

GlueX pid study for tracks that have TOF

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Goals of this preliminary analysis

- Learn how to use the GlueX software
- Get a feel for the detector response and PID

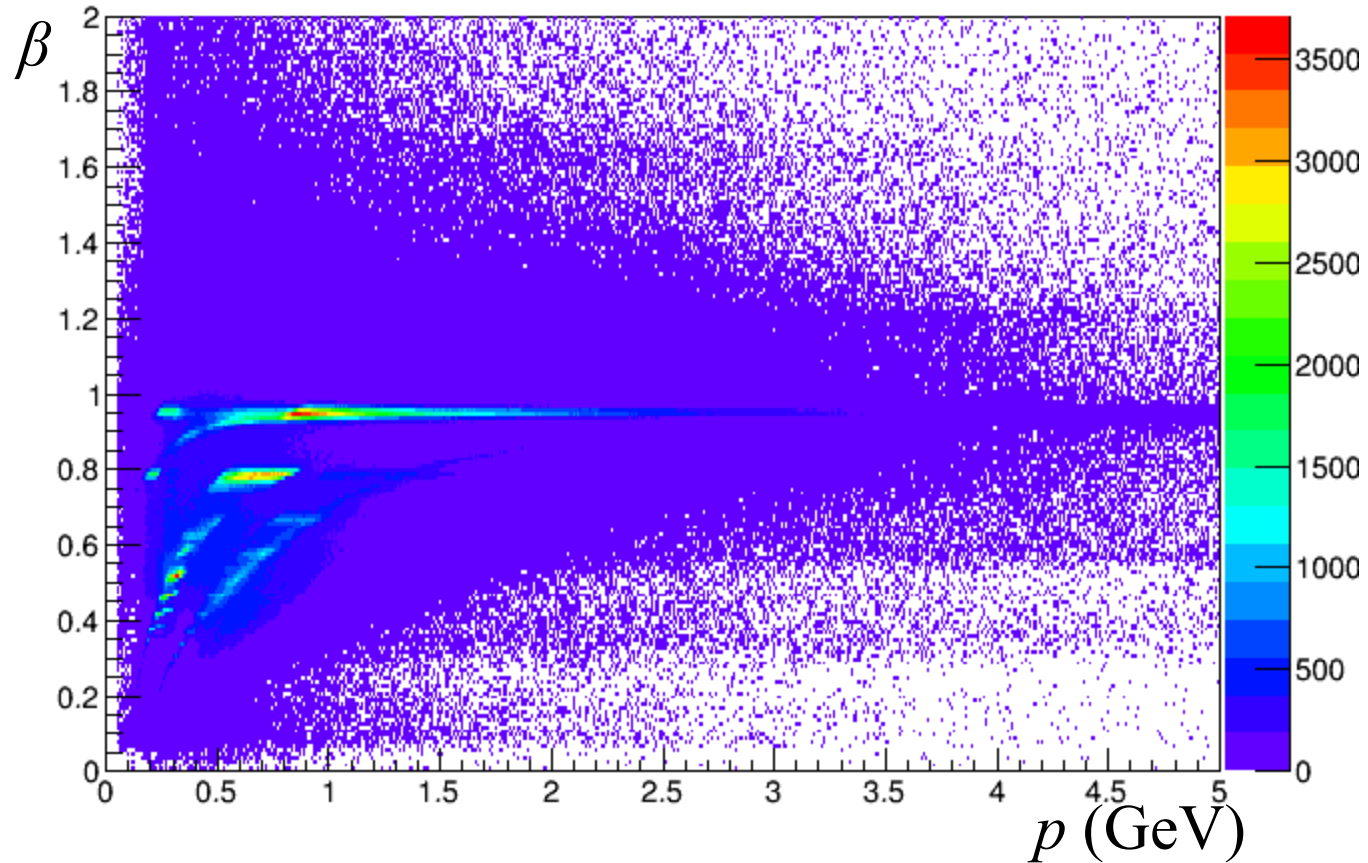
Data

- Using ver07 REST files
- Looking only at a single run (3185)

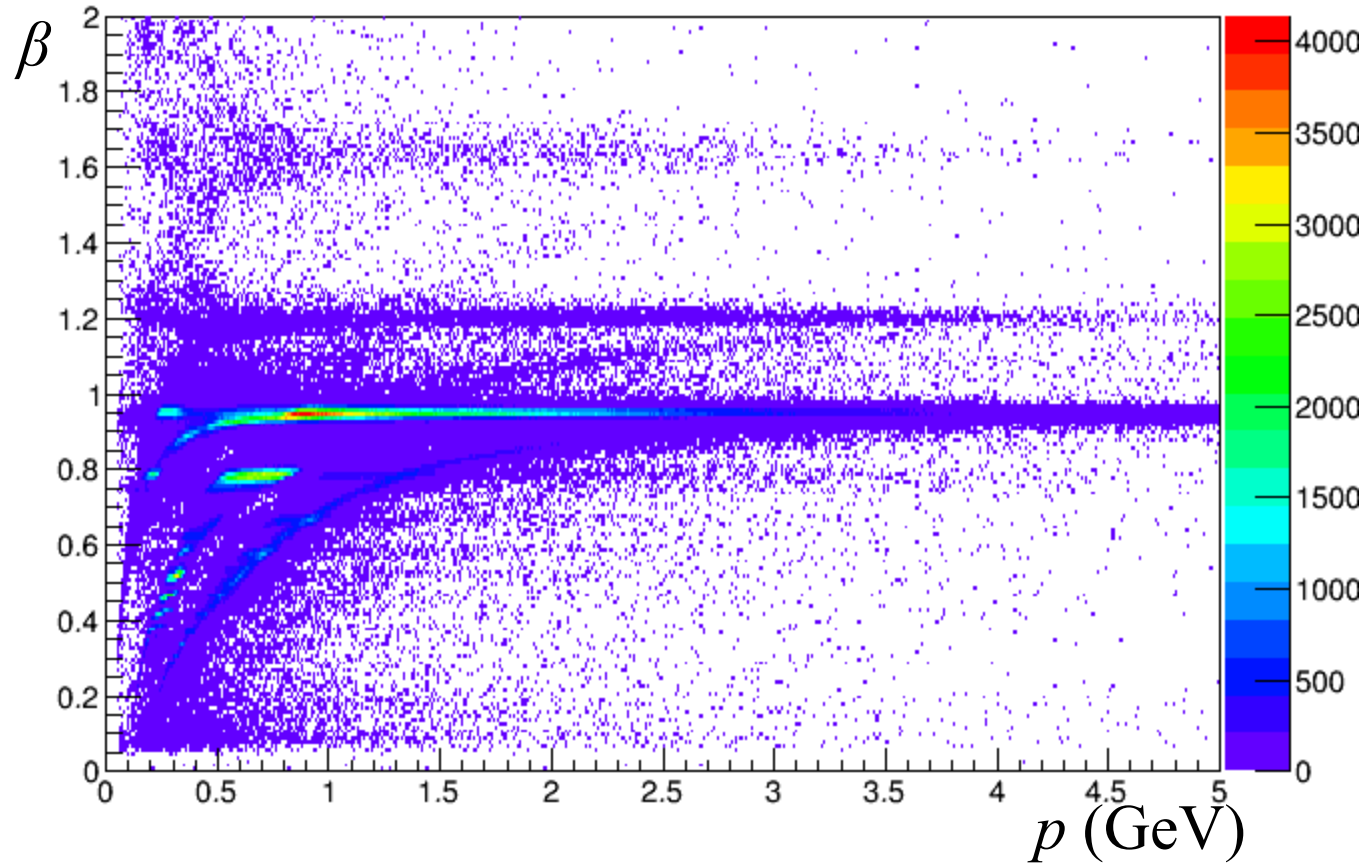
Notes on objects used

- Used `Get_BestFOM()` from `DChargedTrack` to get `DChargedTrackHypothesis`
- From `DChargedTrackHypothesis`:
 - `dFOM`
 - `PID`
 - `charge`
 - `lorentzMomentum`
 - `t0`
 - `t1`
 - `pathLength`
 - `dSCHitMatchParams`
 - `dTOFHitMatchParams`
- Used `DBeamPhoton` to get beam energy and time
- Used `dSCHitMatchParams` to get the vert time for SC tracks
 - `dHitTime - dFlightTime`

