Better Statistics from a Pion Beam?

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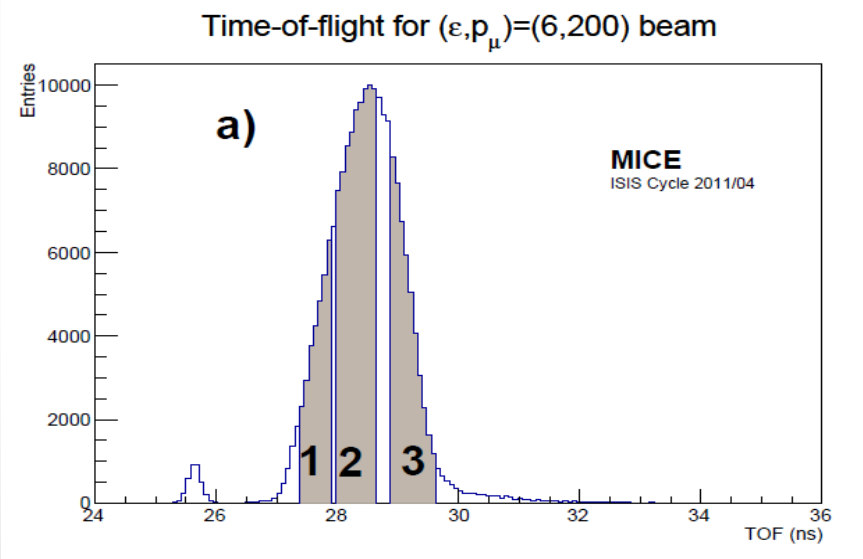
Muon Mode

- D2 set to half the momentum of D1
  - Selects muons which – in the pion rest frame – are backward-going
  - Produces almost pure muon beam as pions with enough momentum to not decay in the DS are filtered out by D2
  - Sub-1% pion contamination by TOF1 [Pion contamination paper]
  - PID aims to reduce this to <0.1%



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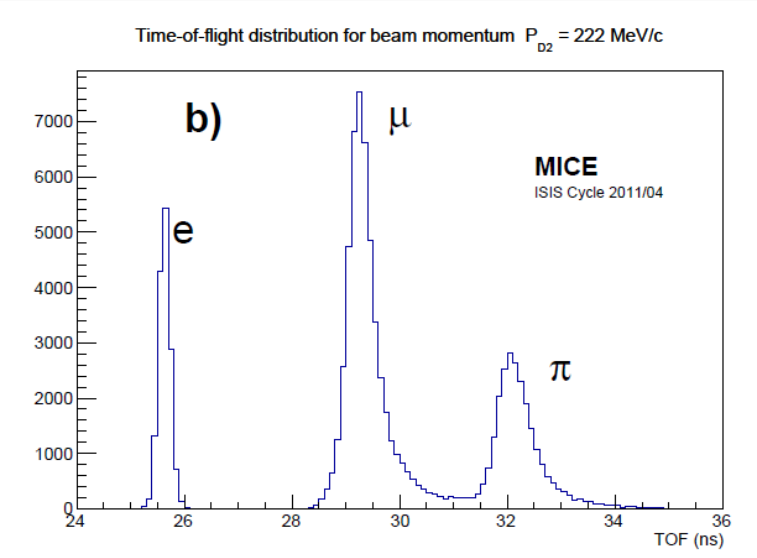
Calibration Mode

- D2 is set ~ D1
  - Mixed beam
  - Relatively well-separated TOF peaks for pions, muons, and electrons



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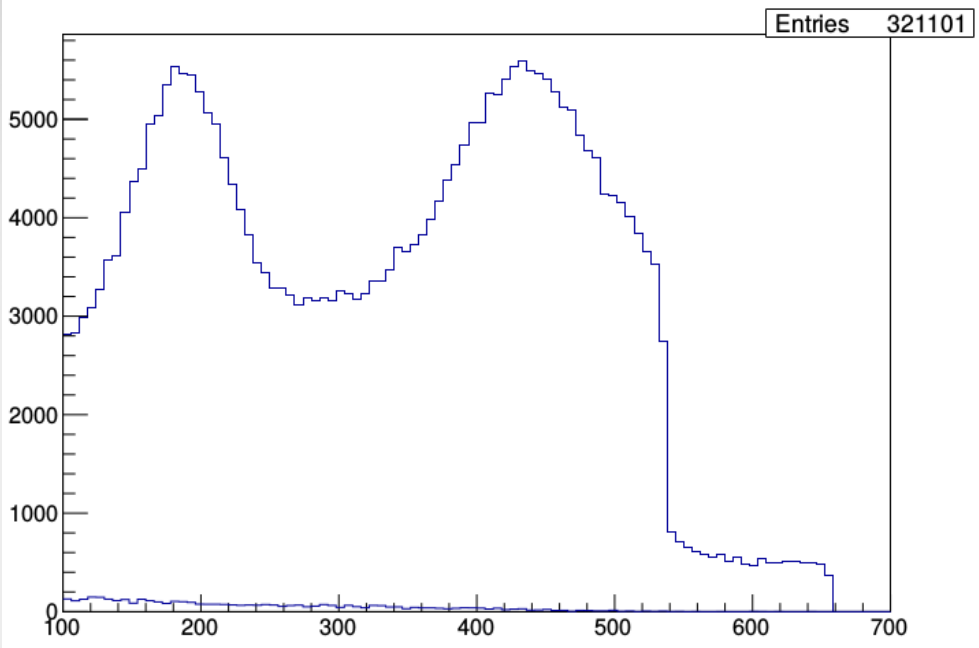
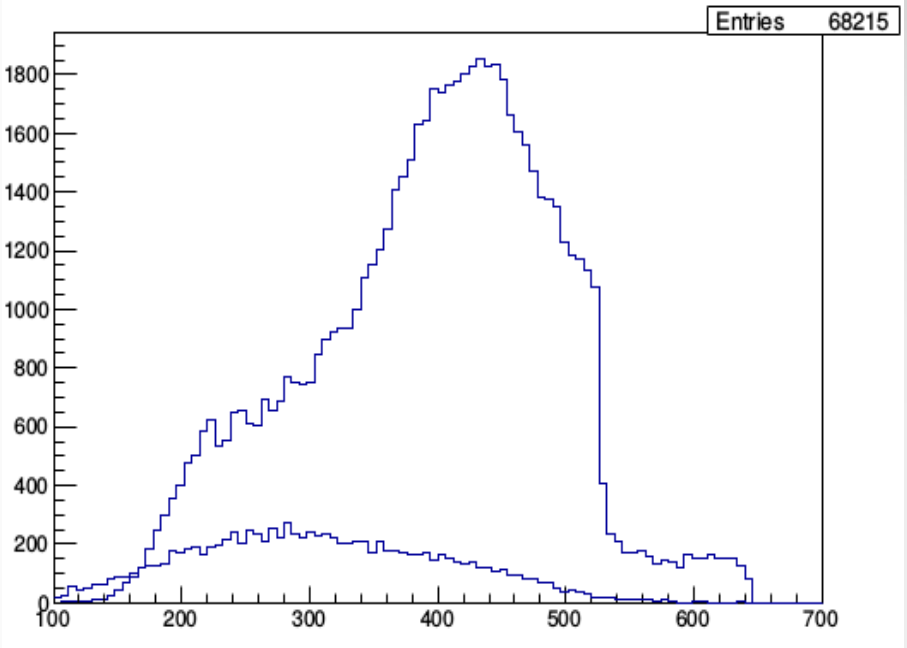
The Task

