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DVCS ep Update

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ePIC Exclusive, Diffractive and Tagging WG meeting
07/10/24

WORLD
CHANGING
GLASGOW



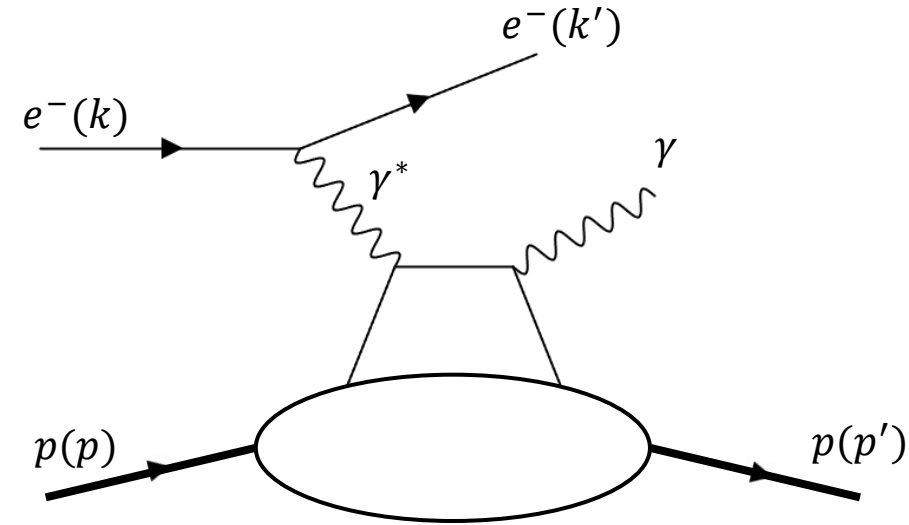


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Introduction

DVCS in ep collisions

- Looking at $e(k)p(p) \rightarrow e'(k')p'(p')\gamma$ process to probe Generalized Parton Distributions (GPDs).
- (Some) Important variables:
 - Photon 4-momentum transfer, $Q^2 = -q^2 = -(k - k')^2$
 - $t = (p' - p)^2$
 - Fractional parton momentum, x
 - Bjorken- x , $x_B = Q^2/2qp$
- Using EpIC generator files, passed through the ePIC detector geometry in monthly simulation campaigns.



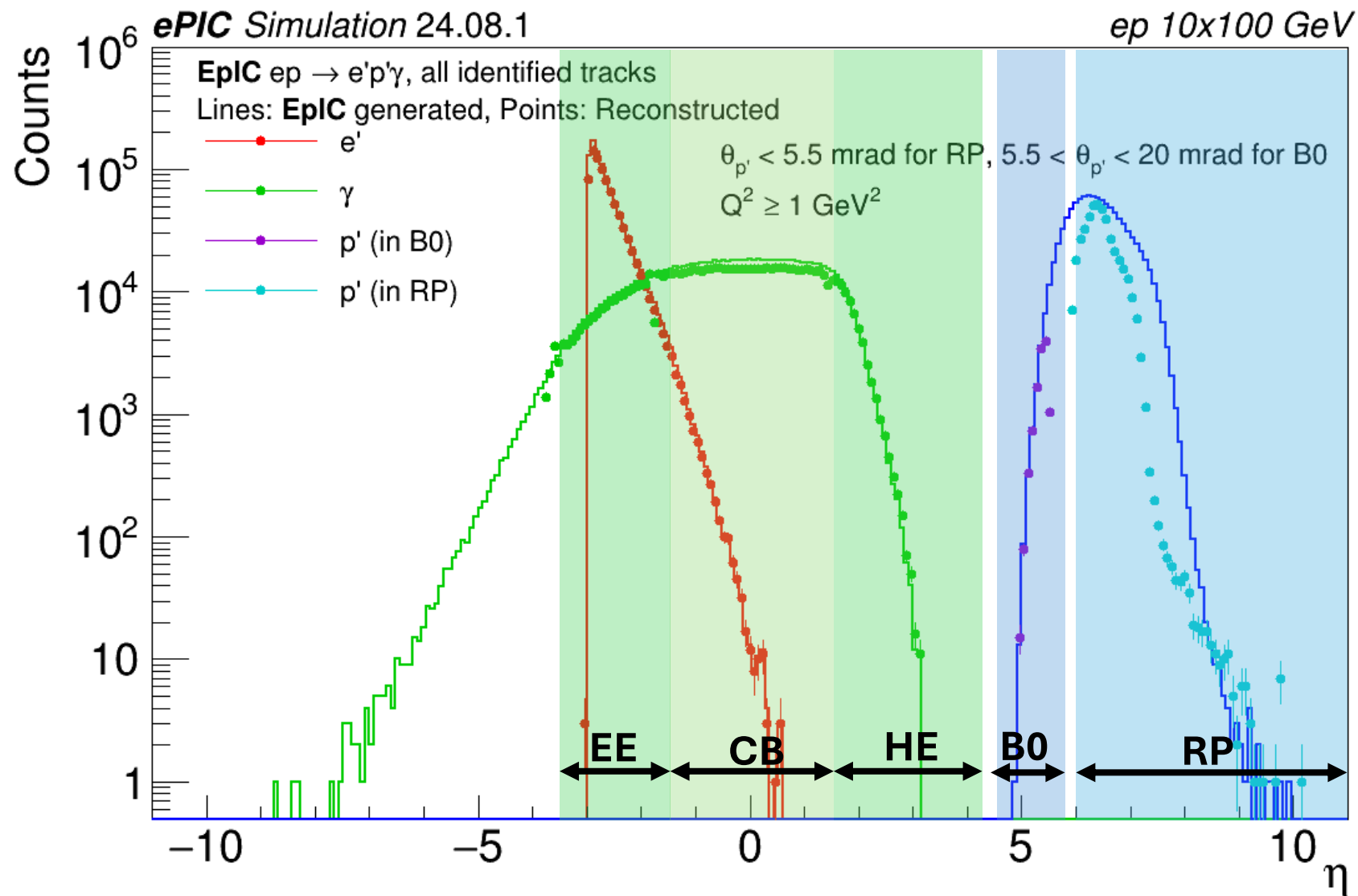
Using DVCS to test ePIC

- DVCS is a good channel to test many of the ePIC subsystems.
- The scattered electron and photon are detected in the central barrel.
 - Can test PID and energy/momentum resolutions in the barrel and endcaps.
- Scattered proton gets picked up in the far forward region.
 - B0 for 5x41 and 10x100.
 - Roman Pots for 10x100 and 18x275.