β vs. p for all charged tracks

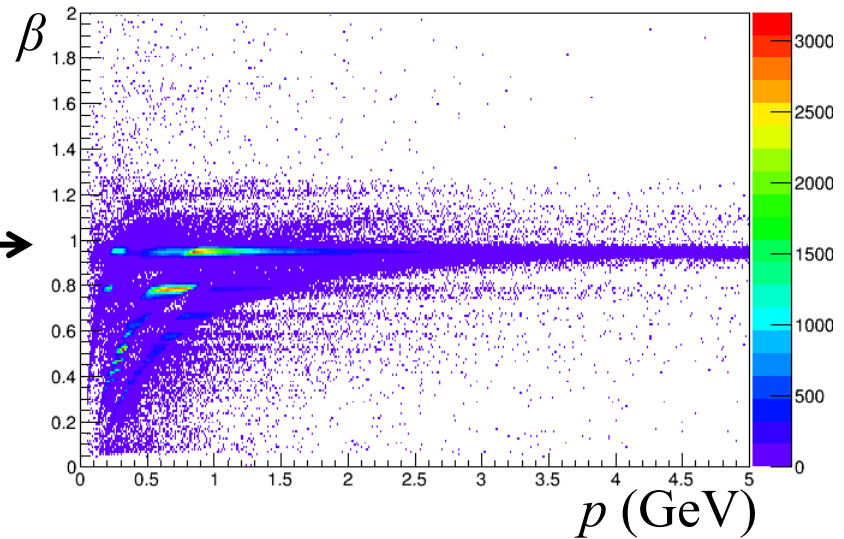


β vs. p tracks with TOF

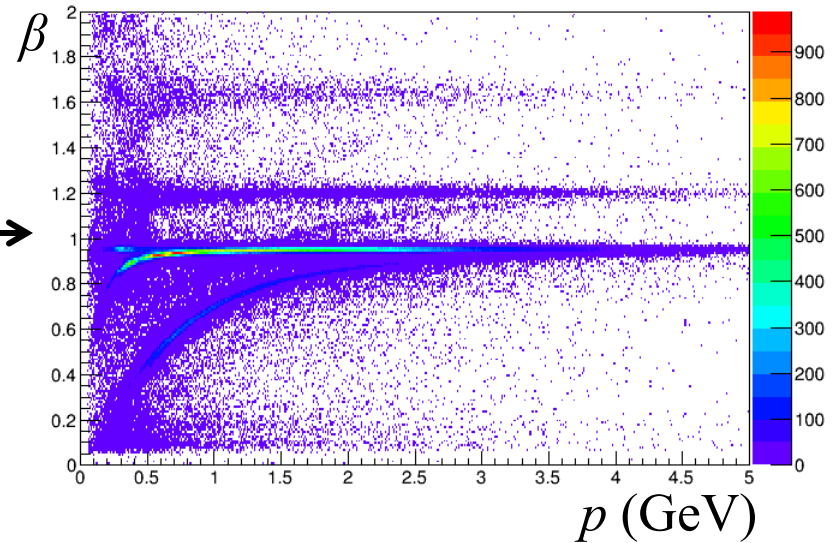


β vs. p for tracks with TOF

No start counter for any track in event

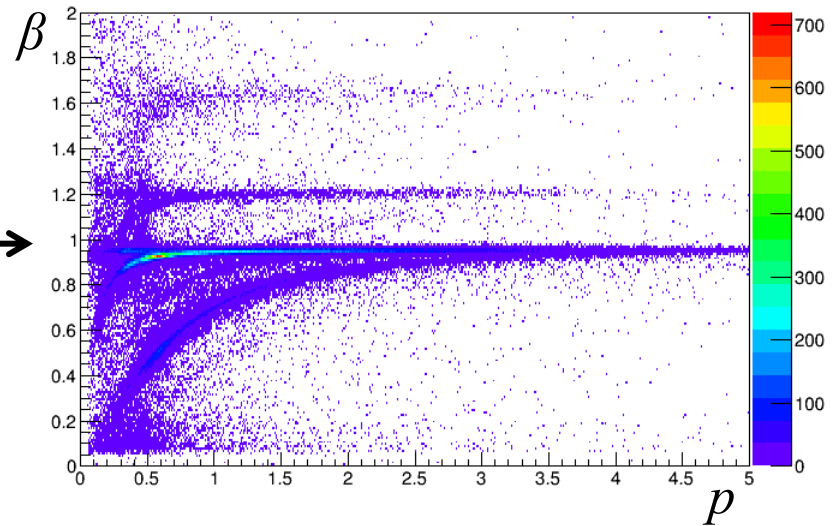


Start counter for at least one track in event

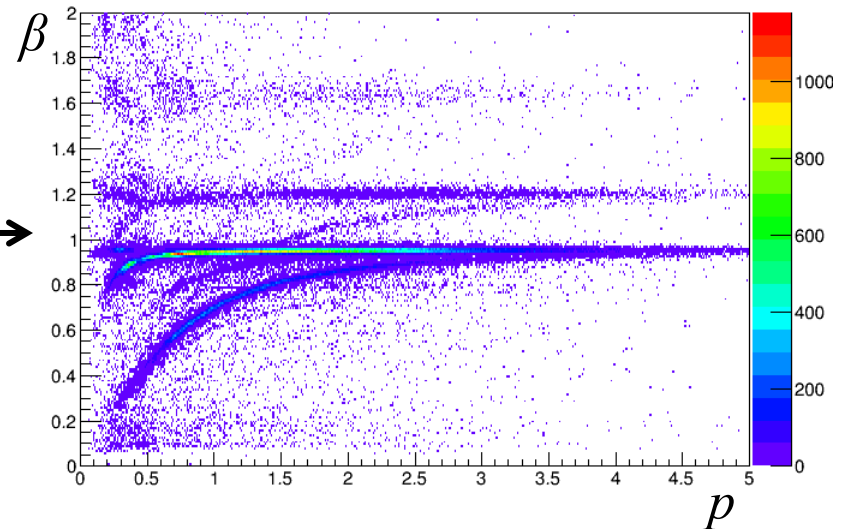


β vs. p tracks with TOF

Start counter in event
but NOT matched to
track



Start counter matched to
track

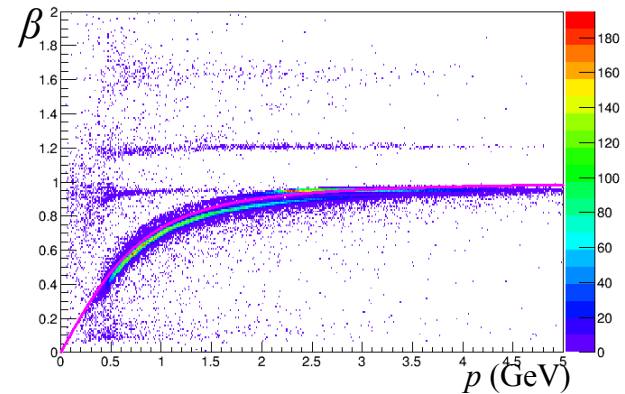


PID

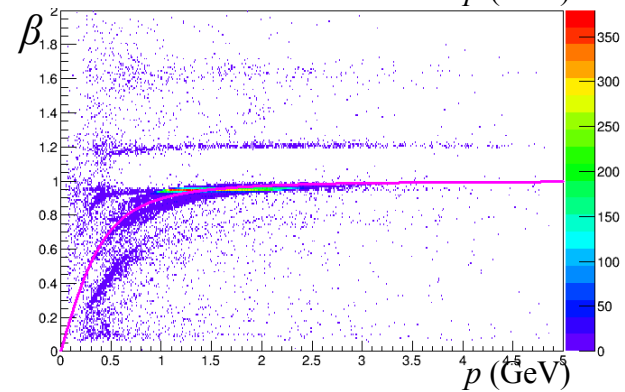
- The following plots are for tracks with TOF and at least one SC in event

Plots of β vs. p from TOF after PID

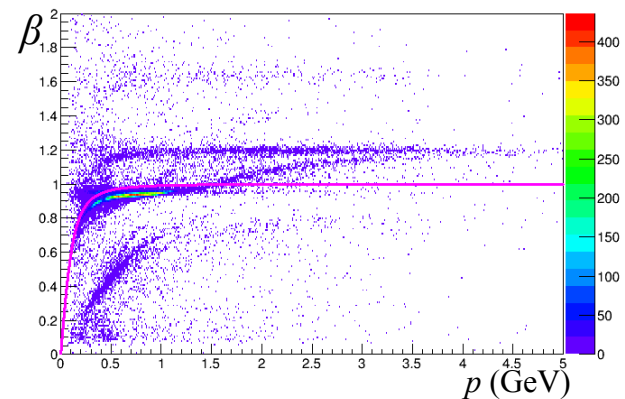
Proton PID \longrightarrow



