

Issues of p_T Resolutions & Tracking Efficiencies

Cheuk-Ping Wong

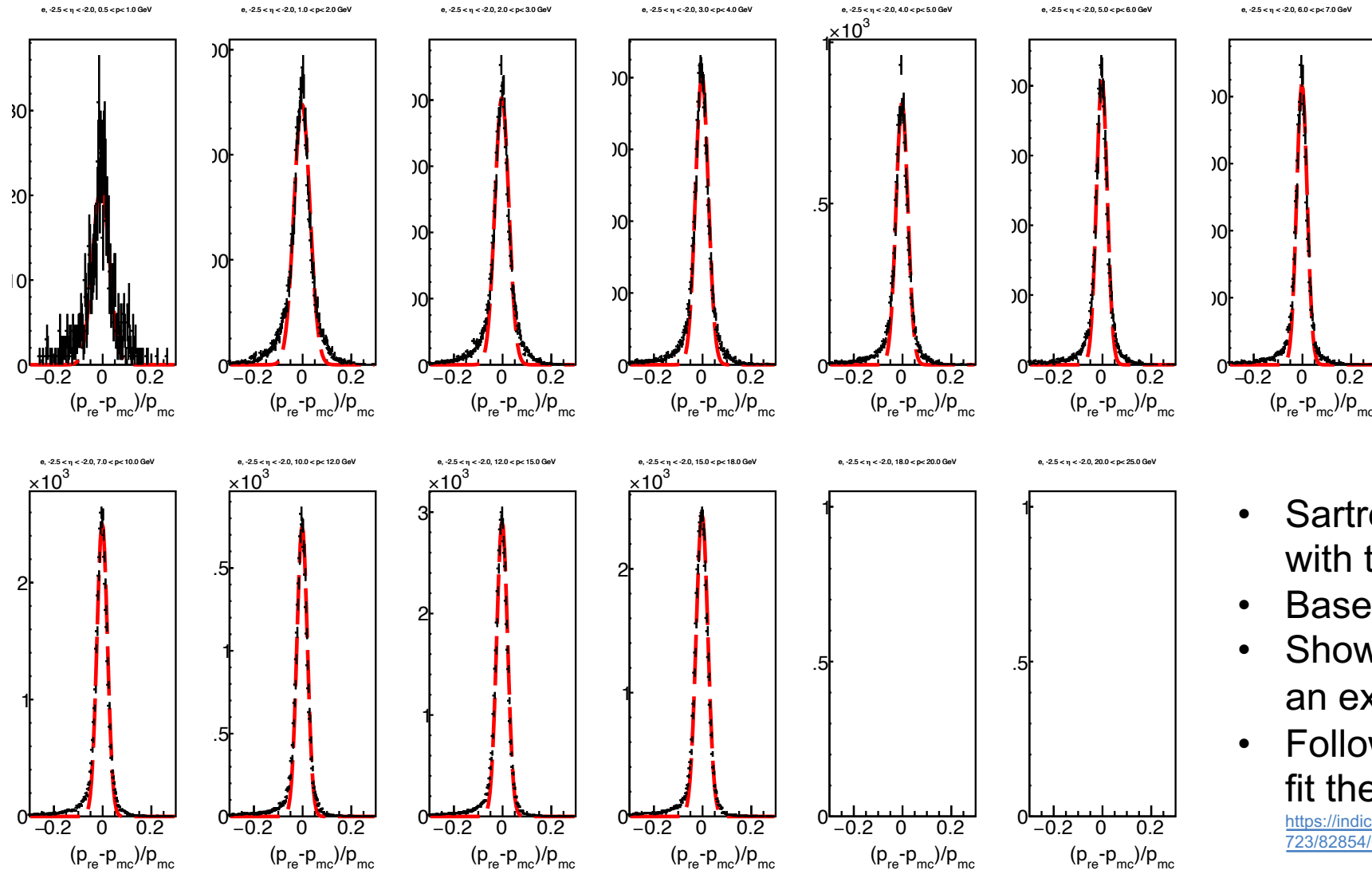
02-08-2024

Brief Summary of My Work

- Explore various detector technologies for the 2nd EIC detector
- Focus on exclusive measurements, such as vector meson diffractive pattern, which **requires excellent p_T resolution** for backward scattered electrons
- Baseline detector design
 - ePIC-2023.10.0
 - epic_craterlake_18x110_Au.xml
 - B=1.7 T

Momentum/Transverse Momentum Resolutions

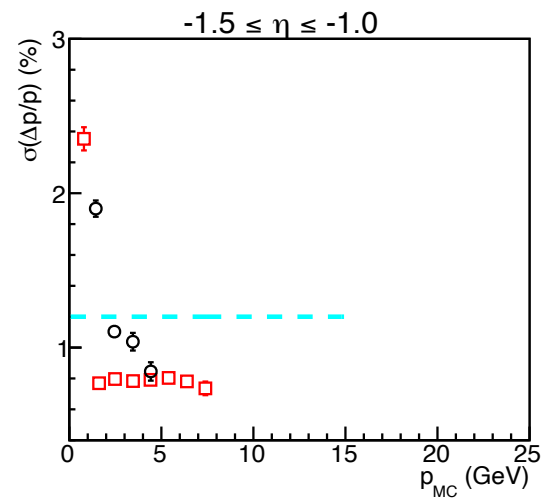
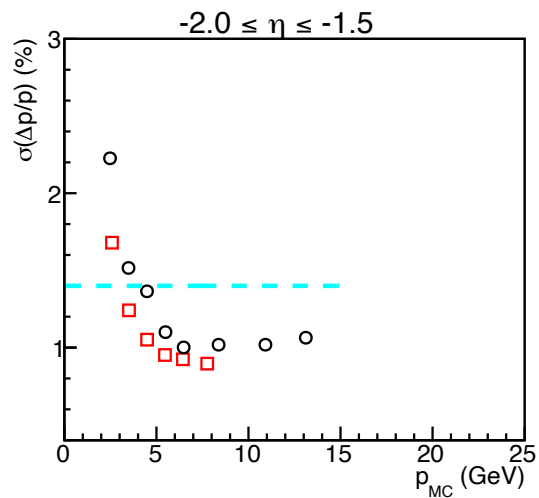
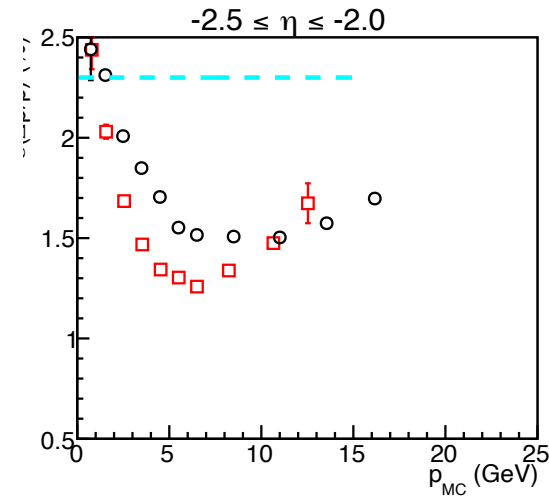
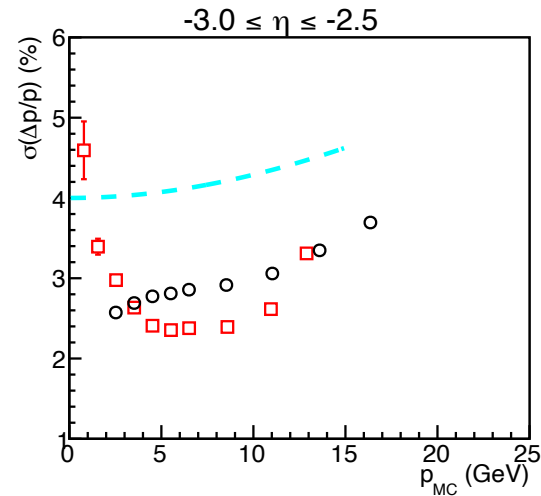
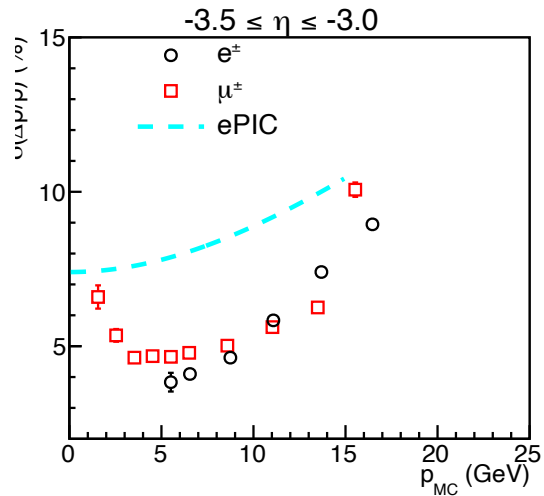
Fitting Momentum Resolutions of Electrons