Changes since last update

- Testing explicit associations between MC and reconstructed particles.
 - No major changes yet seen in plots, but will need more in-depth investigation.
- Inclusion of t-resolution plots.
- TDR-style plots generated for 5x41 and 18x275 campaigns (24.08.0)
- Starting to run on 24.09.0 campaign.
 - Issues arise with results. Will mention at the end.

Generator coverage (10x100, 24.08.1)



Cuts applied

- Cuts only applied if distribution cares about particles of interest (ie. no need to require full exclusivity for Q^2 distribution).
- Cuts used:

Single particle

- Exactly 1 e' , p' , γ
- Momentum of e' , p' no more than 10% above beam momentum
- Proton track angle cut: [5.5, 20]mrad for B0; [0, 5.5]mrad for Roman Pots

Event

- $Q^2 \geq 1 \text{ GeV}^2$
- $t \leq 0.3 \text{ GeV}^2$ for protons in the RP
- Full final state $MM^2 \leq 1 \text{ GeV}^2$
- Cut on tail of reconstructed x_B distribution based on tail of MC generated distribution

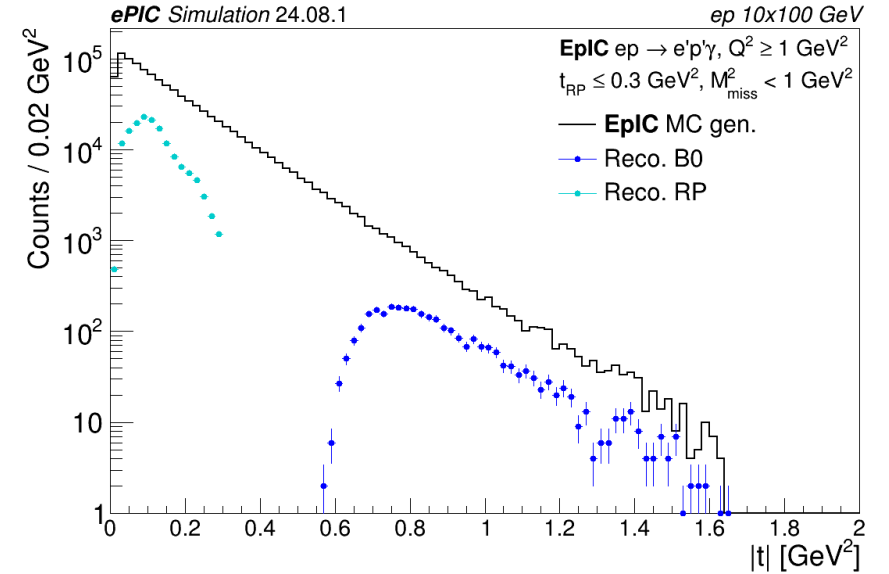
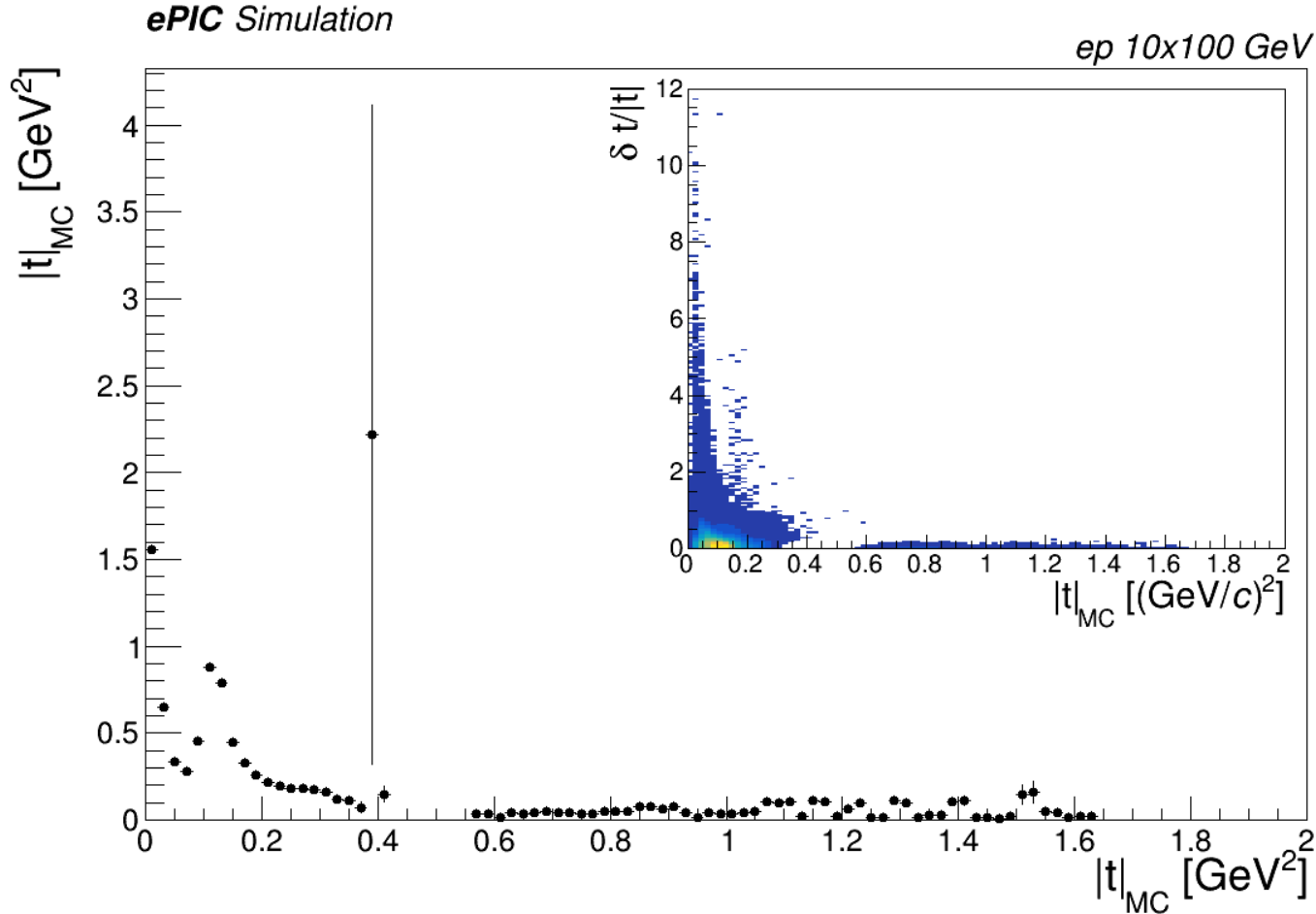


