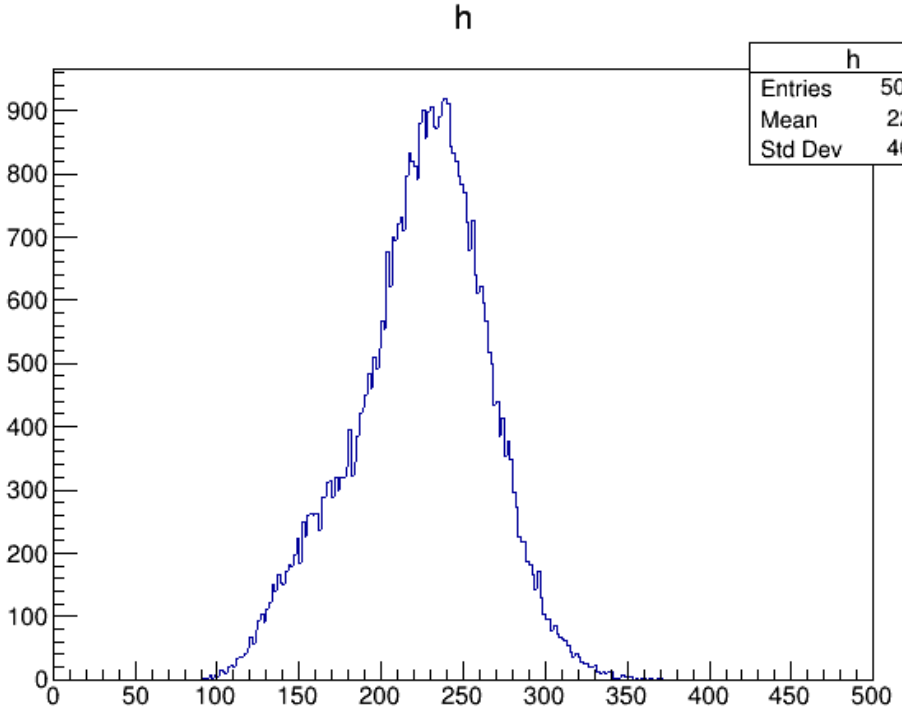
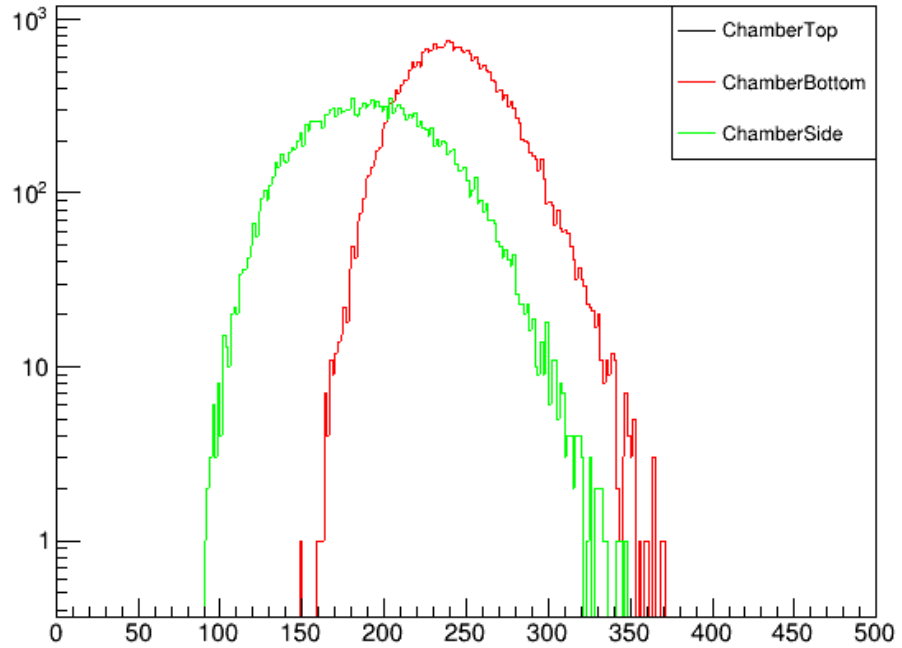
$\overline{H}$ flight time

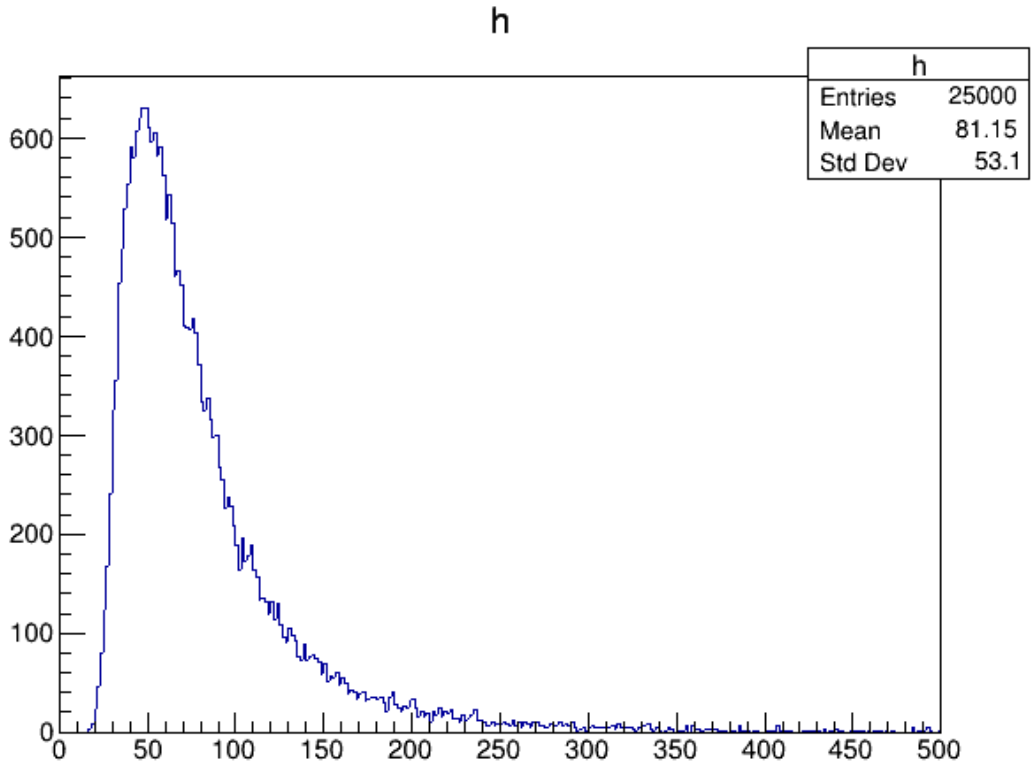
- Add the flight time information into the simulation
- T =10uK , laser line width = 15ueV
- Assuming downward gravity

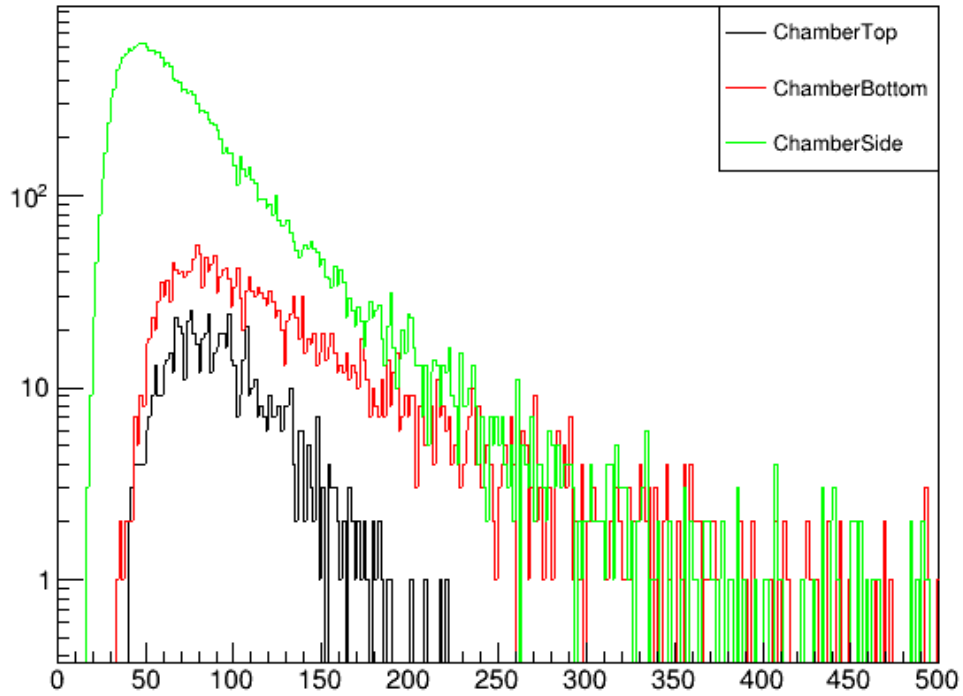




$\overline{H}$ flight time

- T =0.5mK , laser line width = 15ueV
- Downward gravity





$\bar{p}$ annihilation induced radioactive isotope

- Simulation is performed with variance reduction method.