- Sartre coherent J/ψ events with true PID
- Baseline design
- Showing $-2.5 < \eta < -2$ bin as an example
- Following Steven Maple, only fit the peak

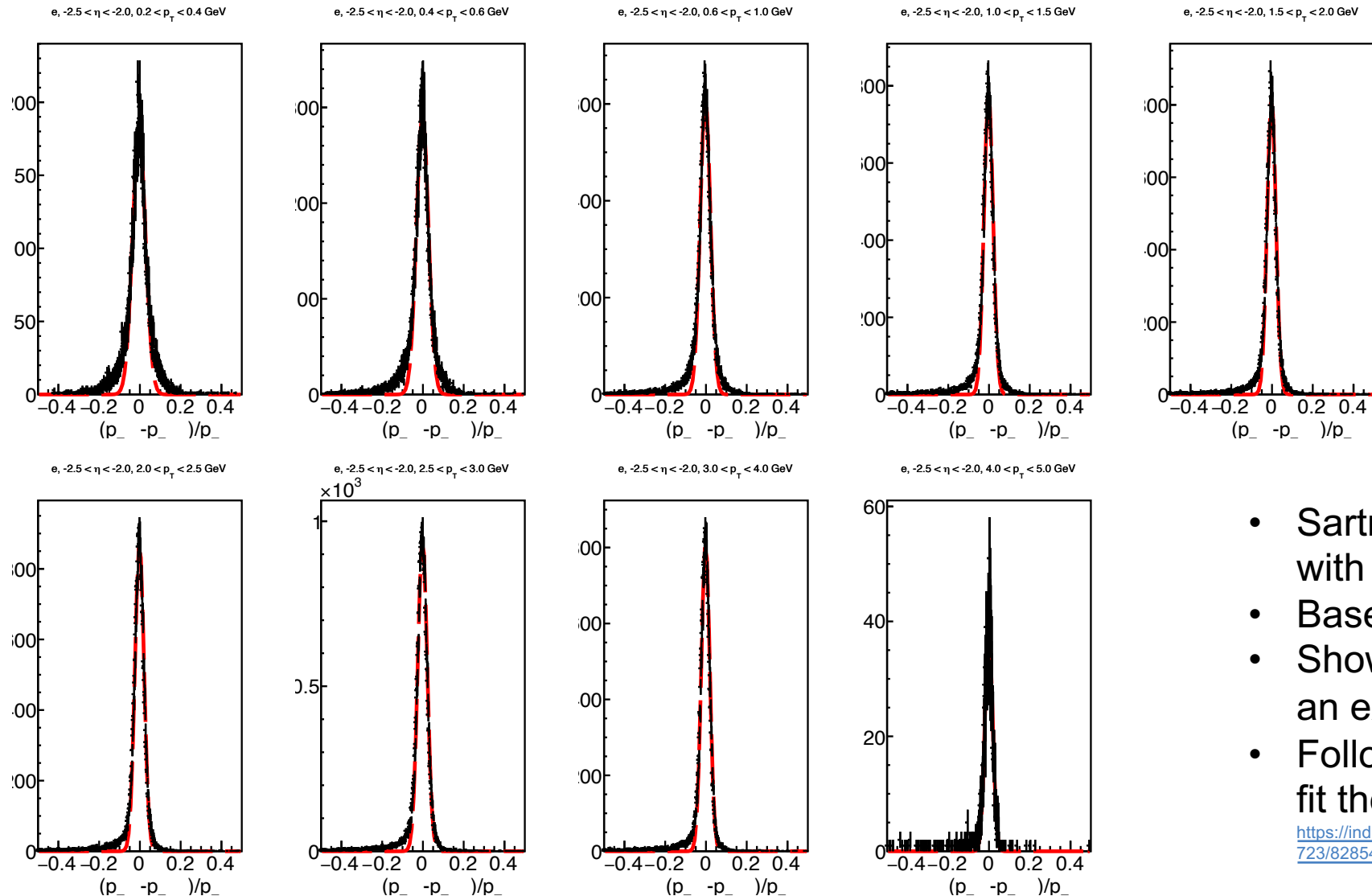
https://indico.bnl.gov/event/20126/contributions/78819/attachments/48723/82854/CraterlakeValidationPlots_2023_07_20.pdf

Momentum Resolutions of Electron & Muons



- **Zyan**: resolutions from Stephen Maple
https://indico.bnl.gov/event/20126/contributions/78819/attachments/48723/82854/CraterlakeValidationPlots_2023_07_20.pdf
- My momentum resolutions are better than Stephen's

