SRC LHRS Efficiency Study

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LHRS PID: electron/pion discrimination

Kinematics (Run 100684):

Ebeam = 4.3 GeV

Angle = 17 . 8 degree,

p0 = 3.543 GeV

Electrons:

large Cerenkov and calorimeter signals

Pion contaminations:

A. π^- :

No Cerenkov signal,

small energy deposit in calorimeter

B. π^- knock out electron (ionization) before/in Cerenkov:

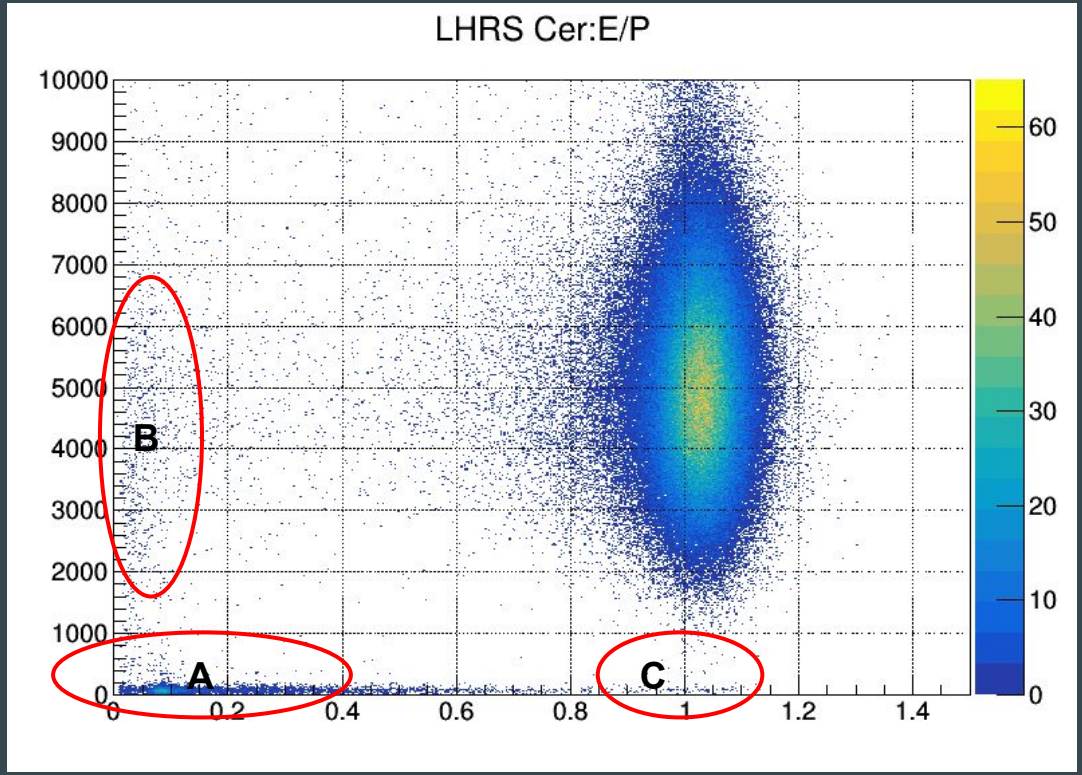
Cerenkov triggered,

small calorimeter signal

C. $\pi^- n \rightarrow \pi^0 p \rightarrow \gamma\gamma$:

No Cerenkov signal,

large calorimeter signal



Question:

how to distinguish detector inefficiency from contamination B, C?