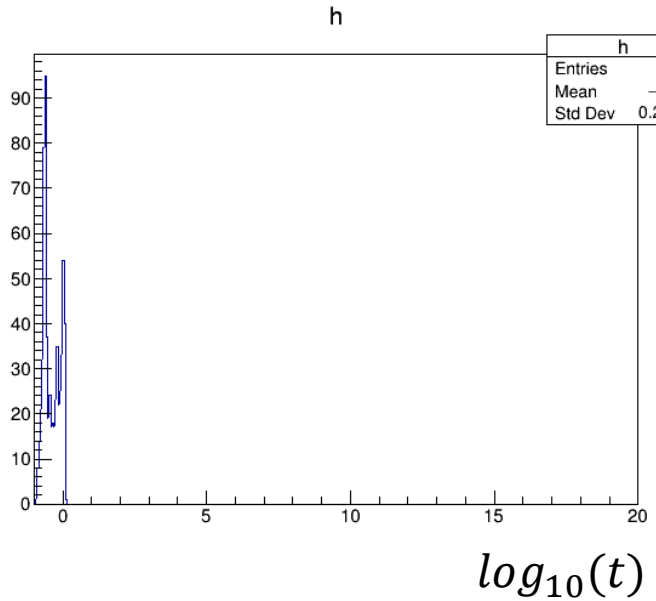
-> Cut off the daughter nucleus proportional to the lifetime

- In the real experiment, long lifetime radioactive can be background source.
- Compare variance reduced(VRM) one and not reduced(NVRM) one
- Test with 50k events.

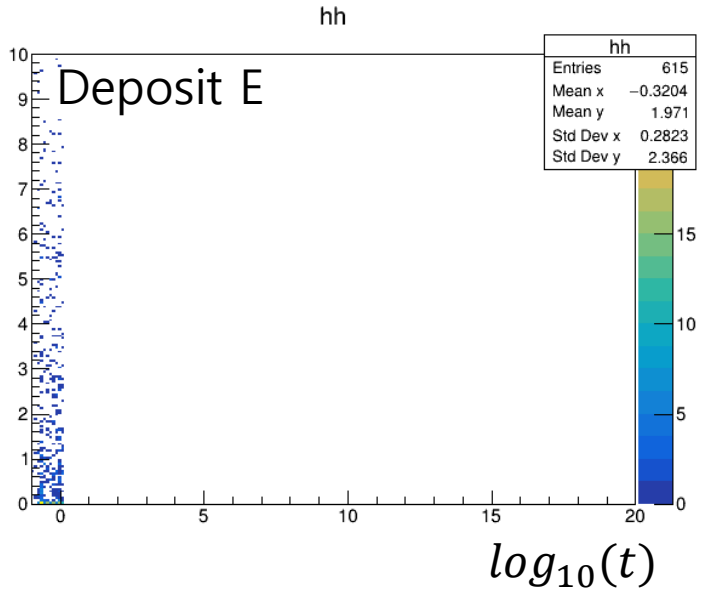
$\bar{p}$ annihilation induced radioactive isotope

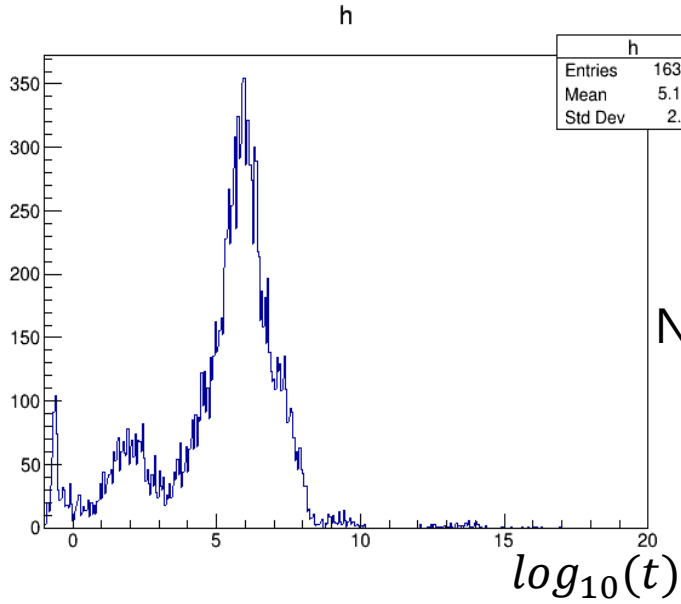
- Long time scale
- After 1s, VRM does not make signal.
- After 1s, NVRM energy deposit are almost smaller than 3MeV.

- 3MeV threshold would be needed.

