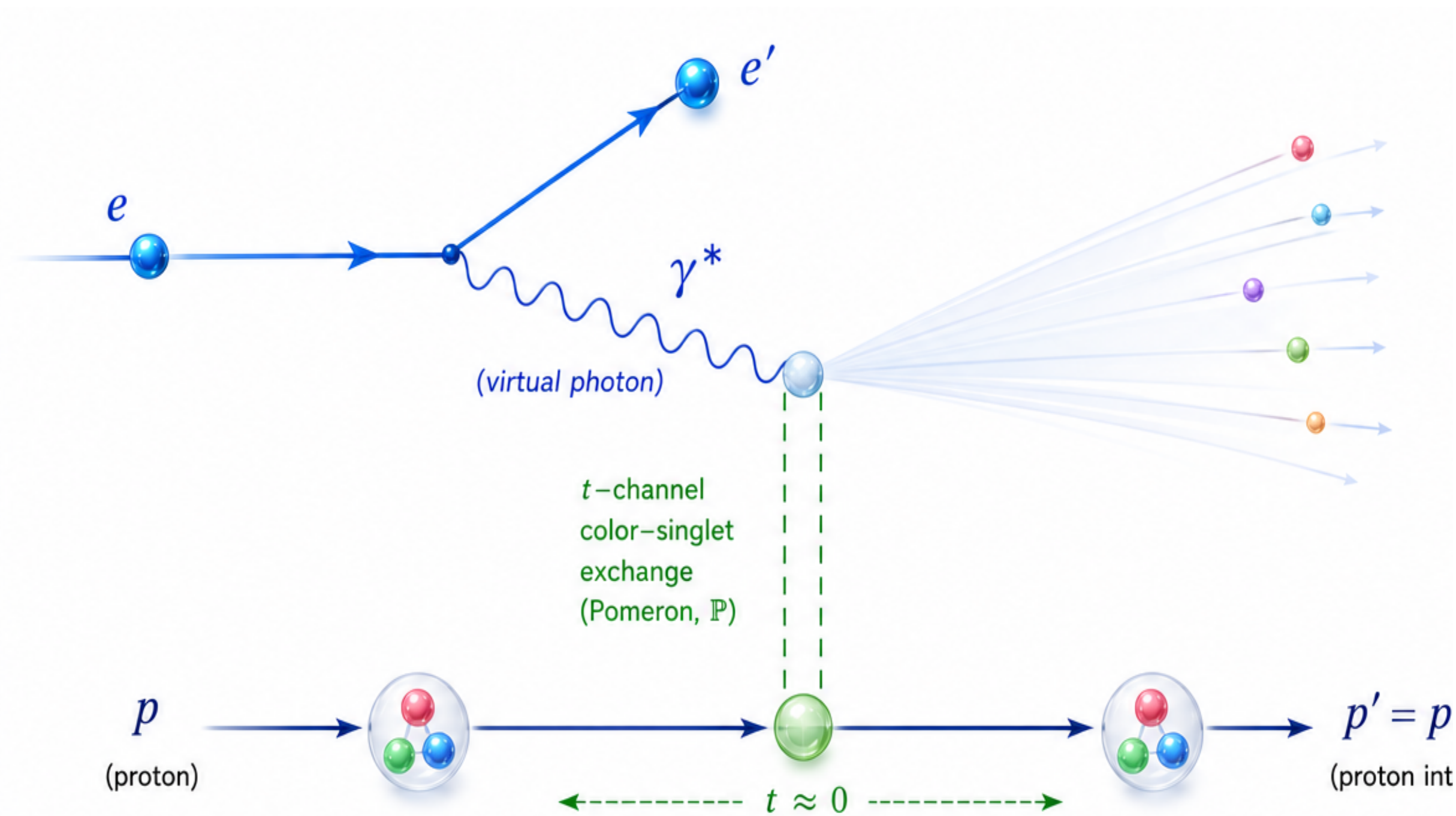


# **Inclusive diffraction on proton**

**ePIC Performance**

**Arjun Kumar**

# Inclusive diffraction on proton



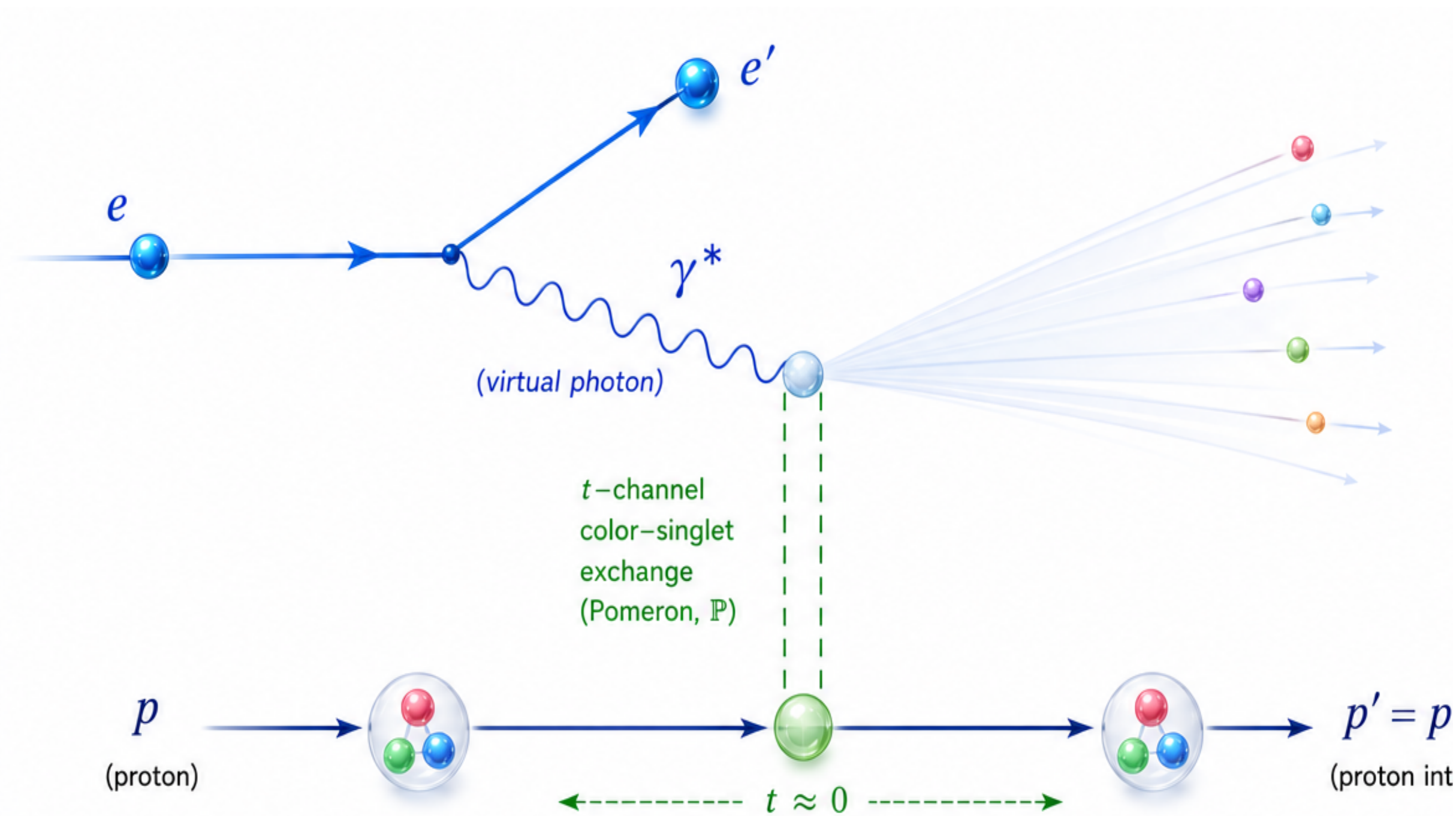
- $e + p \rightarrow e' + X + p'$
- Measure the scattered electron and the forward proton
- Motivation: Baseline measurement for studying nuclear suppression of diffractive structure

function i.e  $R_{\text{diff}}^A = \frac{F_{2,A}^D}{A F_{2,p}^D}$

**Inclusive diffraction is special:**

whole target wavefunction must stay coherent, a bridge between long distance physics and calculable parton dynamics

# Inclusive diffraction on proton



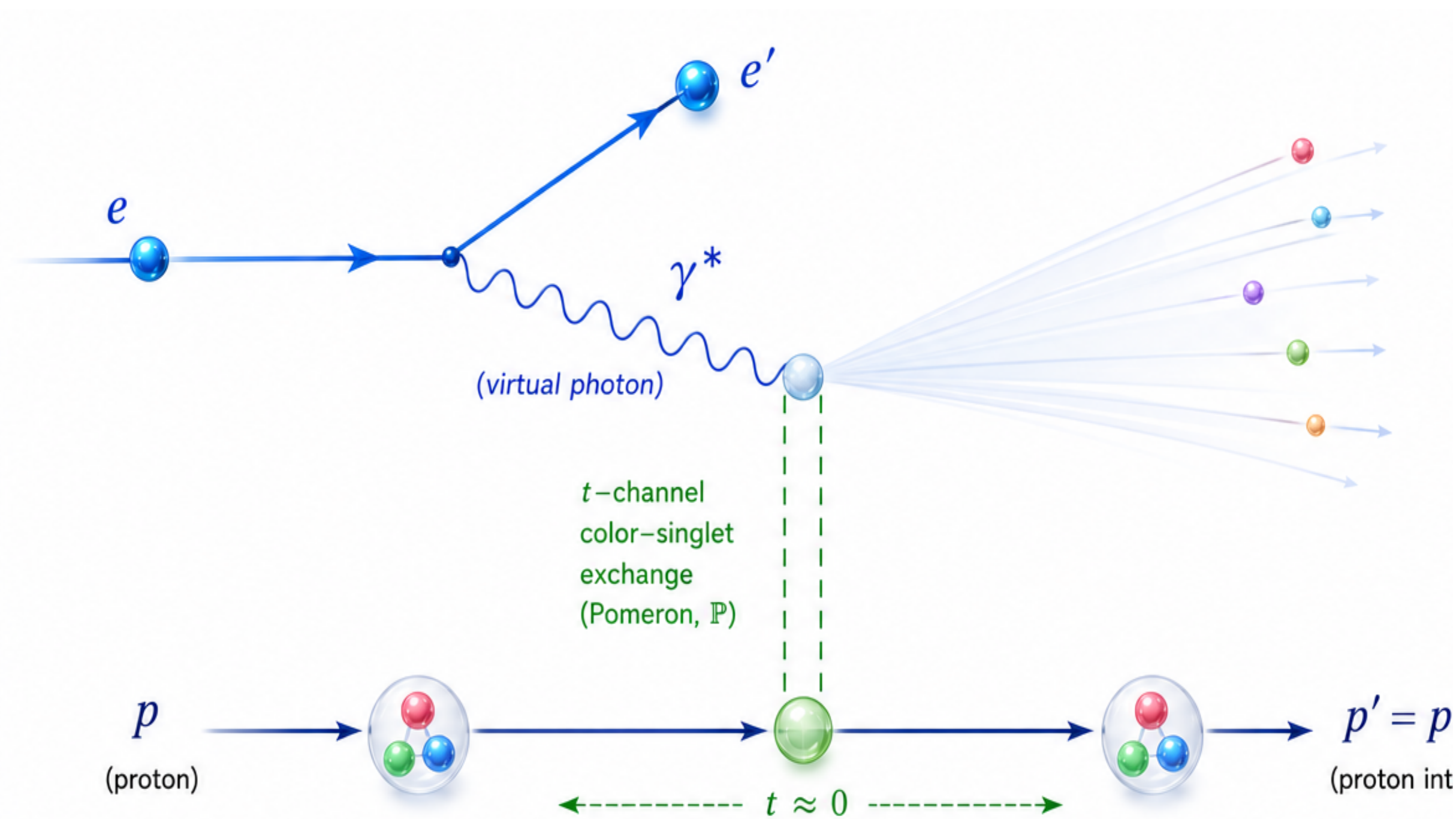
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**Inclusive diffraction is special:**

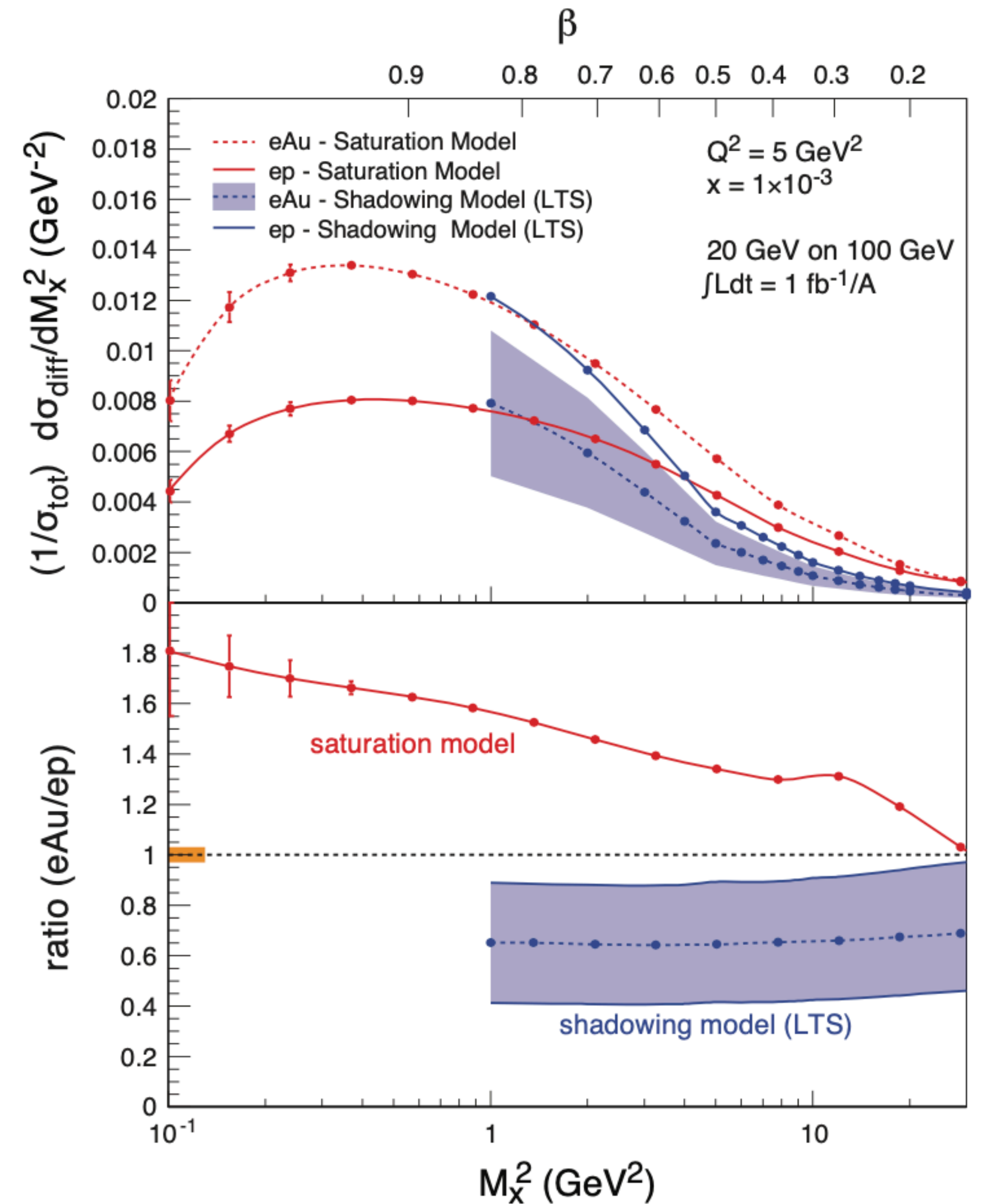
Important observable for Imaging and Saturation program at EIC

