GlueX timing and PID study for BCAL tracks

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Goals of analysis

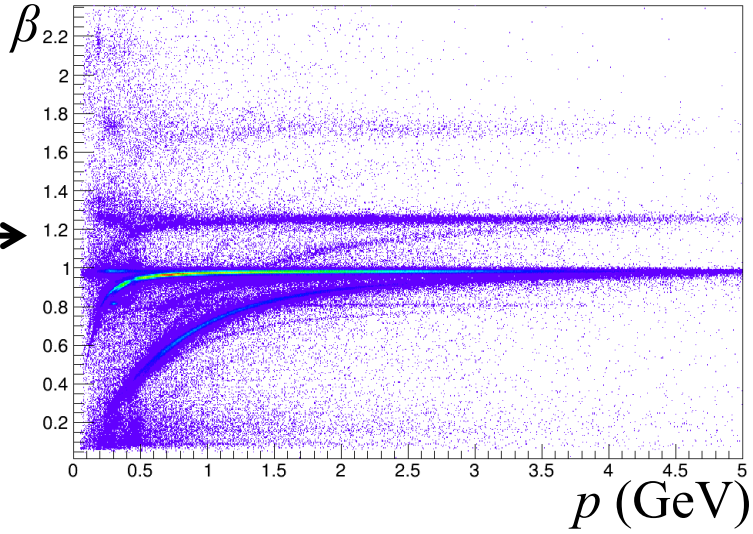
- Continue to learn how to use the GlueX software
- Get a feel for the detector response and PID
- Looking for corrections that may help with calibration

Data

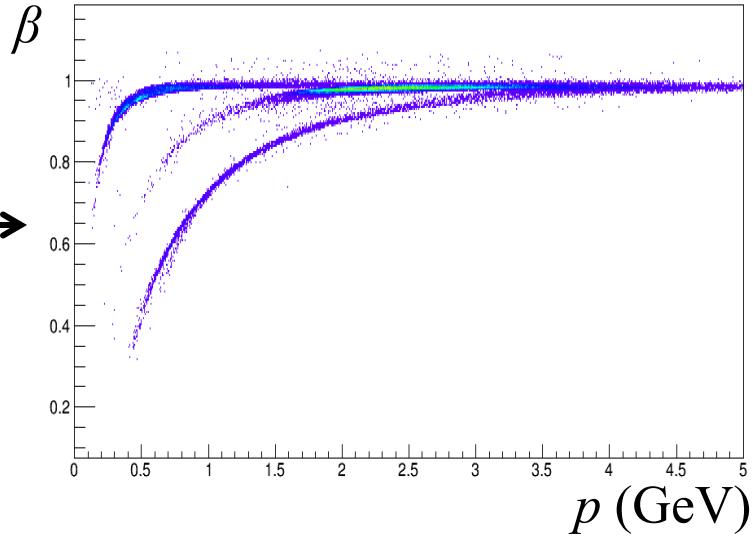
- Using ver09 REST files
- Looking only at a single run (3180)