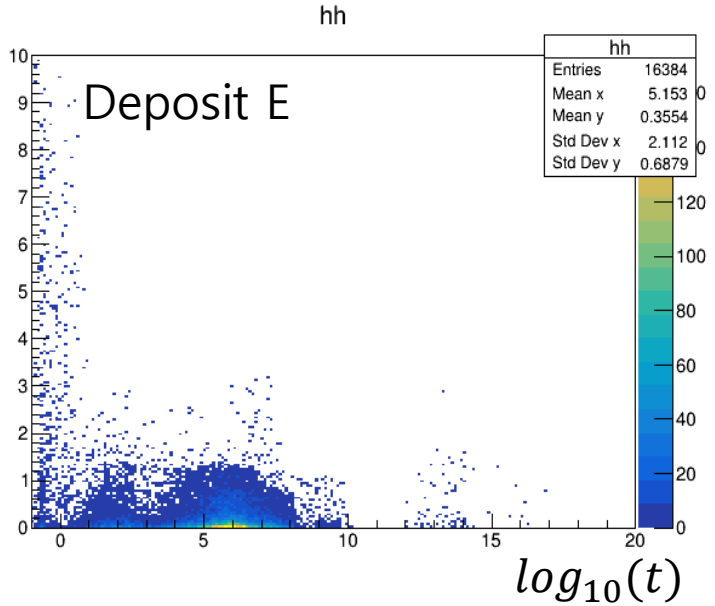


VRM



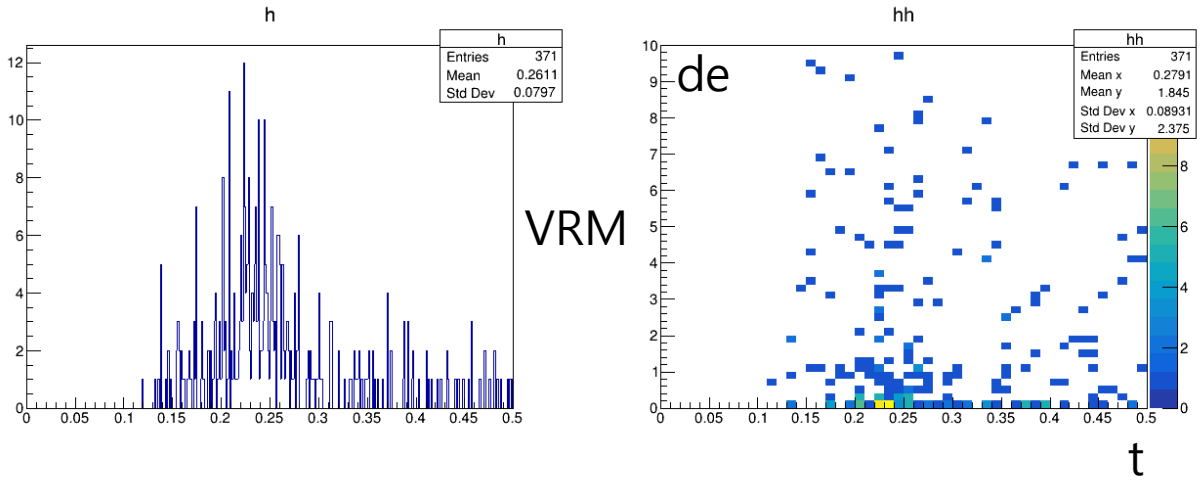


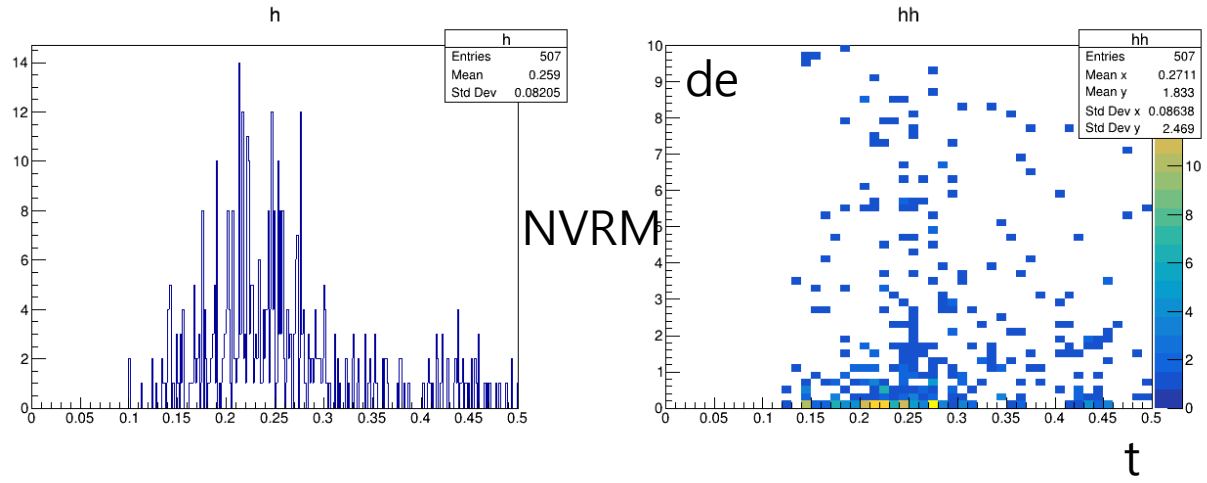
NVRM



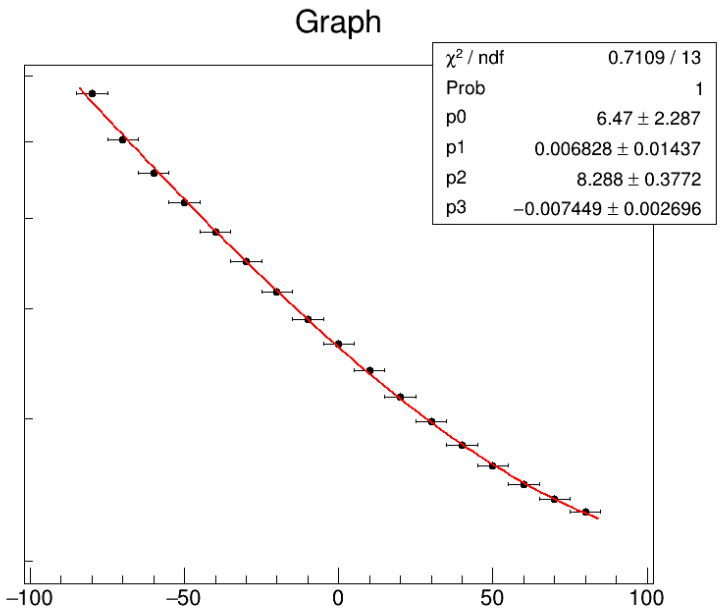
$\bar{p}$ annihilation induced radioactive isotope

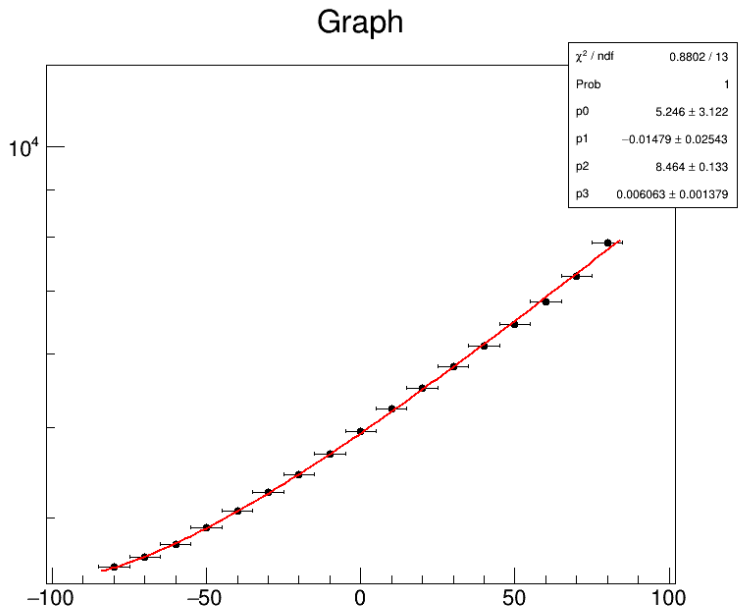
- For an experiment window (500ms)
- VRM : 371 hits per 50k events
- NVRM : 507 hits per 50k events
- No much difference, no need to use NVRM