K^+ PID \longrightarrow



π^+ PID \longrightarrow



- Pink lines are β vs. p for fixed mass

- Plots are shifted down and PID could be better

Time offset (slide 1)

- Looked at tracks with momentum > 2 GeV
- Assumed track is π
- Assumed path length and momentum are correct but Δt is wrong

- Take $\beta'_m = L / (\Delta t + t_{offset})$

- Since $p = \beta'_m \gamma m$, then

$$(\beta'_m)^2 = (p/m)^2 / [1 + (p/m)^2]$$

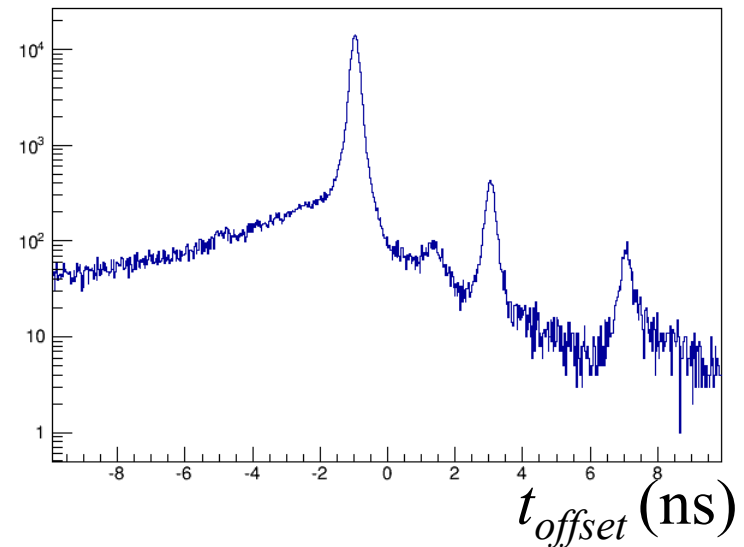
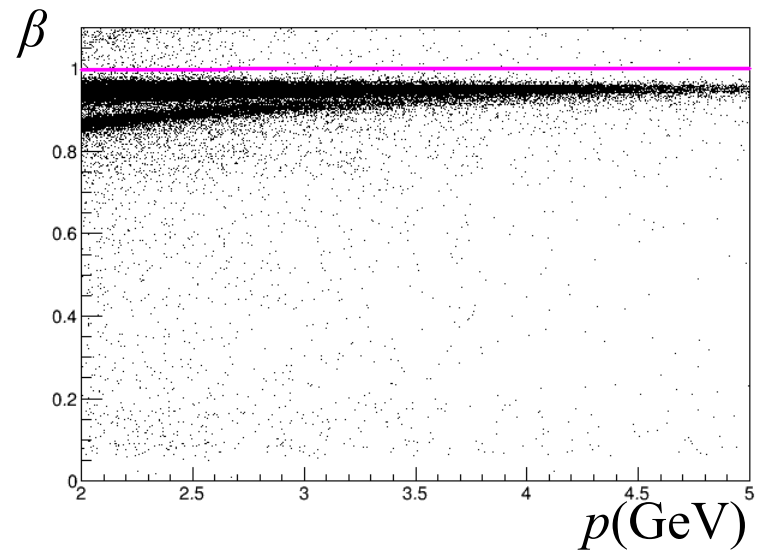
and since $\beta c = L / \Delta t$, then

$$c(\Delta t + t_{offset}) = [1 + (p/m)^2]^{1/2} / (p/m)$$

So that

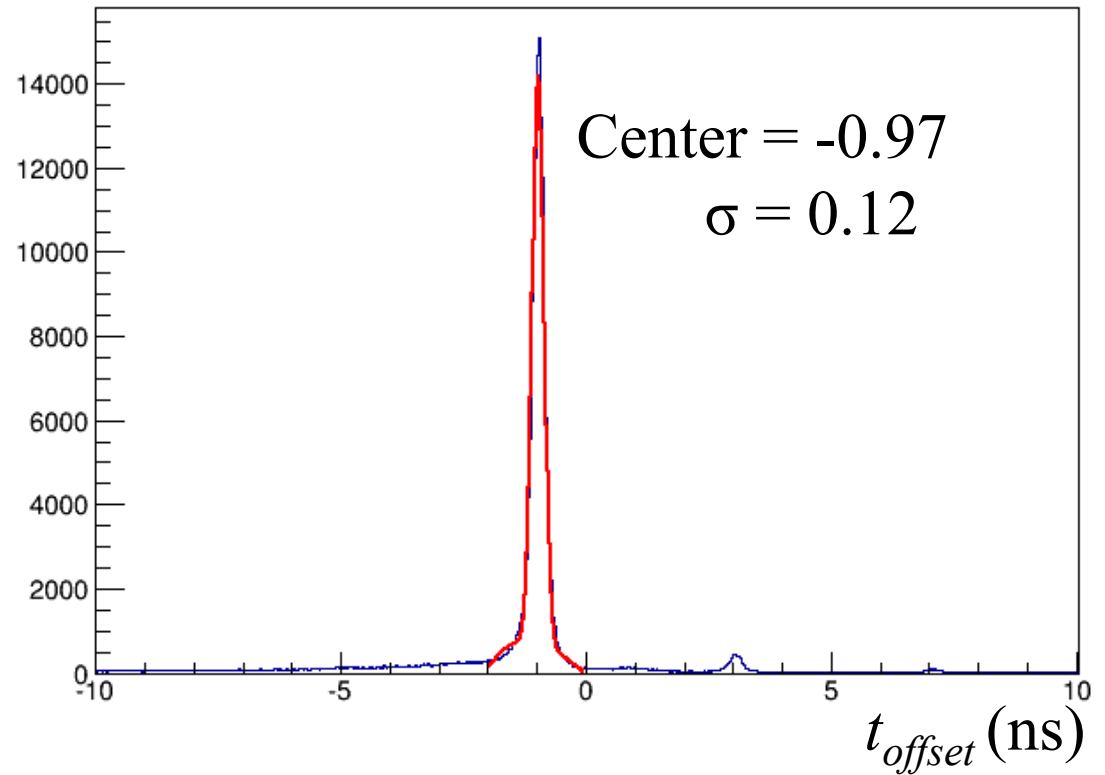
$$t_{offset} = L[1 + (p/m)^2]^{1/2} / (pc/m) - \Delta t$$

