Current status of LAMPS neutron detector cosmic ray data analysis

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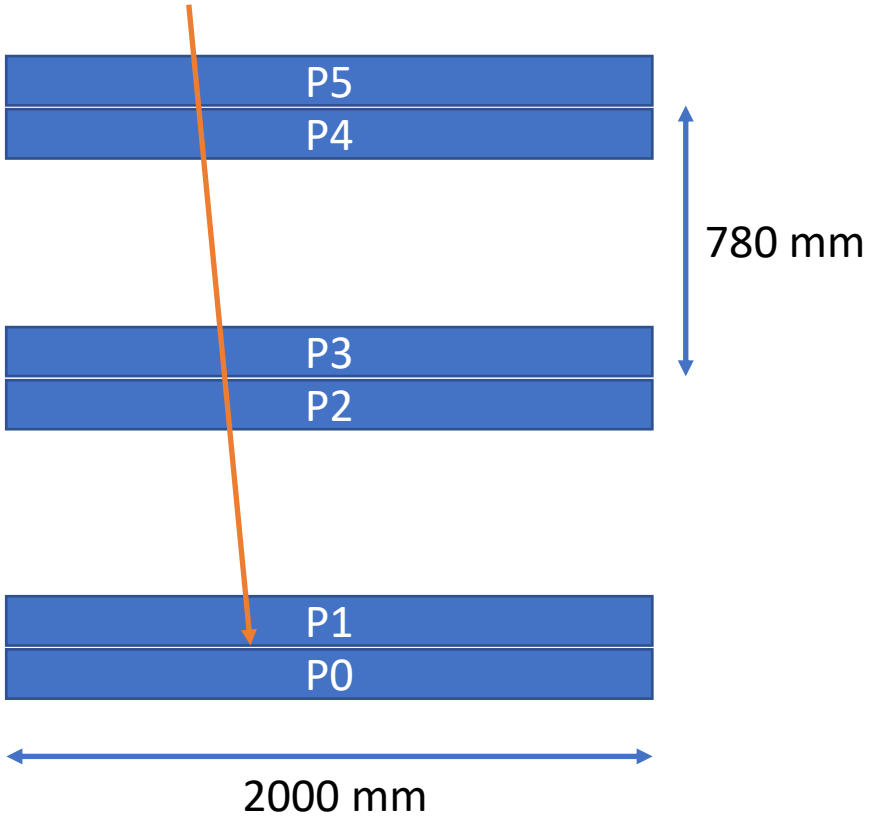
CENuM

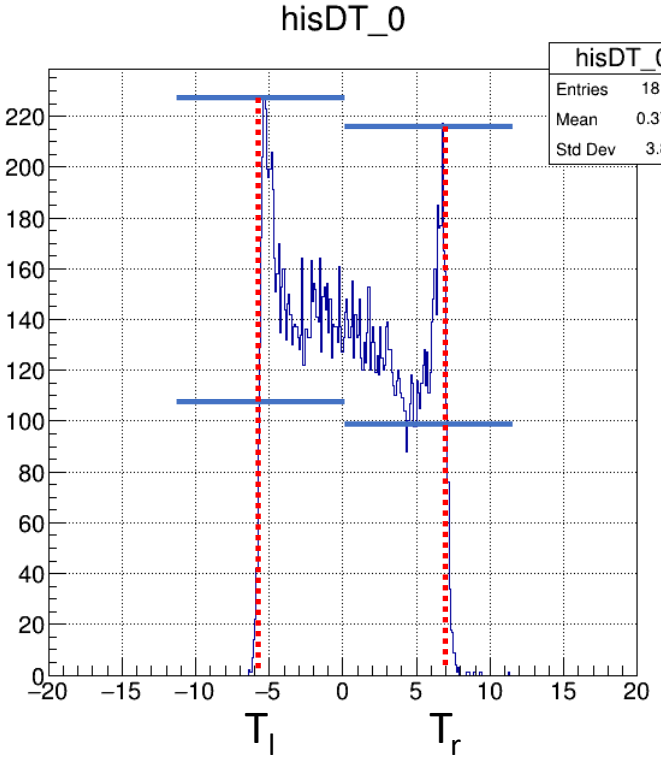
Cosmic ray data taking

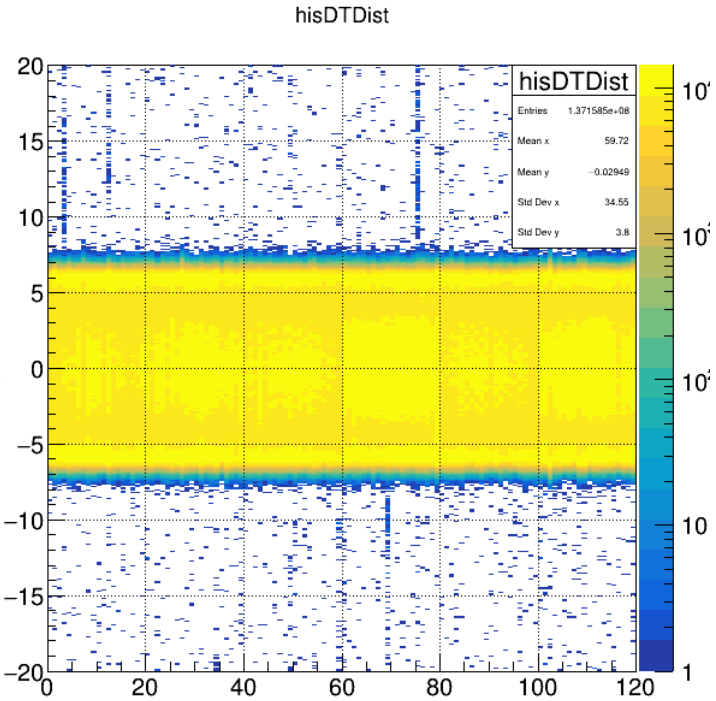
- Feb. 17th – Mar. 30th
- Total data size : 8.1TB
- Run number : 401 – 567, 1 run/4 hr
- Total data taking duration : 665 hr
- Using 3 layers of neutron detector
- Avg 4 kHz Trigger rate.
- Dep E of MIP is 20 MeV.
- 20 MeV = 500mV(= 1000 count)
- Energy calibration is done with Charge of signals.
- Timing calibration is done with vertically penetrated events.