PID Cut Efficiency: Cerenkov

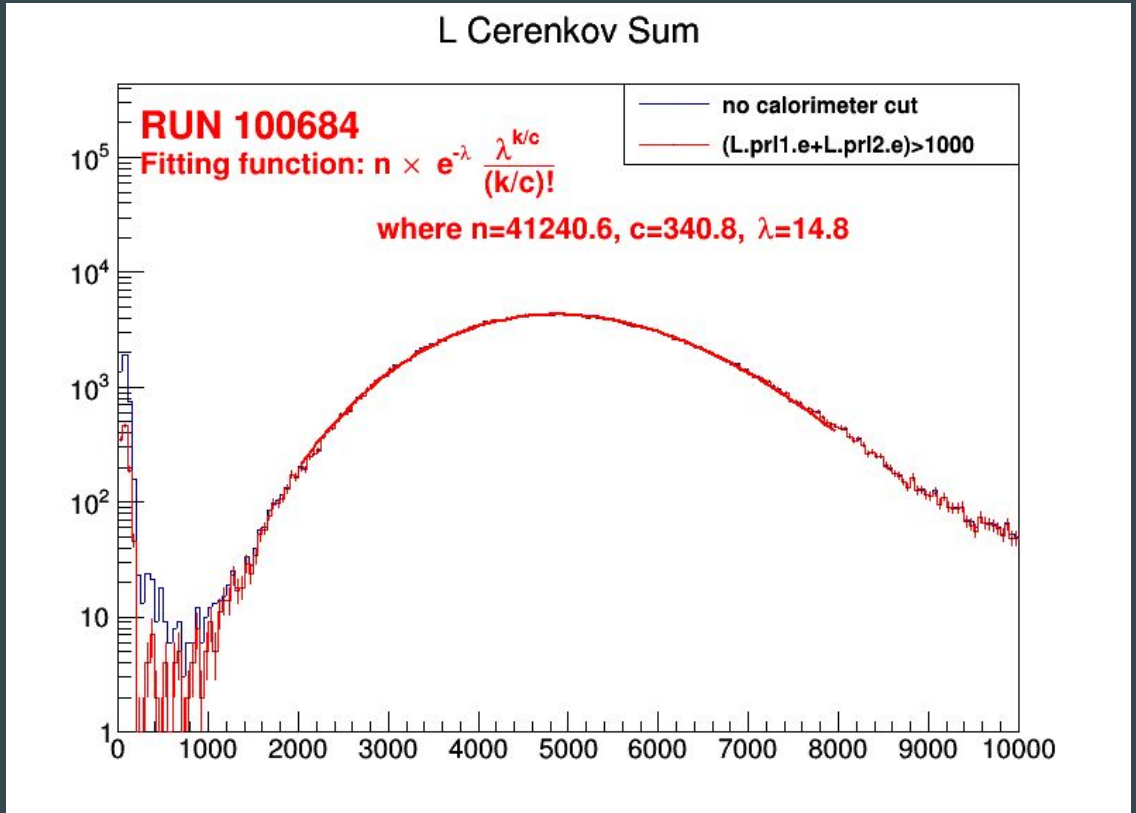
Single photon peak at ADC channel 300 for each PMT

Total number of photons from electron Cerenkov light follows Poisson distribution

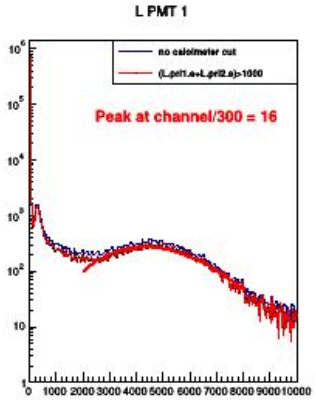
ADC Cut on channel 1500:

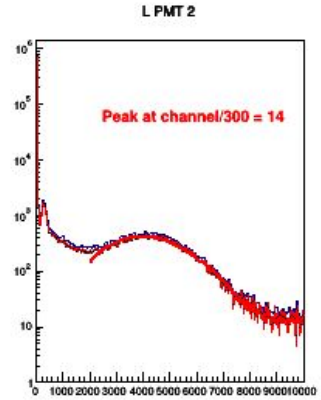
Prob(L.cer.asum_c<1500|elctron) = 0.01%

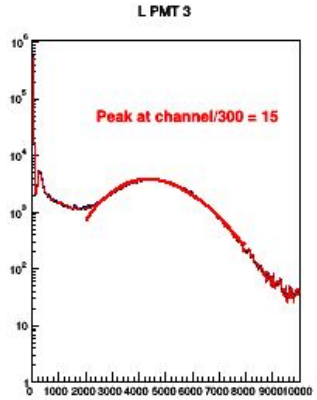
Prob(L.cer.asum_c>1500|pion) -> 0

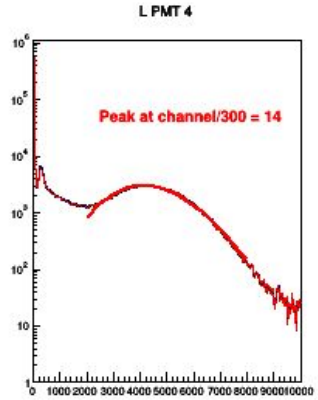


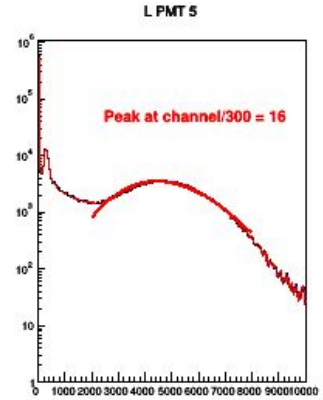
Cerenkov PMTs Performance

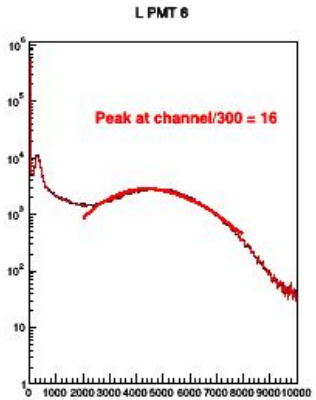


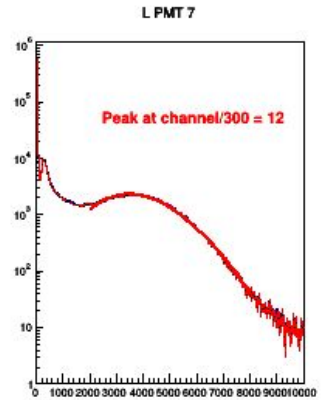


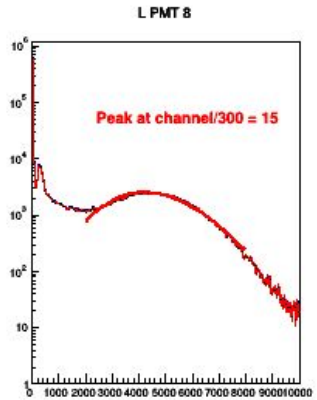


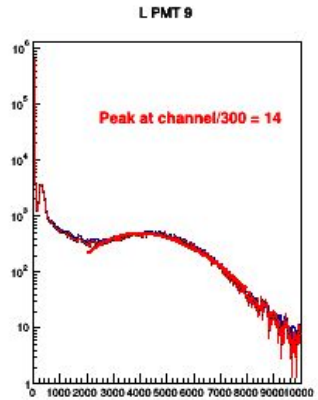


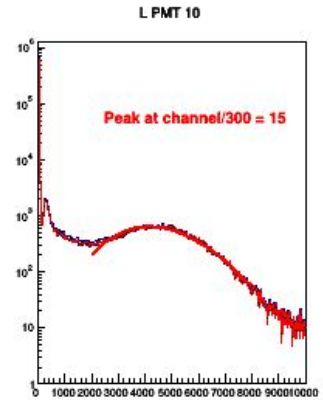












PID Cut Efficiency: Calorimeter(PionRejectors)

Very low pion contamination into electron distribution

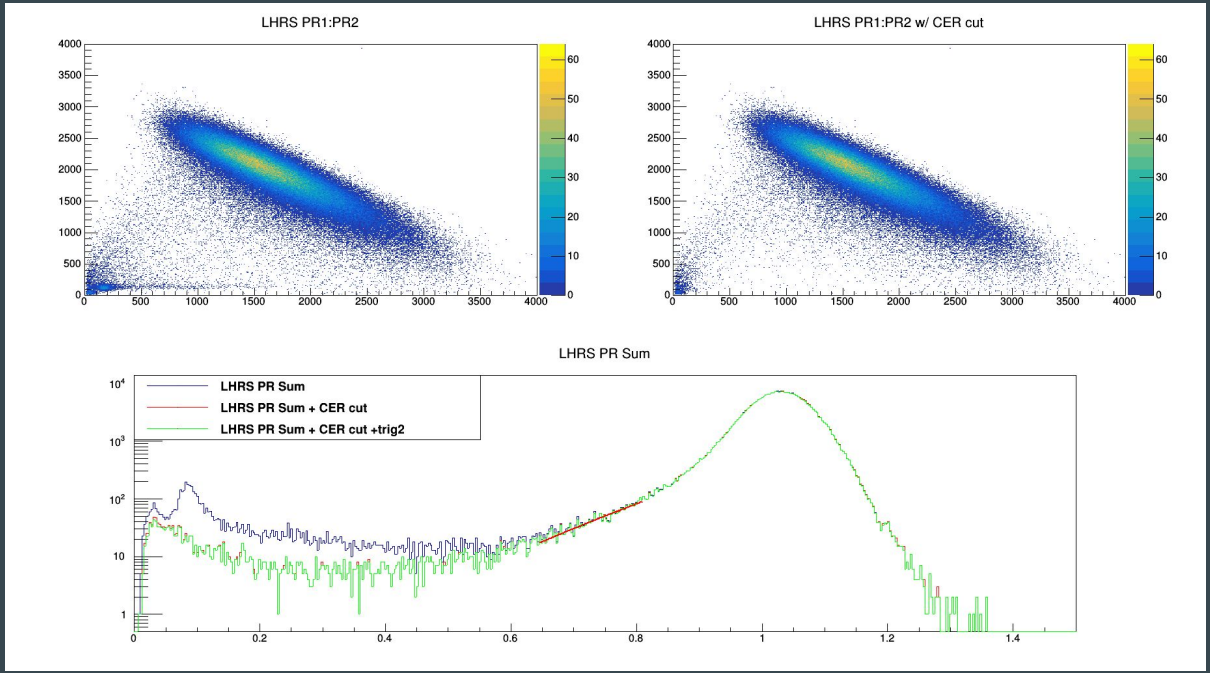
Cuts:

PRL1: no specific cut needed
PRL2: no specific cut needed

PR L1 + L2:

Fit the 1d electron distribution tail with Gaussian.