- Determine whether we can get better muon statistics by running a pion beam
  - PID will have to filter out a much larger fraction of pions
- Run G4Beamline to look at numbers of muons and pions just before TOF0 for varying D1 field at fixed D2 field
- Run generated beams through PID to determine if PID will perform sufficiently for this

Momentum Distribution from Target



Pion & Muon momentum dist. just after target



Pion & Muon momentum dist. after Q3

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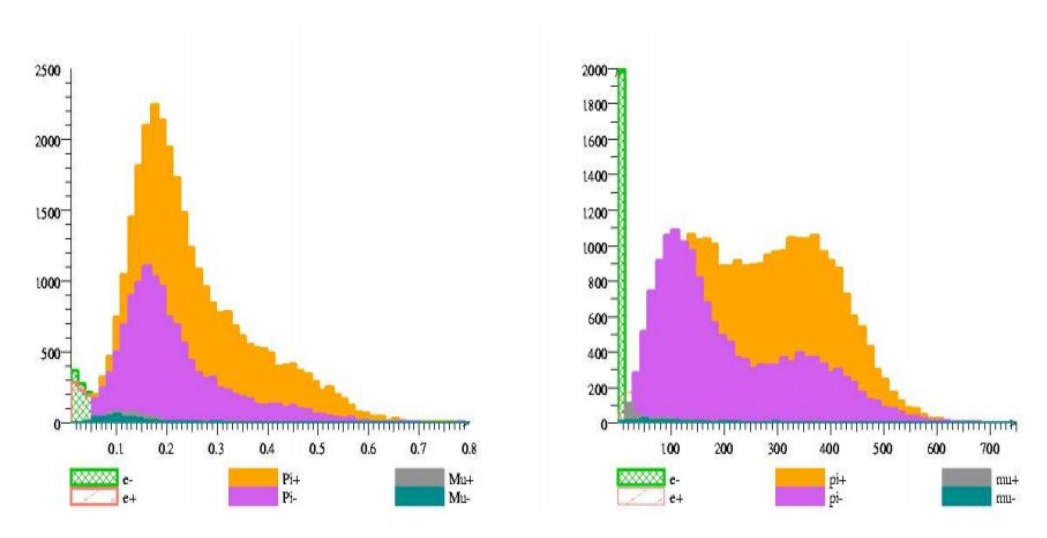
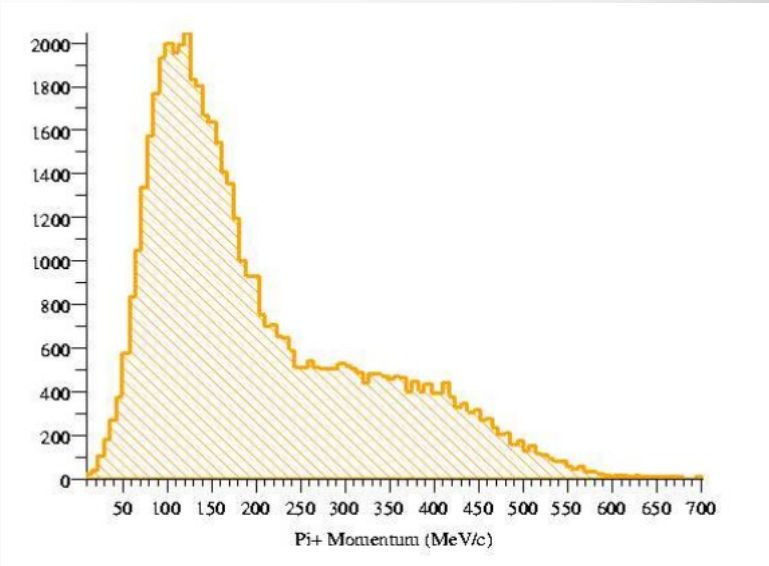
Distributions from Andrew Walaron (2007)



MARS

GEANT4



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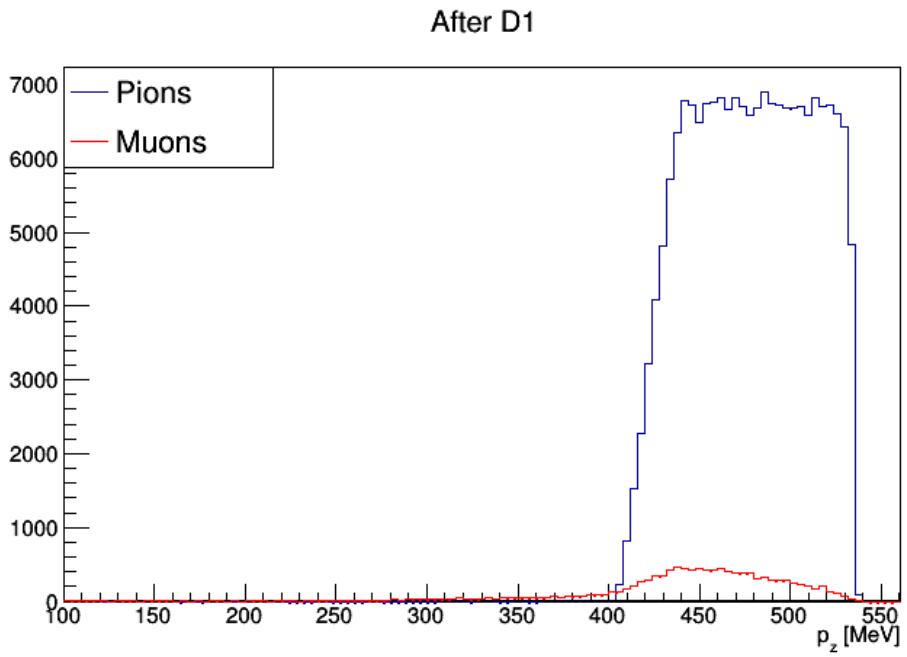
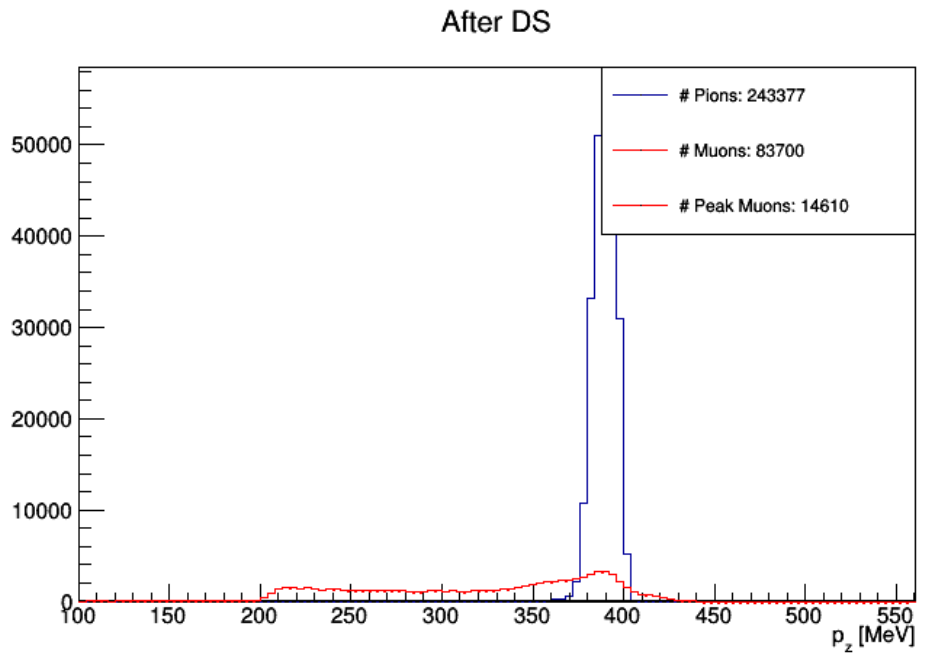
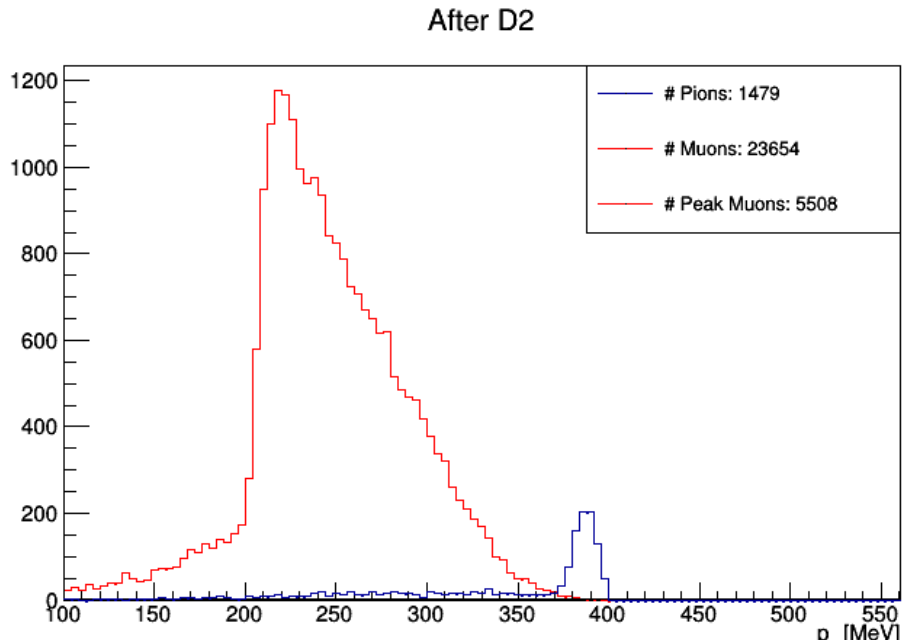
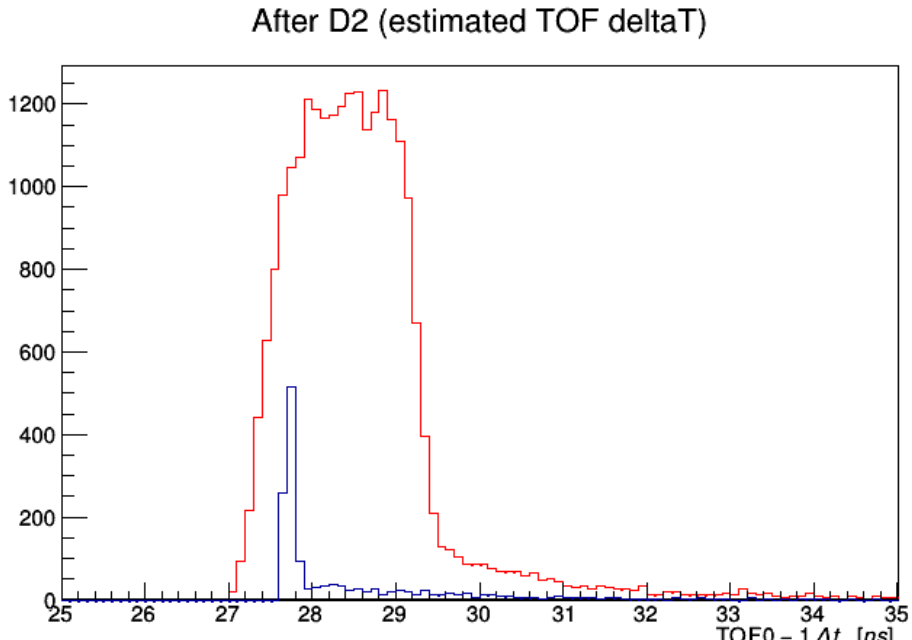
408-238 Beam (Muon Mode)