D offset alignment

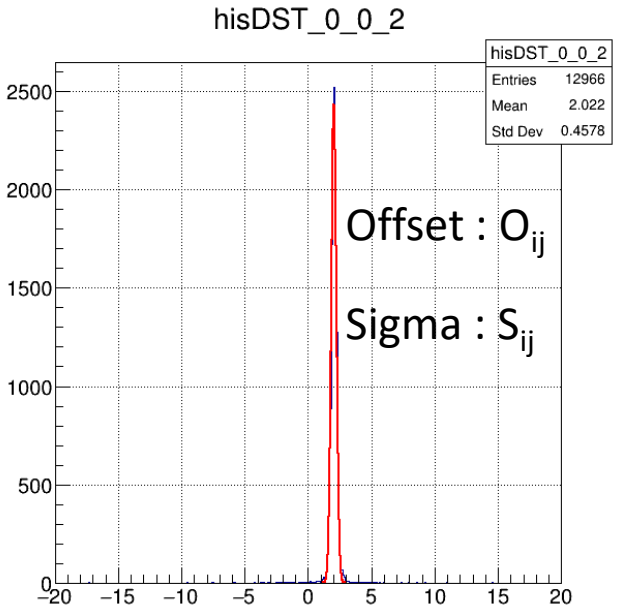
- D offset = Position
- Position alignment methods
  1. Edge finding : Find edge & get offsets
  2. Track fitting : Fit event with line & get offsets



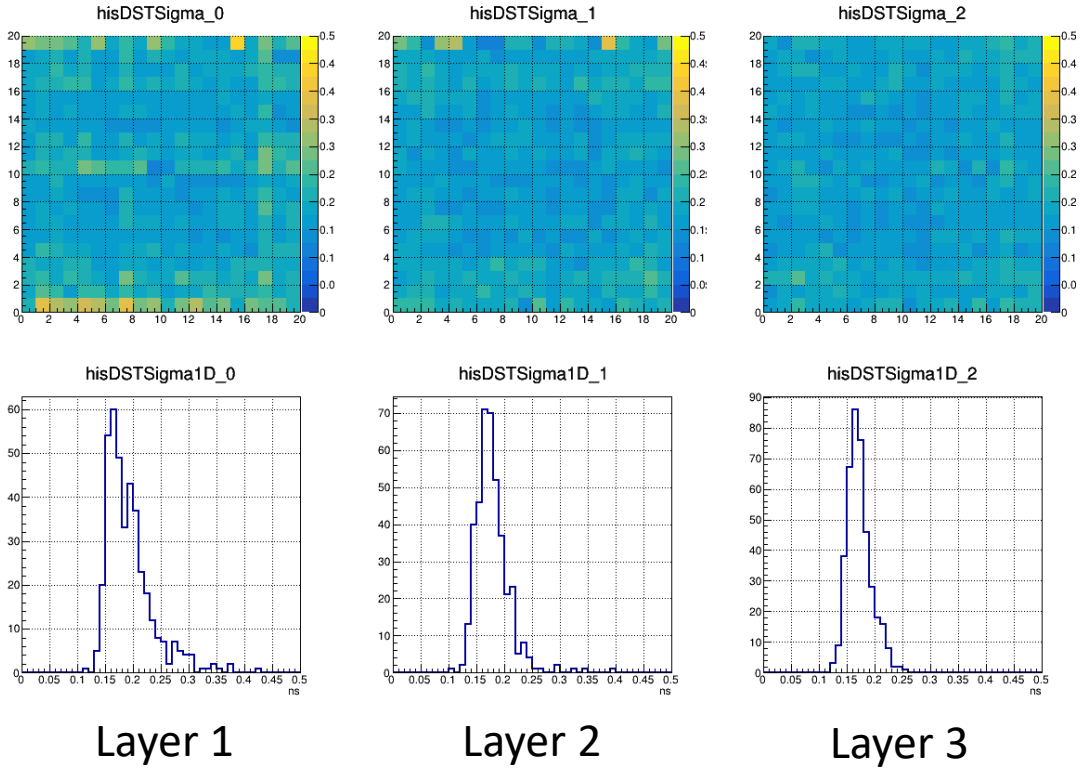


S offset alignment

- Timing of detector : $T_i = (T_r+T_l)/2$
- Timing offsets exist for every case.
  - Time stamp difference between FADC channels
  - Cable length
  - PMT signal speed
- $D_{ij} = t_i - t_j$