Prob(PR sum / P< 0.7 | electron) -> 0
Prob(PR sum/ P> 0.7 | pion) -> 0



Trigger Efficiency

LHRS:

T1: S0 && S2

T2: (S0 && S2) && Cer

T3: (S0 || S2) && Cer

Production Trigger!

Cerenkov trigger efficiency

Scintillators (s0, s2) trigger efficiency

Run 100684, events passed PID and one-track cuts

Evtypebits =

2 -> only T1

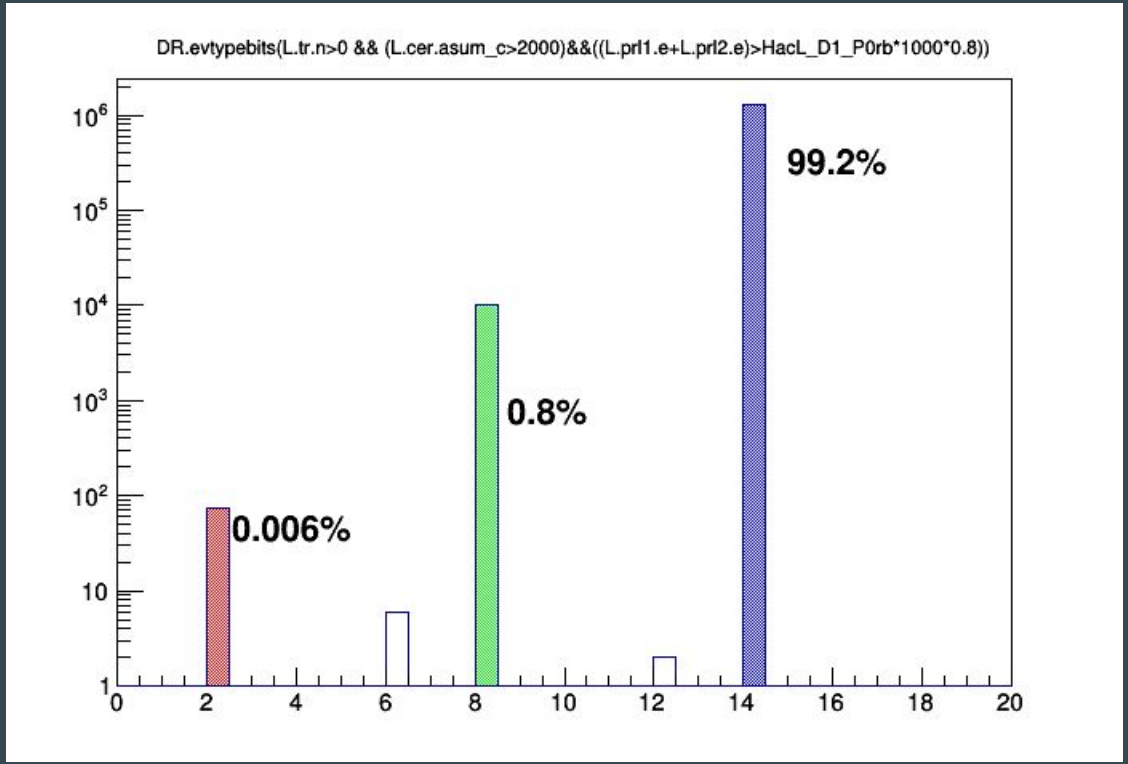
-> Cerenkov trigger inefficient

8 -> only T3

-> S0 or S2 triggers inefficient

14 -> T1 + T2 + T3

-> good



Tracking Efficiency: no track

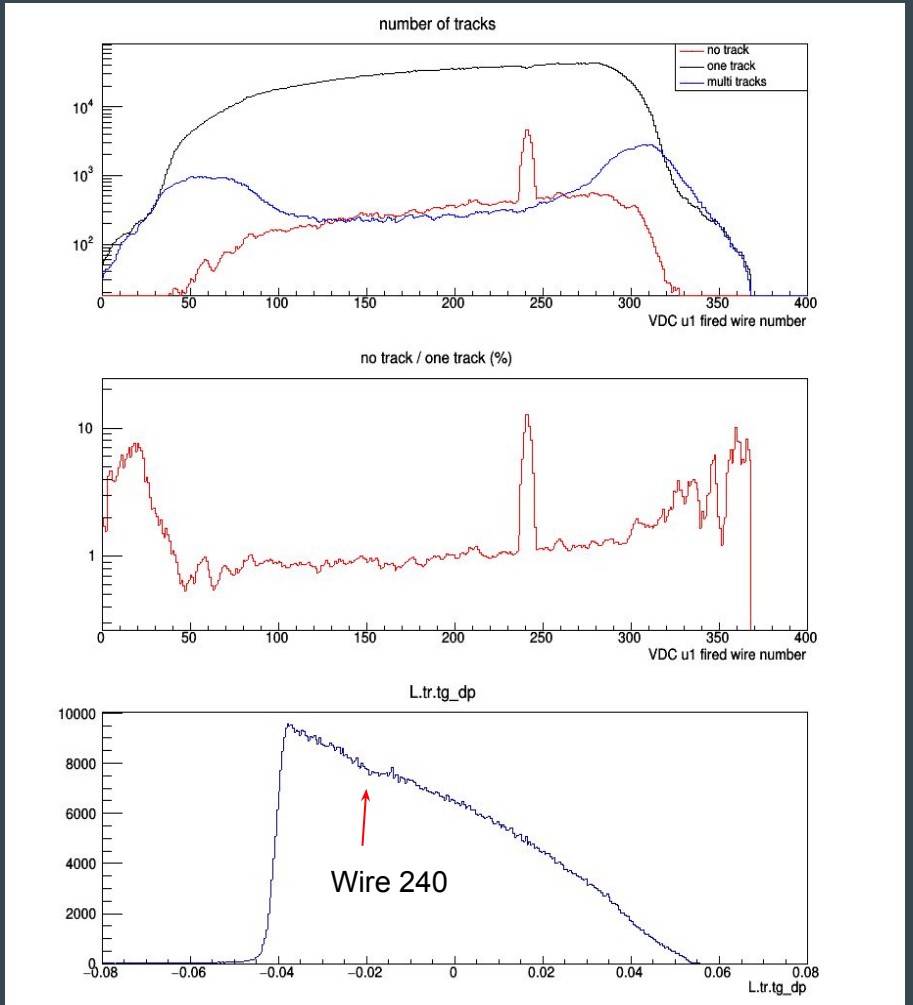
Among good electron events
(cer sum>1500, E/P > 0.7):

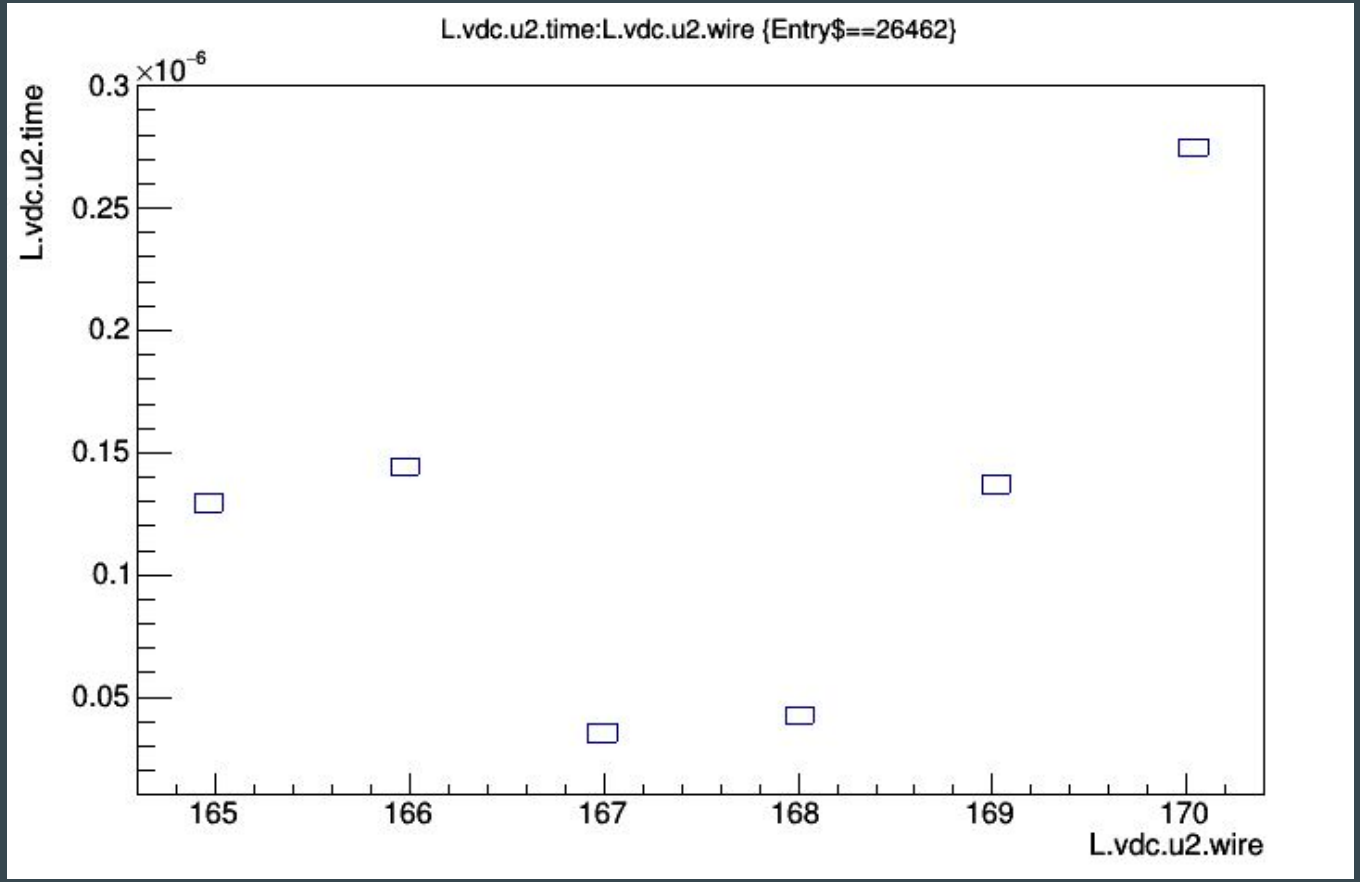
~1 % events with U1 plane fired has no track

