

Proton ID performance with $\Lambda^0 \rightarrow p\pi$

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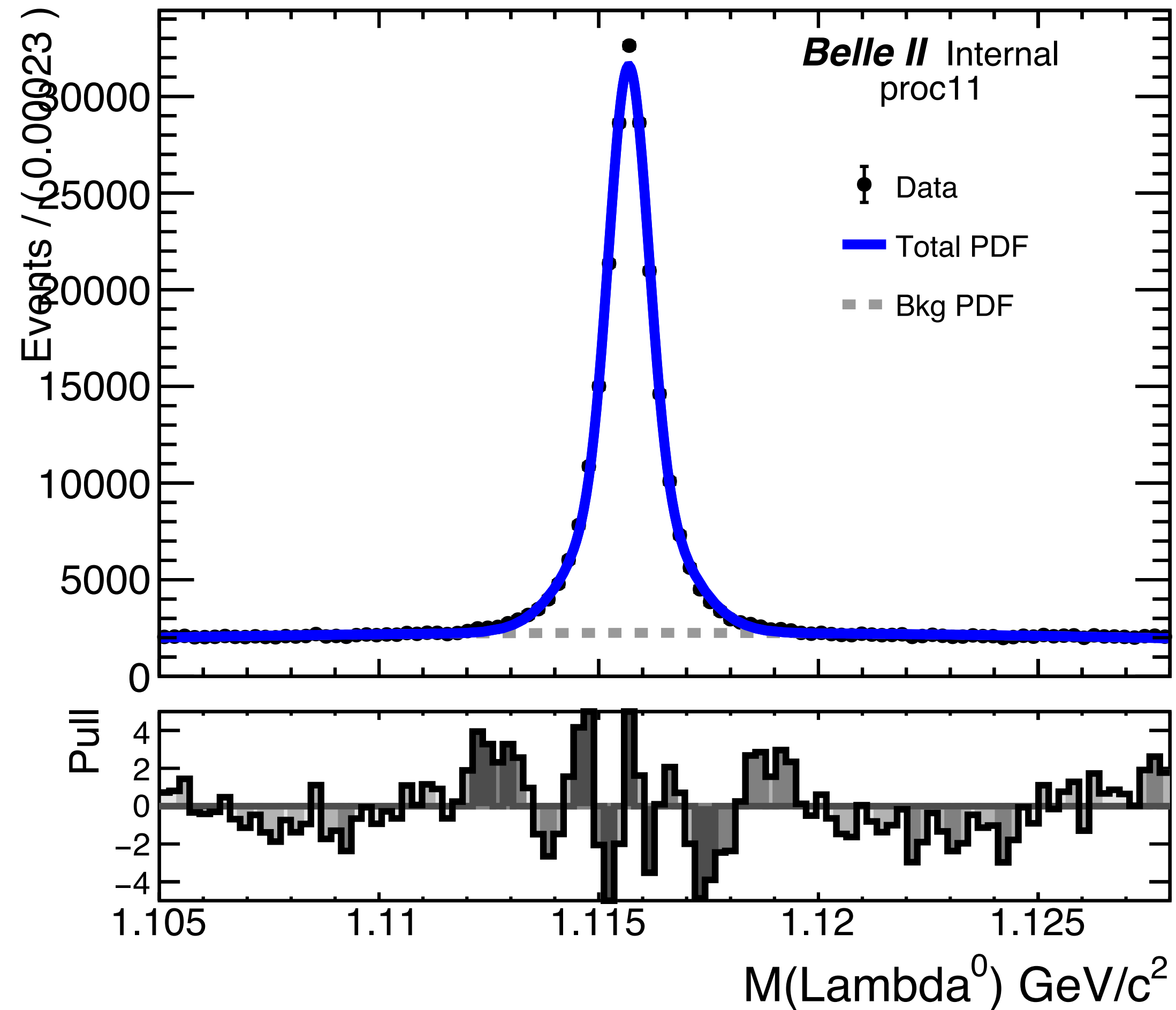
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Motivation

- Incorporate proton corrections using inclusive $\Lambda^0 \rightarrow p\pi$ decays into the systematics framework
 - Automates the calculation of correction factors and hopefully systematic uncertainties
 - Uses the sPlot technique, extracting sWeights from invariant mass fits and adding them to ntuple files
- Requirements
 - Systematics skims for $\Lambda^0 \rightarrow p\pi$ (centrally produced, perhaps during processing)
 - Incorporate additional skimming as well as pdf model for fitting into the systematics framework
 - Validate the performance of sWeights relative to MC truth matching
 - Test grid production - done by Sviat for proc12 and prompt systematic skims
 - Determine correction factors for proton ID
- Also check the performance of proton PID in release-05 (proc12, MC14) and release-04 (proc11, MC13)
 - In particular, proton efficiency for TOP and CDC

Systematic framework run for D^* and Λ^0



Model: Lambda0

$$F_s = 0.46 \pm 0.01$$

$$N_{\text{bkg}} = 216390.47 \pm 645.37$$

$$c_0 = -0.01 \pm 0.0$$

$$c_1 = -0.06 \pm 0.0$$

$$\mu = 1.12 \pm 0.0$$

$$\sigma_1 = 0.0 \pm 0.0$$

$$\sigma_2 = 0.0 \pm 0.0$$

$$N_{\text{sig}} = 195509.36 \pm 629.0$$

Fit

$$\text{Status} = 0 \quad \chi^2 = 4.16$$

$$\text{EDM: } 8.779\text{e-}04 \quad \text{Covariance quality: } 3$$

Covariance matrix for sWeights:

$$244088.50 \quad -48566.13$$

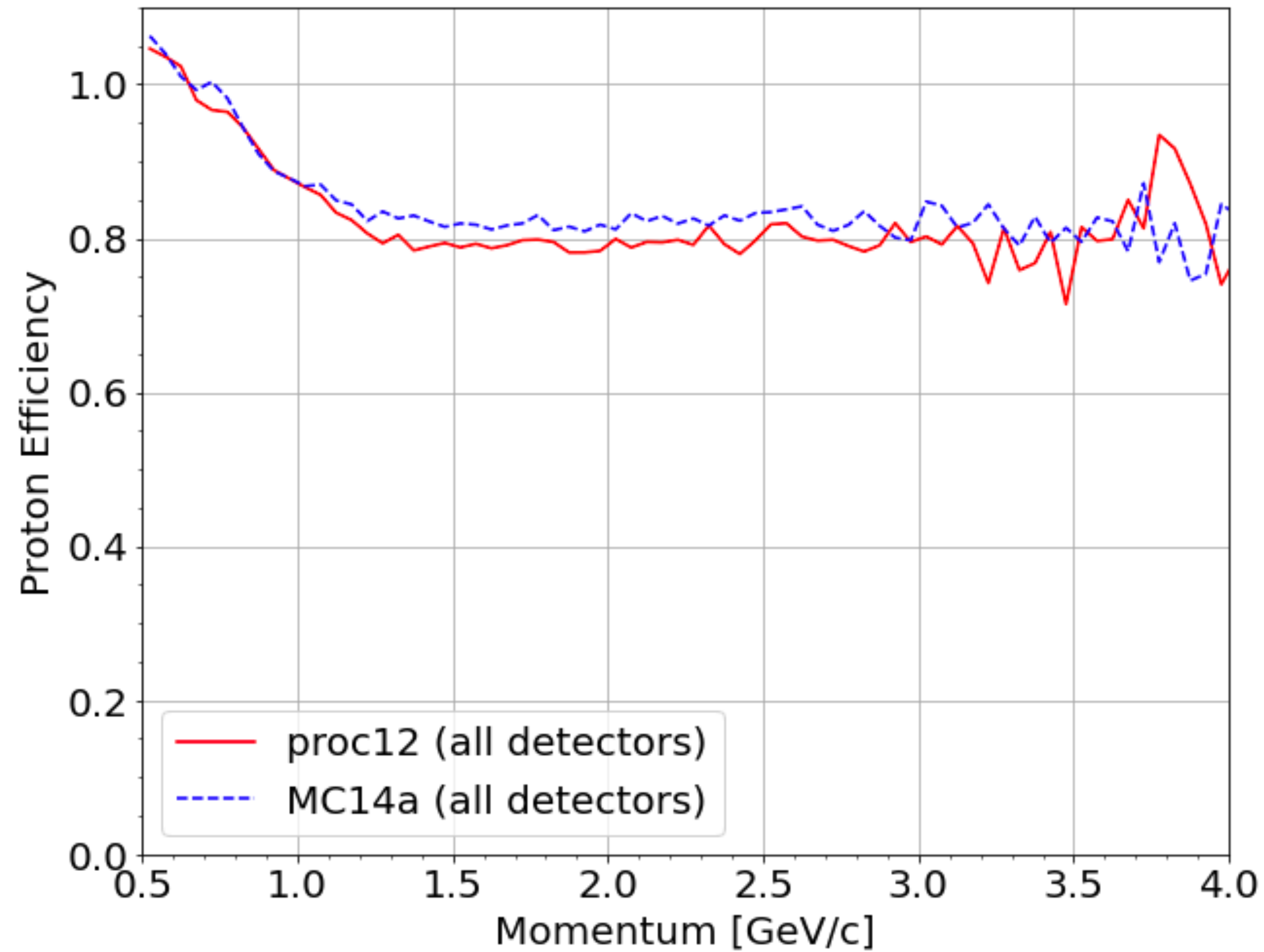
$$-48566.13 \quad 264967.15$$

Proton PID performance

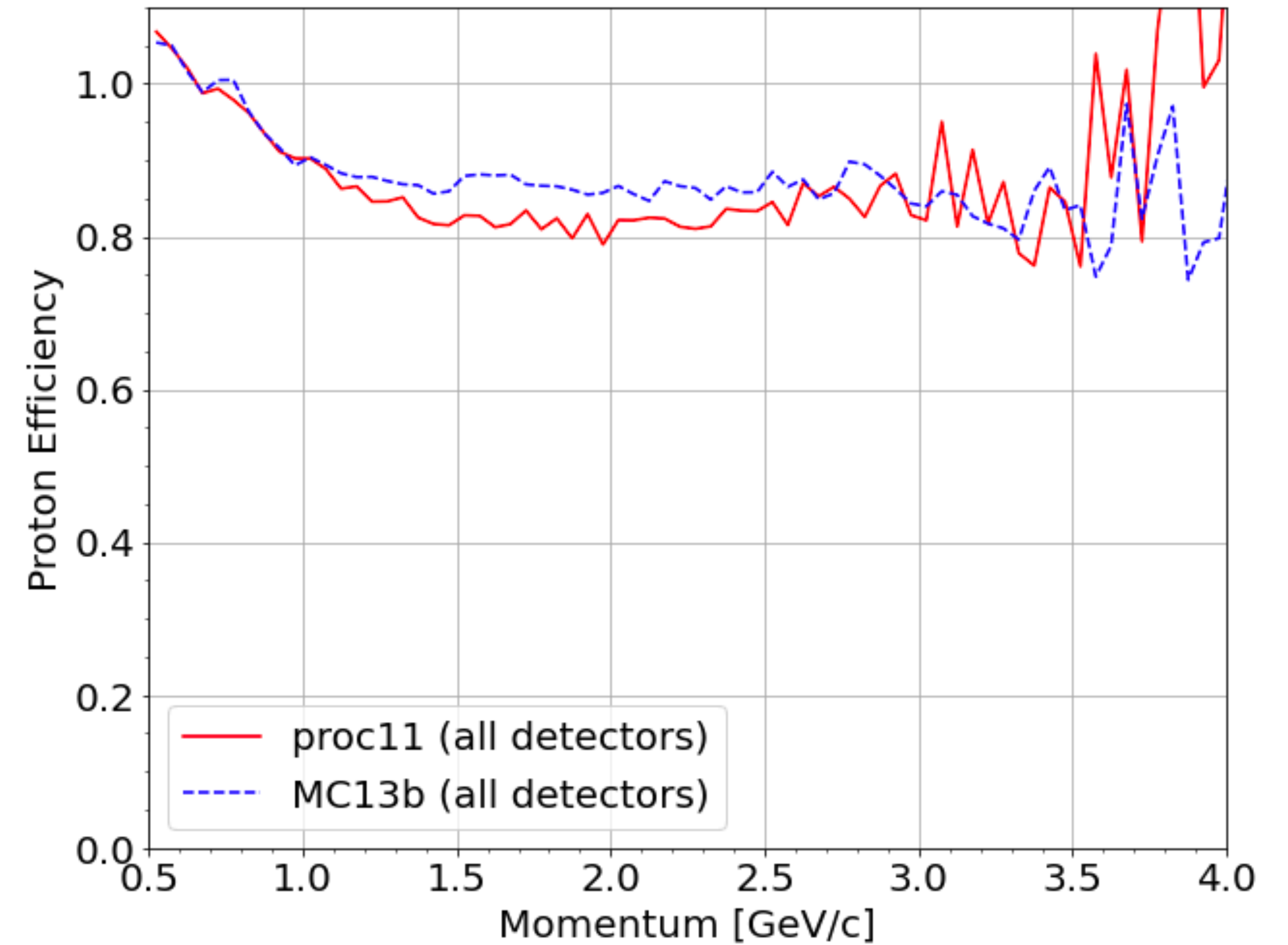
- Global proton PID (all particle types) for all detectors

$$\frac{L(p)}{L(K) + L(\pi) + L(p) + L(d) + L(e) + L(\mu)} > 0.5$$

release-05



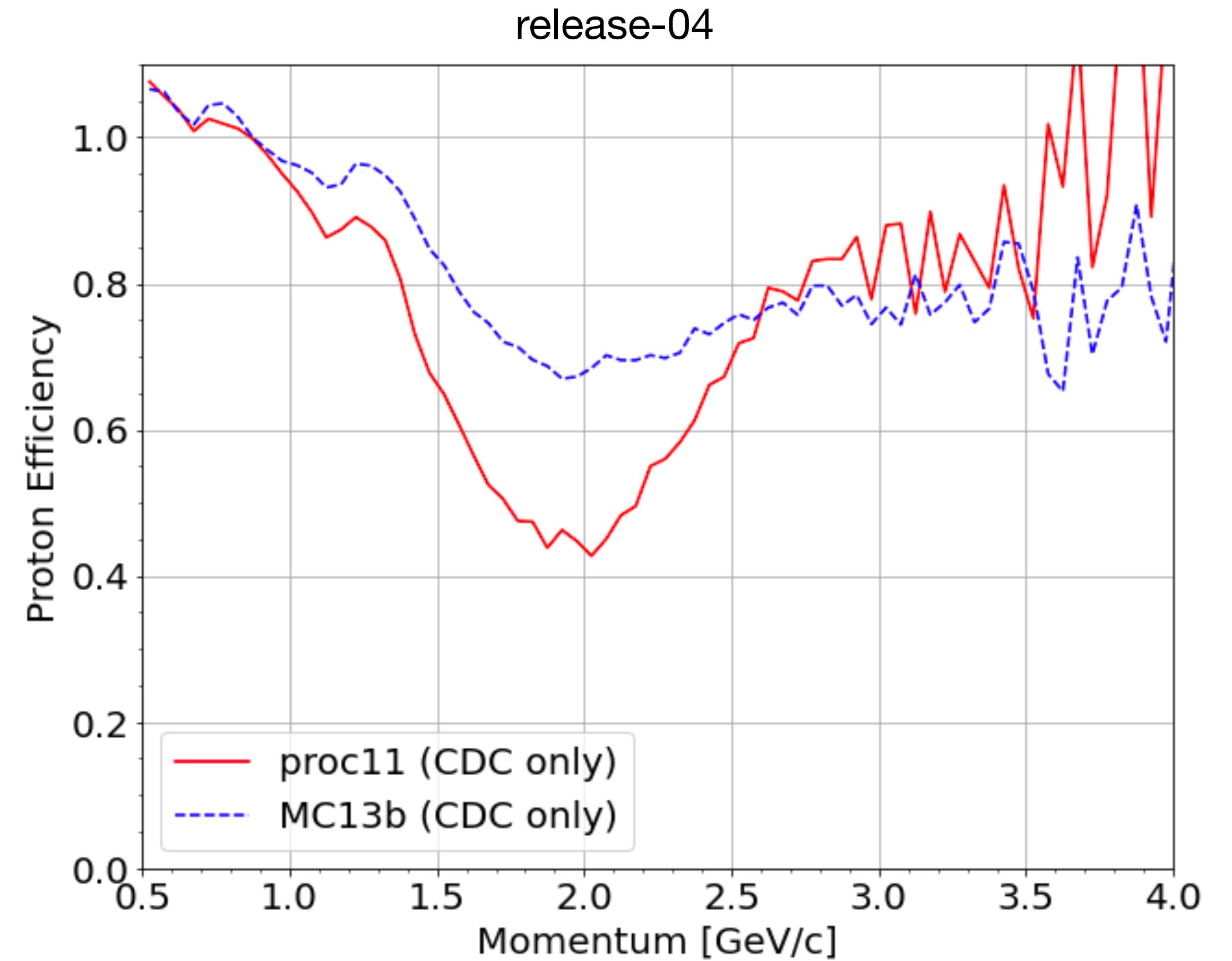
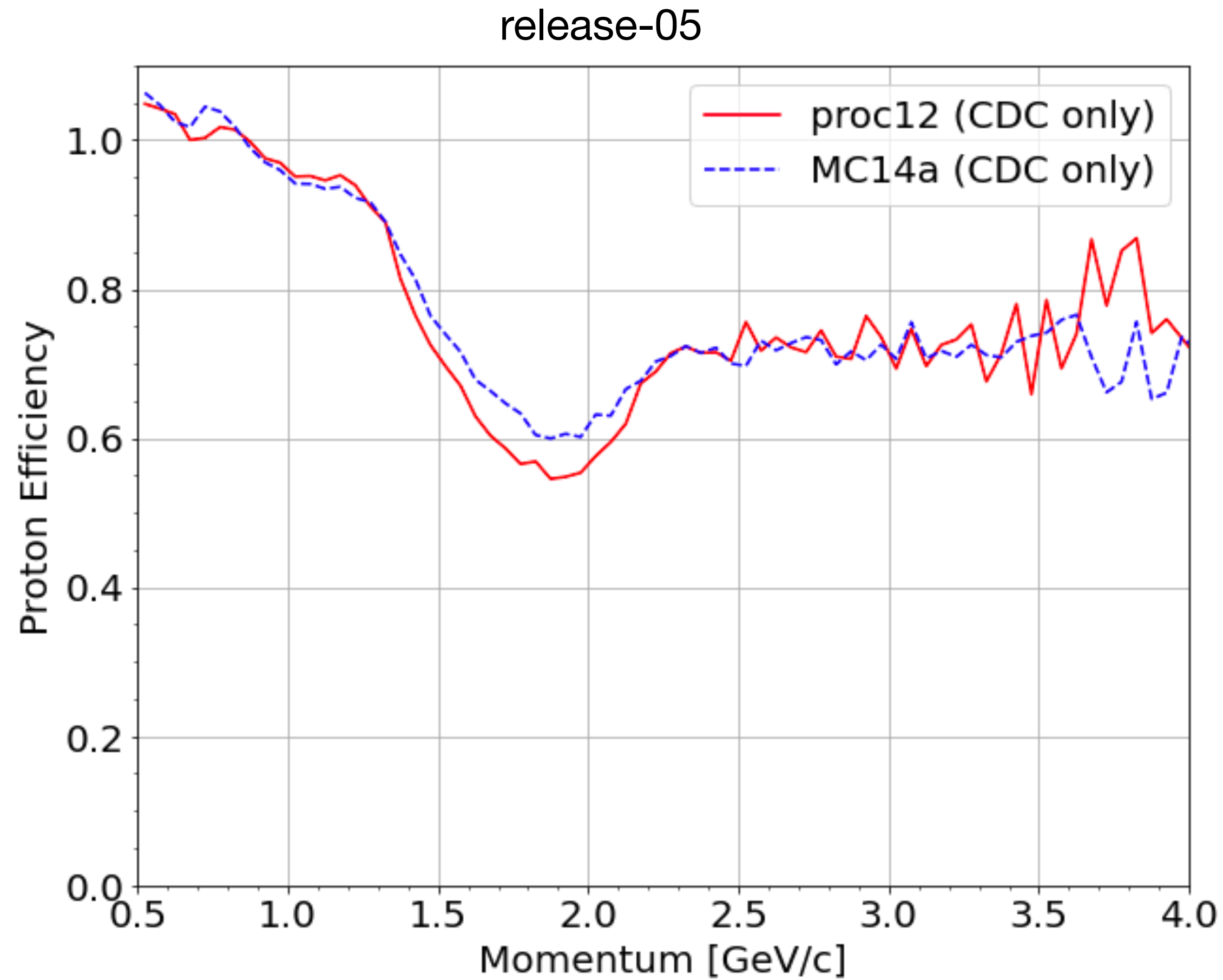
release-04



Proton PID performance in the CDC

- Global proton PID vs. momentum

$$\frac{L(p)}{L(K) + L(\pi) + L(p) + L(d) + L(e) + L(\mu)} > 0.24$$

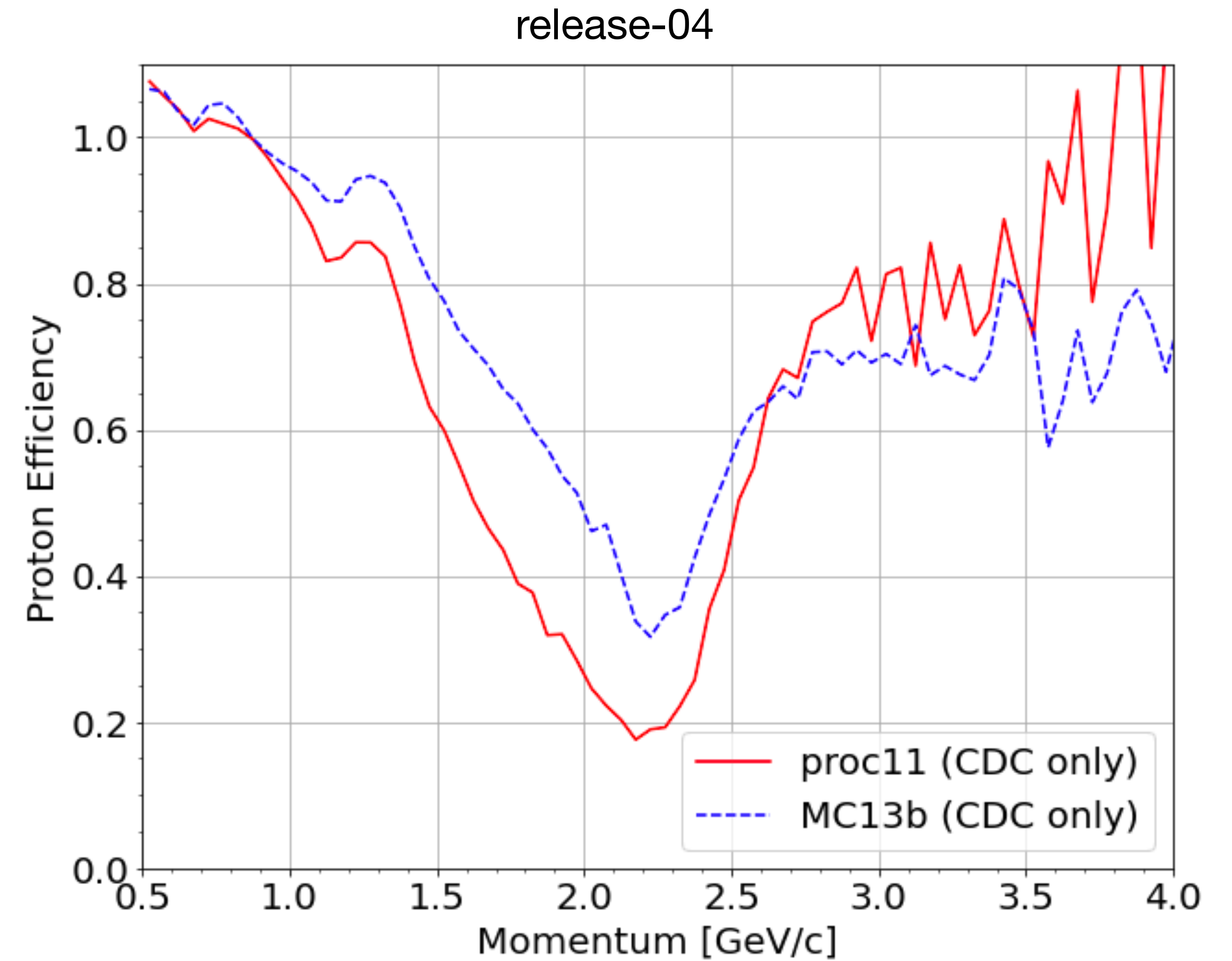
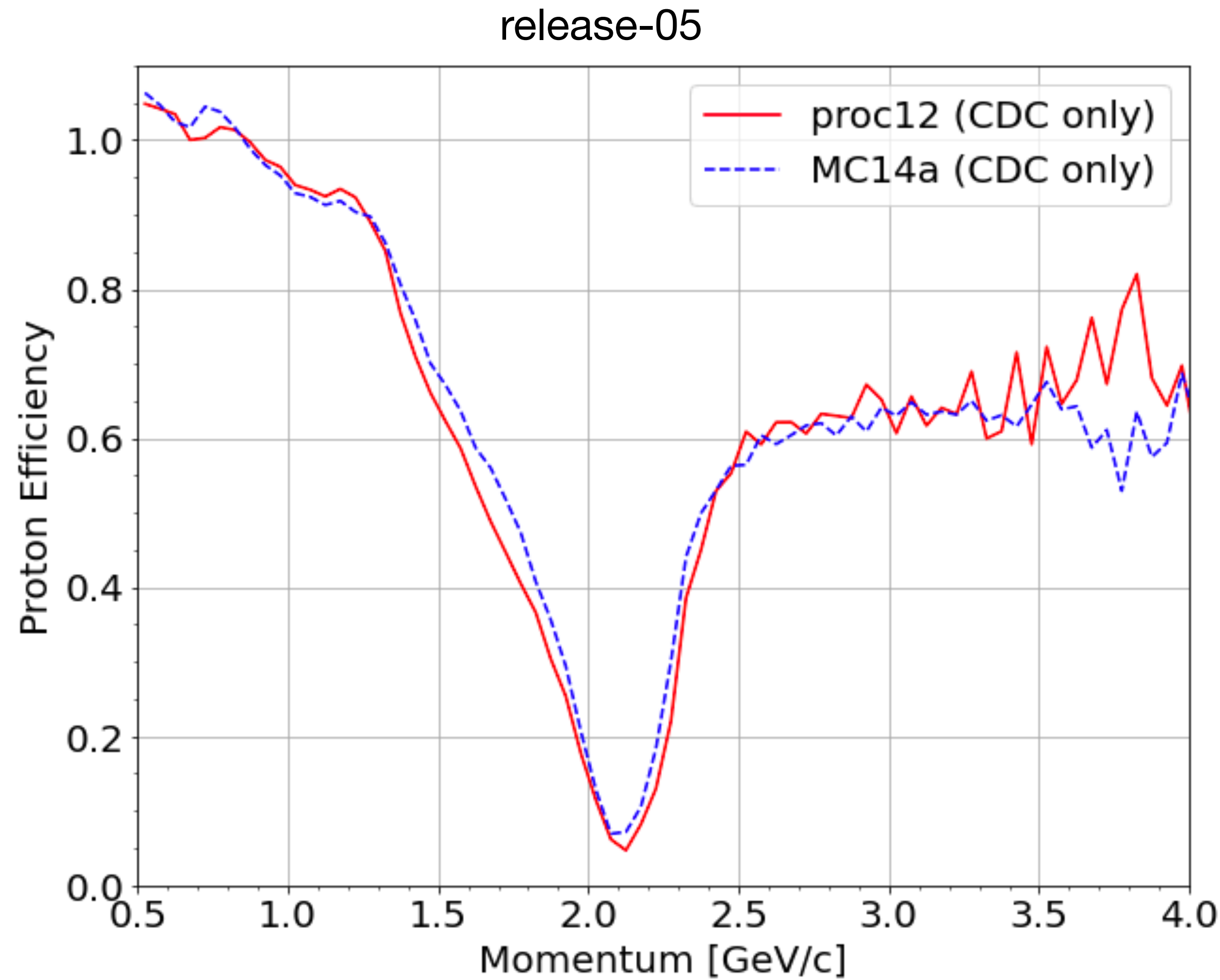


Much better data/MC agreement for CDC proton PID in release-05

Proton PID performance in the CDC

- Global proton PID vs. momentum

$$\frac{L(p)}{L(K) + L(\pi) + L(p) + L(d) + L(e) + L(\mu)} > 0.28$$

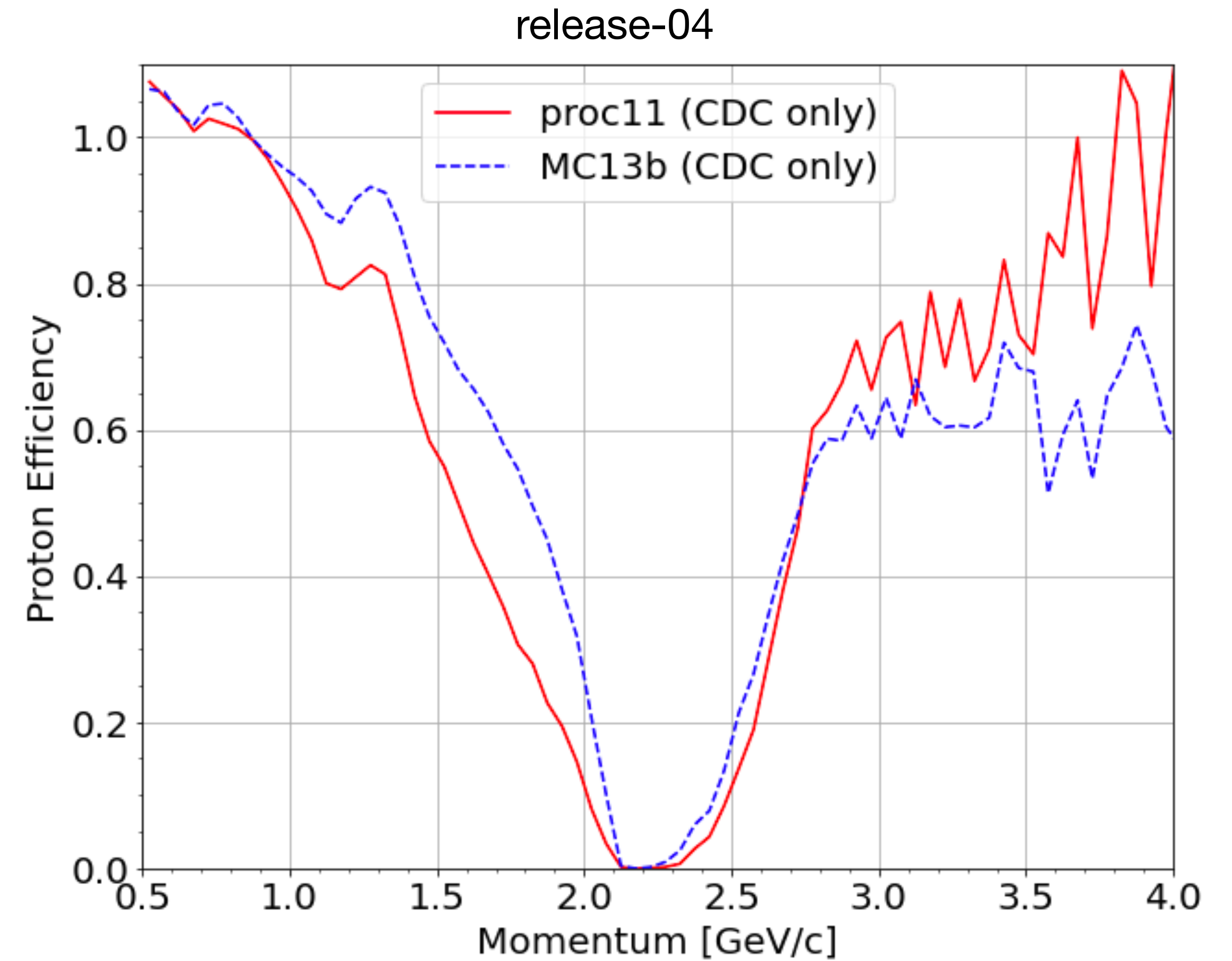
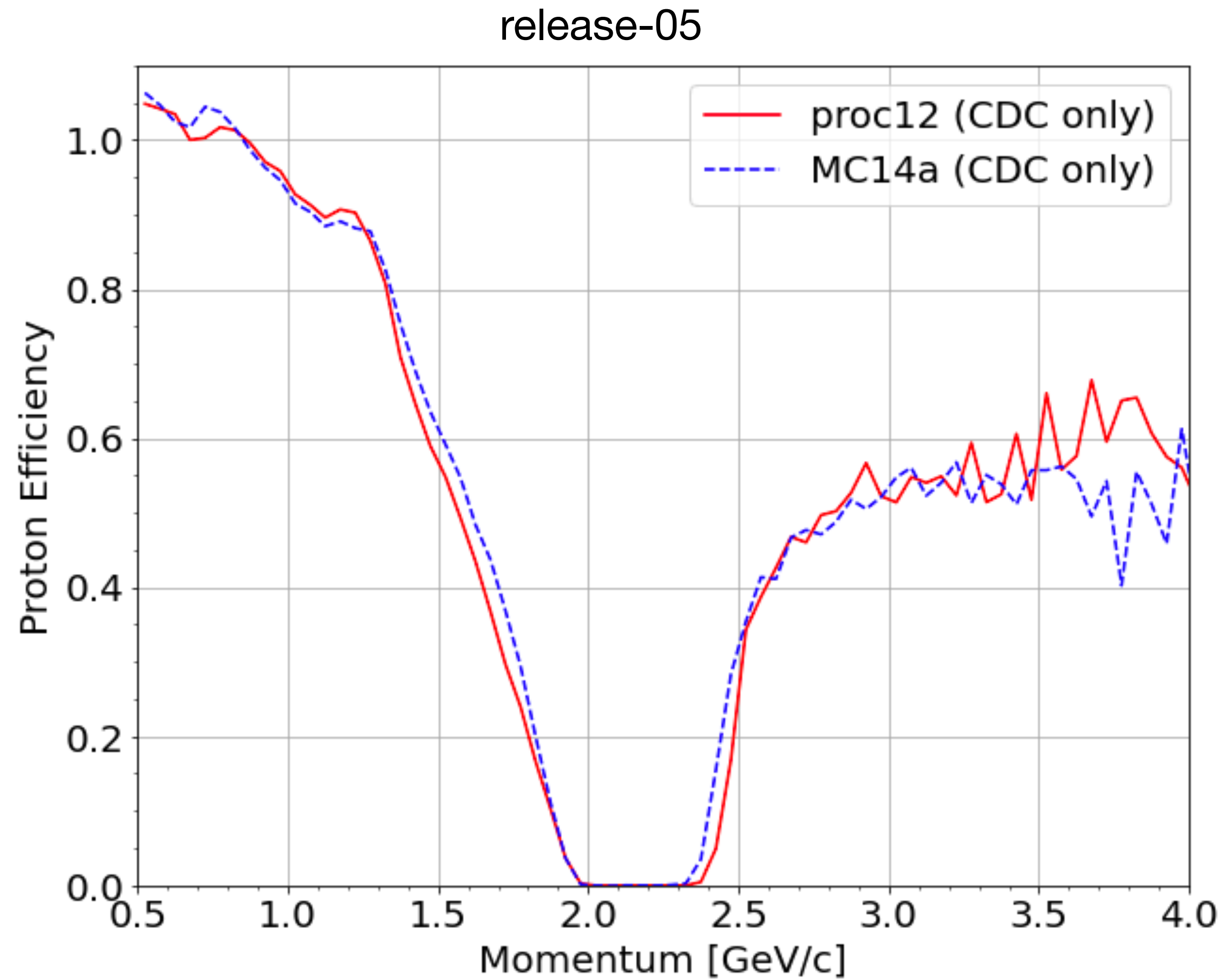