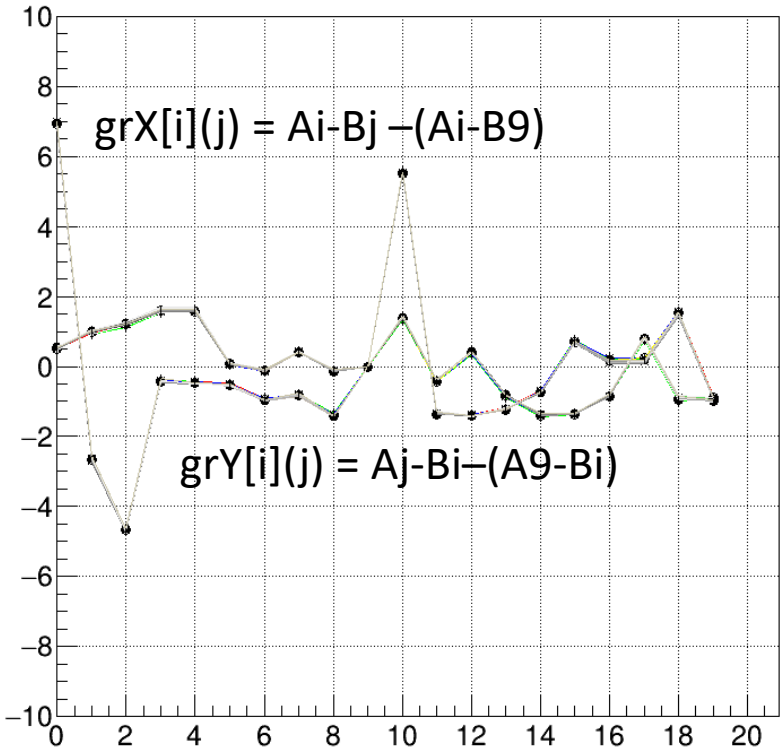
Distribution of sigma (S_{ij} dist. for i, j)

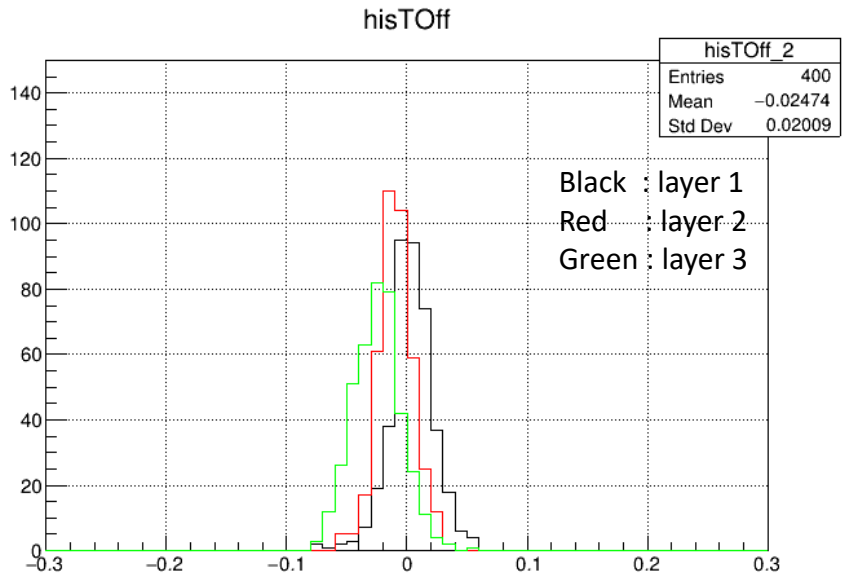


Mean value of Sigma : 181 ps -> **<u>Expected Timing resolution(FWHM) = 301 ps</u>**

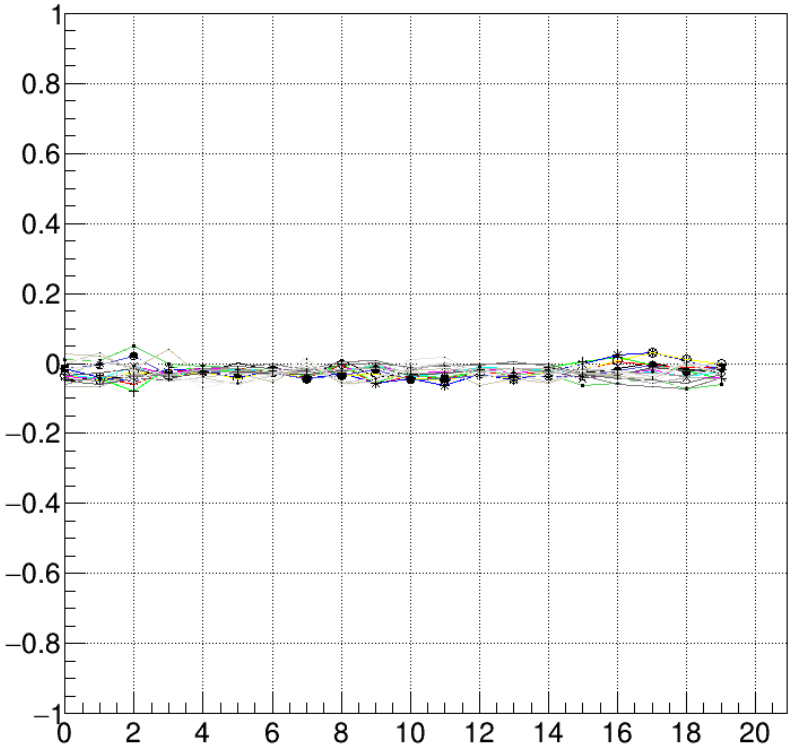
Simple method for t cal

Offsets between two modules in diff. planes
Before Offset subtraction(O_{ij} dist)