Known issue:
Wire 240 has bad signal, local no track percentage>10%.

Possible Solutions:

1. Event-by-event efficiency based on wire number
2. Absorb this efficiency in data/simulation comparison
3. Apply correction on delta
4. Cancelled in ratio ?!

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×10⁻⁶
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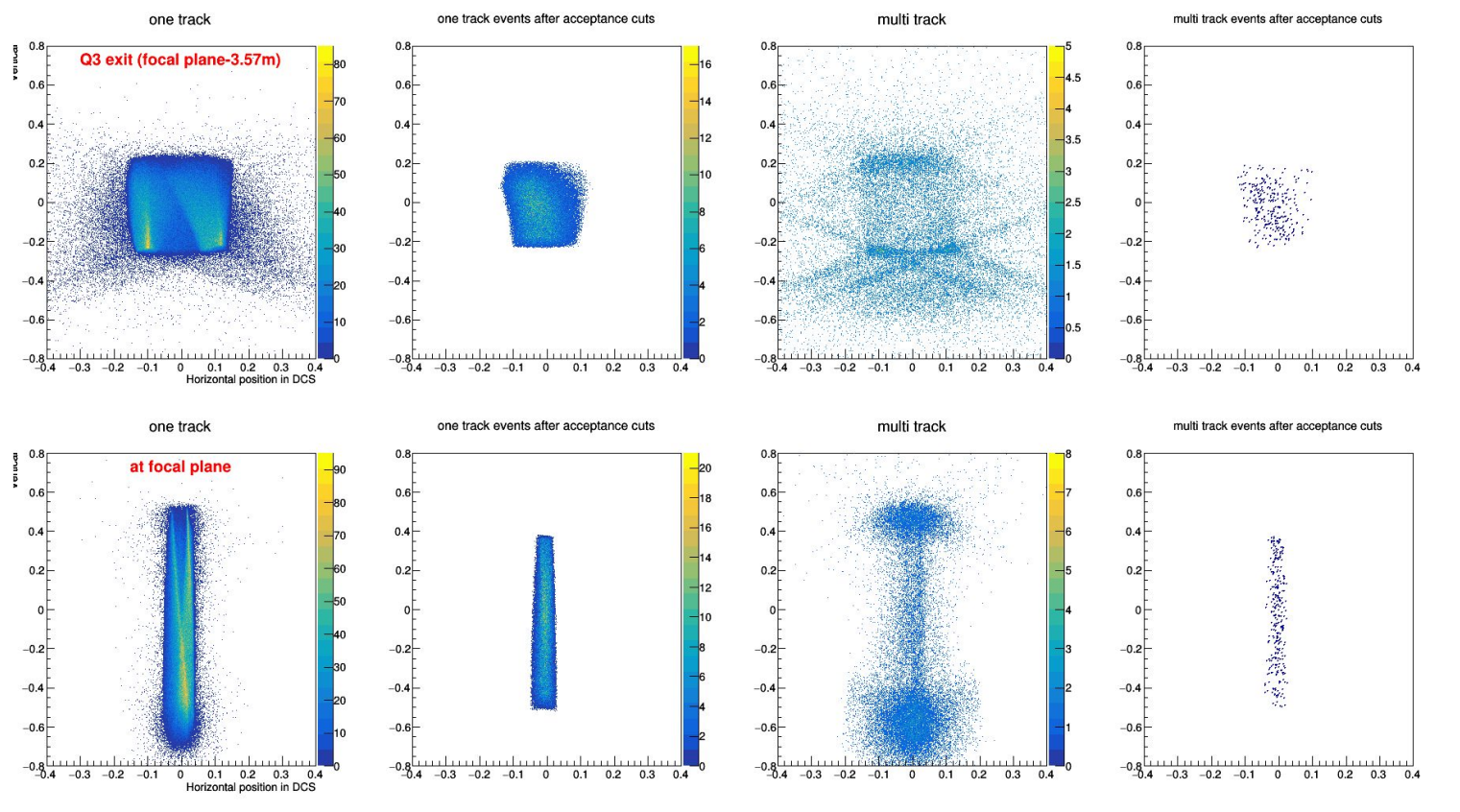
0.25
0.2
0.15
0.1
0.05
L.vdc.u2.time
165
166
167
168
169
170
L.vdc.u2.wire