Much better data/MC agreement for CDC proton PID in release-05

Proton PID performance in the CDC

- Global proton PID vs. momentum

$$\frac{L(p)}{L(K) + L(\pi) + L(p) + L(d) + L(e) + L(\mu)} > 0.32$$



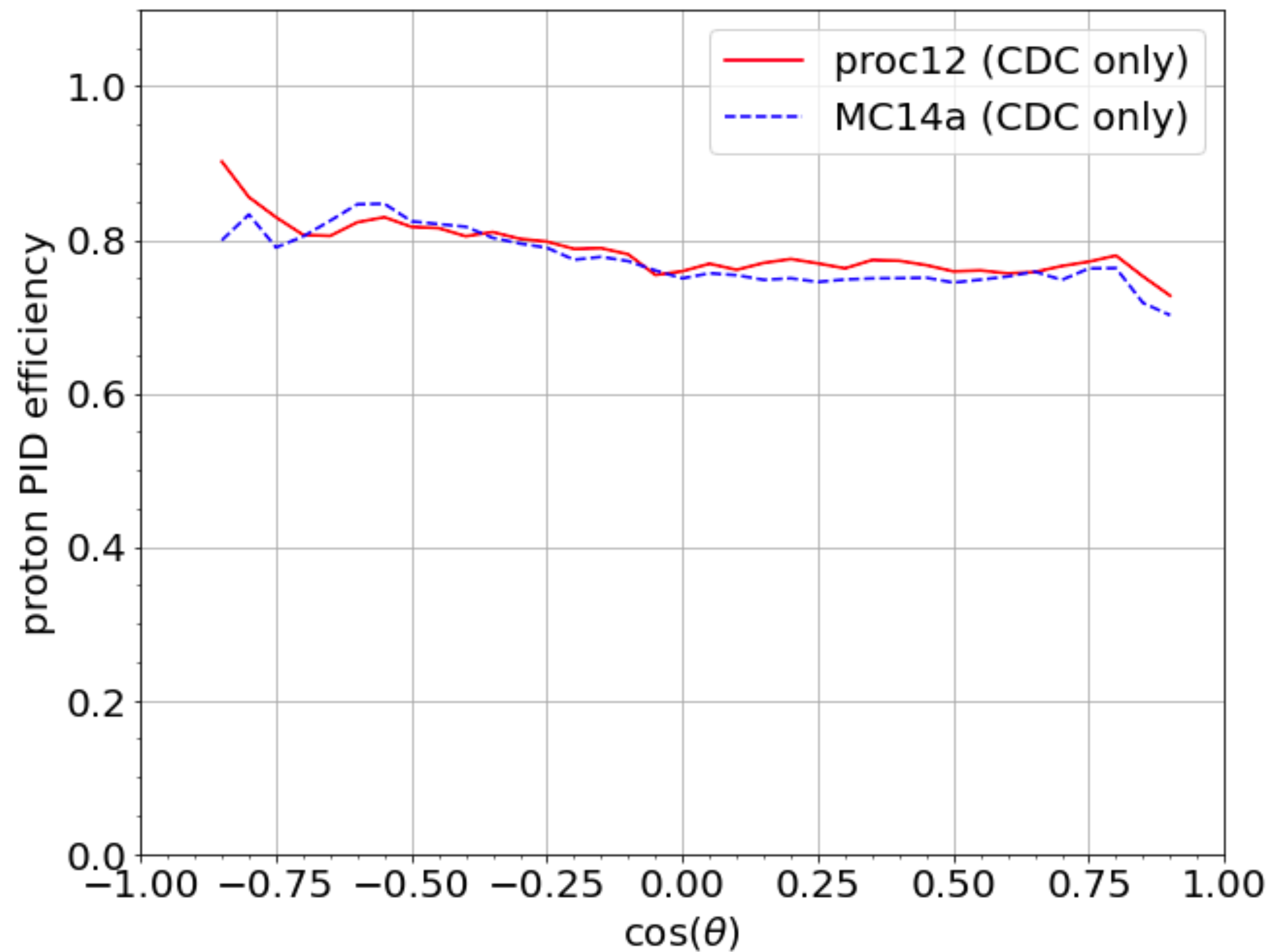
Much better data/MC agreement for CDC proton PID in release-05

Proton PID performance in the CDC

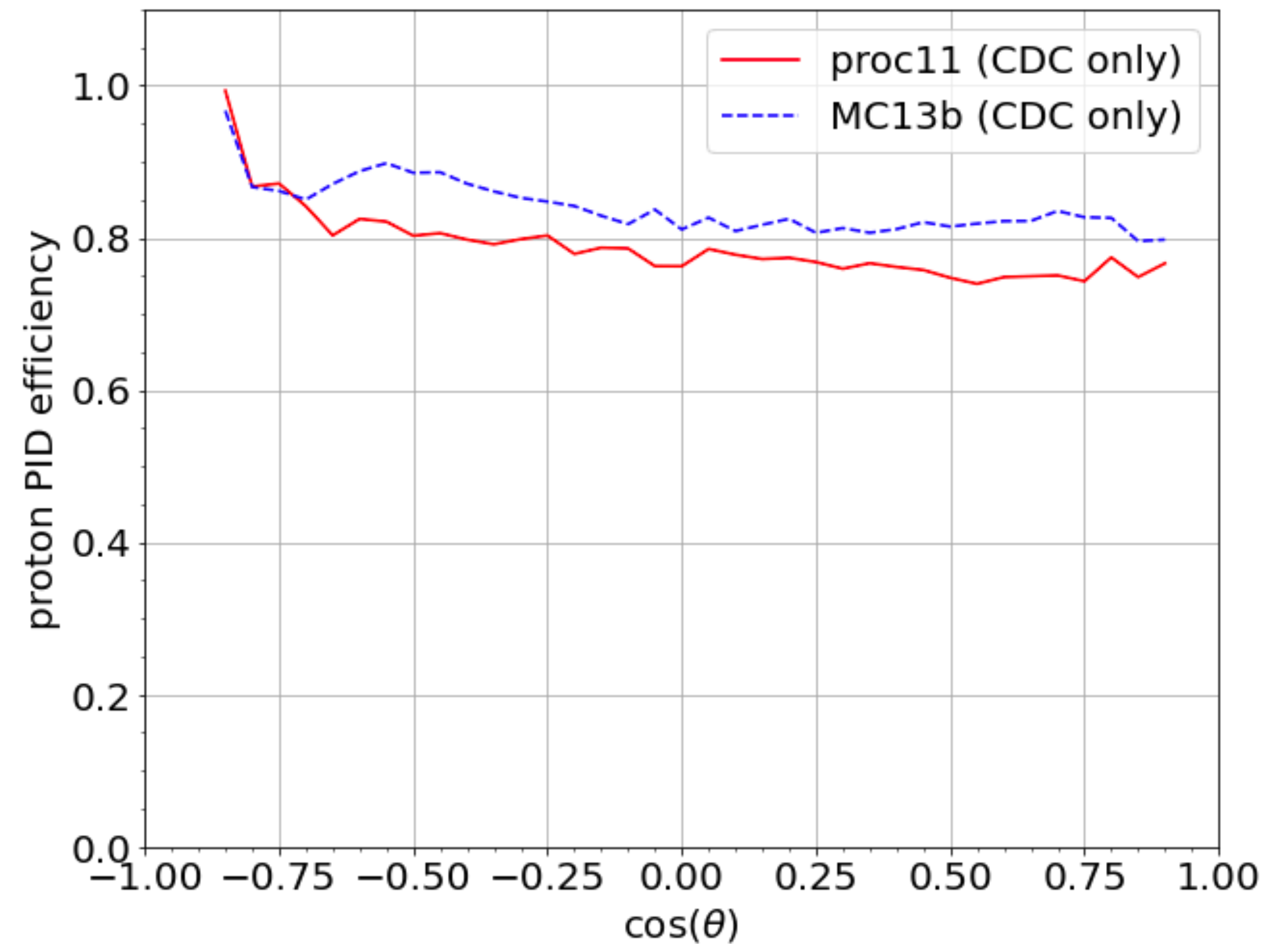
- Global proton PID vs. $\cos(\theta)$

$$\frac{L(p)}{L(K) + L(\pi) + L(p) + L(d) + L(e) + L(\mu)} > 0.28$$

release-05



release-04

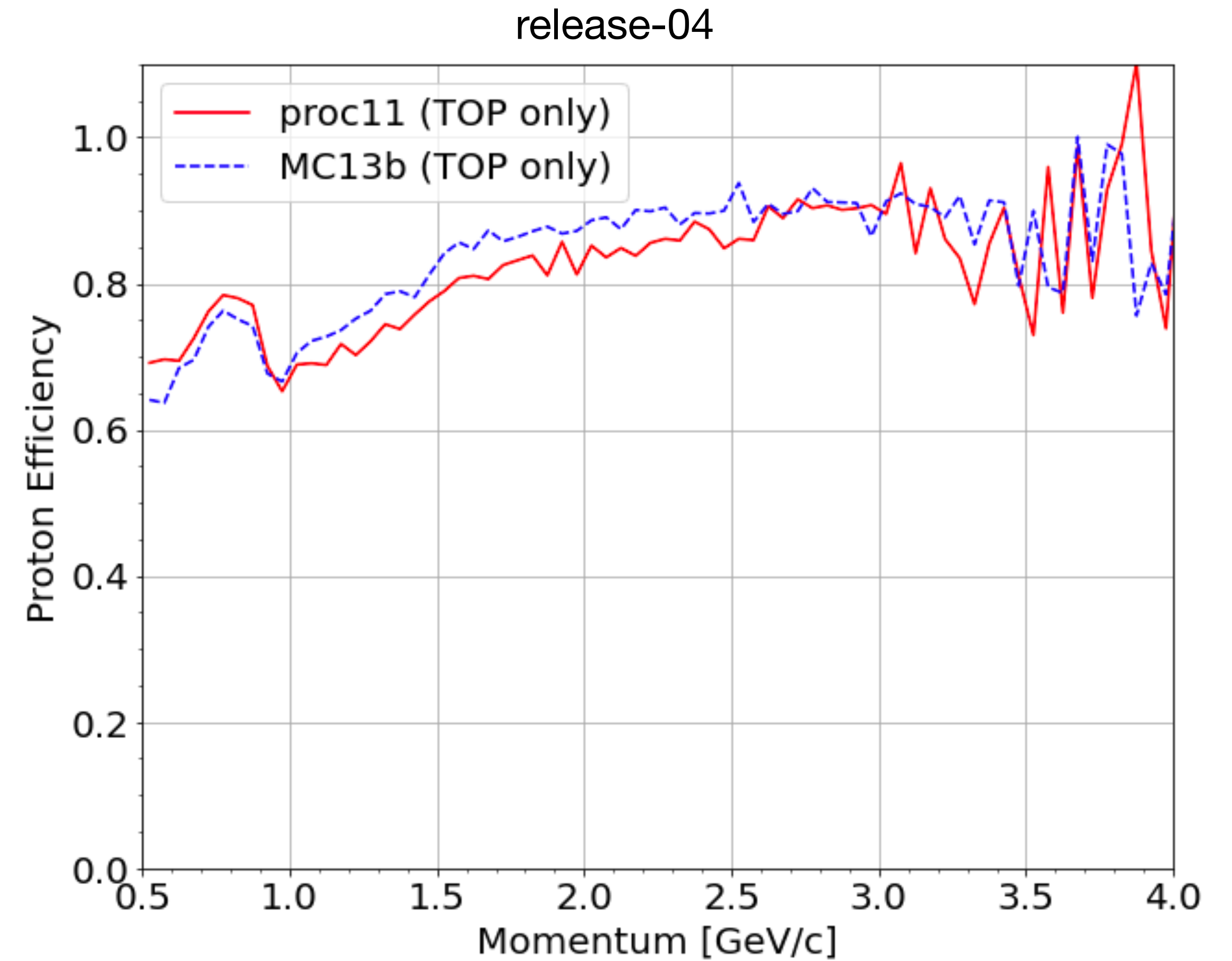
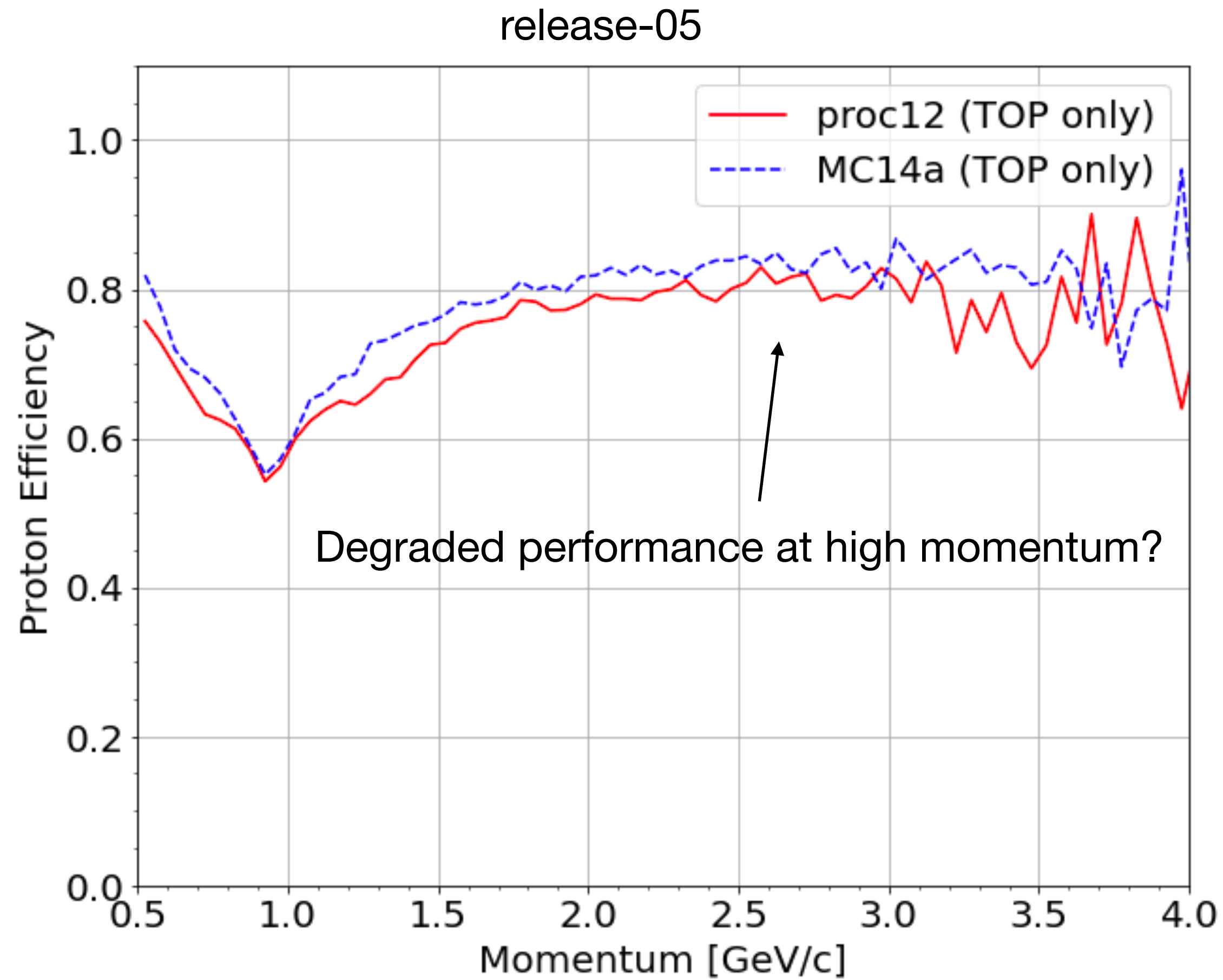


Much better data/MC agreement for CDC proton PID in release-05

Proton PID performance in the TOP

- Global proton PID vs. momentum

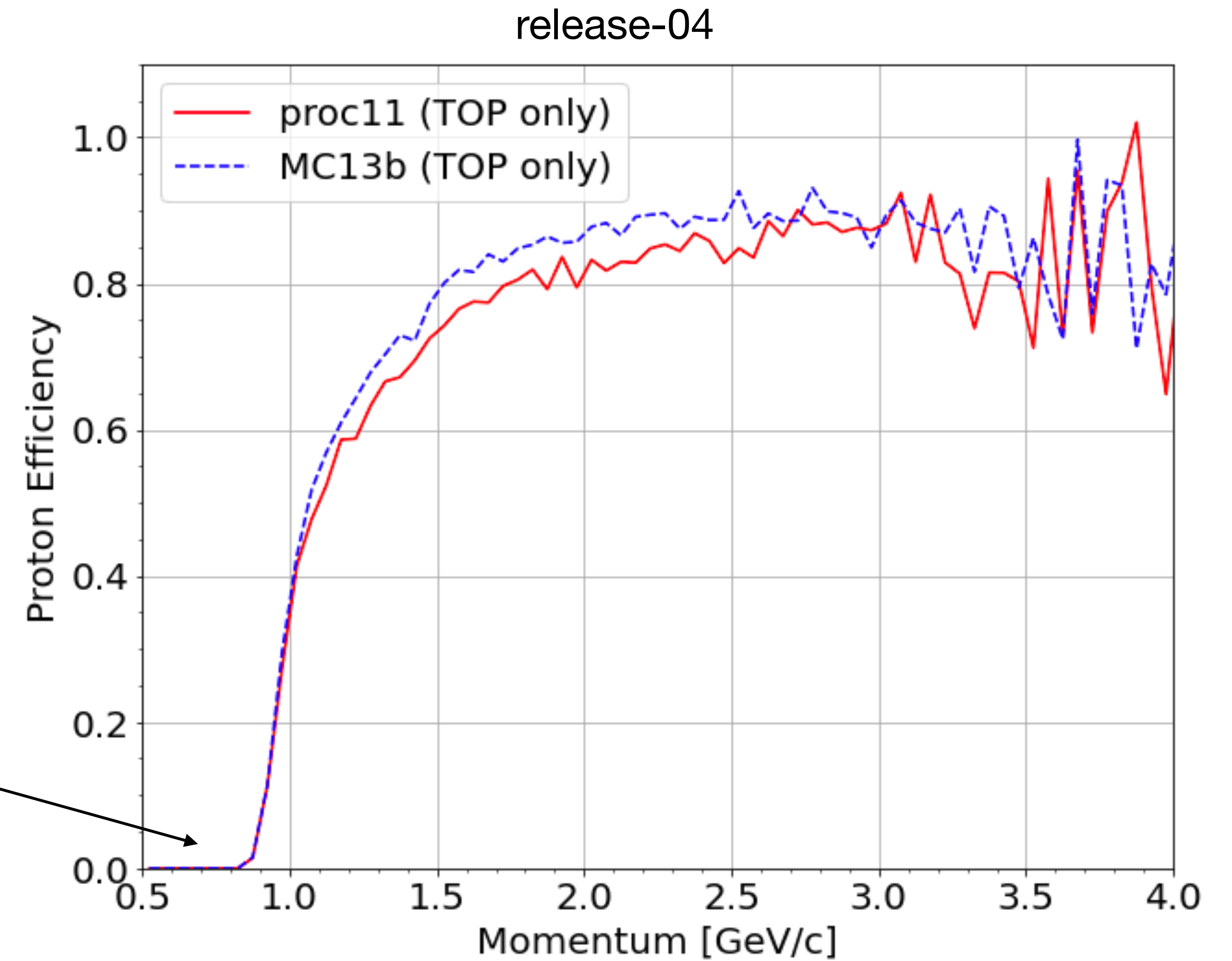
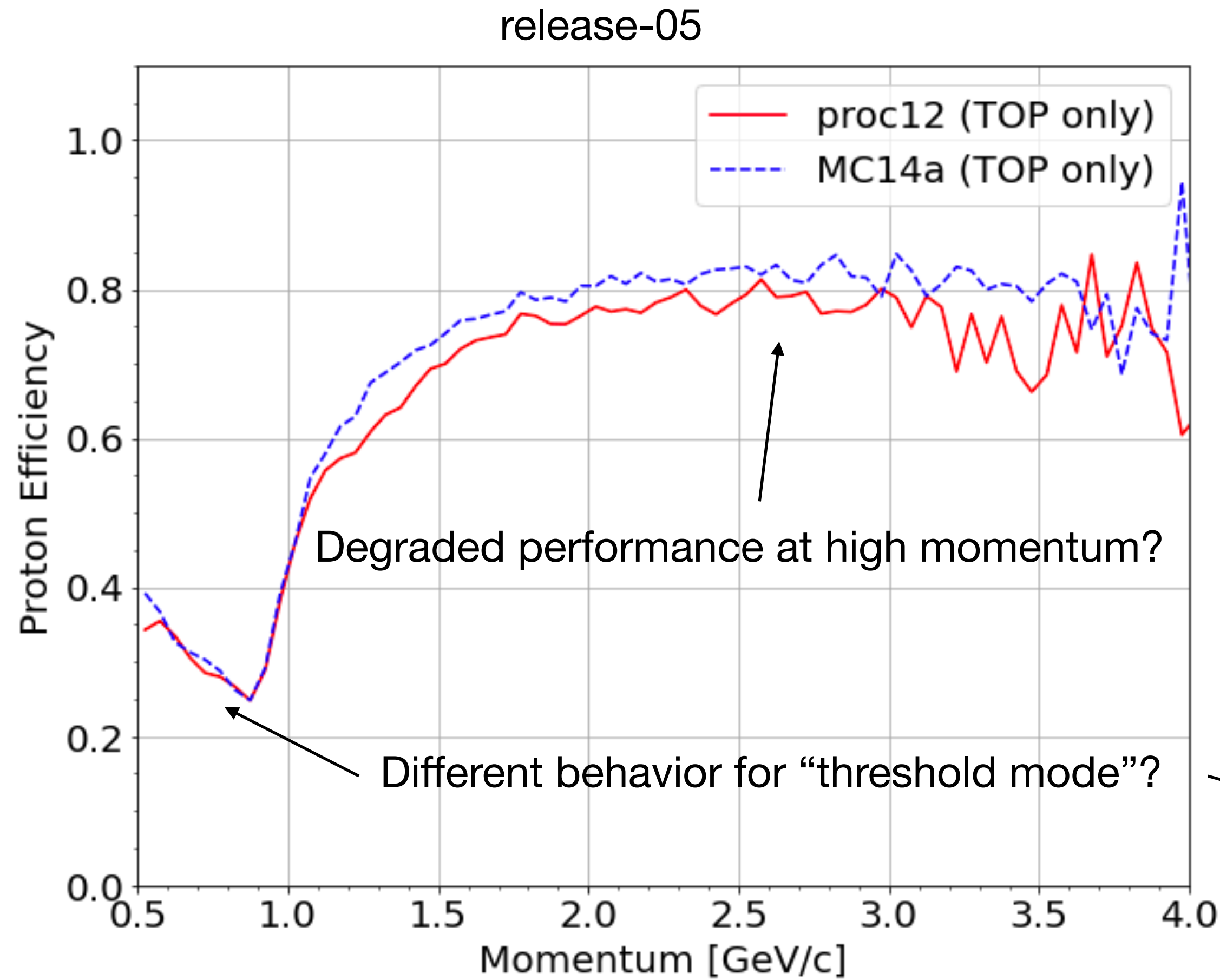
$$\frac{L(p)}{L(K) + L(\pi) + L(p) + L(d) + L(e) + L(\mu)} > 0.25$$



Proton PID performance in the TOP

- Global proton PID vs. momentum

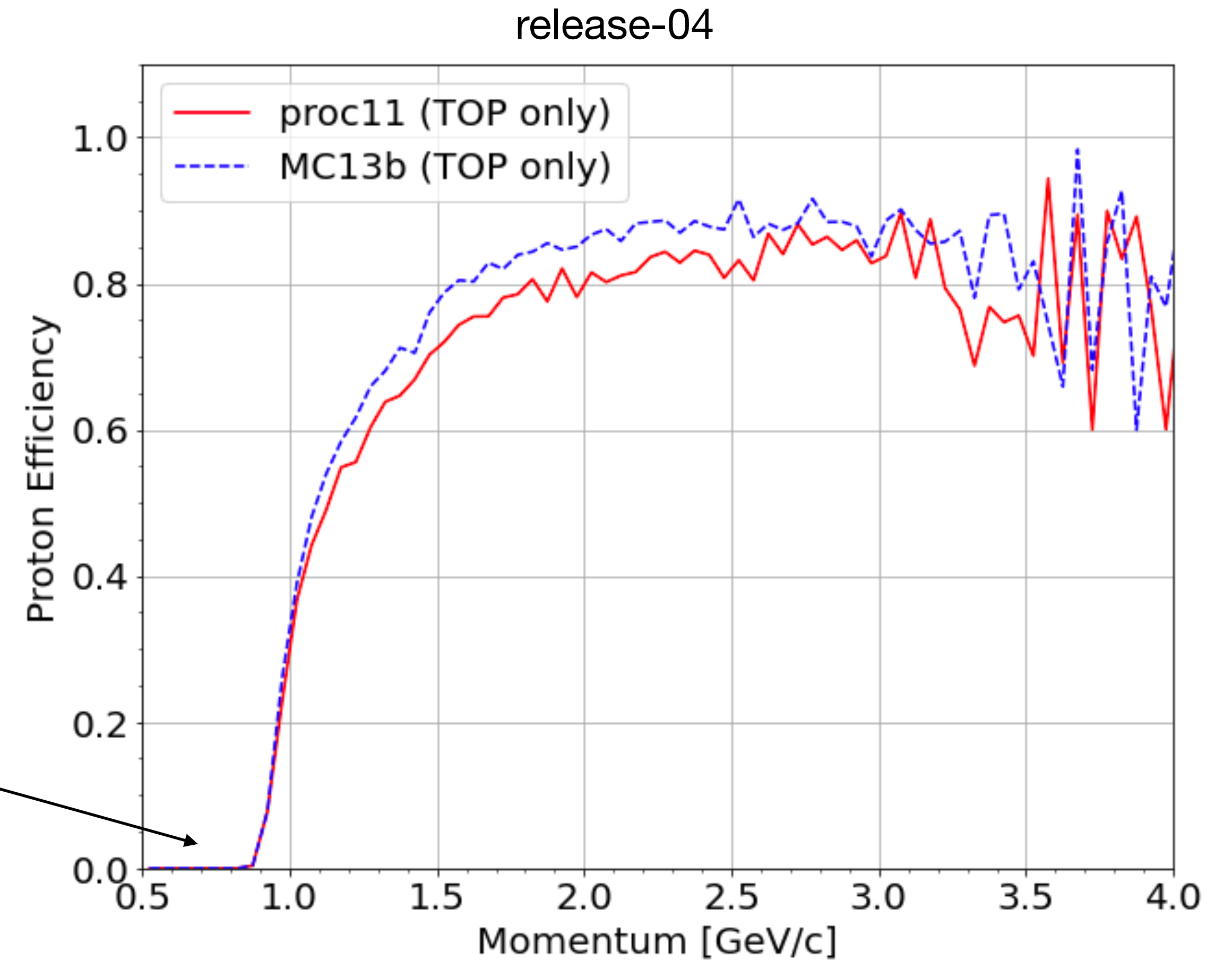
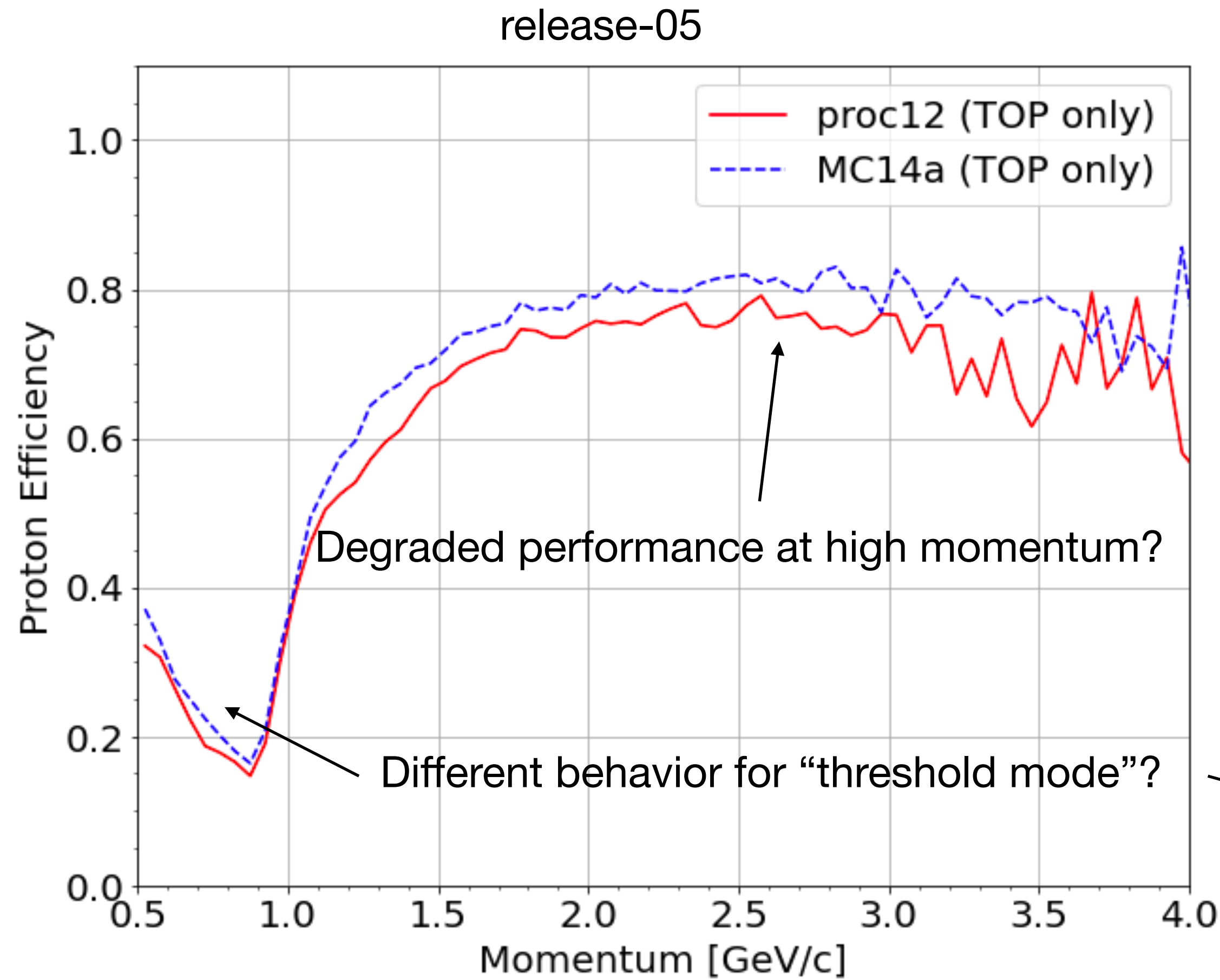
$$\frac{L(p)}{L(K) + L(\pi) + L(p) + L(d) + L(e) + L(\mu)} > 0.5$$