- pathlength from hypothesis
- $\Delta t = t1 - t0$, from hypothesis



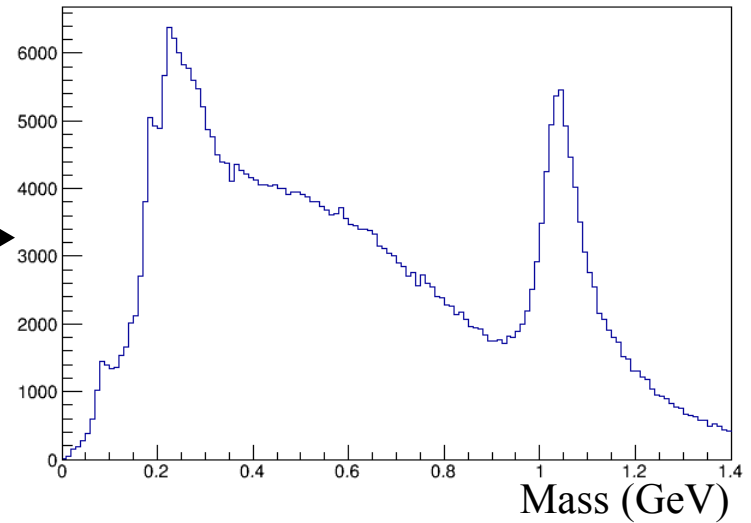
Time offset (slide 2)

- Found time offset
- $t_{offset} = -0.97$

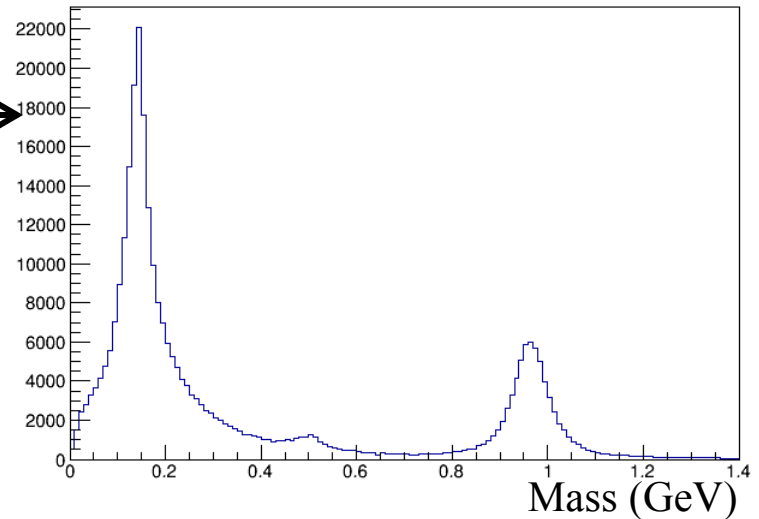


Mass of charged tracks

Mass from original momentum and measured β_m



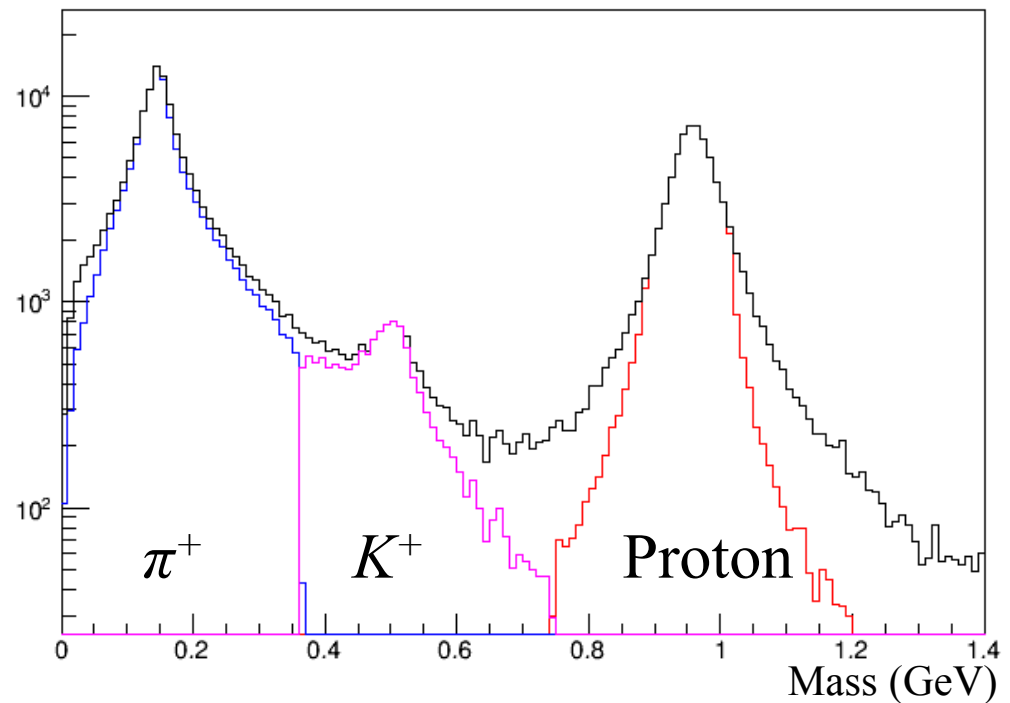
Mass when β_m has corrected time (β'_m)