# Inclusive diffraction on proton



**Inclusive diffraction is special:**

Important observable for Imaging and Saturation program at EIC



# Electron-Finder for scattered electron

- **MC ID:** MC outgoing electron using initial beam electron genealogy
- **Truth ID:** Reconstructed electron using truth MC electron link
- **Det ID:** Using cluster and tracking to find the electron

## Current detector-based electron ID

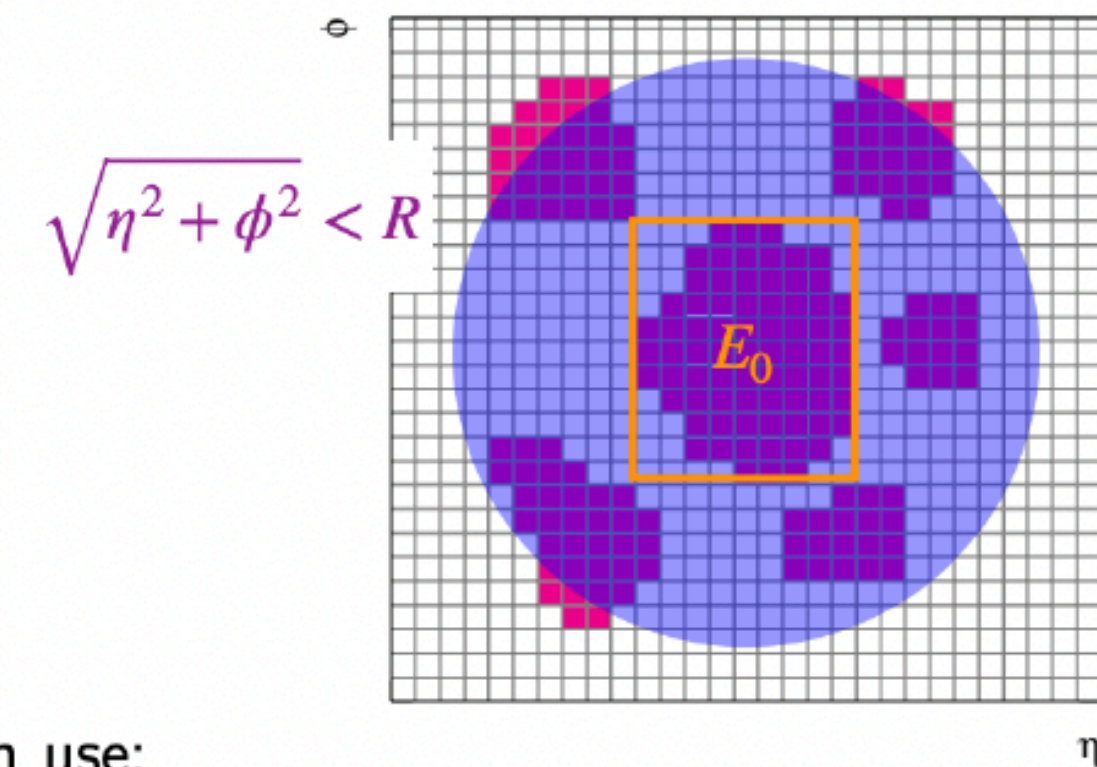
```
edm4eic::ReconstructedParticleCollection ElectronID::FindScatteredElectron()
```

- Loop over all reconstructed particles, and apply cuts on:

- Require negative tracks
- $0.9 < E/p < 1.2$
- Isolated cluster

$$R = 0.4$$

$$E_0 / \Sigma E_R < 0.9$$



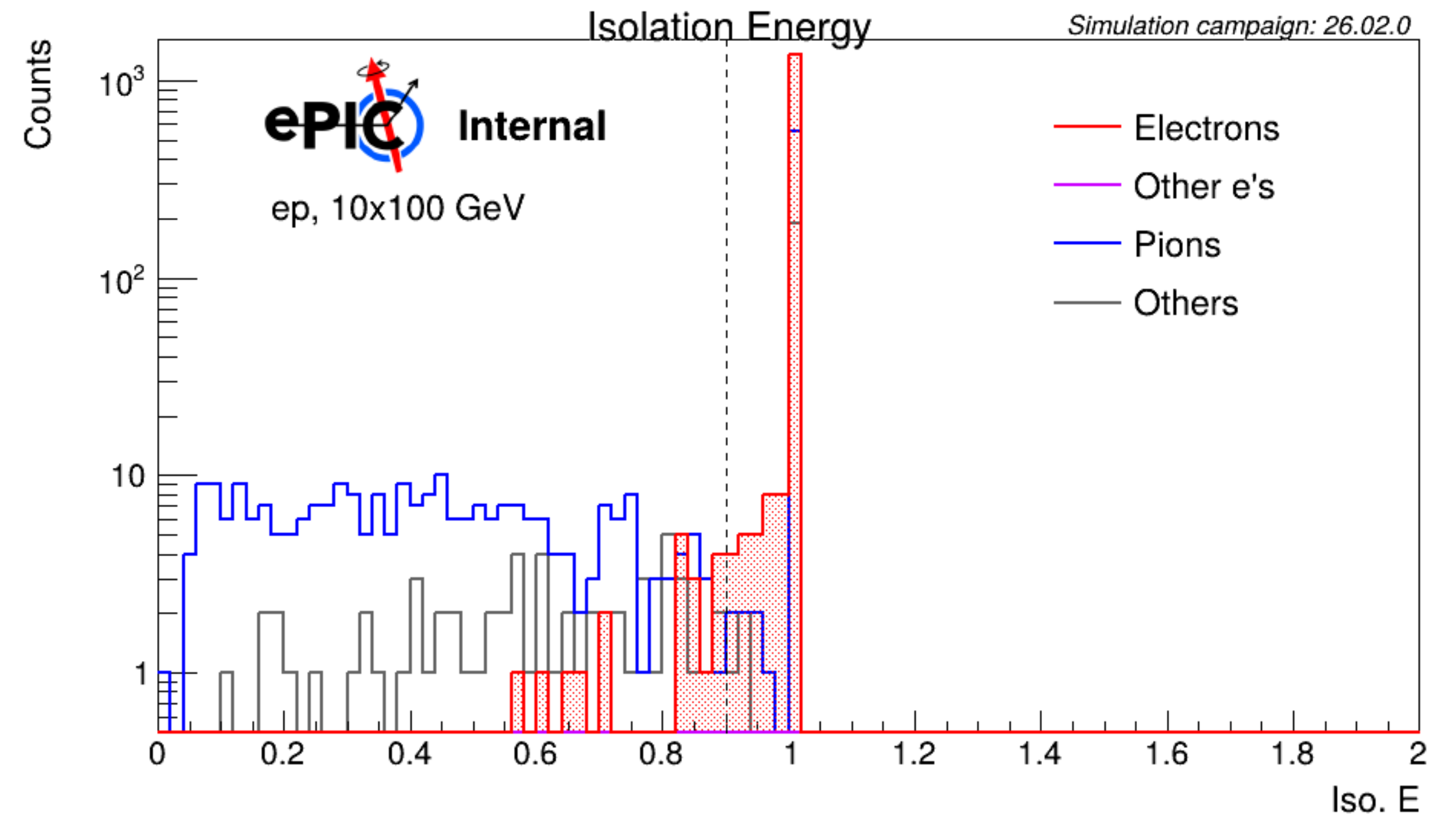
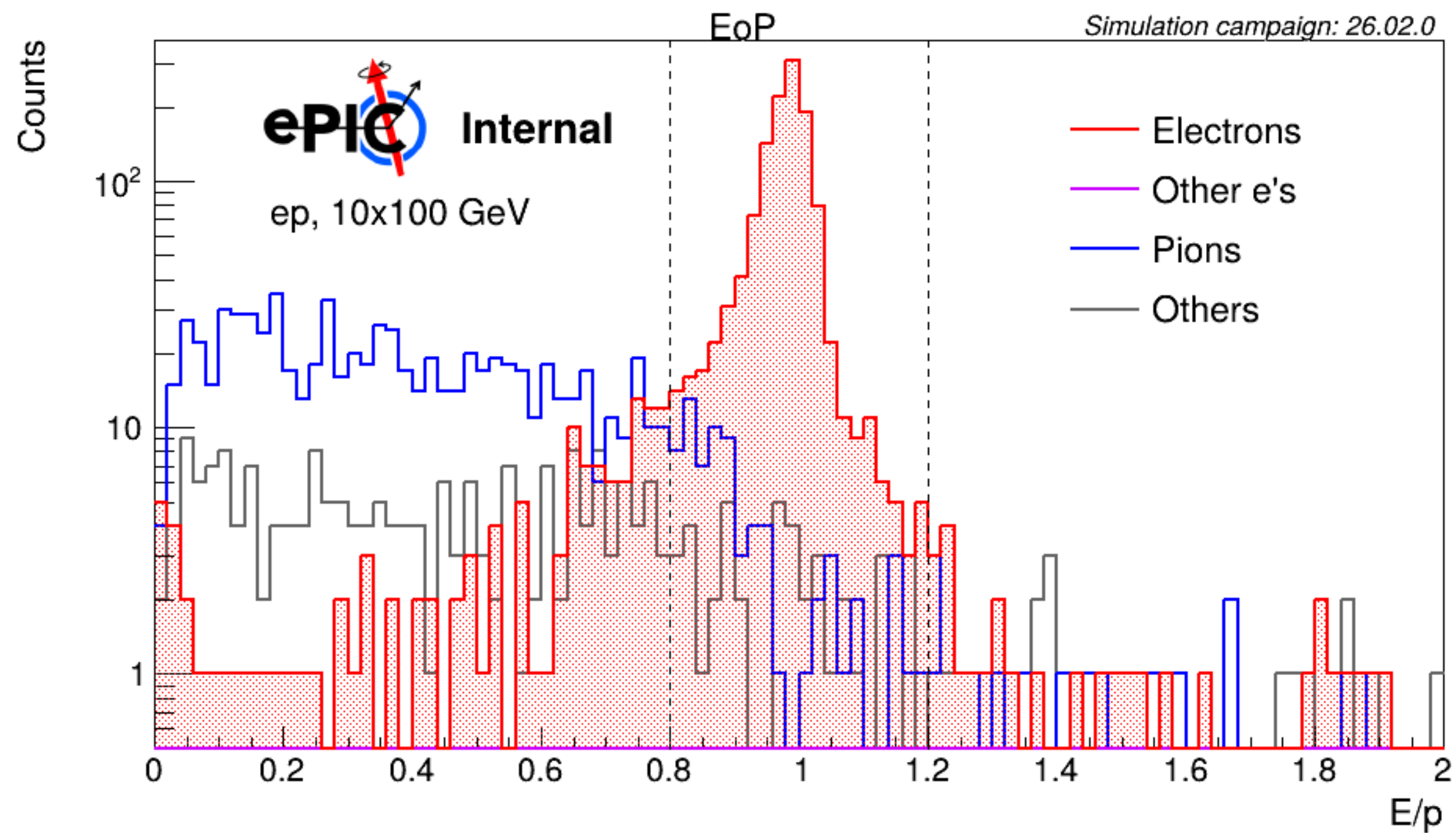
- If  $> 1$  particles in collection, can use:

```
edm4eic::ReconstructedParticle
```

```
SelectHighestPT(edm4eic::ReconstructedParticleCollection)
```

Tyler K. (JGU Mainz)