Proton PID performance in the TOP

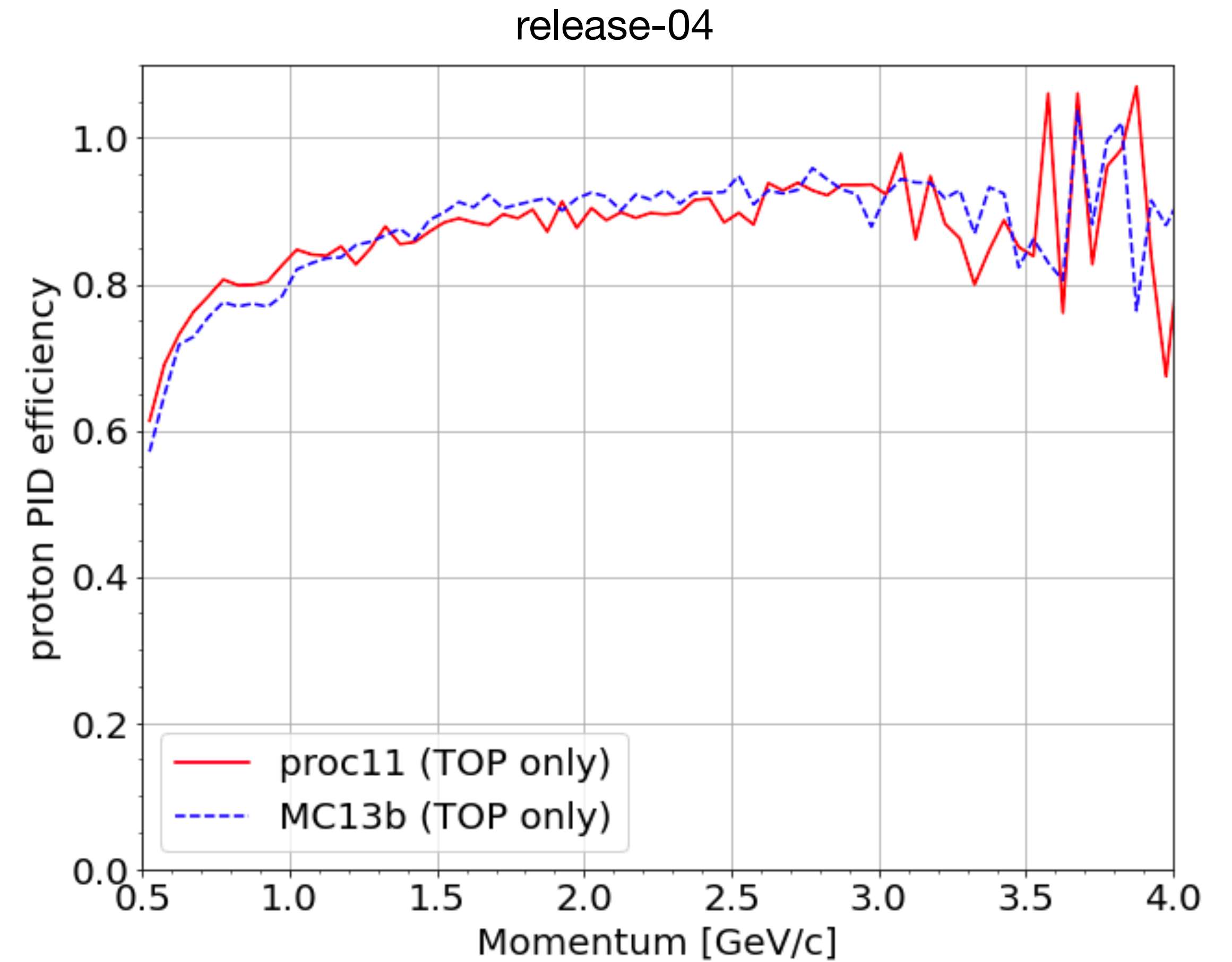
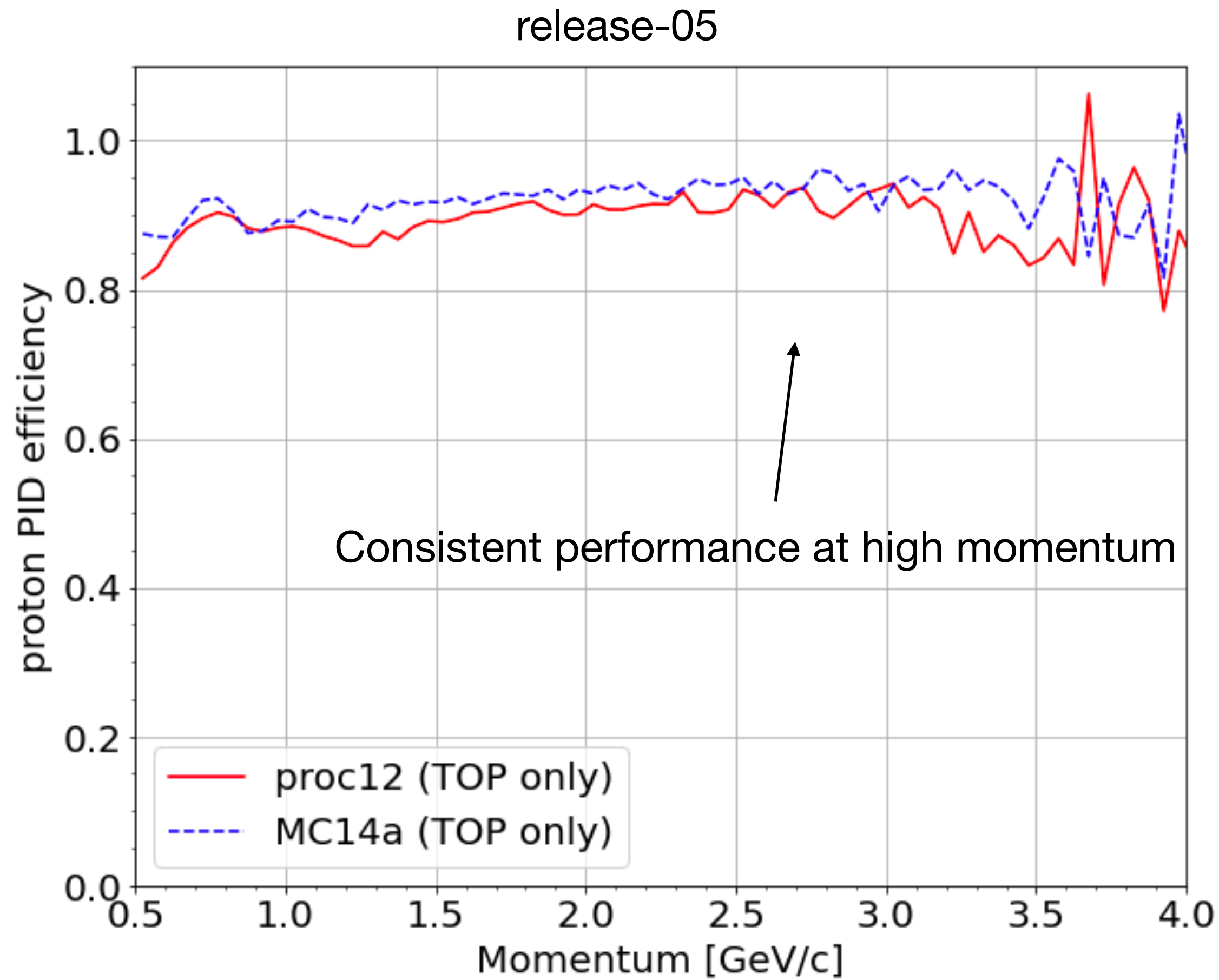
- Global proton PID vs. momentum

$$\frac{L(p)}{L(K) + L(\pi) + L(p) + L(d) + L(e) + L(\mu)} > 0.75$$



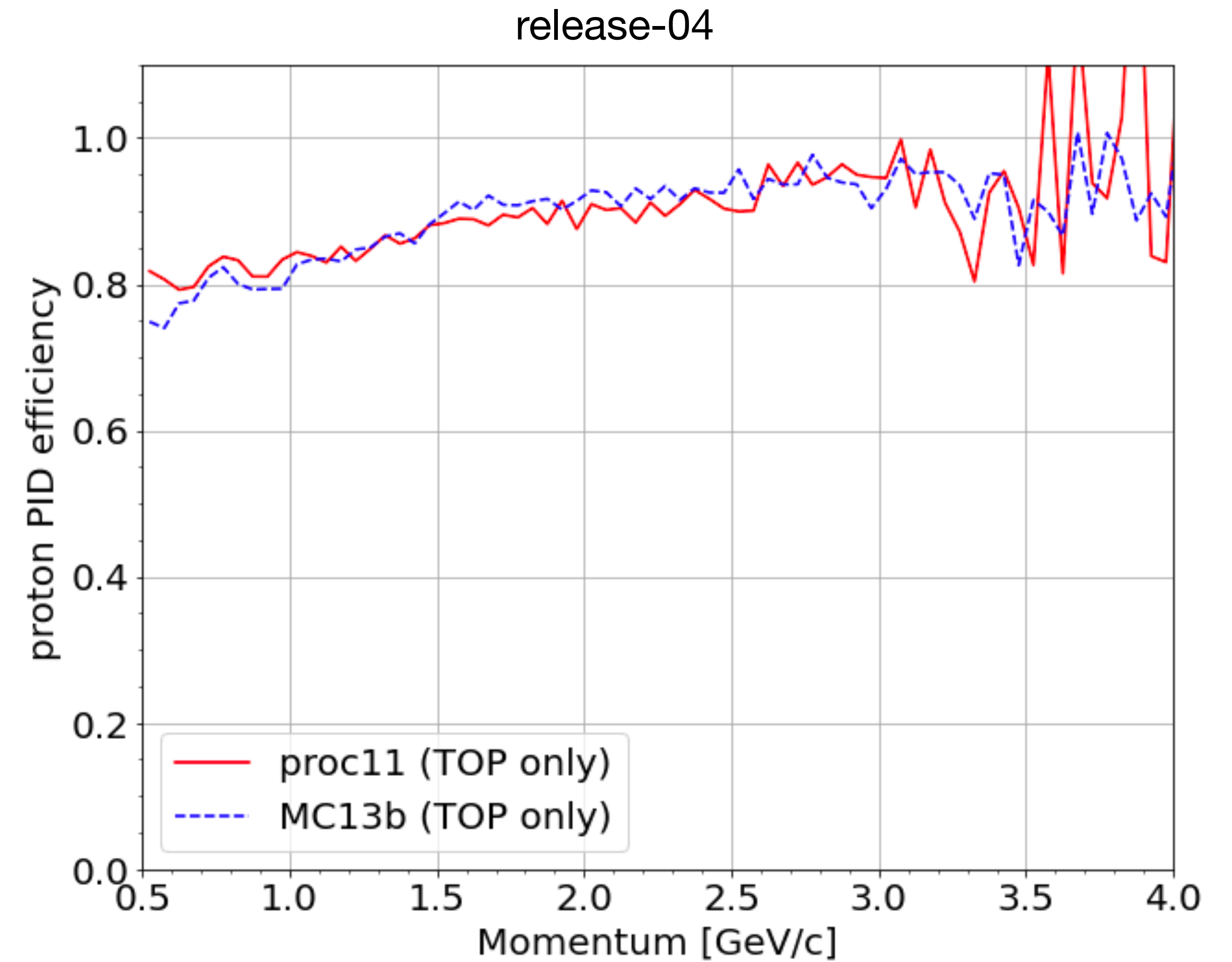
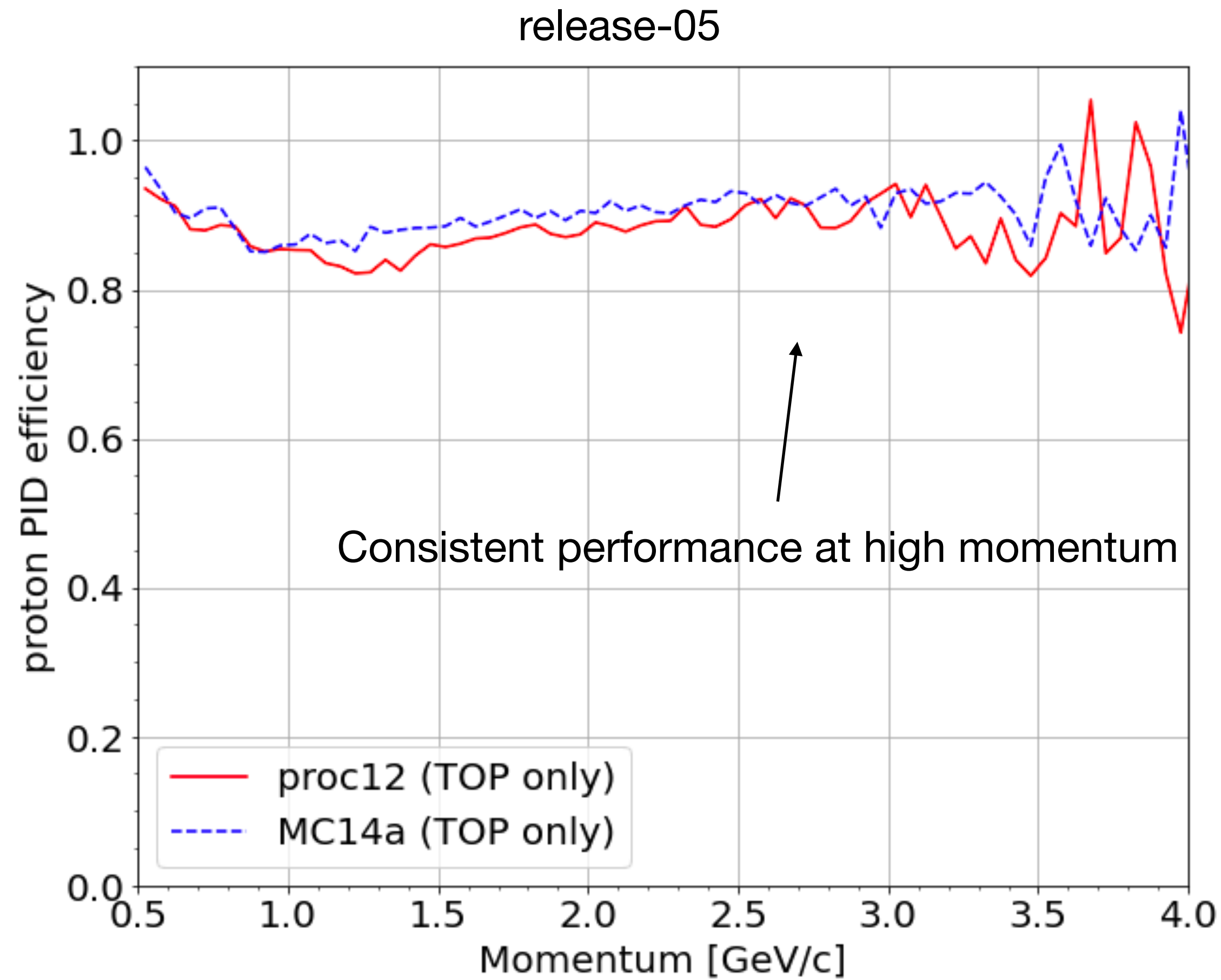
Proton PID performance in the TOP: $\mathcal{L}(p) > \mathcal{L}(K)$

- Efficiency for TOP PID requiring the proton log likelihood greater than that for kaons



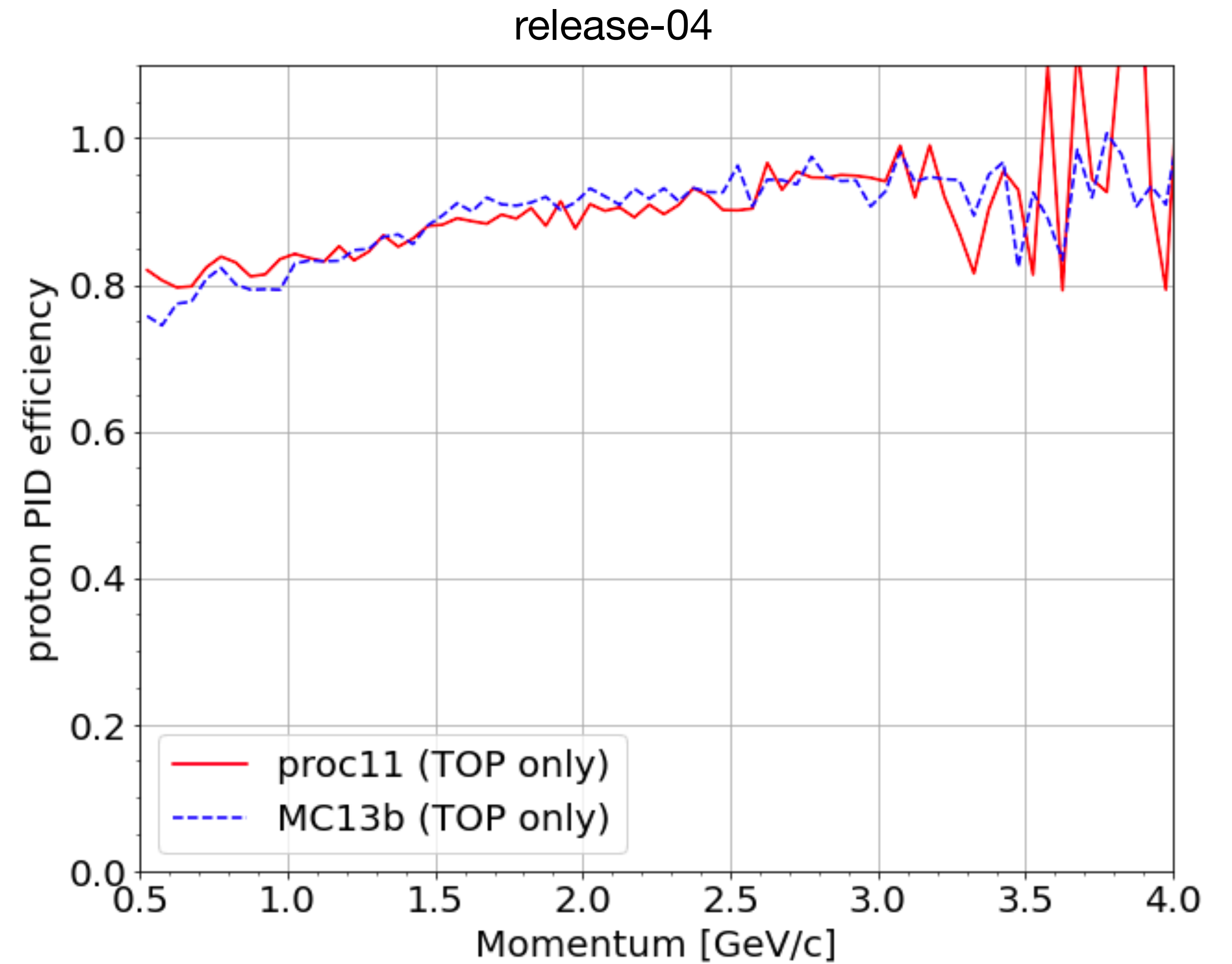
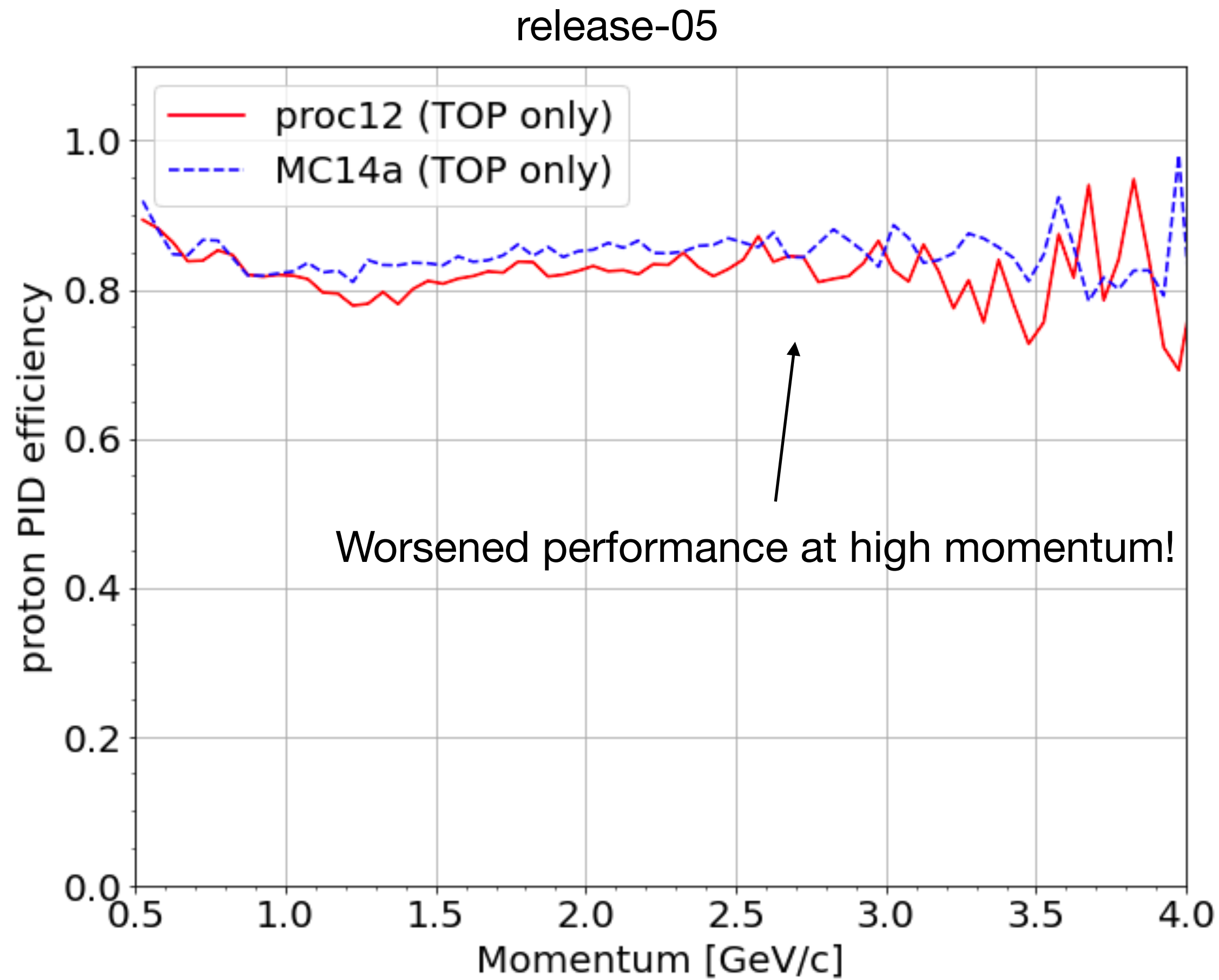
Proton PID performance in the TOP: $\mathcal{L}(p) > \mathcal{L}(\pi)$

- Efficiency for TOP PID requiring the proton log likelihood greater than that for pions



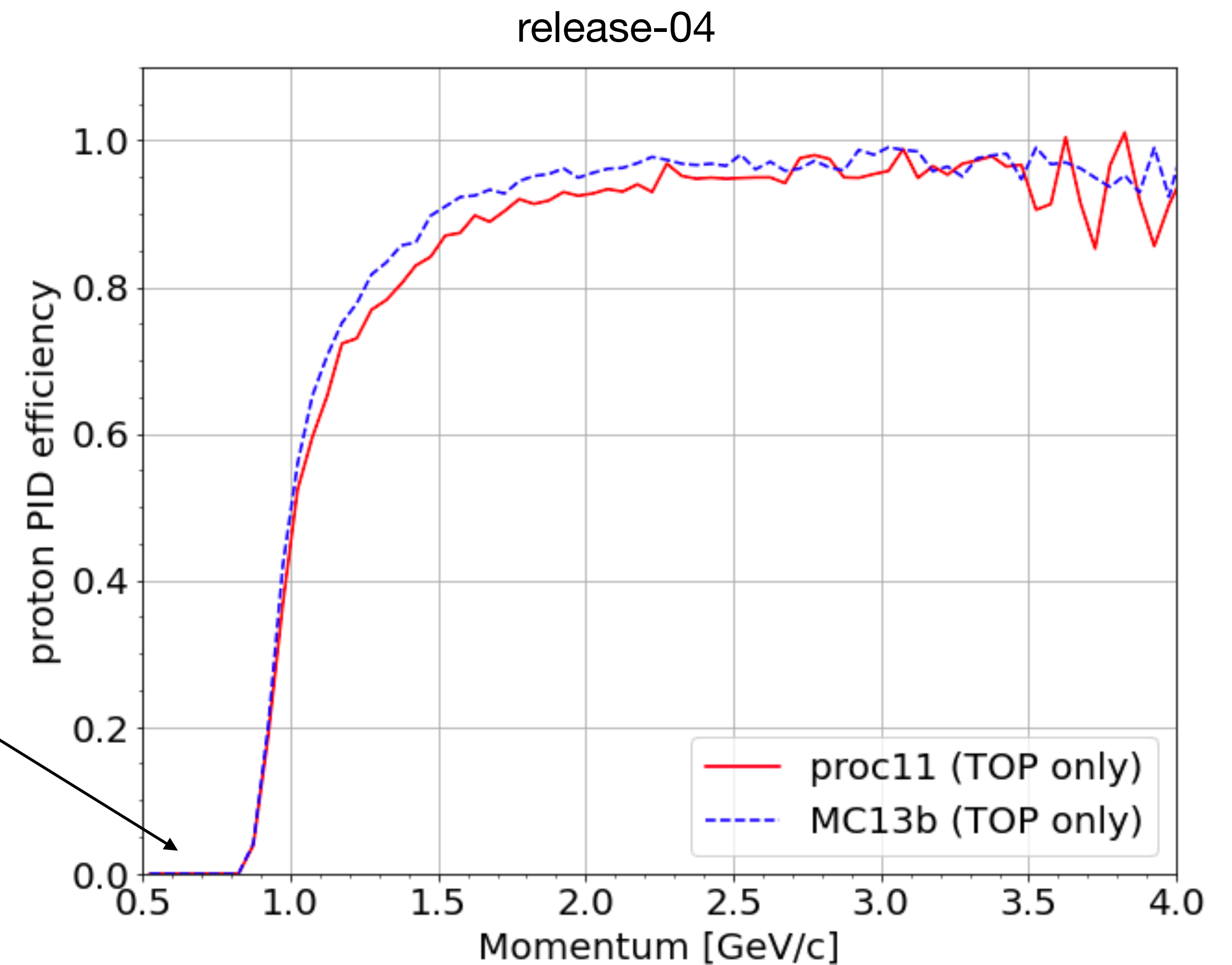
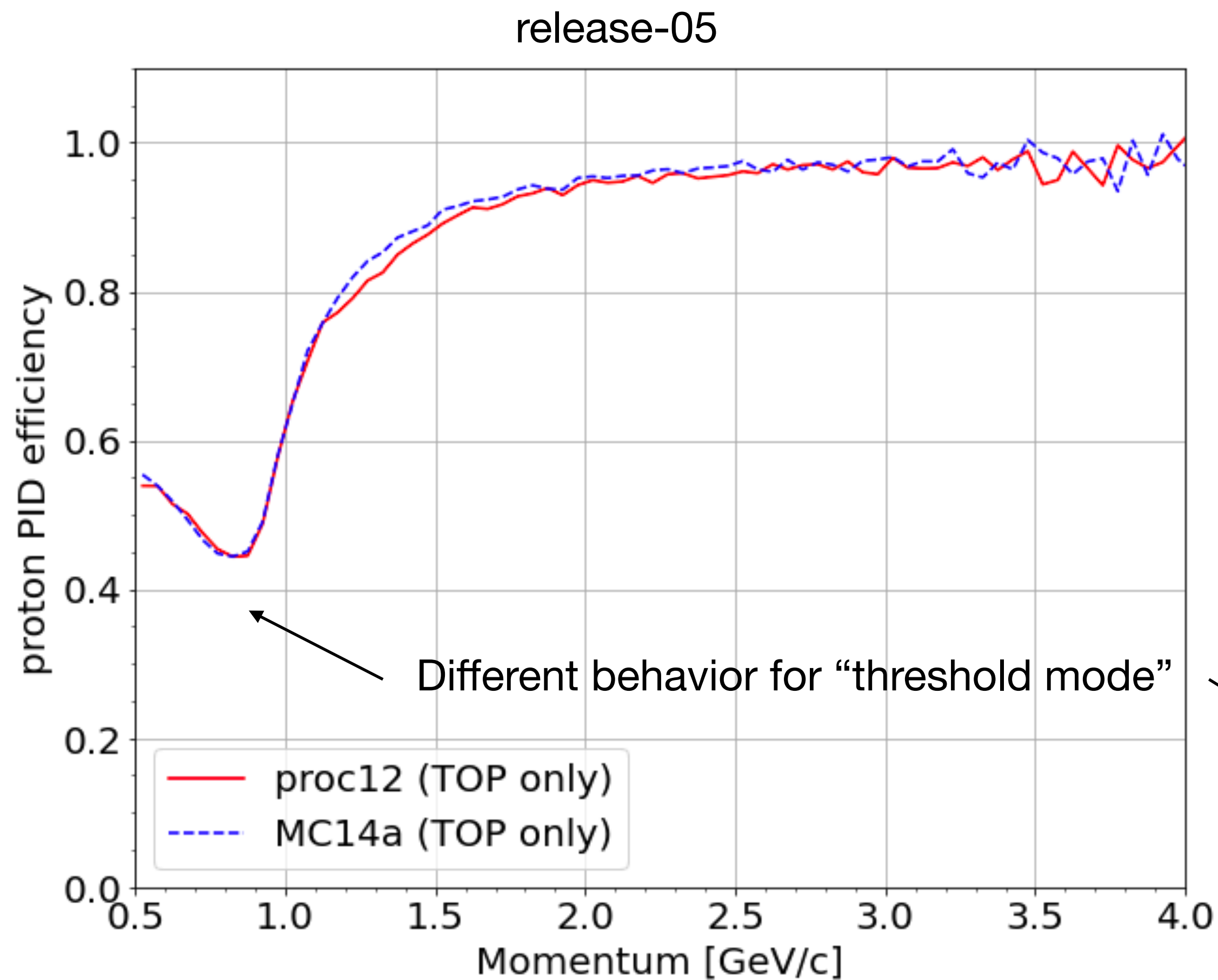
Proton PID performance in the TOP: $\mathcal{L}(p) > \mathcal{L}(e)$