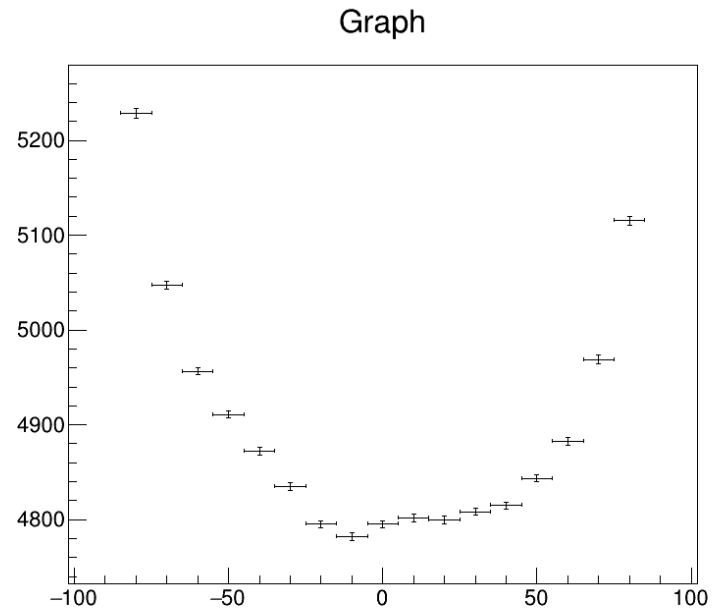




Charge correction

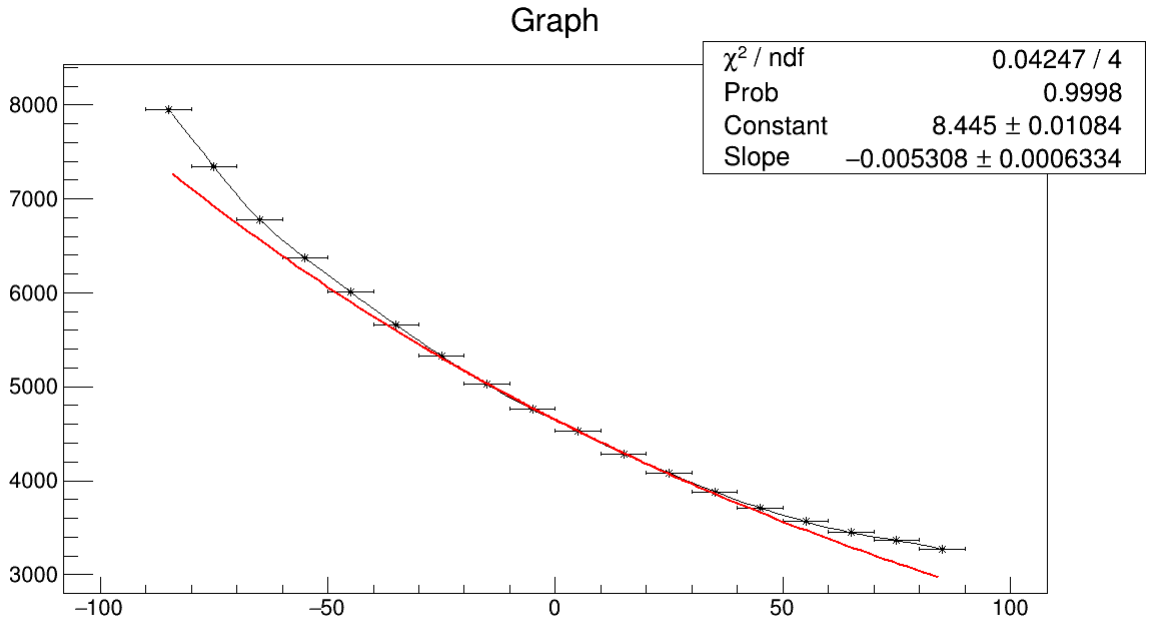


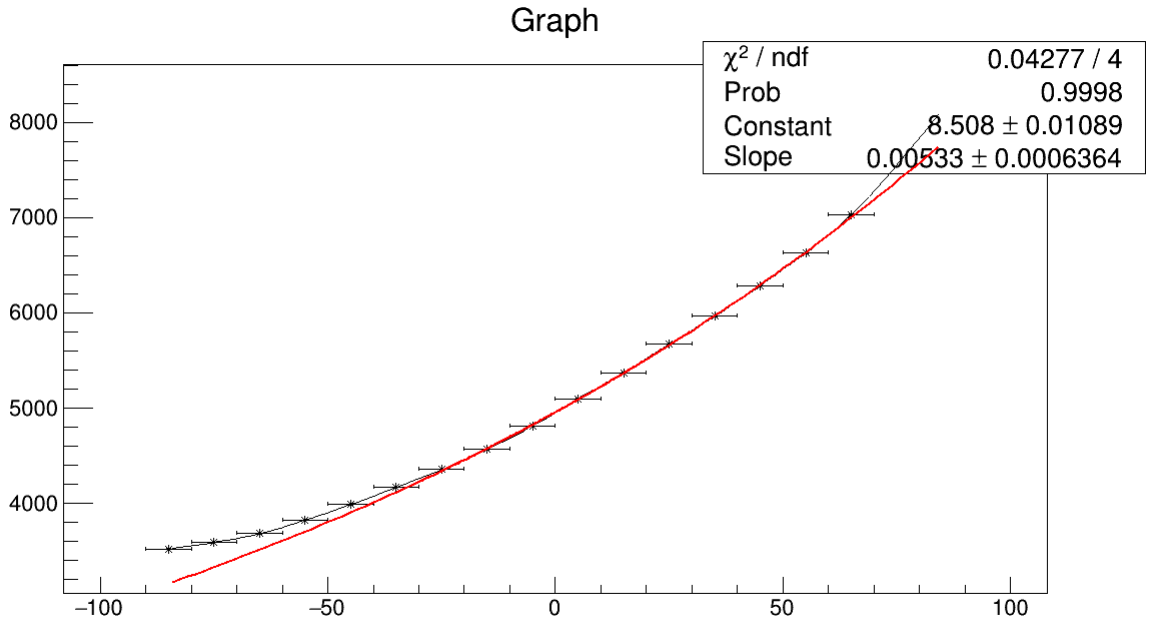




Charge correction

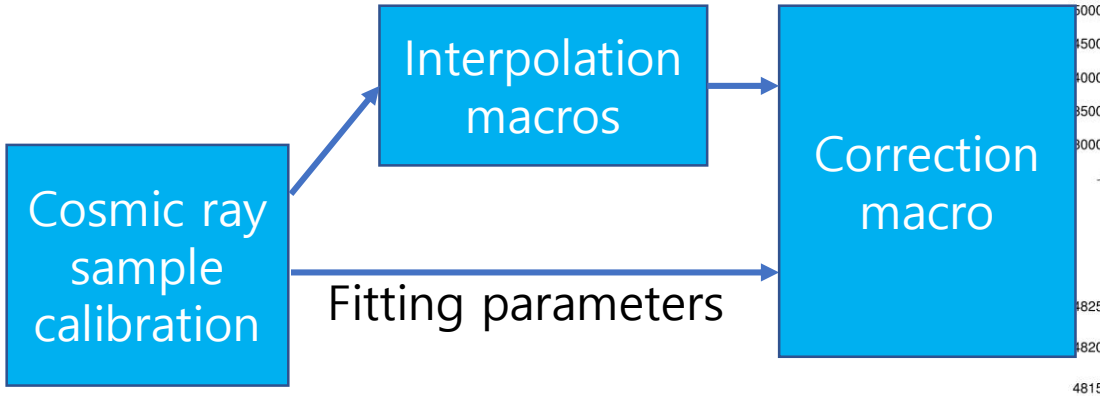
- Compare interpolated MPV and center fitted MPV
- Interpolation functions can be saved as C macros.
- $I_{corr} = I - \frac{I}{I_{MPV}}\left(I_{MPV,inter} - I_{MPV,fit}\right),\ where\ I = charge$

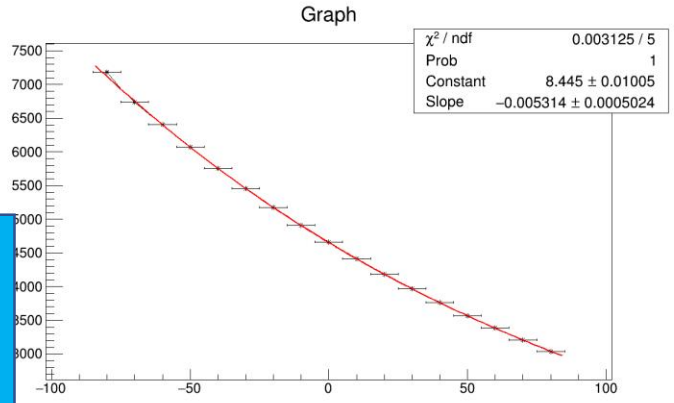


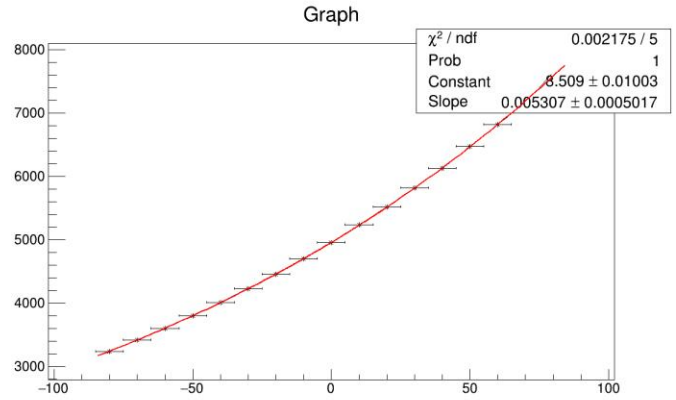


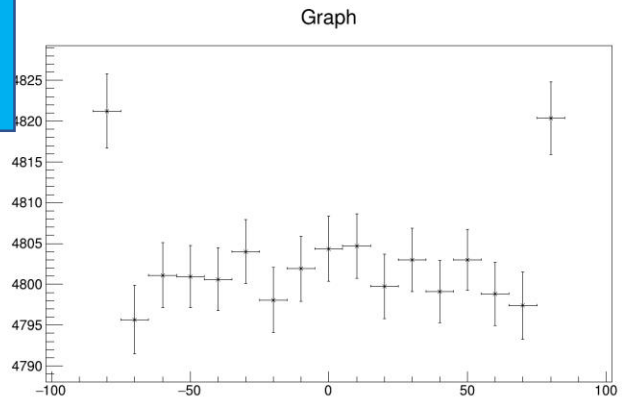
Charge correction

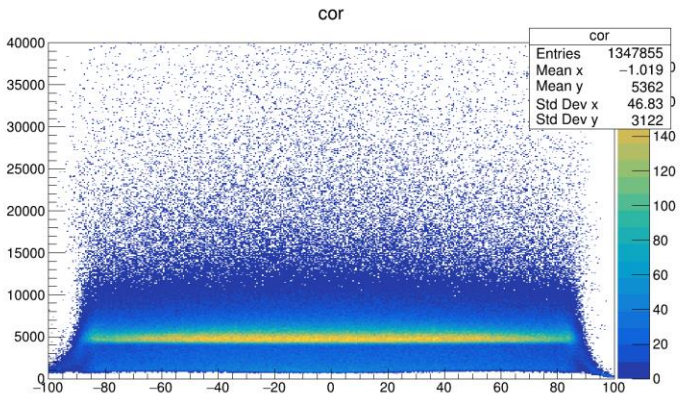
- By using fitting parameters and interpolation macros, one can correct charge event by event.