Plots of β vs. p from TOF

Start counter for at least one track in event with no FOM cut

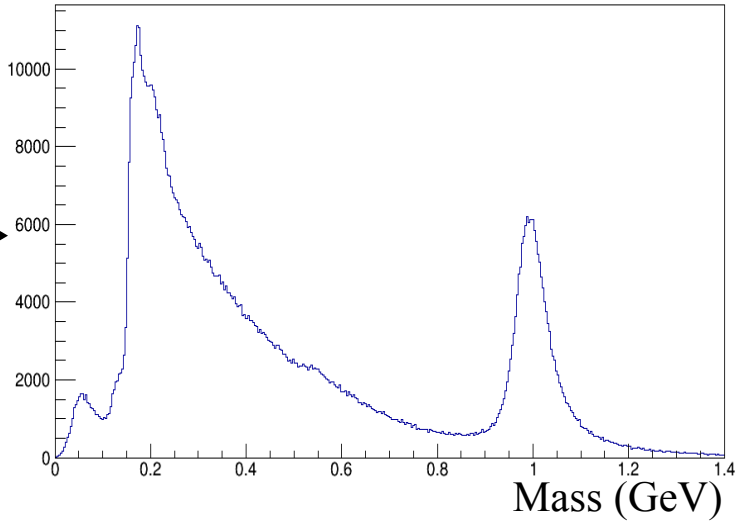


Start counter for at least one track in event with FOM cut of 0.0027

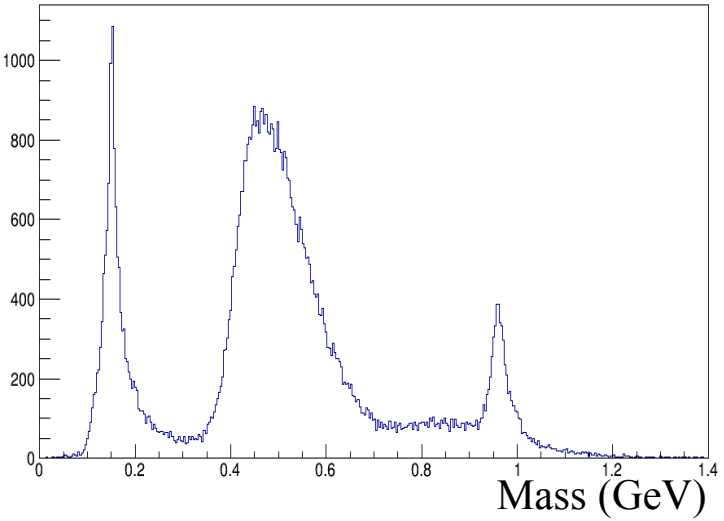


Mass of charged tracks from TOF

Mass from original momentum and measured β_m with no FOM cut

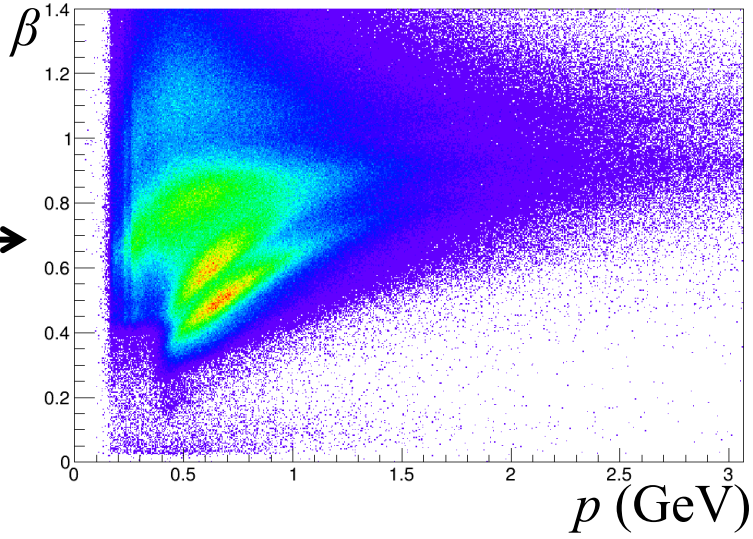


Mass from original momentum and measured β_m with FOM cut of 0.0027

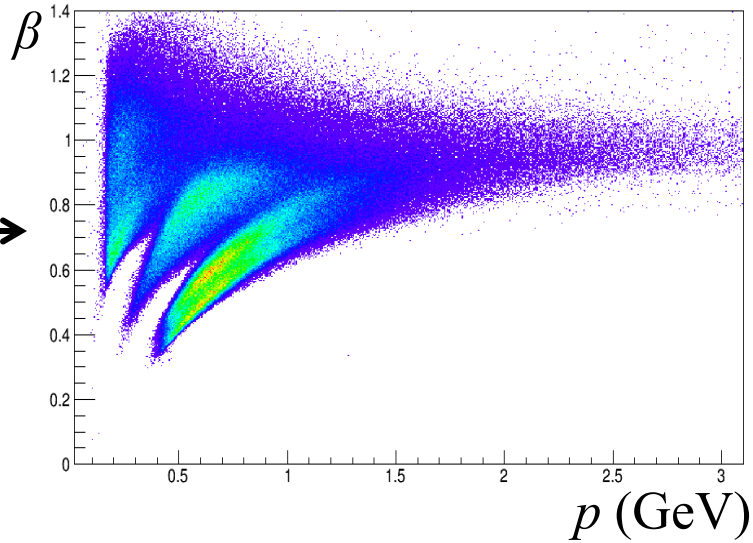


Plots of β vs. p from BCAL only

Start counter for at least one track in event with no FOM cut



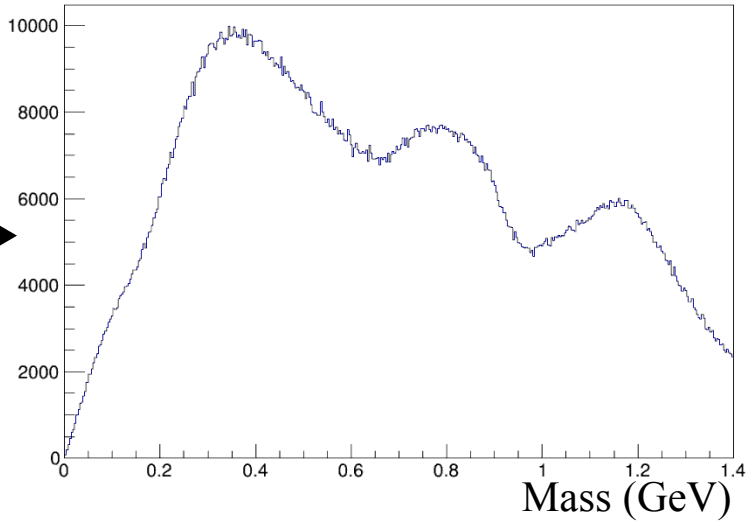
Start counter for at least one track in event with FOM cut



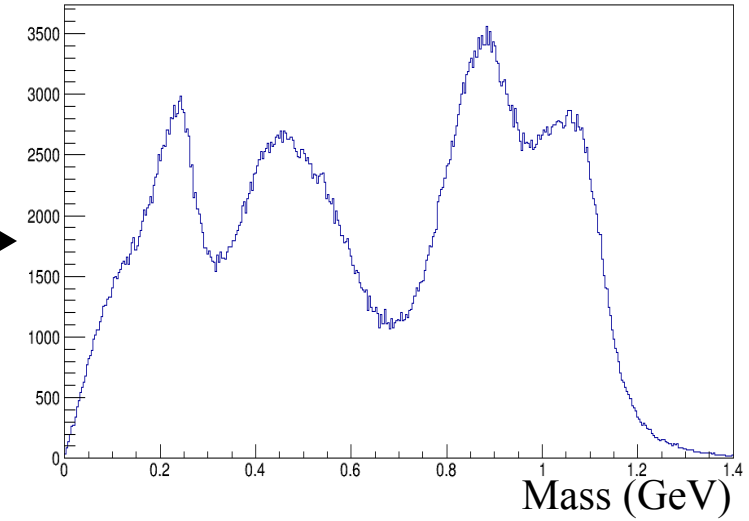
ASU

Mass of charged tracks from BCAL only

Mass from original momentum and measured β_m with no FOM cut



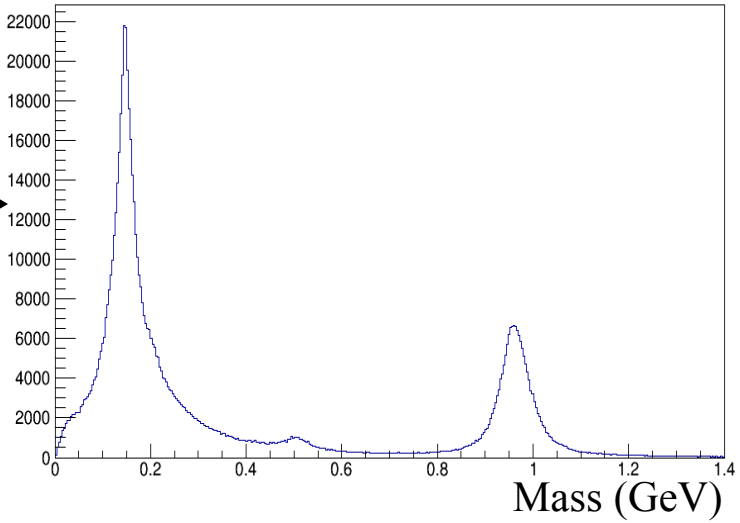
Mass from original momentum and measured β_m with FOM cut of 0.0027



TOF corrections

- Using correction method discussed in previous talk

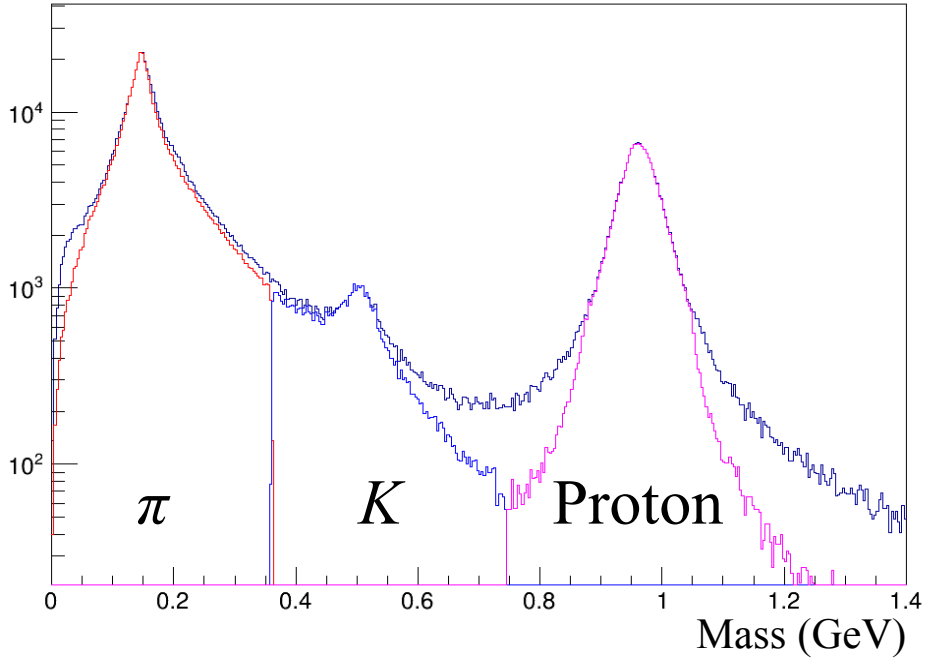
Mass when β_m has corrected time (β'_m)