- Efficiency for TOP PID log likelihood for proton greater than for electron



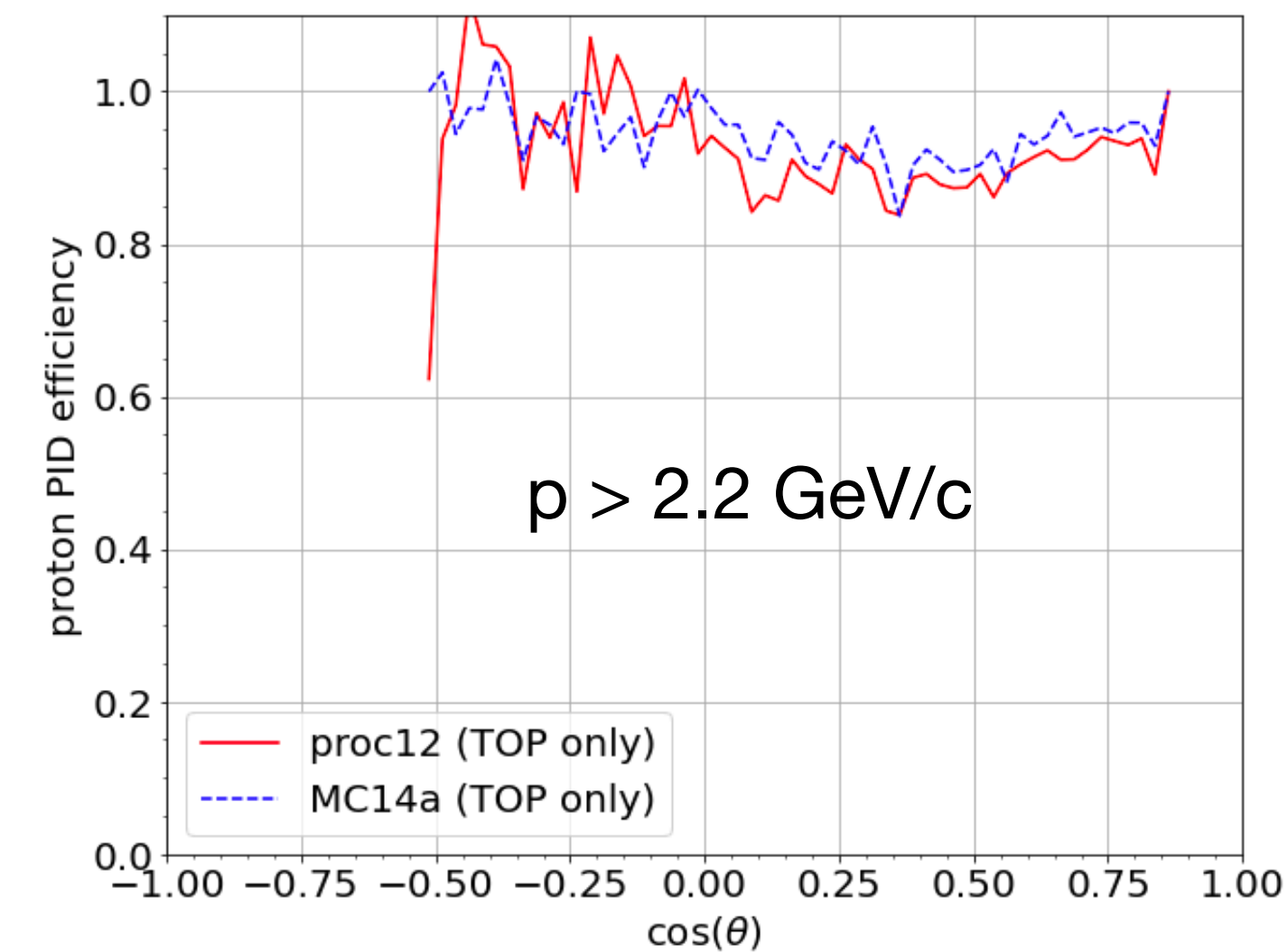
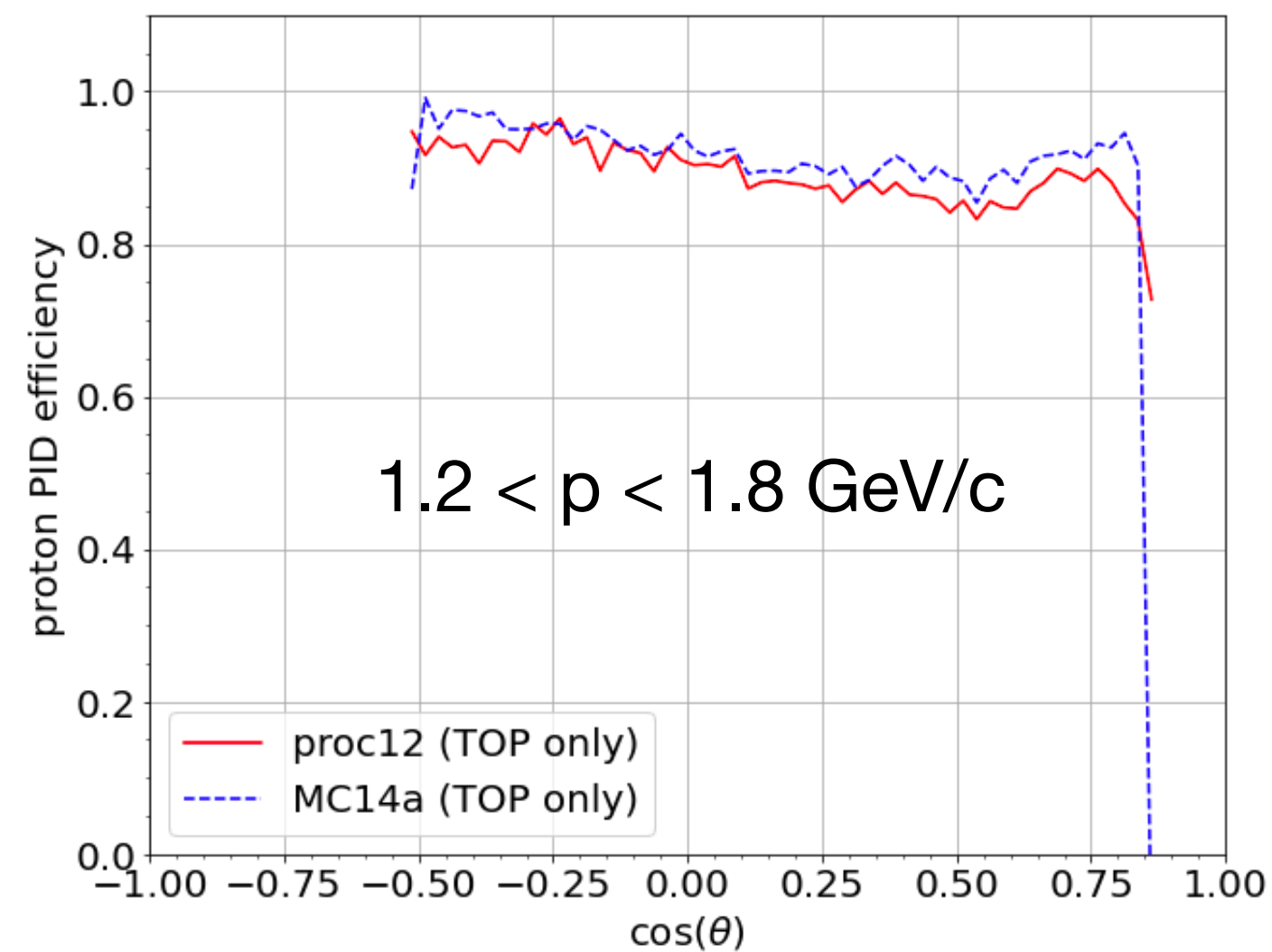
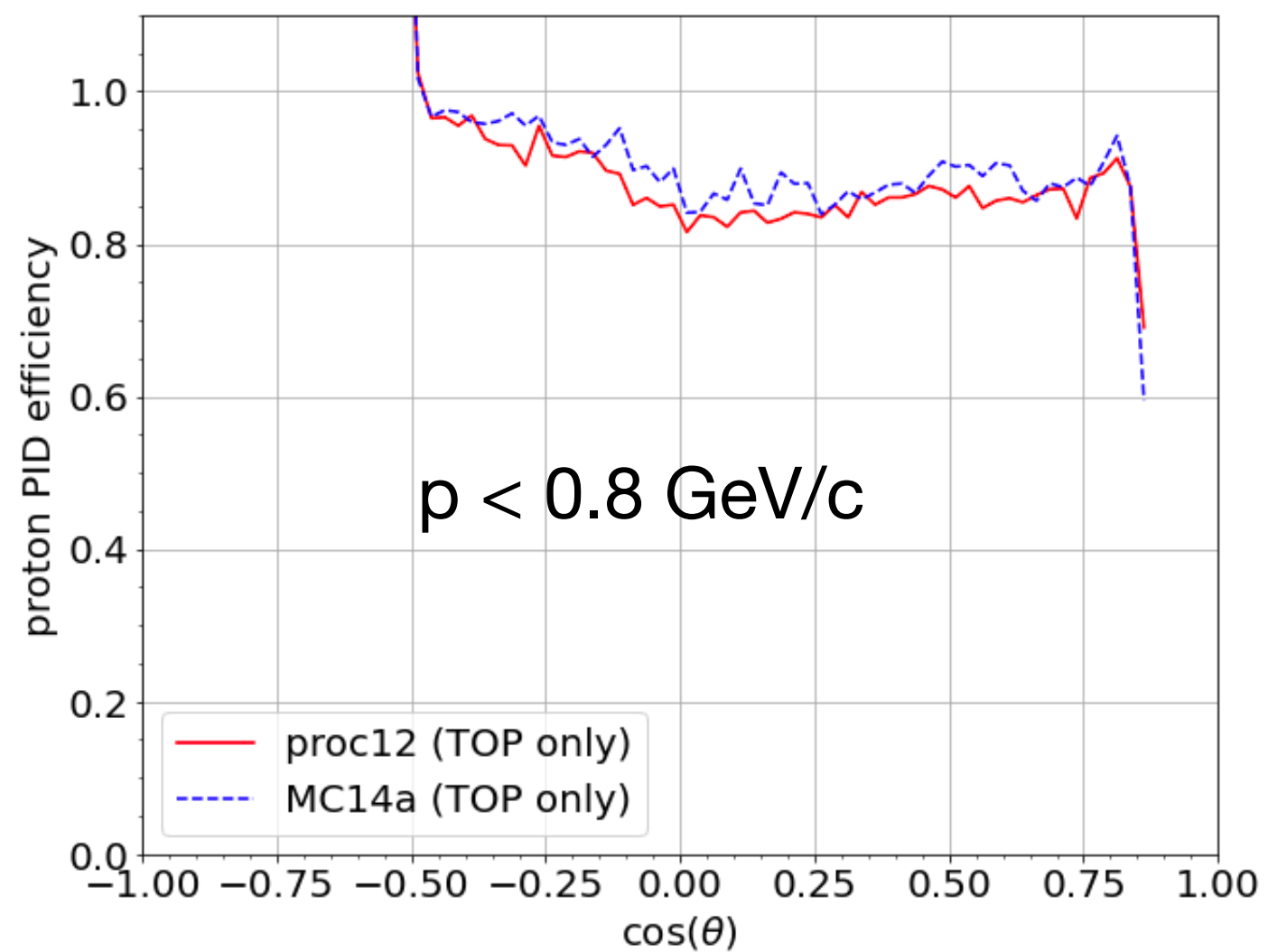
Proton PID performance in the TOP: $\mathcal{L}(p) > \mathcal{L}(d)$

- Efficiency for TOP PID log likelihood for proton greater than for deuteron

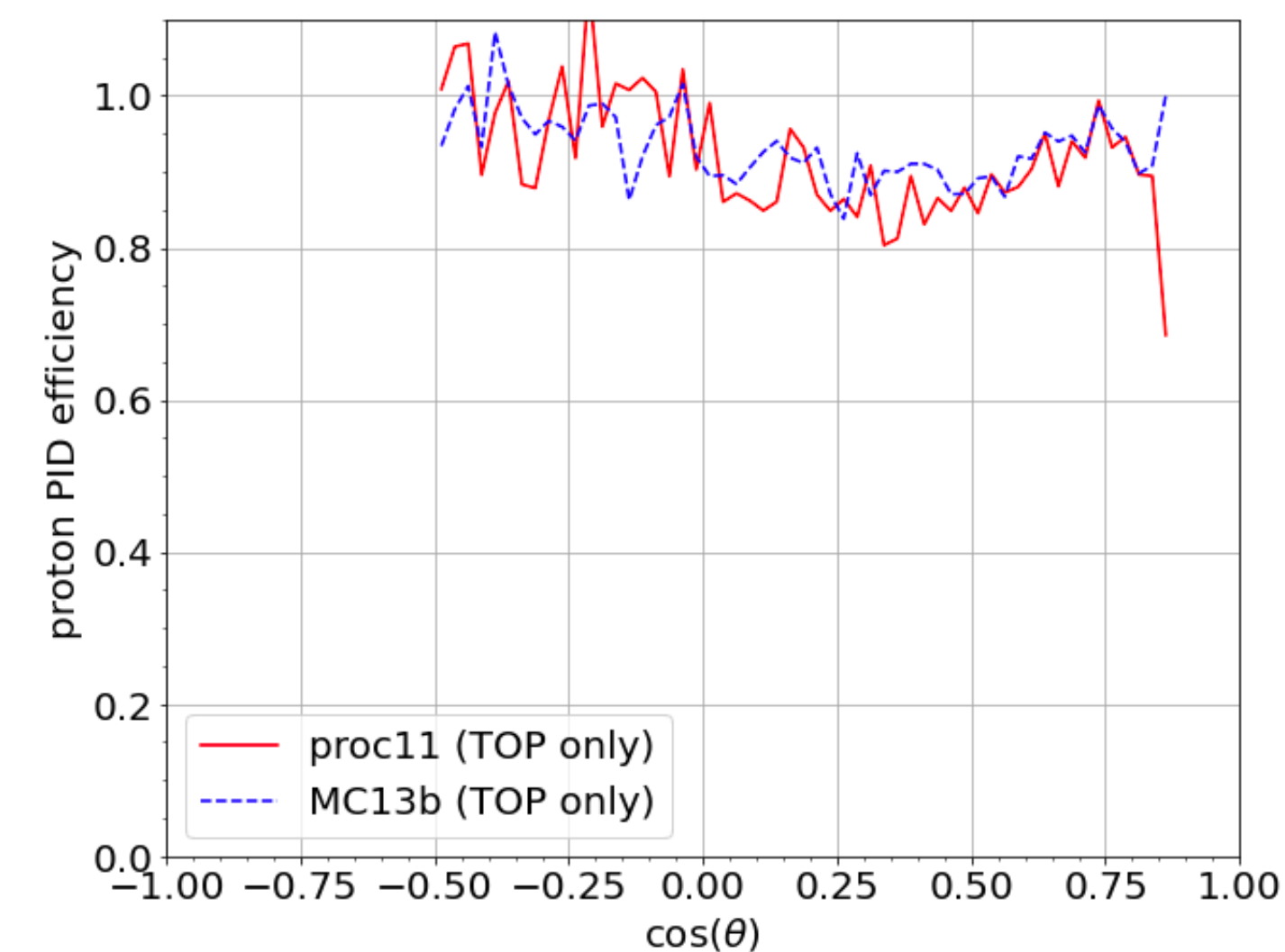
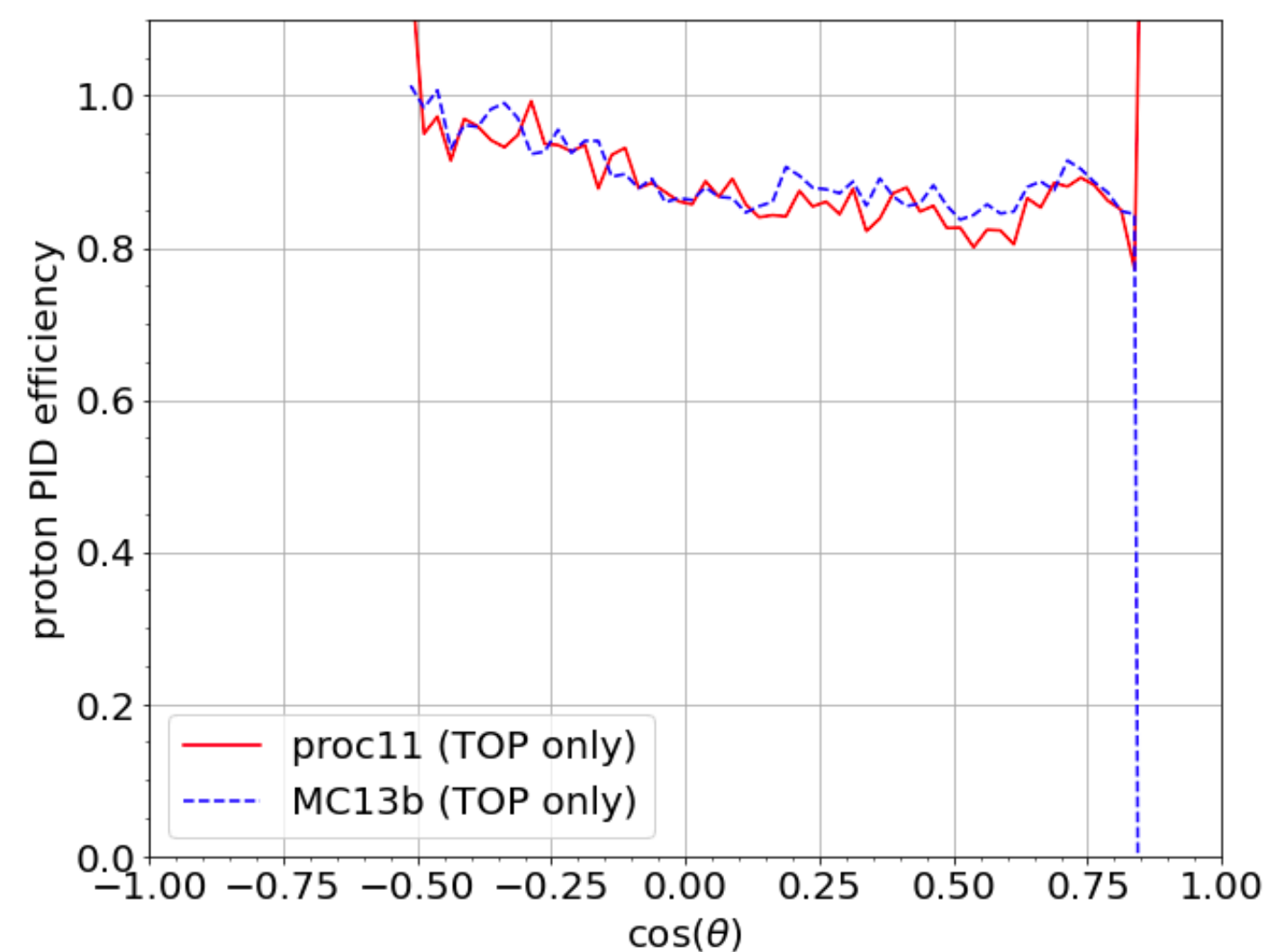
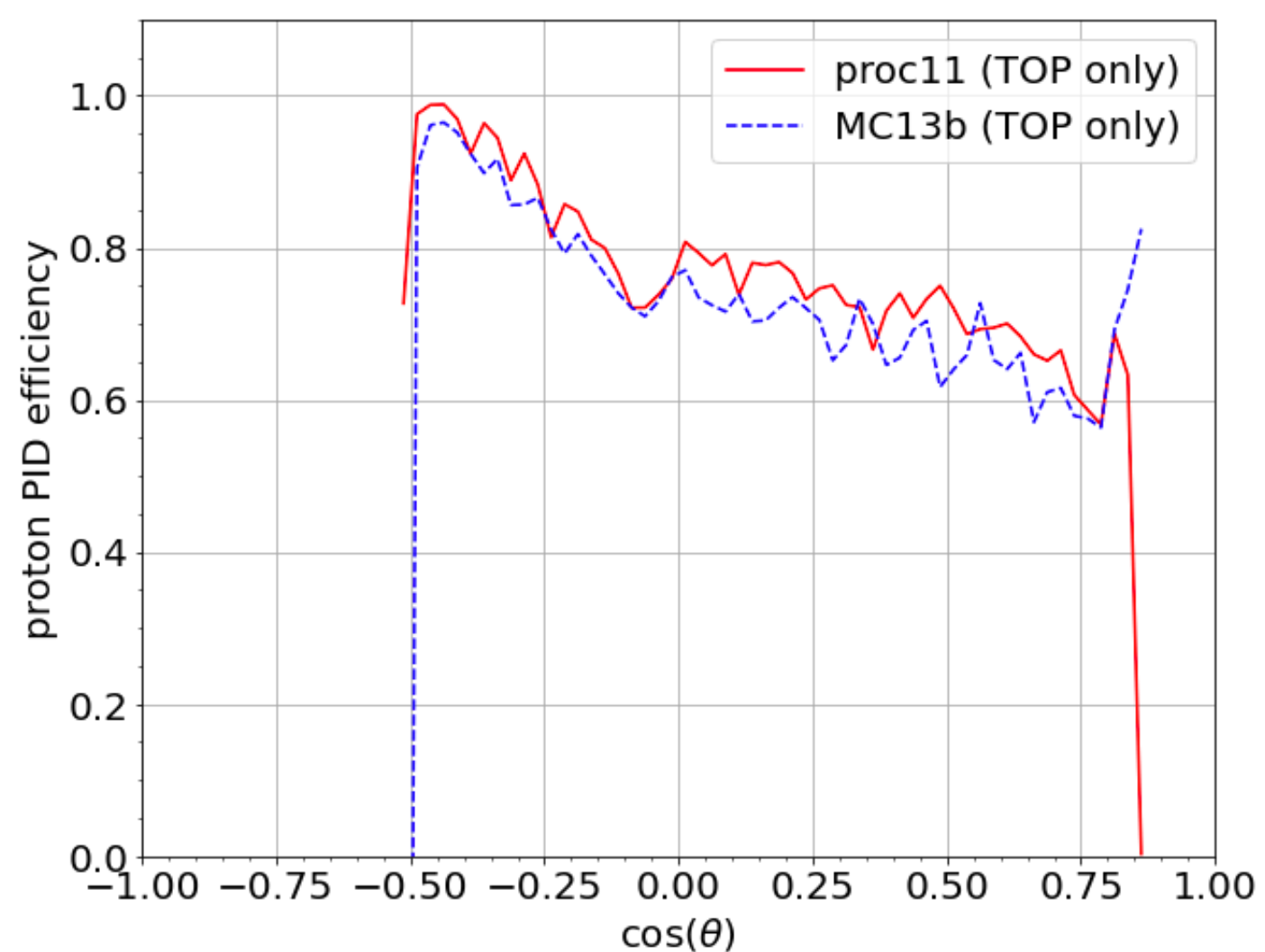


Proton PID performance in the TOP: $\mathcal{L}(p) > \mathcal{L}(K)$

release-05

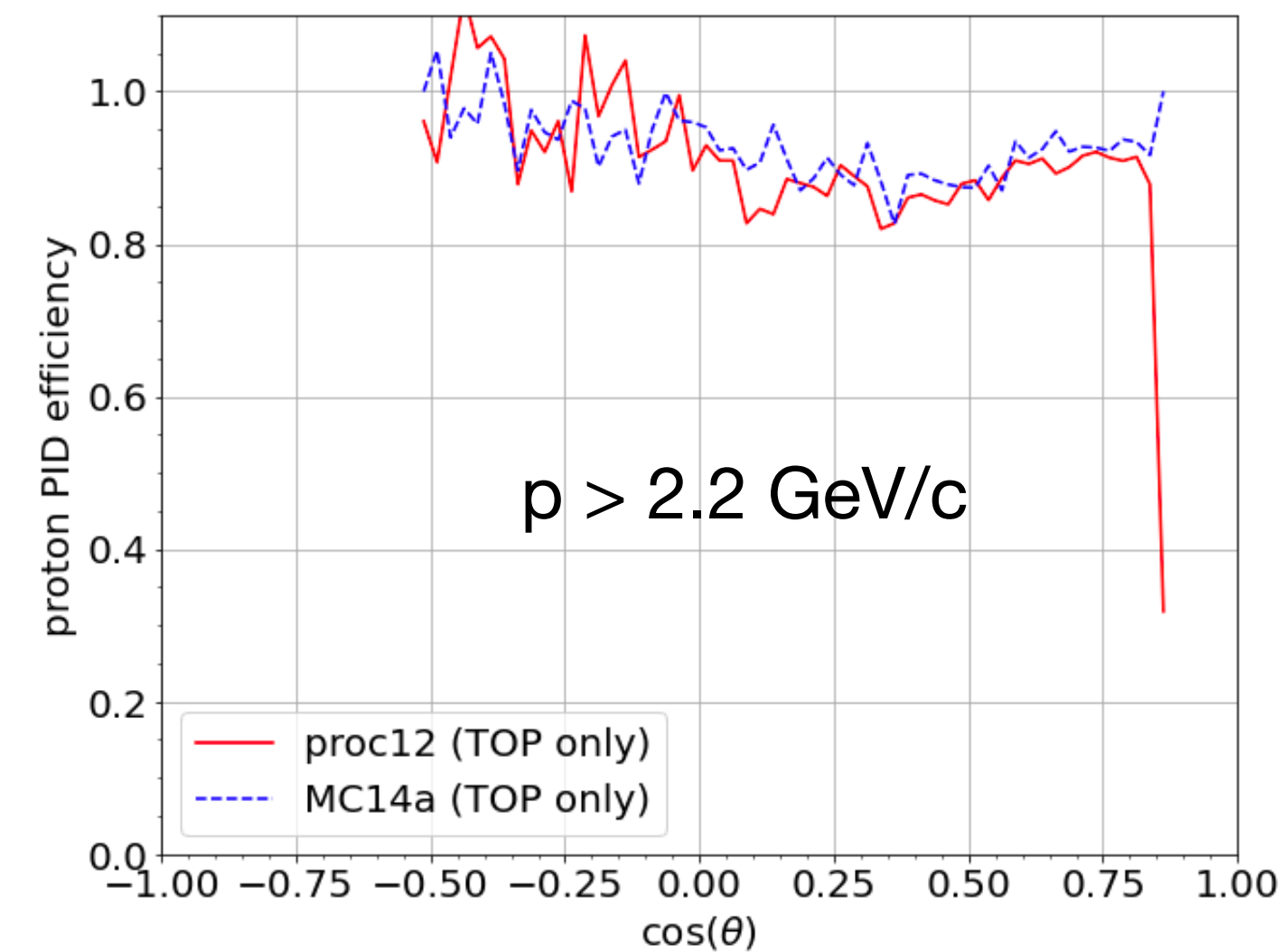
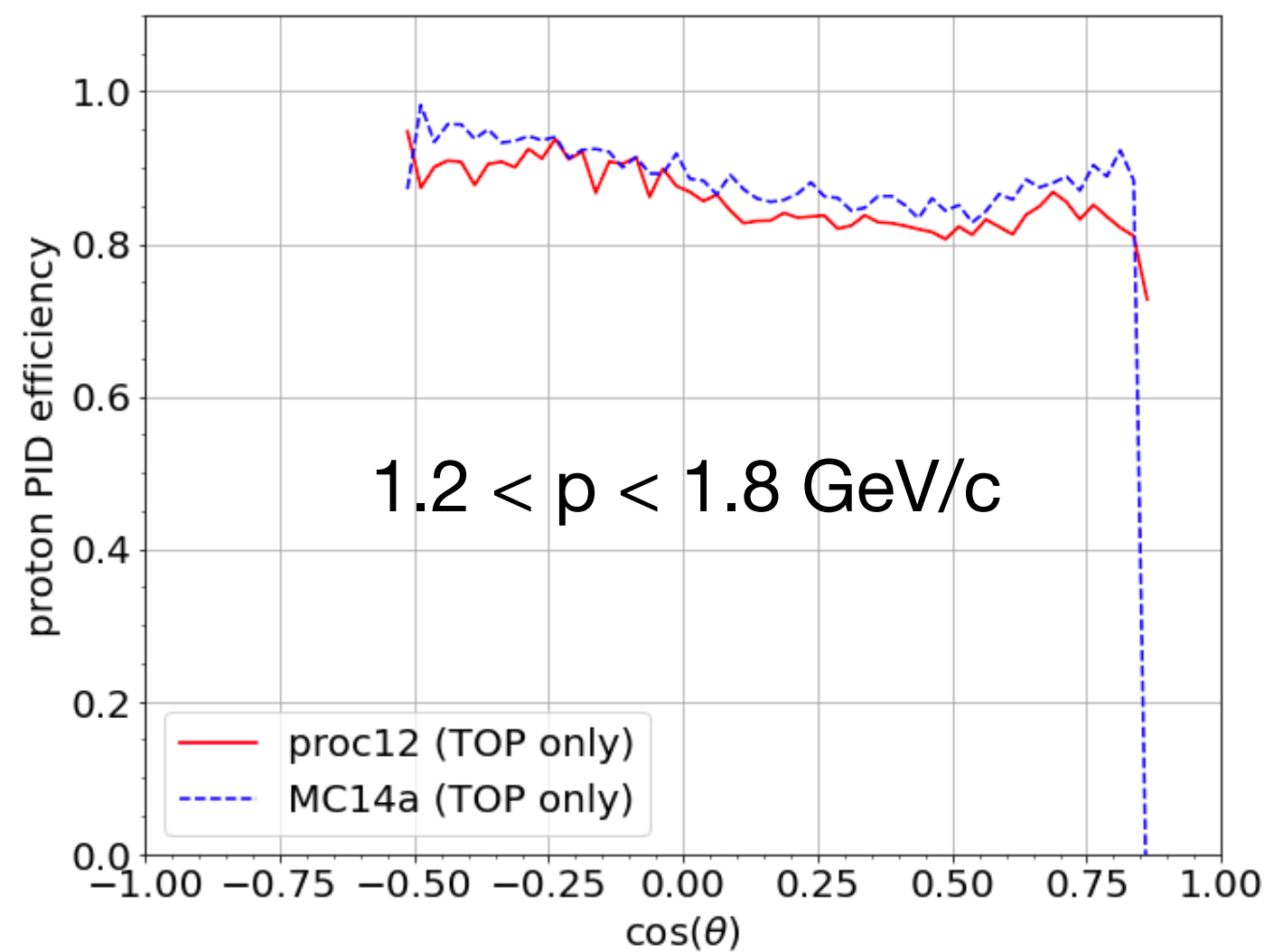
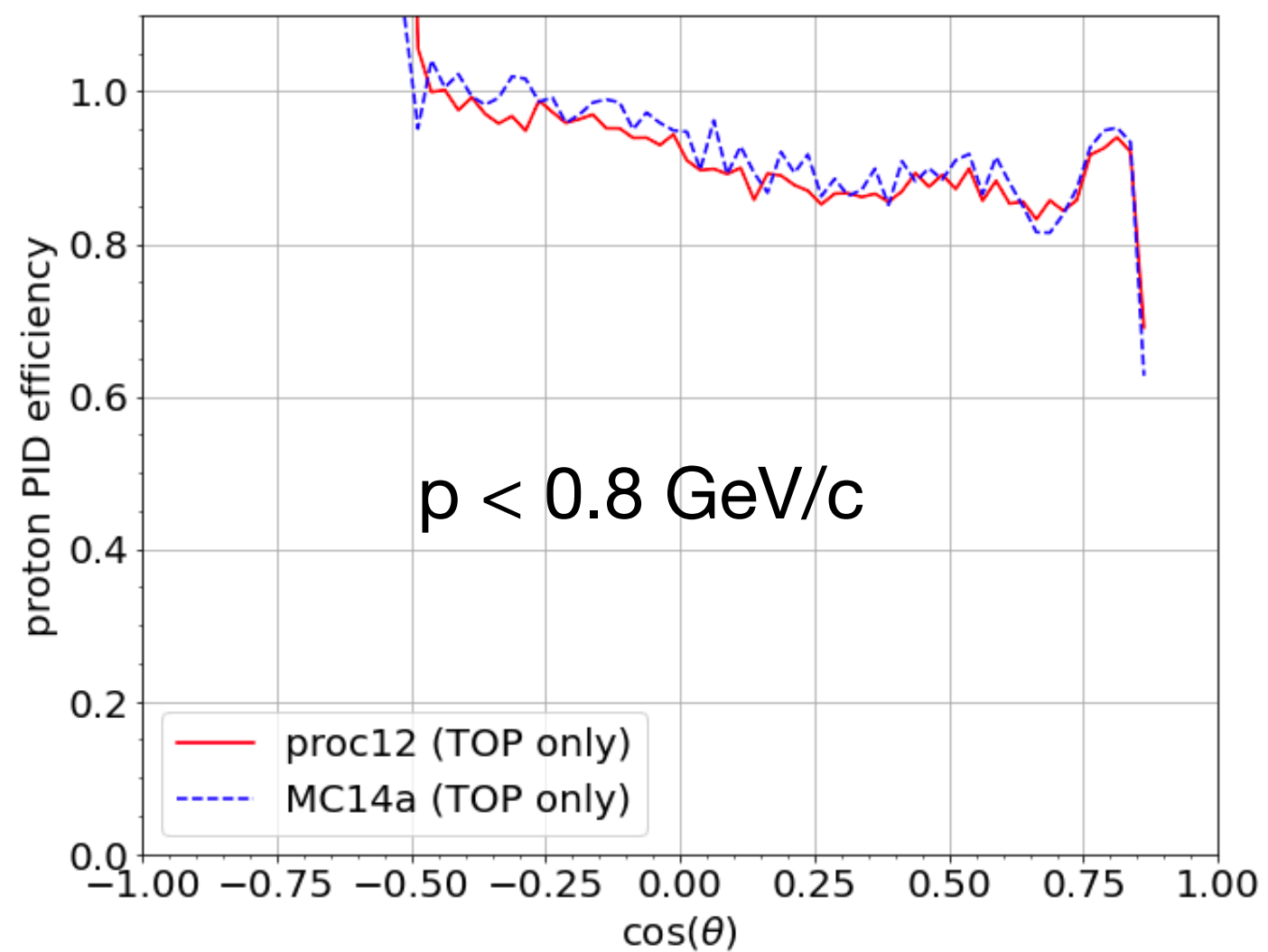