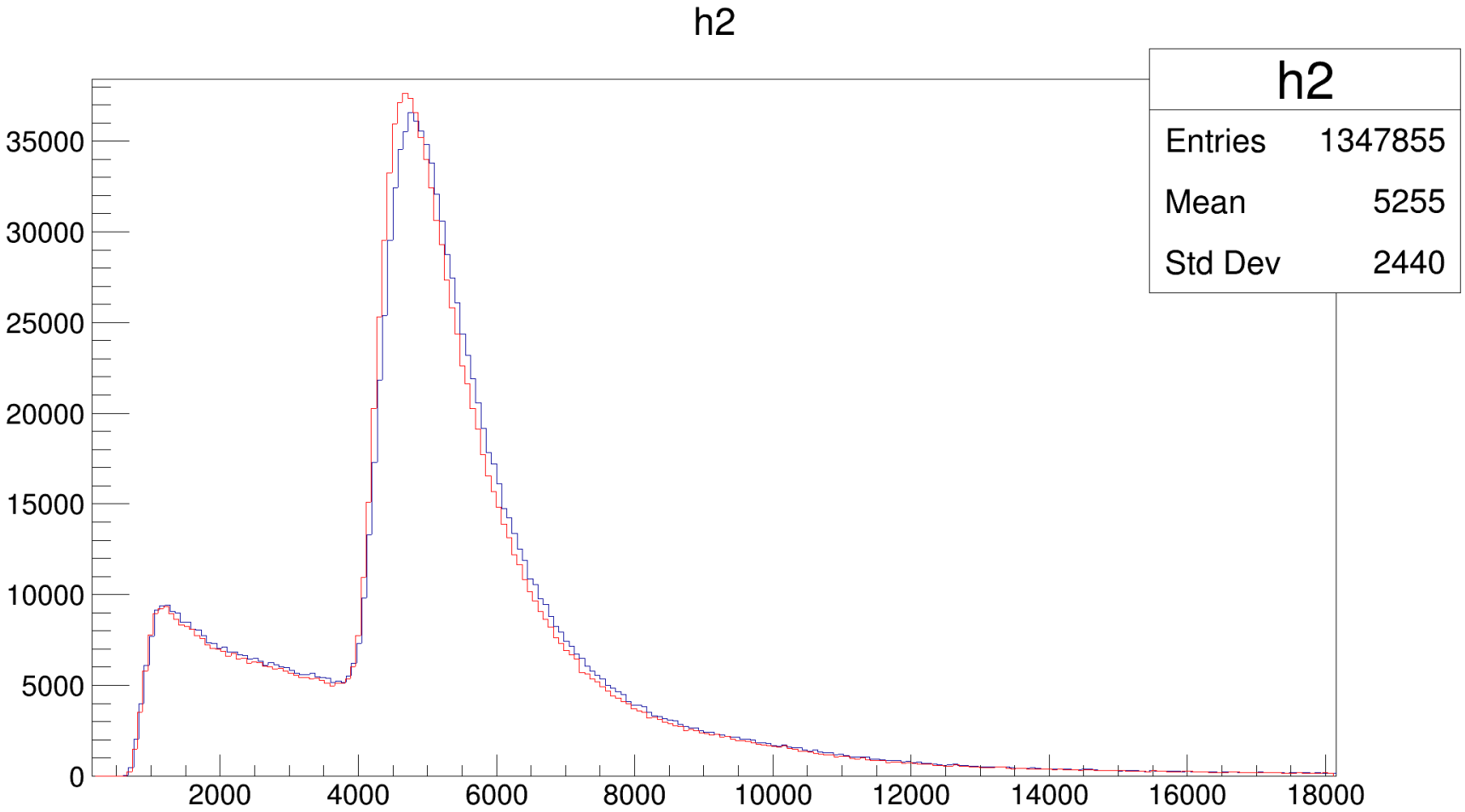






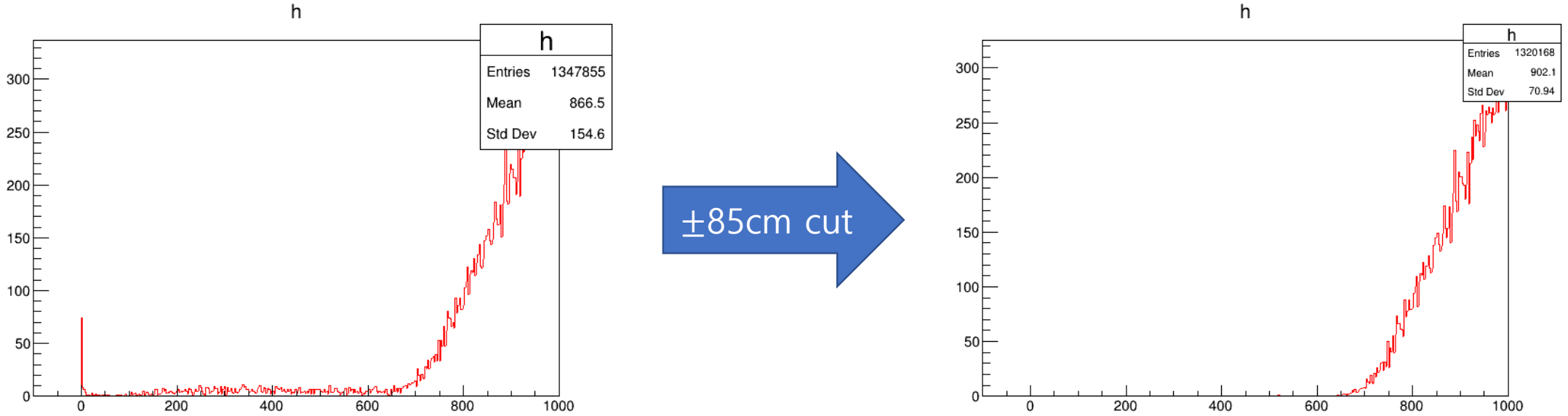
Charge correction

- Uncorrected : blue, corrected : red



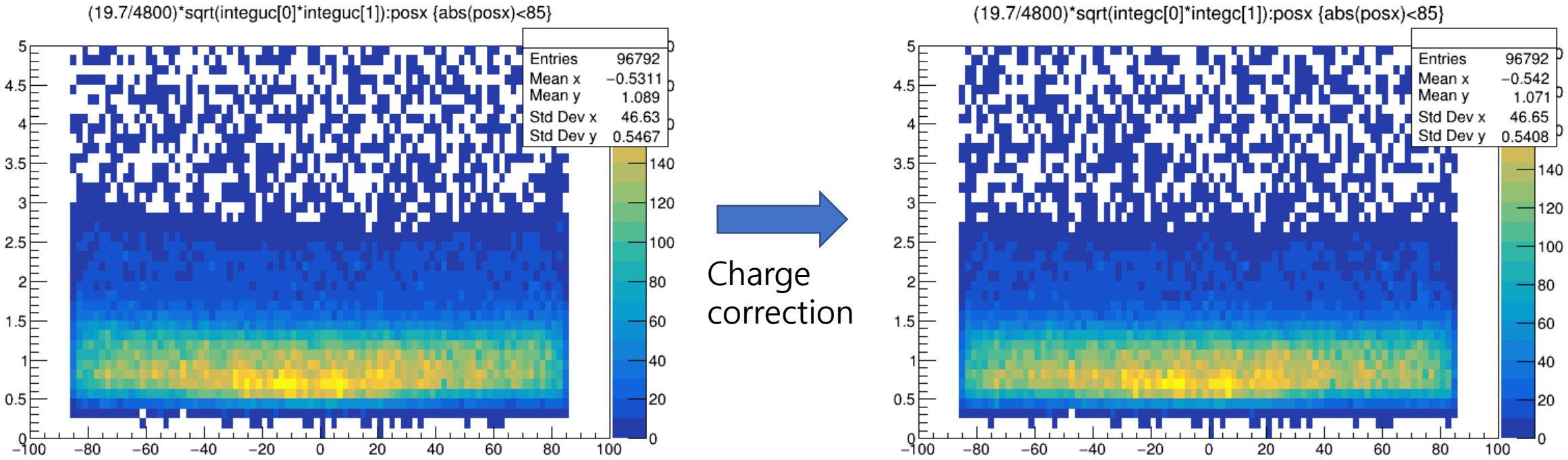
Charge correction

- After interpolation points(outside of bar), charge correction is not valid. -> Limit of the interpolation
- It makes some tales or something strange.
- It would be better not to correct charge of abs(position) > 85



Low energy structure

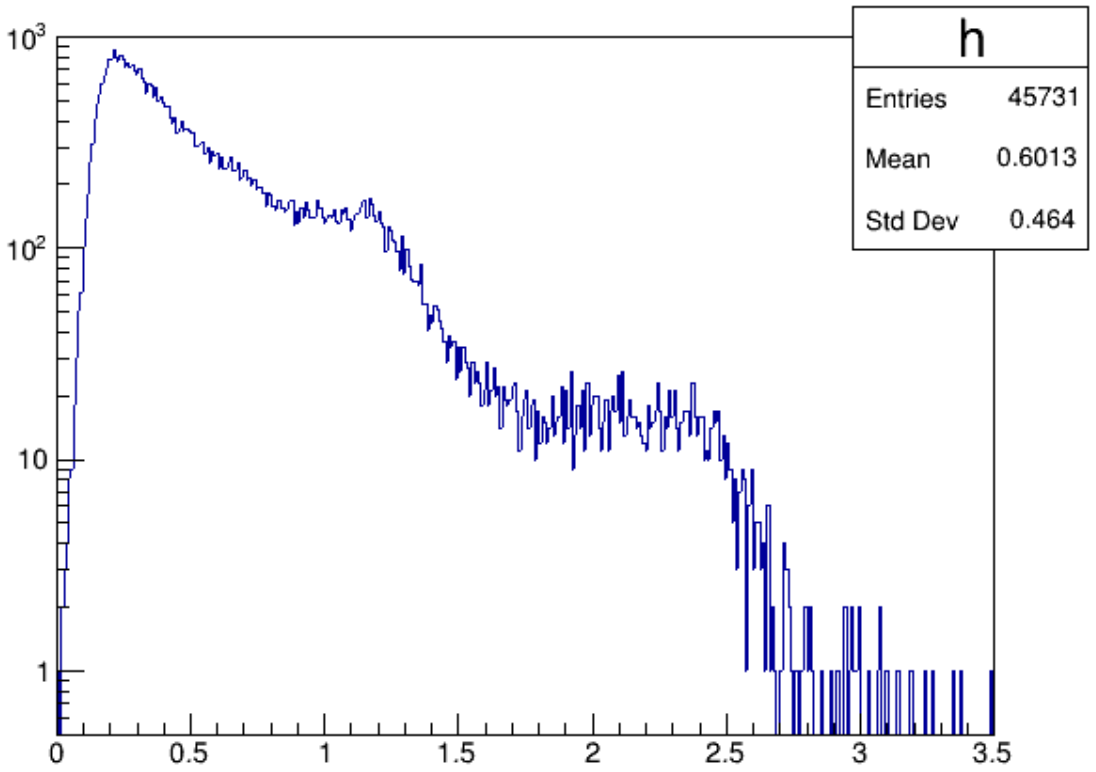
- Data charge correction



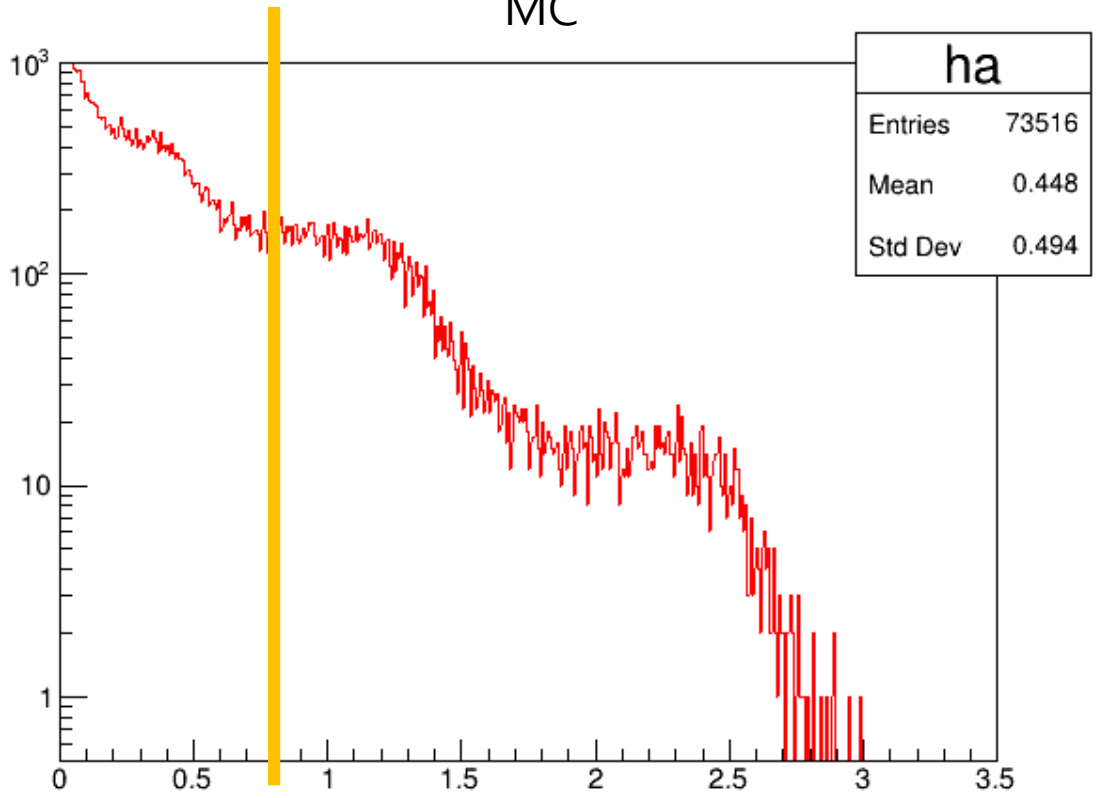
Low energy structure

- In the simulation, assume $\frac{\Delta E}{E} = \frac{0.1}{\sqrt{E}}$
- Gamma from K40, Bi214, Tl208