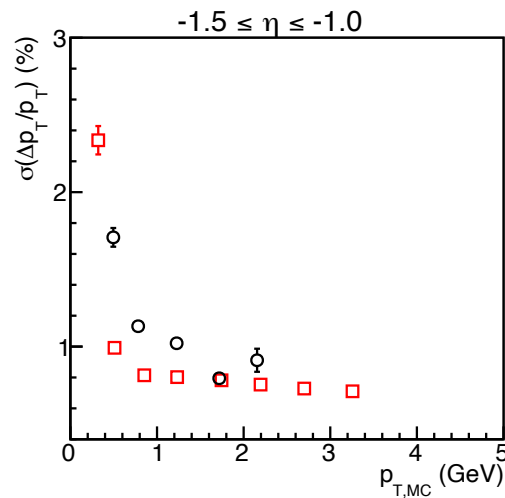
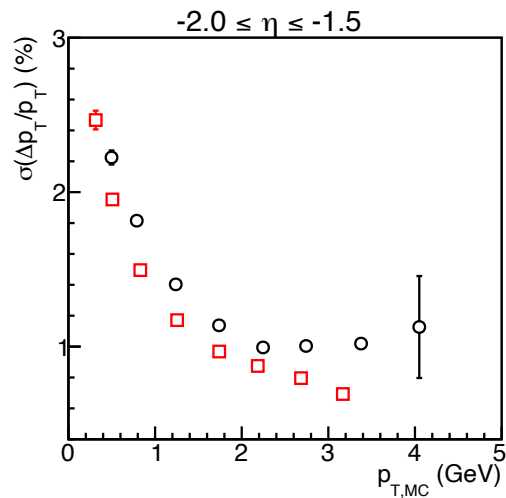
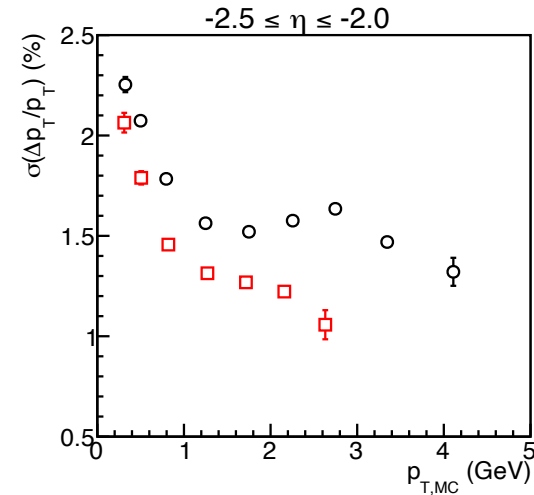
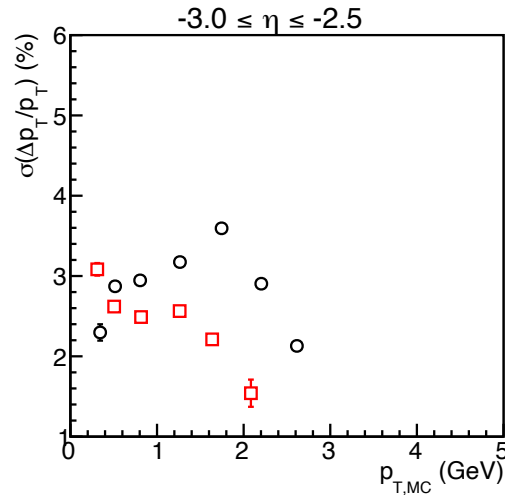
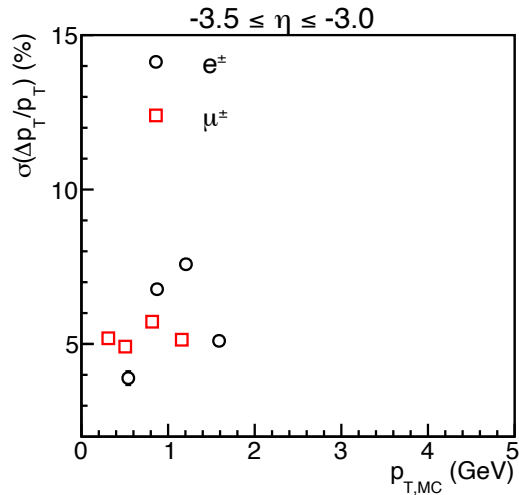
Fitting p_T Resolutions of Electrons



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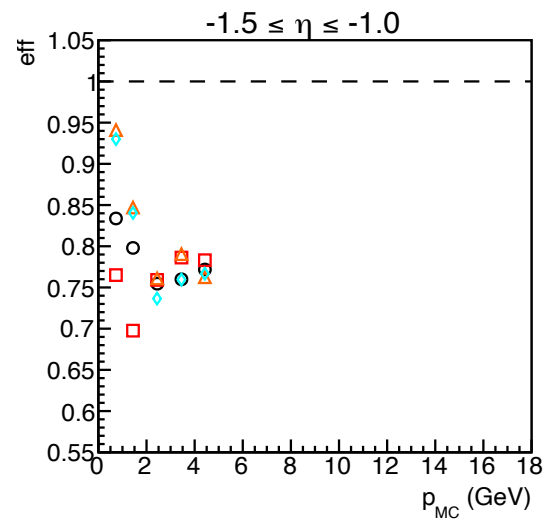
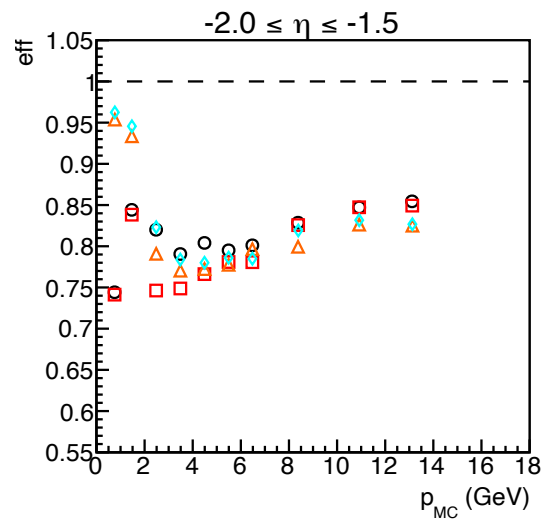
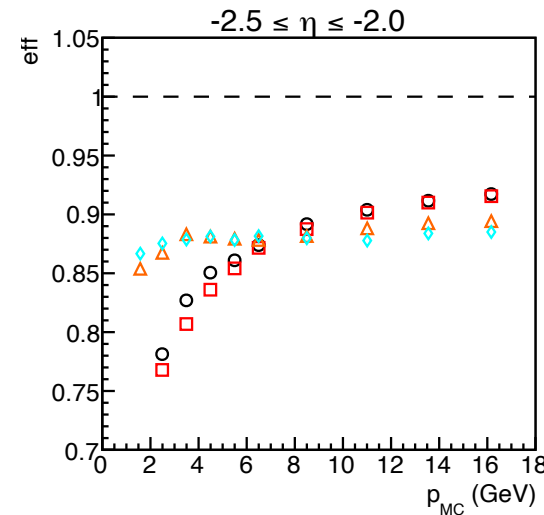
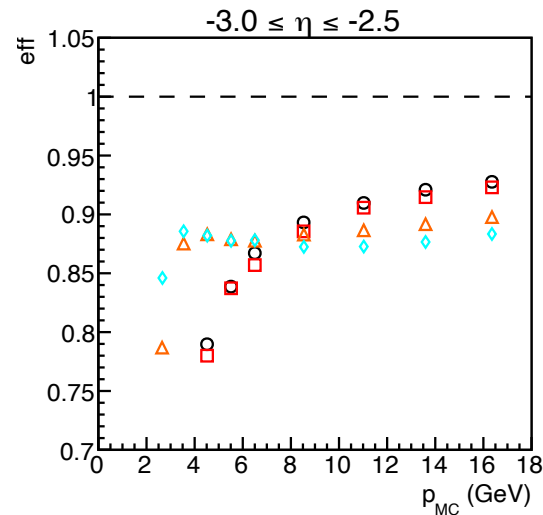
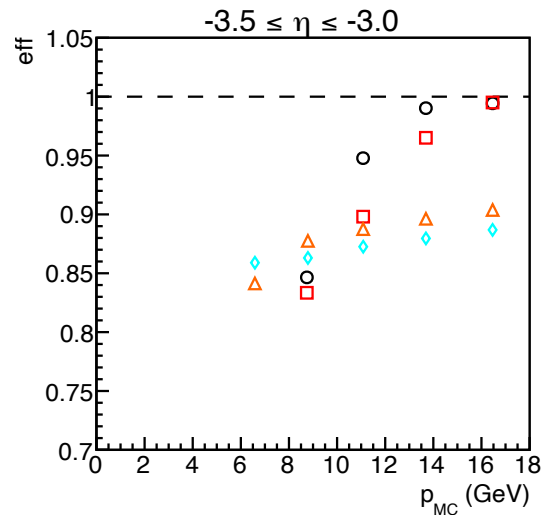
p_T Resolutions of Electron & Muons



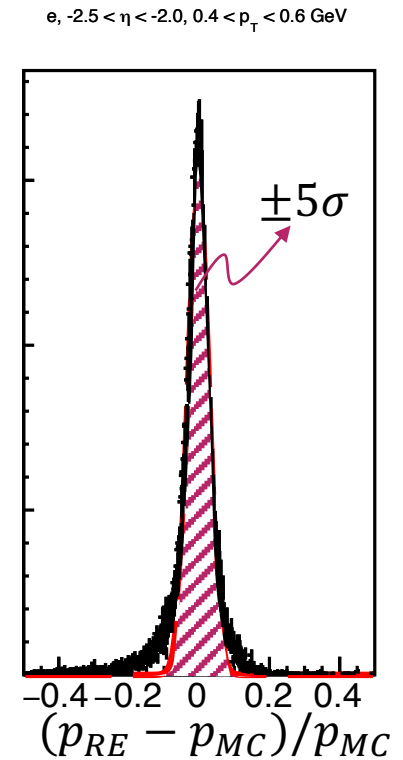
Why the wiggles at $\eta < -2$?