release-04

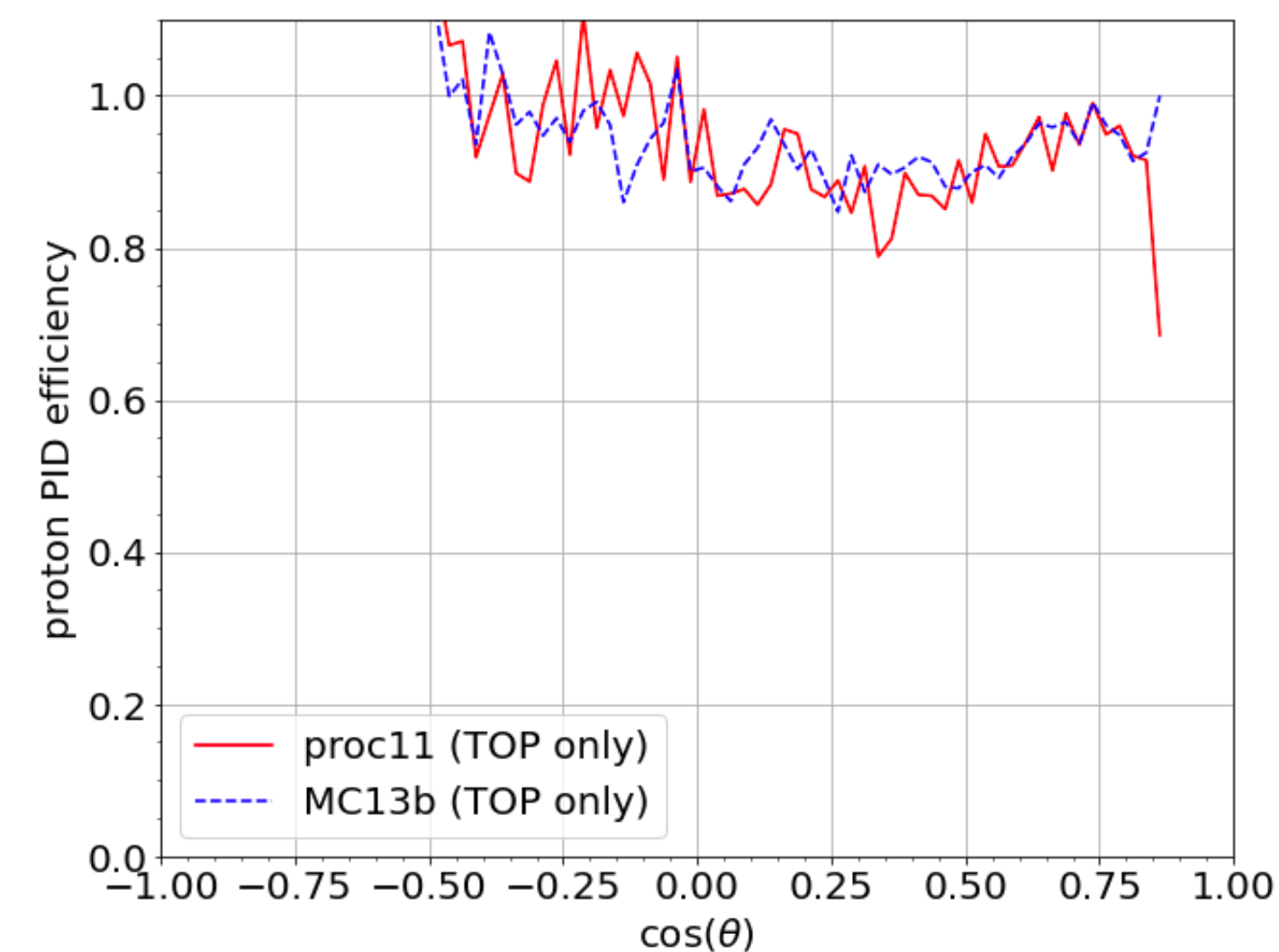
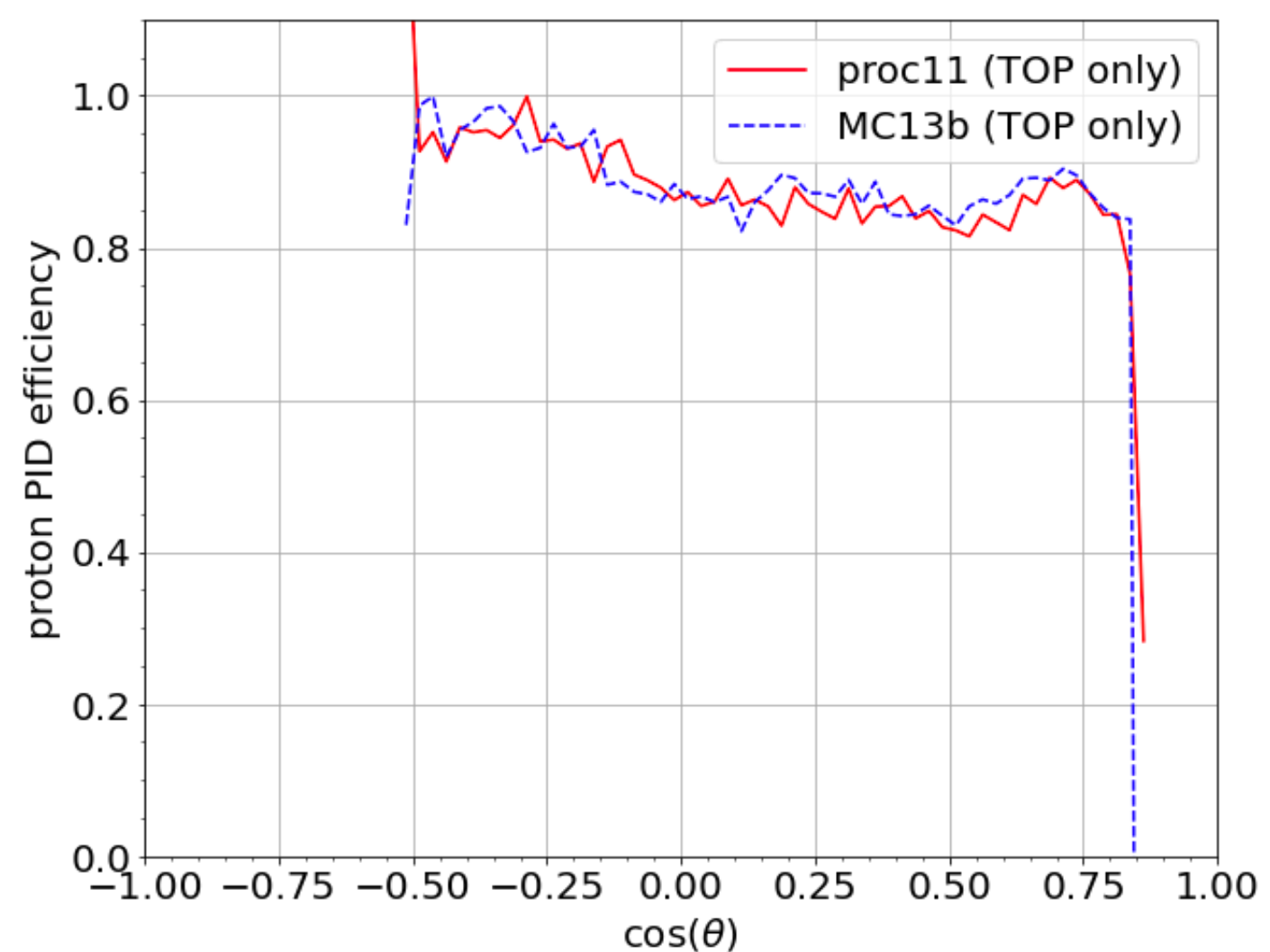
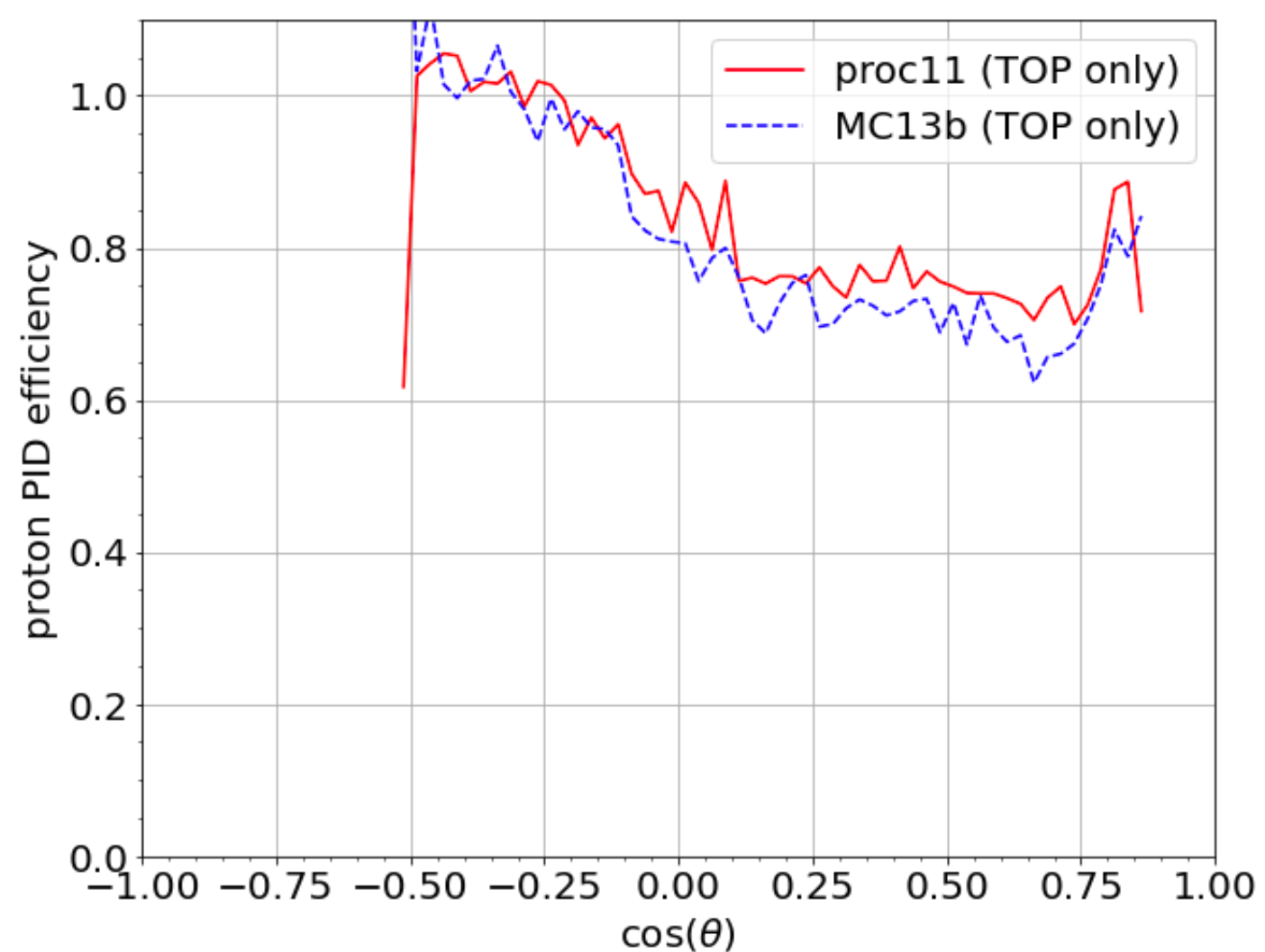


Proton PID performance in the TOP: $\mathcal{L}(p) > \mathcal{L}(\pi)$

release-05

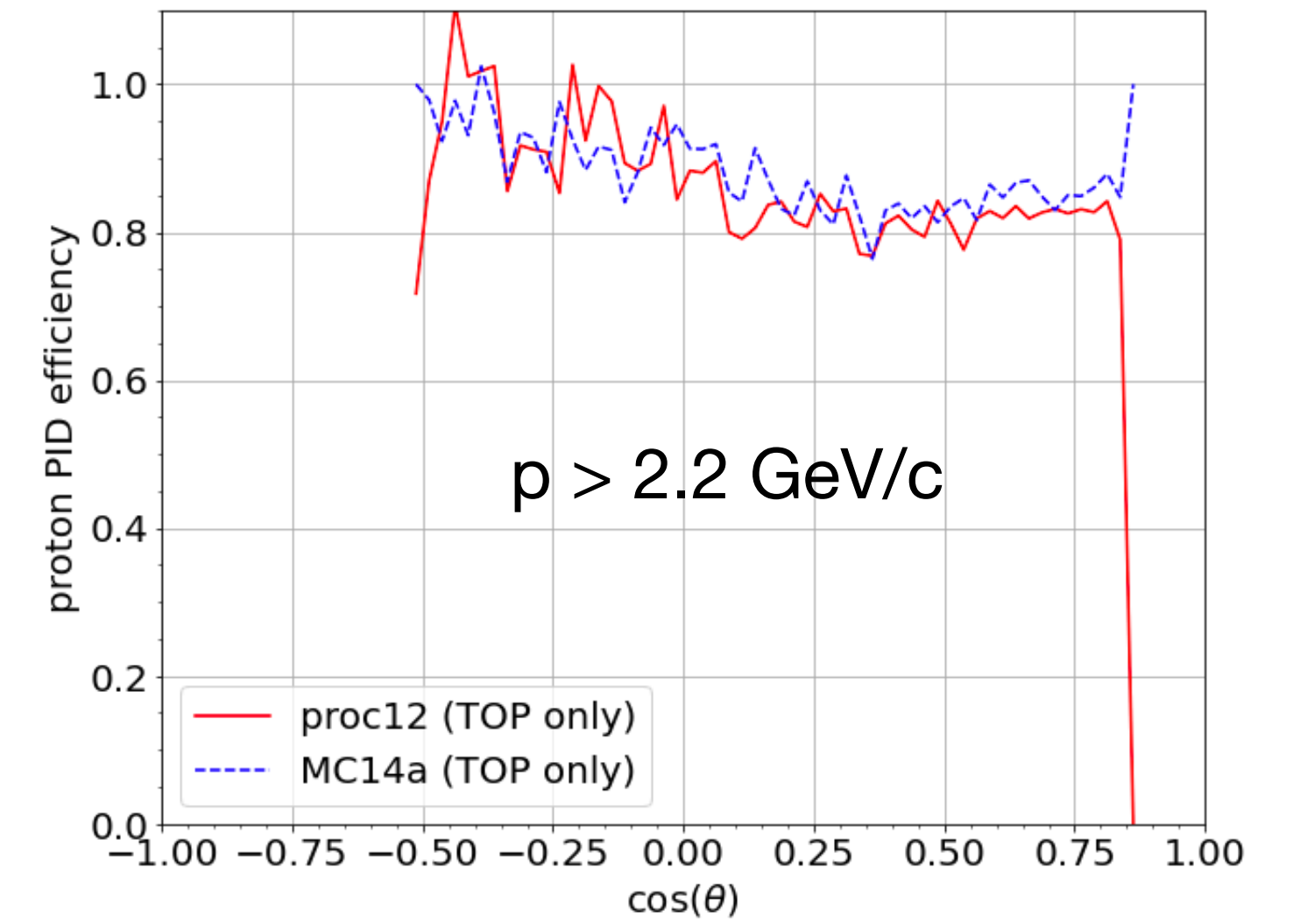
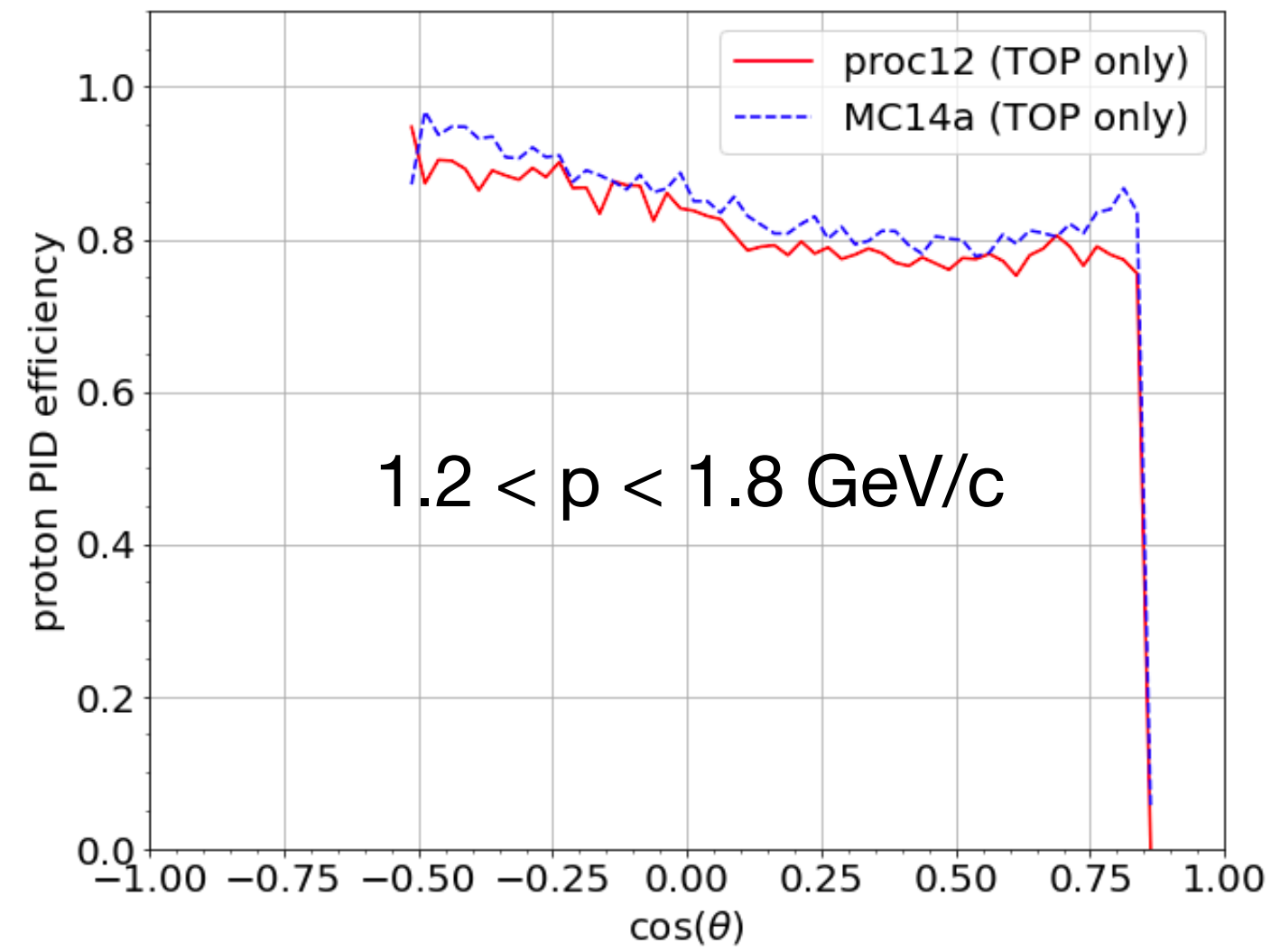
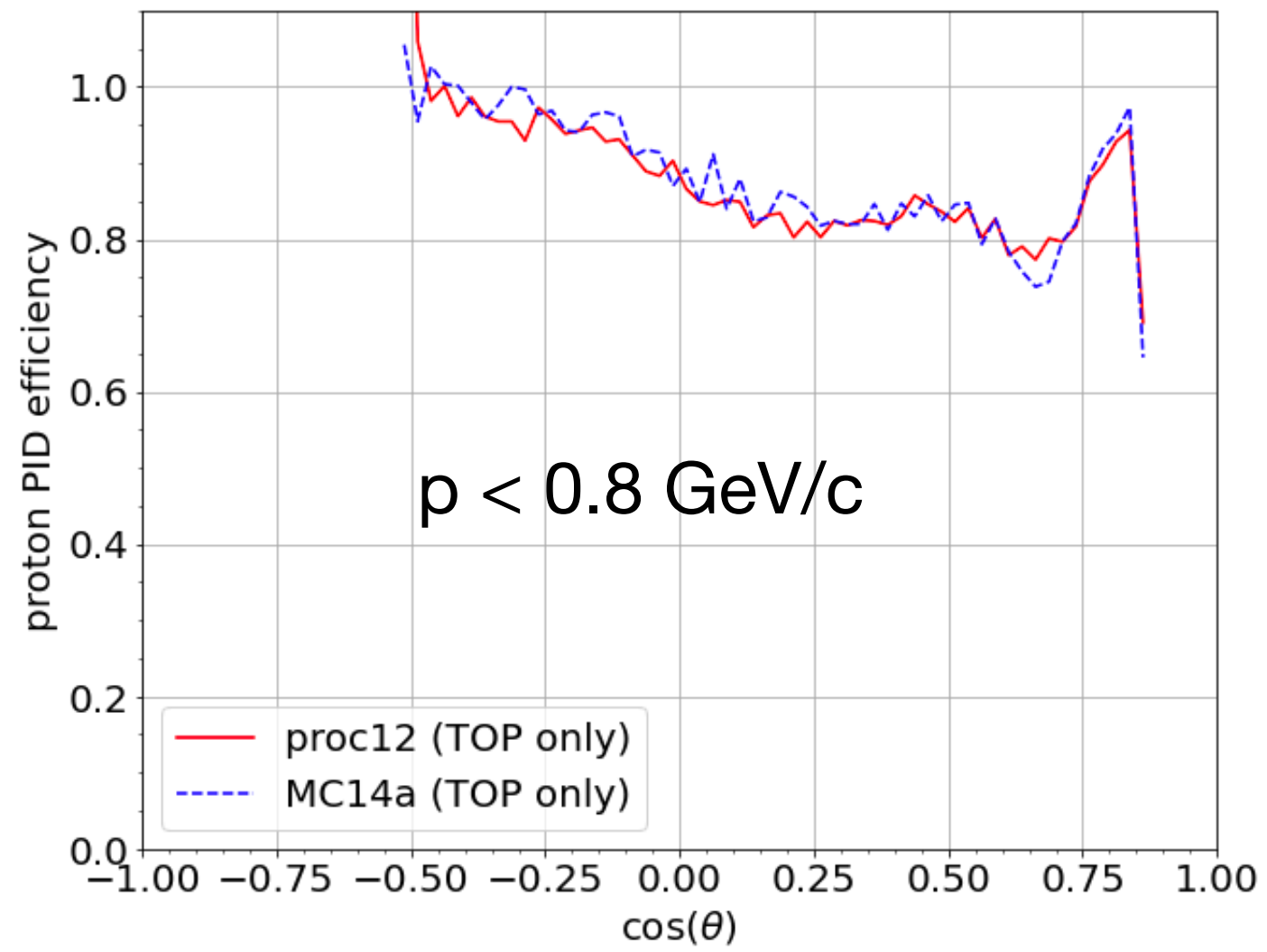


release-04

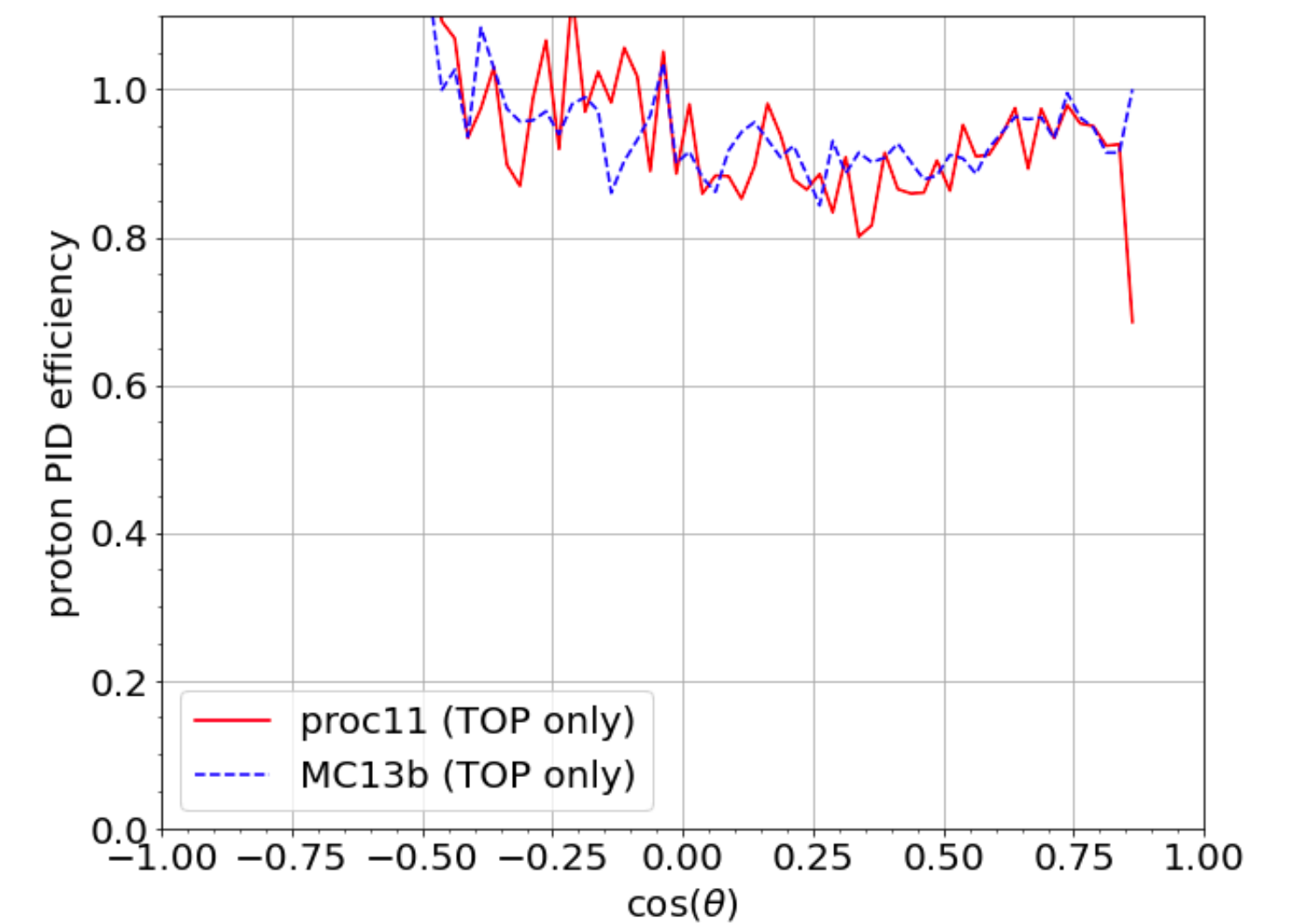
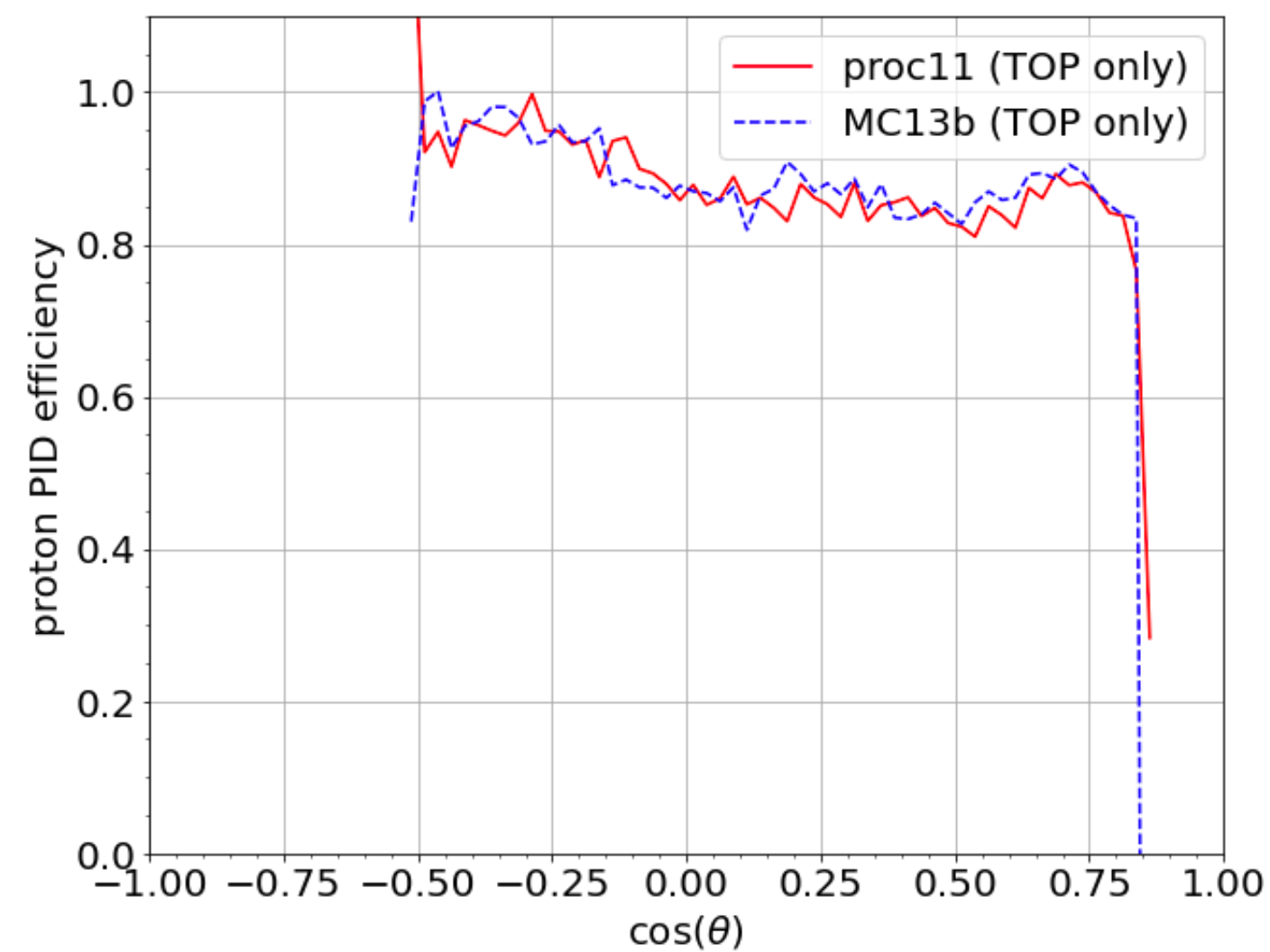
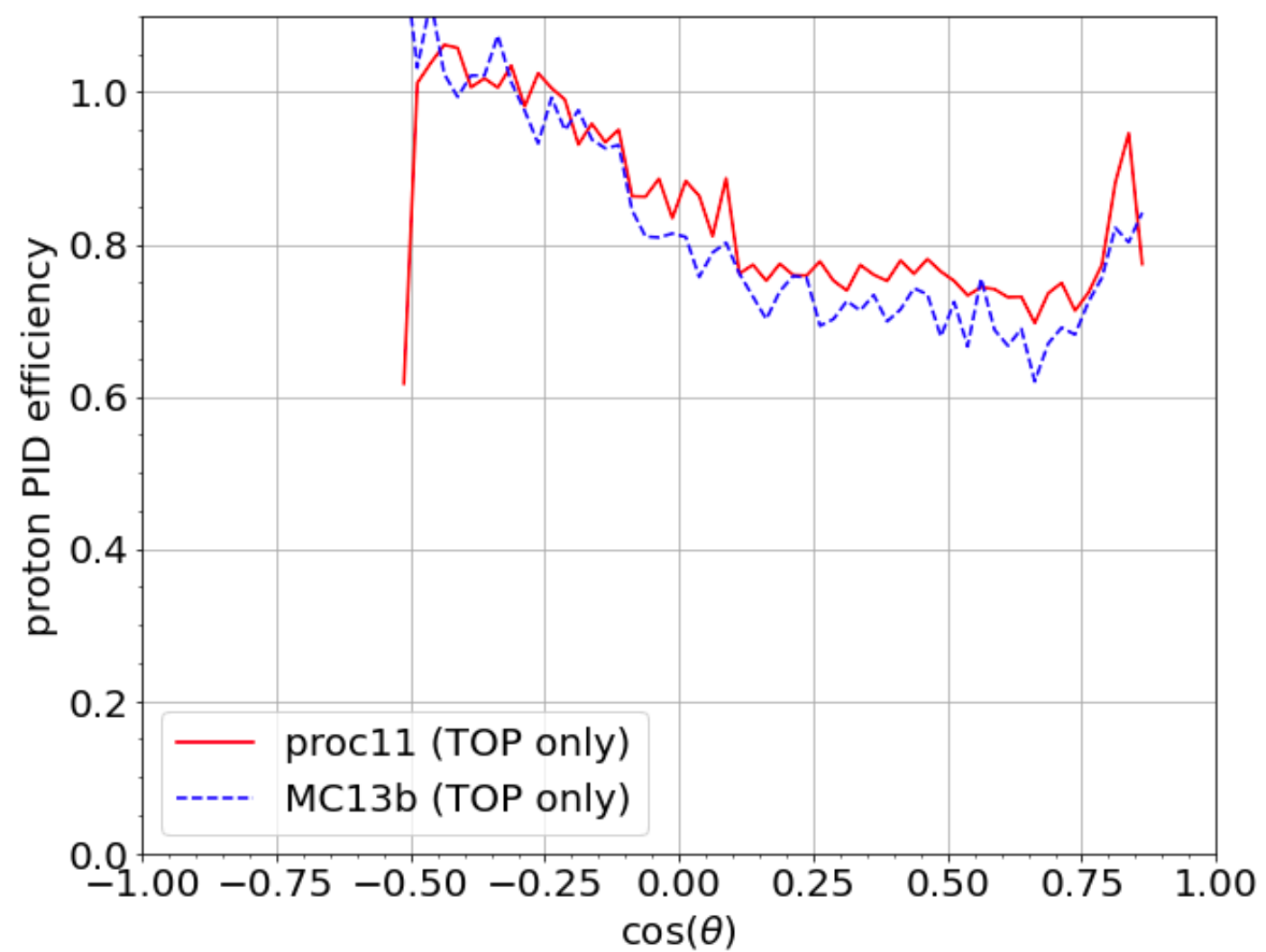