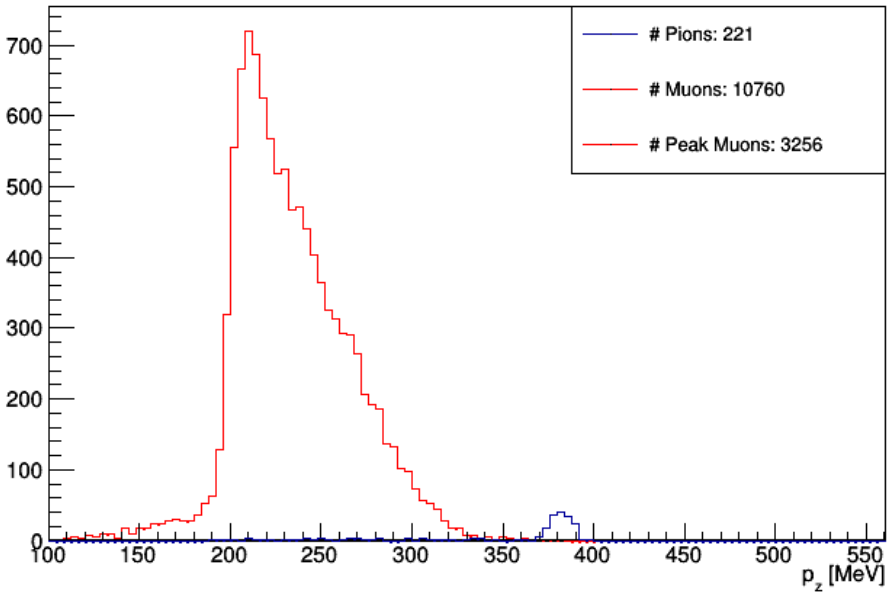




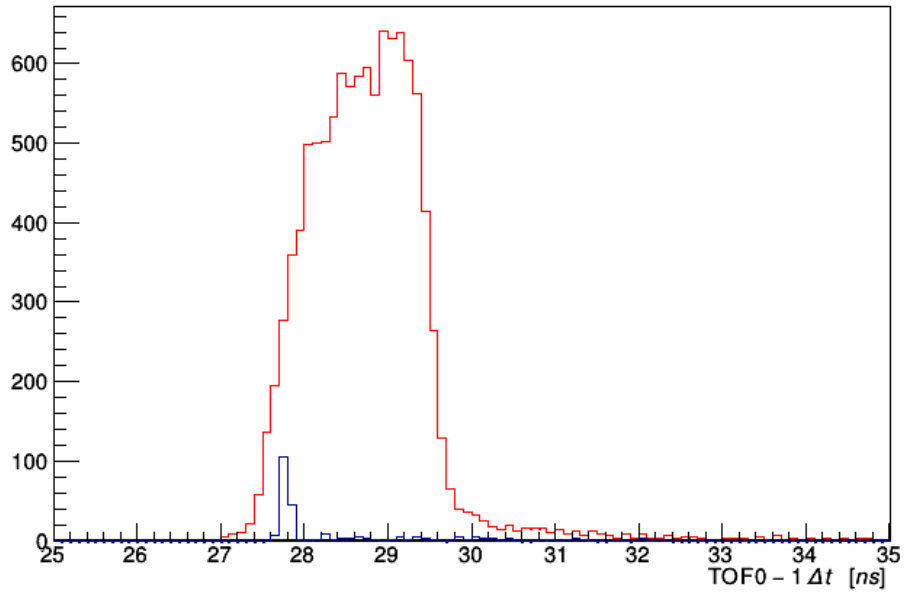


408-238 Beam (Muon Mode)