Tracking Efficiency

Electron Efficiency

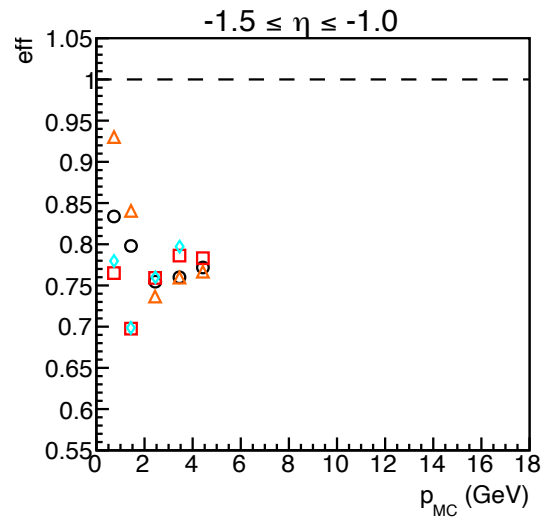
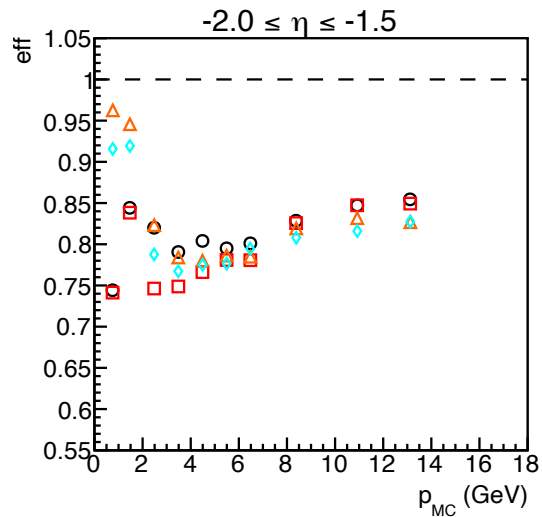
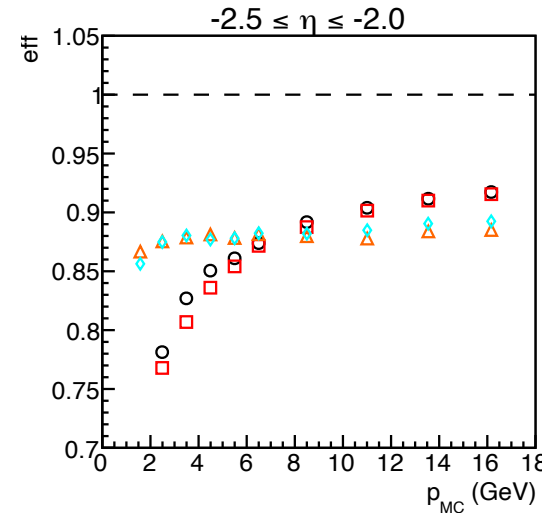
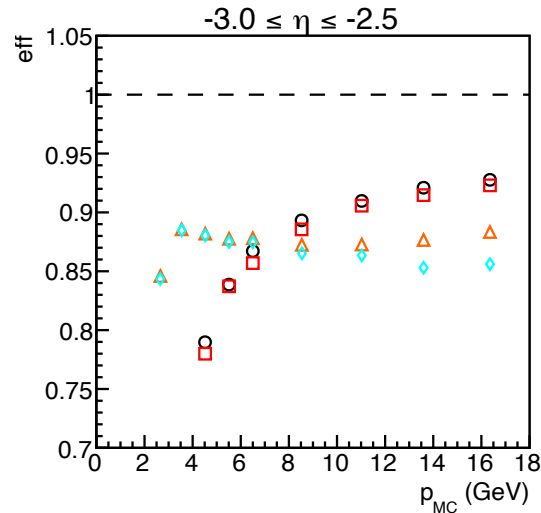
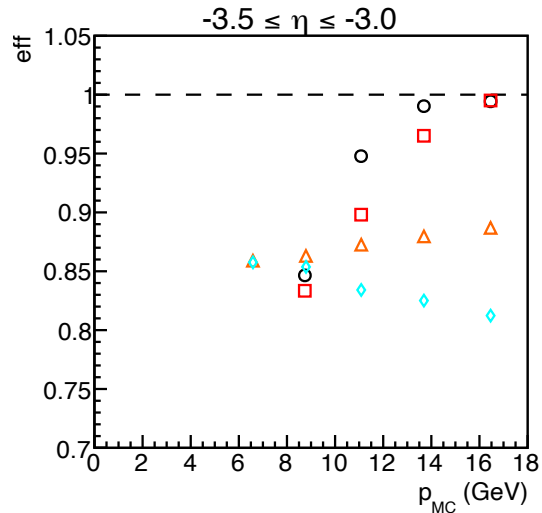


- ePIC
- +vacuum, 2T
- △ +MPGD at 1.5m
- ◇ +all si at 1.5m (5 disks)

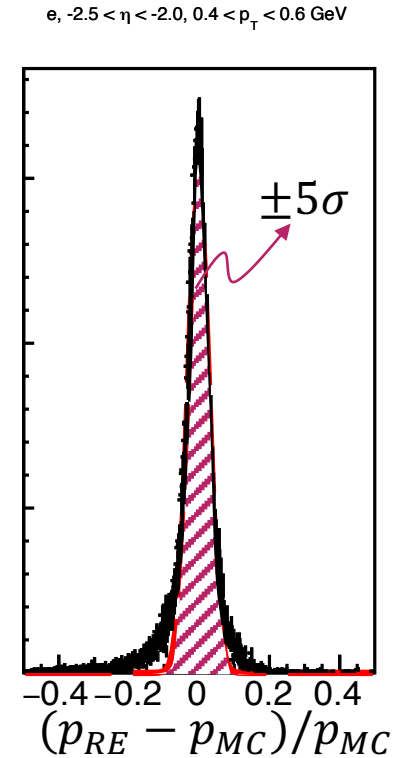


$$\text{eff} = \frac{\text{Num. of reco. tracks within } \pm 5\sigma}{\text{Num. of MC tracks}}$$