Proton PID performance in the TOP: $\mathcal{L}(p) > \mathcal{L}(e)$

release-05

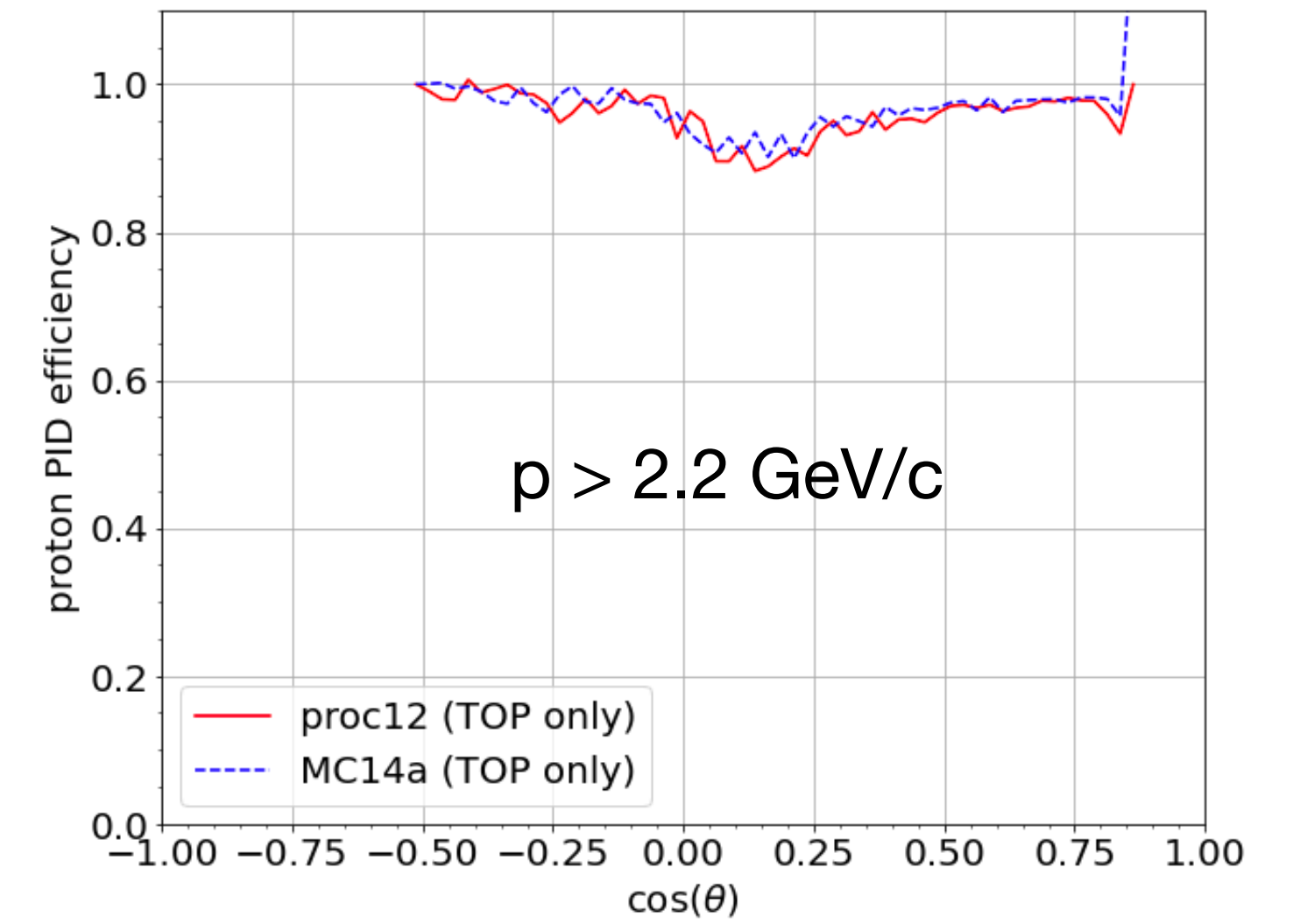
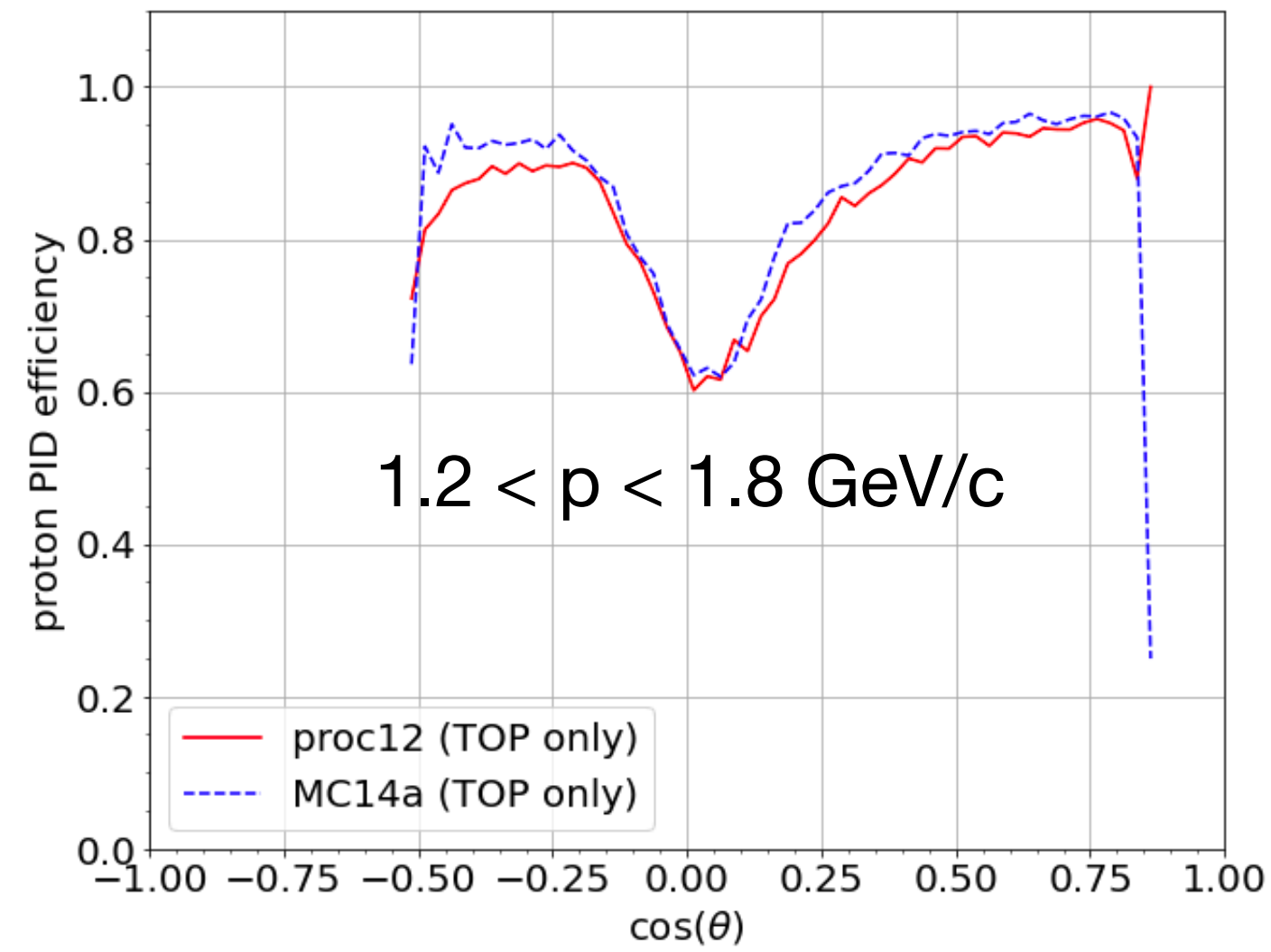
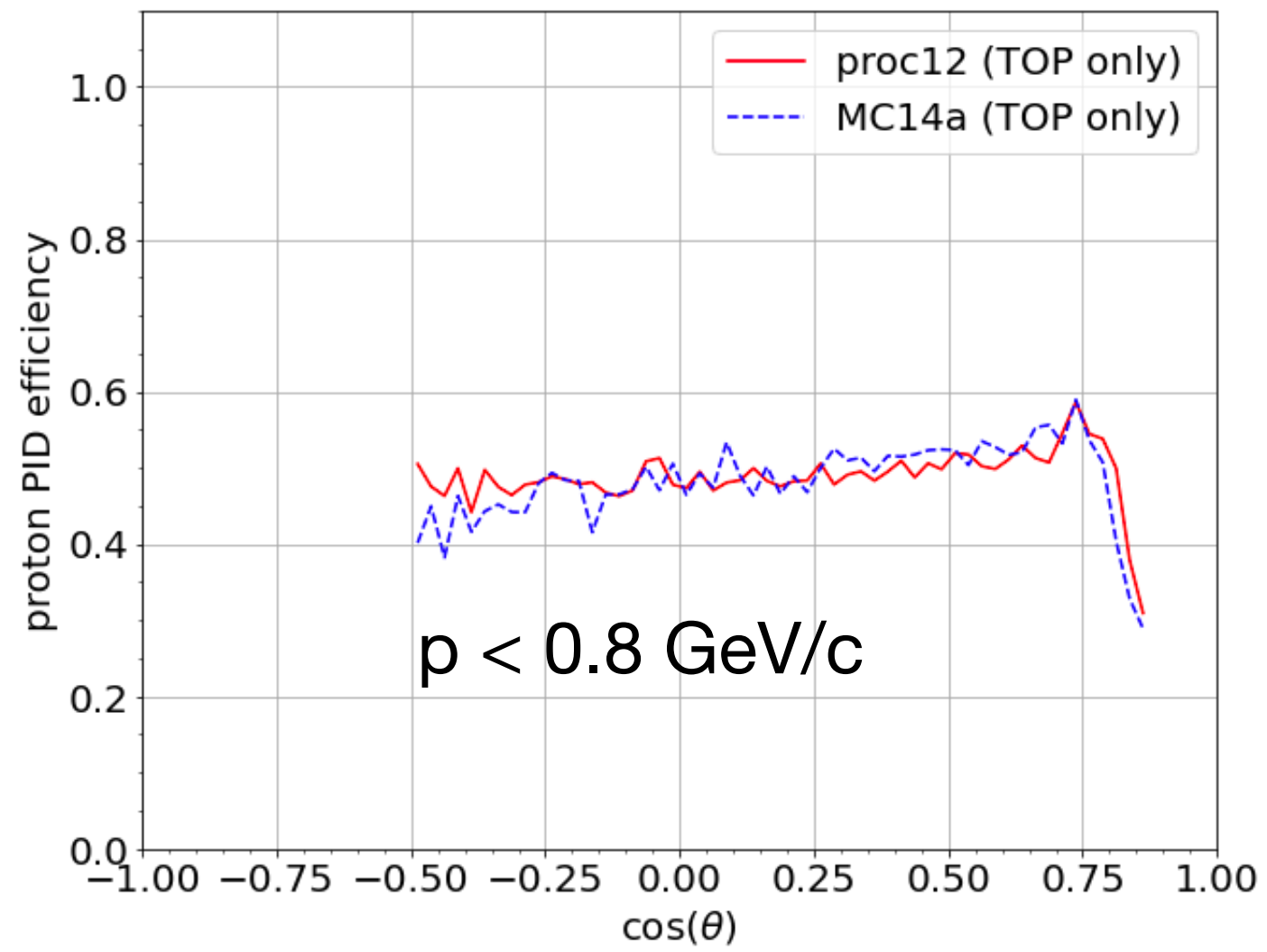


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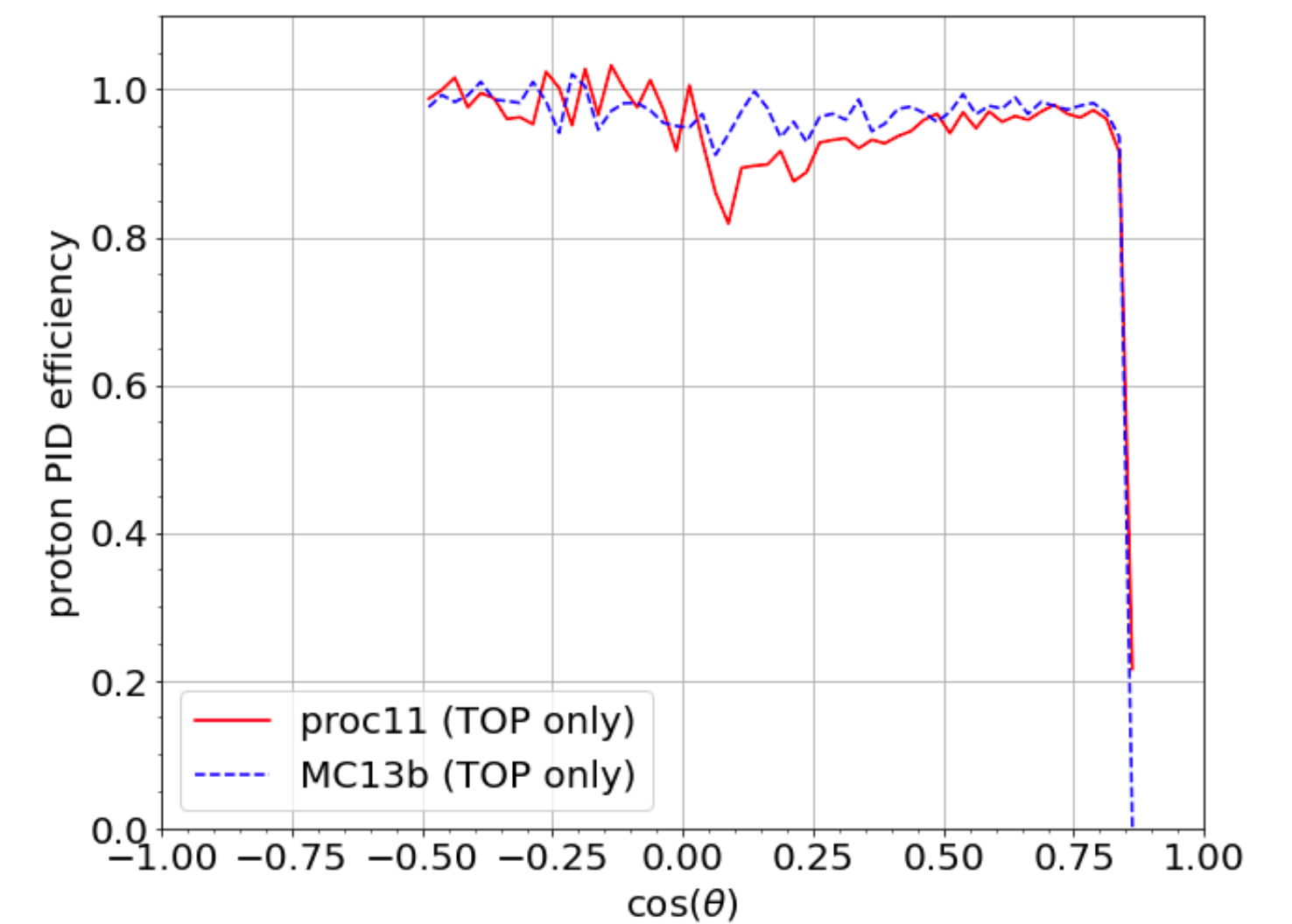
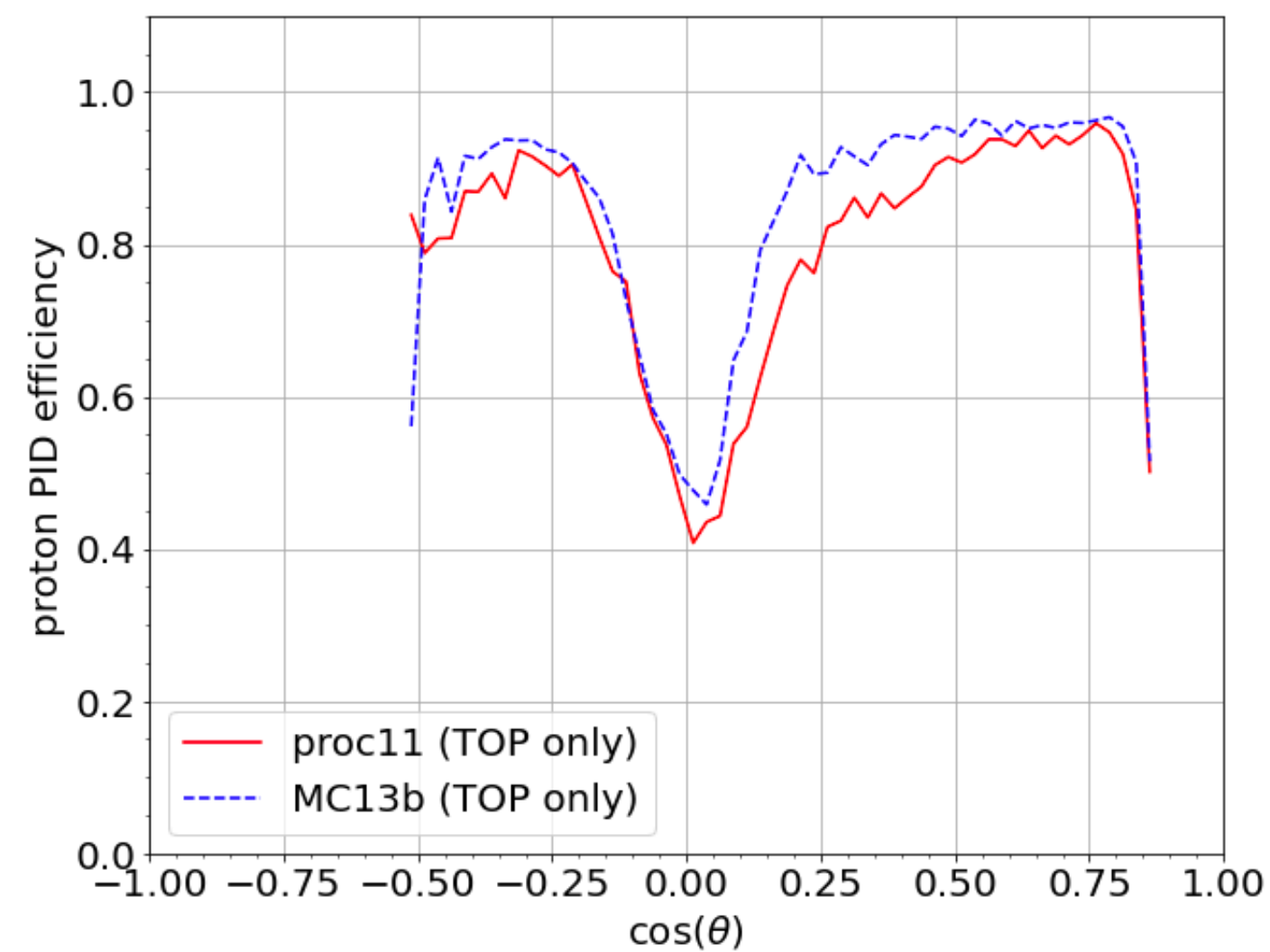
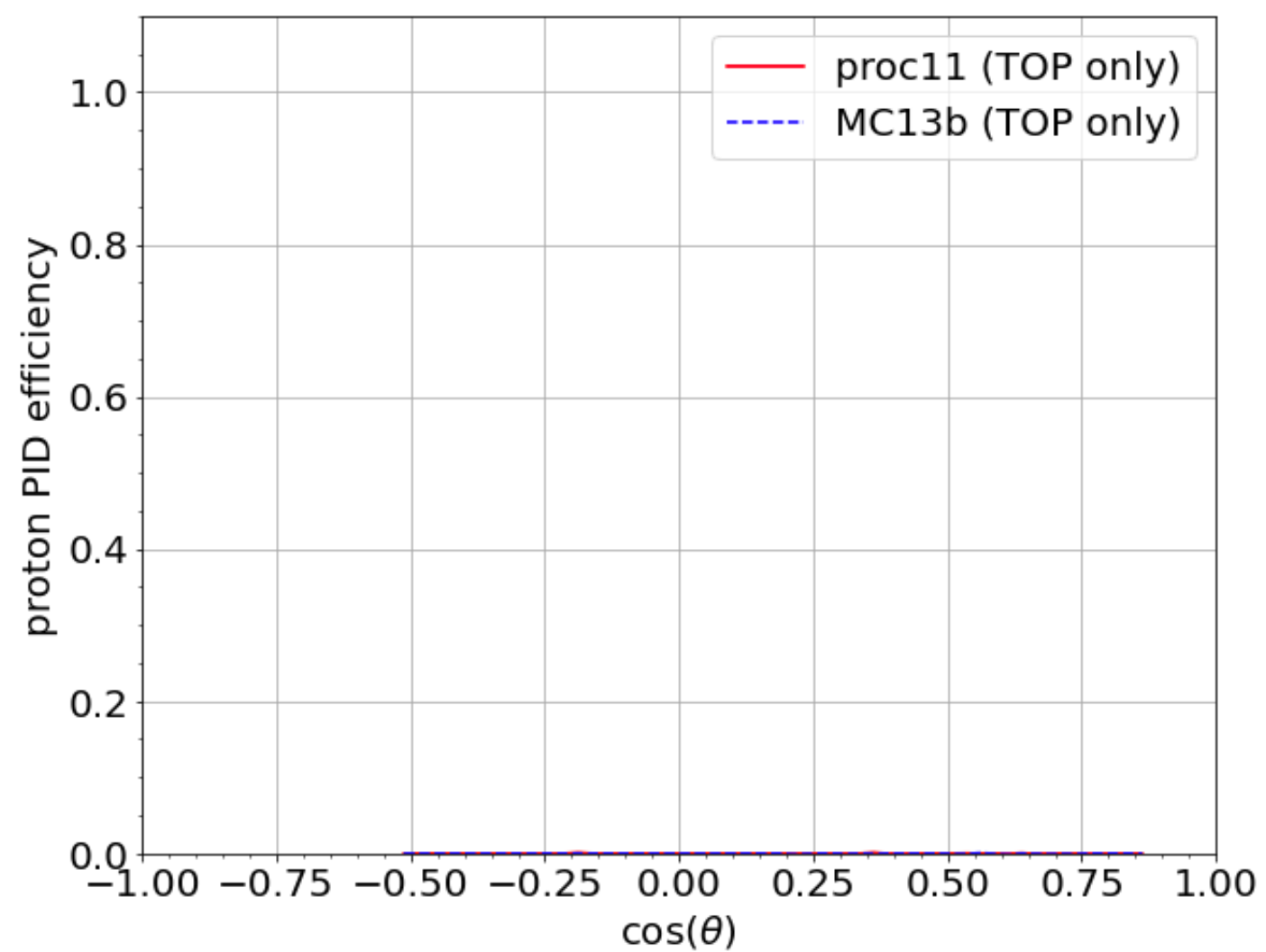


Proton PID performance in the TOP: $\mathcal{L}(p) > \mathcal{L}(d)$

release-05

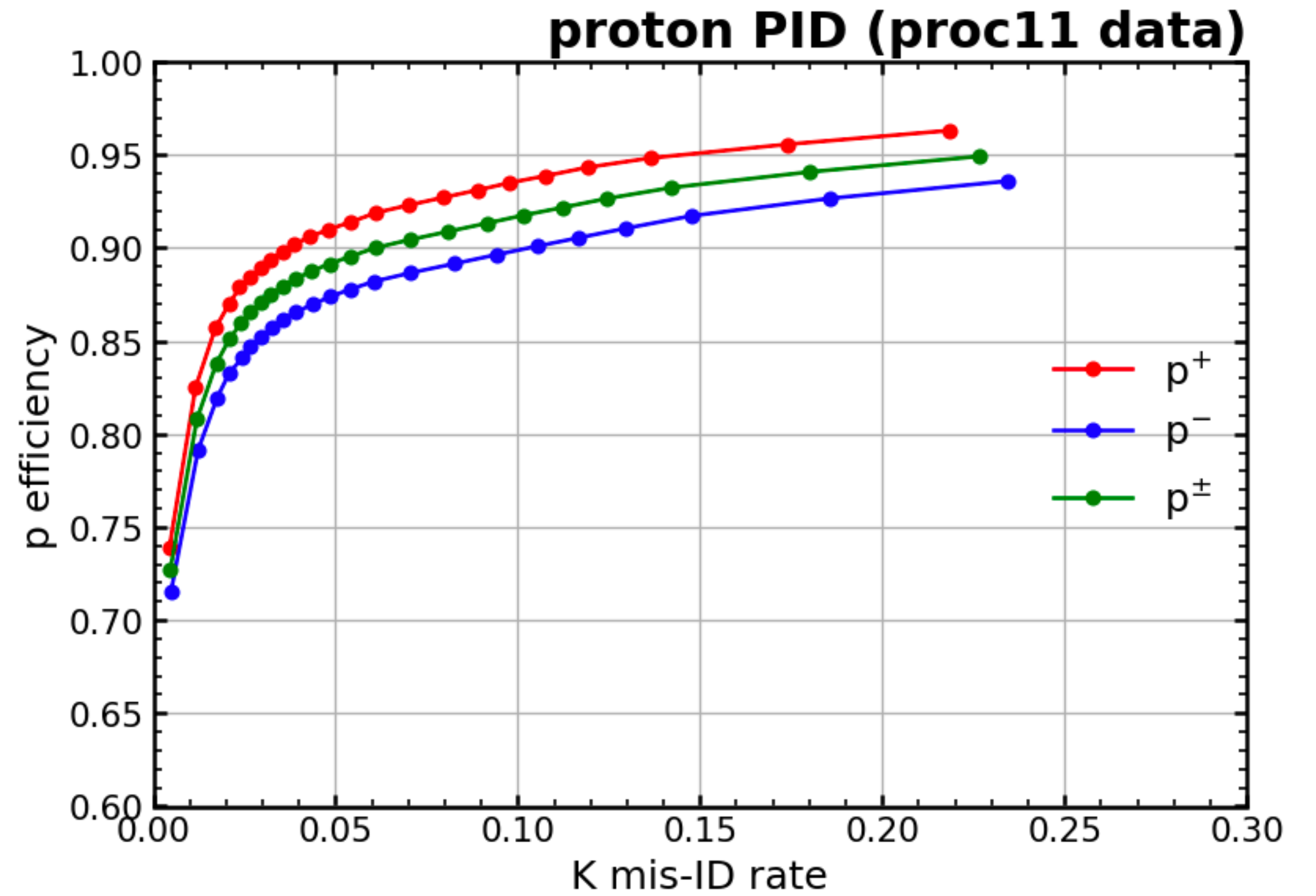
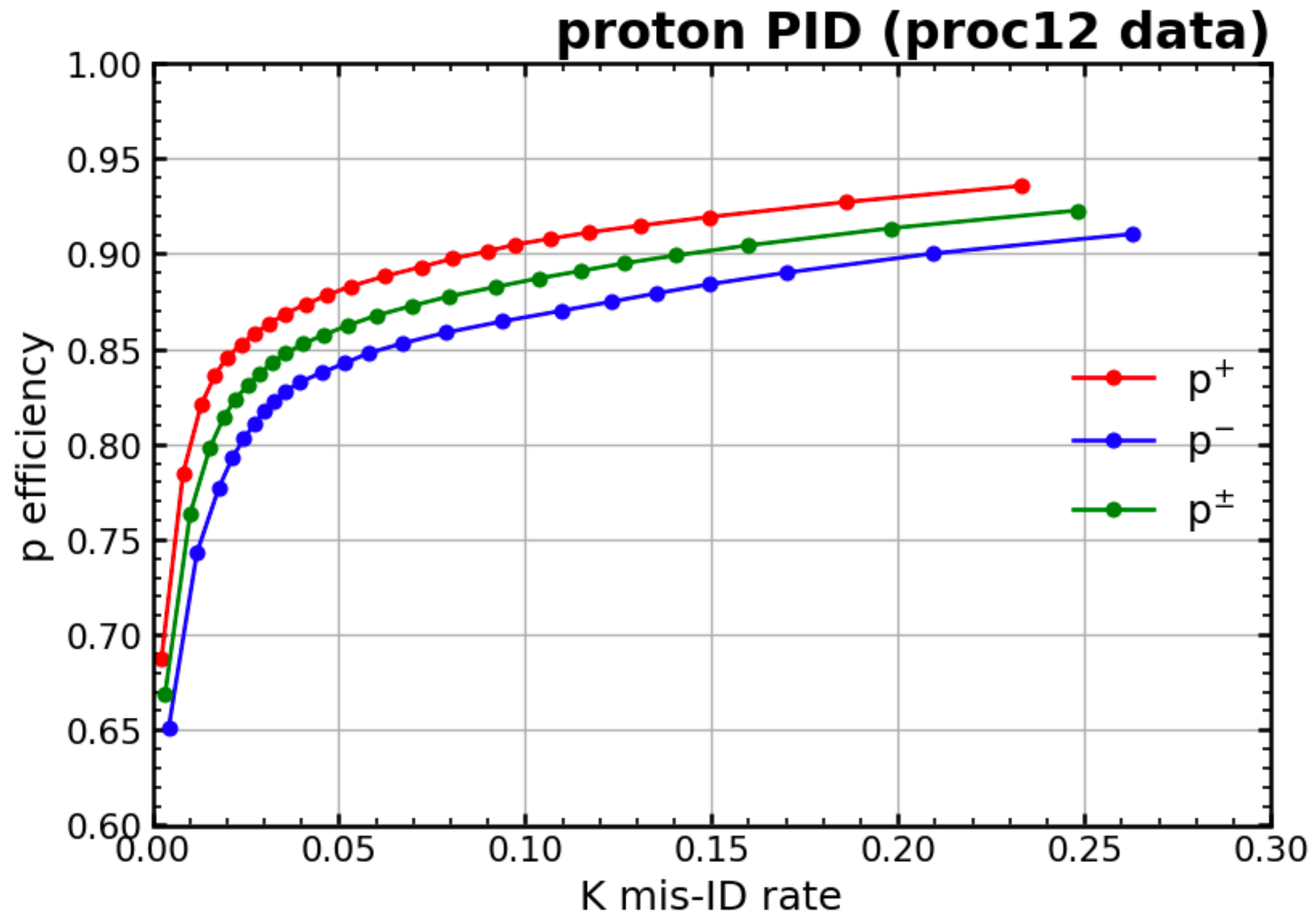


release-04



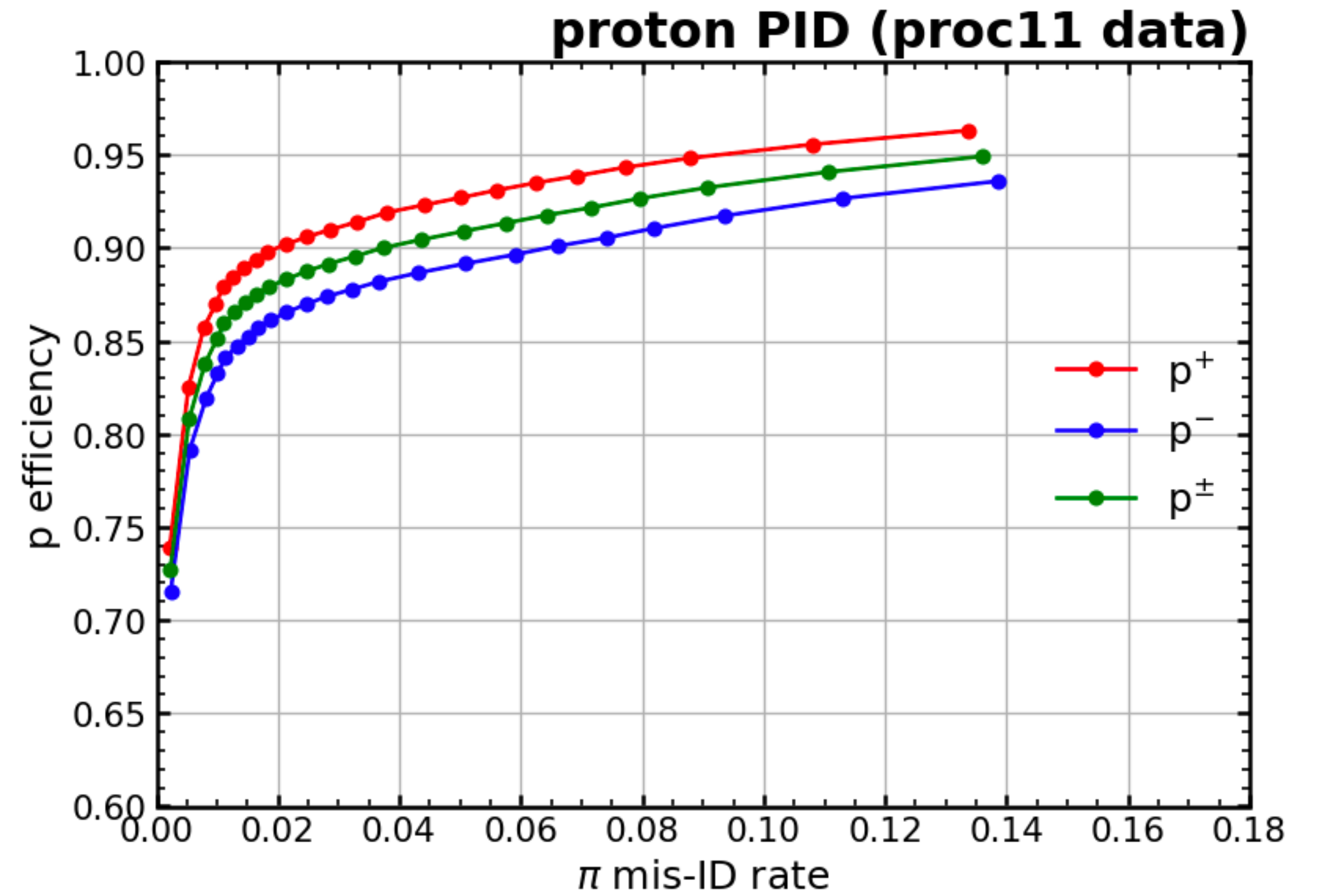
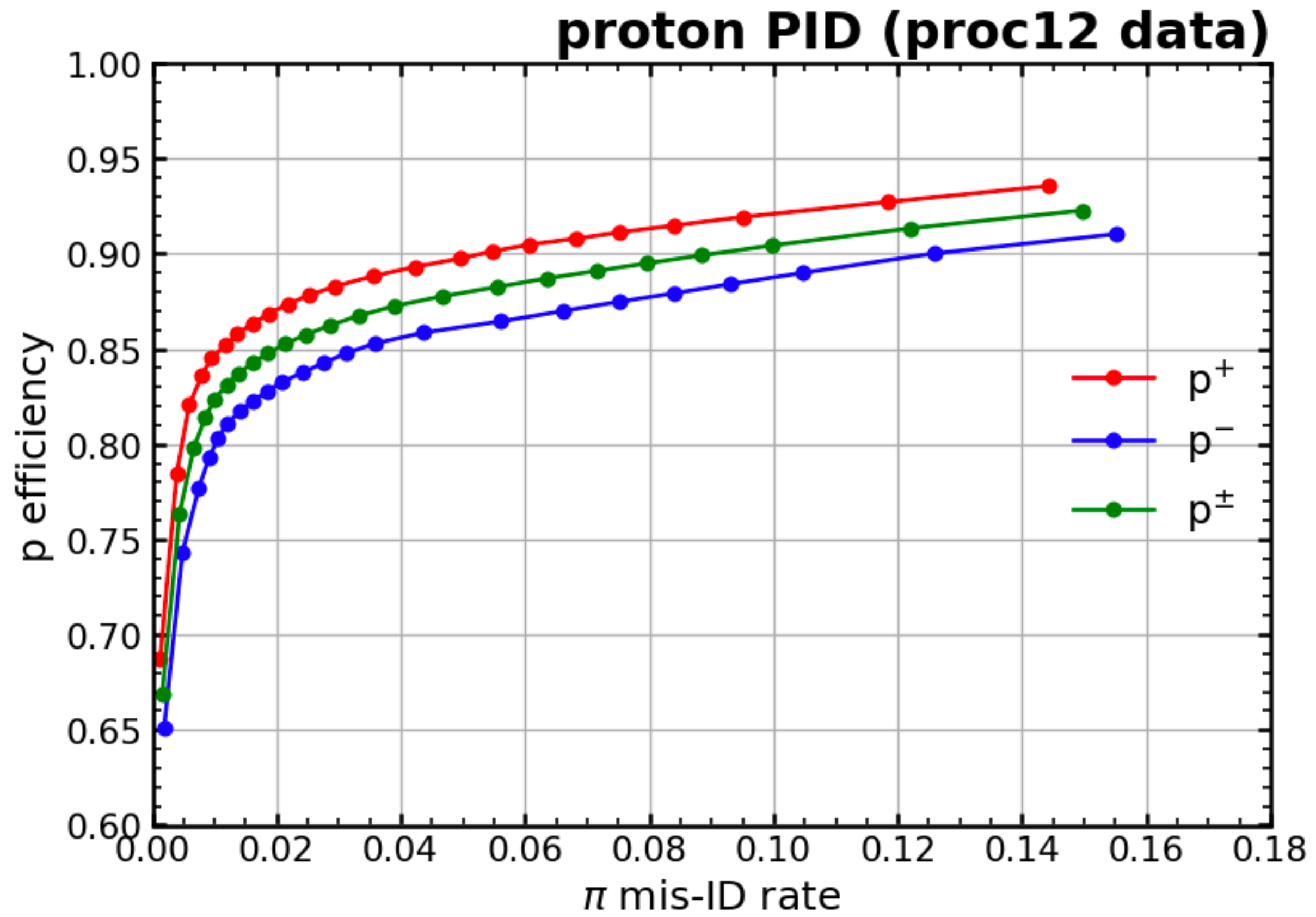
ROC curves