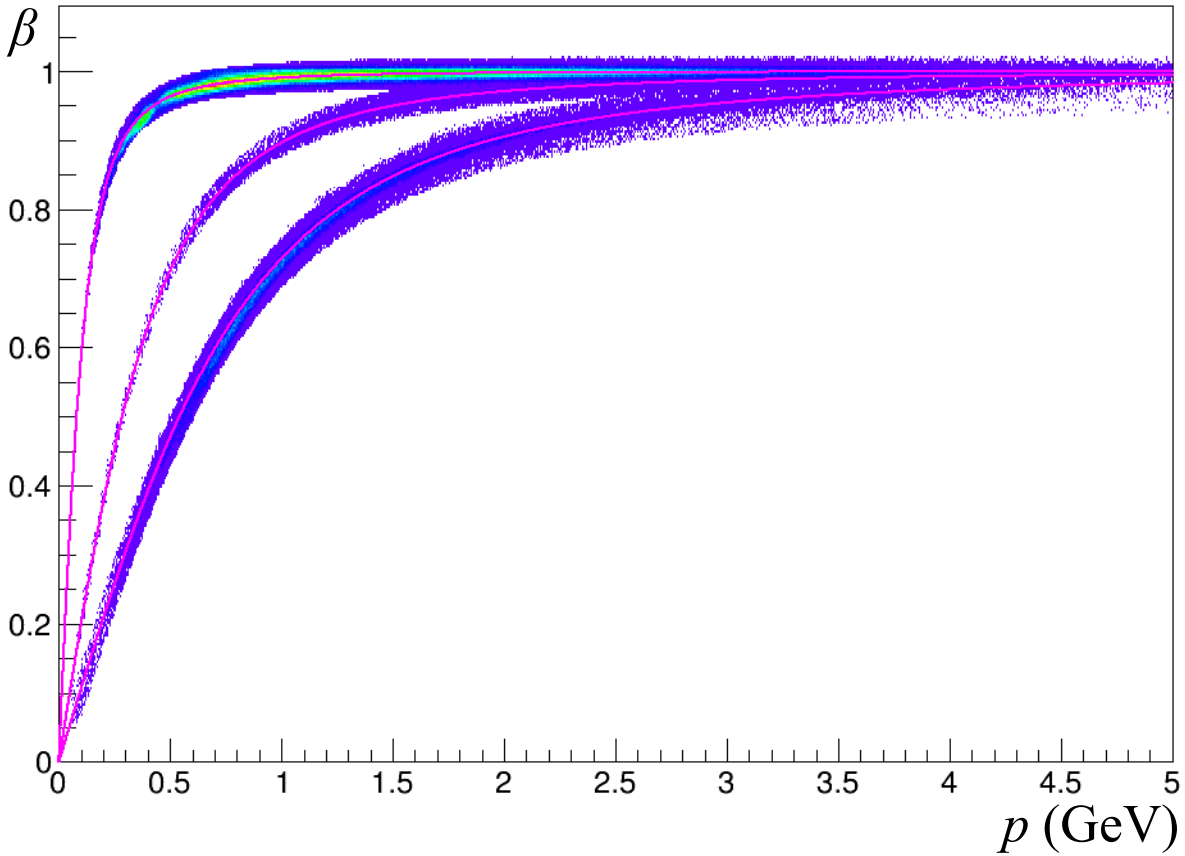
rePID

- 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 3 σ, set particle to Unknown

Particle	$\beta_c - \beta'_m$	σ
p	7.47×10^{-3}	1.19×10^{-2}
π^+	2.30×10^{-4}	6.84×10^{-3}
π^-	-1.66×10^{-4}	6.94×10^{-3}
K^+	-2.87×10^{-4}	6.82×10^{-3}
K^-	-1.25×10^{-3}	6.86×10^{-3}



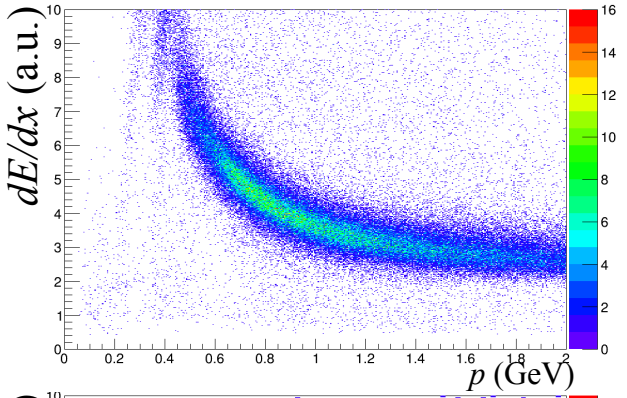
Plots of β vs. p from TOF after rePID



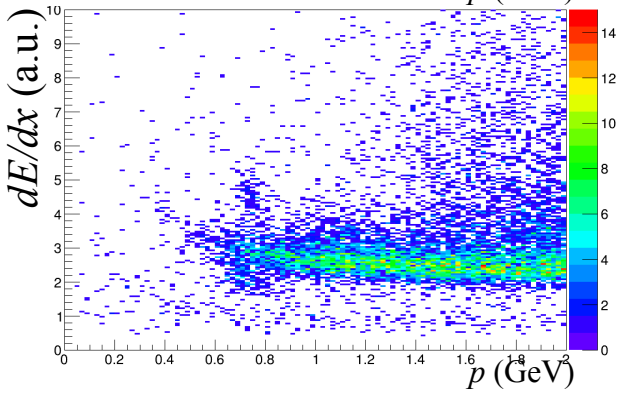
- **Pink lines are β vs. p for fixed mass**