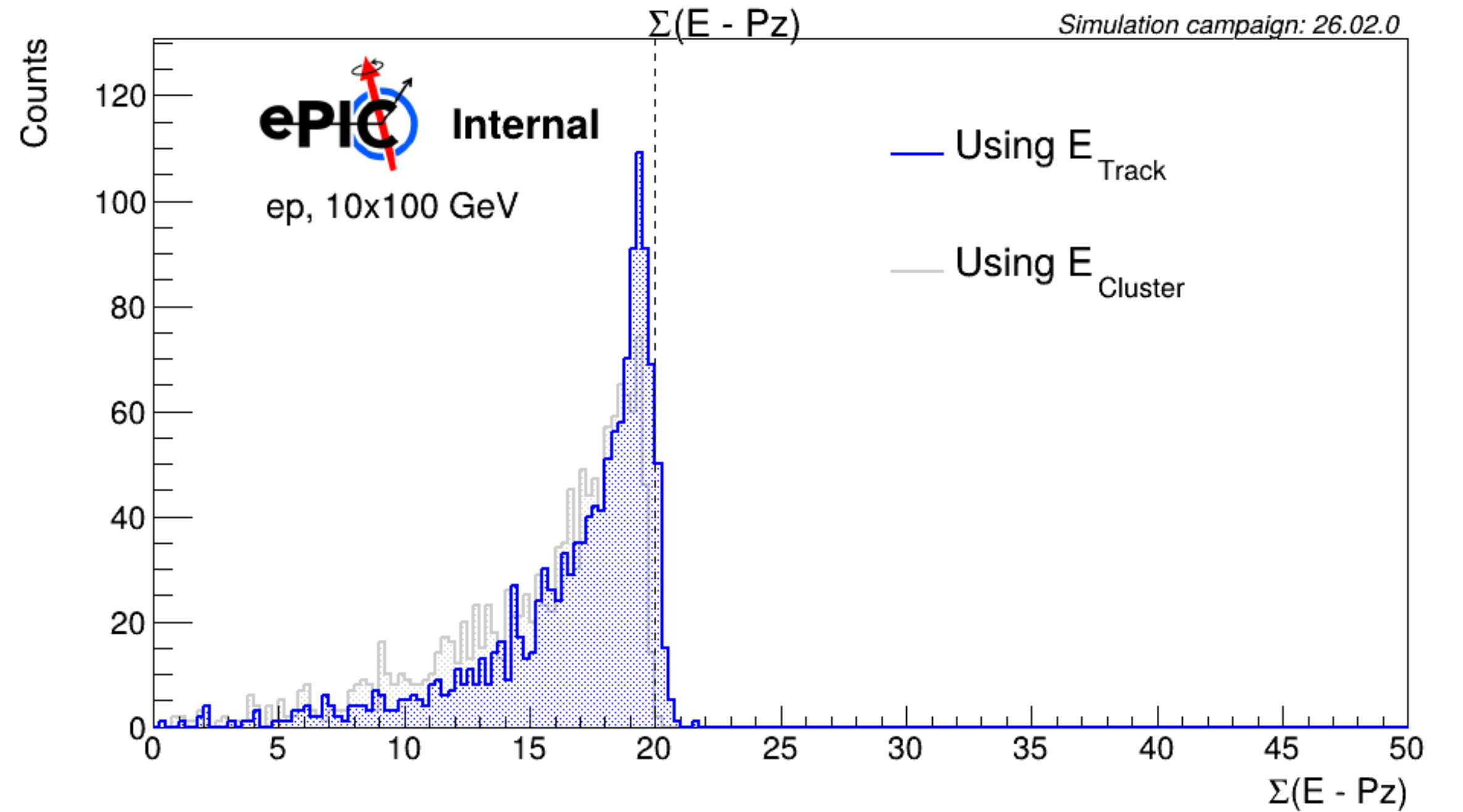
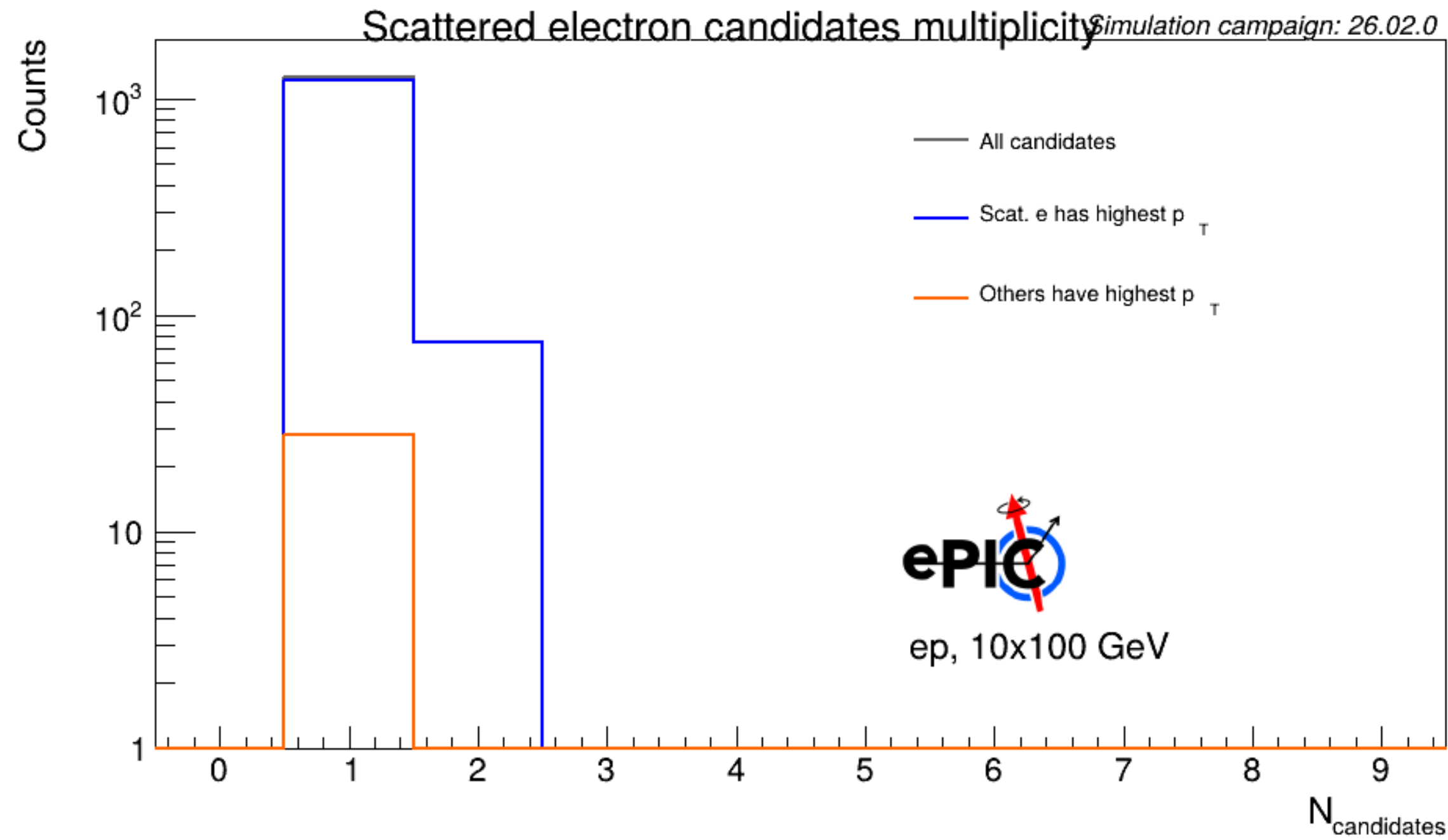
# Electron-Finder for scattered electron



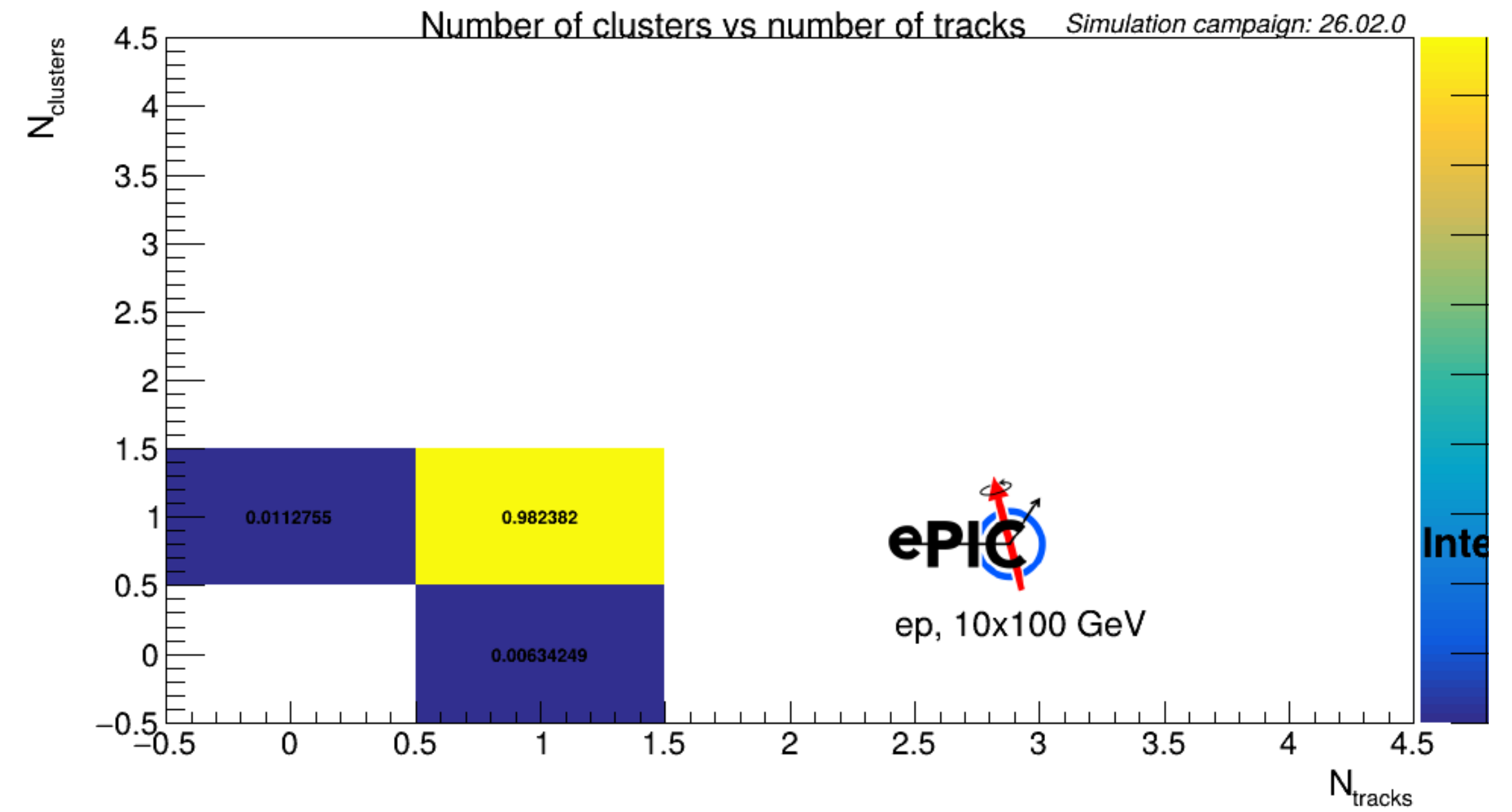
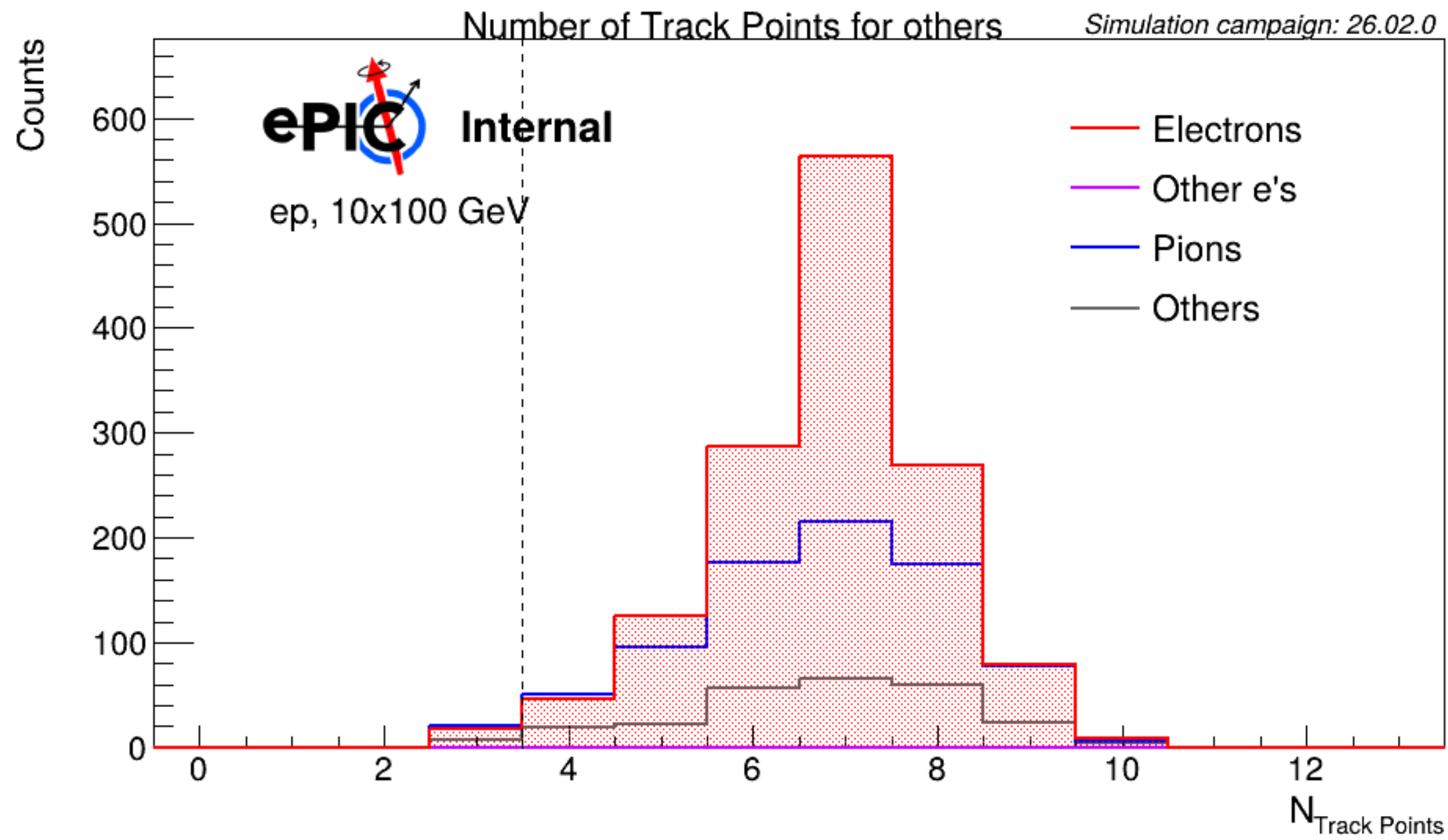
Using Rapgap for samples from 26.02.0 campaign