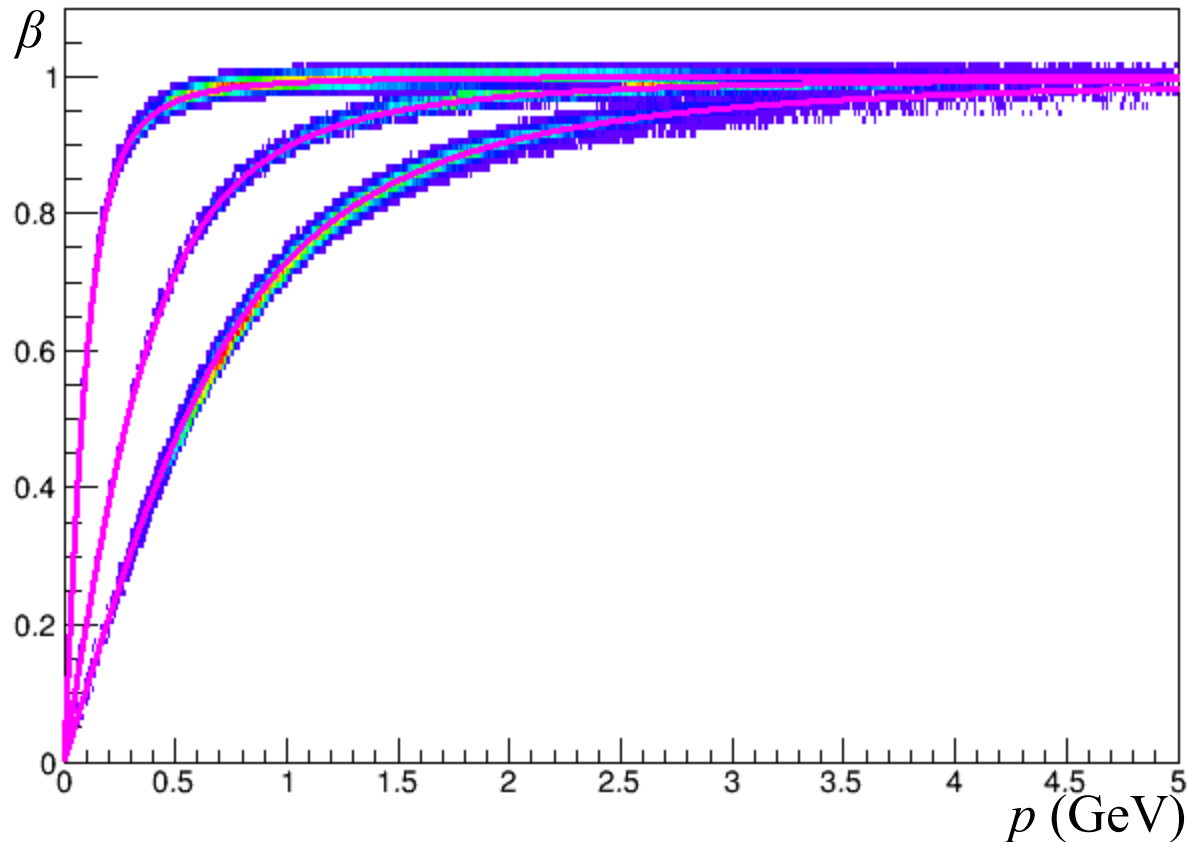
rePID (temporary solution for now)

- Took PID of particle with best match of calculated β_c to corrected β'_m
- Fit $\beta_c - \beta'_m$ to gaussian
- If $\beta_c - \beta'_m$ outside of 4σ , set particle to Unknown

Particle	$\beta_c - \beta'_m$	σ
p	4.31×10^{-3}	8.90×10^{-3}
π^+	-1.60×10^{-4}	6.43×10^{-3}
π	-6.68×10^{-4}	6.18×10^{-3}
K^+	-6.79×10^{-4}	5.97×10^{-3}
K^-	-2.37×10^{-3}	5.05×10^{-3}