Plots of d*E*/d*x* from TOF after rePID

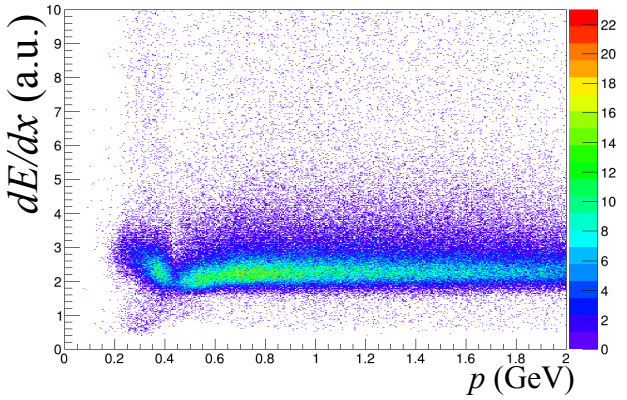
Proton rePID →



K^+ rePID →

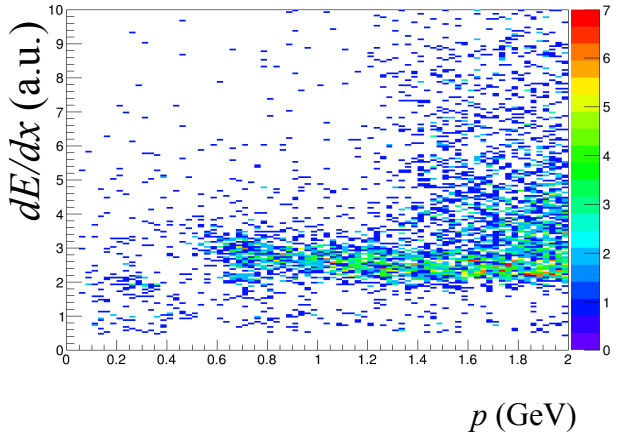


π^+ rePID →

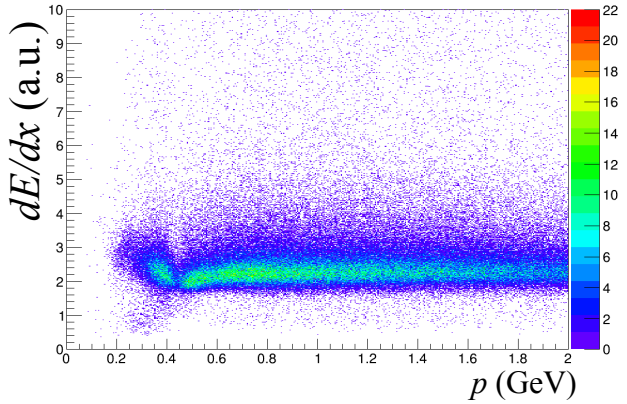


Plots of d*E*/d*x* from TOF after rePID cont.

K^- rePID

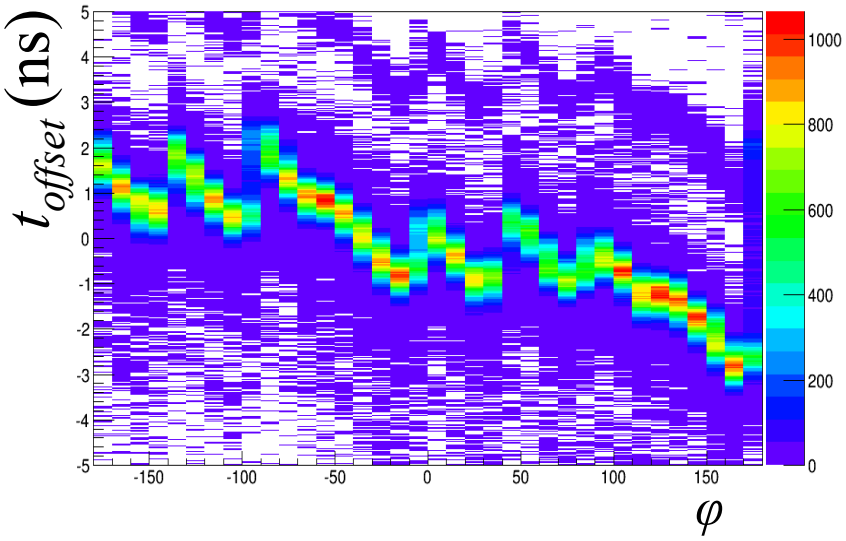


π^- rePID



Time offset BCAL only tracks

- Looked at negative tracks
- 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