Using Win's code for electron finder

# Electron-Finder for scattered electron



# Electron-Finder for scattered electron

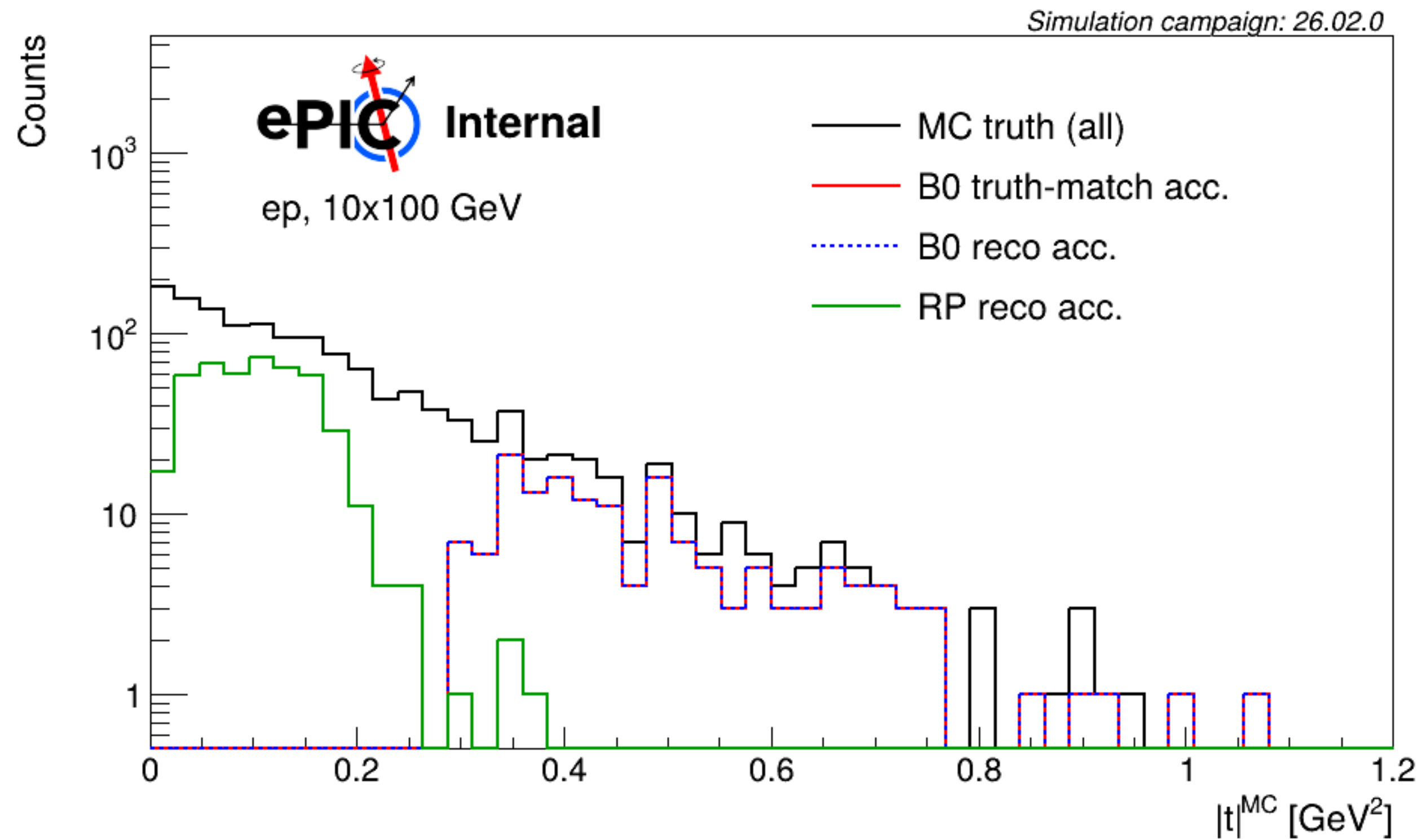
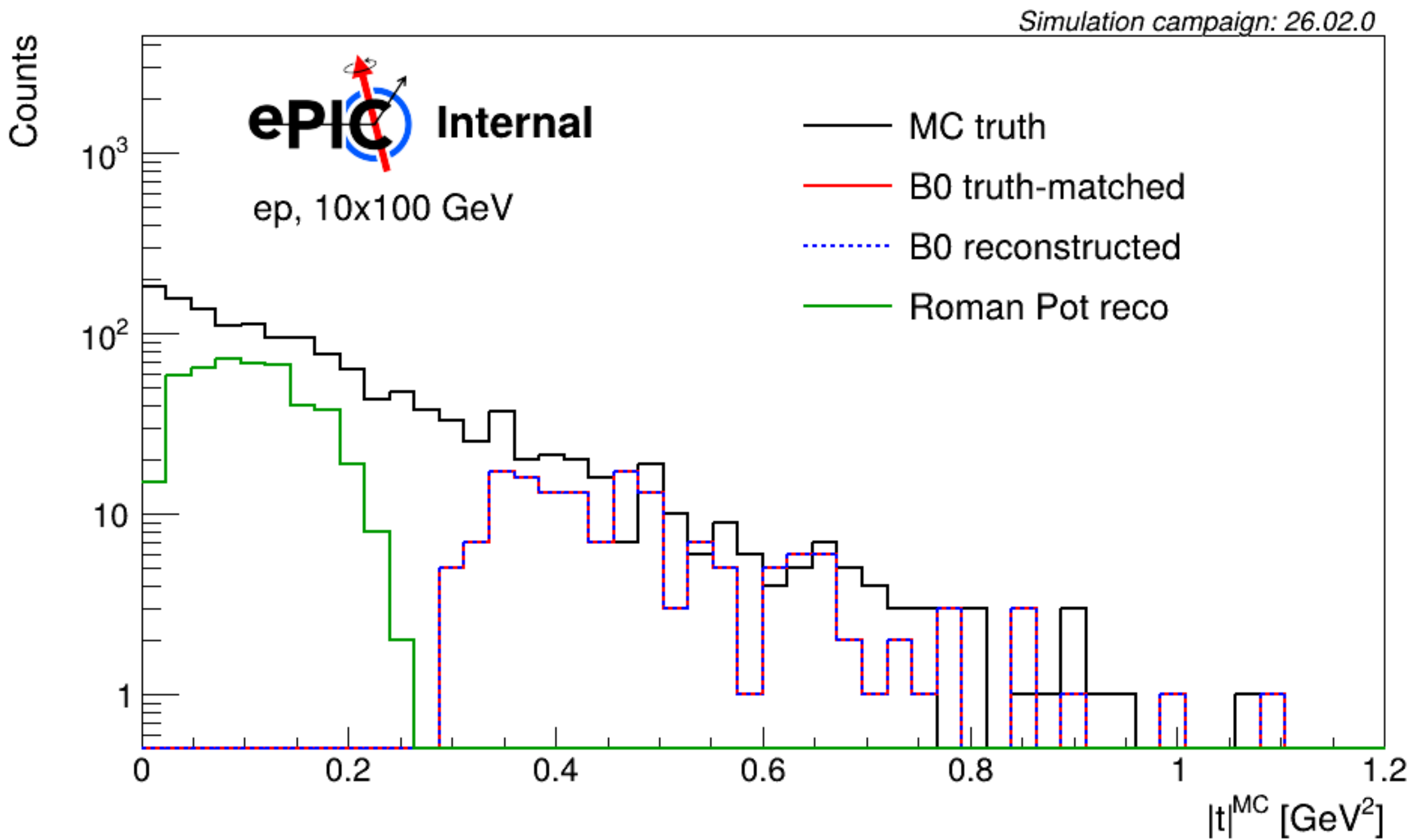


# Identification of Forward proton

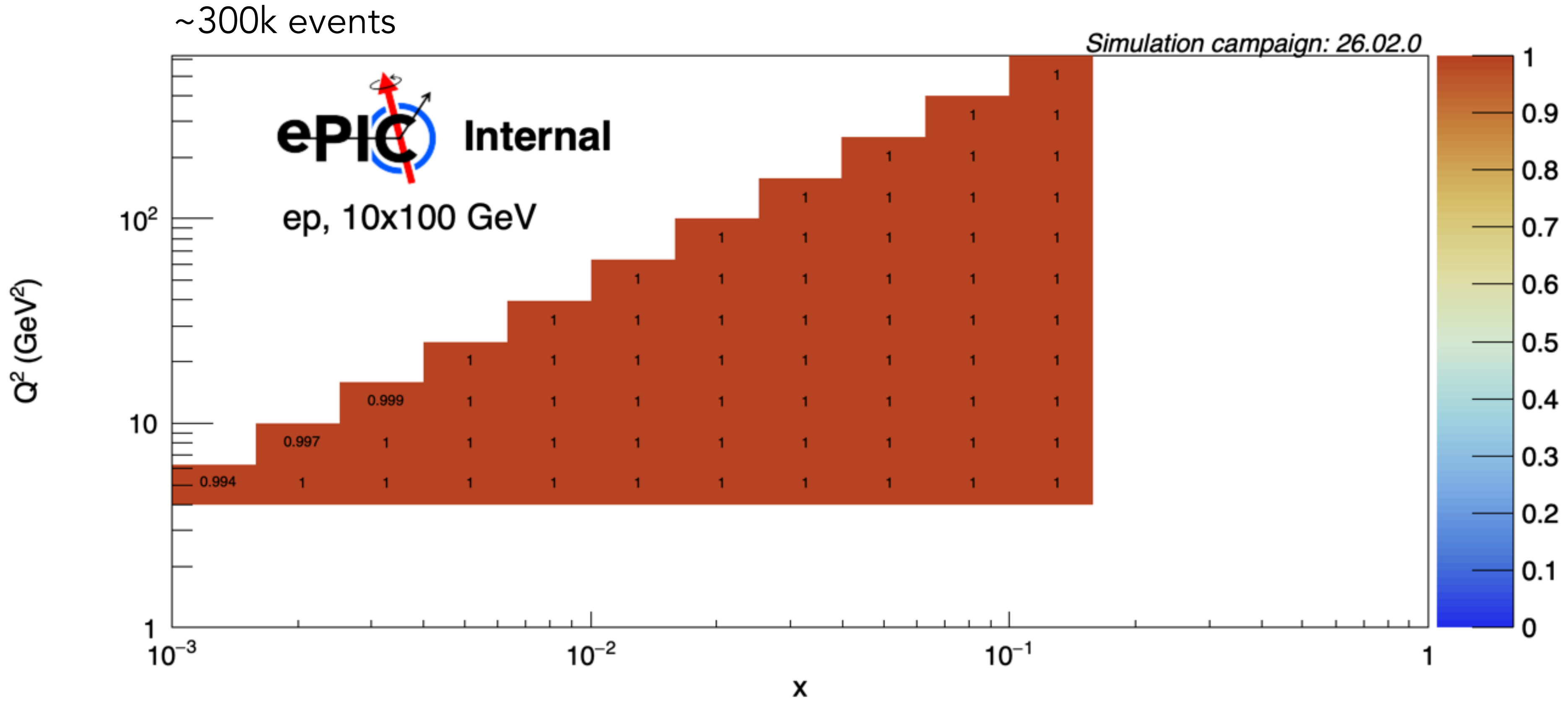
- **MC Particles:** MC truth Particles
  - **ReconstructedTruthSeededChargedParticles:** B0 reconstructed charged tracks
  - **ReconstructedTruthSeededChargedParticlesAssociations:** MC-to-reco matching for B0
  - **ForwardRomanPotRecParticles:** Roman pot reconstructed particles
- Looping over all particles and require positive charge
  - Selection based on  $5.5 \text{ mrad} \leq \theta \leq 20 \text{ mrad}$  for B0
  - RP theta cut : 0-5mrad