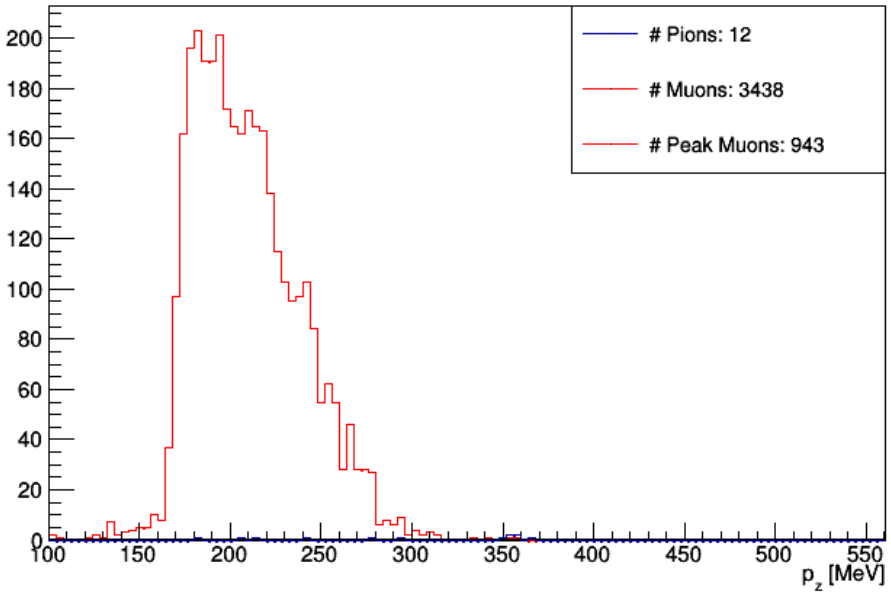
TOF0



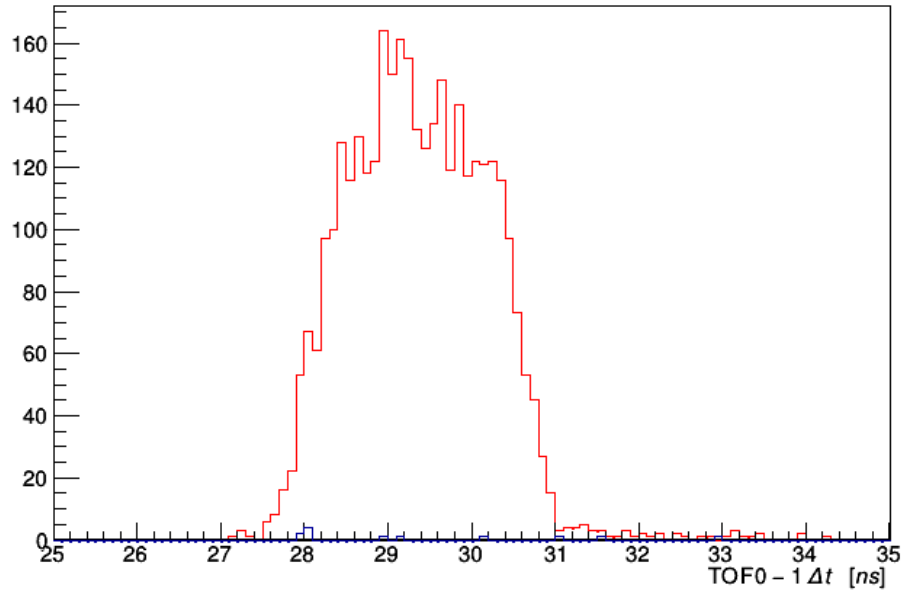
TOF0 (estimated TOF deltaT)