- Substantial remaining charge asymmetry



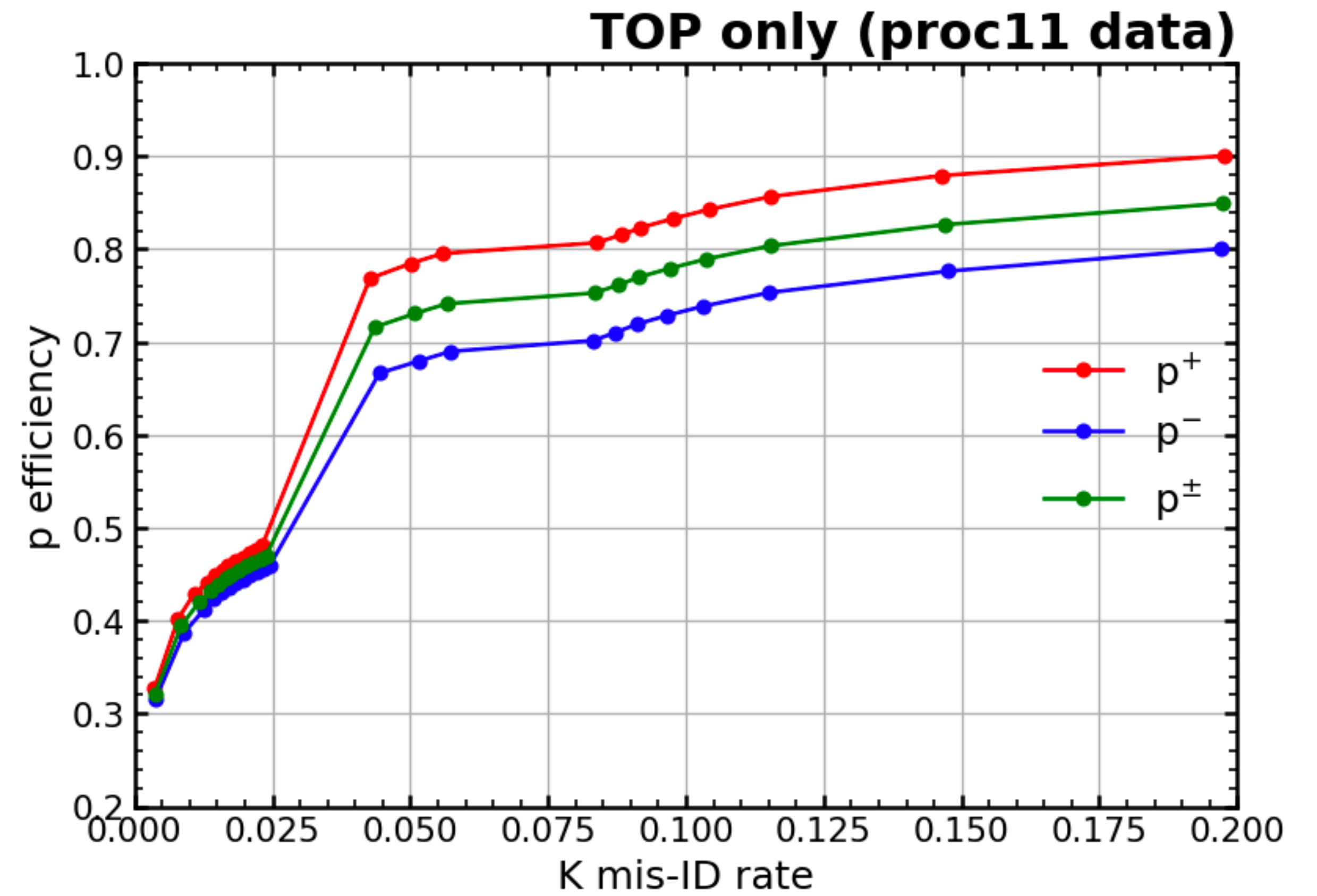
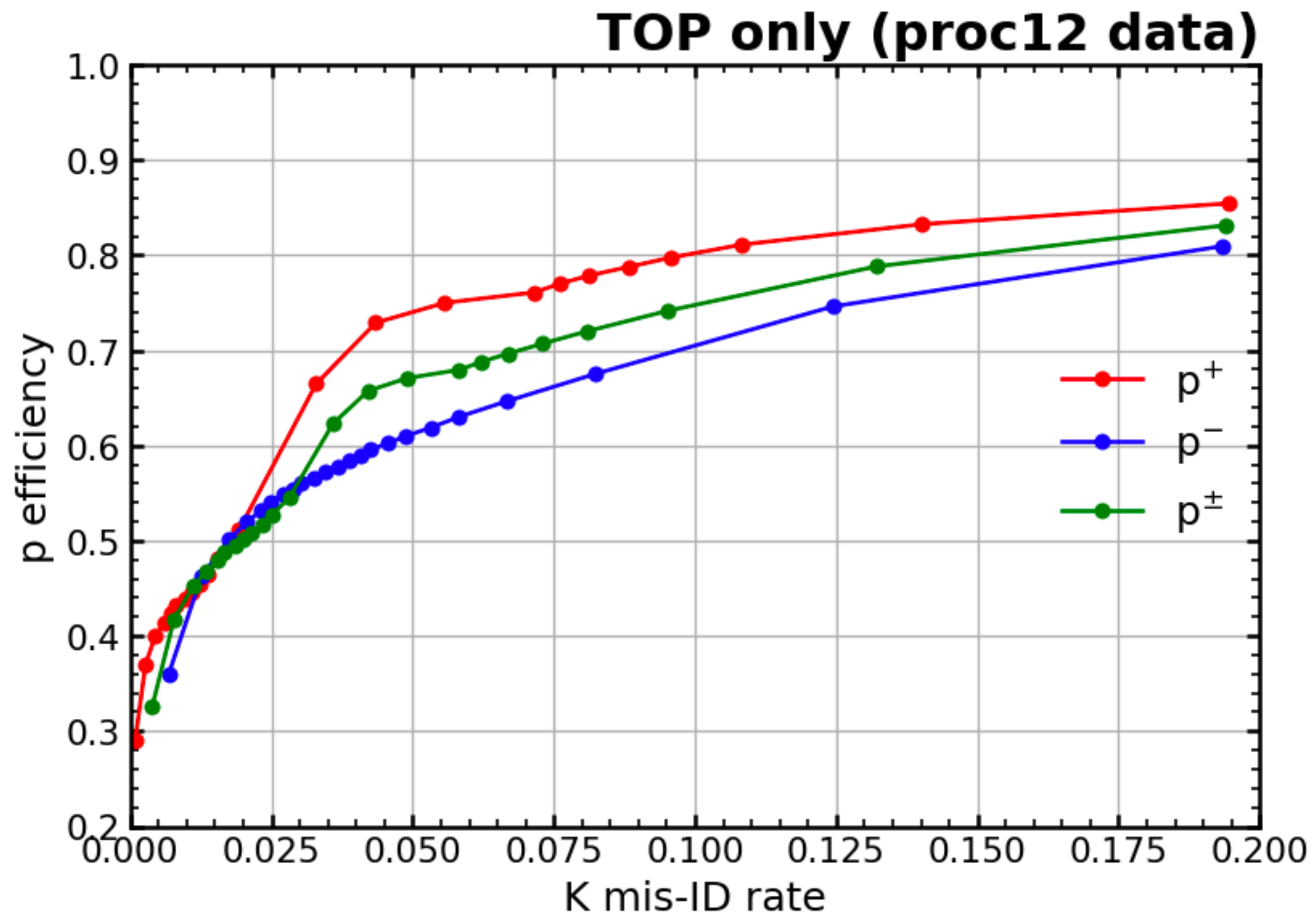
ROC curves

- Substantial remaining charge asymmetry



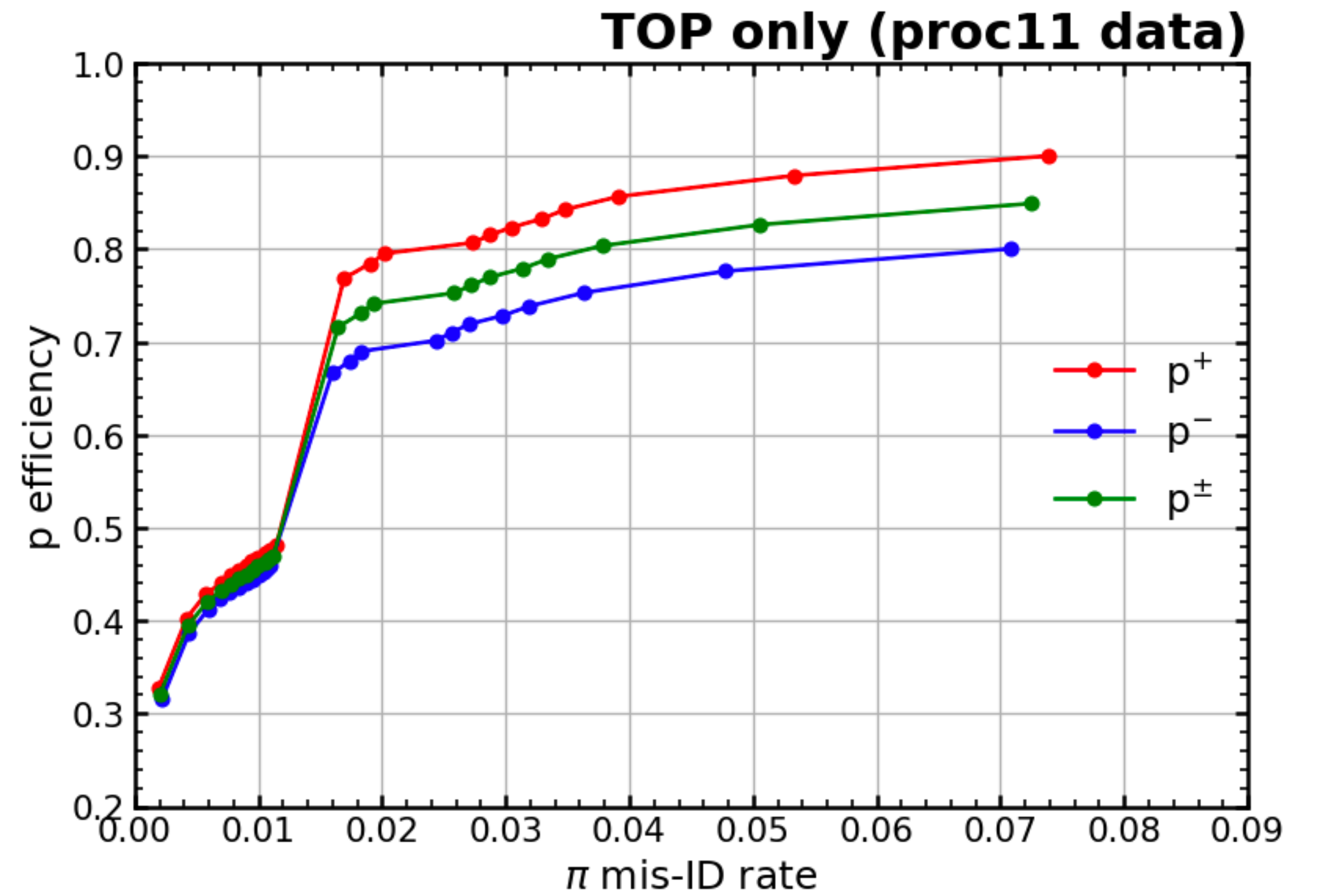
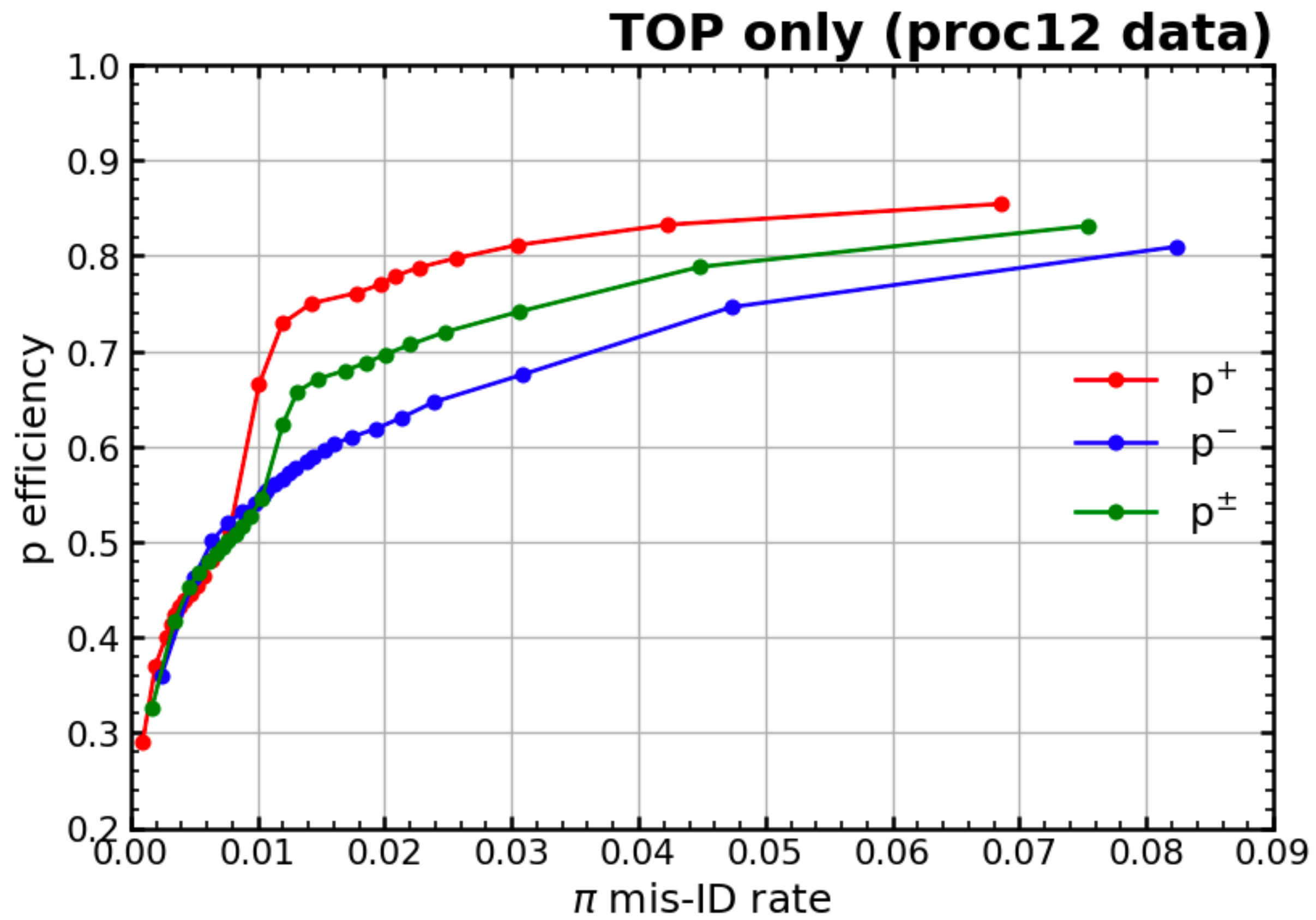
ROC curves

- Substantial remaining charge asymmetry

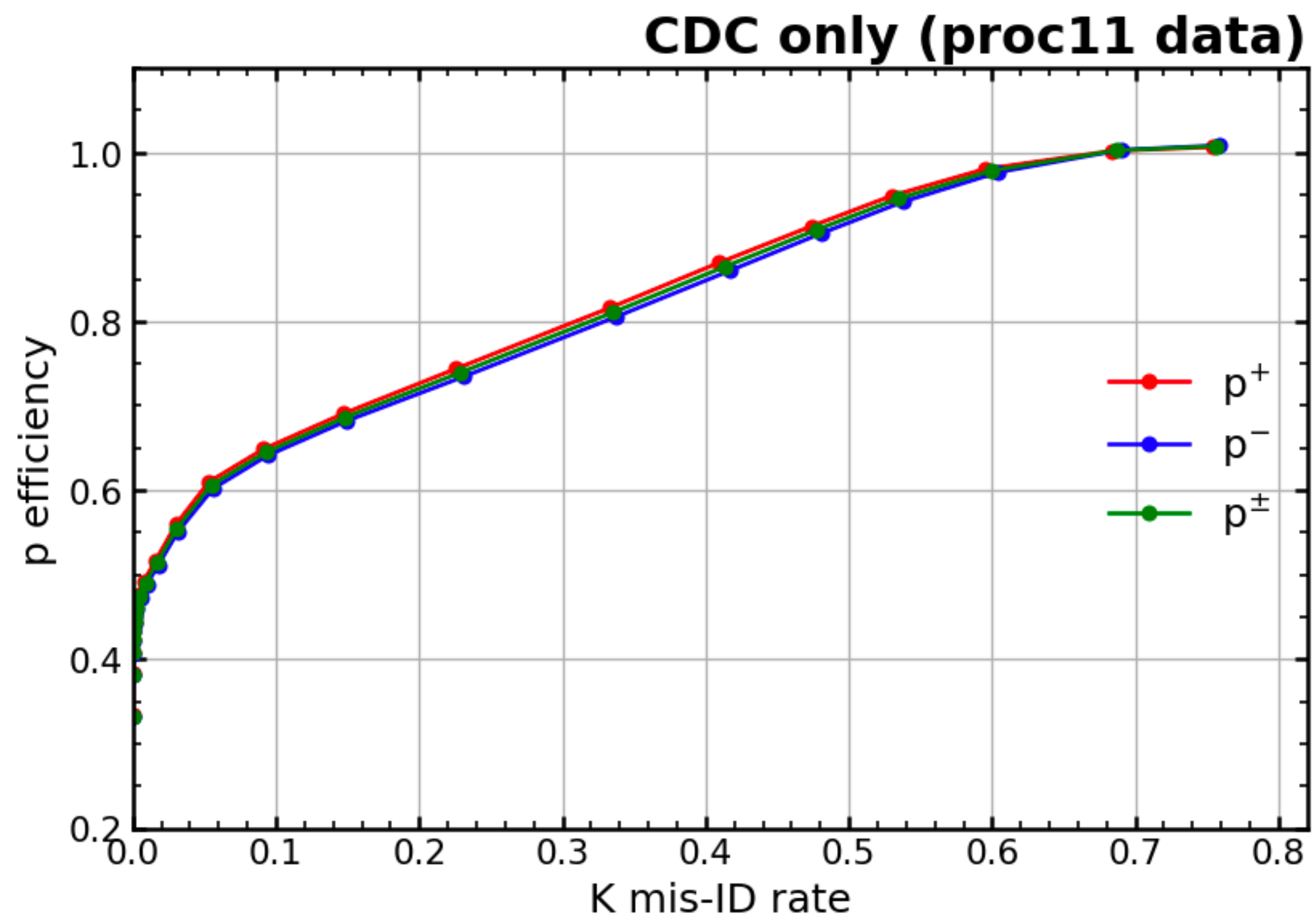
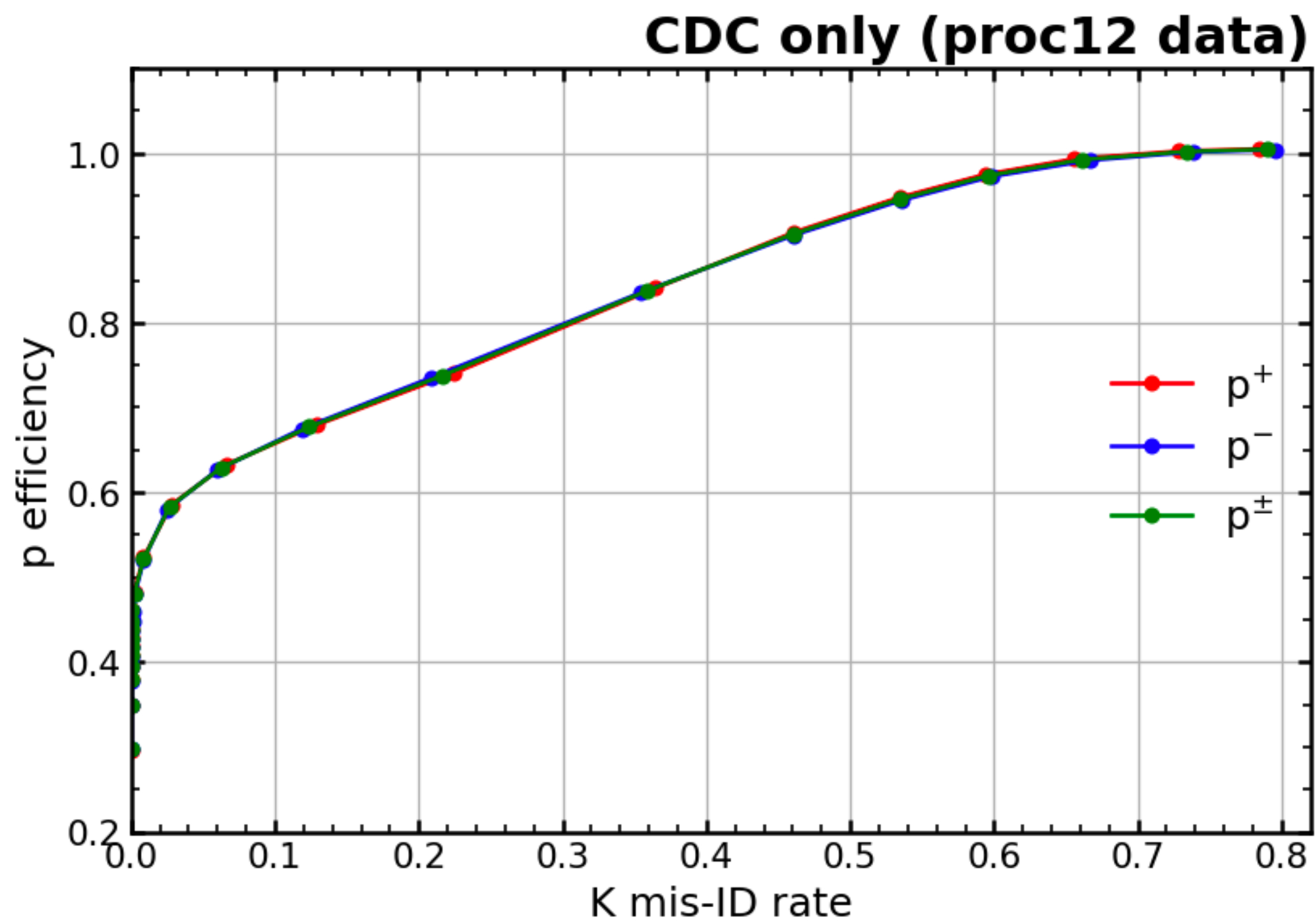


ROC curves

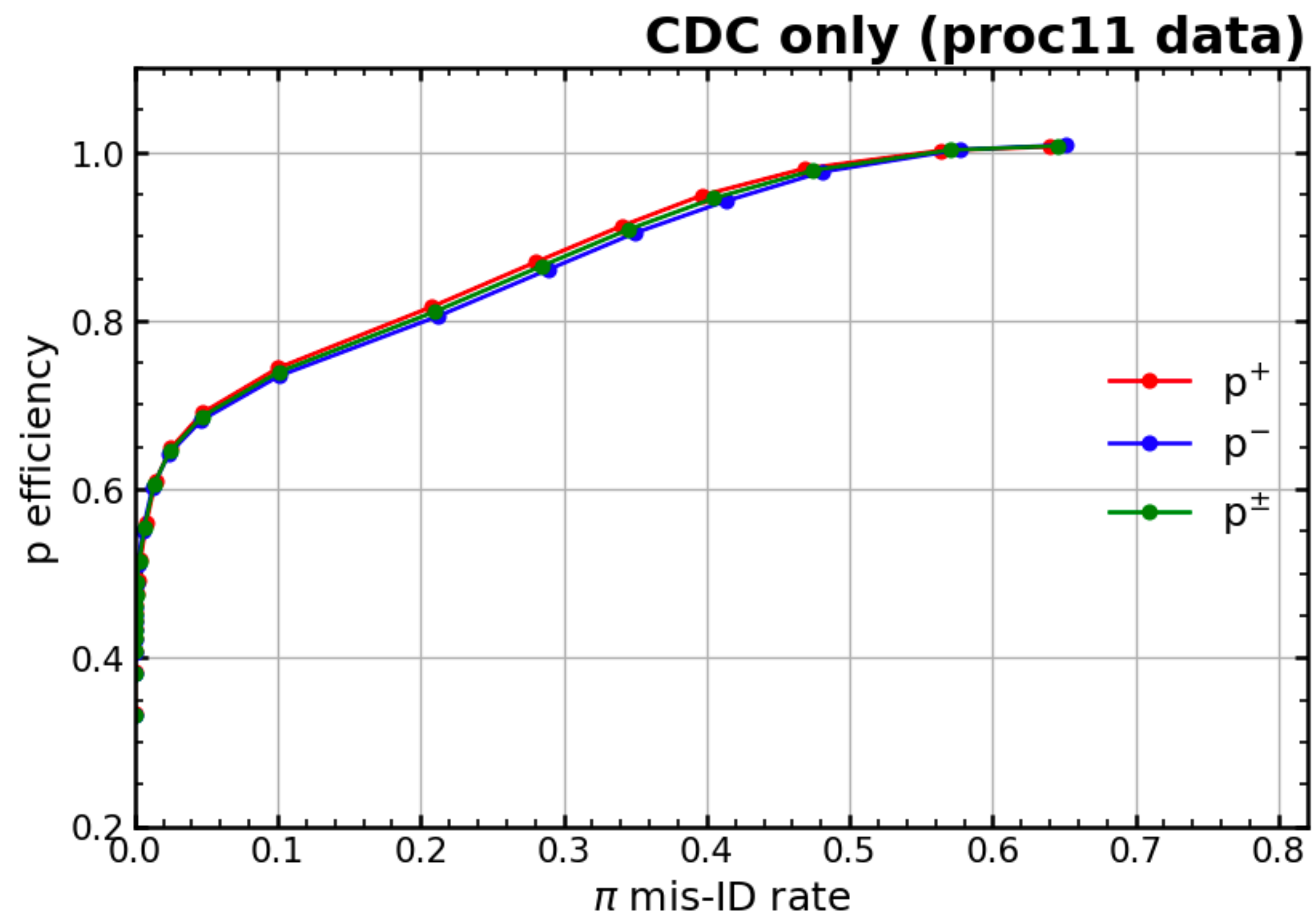
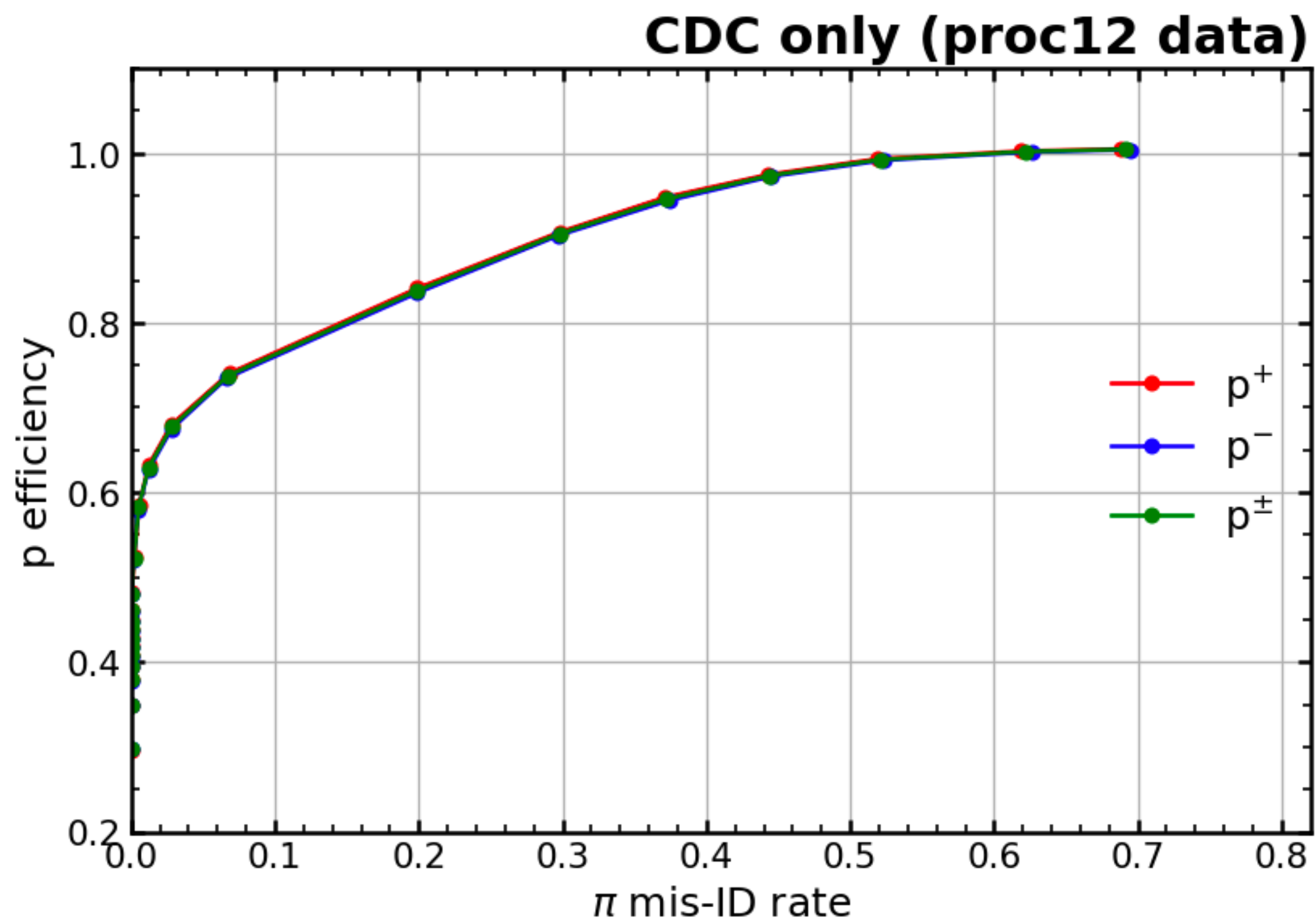
- Substantial remaining charge asymmetry