\*RP reconstructed particles already in head-on frame in simulation file

# Identification of Forward proton



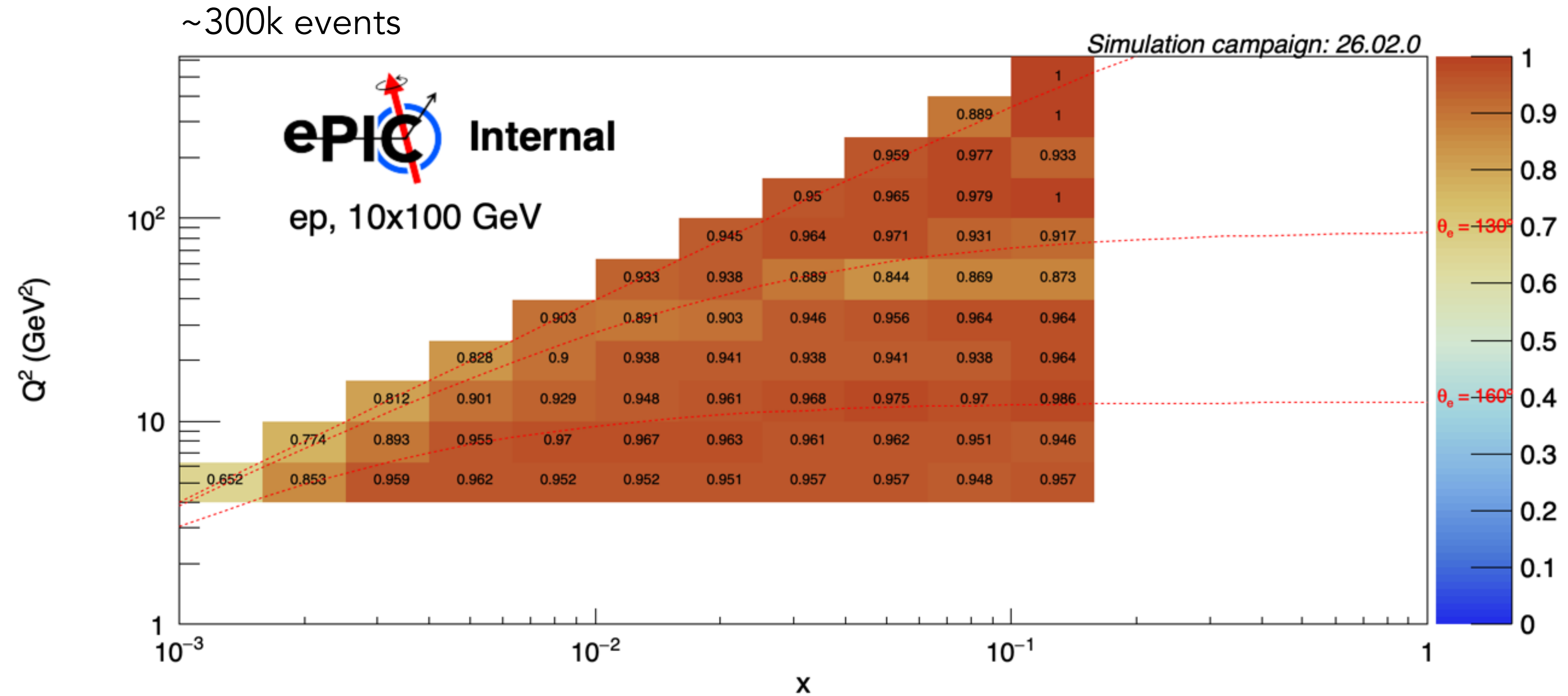
# Acceptance



$\frac{\text{No. of truth electrons (assoc. link)}}{\text{Total MC Electrons}}$

$\frac{\text{MC electron in acceptance of detector}}{\text{Total MC Electrons}}$

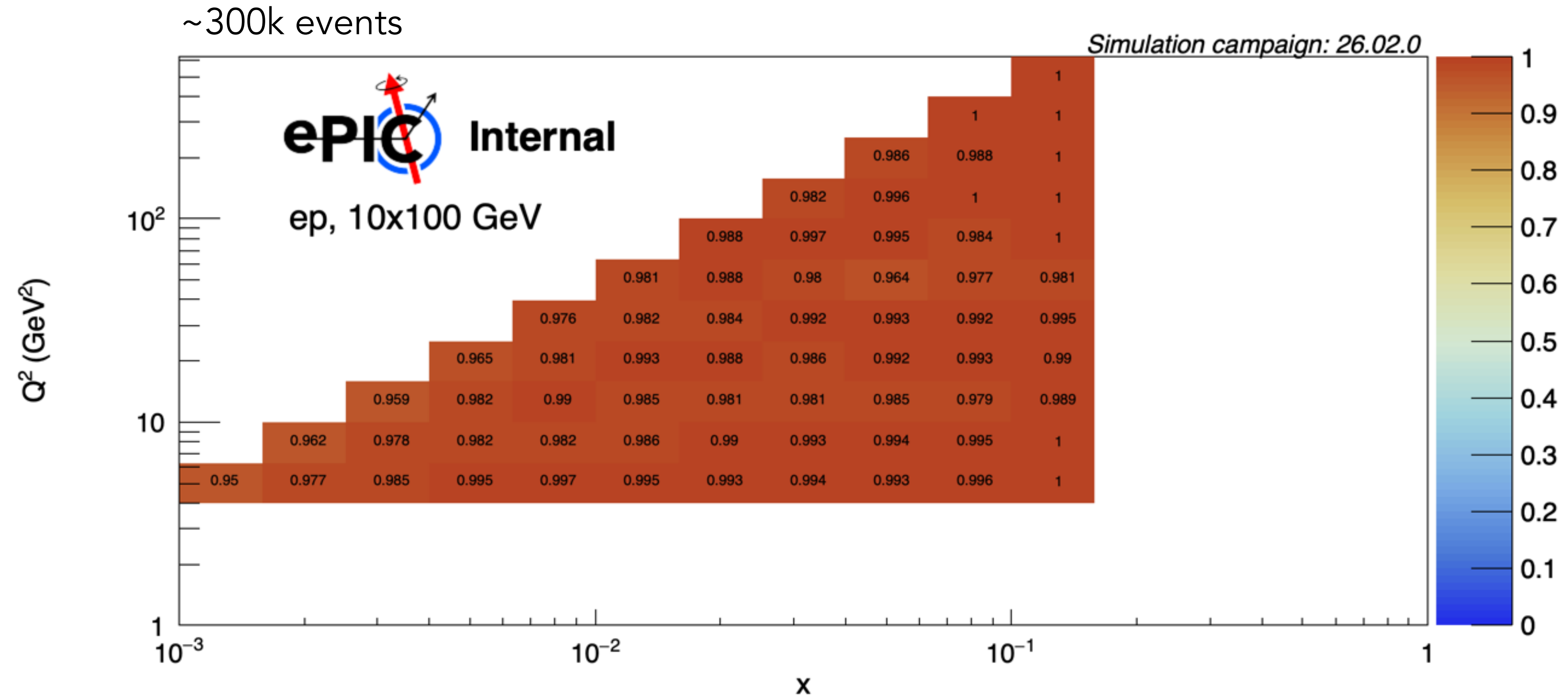
# Efficiency



No. of Reconstructed electrons  
Total MC Electrons

Signal events + Background events (passing cuts)  
Total MC Electrons

# Purity

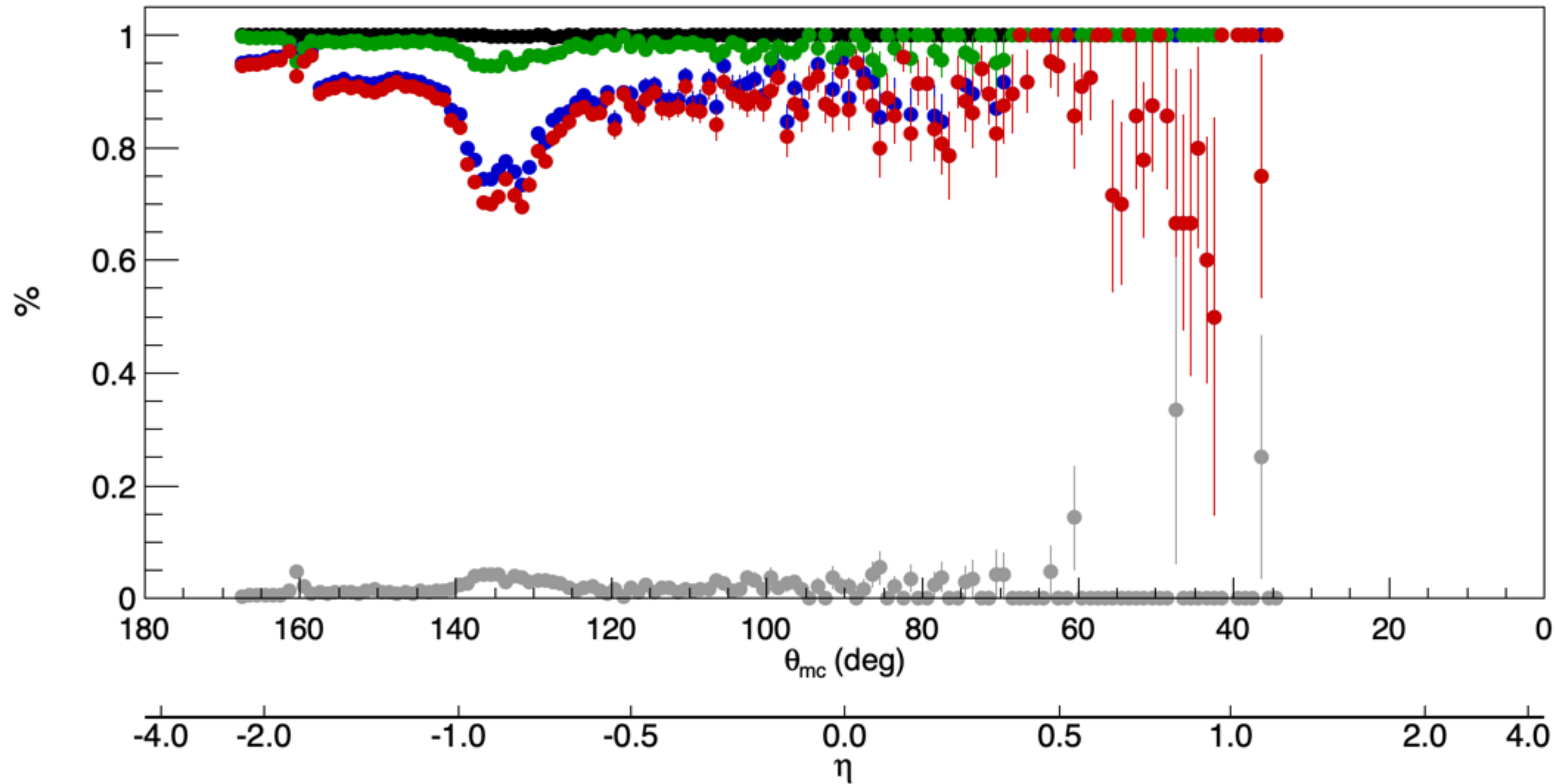


eID Reconstructed electrons  
Reconstructed electrons

Signal events  
Signal events + Background events (passing cuts)

# Angular

~300k events



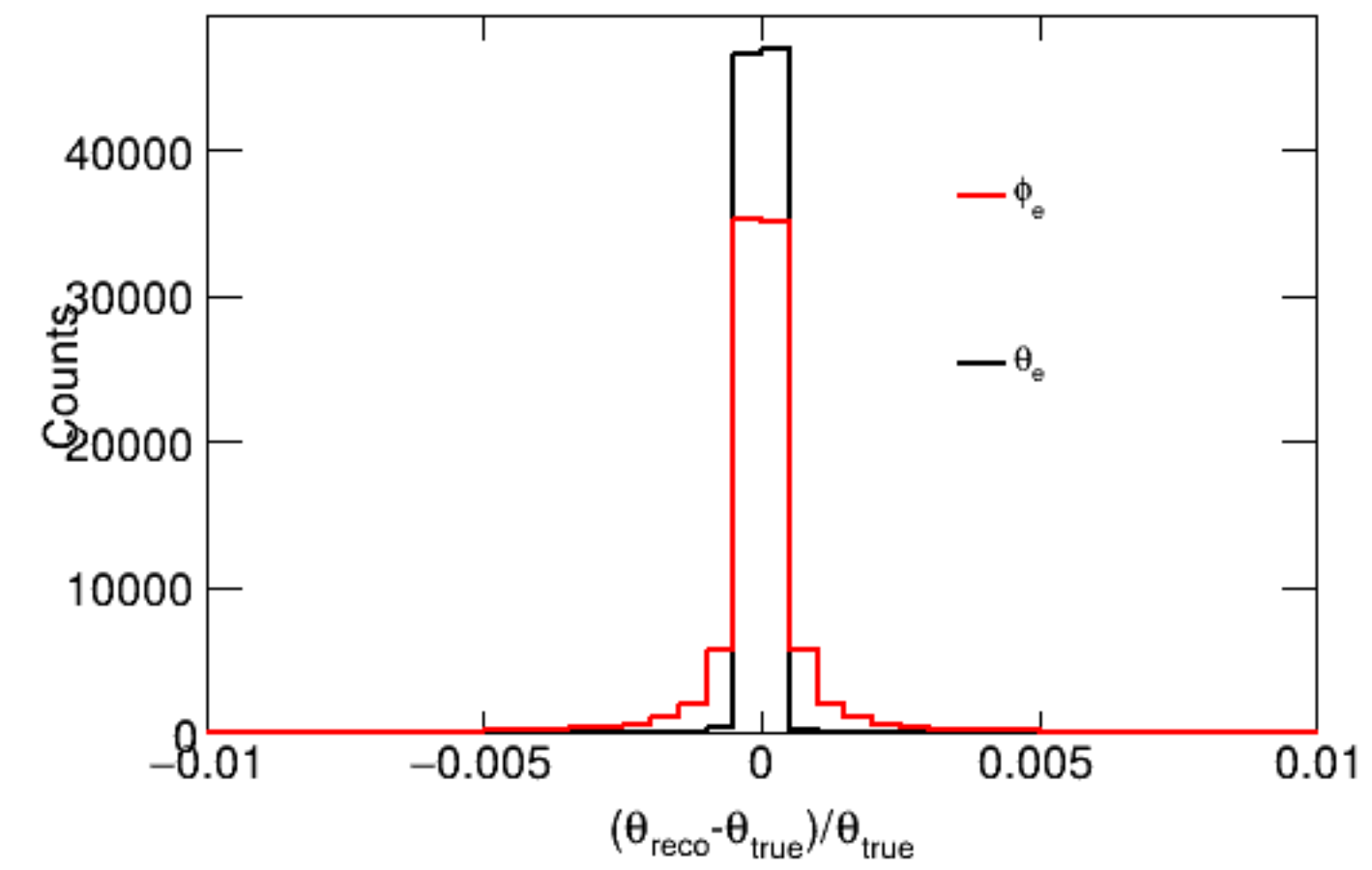
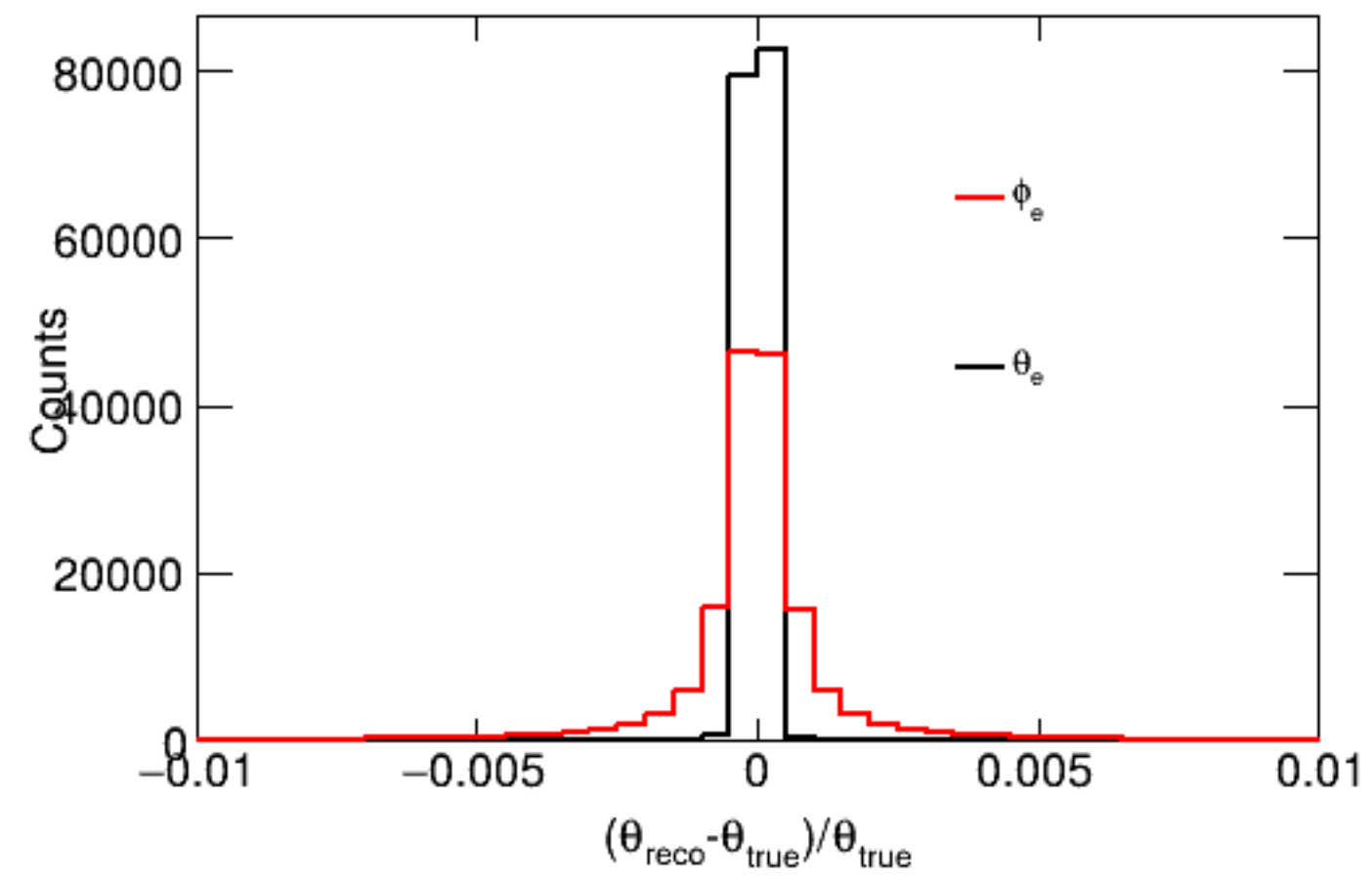
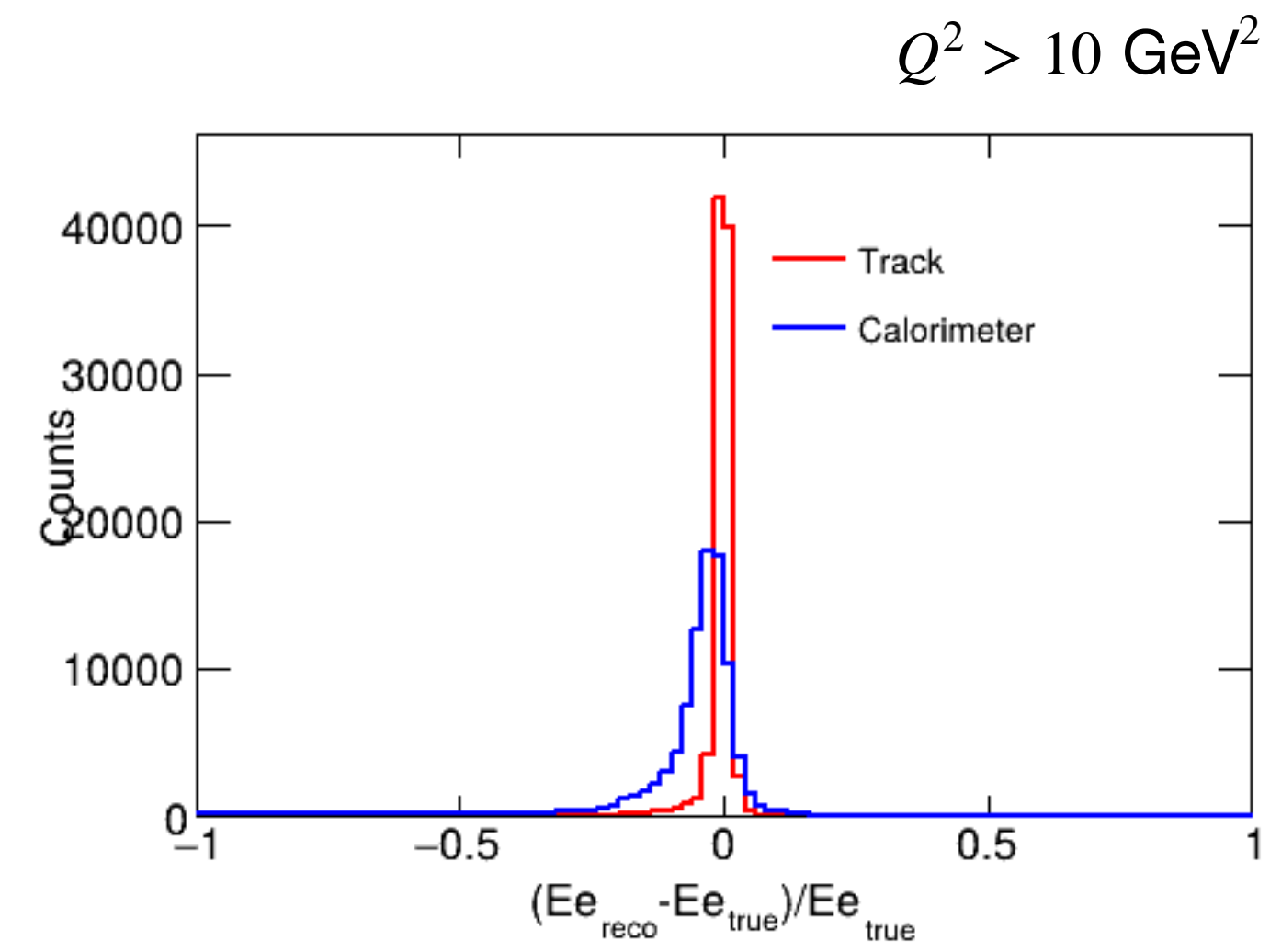
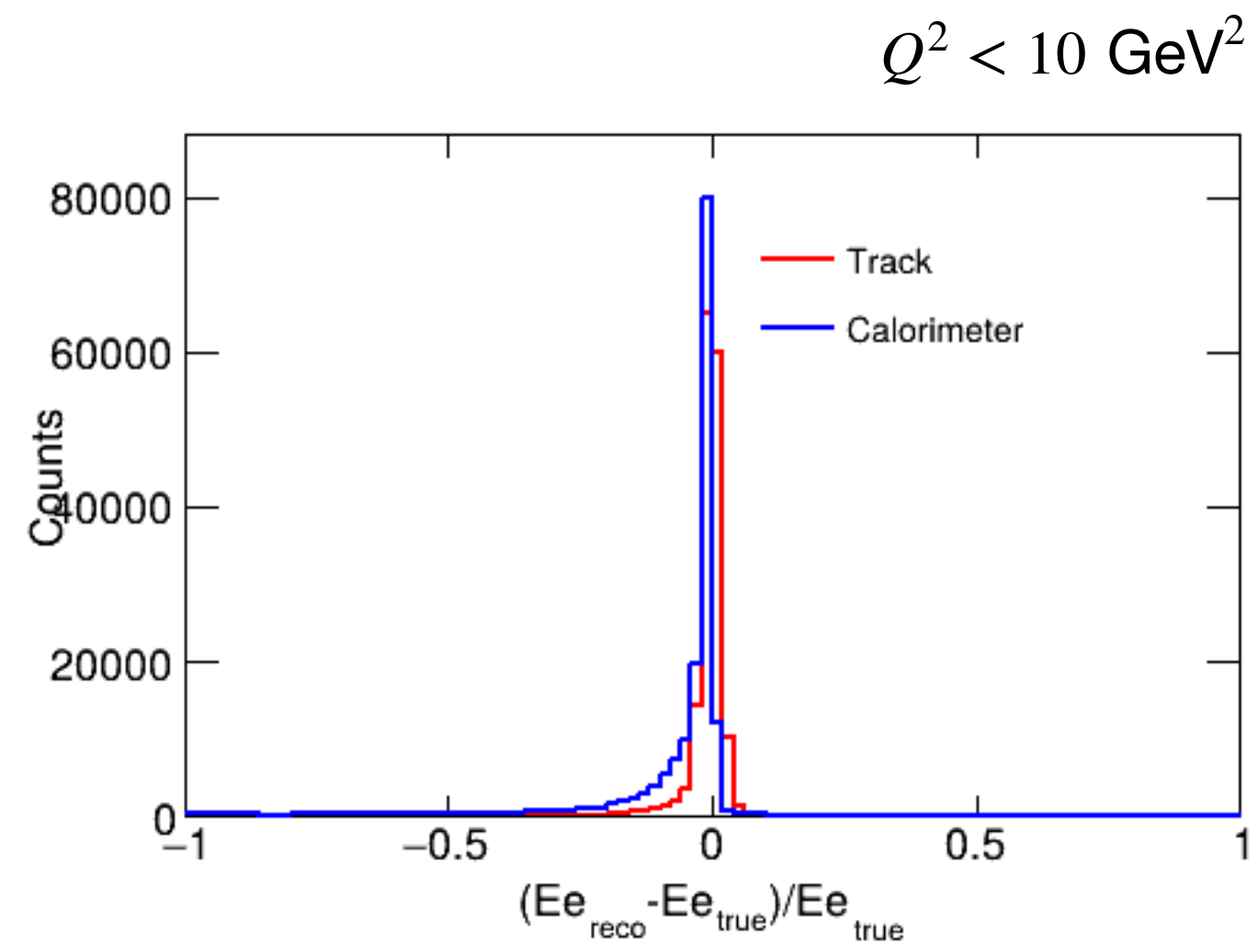
 Internal