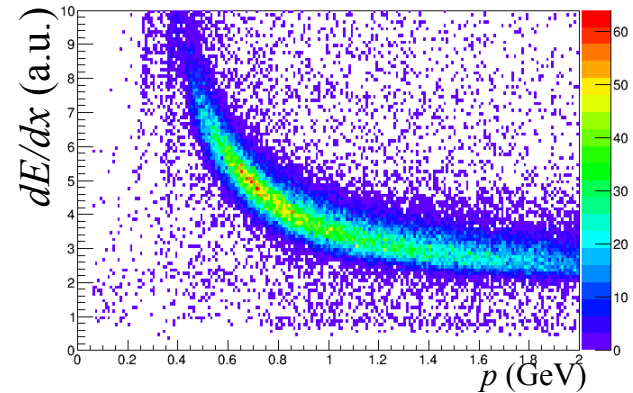
Plots of β vs. p from TOF after rePID



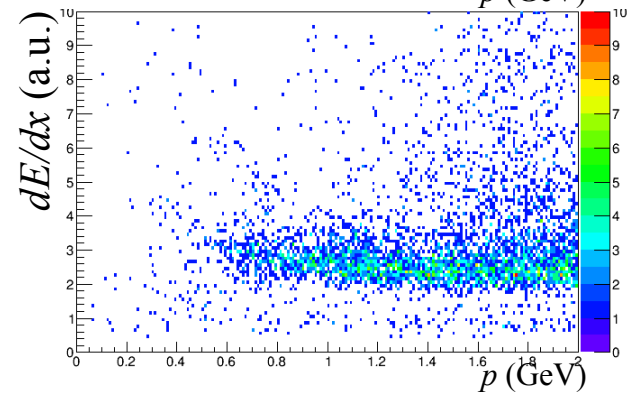
- Pink lines are β vs. p for fixed mass

Plots of dE/dx from TOF after rePID

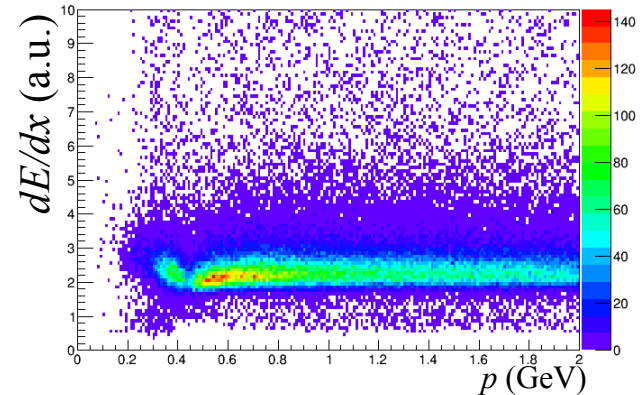
Proton rePID



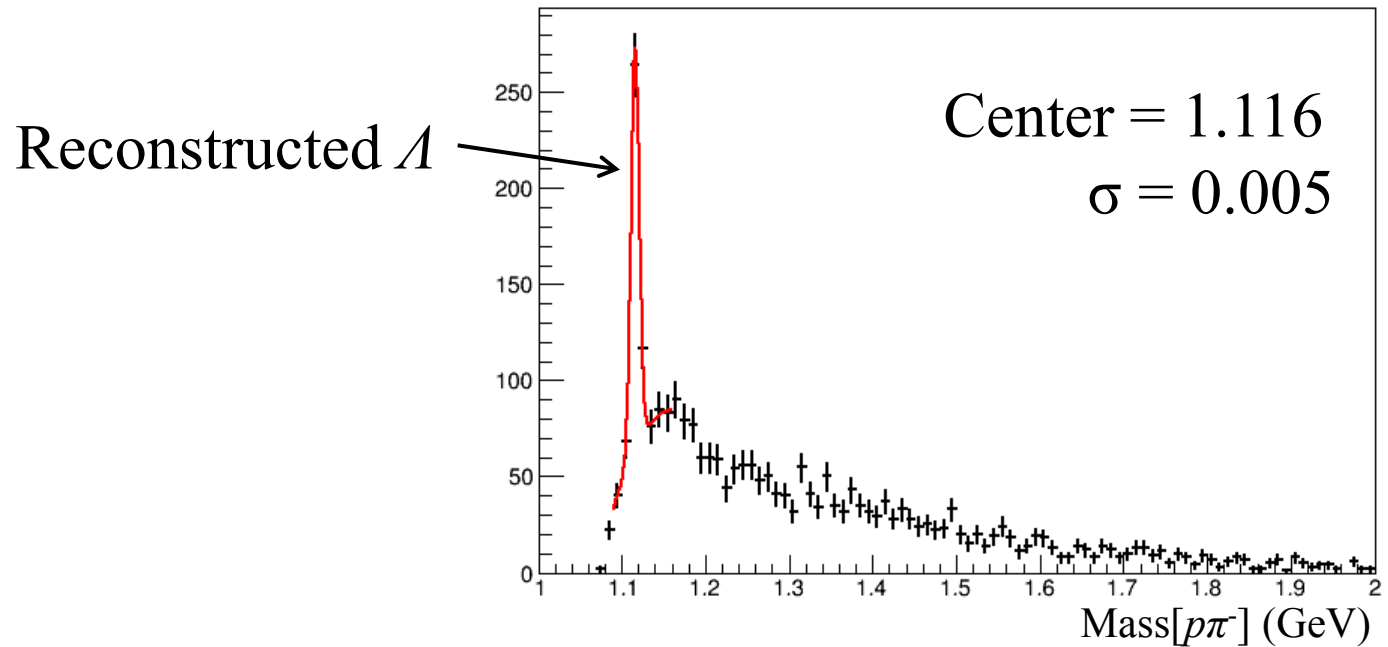
K^+ rePID



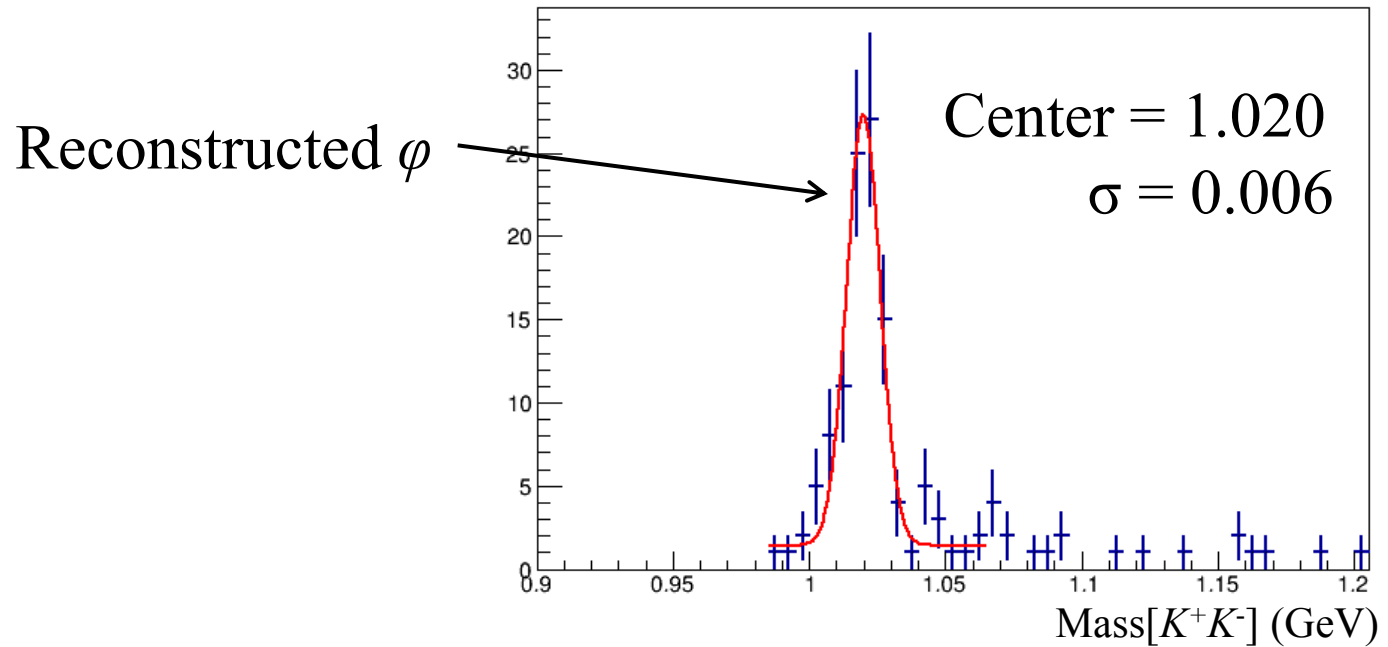
π^+ rePID



Invariant mass of proton π^-



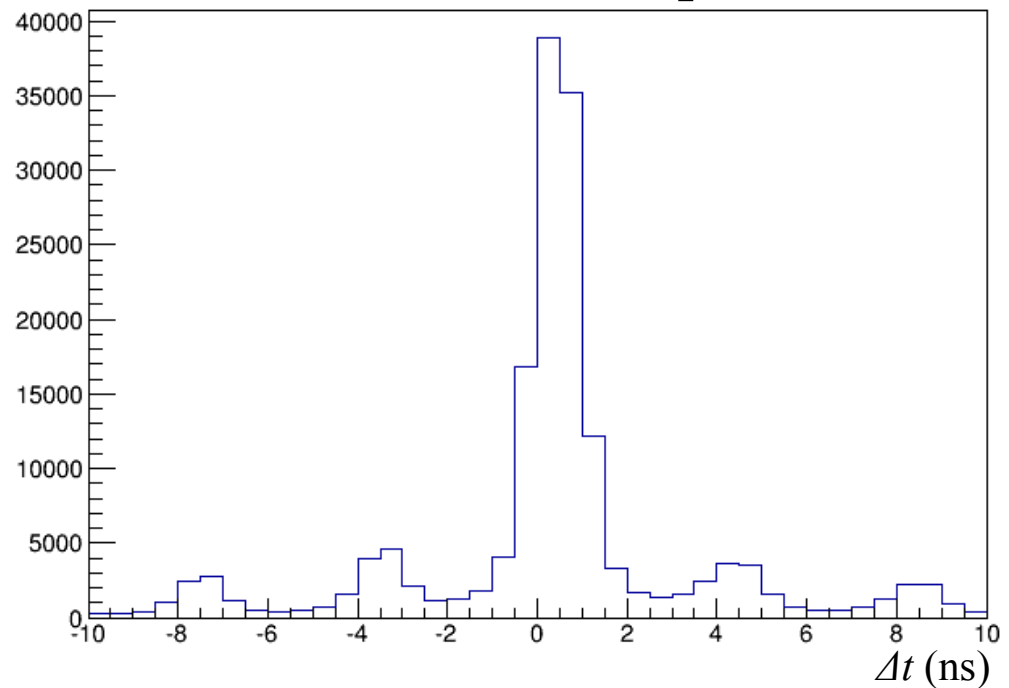
Invariant mass of $K^+ K^-$



Beam photon time

- $\Delta t = \text{vertex time} - \text{beam time}$
- Picked best timed photon one with smallest Δt
- Require track to have only one photon within 2 ns of best timed photon

