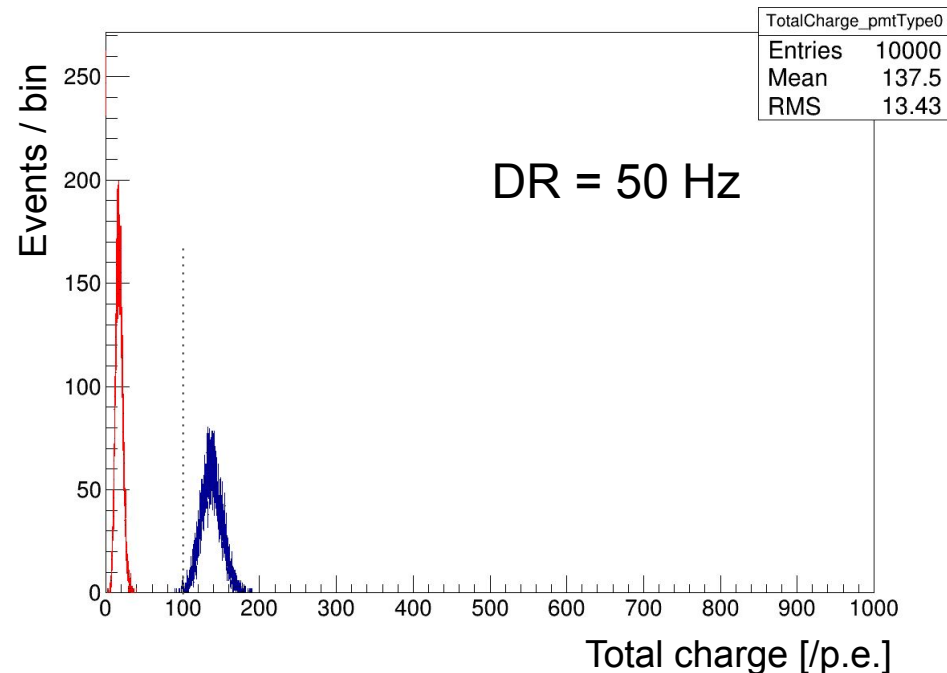
Time / hit profiles

- $E = 3 \text{ MeV}$
- $DR = 50 \text{ Hz}$
- Blue = B&L, red = mPMT



Total charge

- $E = 3 \text{ MeV}$
- Blue = B&L, red = mPMT
- Dotted line shows 100 p.e.