*ep, 10x100 GeV*

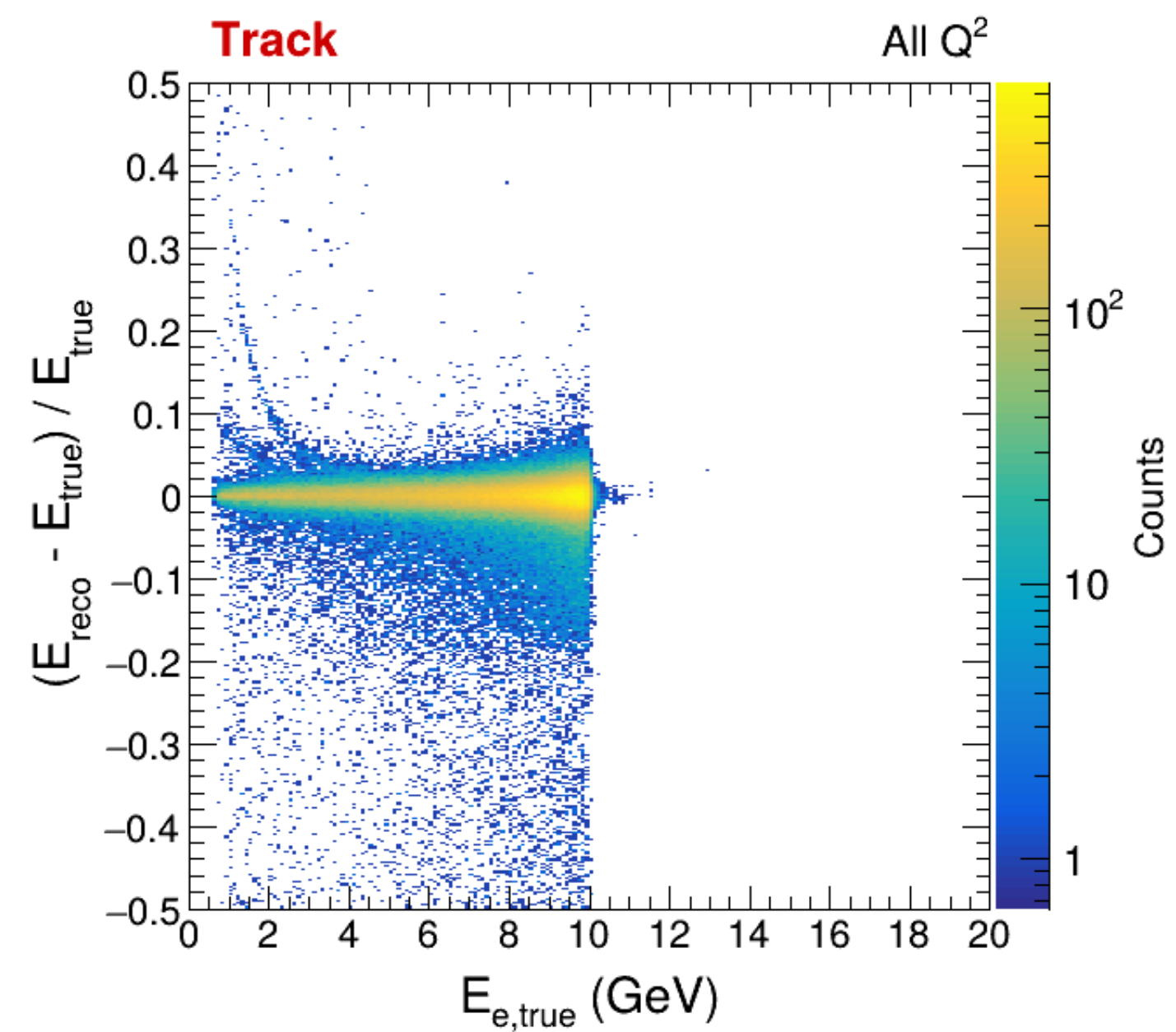
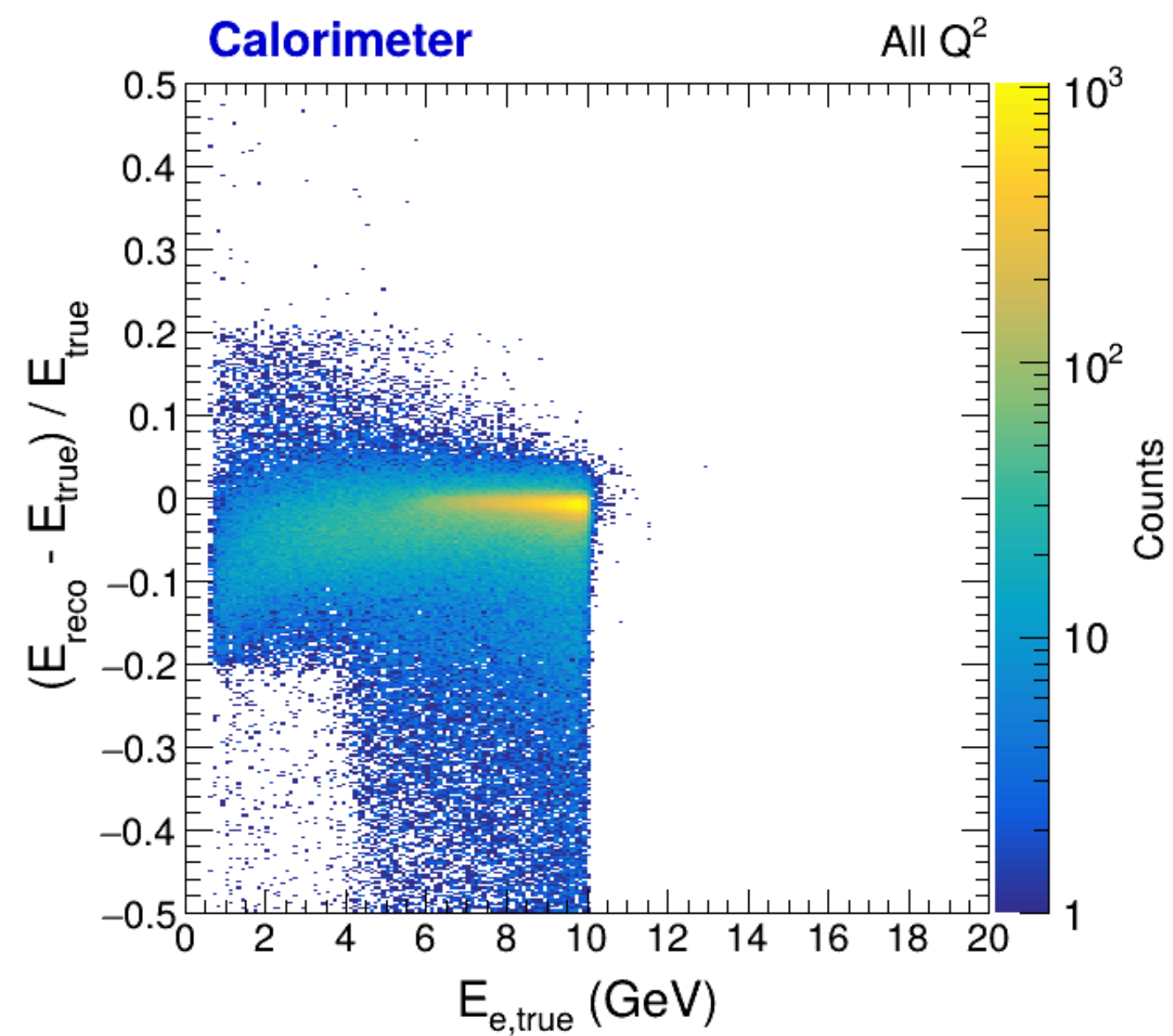
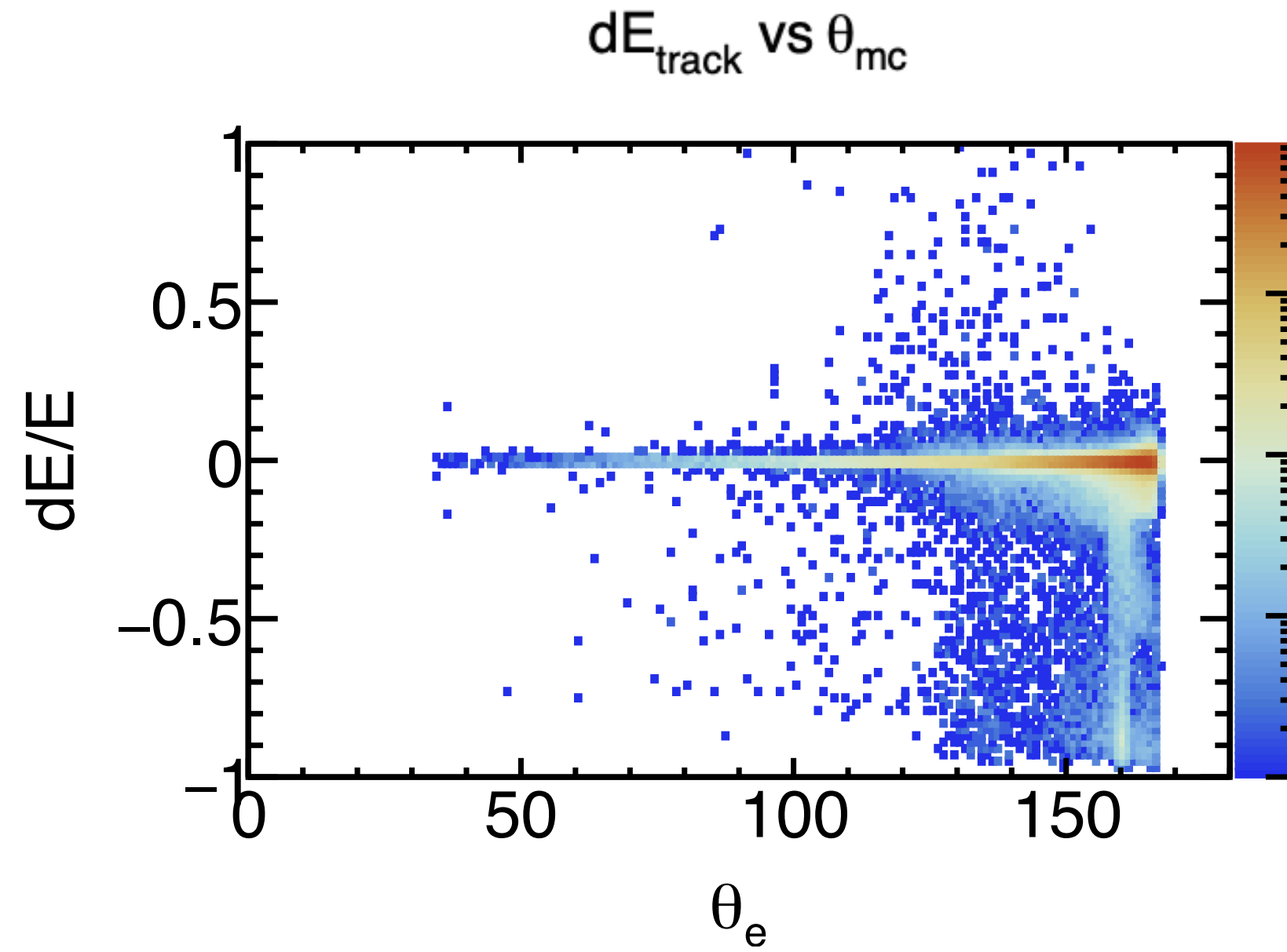
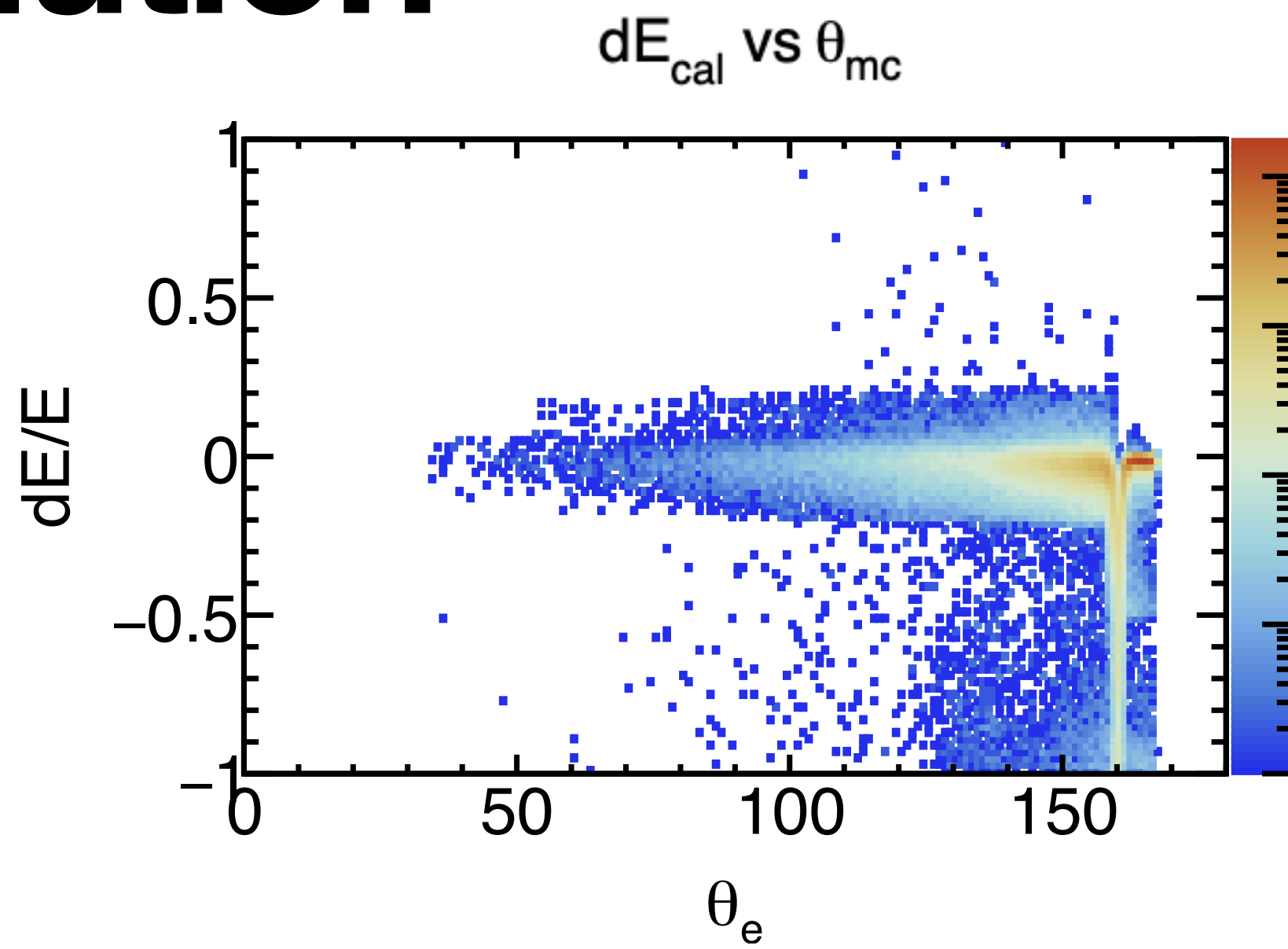
- Acceptance
- Efficiency
- Purity
- Overall rate
- $\pi$  contamination