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

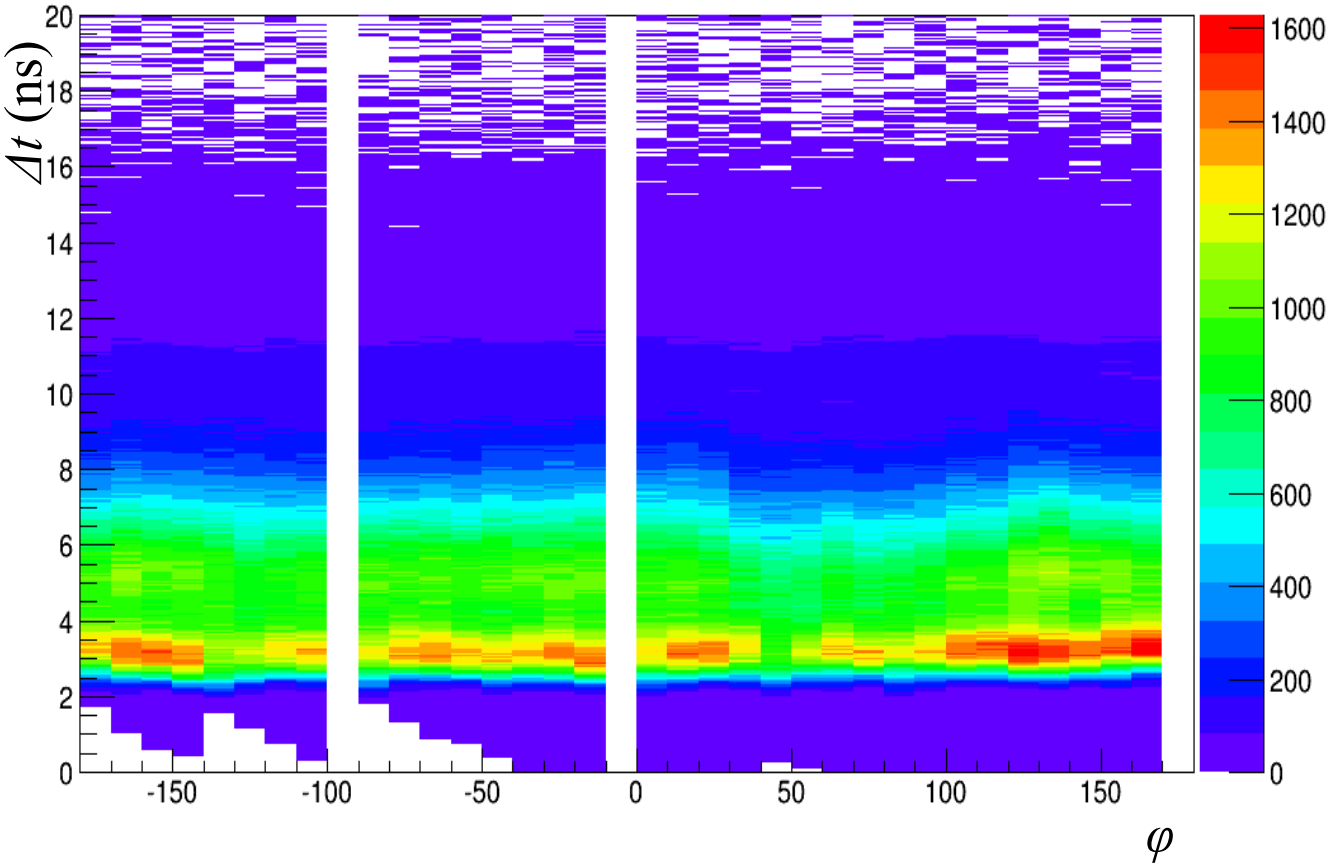
So that

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

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

- Ignore corrections to bins 9, 17, and 36 or -100° to -90°, -10° to 0°, and 350° to 360°, respectively, due to multiple peaks

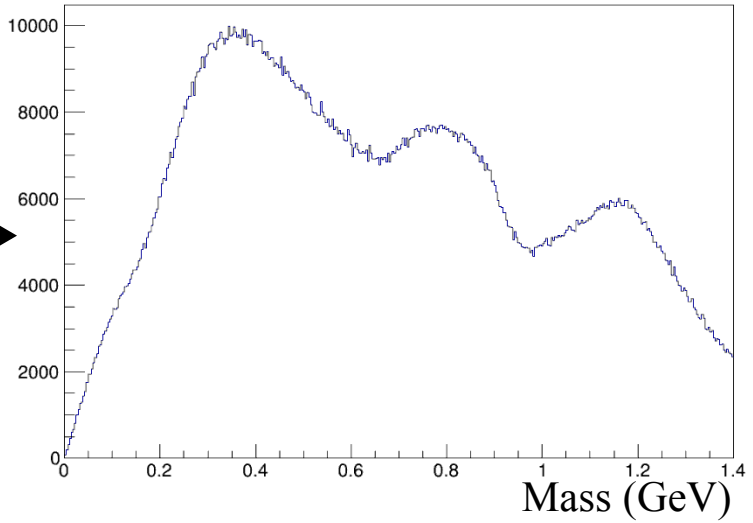
Plot of flight time vs. φ for BCAL only tracks corrected



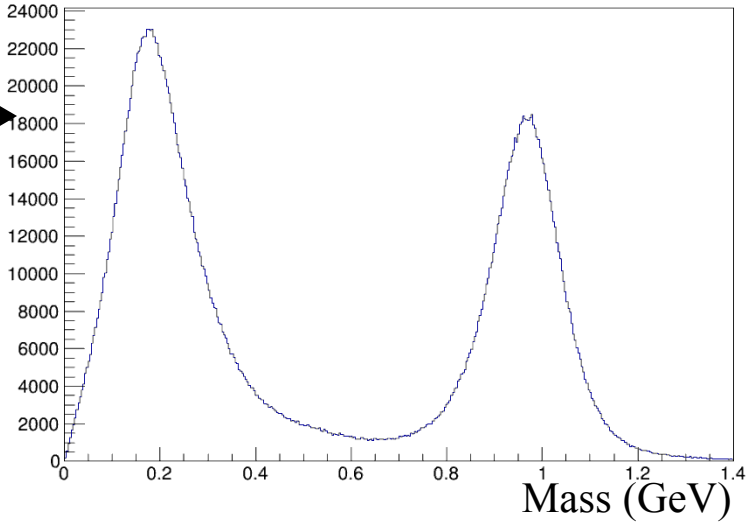
- Remember ignoring 3 bins

Mass of charged tracks

Mass from original momentum and measured β_m



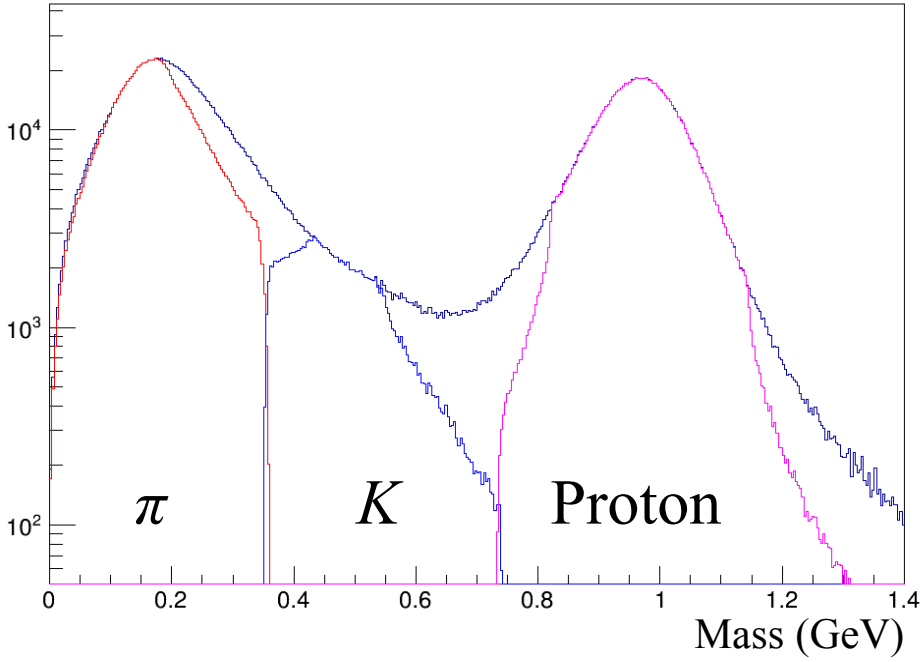
Mass when β_m has corrected time (β'_m)