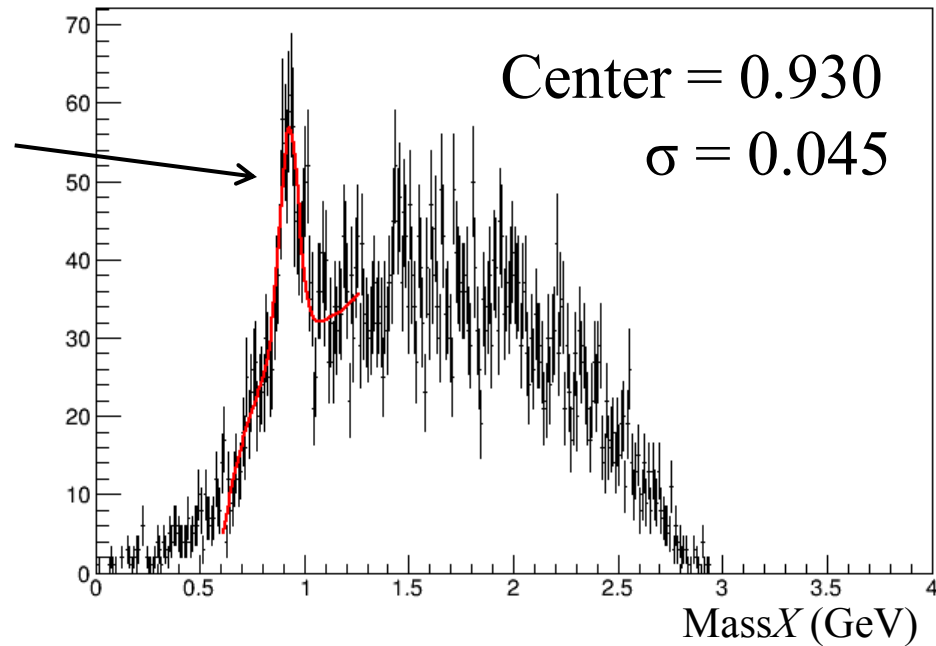
Δt for best timed photon



Missing mass for $\pi^+ \pi^-$

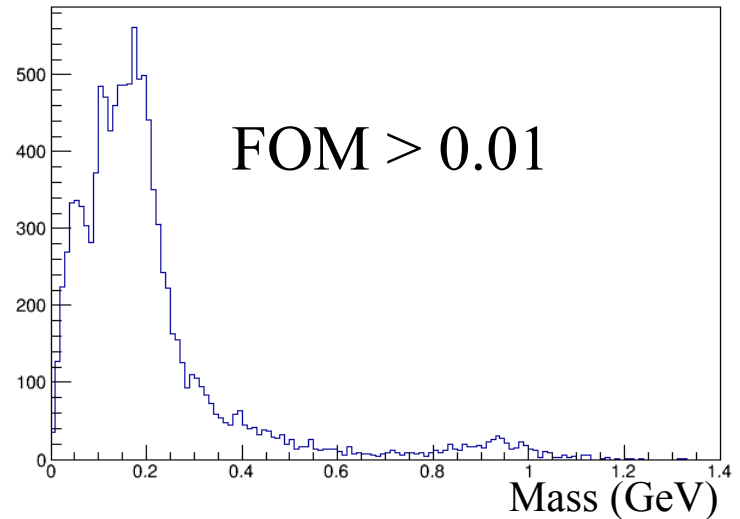
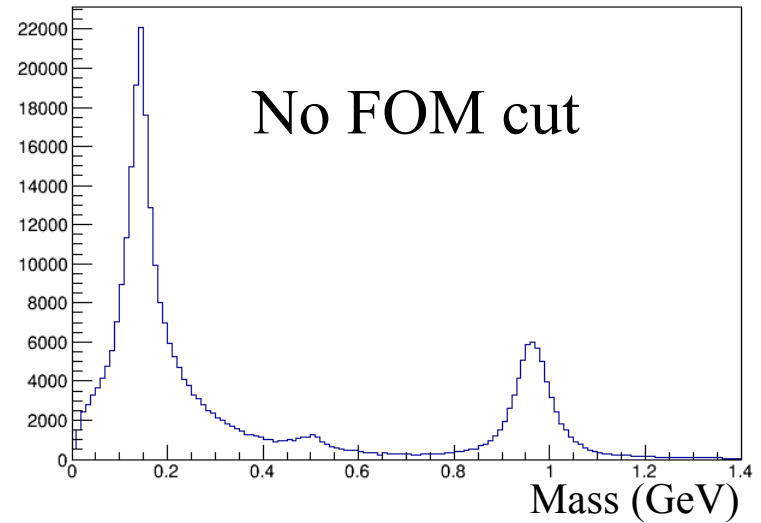
- Reaction $\gamma p \rightarrow \pi^+ \pi^- X$

Proton peak



Result of FOM cut

- FOM cut kills 96.3% of tracks that have start counter in the event and TOF for the track

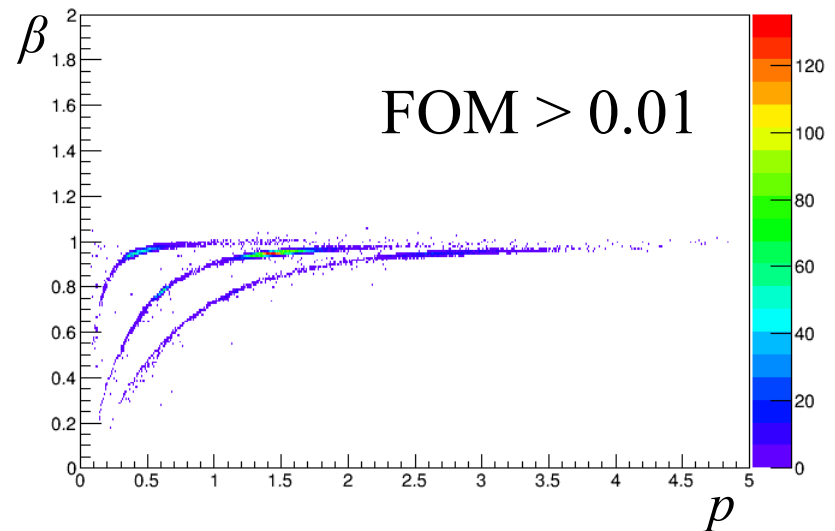
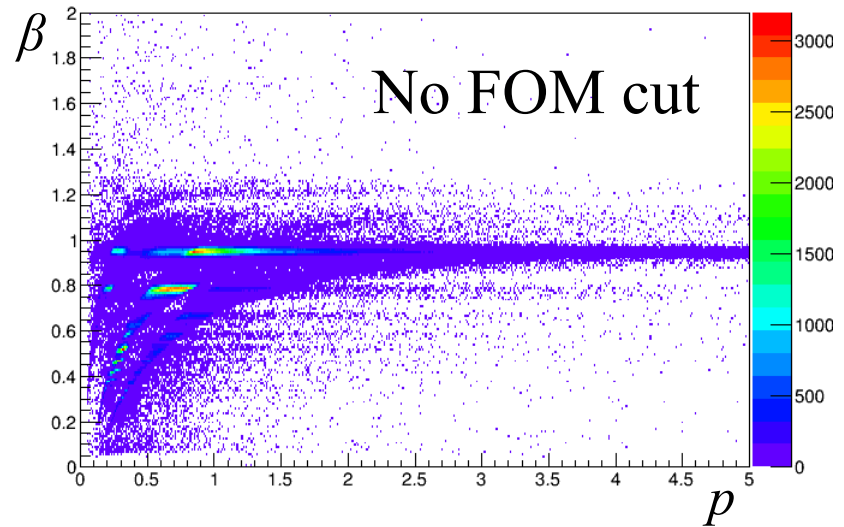


TOF event with no start counter in event

- The following slides contain tracks that have TOF but there was no start counter anywhere in the event