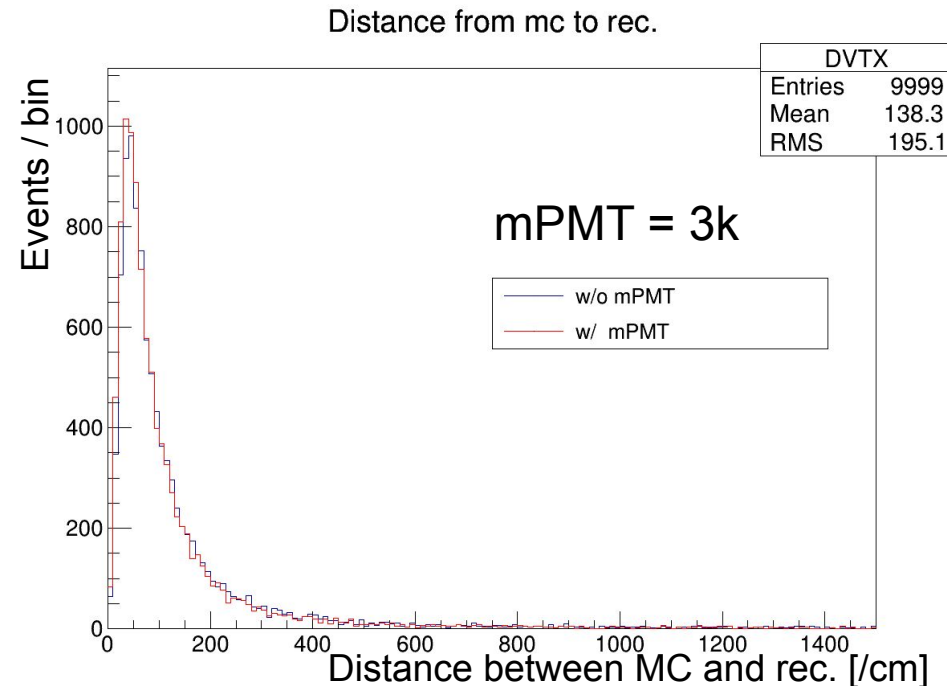
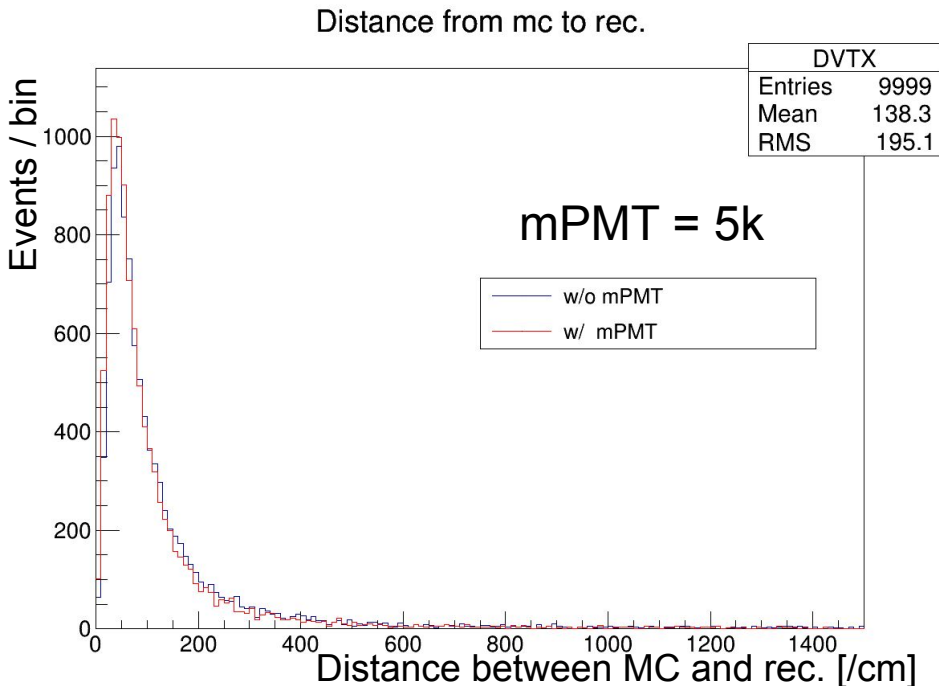