Data

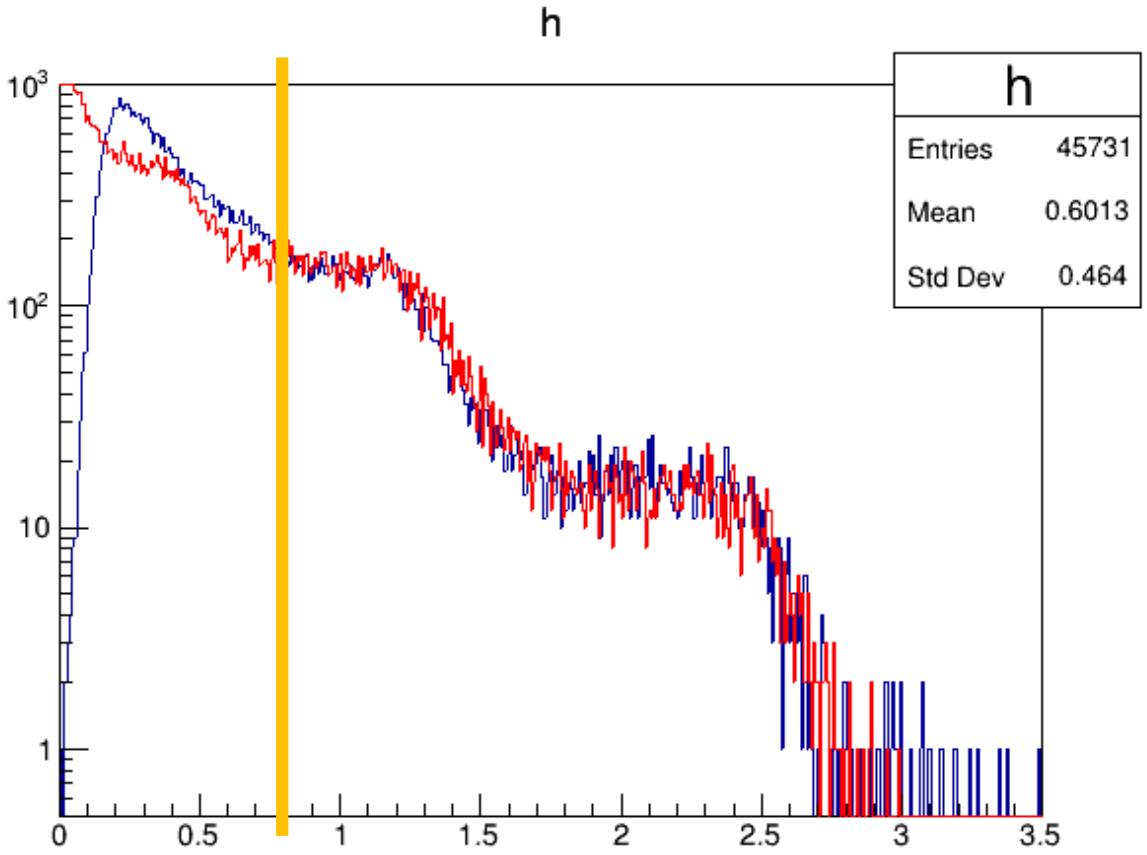


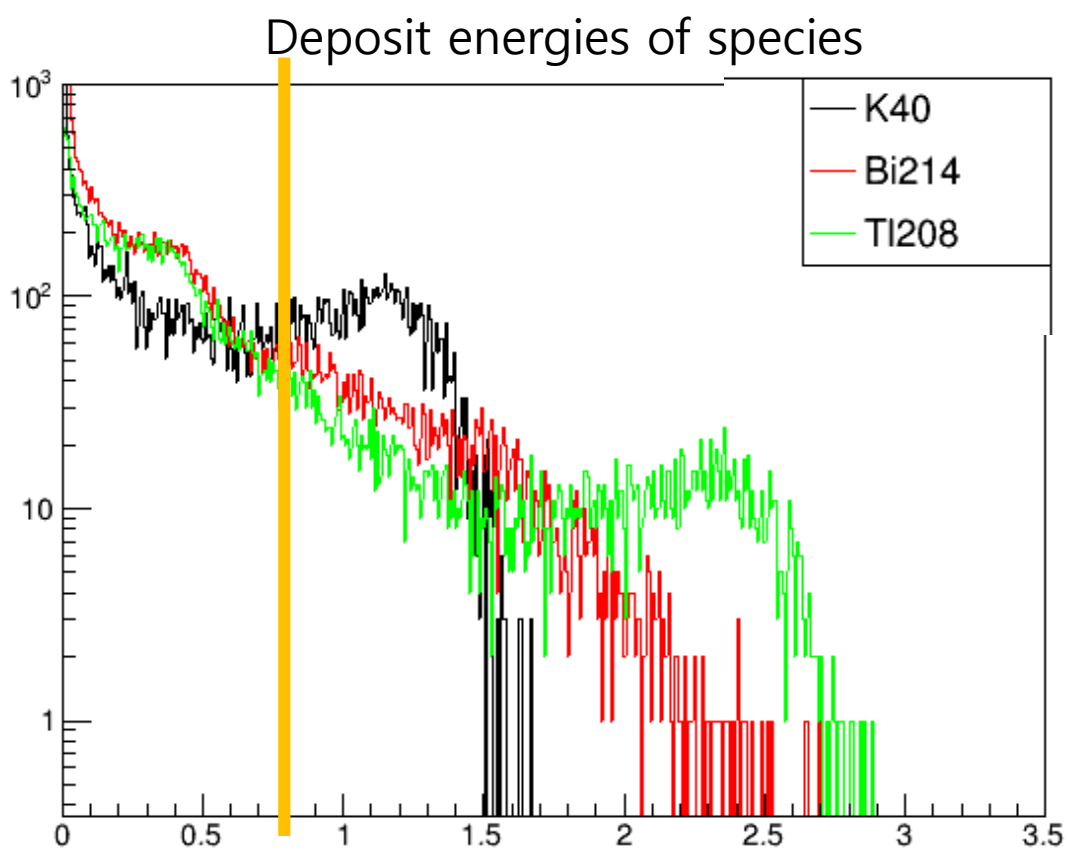
MC



Low energy structure

- Data (blue line) and MC (red line)