t-resolution (10x100)

(Error in plots: y-axis *should* read “ $\delta t/|t|$ ”)



Full coverage resolution

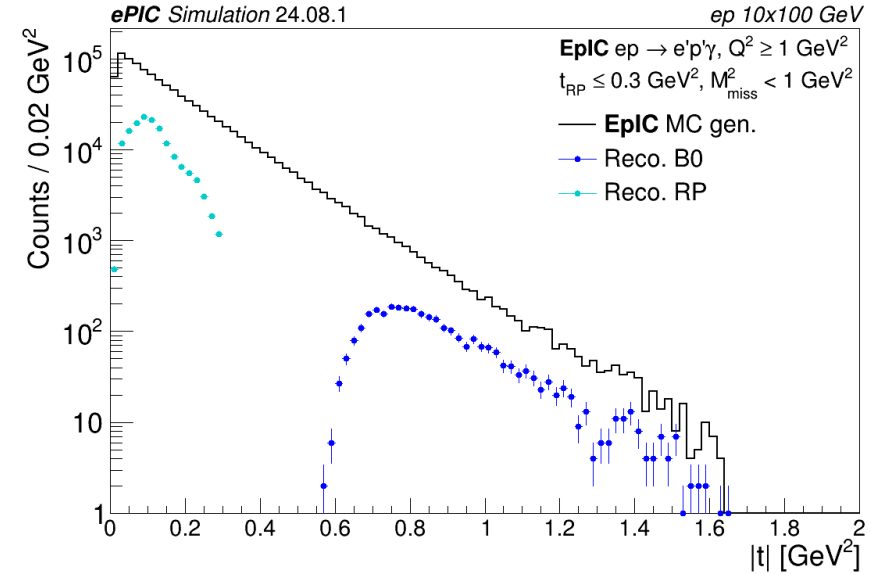
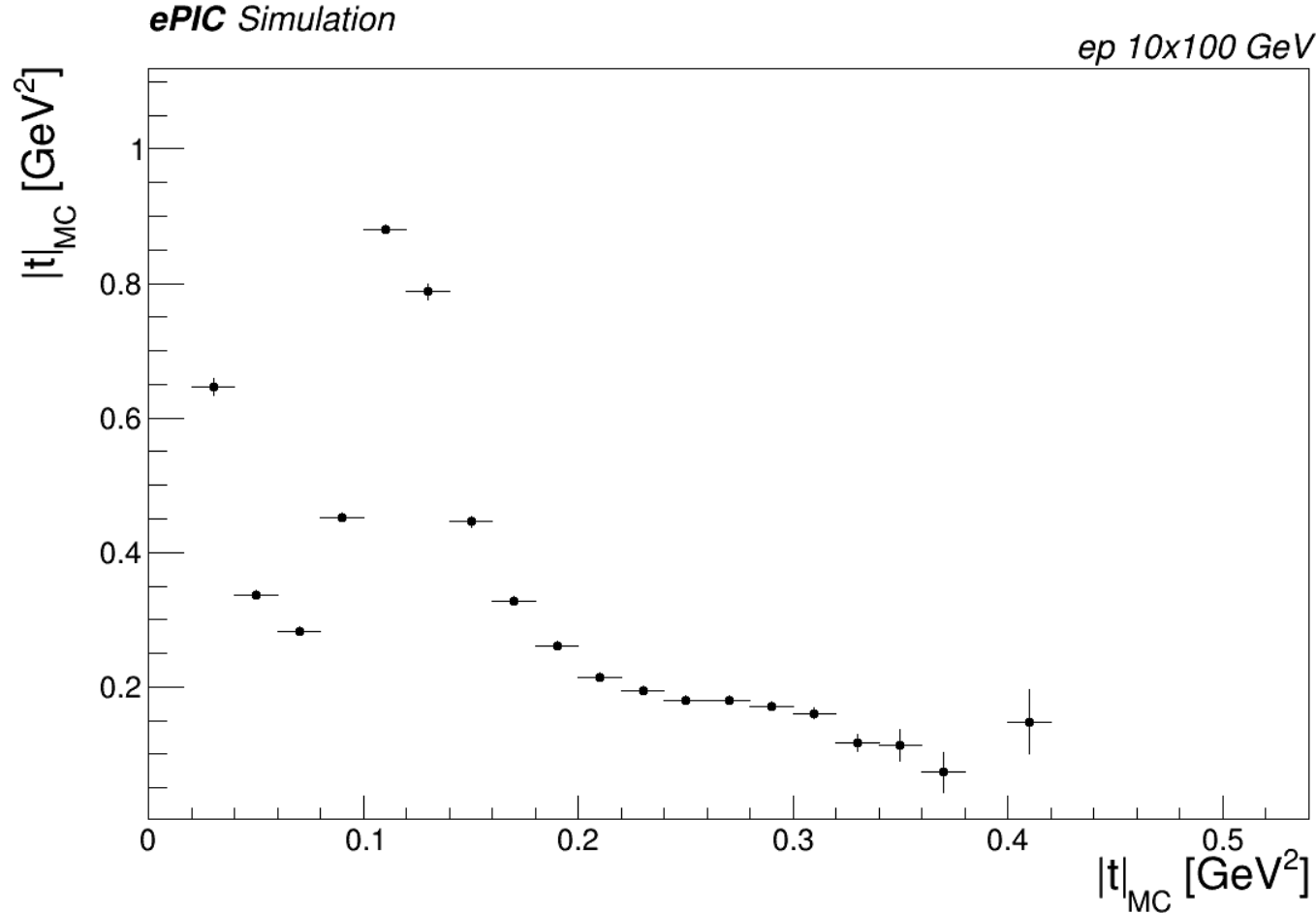


$$\text{Resolution} = \frac{\text{Reco.} - \text{Gen.}}{\text{Gen.}}$$





Low-t resolution (RP)