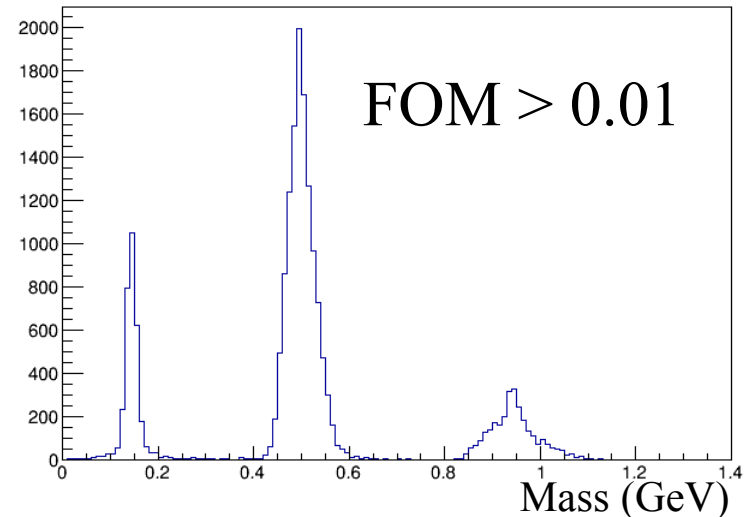
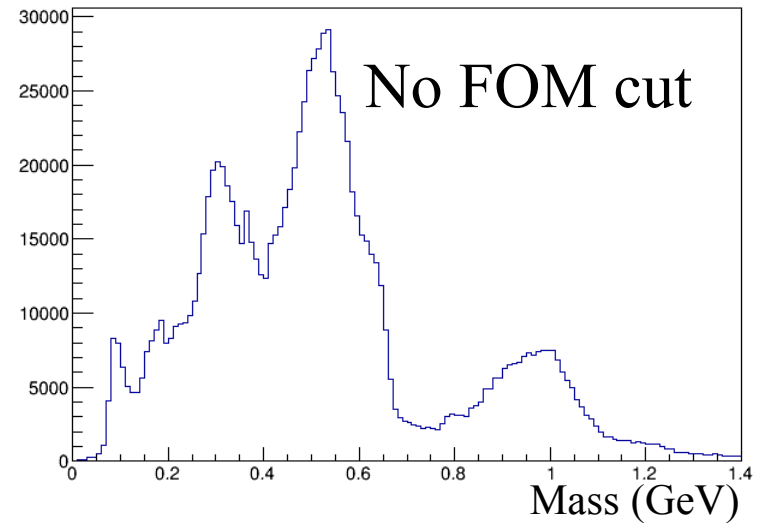
β vs. p for tracks with TOF

- FOM cut results have very nice looking β vs. p plot
- FOM cut results have no time offset needed



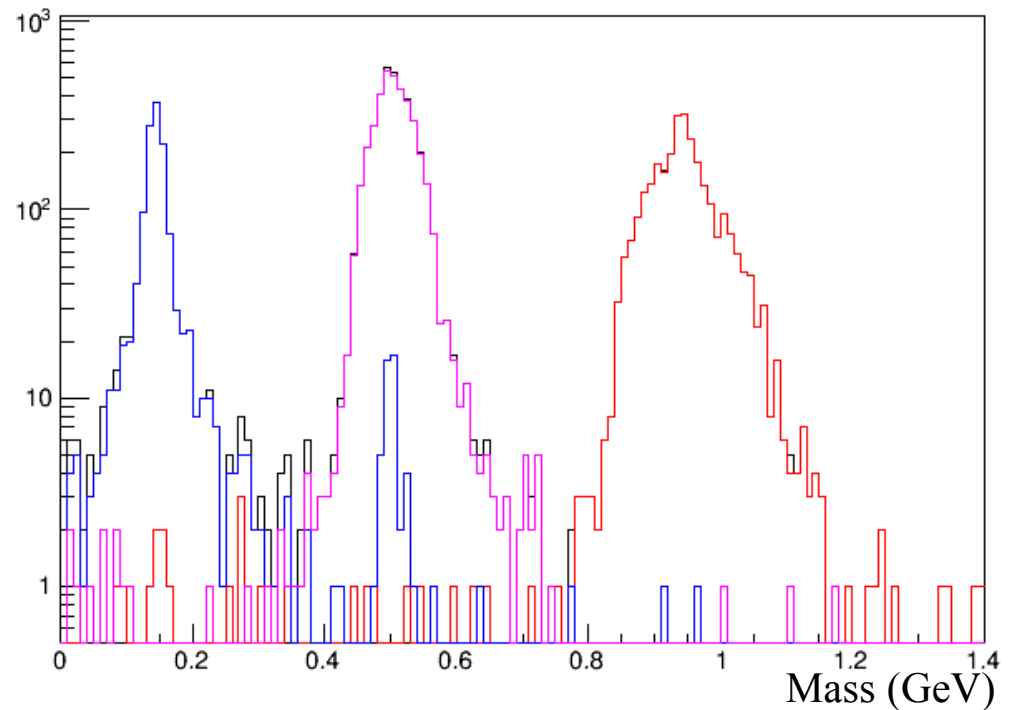
Mass plots

- Mass plot for FOM cut looks too good
- Looks like too many kaons for FOM-cut tracks
- Are the FOM-cut tracks good?



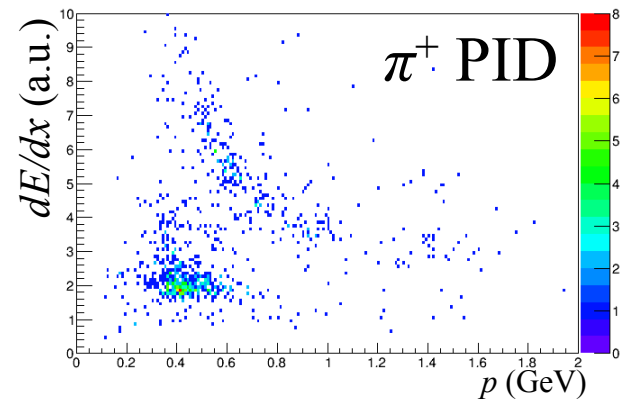
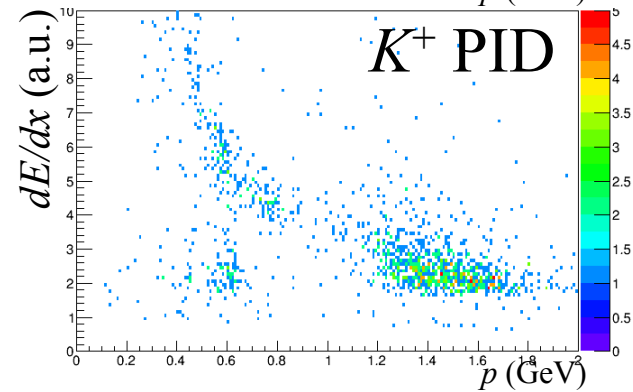
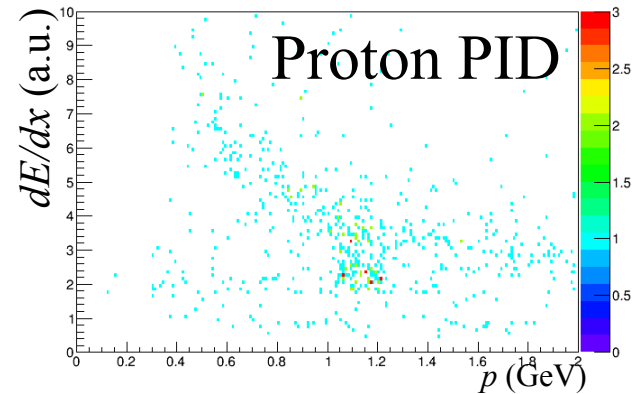
PID from hypothesis for positive tracks with $FOM > 0.1$

- Will go with the original PID for these tracks



Plots of dE/dx from TOF with $FOM > 0.1$

- Each of the particles look contaminated



Title