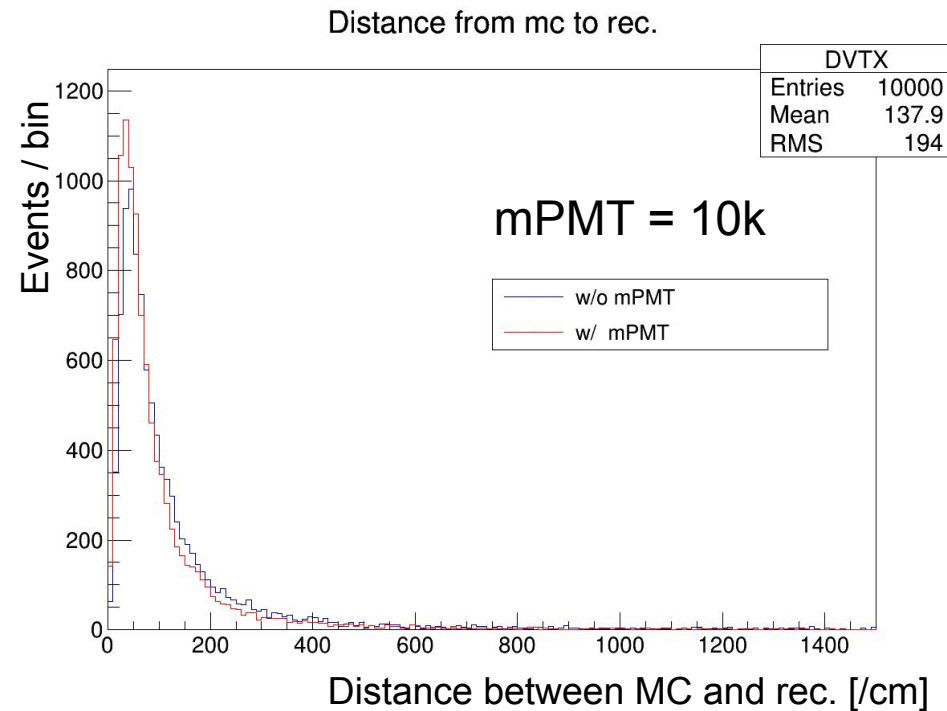