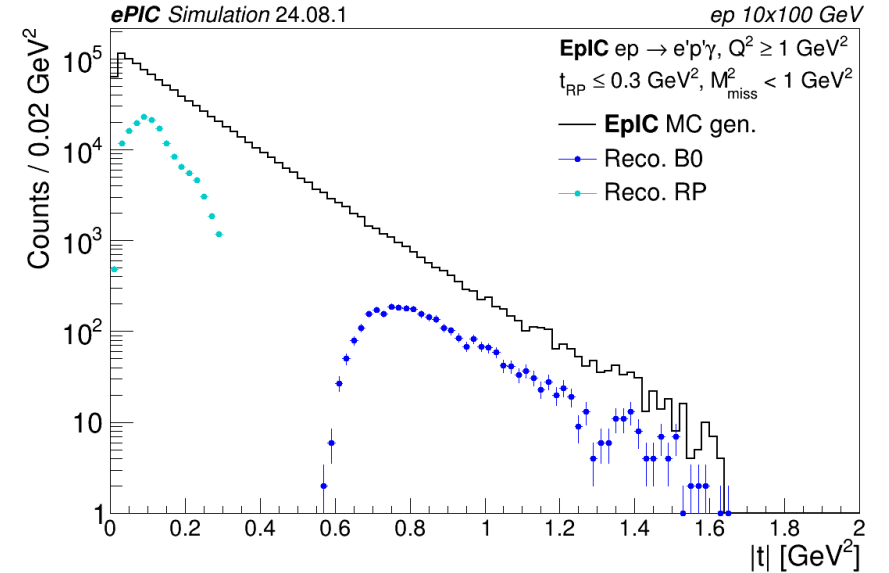
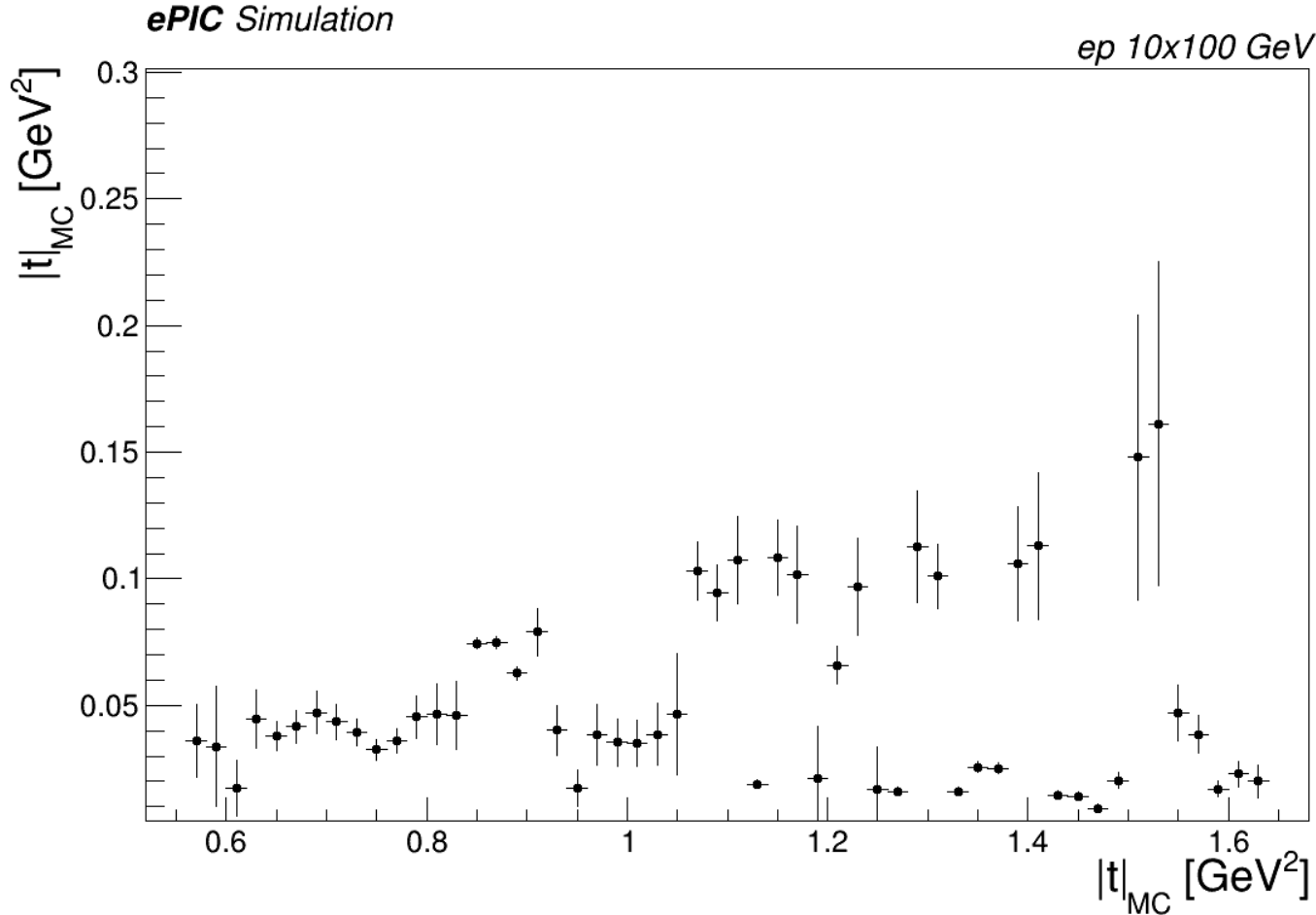
Using implicit association between generated and reconstructed tracks.

$$\text{Resolution} = \frac{\text{Reco.} - \text{Gen.}}{\text{Gen.}}$$





High-t resolution (B0)



Using explicit association between generated and reconstructed tracks.