*Simulation campaign: 26.02.0*

# Resolution



# Resolution



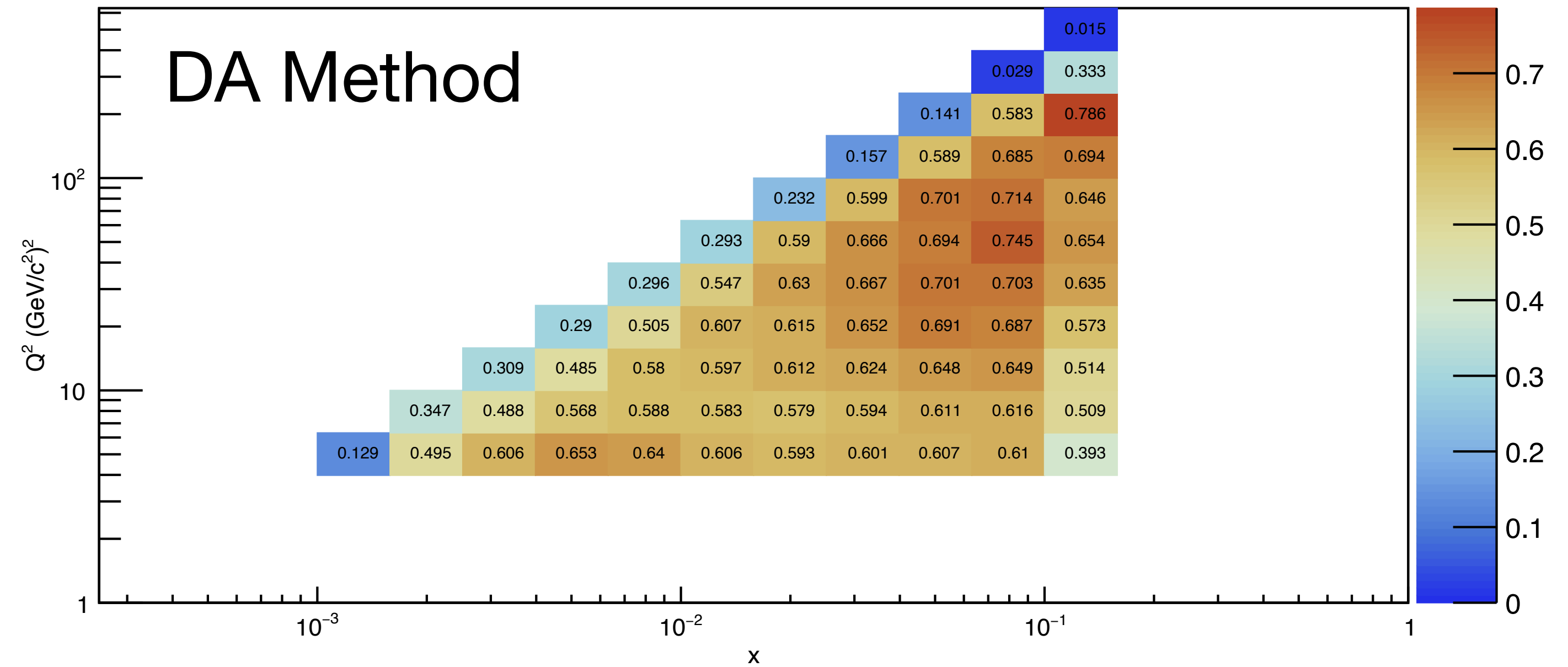
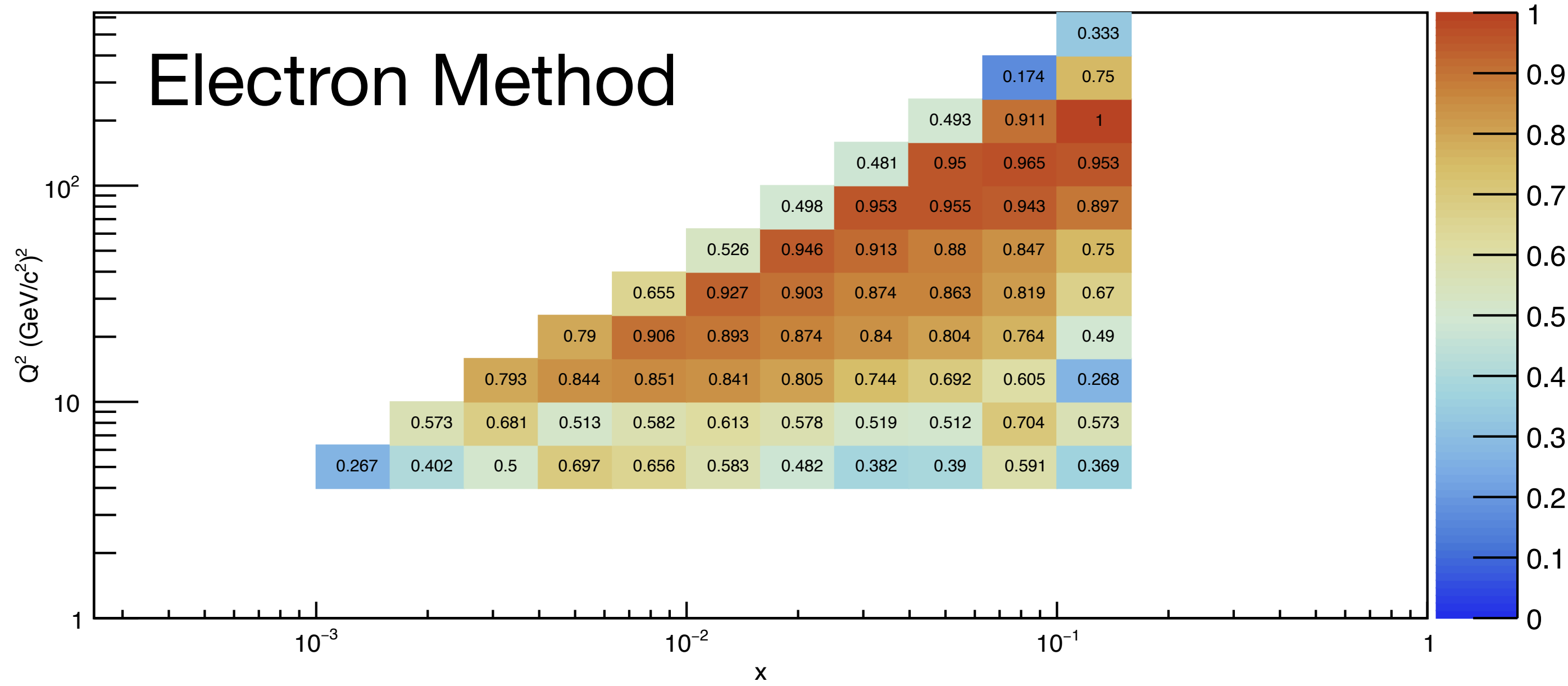
# Kinematic reconstruction

Algorithm	$Q^2$	Inelasticity $y$	Bjorken $x$
Electron (E)	$2E_0 E_e (1 + \cos \theta_e)$	$1 - \frac{E_e (1 - \cos \theta_e)}{2E_0}$	$\frac{Q^2}{4E_0 E_\beta y}$
Jacquet-Blondel (JB)	$\frac{p_{t,h}^2}{1-y}$	$\frac{\delta_h}{2E_0}$	
Double-Angle (DA)	$\frac{4E_0^2}{\tan(\frac{\theta_e}{2})(\tan(\frac{\theta_e}{2}) + \delta_h/p_{t,h})}$	$\frac{\delta_h/p_{t,h}}{\tan(\frac{\theta_e}{2}) + \delta_h/p_{t,h}}$	
Sigma ( $\Sigma$ )	$\frac{E_e^2 \sin^2 \theta_e}{1-y}$	$\frac{\delta_h}{\delta_h + E_e (1 - \cos \theta_e)}$	
E-Sigma ( $e\Sigma$ )	$Q_E^2$	$\frac{Q_E^2}{4E_0 E_\beta x_\Sigma}$	$x_\Sigma$

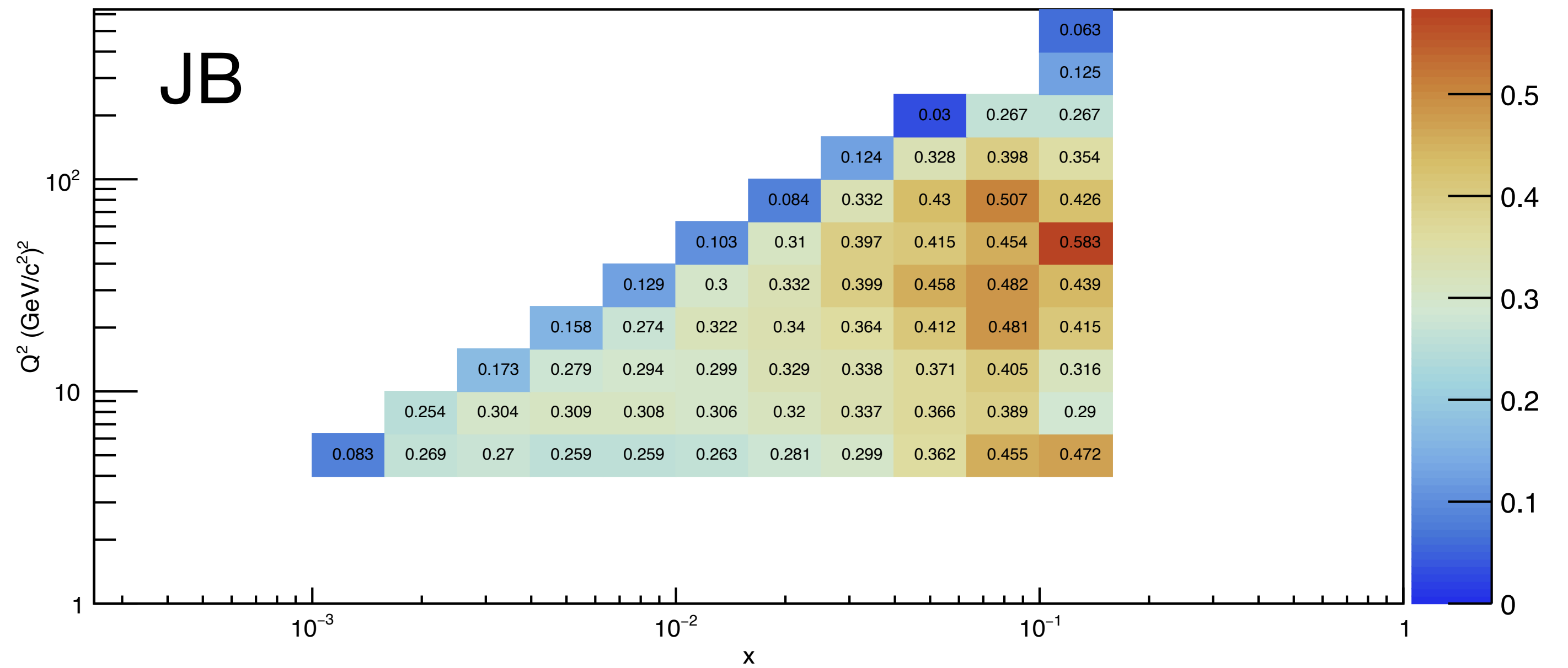
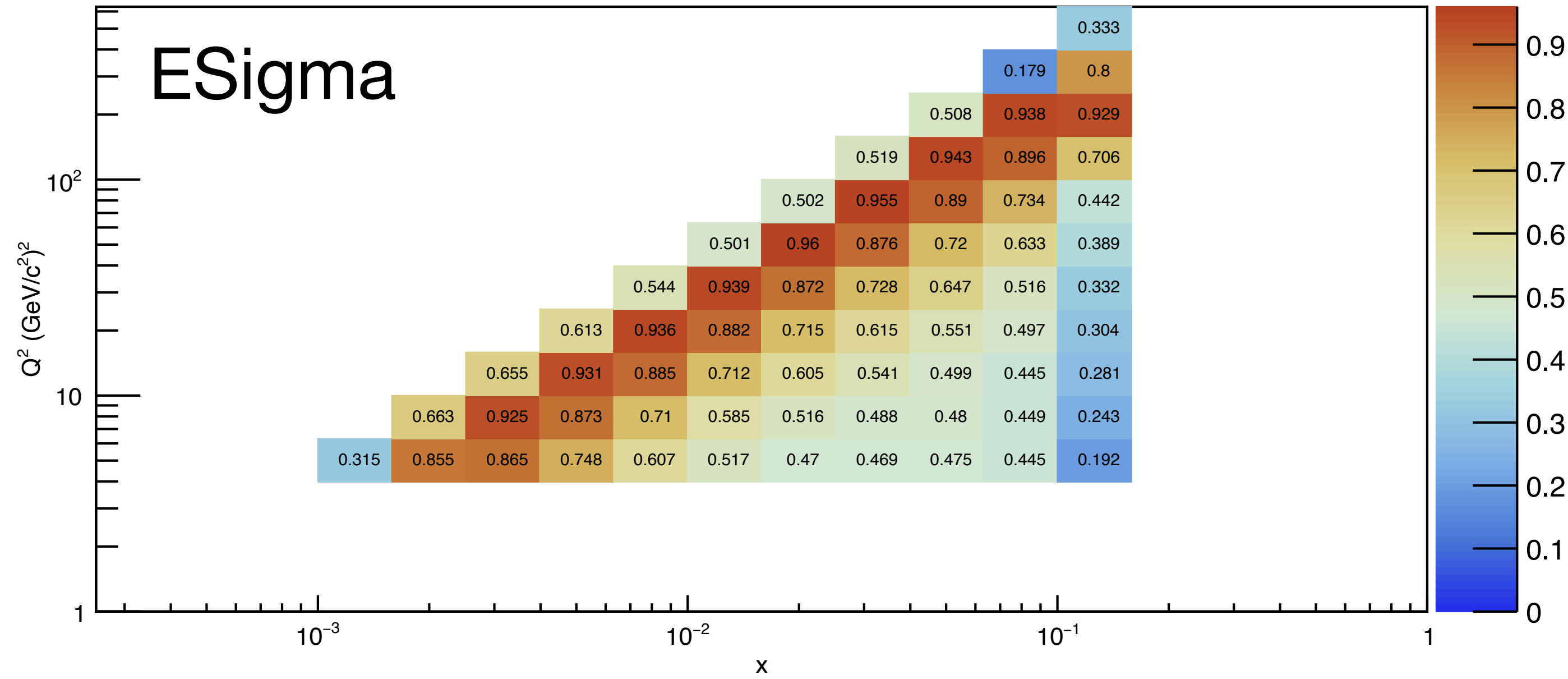
$$p_{t,h}^2 = \left( \sum_h p_{x,h} \right)^2 + \left( \sum_h p_{y,h} \right)^2$$