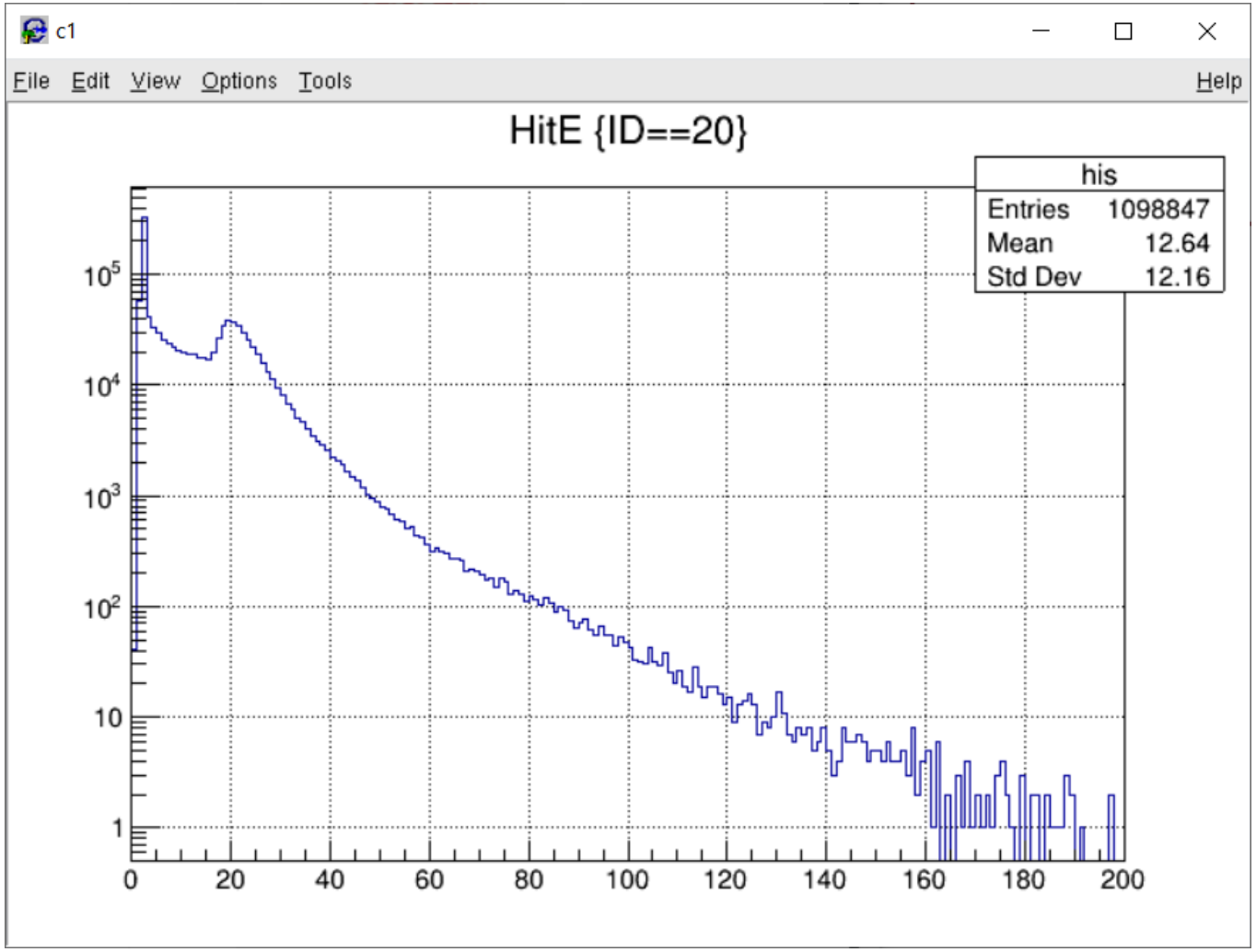
After Offset subtraction



After Offset subtraction, O_{ij} distribution was aligned to 0, with 20 ps deviation

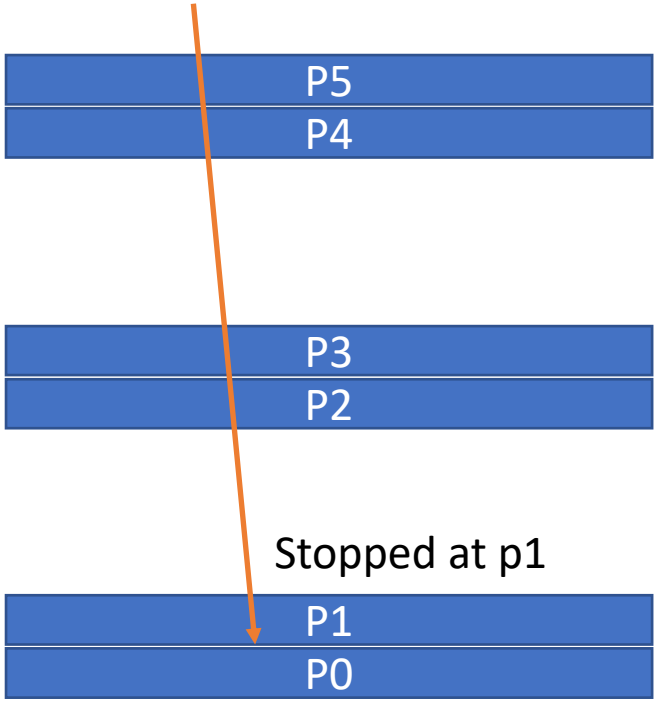
Energy calibration

MIP peak = 20 MeV



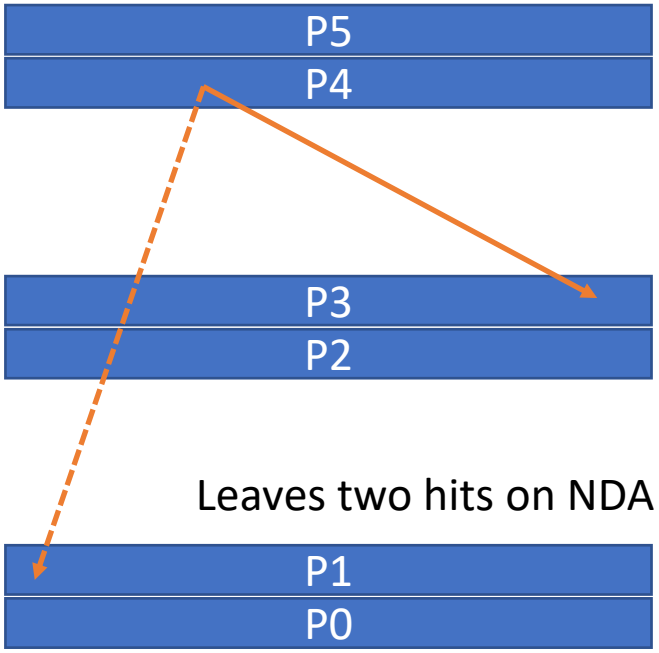
What I want to see was…

Proton penetrated 4 planes and..