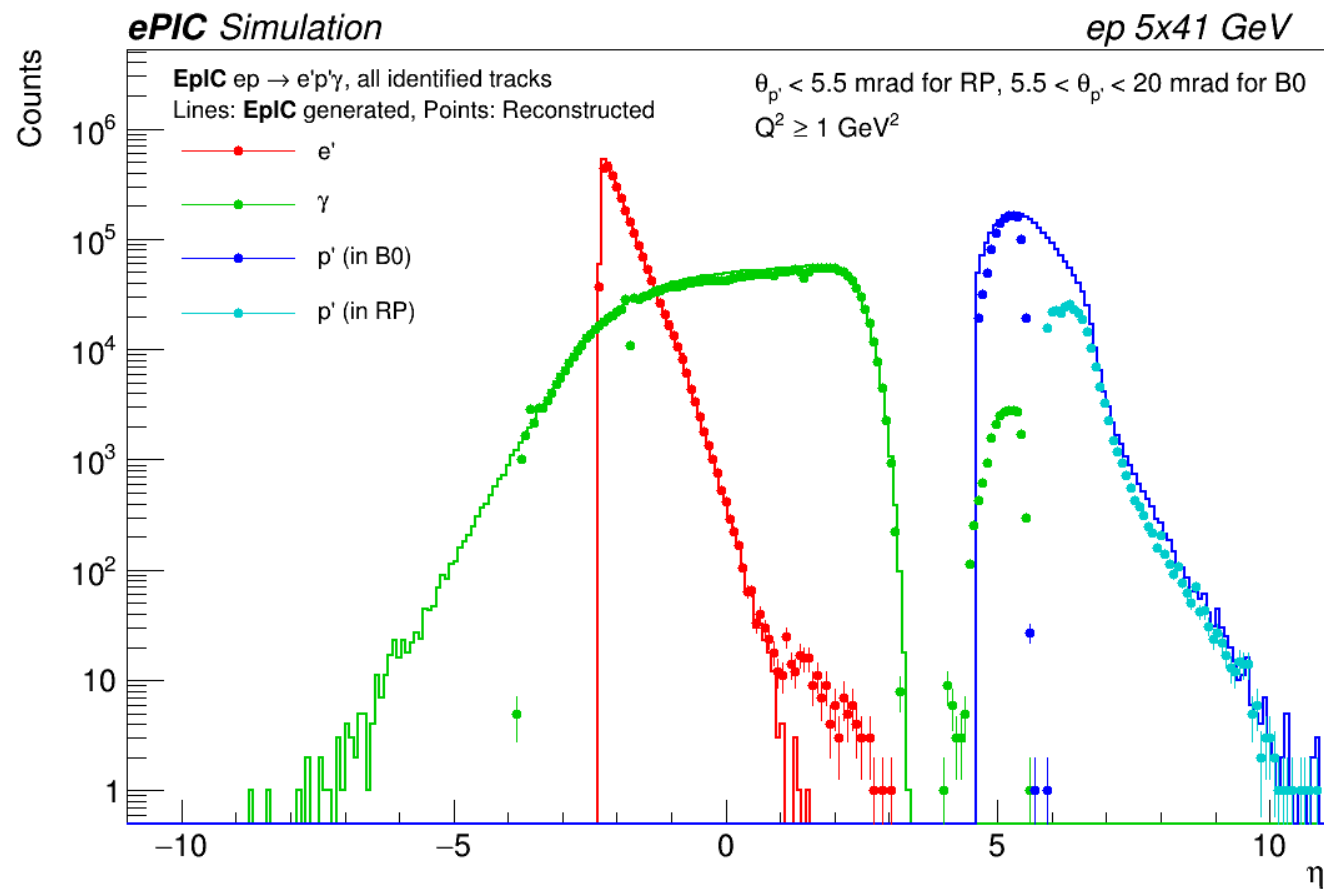
$$\text{Resolution} = \frac{\text{Reco.} - \text{Gen.}}{\text{Gen.}}$$