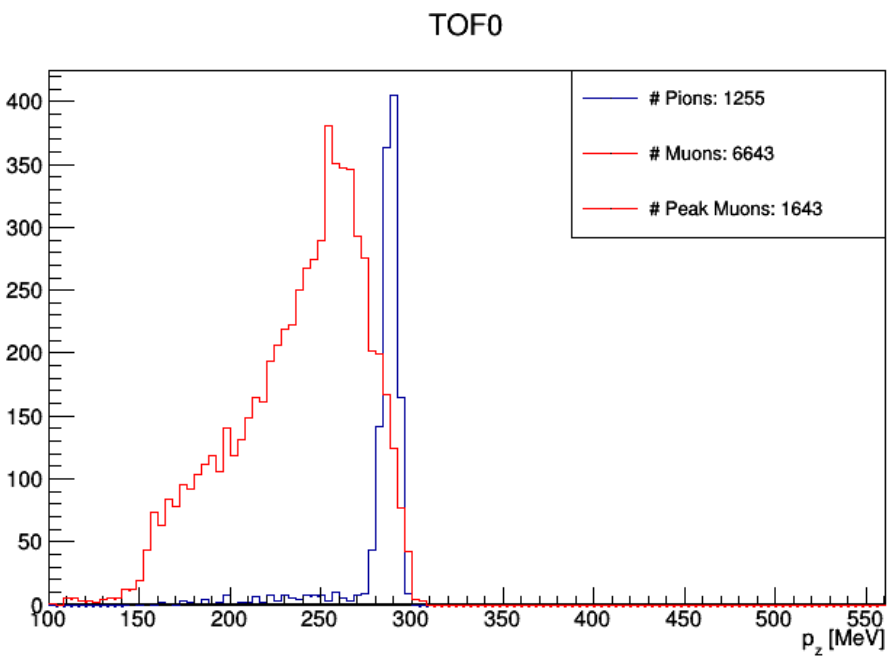
TOF1

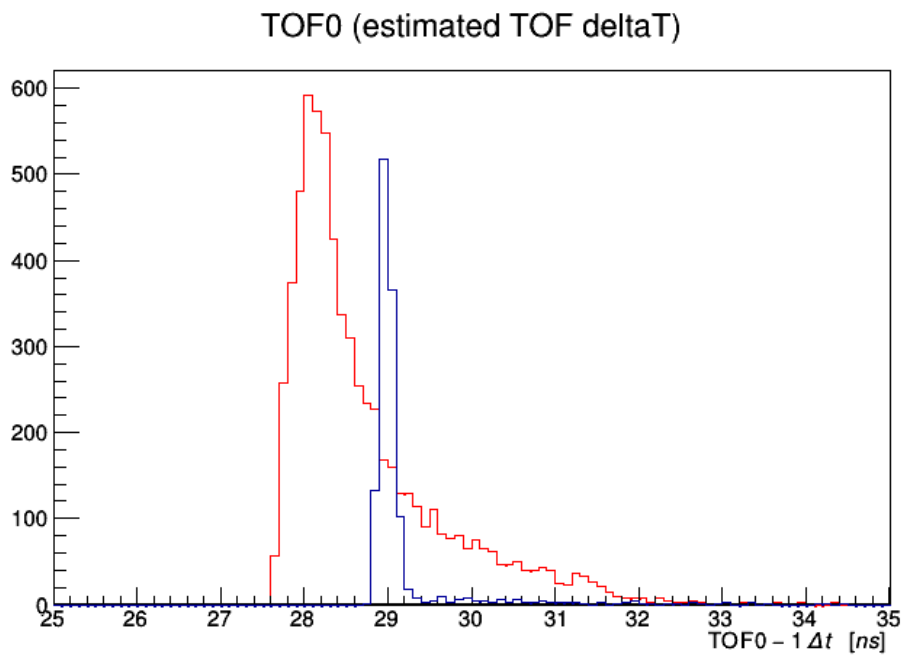


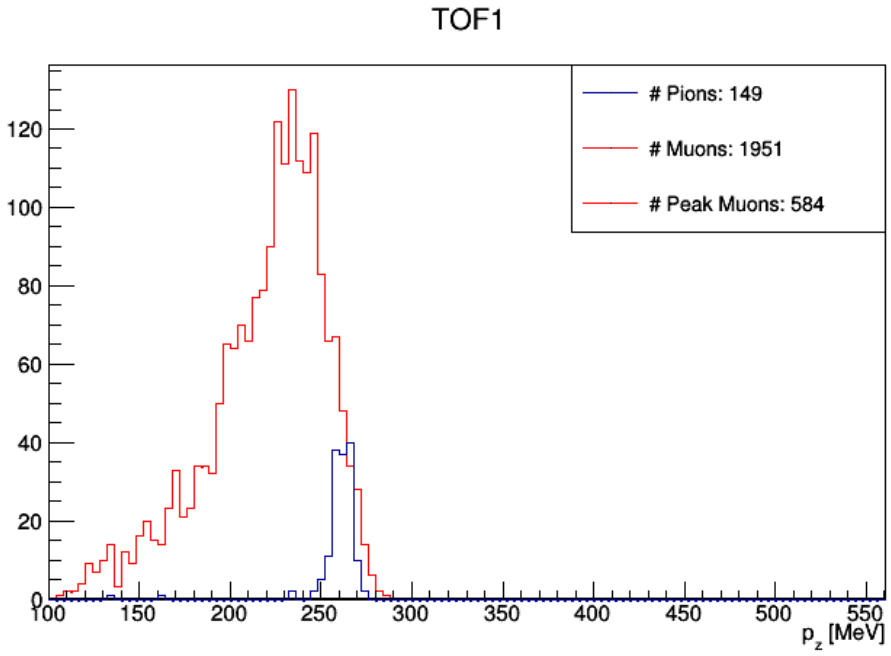
TOF1 (estimated TOF deltaT)

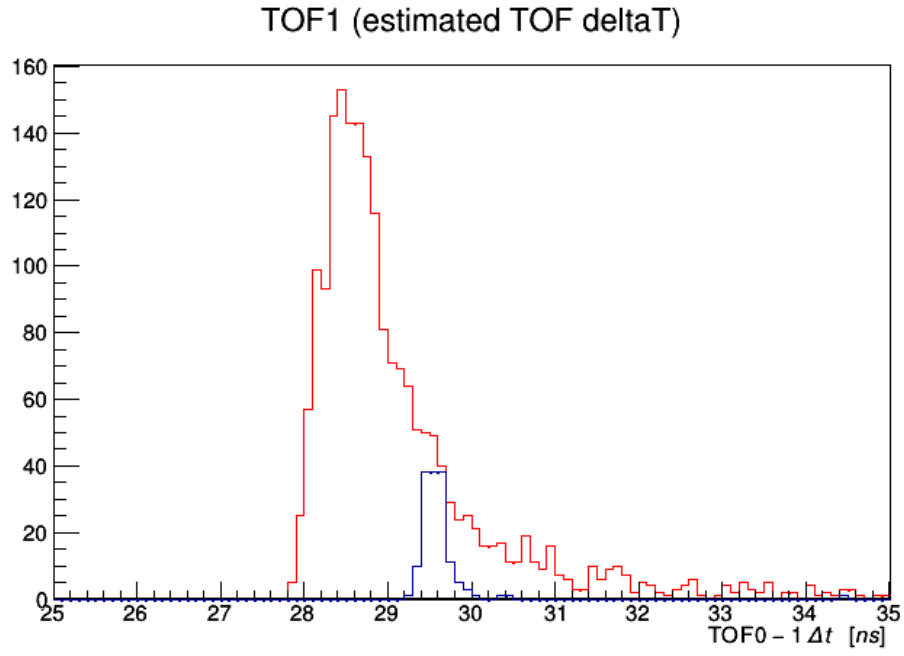


318-238 Beam


TOF0
Pions: 1255
Muons: 6643
Peak Muons: 1643
p_z [MeV]

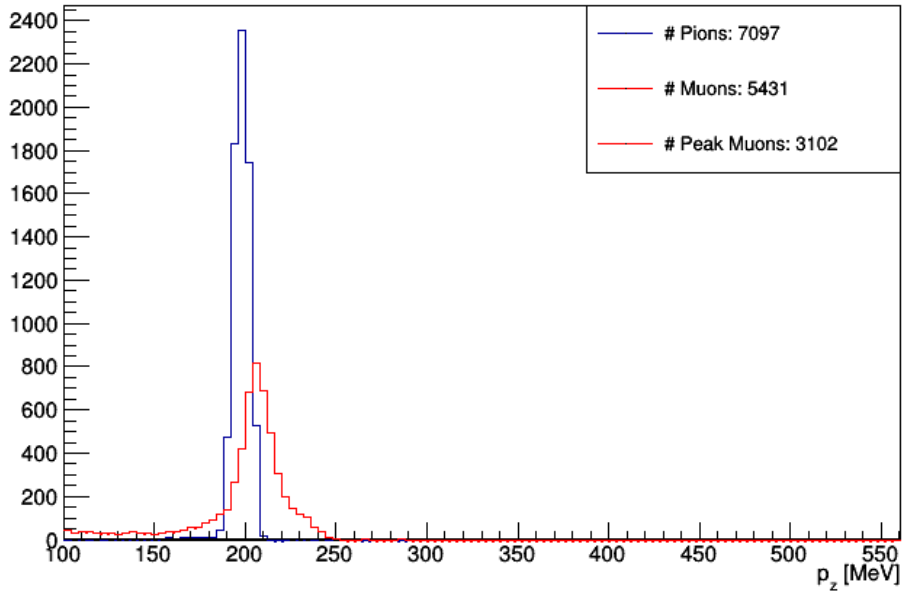

TOF0 (estimated TOF deltaT)
TOF0 – 1 Δt [ns]


TOF1
Pions: 149
Muons: 1951
Peak Muons: 584
p_z [MeV]

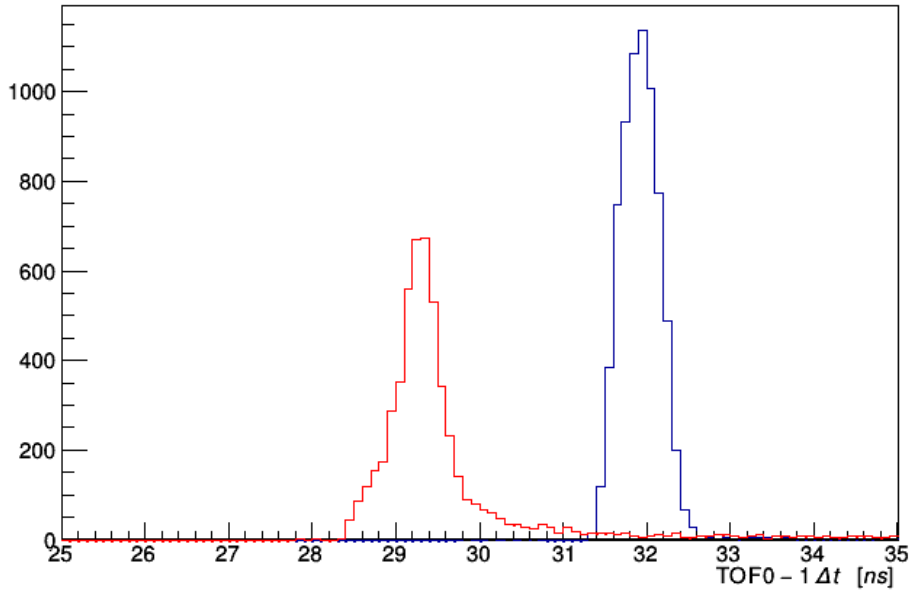

TOF1 (estimated TOF deltaT)
TOF0 – 1 Δt [ns]

238-238 Beam (Pion Mode)