Electron Efficiency



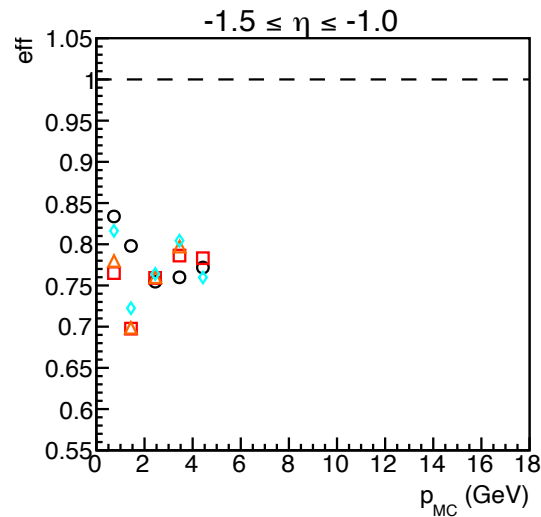
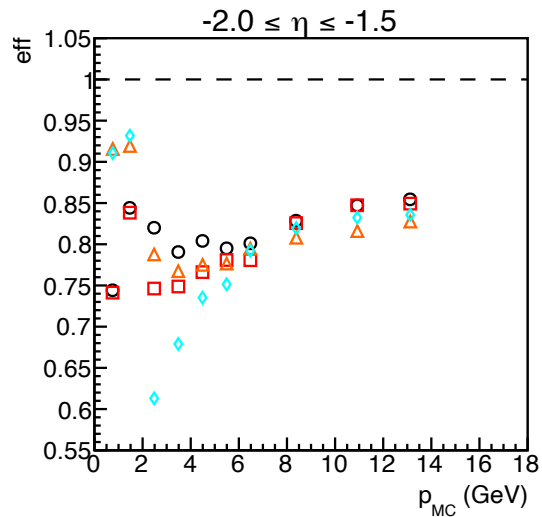
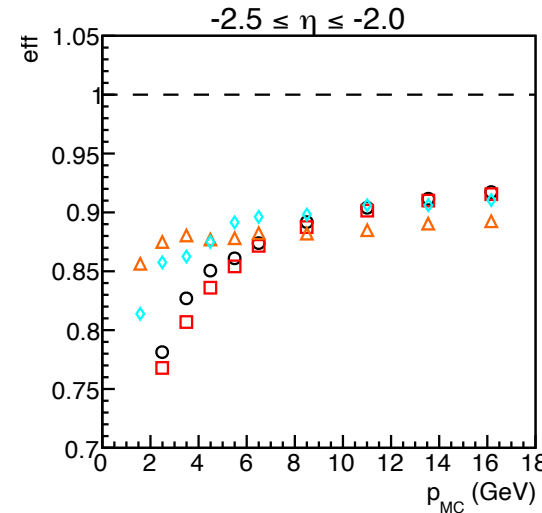
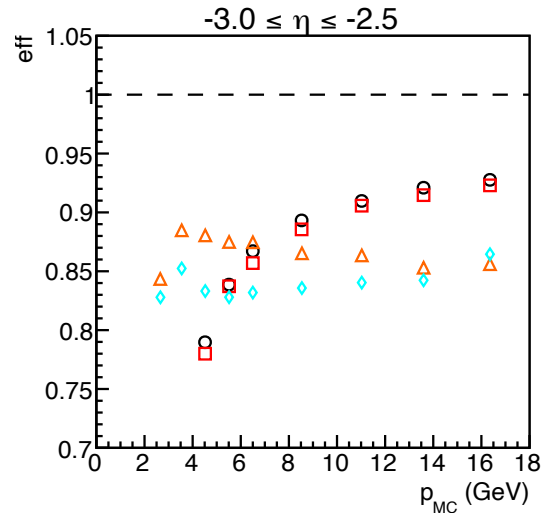
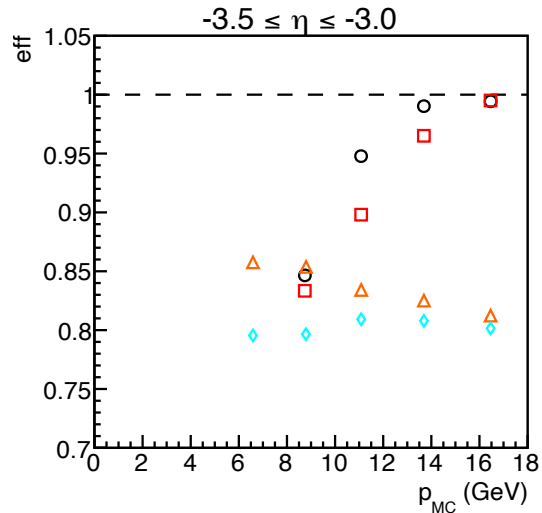
- ePIC
- +vacuum, 2T
- △ +all si at 1.5m (5 disks)
- ◇ +6th disk, last disk at 2.5m



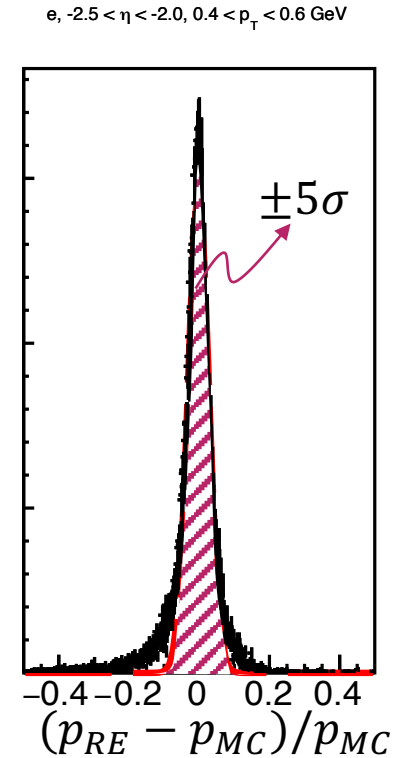
$$\text{eff} = \frac{\text{Num. of reco. tracks within } \pm 5\sigma}{\text{Num. of MC tracks}}$$

Better efficiency at low momentum,
but worsen at high momentum?

Electron Efficiency



- ePIC
- +vacuum, 2T
- △ +6th disk, last disk at 2.5m
- ◇ +6th disk, last disk at 2.5m, no serv