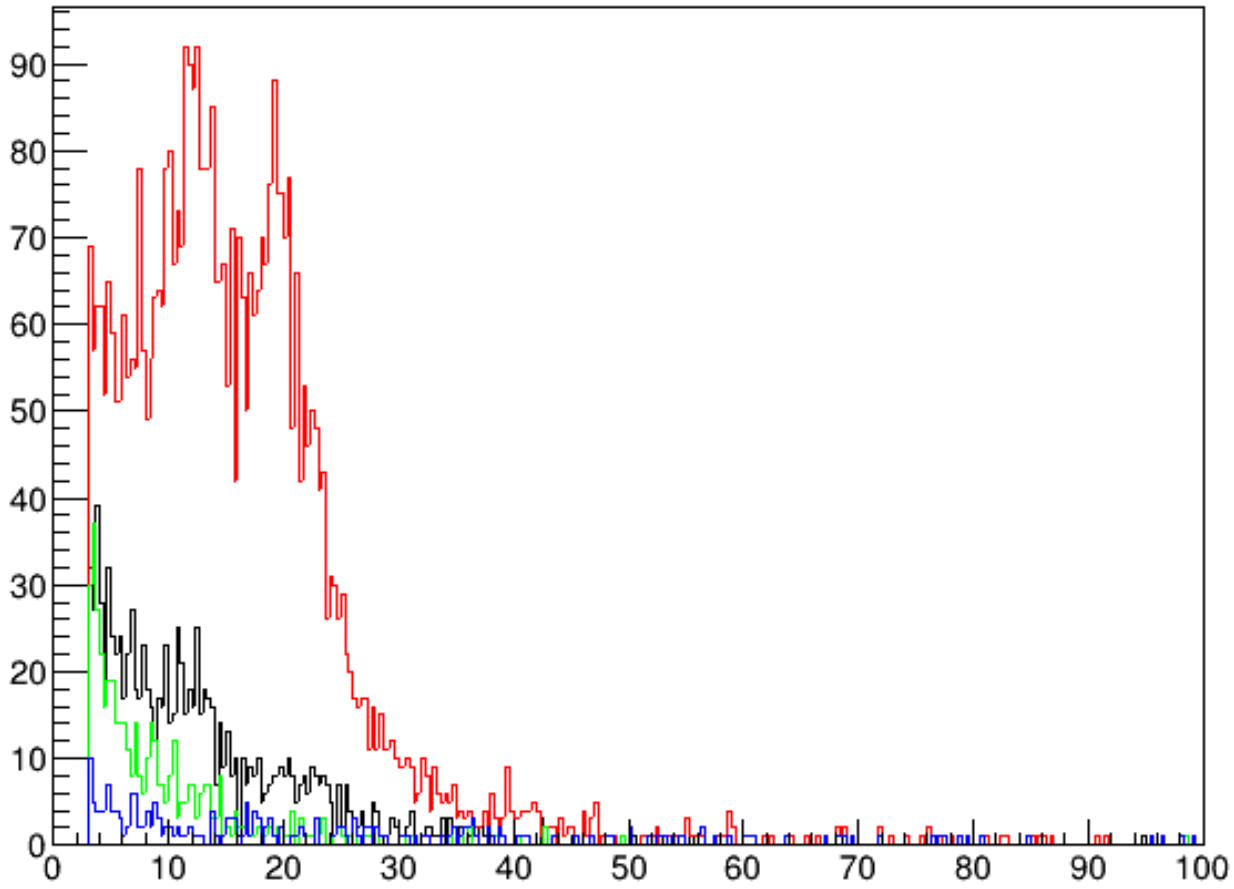
Data and CRY

- To confirm validity of CRY library, check the rate of hits.
- CERN single track trigger data (taken in June)
- data taken Length : 250s (500 experiments)
- CRY setting : generate all particles (not only muons)
  latitude: 50, altitude: 0, date: 2019-6-15

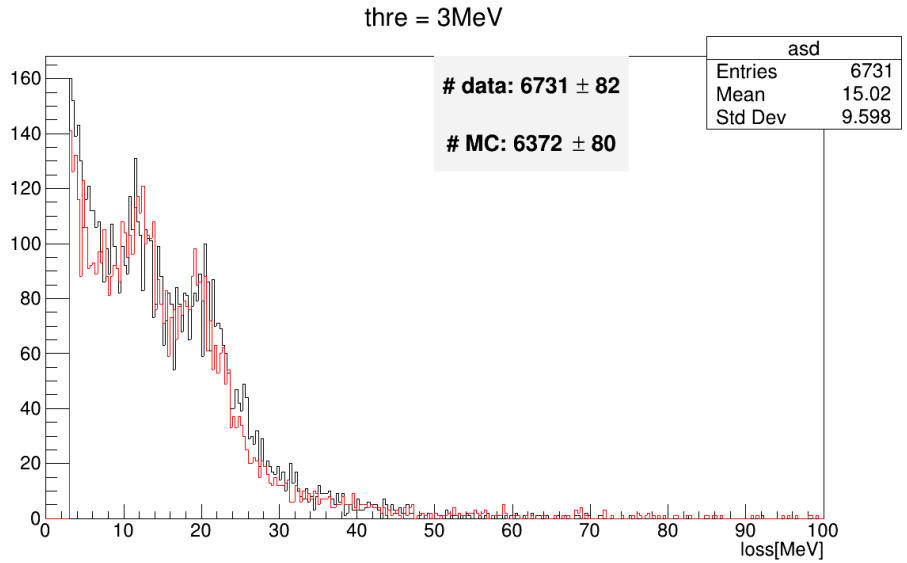
The main difference is altitude -> CERN is at 400m altitude.

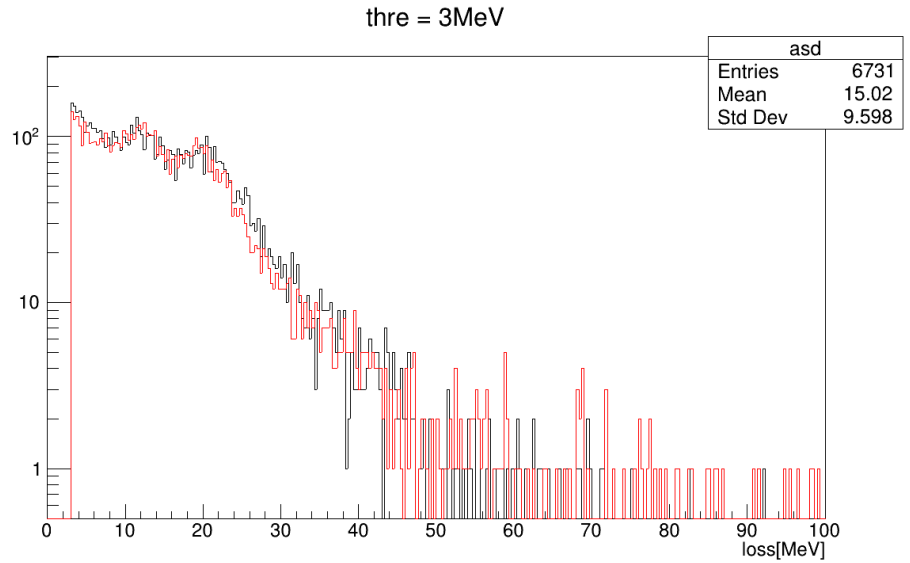
Data and CRY

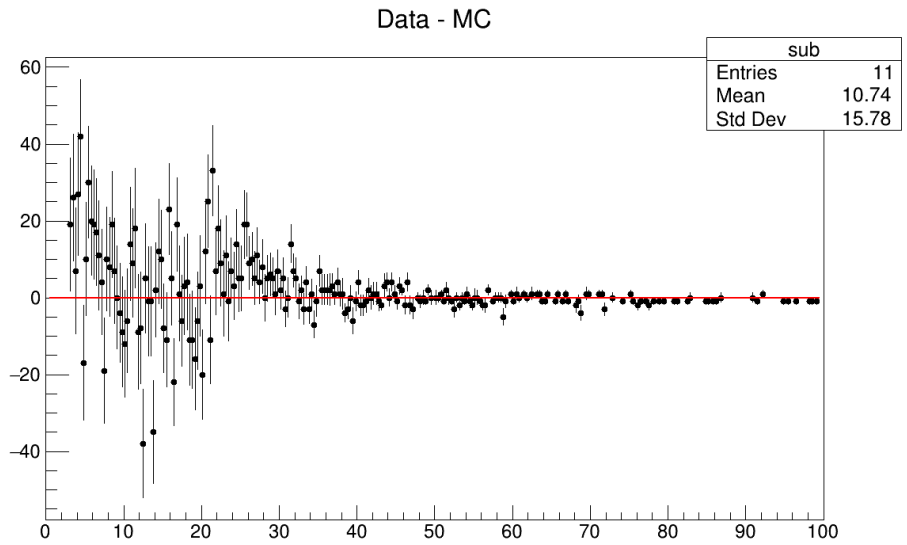
- CRY proportion
- 3MeV threshold
- Muon : red (about 75%)
- Electron, positron : black
- Gamma : green
- Others : blue