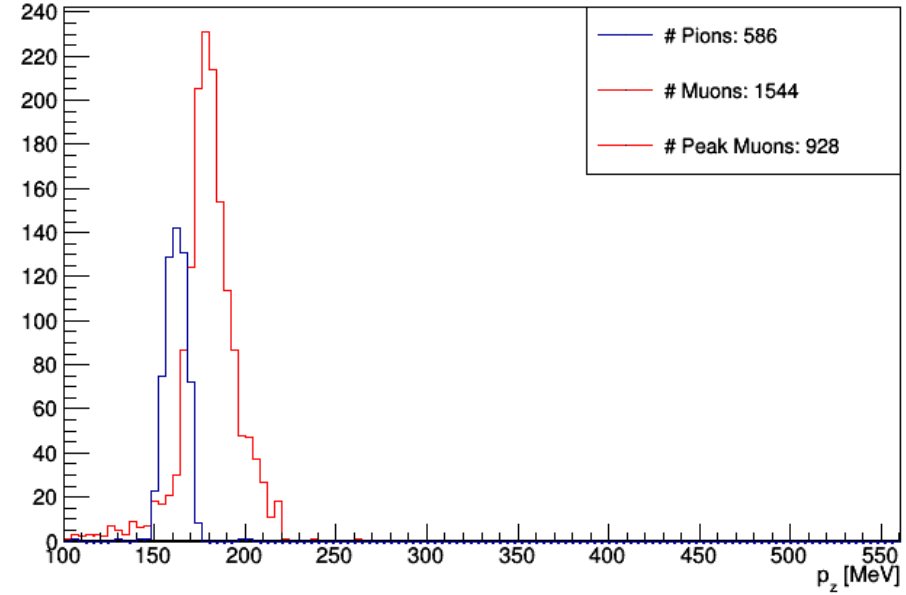
TOF0



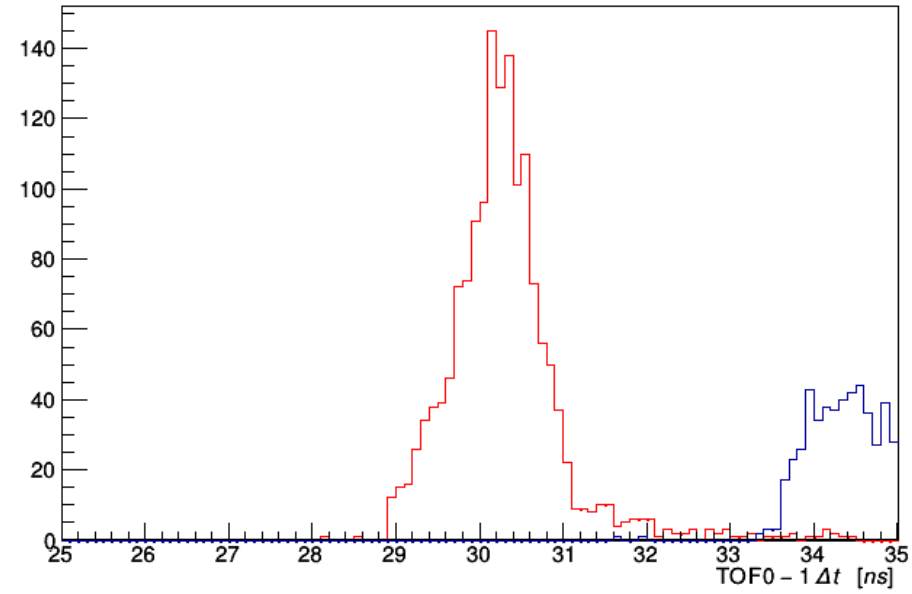
TOF0 (estimated TOF deltaT)