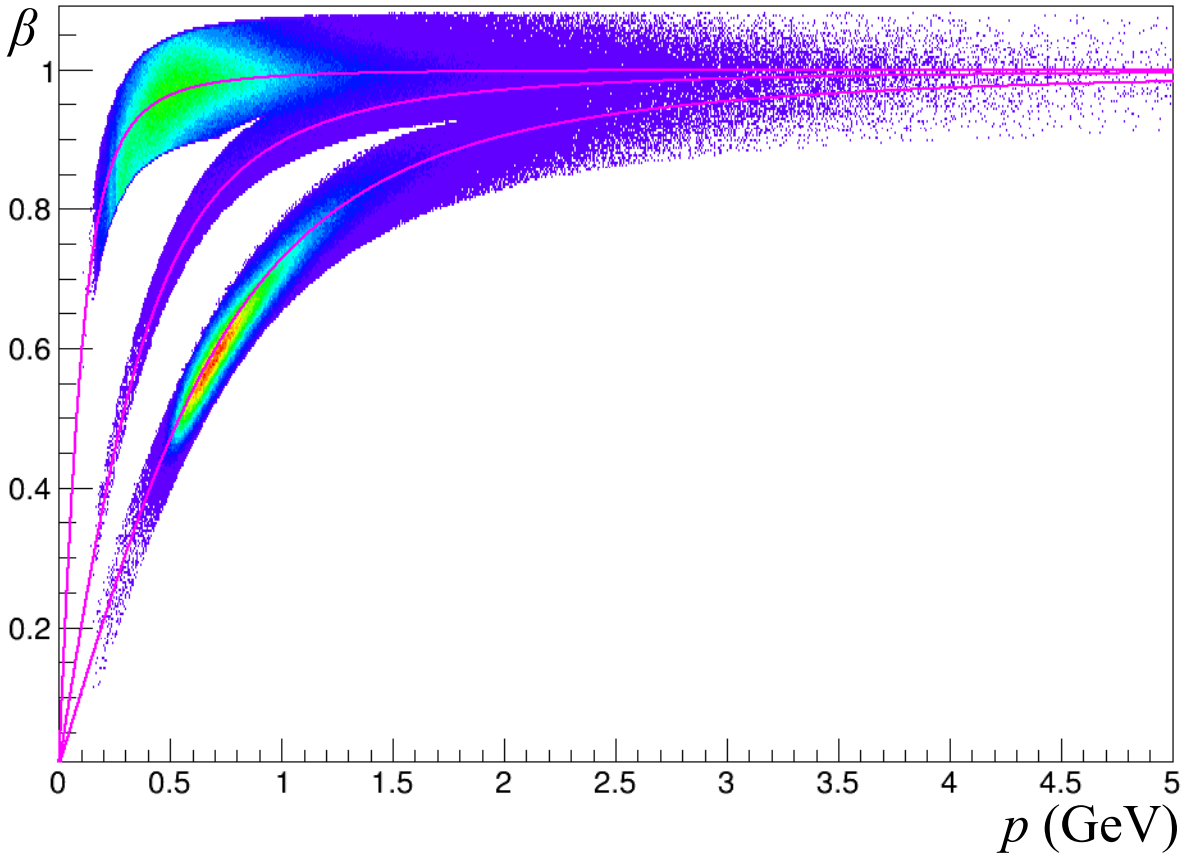
rePID

- 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 3 σ, set particle to Unknown

Particle	$\beta_c - \beta'_m$	σ
p	1.25×10^{-3}	2.13×10^{-2}
π^+	-5.38×10^{-4}	2.64×10^{-2}
π^-	-1.46×10^{-3}	2.71×10^{-2}
K^+	-7.43×10^{-3}	1.43×10^{-2}
K^-	-1.05×10^{-2}	1.36×10^{-2}



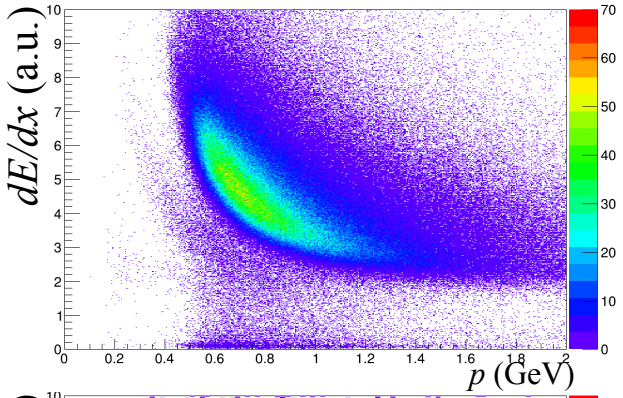
Plots of β vs. p from TOF after rePID



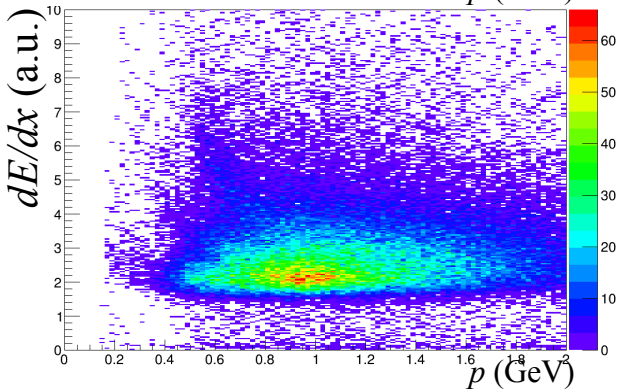
- **Pink lines are β vs. p for fixed mass**

Plots of d*E*/d*x* from BCAL after rePID

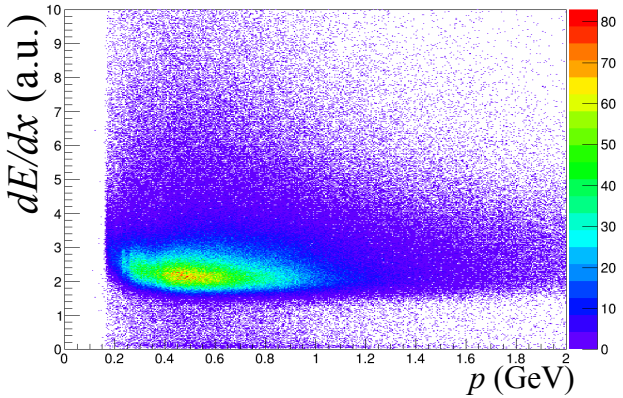
Proton rePID →



K^+ rePID →

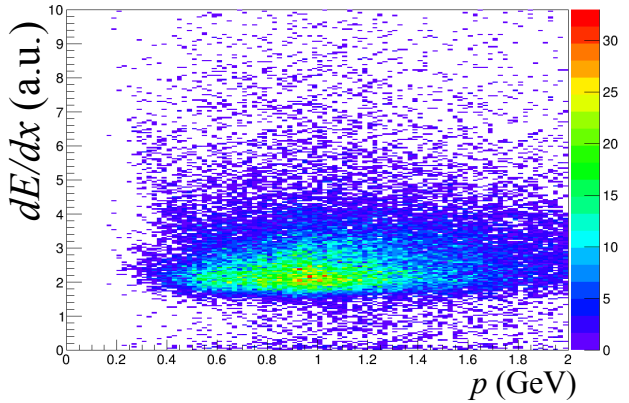


π^+ rePID →

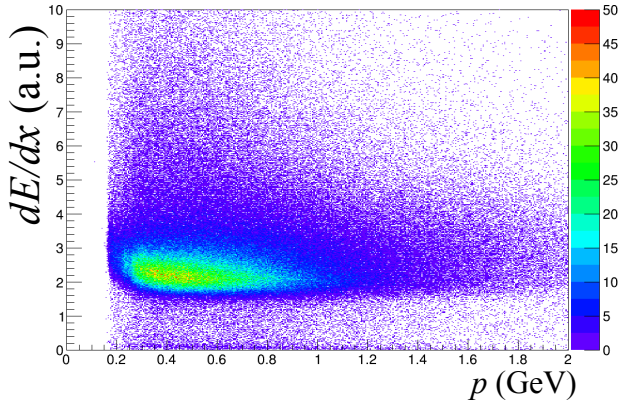


Plots of d*E*d*x* from BCAL after rePID cont.