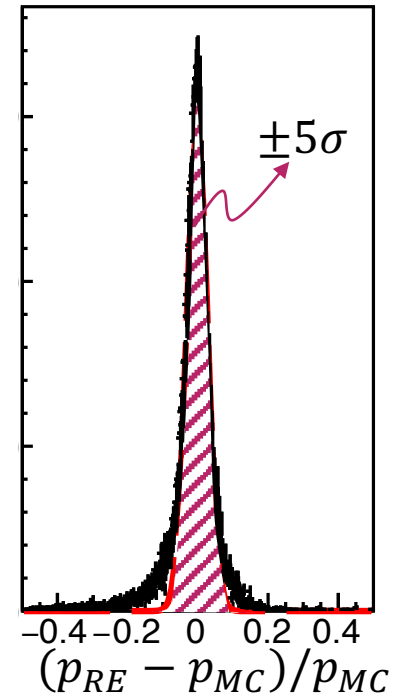
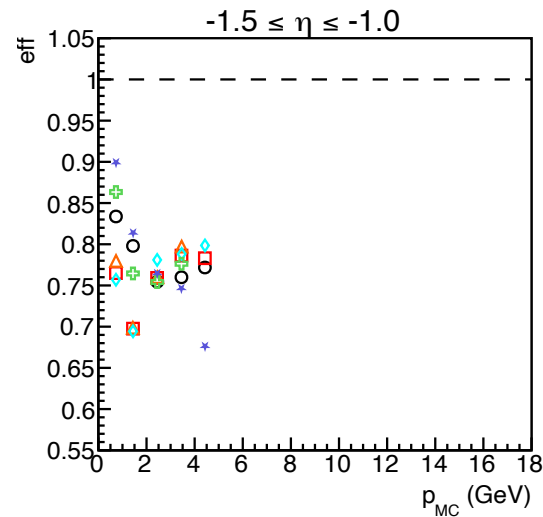
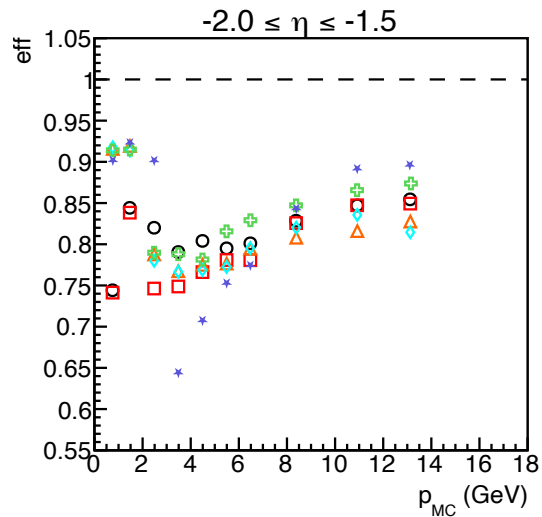
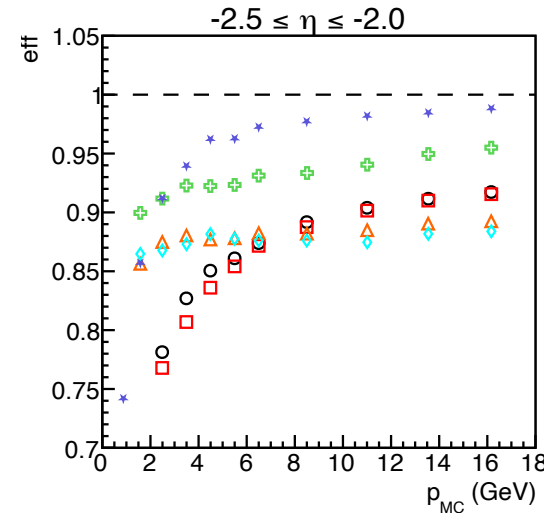
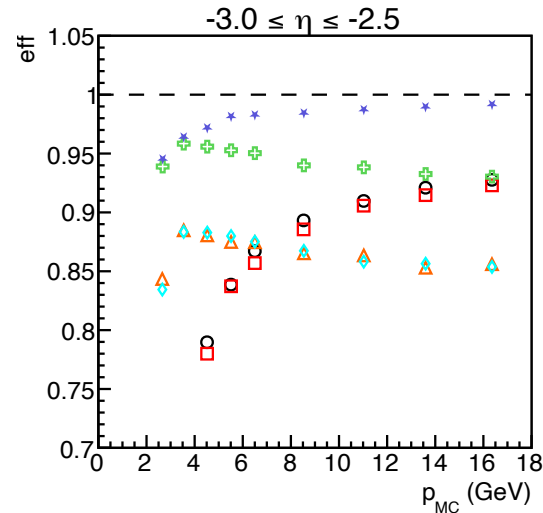
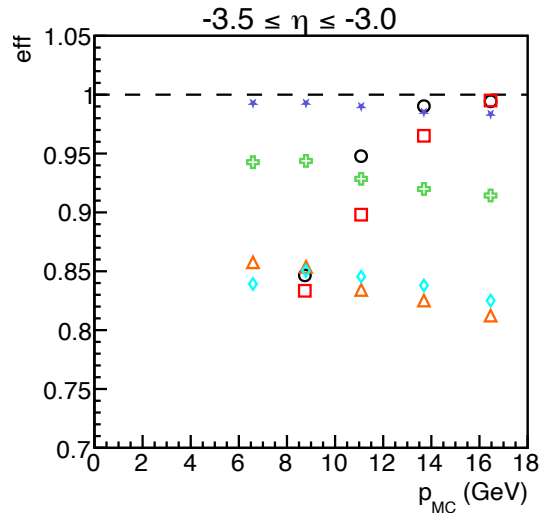


$$\text{eff} = \frac{\text{Num. of reco. tracks within } \pm 5\sigma}{\text{Num. of MC tracks}}$$

Worse efficiency without service parts?

Electron Efficiency

e, $-2.5 < \eta < -2.0$, $0.4 < p_T < 0.6$ GeV



- ePIC
- +vacuum, 2T
- △ +6th disk, last disk at 2.5m
- ◇ +7th disk, last disk at 2.5m
- ⊕ +8th disk, last disk at 2.5m
- ☆ +12th disk, last disk at 2.5m

include service parts

$$\text{eff} = \frac{\text{Num. of reco. tracks within } \pm 5\sigma}{\text{Num. of MC tracks}}$$