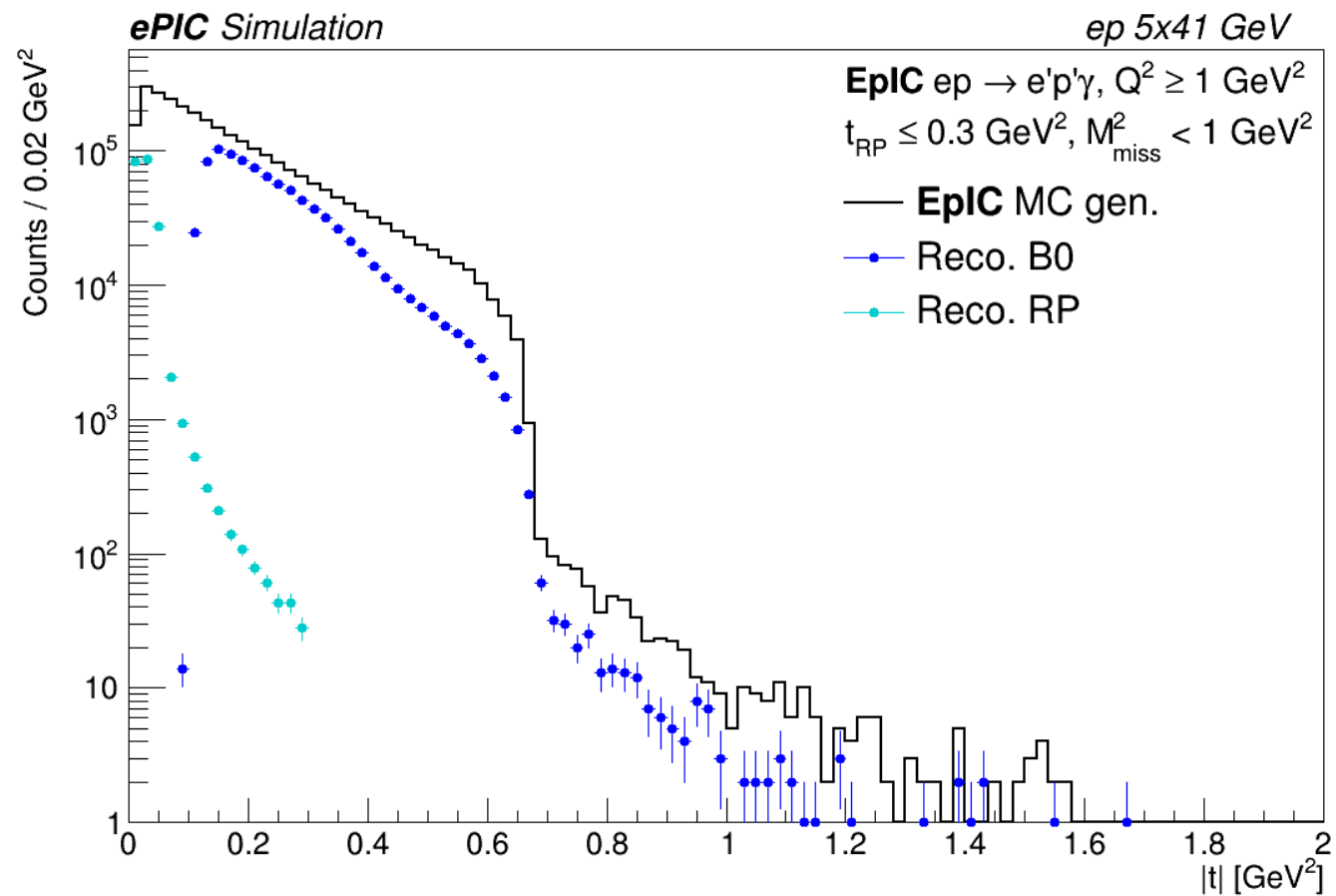


Other beam energies

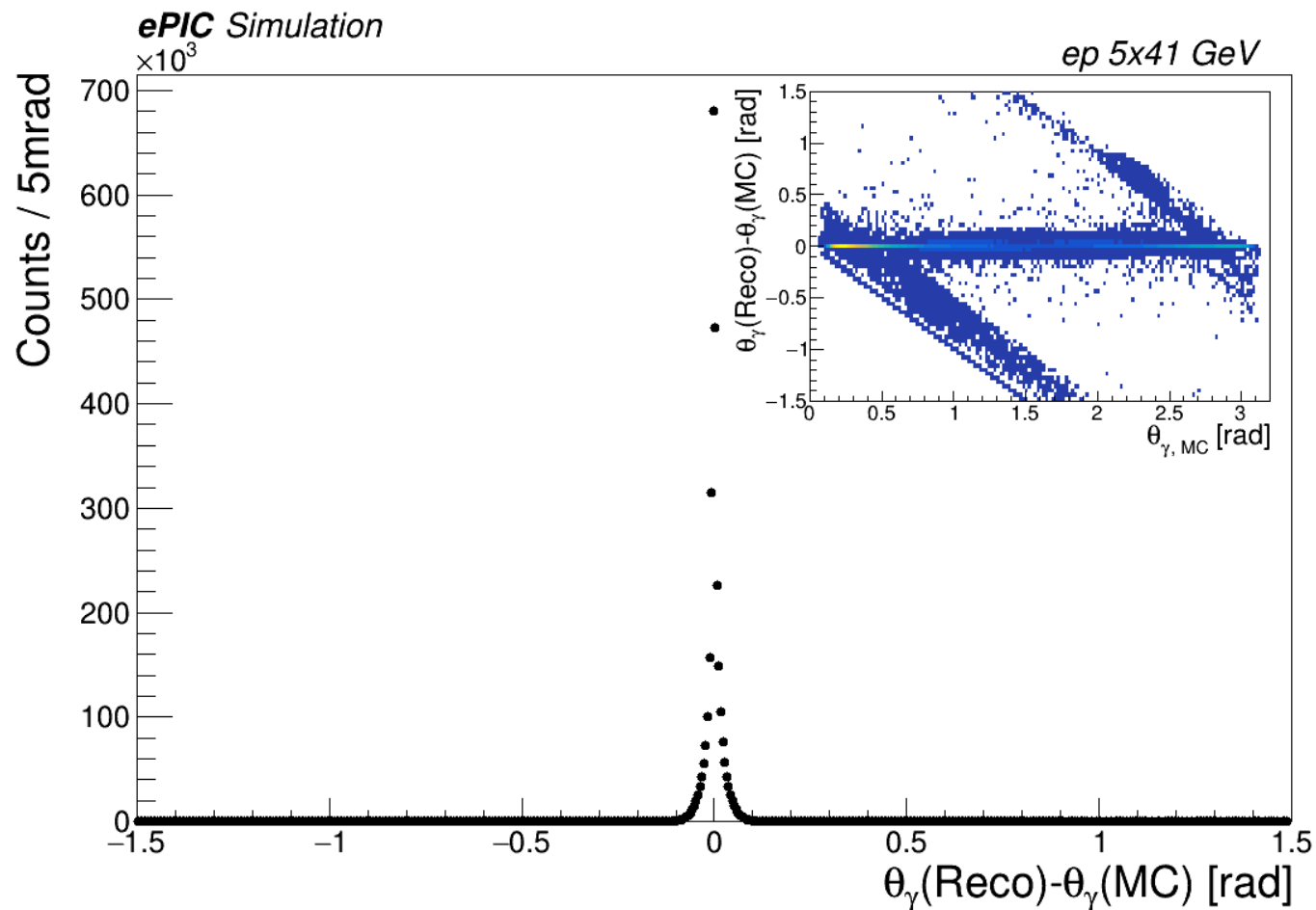
5x41: η distribution



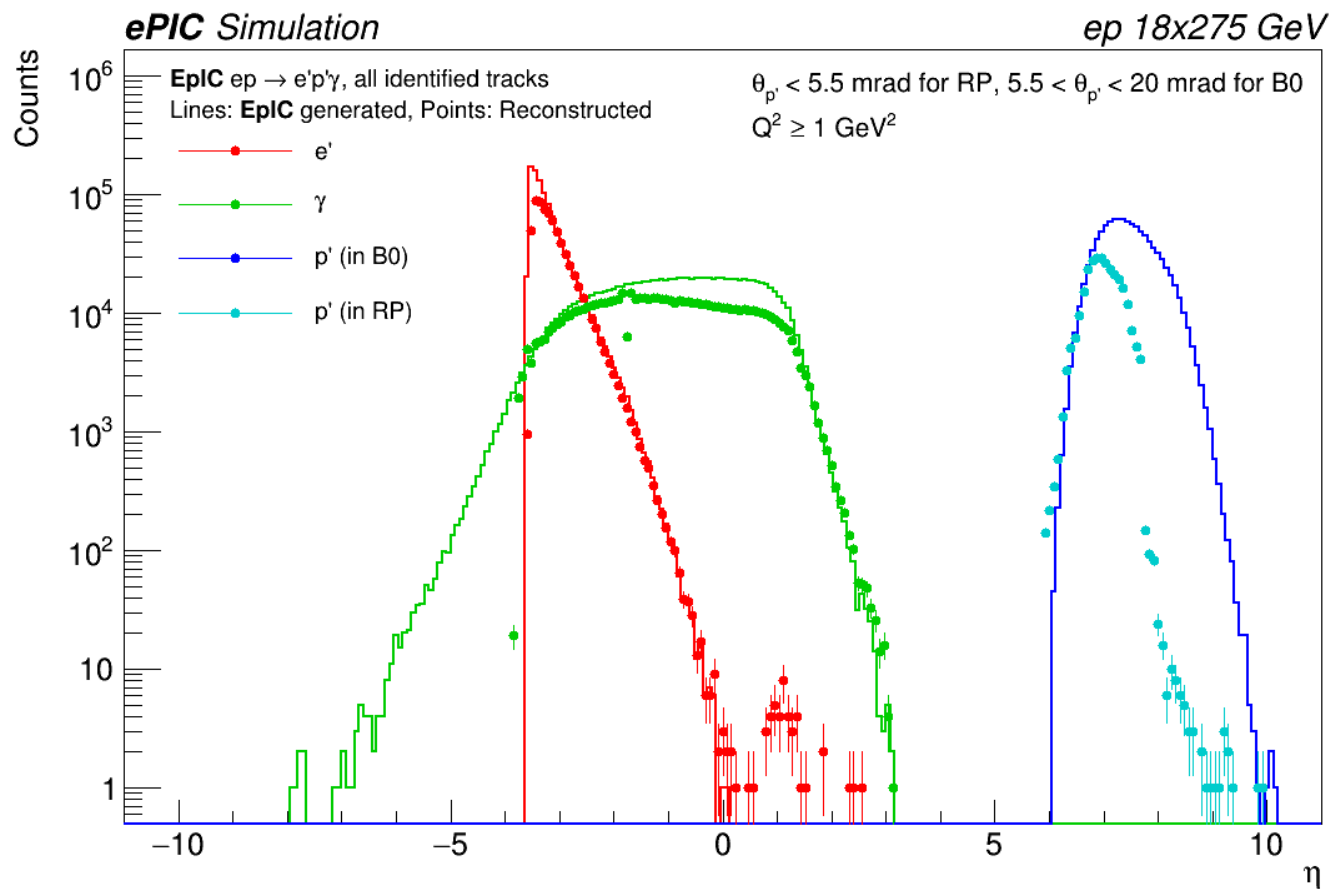
5x41: t distribution



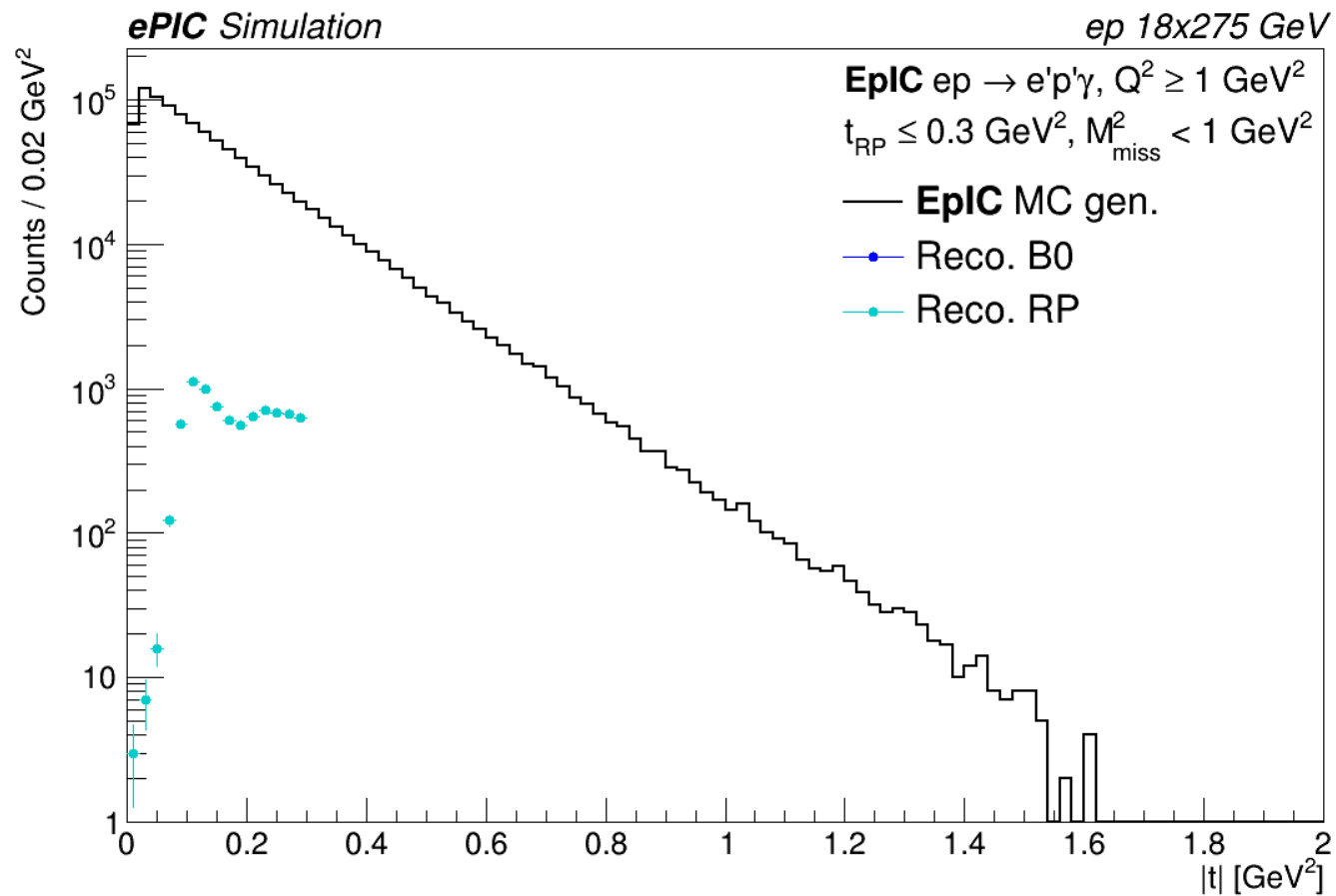
5x41: γ angular performance