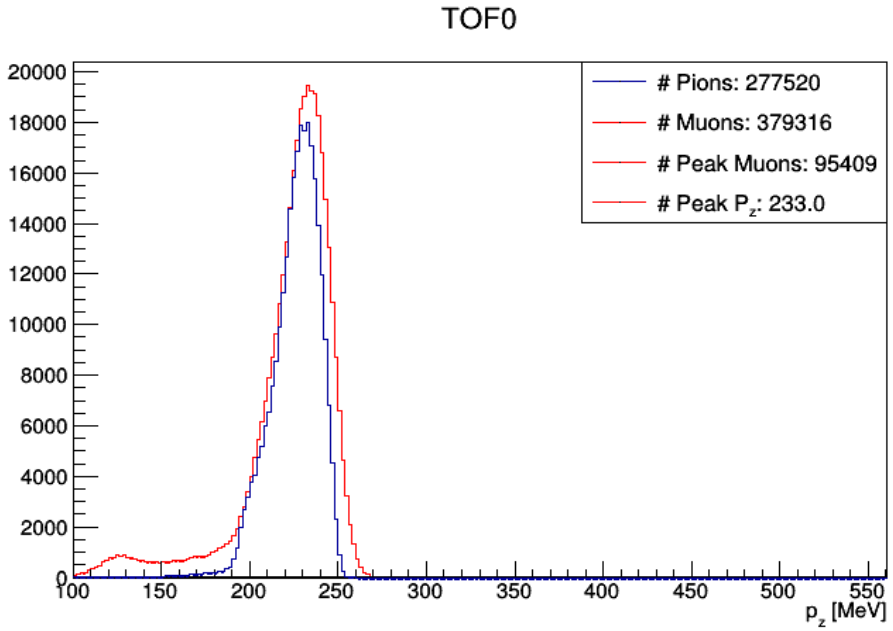
TOF1

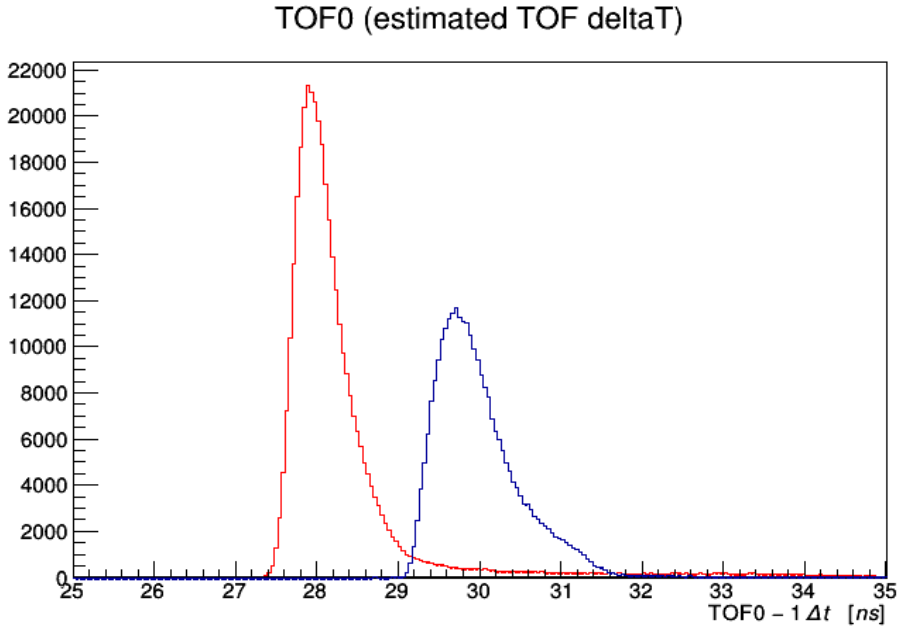


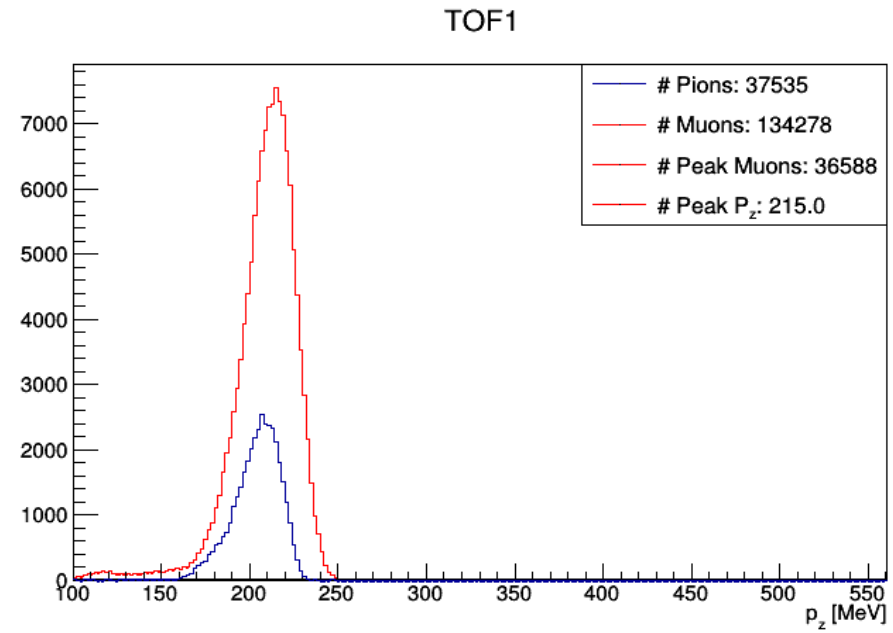
TOF1 (estimated TOF deltaT)

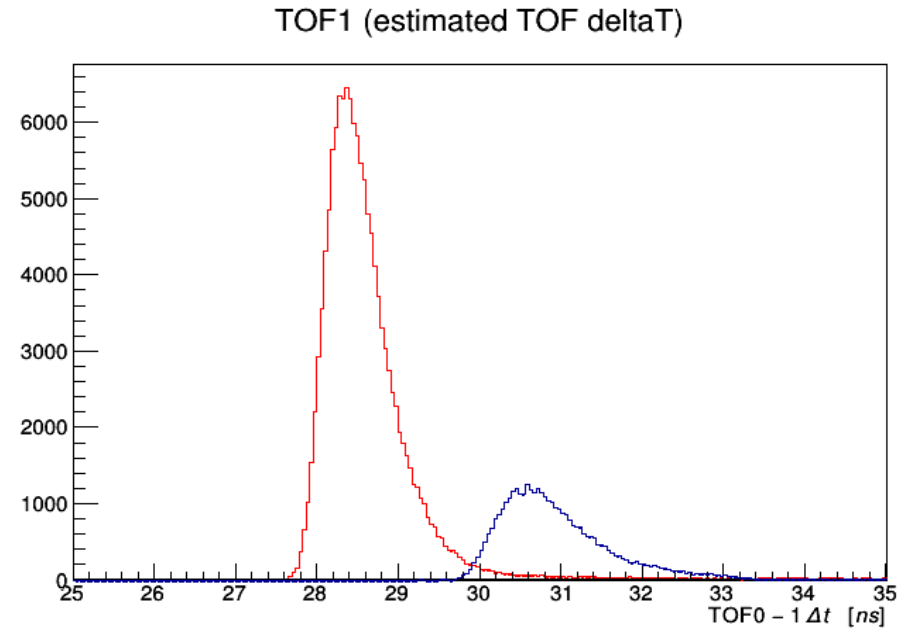


260-245 Beam (High Stats)