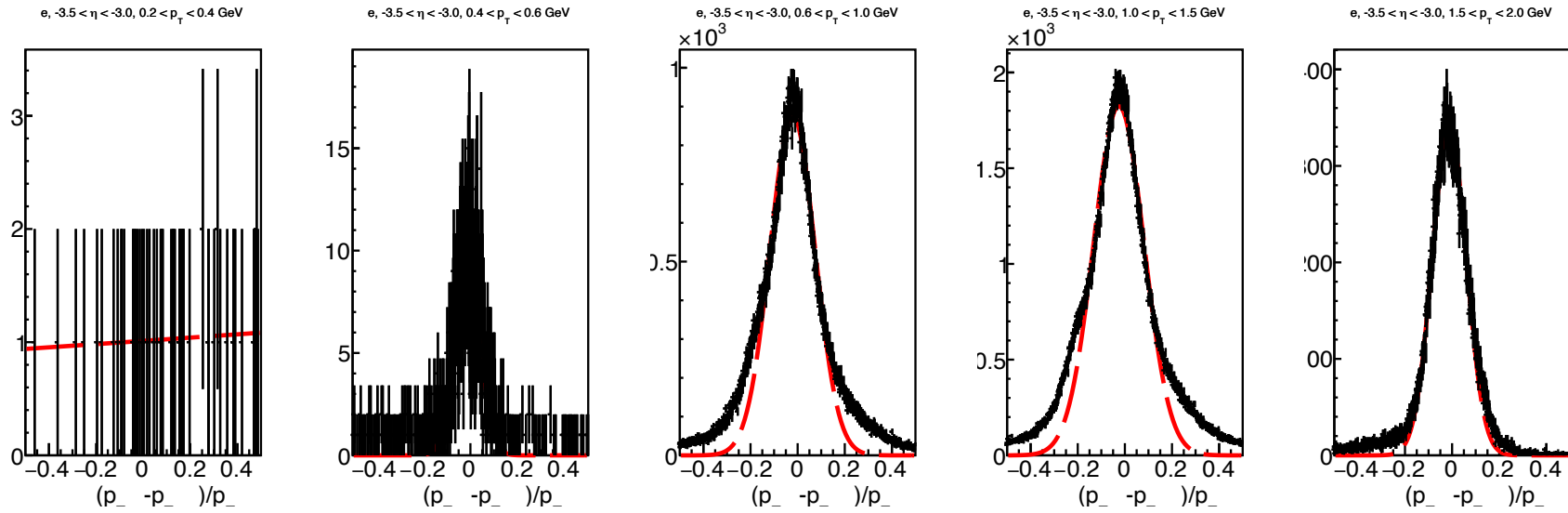
More disks improve efficiency

Summary

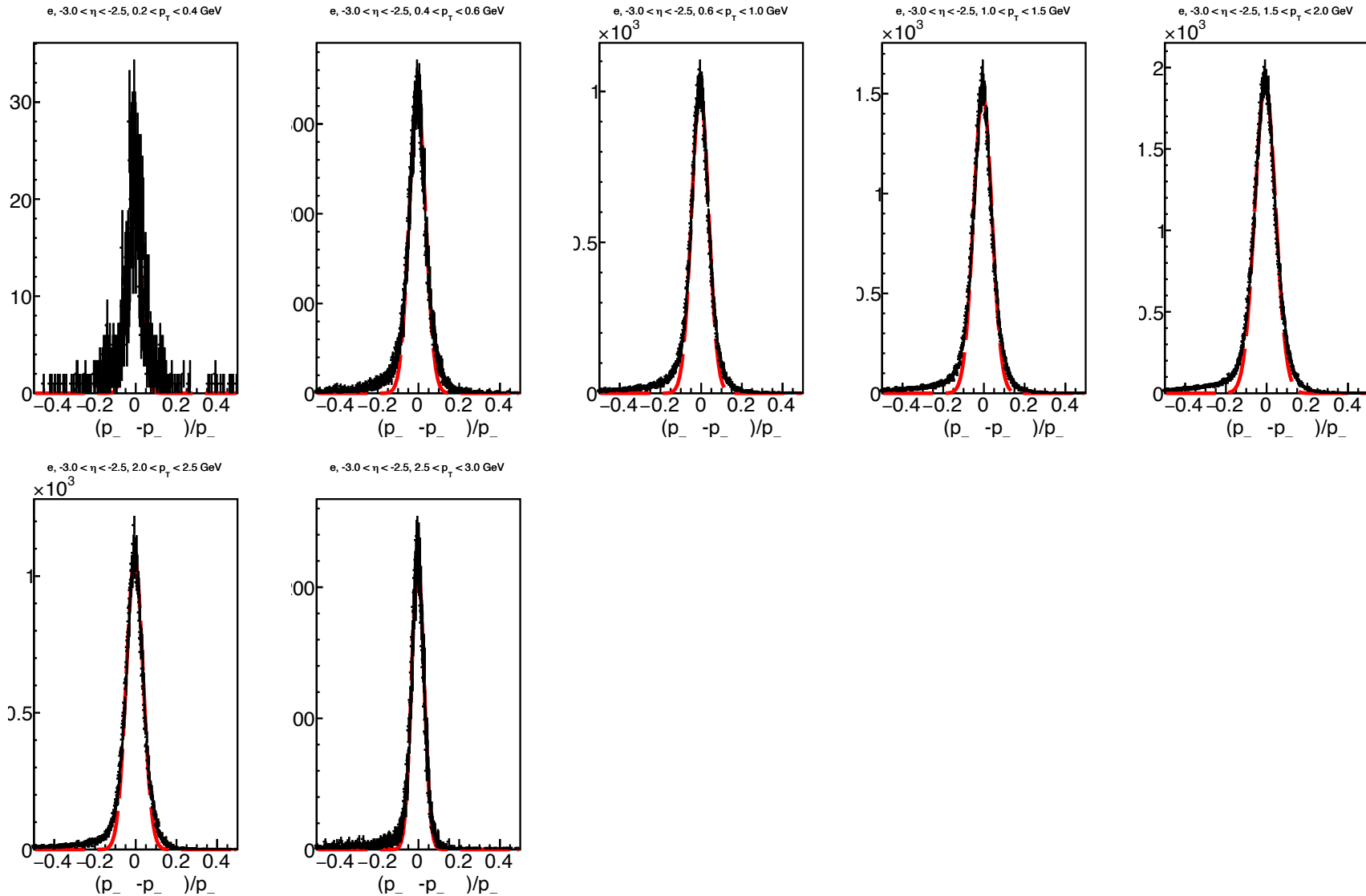
- Transverse momentum resolutions of electrons and muons wiggle at $\eta < -2$
- Efficiencies decrease when the tracking system is longer

Backup

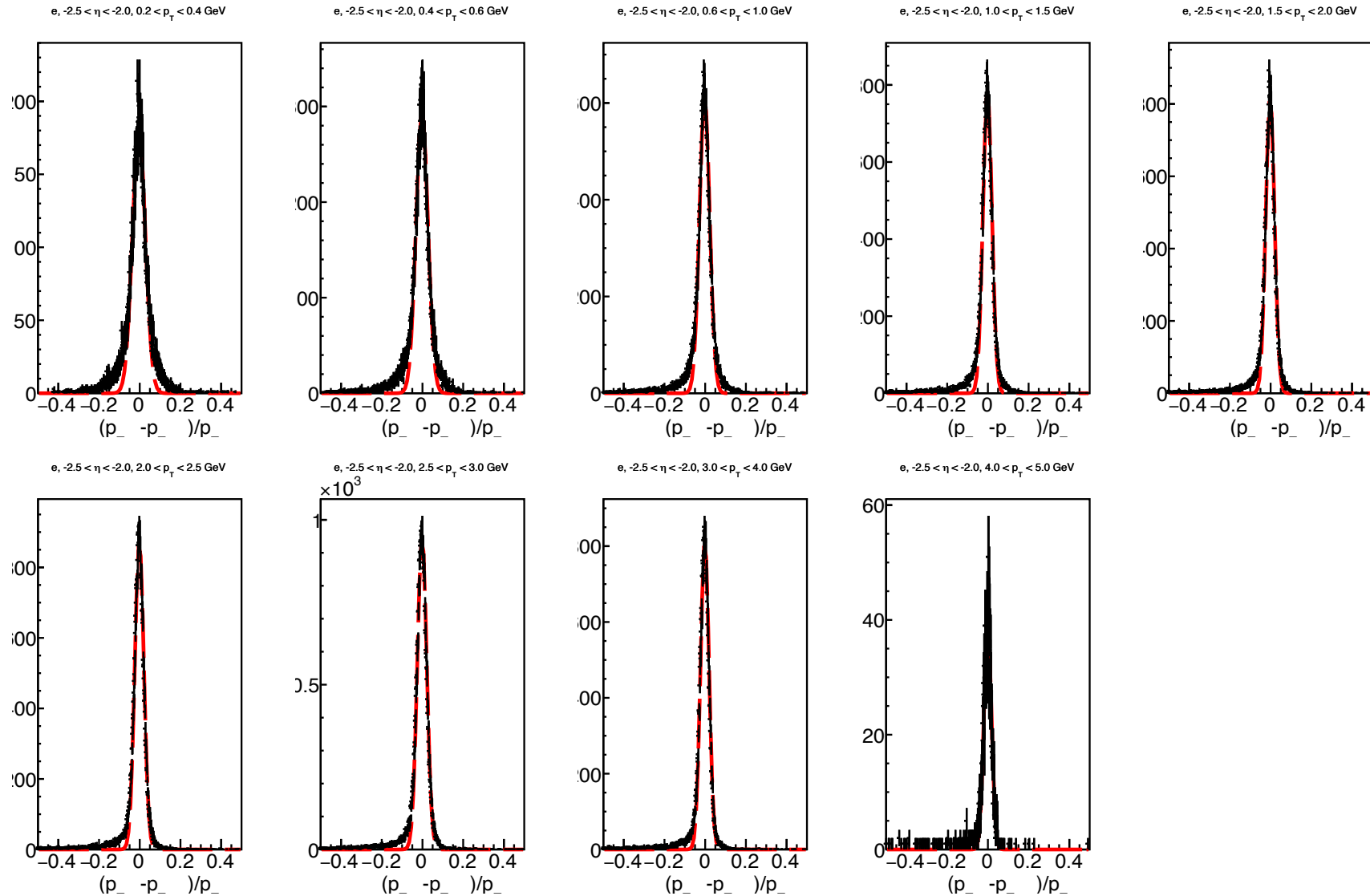
Fitting Electron p_T Resolution at $-3.5 < \eta < -3$