ROC curves

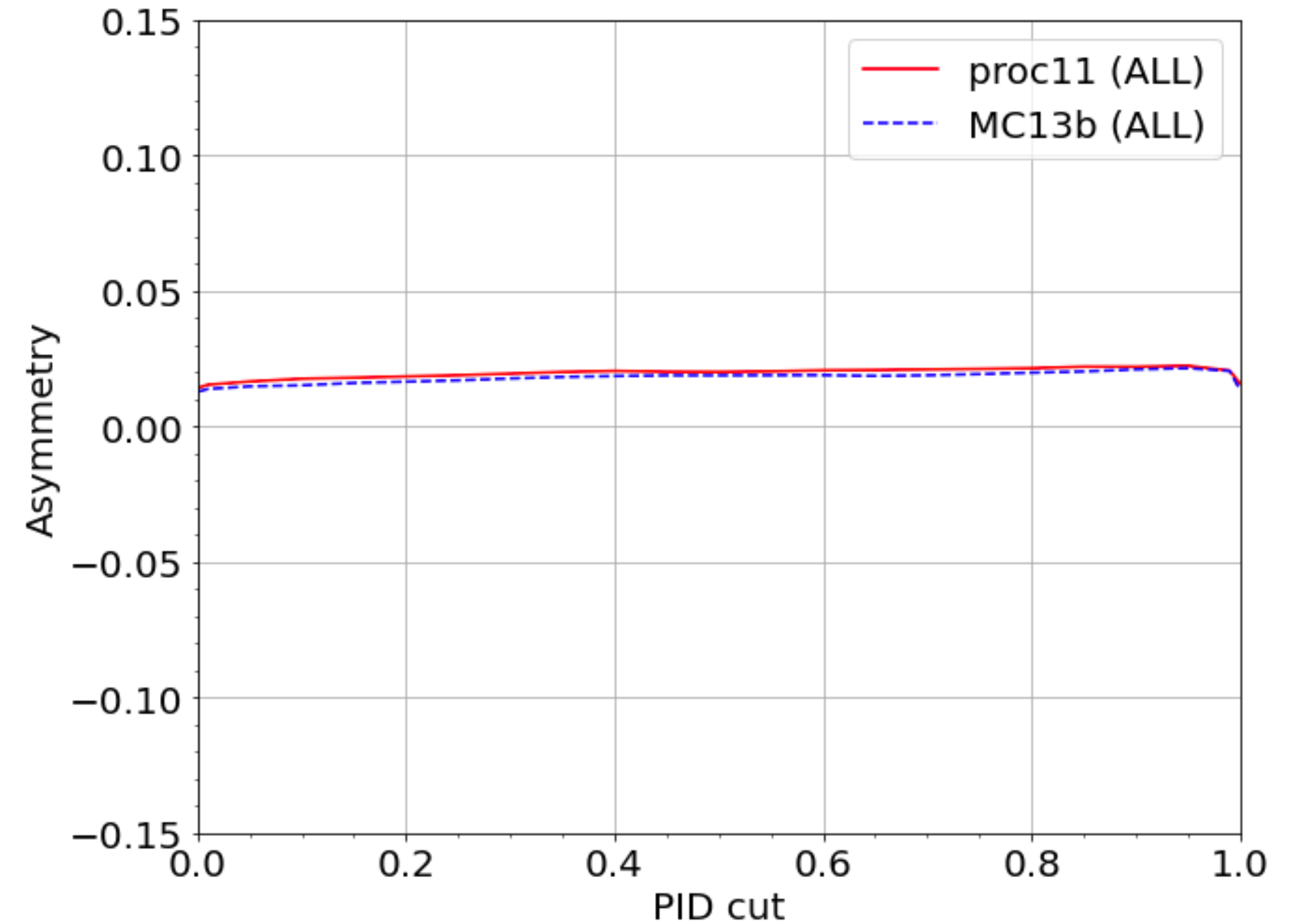
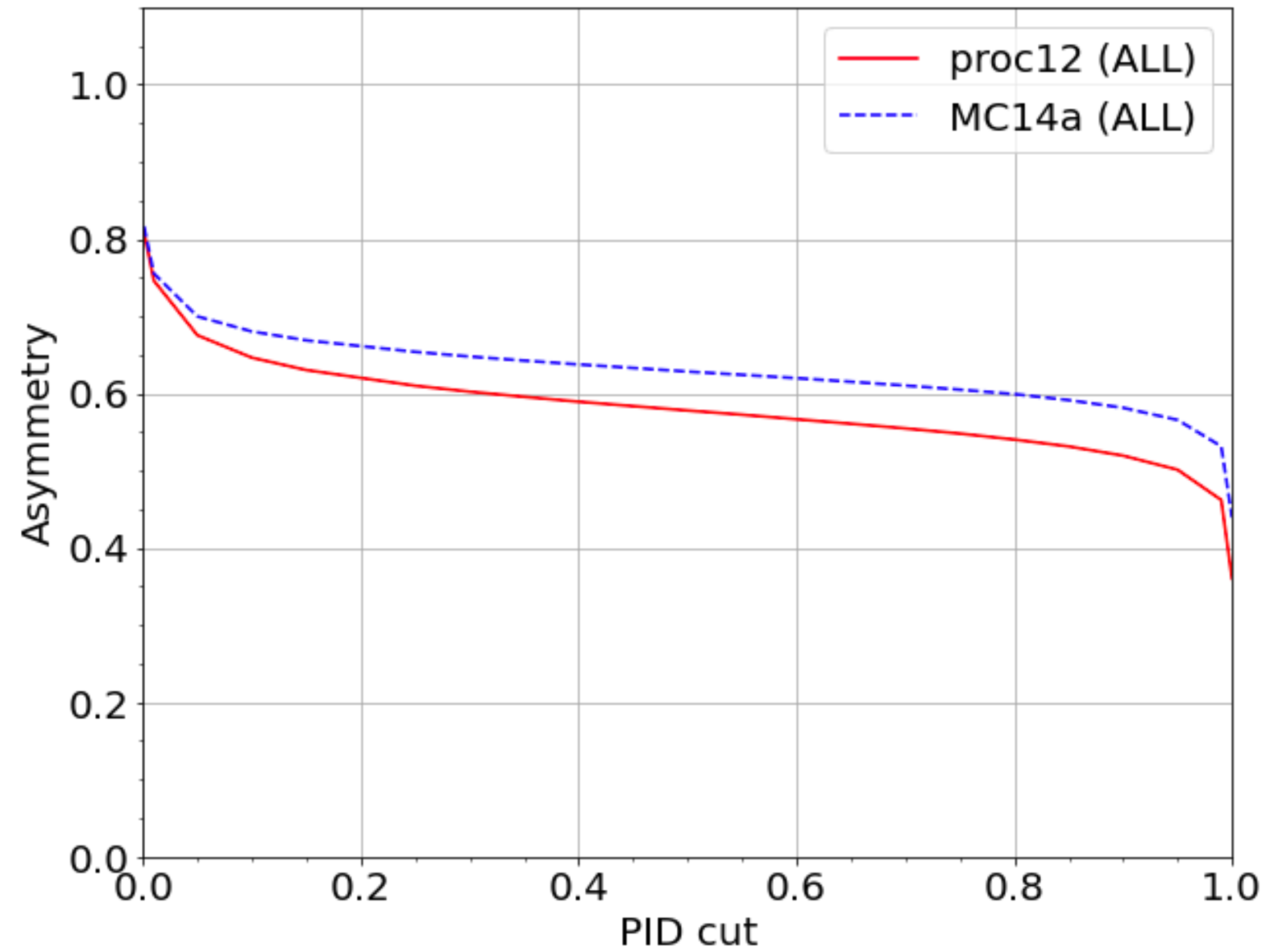


ROC curves



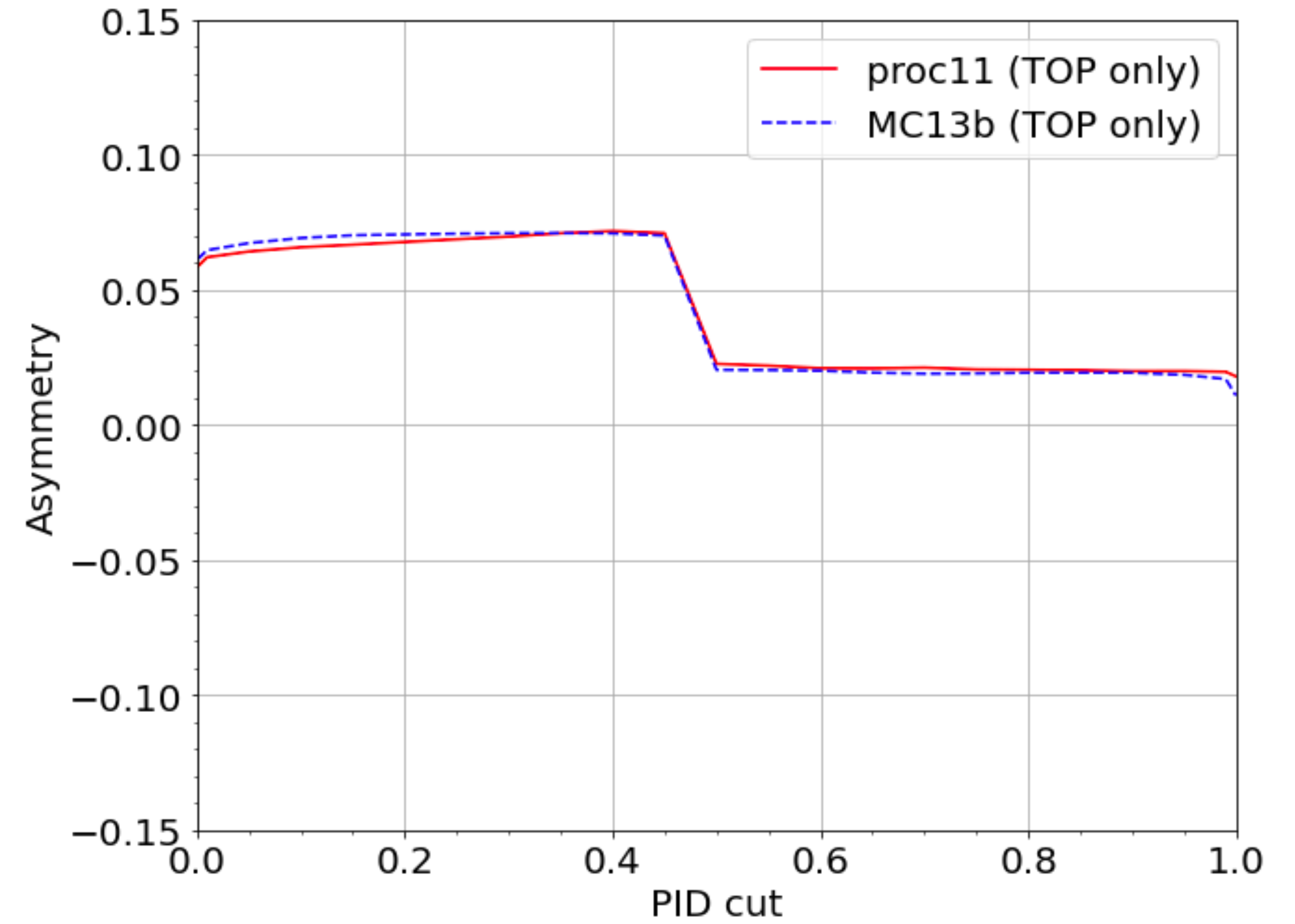
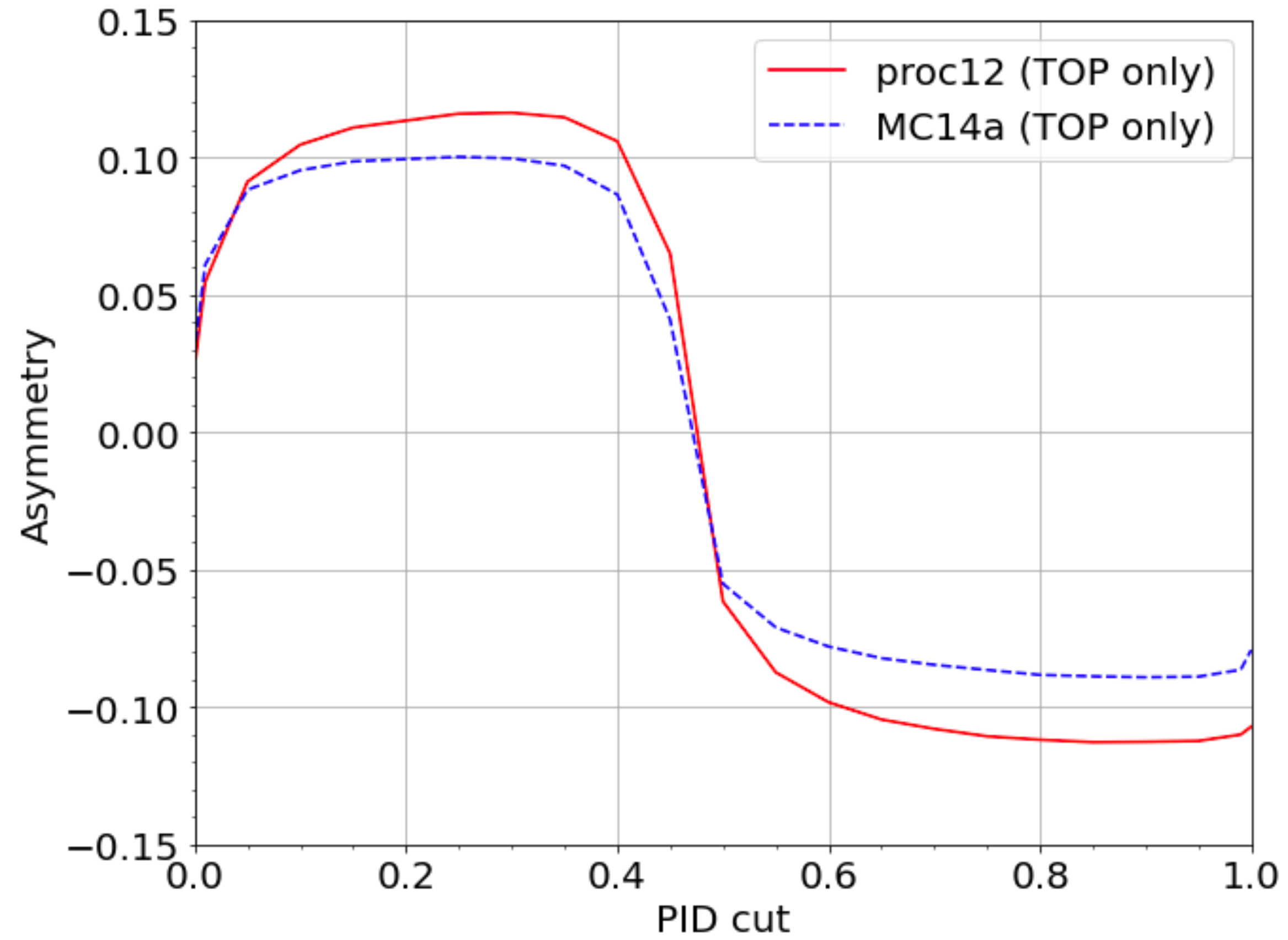
Proton PID efficiency asymmetry

$$\text{Asymmetry} = \frac{e_+ - e_-}{e_+ + e_-}$$



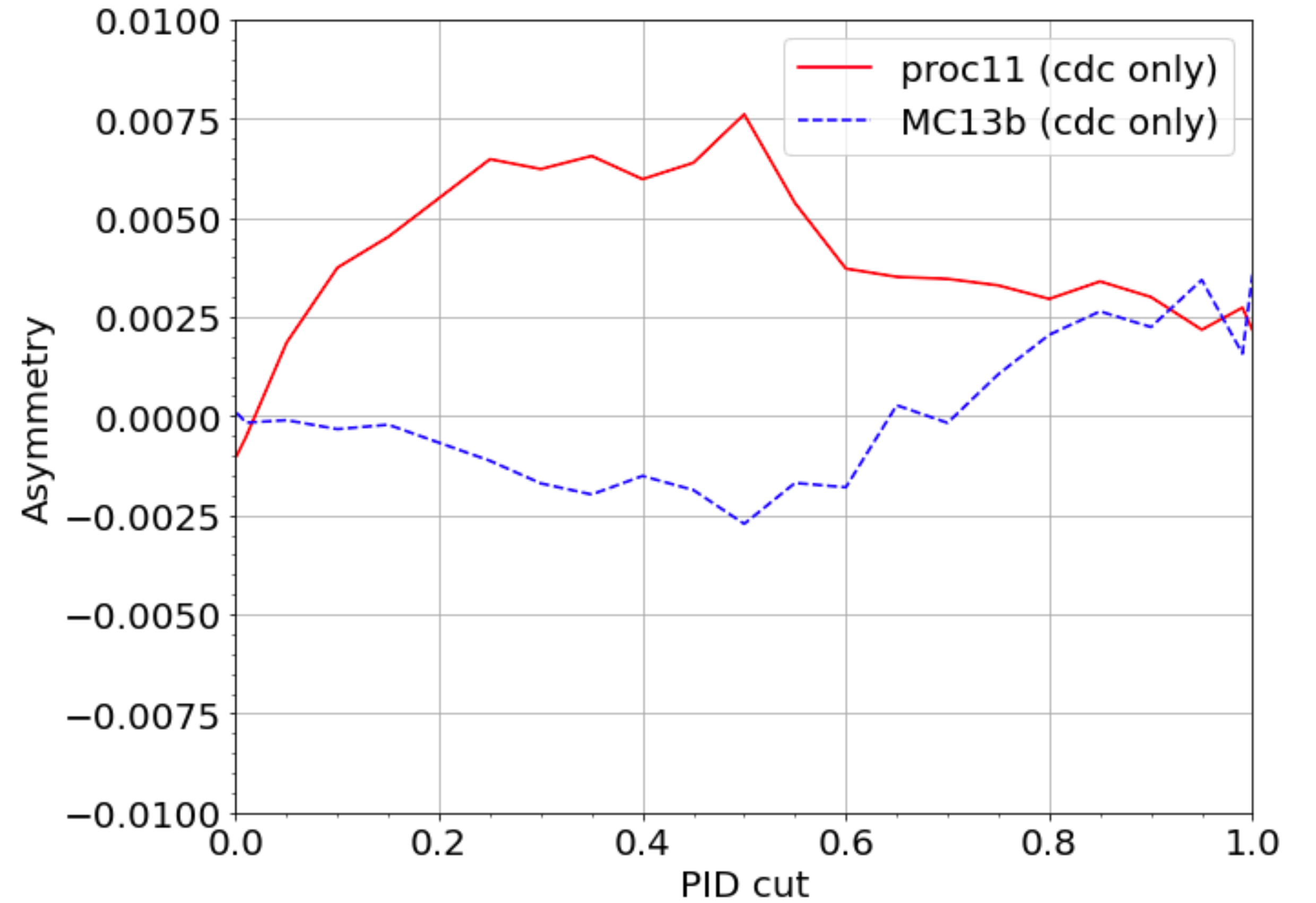
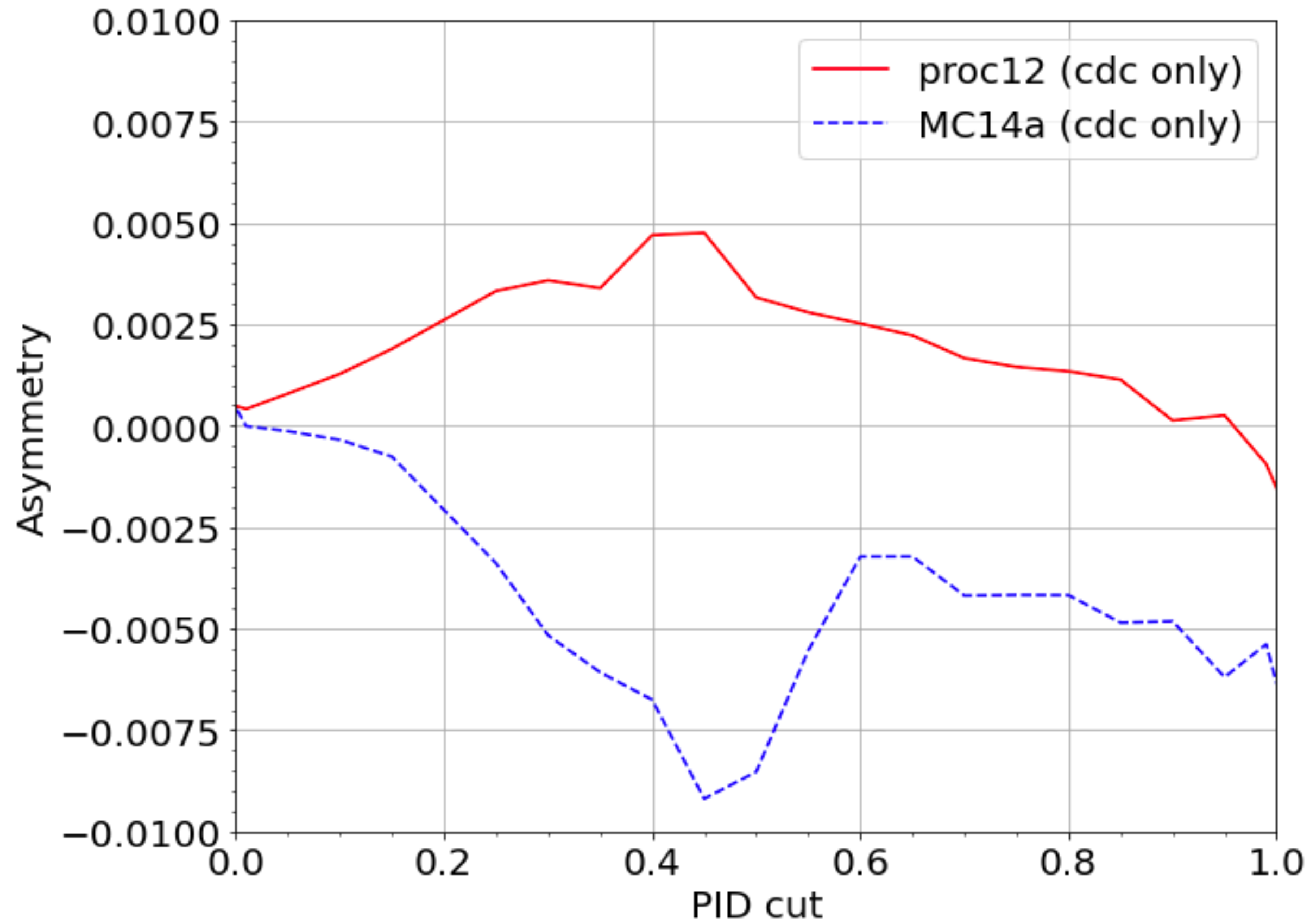
Proton PID efficiency asymmetry

$$\text{Asymmetry} = \frac{e_+ - e_-}{e_+ + e_-}$$

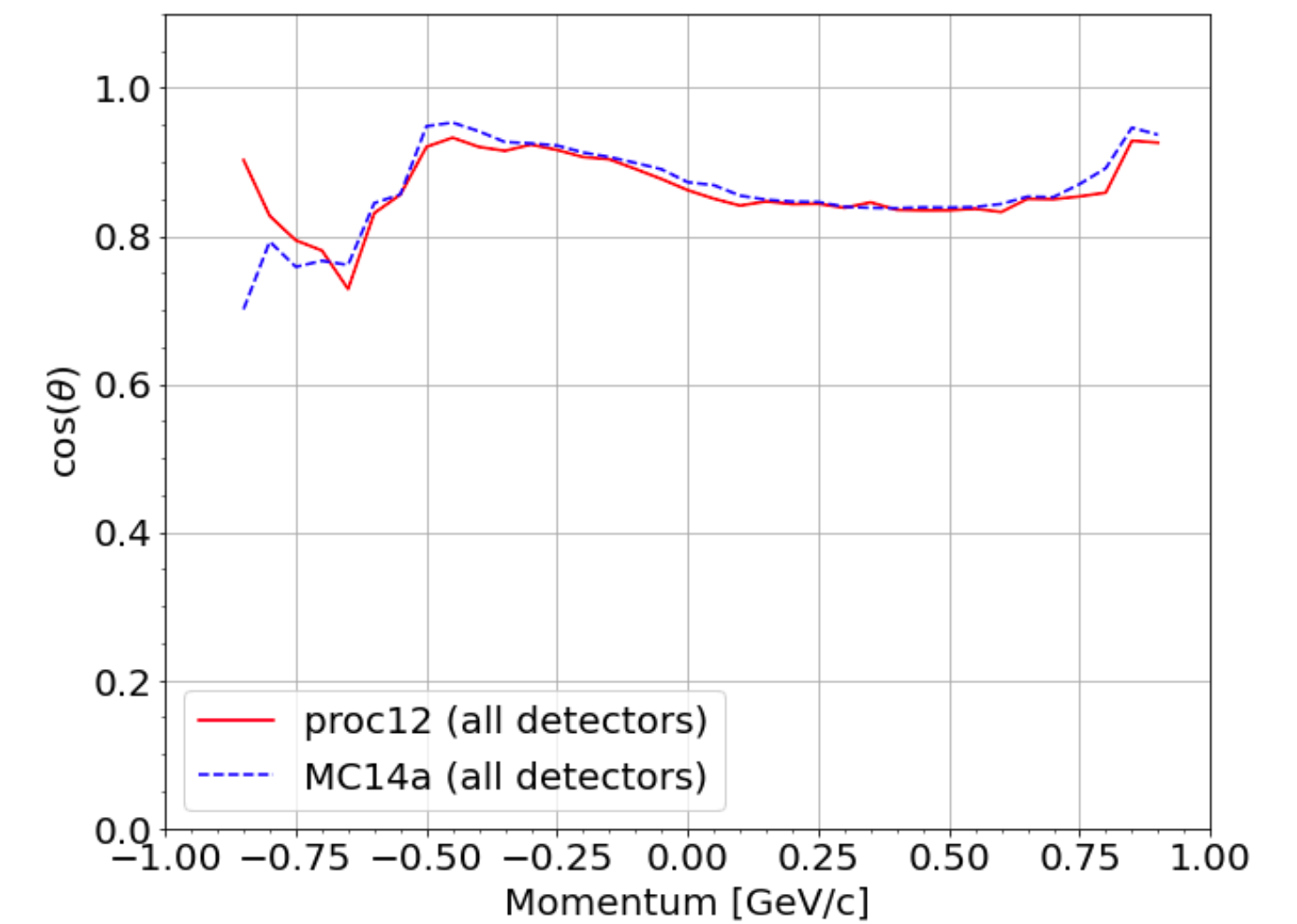
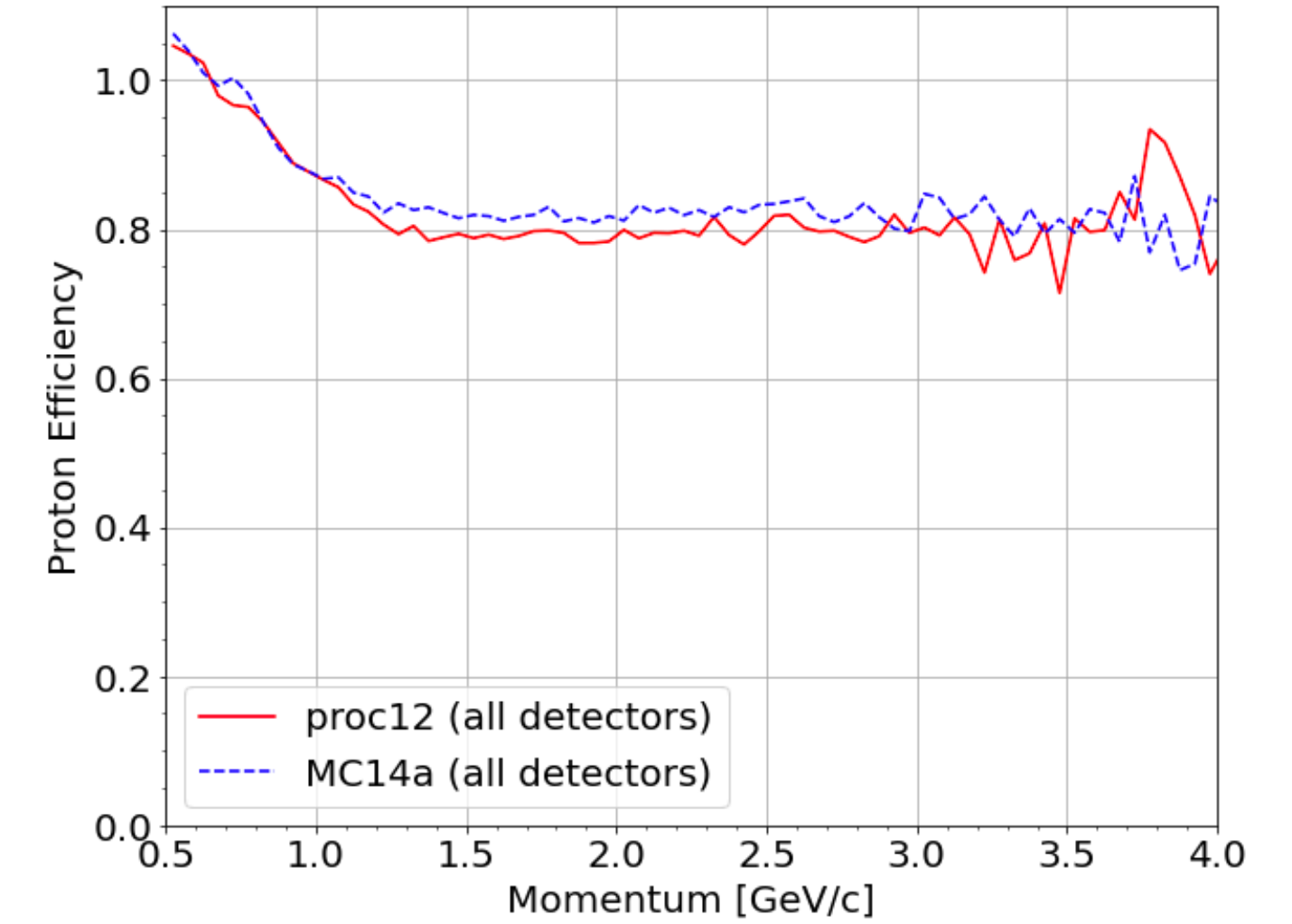
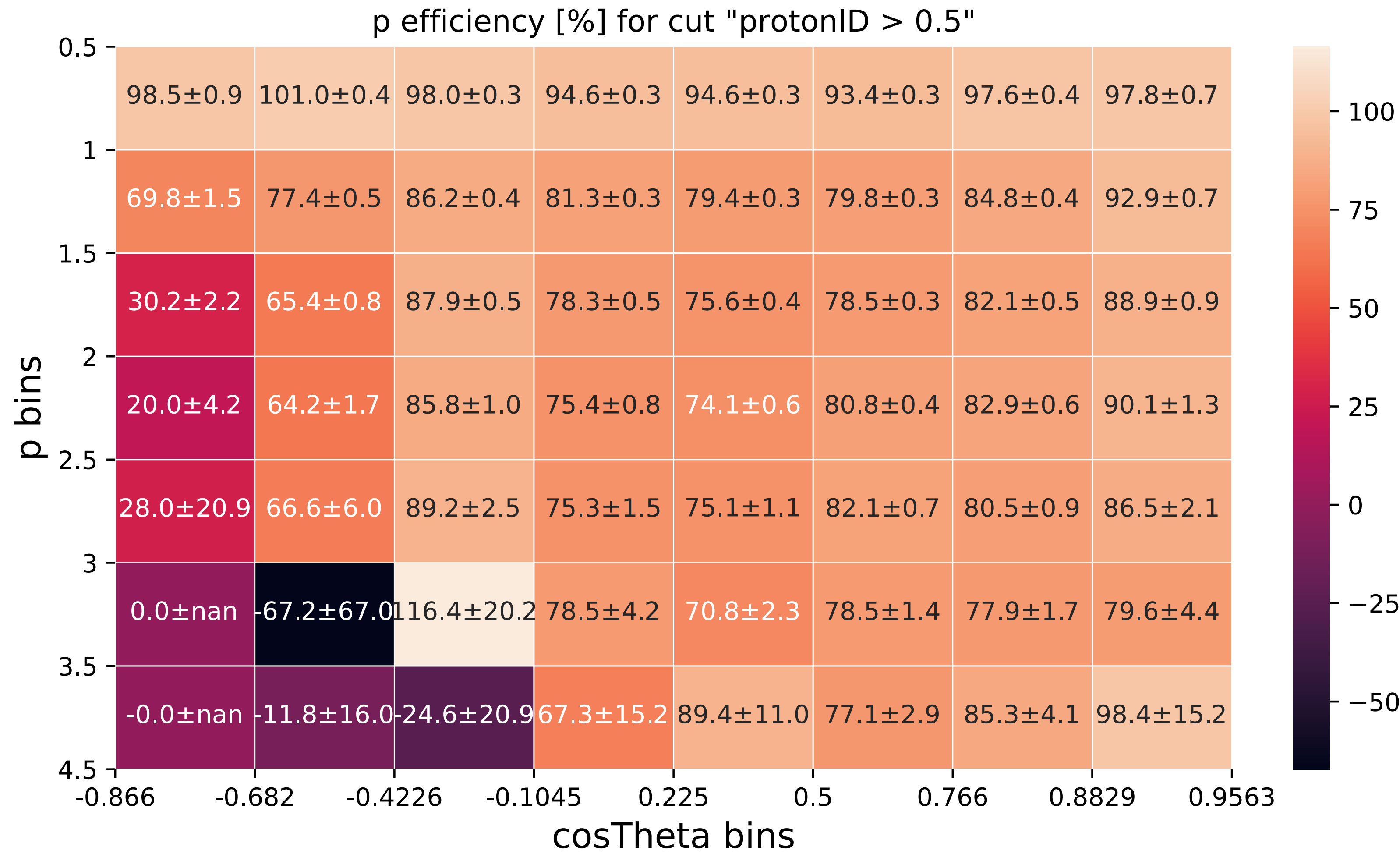


Proton PID efficiency asymmetry

$$\text{Asymmetry} = \frac{e_+ - e_-}{e_+ + e_-}$$



Efficiency table



Conclusions and next steps

- Much better proton PID efficiency agreement in proc12 and MC14
- Will update with MC14ri_a samples when available and include correction factors
- Still some apparent charge asymmetries that deserve attention