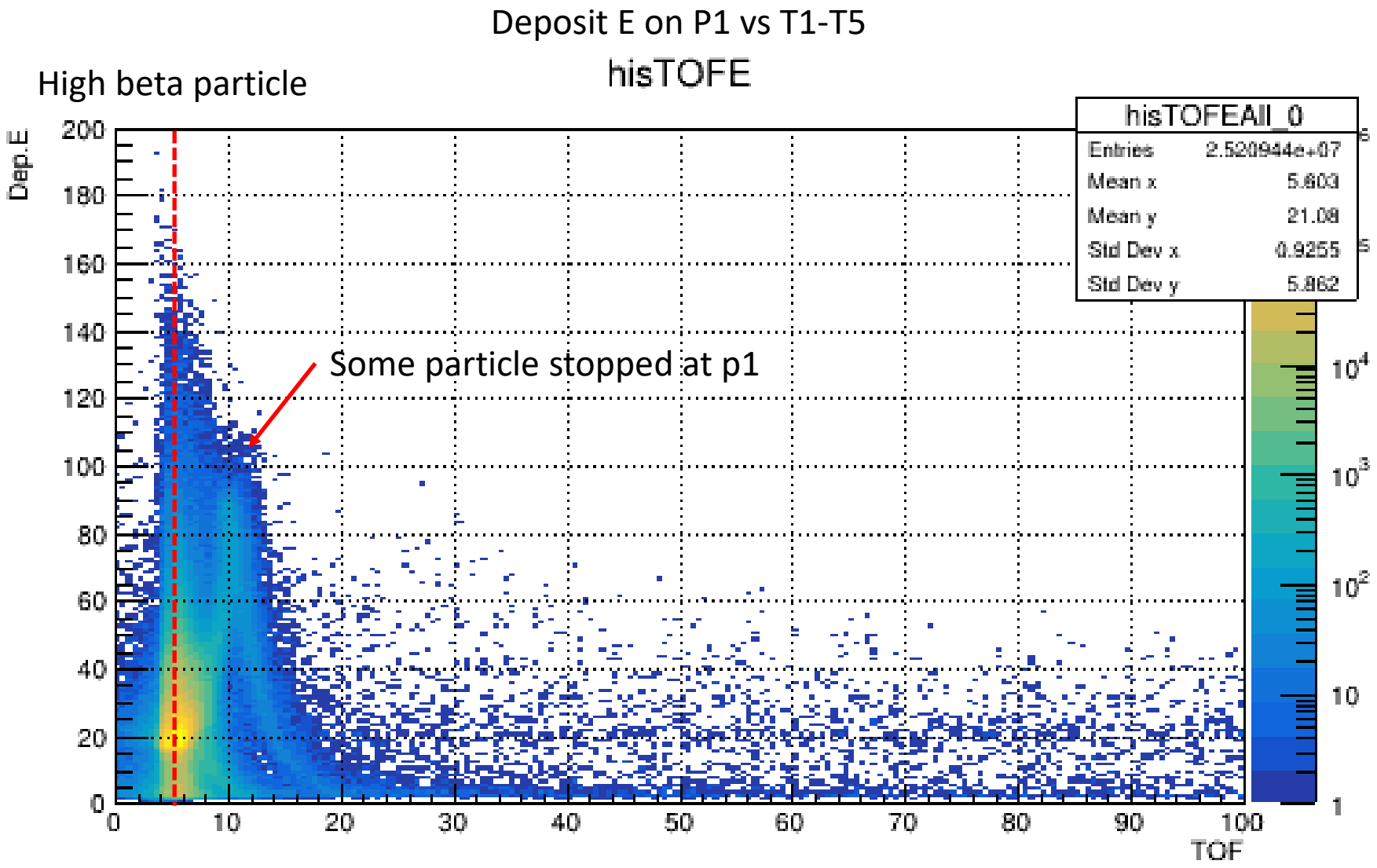


or

Neutron? hits p4 or p5 and



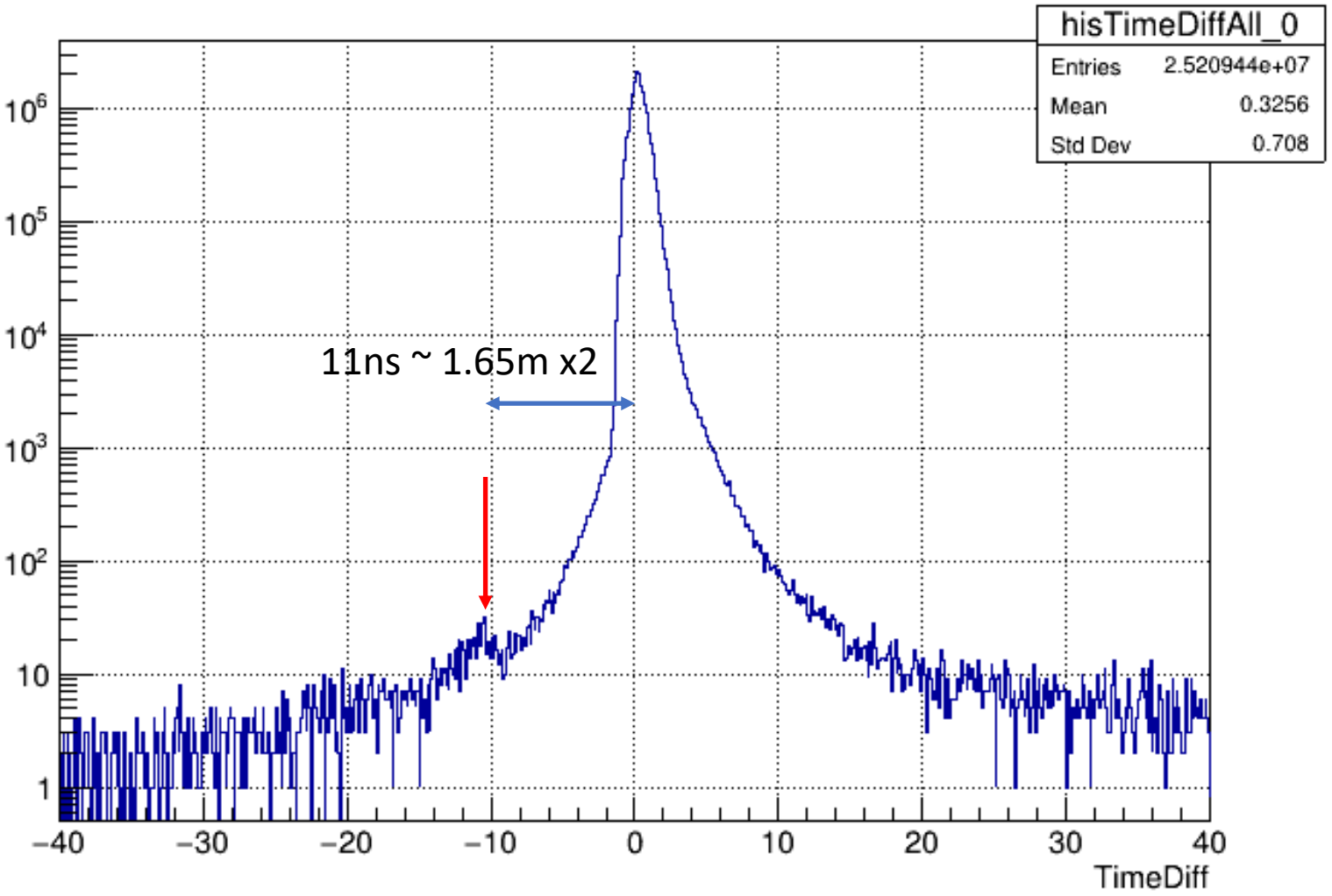
What I saw



Cut condition : P1-5 have single hits. No req. on P0.