K^- rePID



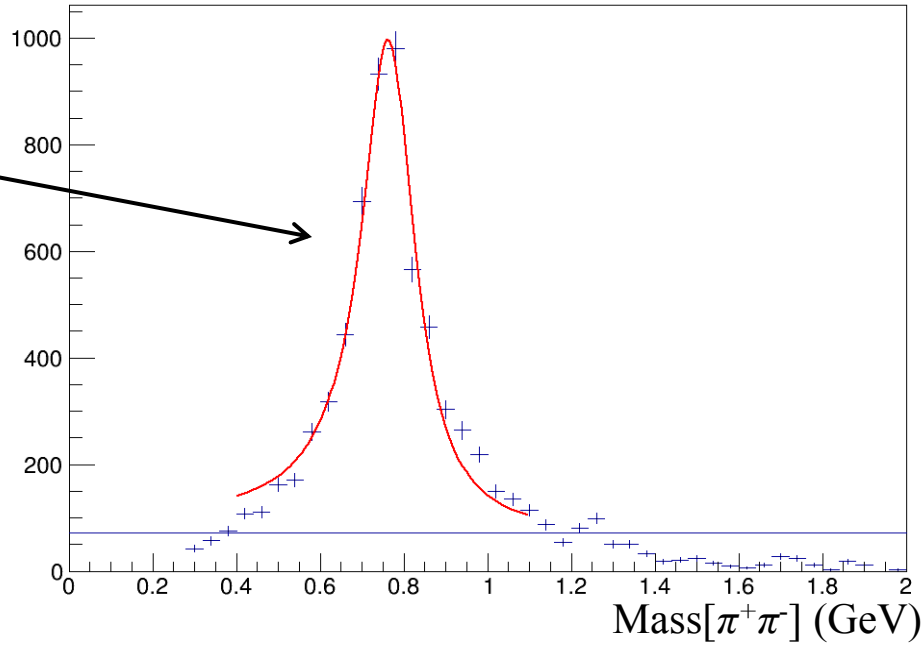
π^- rePID



- Better timing resolution would help with the ID, as shown in TOF plots

Invariant mass $\pi^+\pi^-$

Reconstructed ρ^0

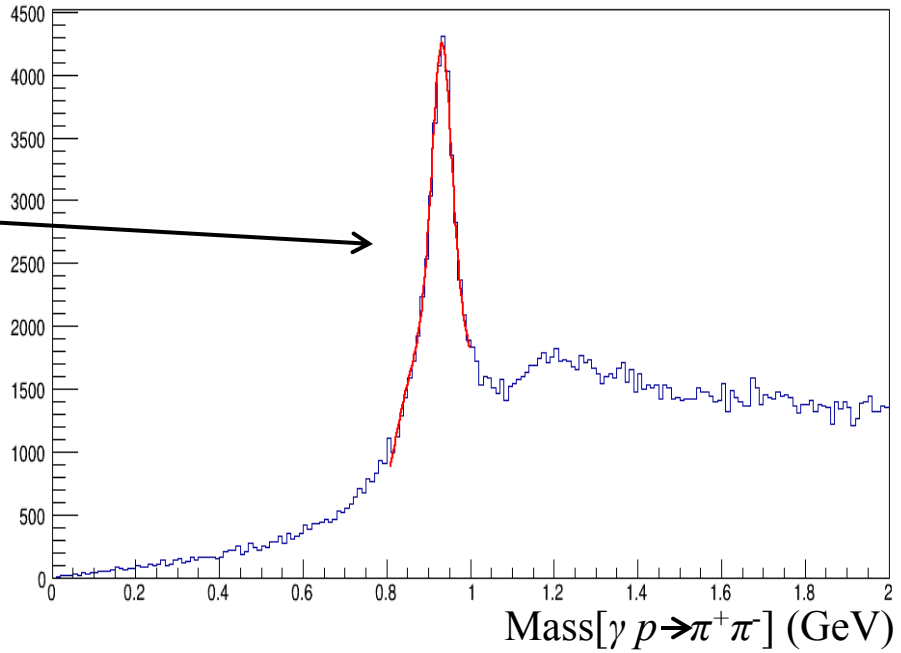


Center: 763.88 + - 1.68

Width: 156.75 + - 6.41

Missing mass $\gamma\, p \rightarrow \pi^{+}\pi^{-}$

Missing p

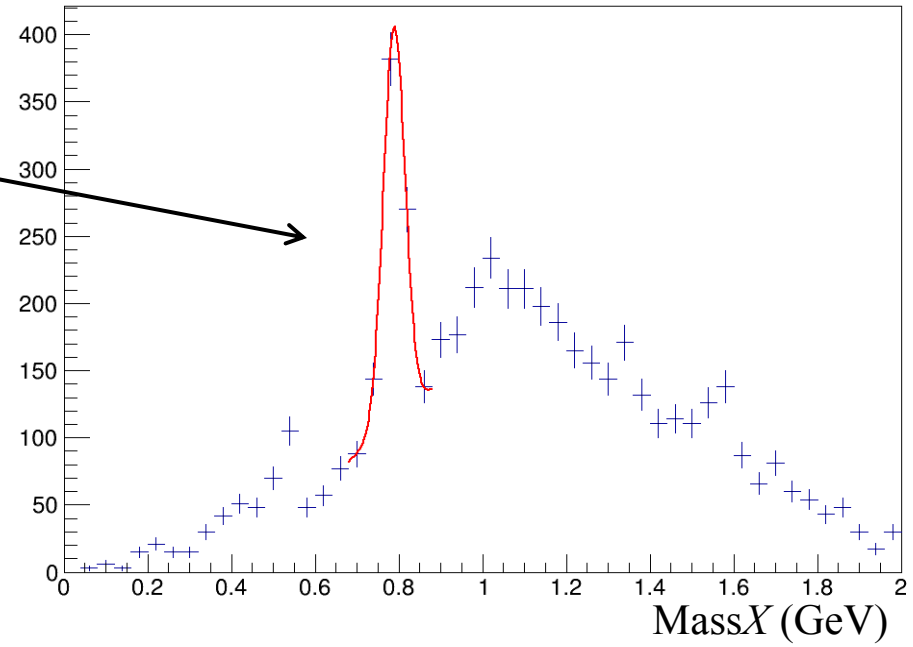


Center: 932.78 + - 0.44

Sigma: 23.00 + - 0.54

Mass of ω

Reconstructed ω^0

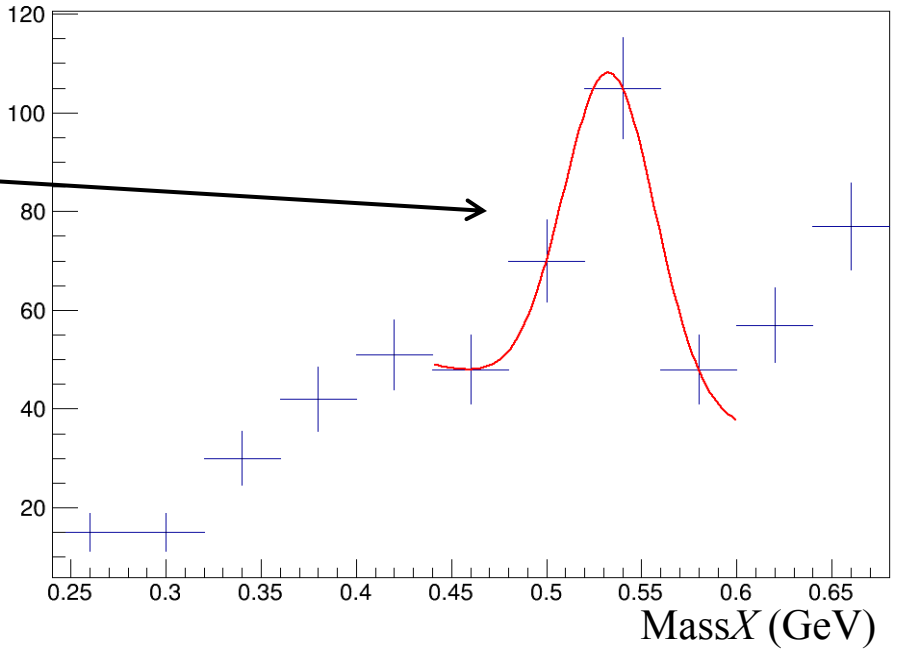


Center: 789.97 + - 2.03
Sigma: 25.93 + - 2.14

- π^0 selected from missing mass of $\gamma\, p \longrightarrow p\, X$ where X has been identified as $\pi^+\pi^-(\pi^0)$

Mass of η

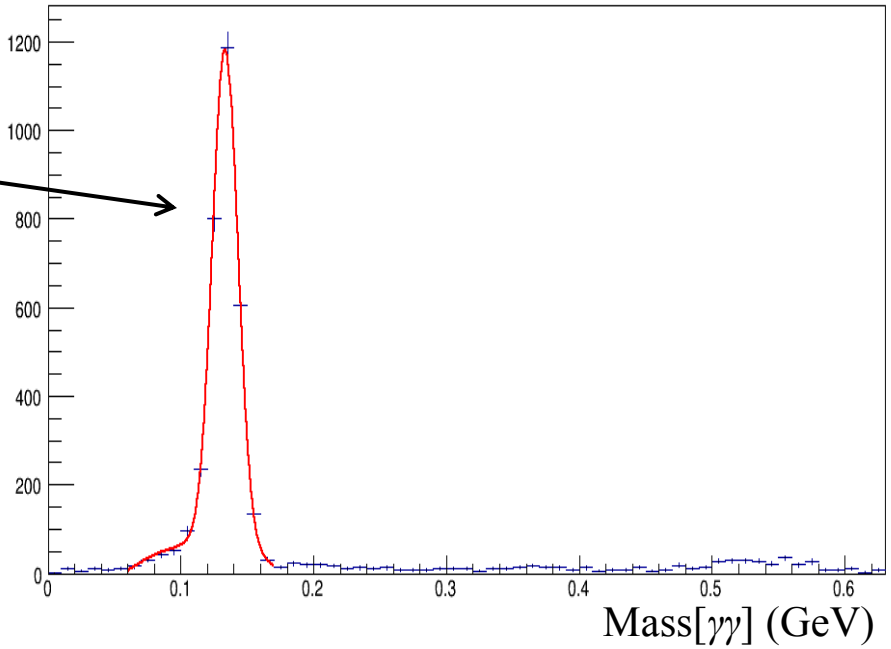
Reconstructed η^0