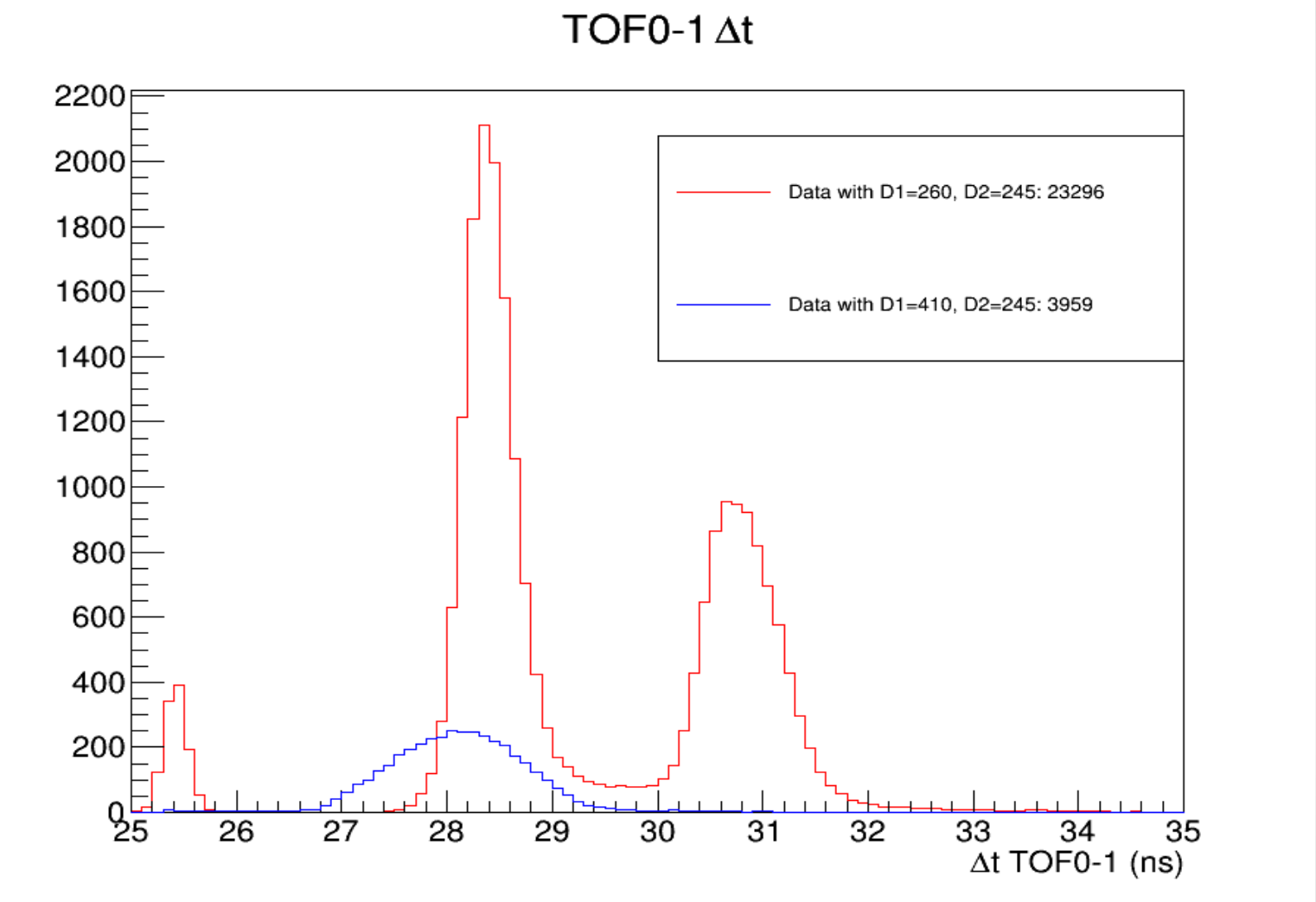








Difference in Data Rate



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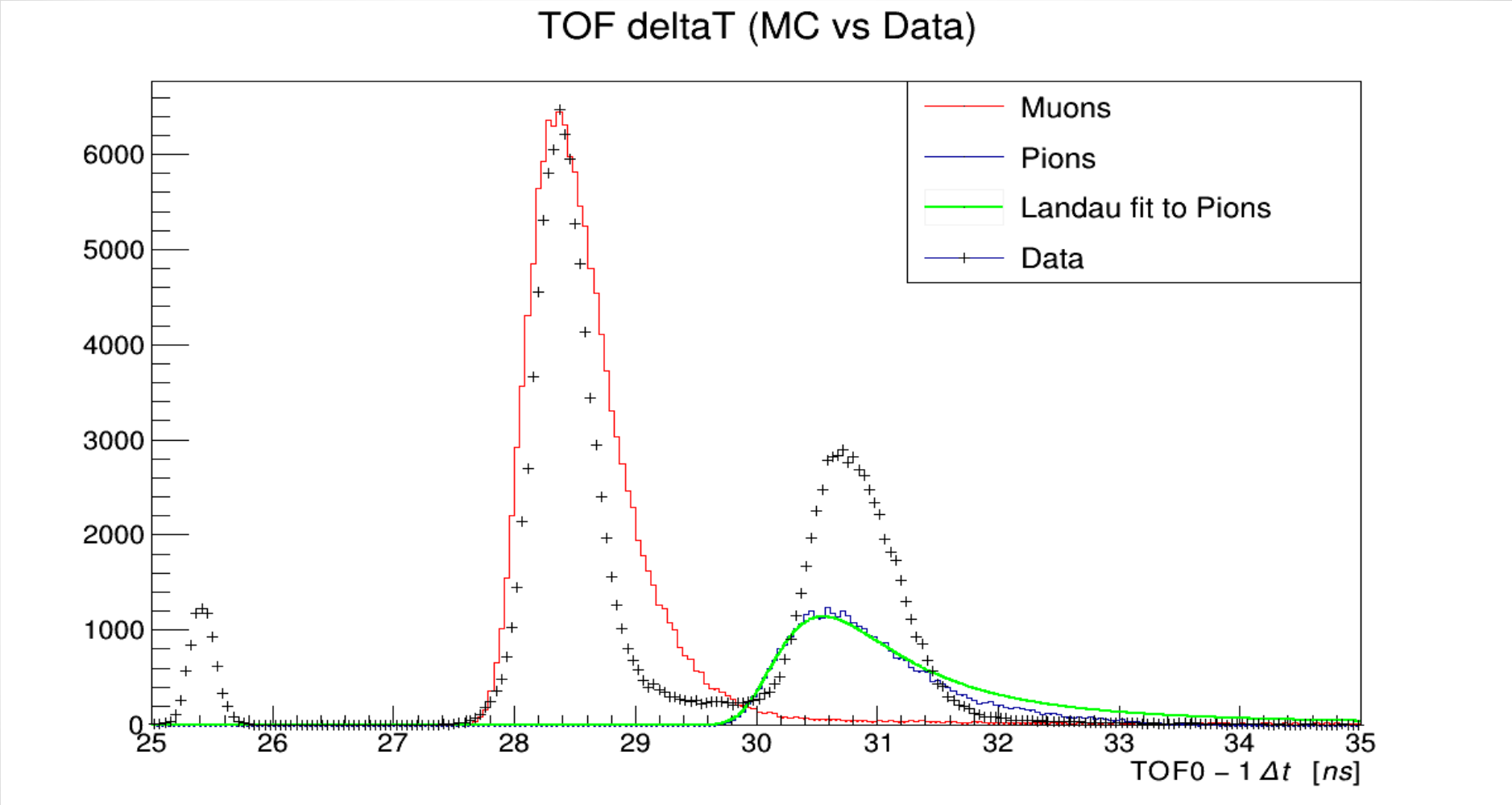
Pion Contamination



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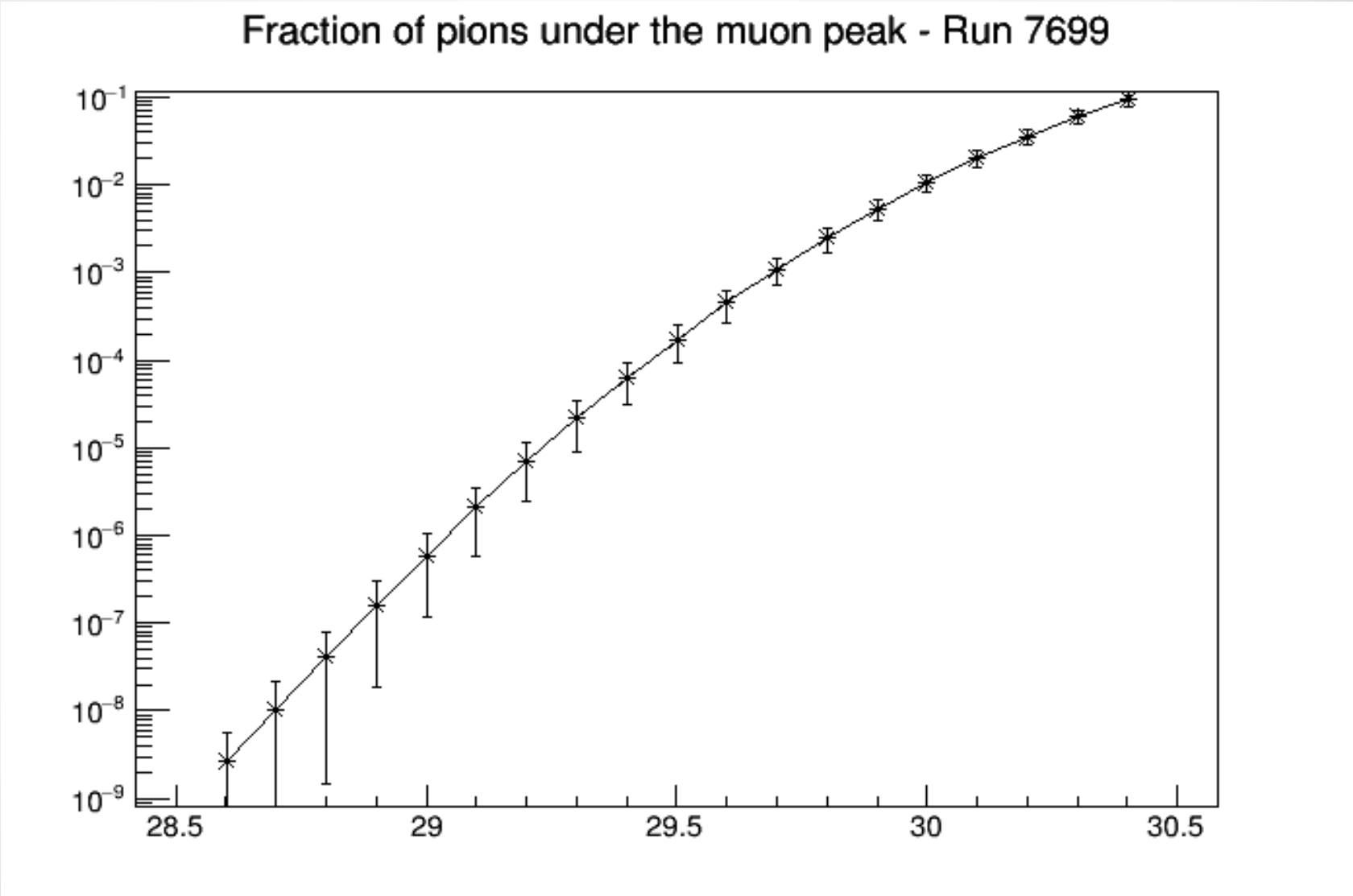
Fraction of pions under the muon peak - Run 7699
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
28.5
29
29.5
30
30.5

Next Steps

- Run PID on data to get reliable figures for pion contamination