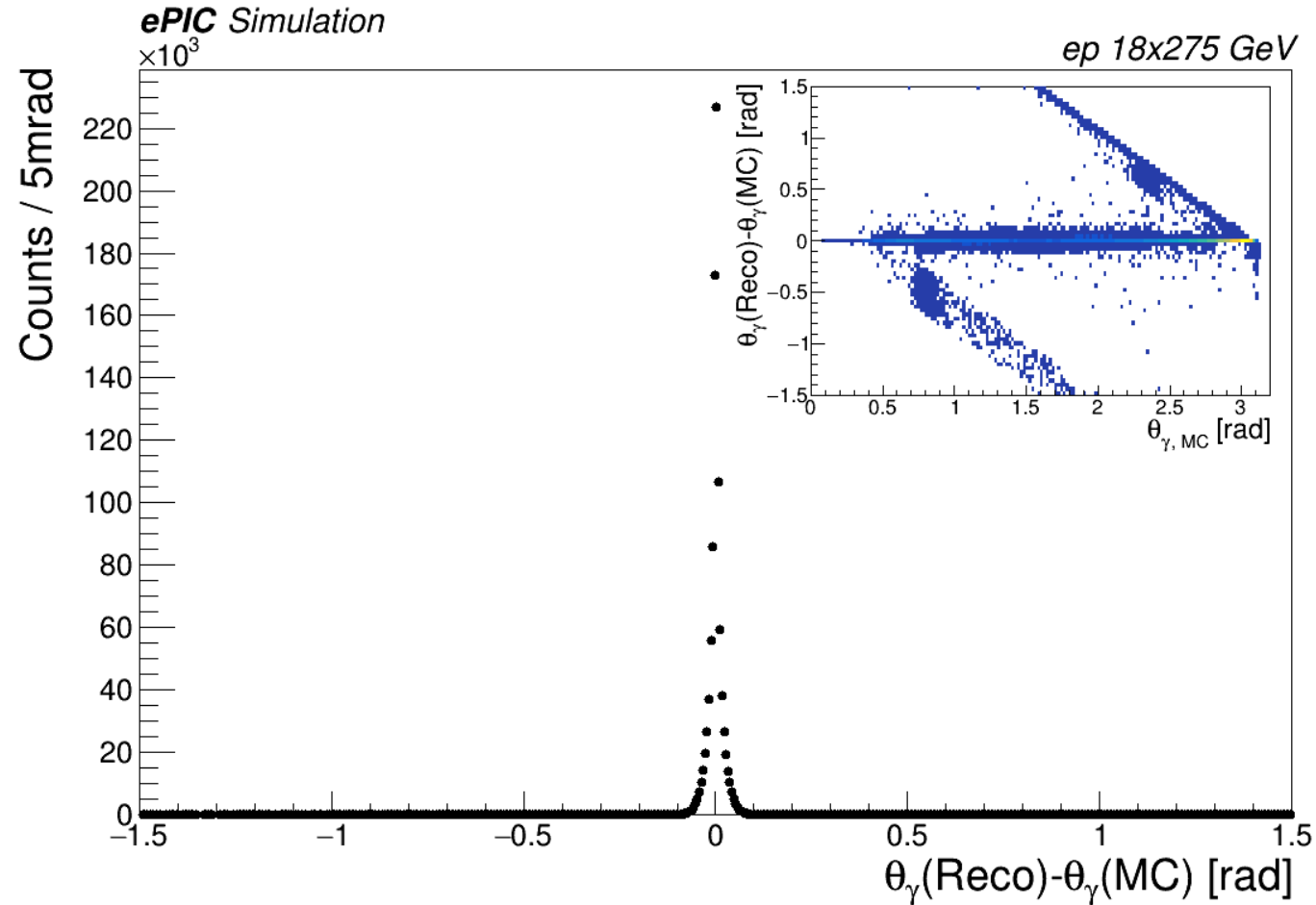
18x275: η distribution



18x275: t distribution



18x275: γ angular performance



Wrap-up

- Use of explicit associations does not seem to change the results of analysis so far.
 - More investigation needed to confirm this.
- Definite issue in photon reconstruction for 24.08.0 5x41 setting.
 - Will need to test this on 24.09.0.
- 24.09.0 shows no reconstructed protons in B0.
 - Not sure why yet. Still under investigation.
 - Could be from associations, could be from cuts, could be something more fundamental to the simulation.