Time diff distribution

T1-T5 (before offset adjust)

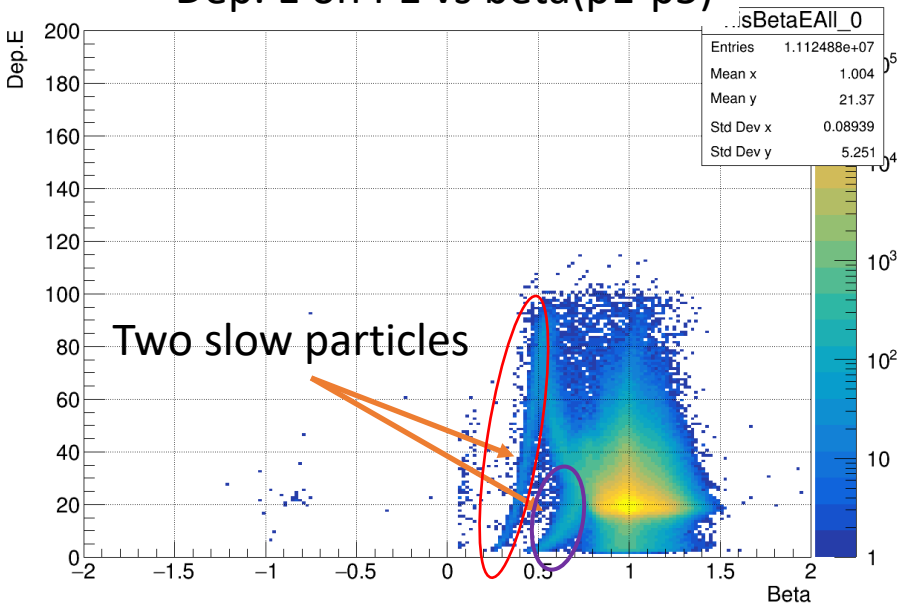


Up going particle?

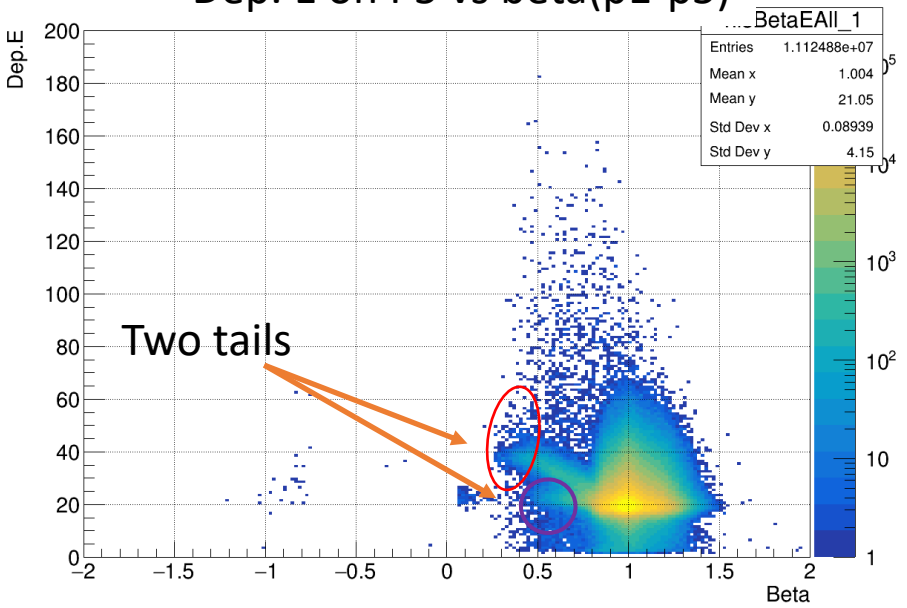
Analysis 25 run (100 hr) data with tight cut