Reconstruction

- Reconstructed with masking method to compare # of mPMTs
 - Masked probability = 0.5, 0.7 (in LE fitter) → # of mPMT = 5k, 3k

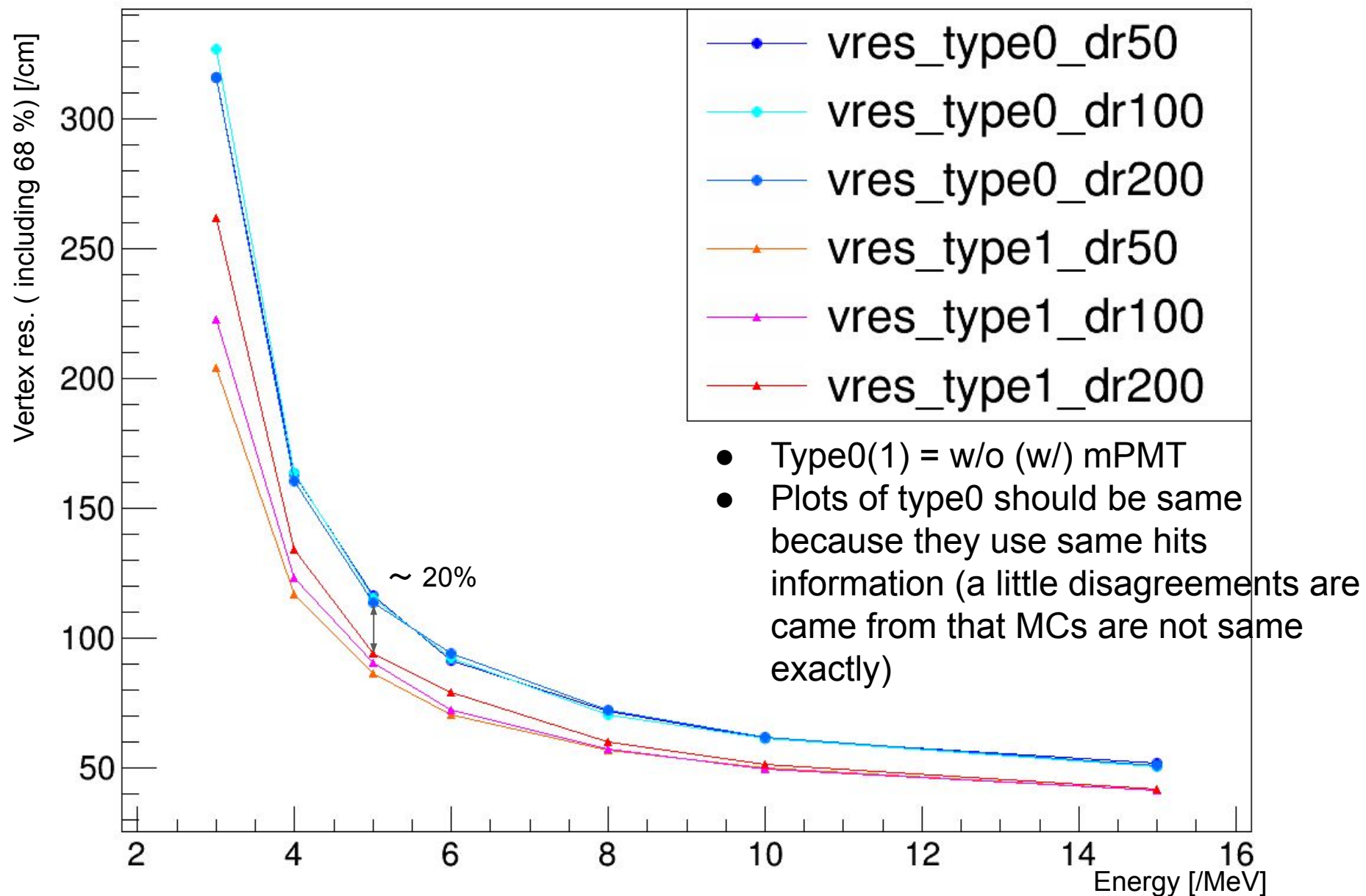
Distance between MC and rec.