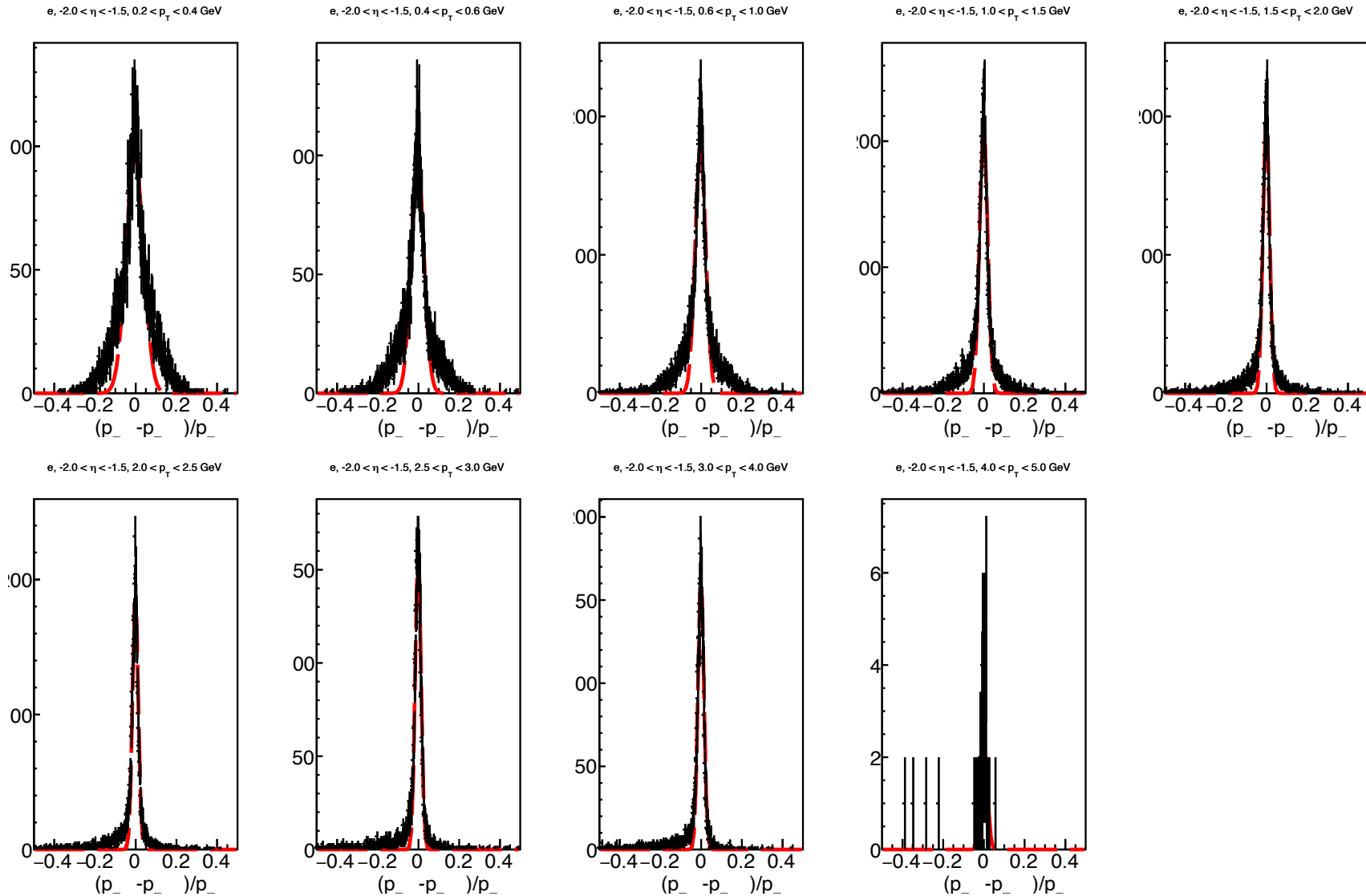
Fitting Electron p_T Resolution at $-3 < \eta < -2.5$



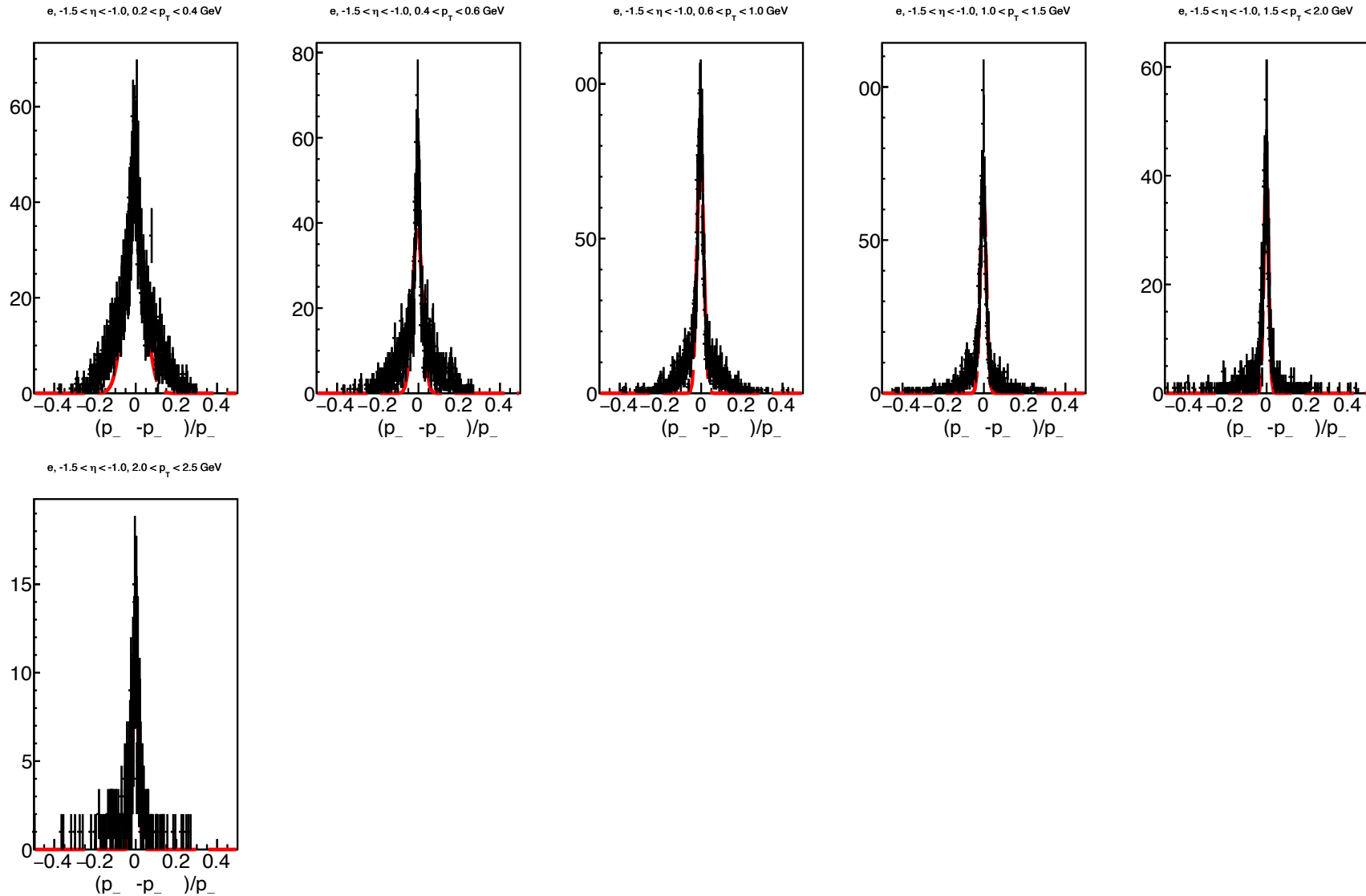
Fitting Electron p_T Resolution at $-2.5 < \eta < -2$



Fitting Electron p_T Resolution at $-2 < \eta < -1.5$



Fitting Electron p_T Resolution at $-1.5 < \eta < -1$



Forward p_T Resolutions of Muons