- Cut condition
  - P1-5 had single hit.
  - Dep. E on P2-4 > 15 MeV
  - Abs(x,y) < 0.9 (fiducial cut)
  - Hit position on P3 is on the track (distance < 5 cm)

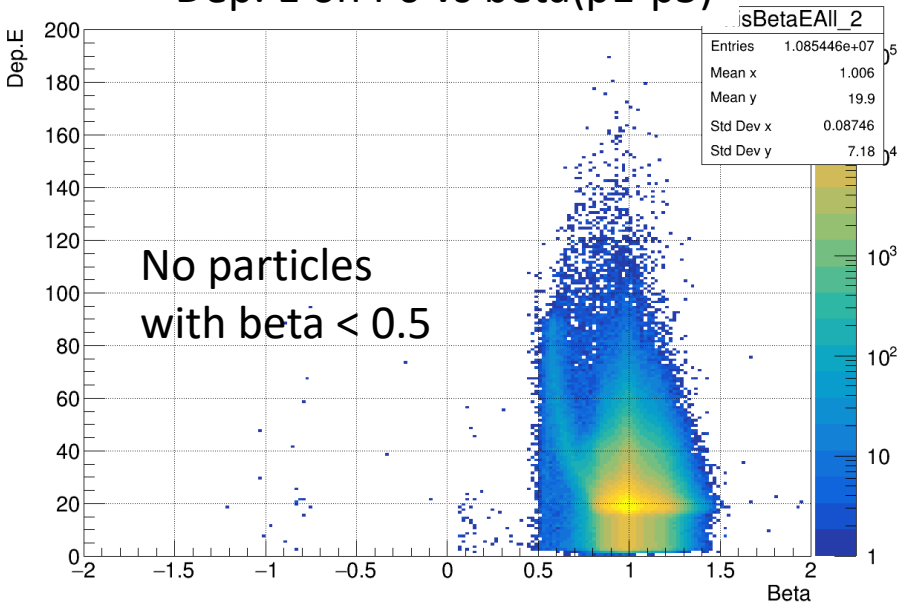
Dep. E on P1 vs beta(p1-p5)



Dep. E on P5 vs beta(p1-p5)