- $E = 10 \text{ MeV}$
- $DR = 100 \text{ Hz}$
- Y-scales are not aligned



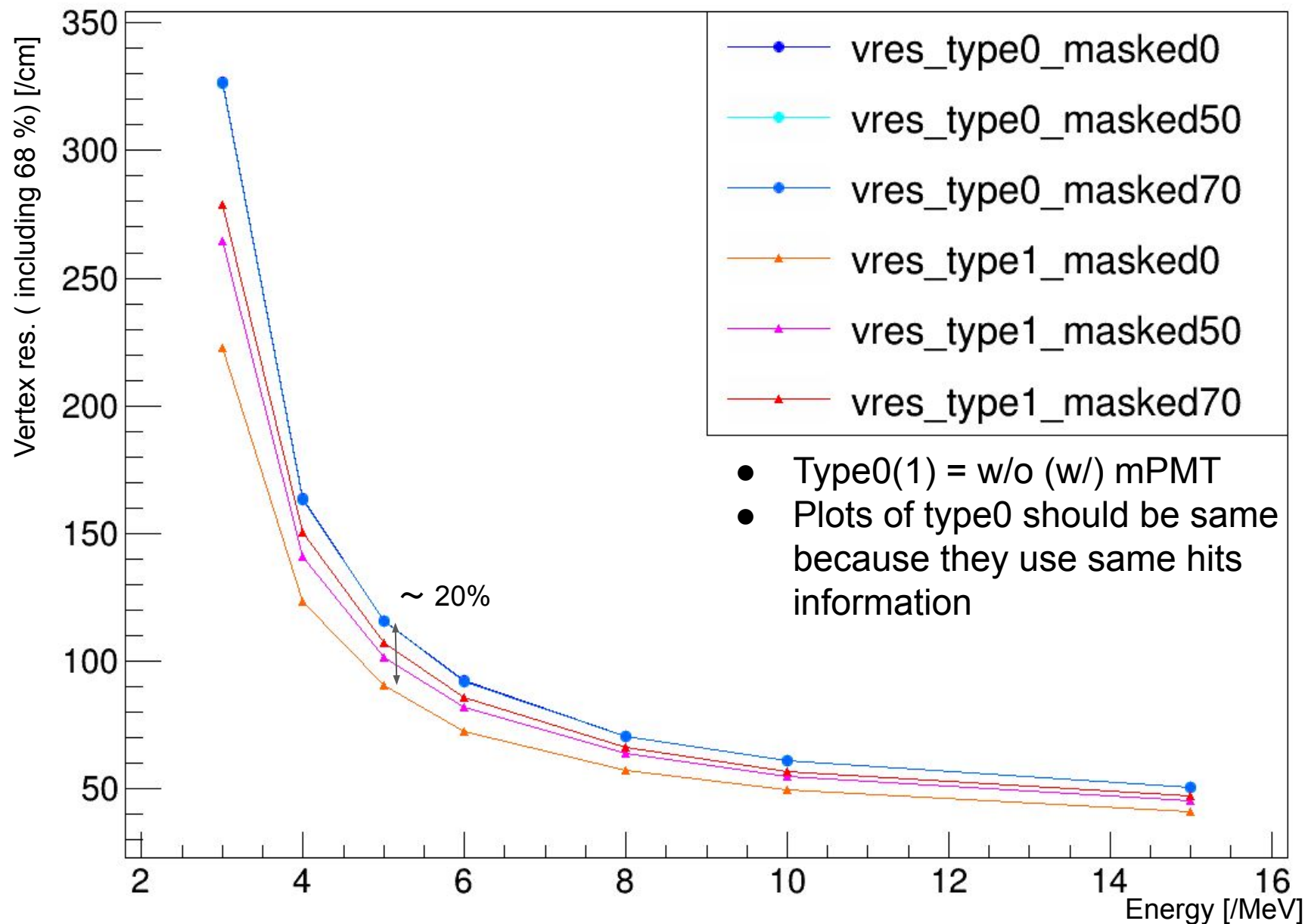
Comparison of DR

vertex resolution



Comparison of PC

vertex resolution



Miss-reconstruction rate

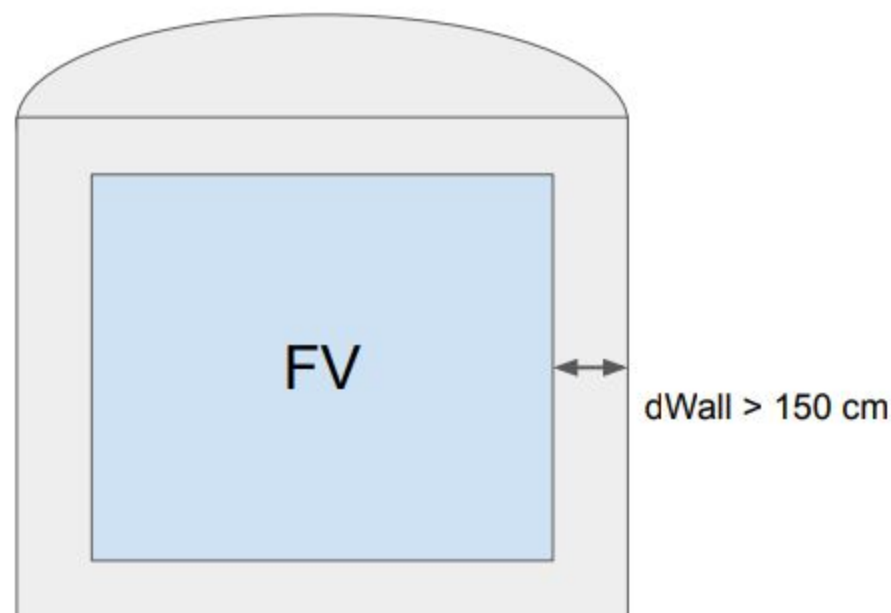
Slide of 1st Nov.
mPMT-Japan meeting