- π^0 selected from missing mass of $\gamma\, p \longrightarrow p\, X$ where X has been identified as $\pi^+\pi^-\,(\pi^0)$

Invariant mass of $\gamma\gamma$ for $\gamma\, p \longrightarrow \quad p\, \gamma\gamma$

Reconstructed π^0

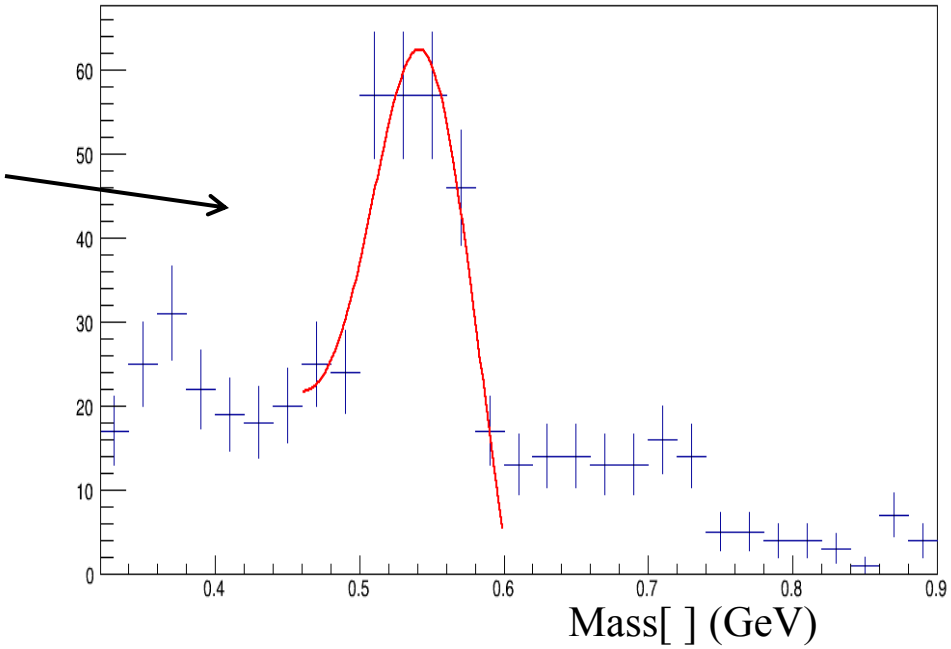


Center: 133.65 + - .22
Sigma: 9.60 + - .20

- $\gamma\gamma$ coming from NeutralParticleHypothesis PID with best FOM and cuts on FCAL and BCAL Justin defined at the last meeting

Invariant mass of $\gamma\gamma$ for $\gamma\, p \longrightarrow \quad p\, \gamma\gamma$

Reconstructed η^0



Center: 546.68 + - 13.11
Sigma: 36.67 + - 15.50

- $\gamma\gamma$ coming from NeutralParticleHypothesis PID with best FOM and cuts on FCAL and BCAL Justin defined at the last meeting

Title