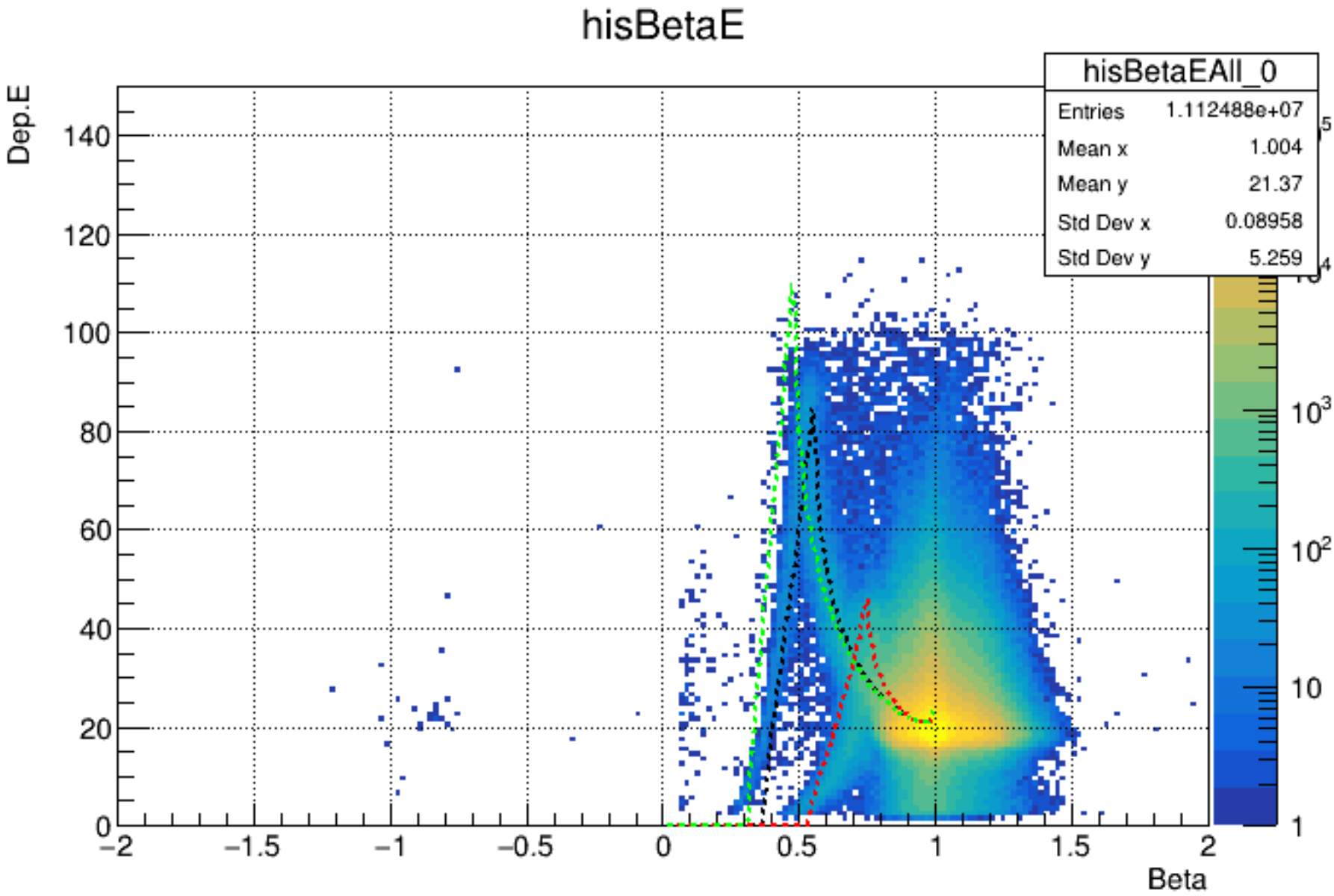


Dep. E on P0 vs beta(p1-p5)

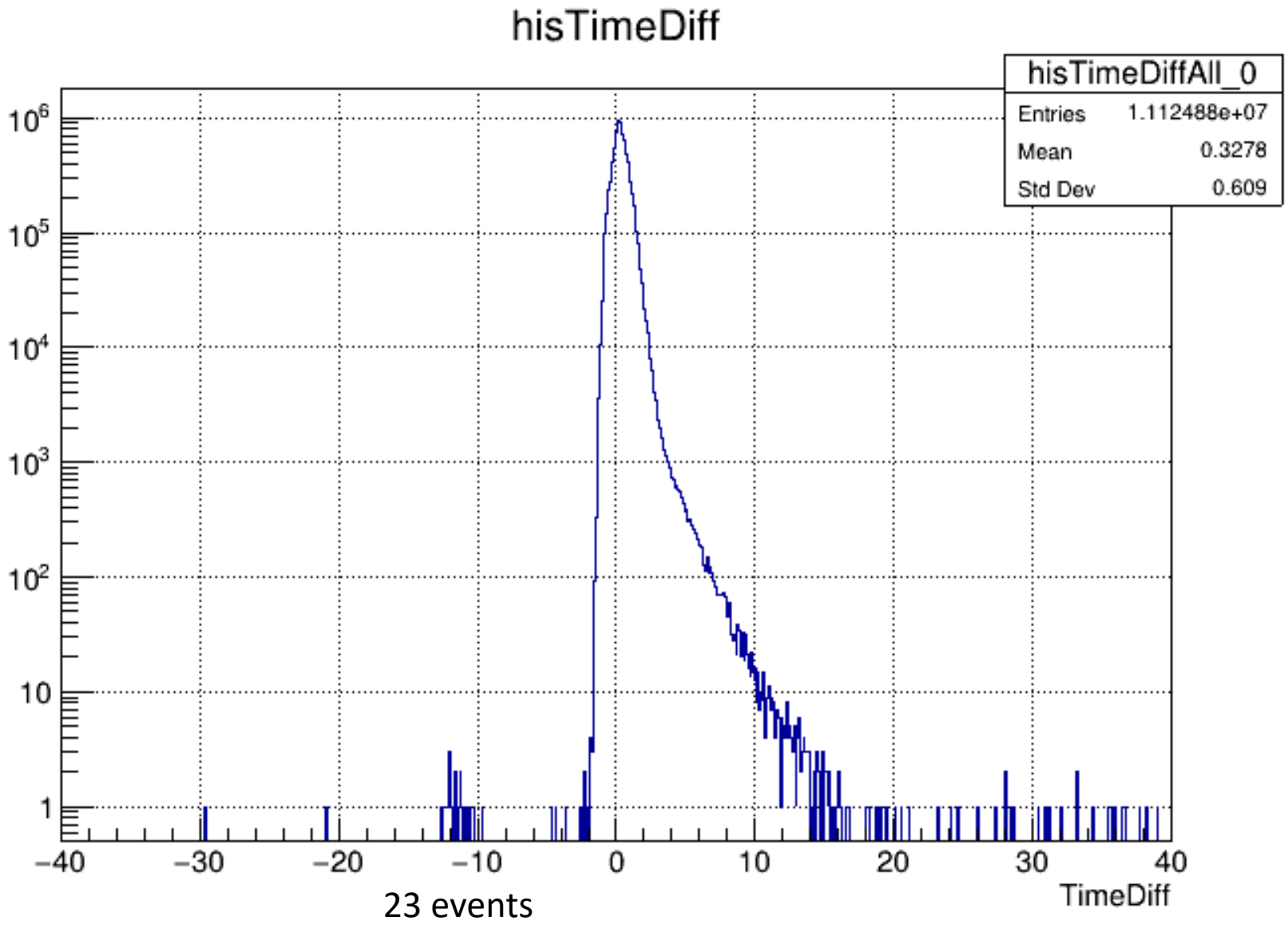


1. There were two peak-like structure.
2. No particle found under beta < 0.5(particle was stopped at p1)
3. Two tails
    1. Slow particle with high energy loss(kaon??)
    2. Fast particle with MIP energy loss (pion, muon)

Check with bethe-bloch equation


hisBetaE
hisBetaEAll_0
Entries 1.112488e+07
Mean x 1.004
Mean y 21.37
Std Dev x 0.08958
Std Dev y 5.259
Dep.E
Beta
0
20
40
60
80
100
120
140
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2
1
10
10^2
10^3

Upgoing particle…



23 events