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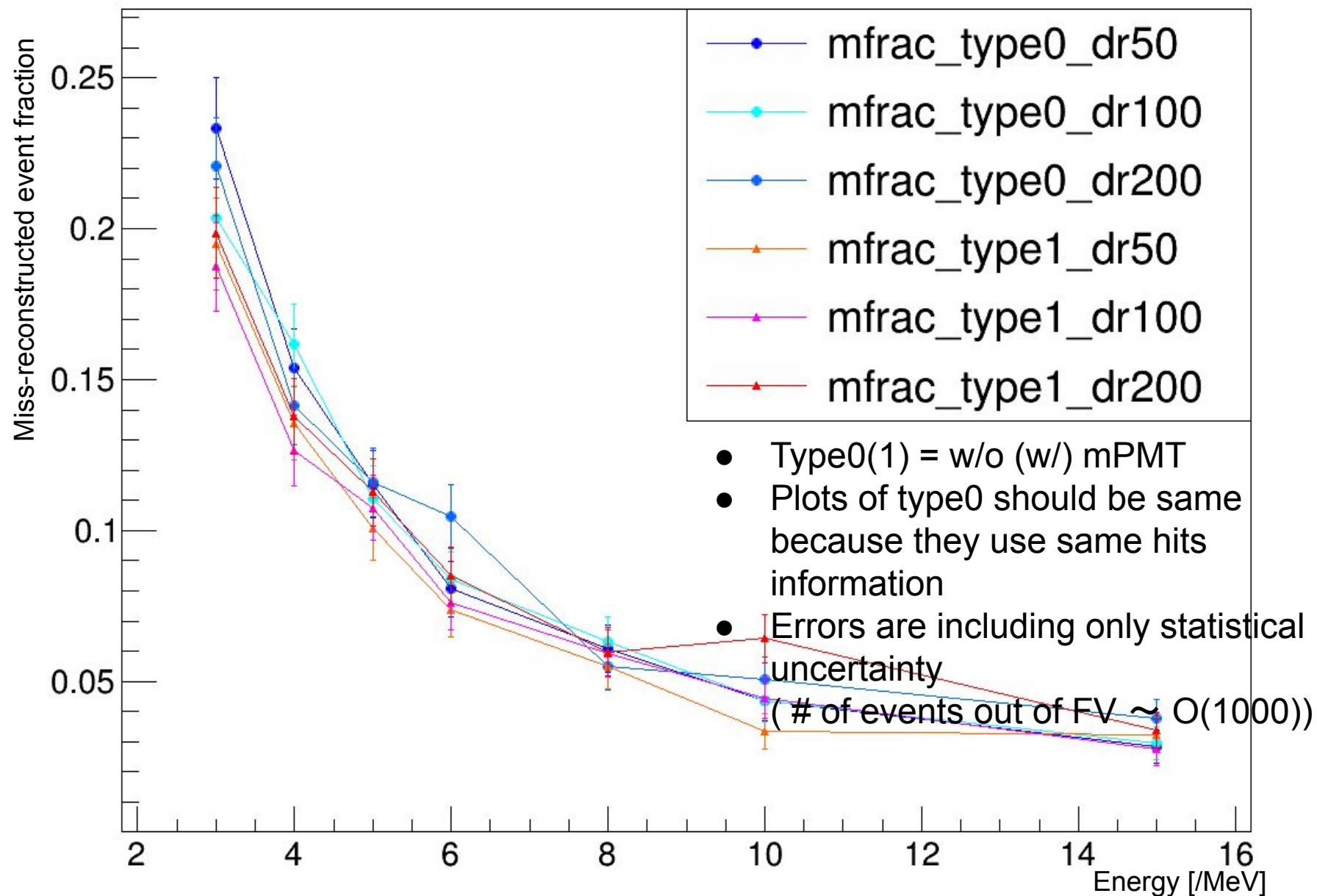
- Calculated the miss-rec. rate: how many events are reconstructed inner volume.

$$(\text{miss-rec. rate}) = \frac{(\# \text{ of events generated out of FV and reconstructed in FV})}{(\# \text{ of events generated out of FV})}$$