Tracking Efficiency: multi track

Most multi track events are from endcaps rescattering on Q3 exit, it can be removed by tight acceptance cuts: 35 mrad theta, 20 mrad phi, 3.5% delta, 16 cm ztarget.
May be better to cut on Q3 exit directly (will explore this option with simulation)



Tracking Efficiency: multi track ~ 1%

Most multi track events are from endcaps rescattering on Q3 exit, it can be removed by tight acceptance cuts: 35 mrad theta, 20 mrad phi, 3.5% delta, 16 cm ztarget.
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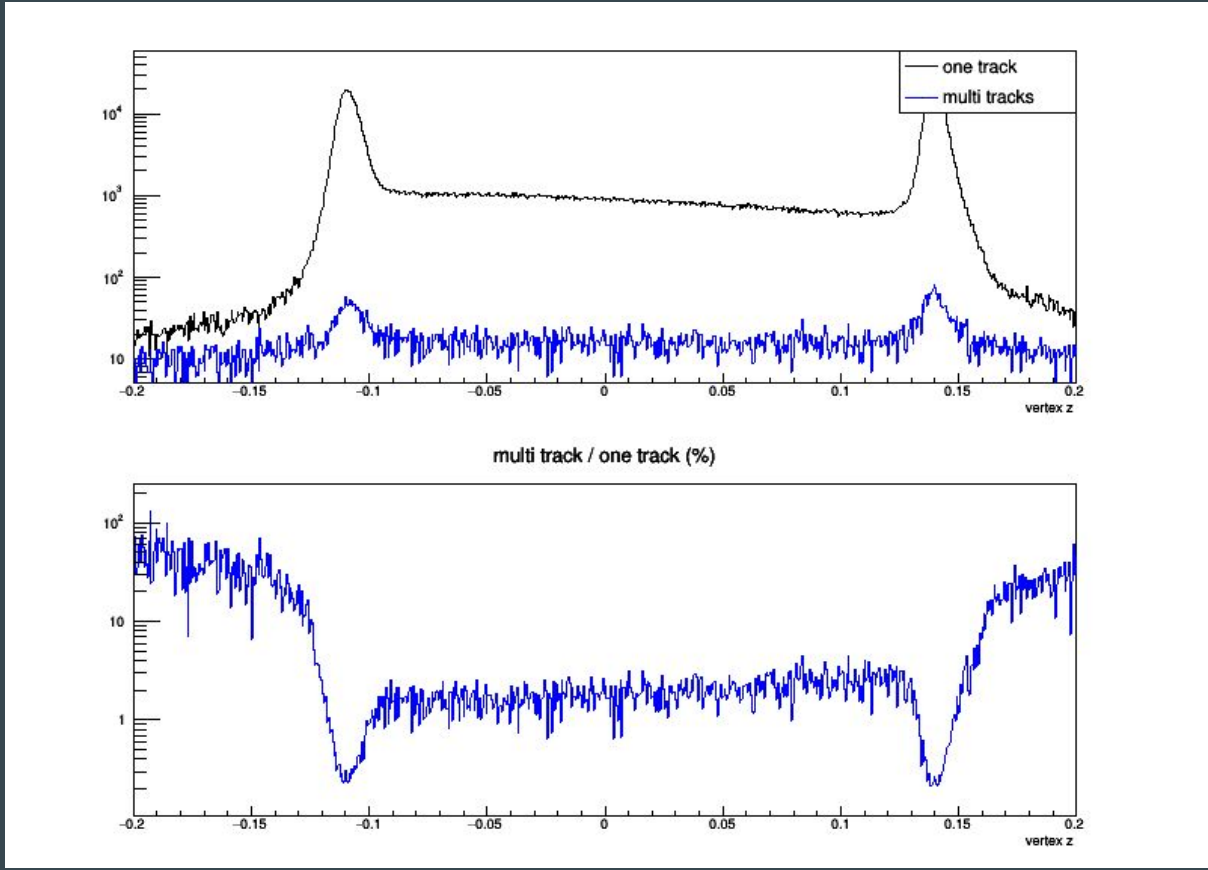
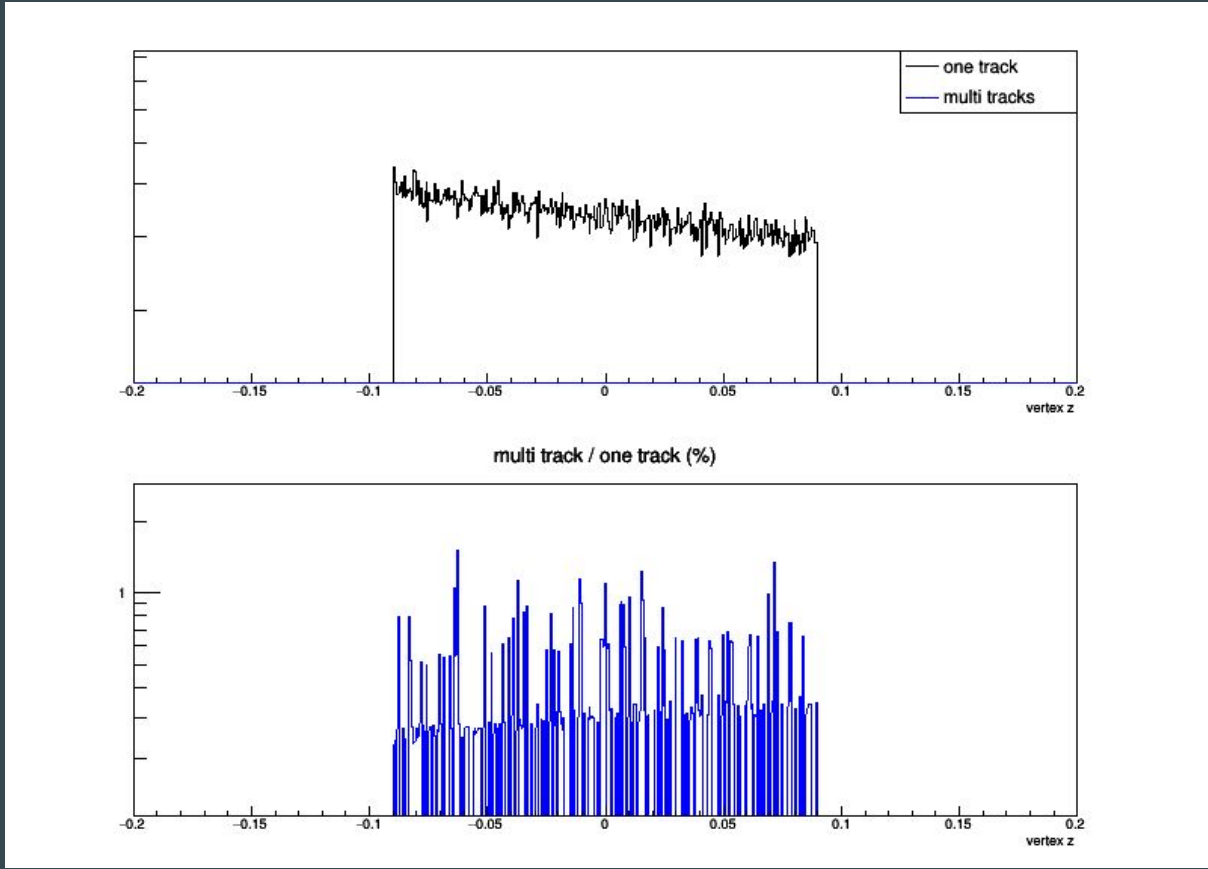


Tracking Efficiency: multi track < 1%

Most multi track events are from endcaps rescattering on Q3 exit, it can be removed by tight acceptance cuts: 35 mrad theta, 20 mrad phi, 3.5% delta, 16 cm ztarget.
May be better to cut on Q3 exit directly (will explore this option with simulation)



TODO:
calculate efficiencies for each kinematics / run-by-run