Data and CRY

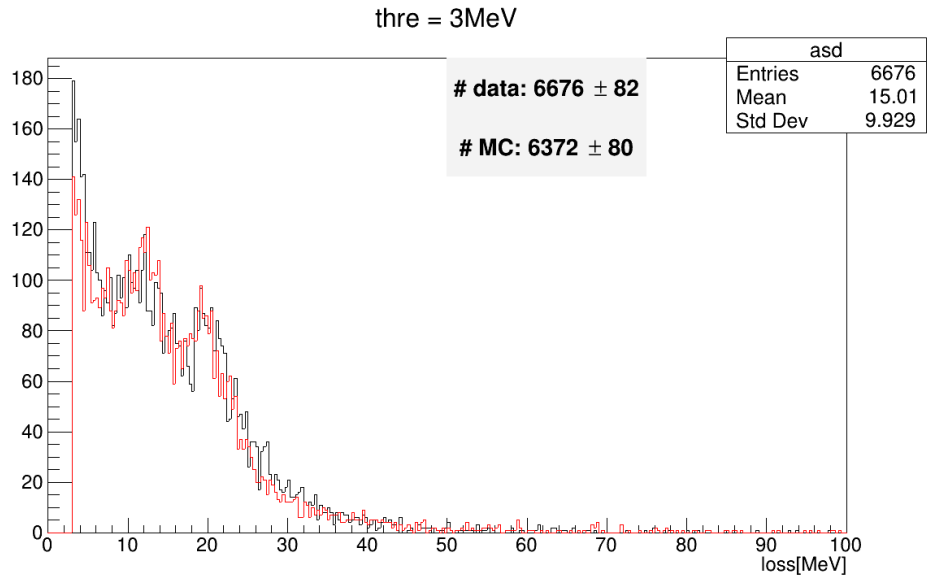


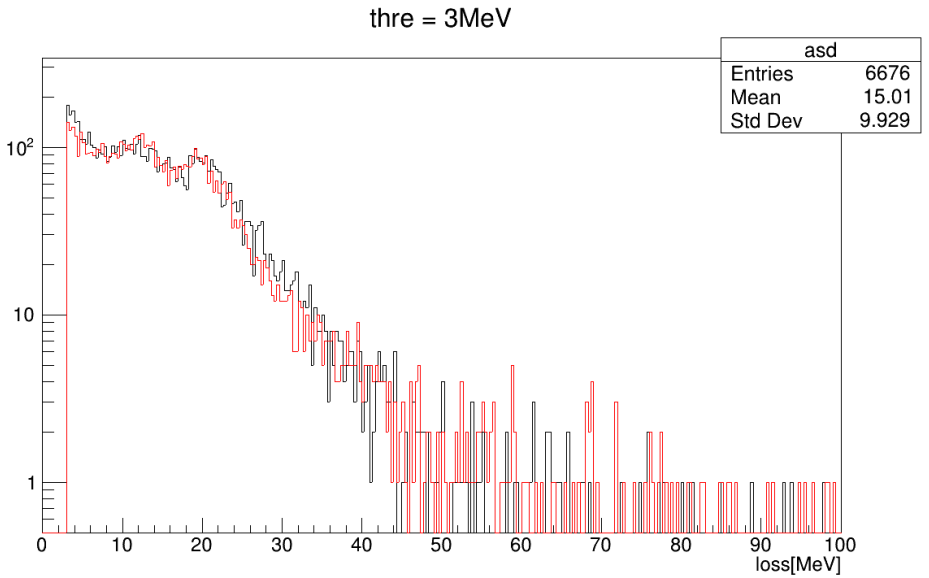


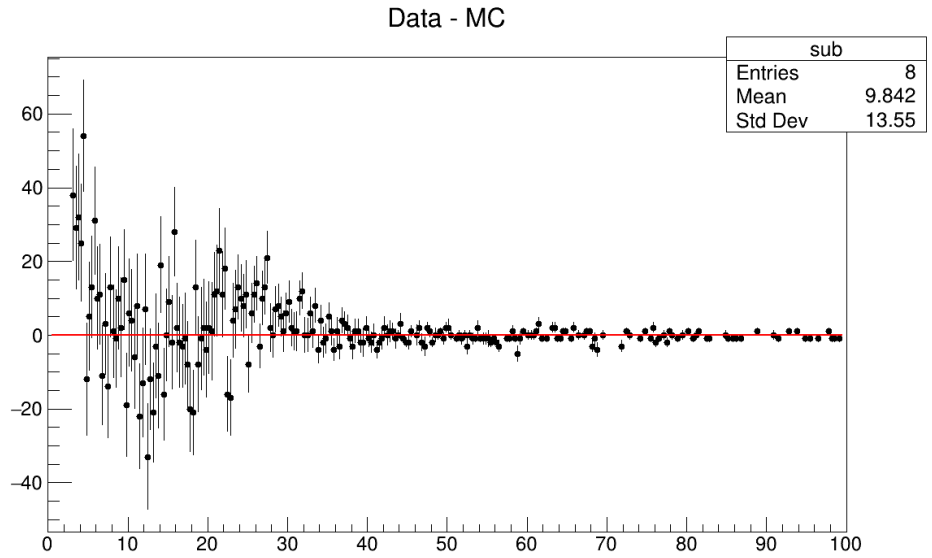


- Data set 1 in CERN
- Data abundance
- About 3.1 sigma

Data and CRY



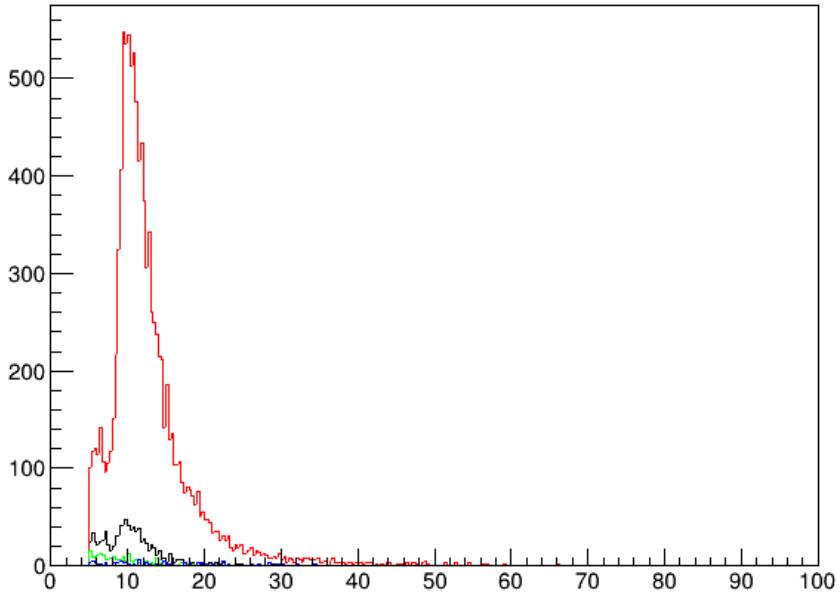




- Data set 2 in CERN
- Data abundance
- About 2.6 sigma
- More data set?

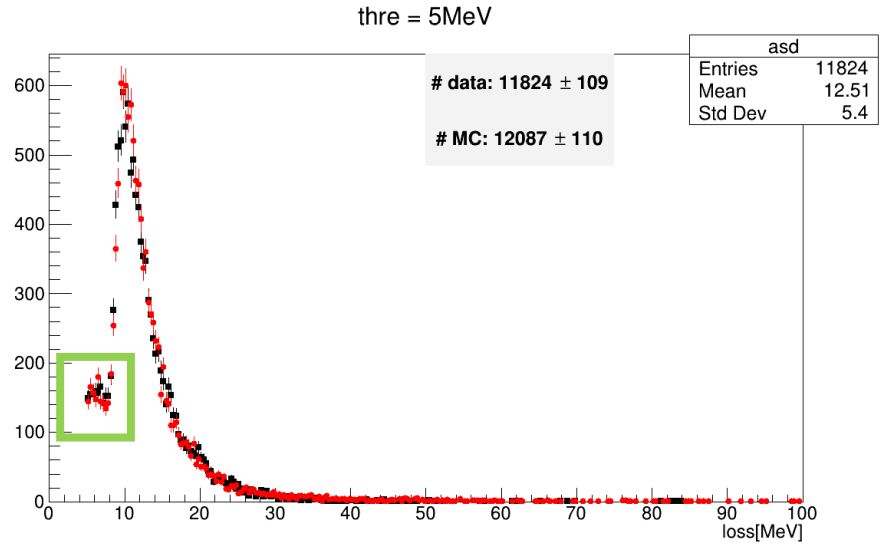
Data and CRY

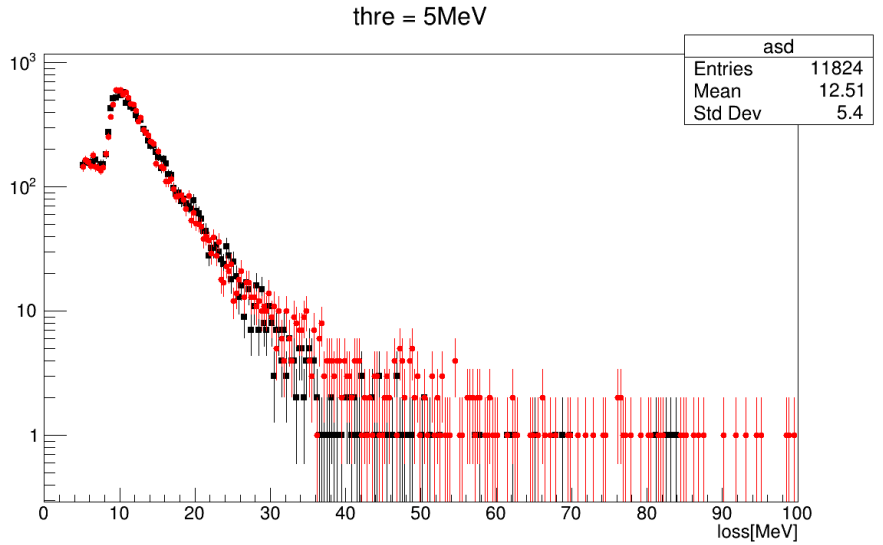
- Single track trigger data in SNU
- Data taken length: 500s
- CRY setting: latitude 37, generate all particles
- With 40cm concrete wall

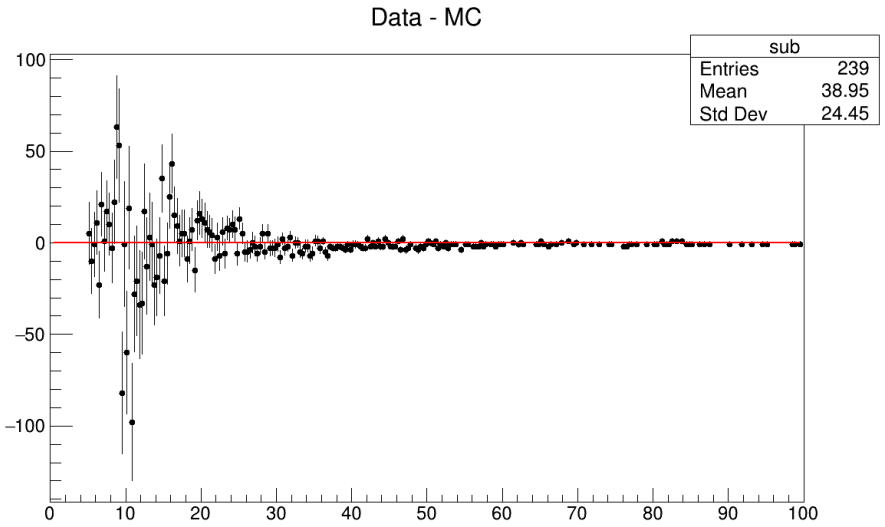


Data and CRY

- With only muon, values under MPV cannot be fitted.(inside green square)







- MC abundance
- About 1.7 sigma
- acceptable

Simulation geometry change

- Upper side MMs is added.
- MMs are rotated.
- Exact design of FFC?