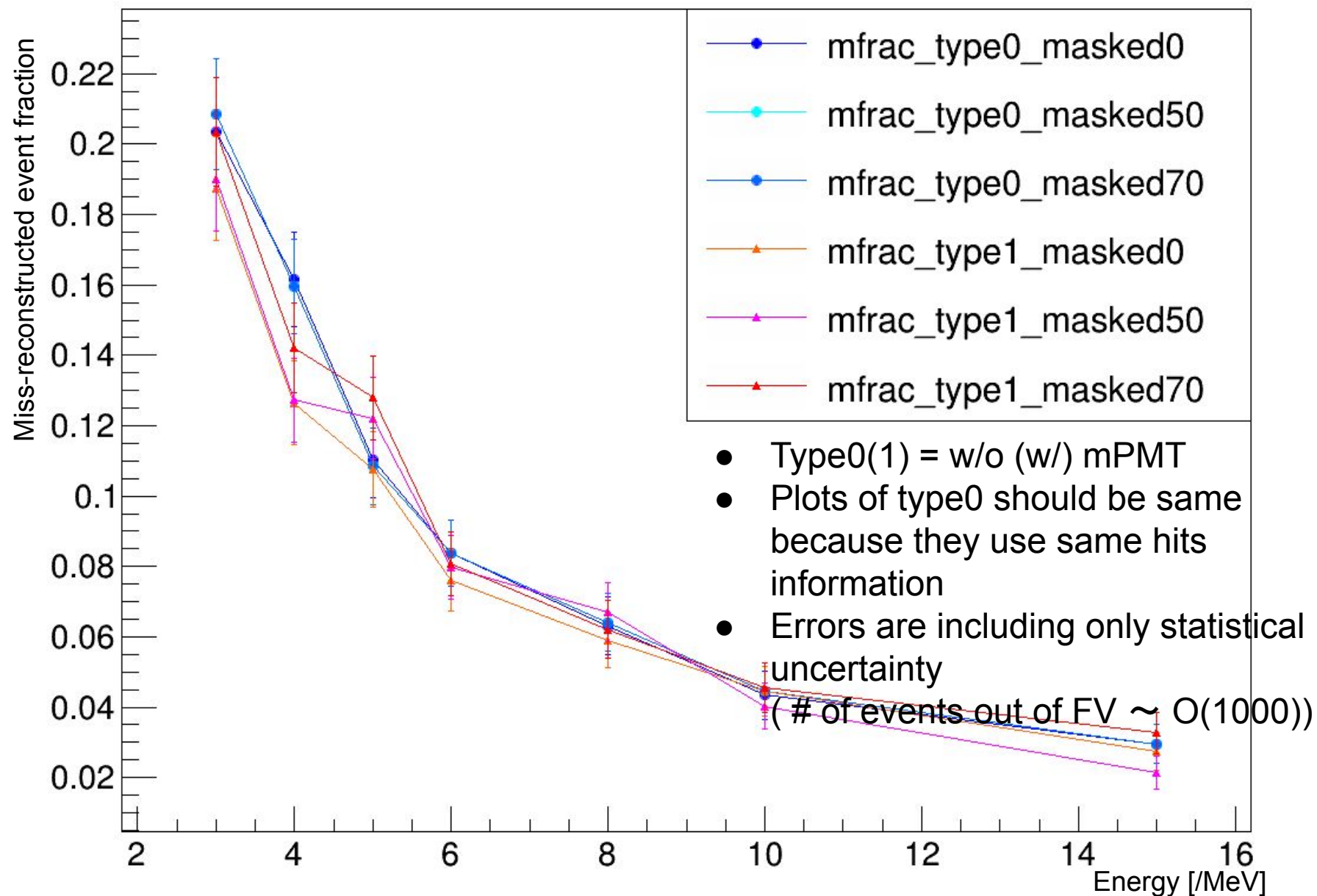
- FV := {volume | dWall > 150 cm}
- Calculated it at some energies: 3,4,5,6,8,10,15 MeV



Comparison of DR mis-reconstructed fraction



Comparison of PC mis-reconstructed fraction



Summary

- Fixed the problem that dark hits were not collected
- Produced new MC and ran LE fitter
- All distribution look good
 - Plots of other energies, dark rate etc. are attached with this slide
- Calculated and compared vertex resolution and miss-reconstructed fraction
- Todo:
 - Make more statistic of events around near the wall
 - Check other variables (dWall distribution of events out of FV ?) to compare detector performance for events around wall

- $E = 5 \text{ MeV}$
- W/ 10k mPMT