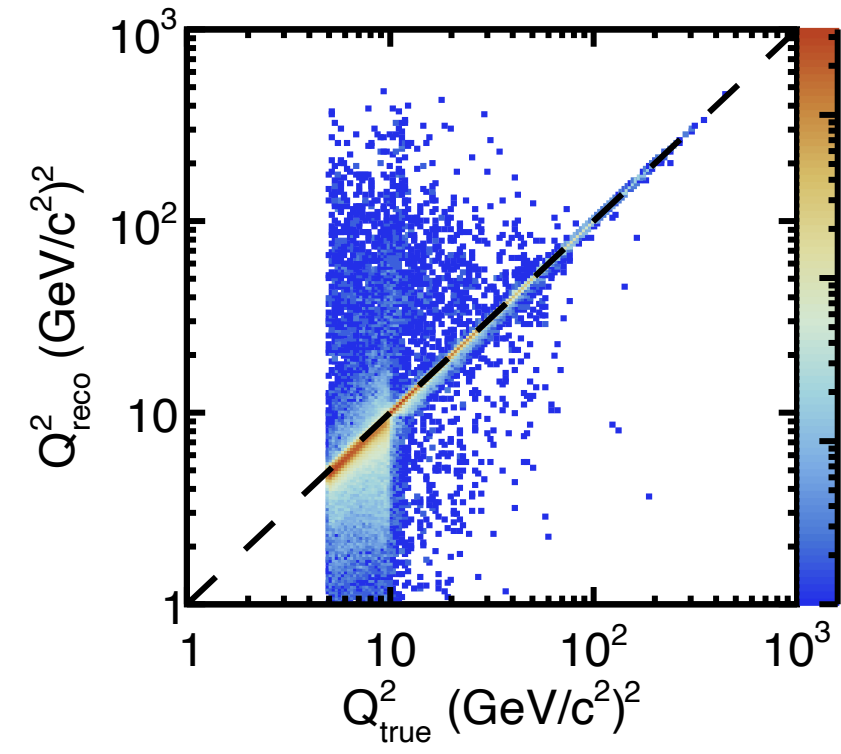
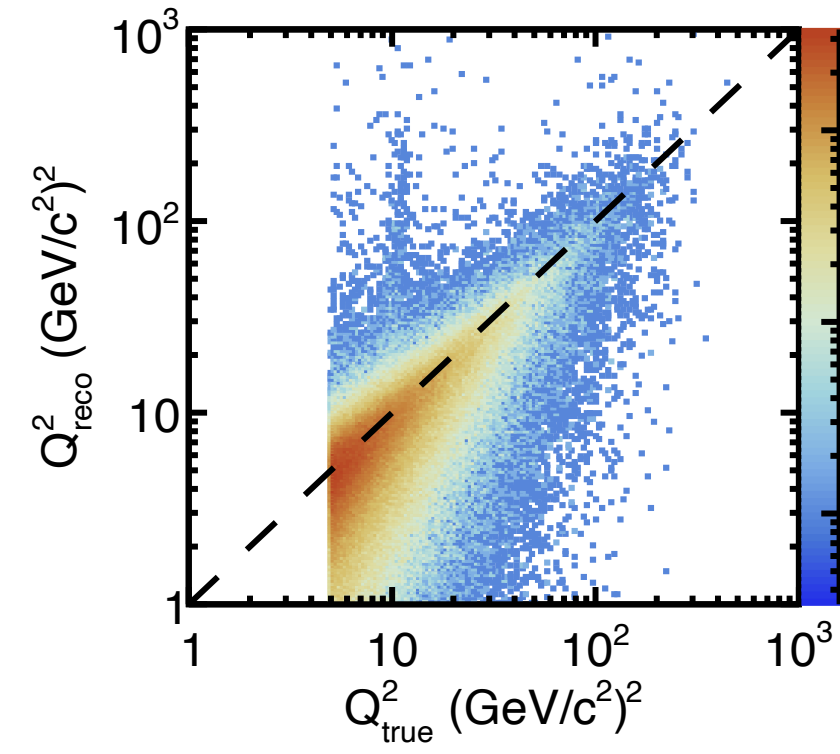
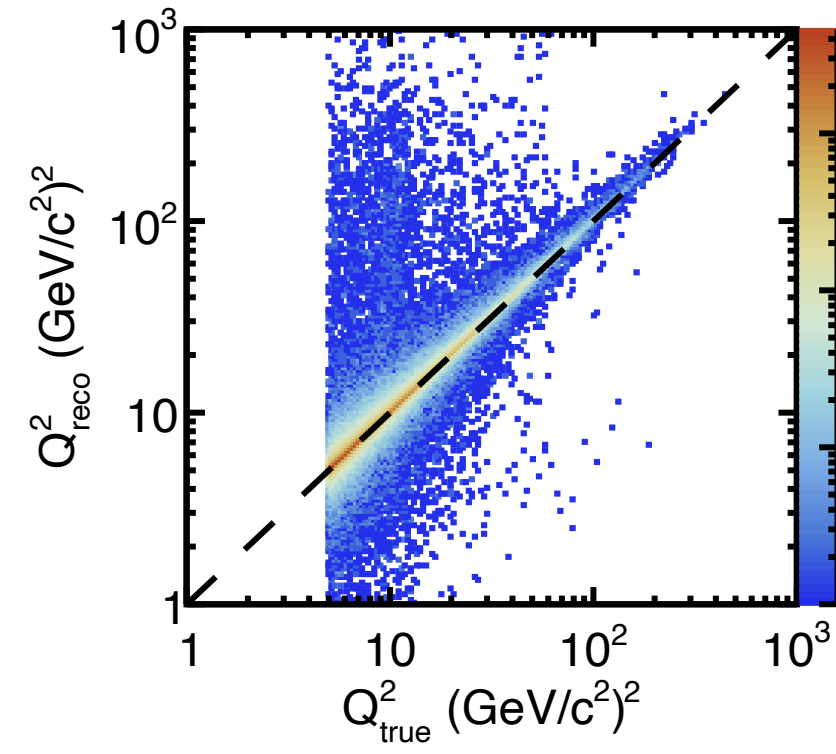
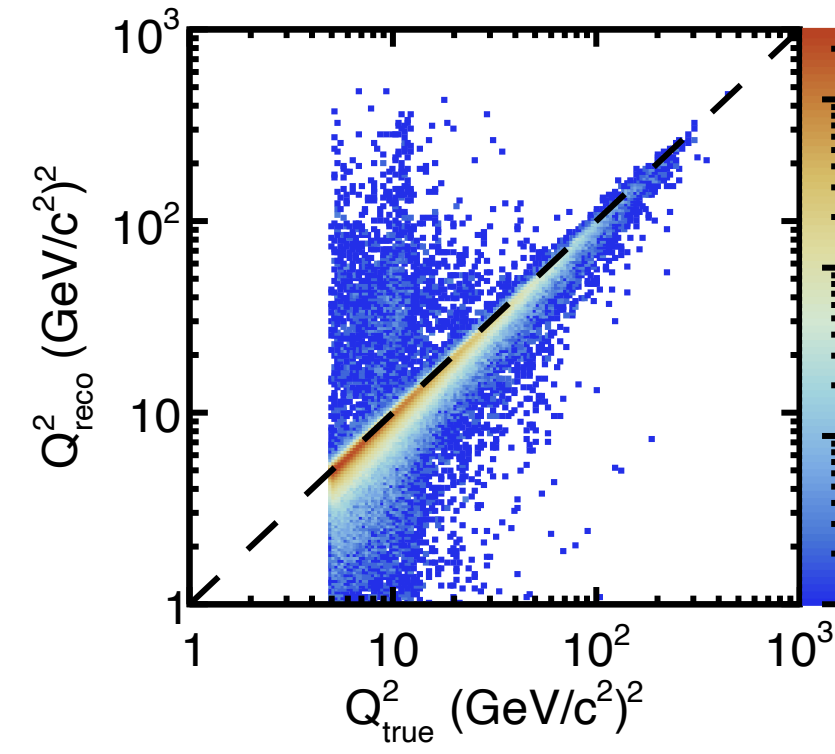
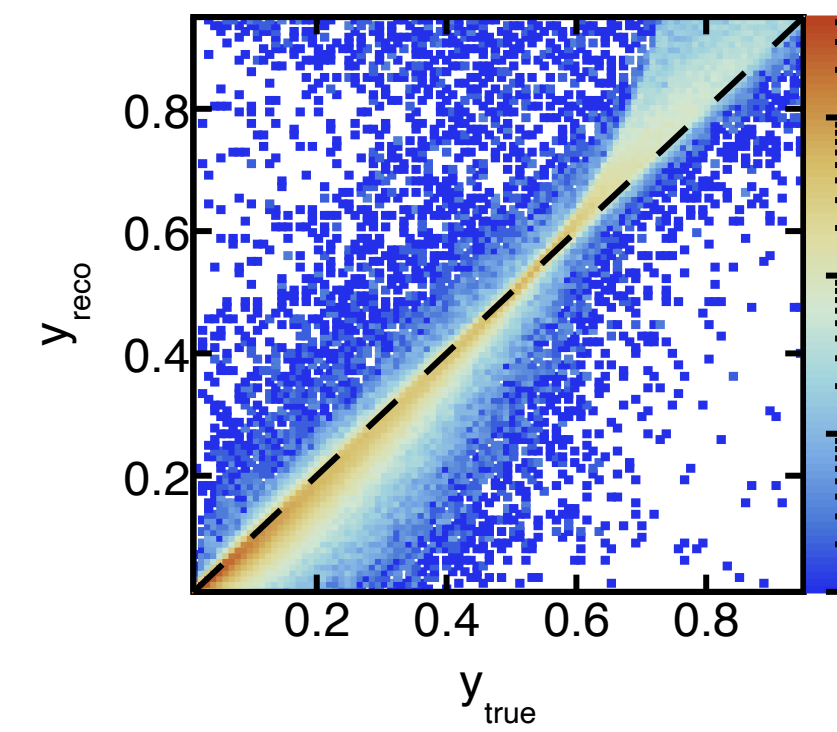
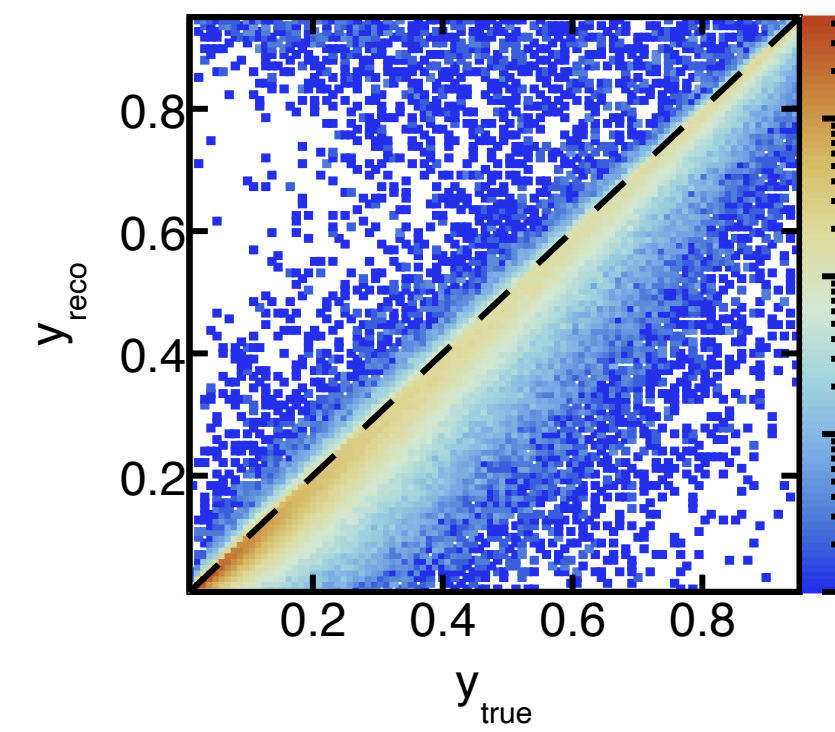
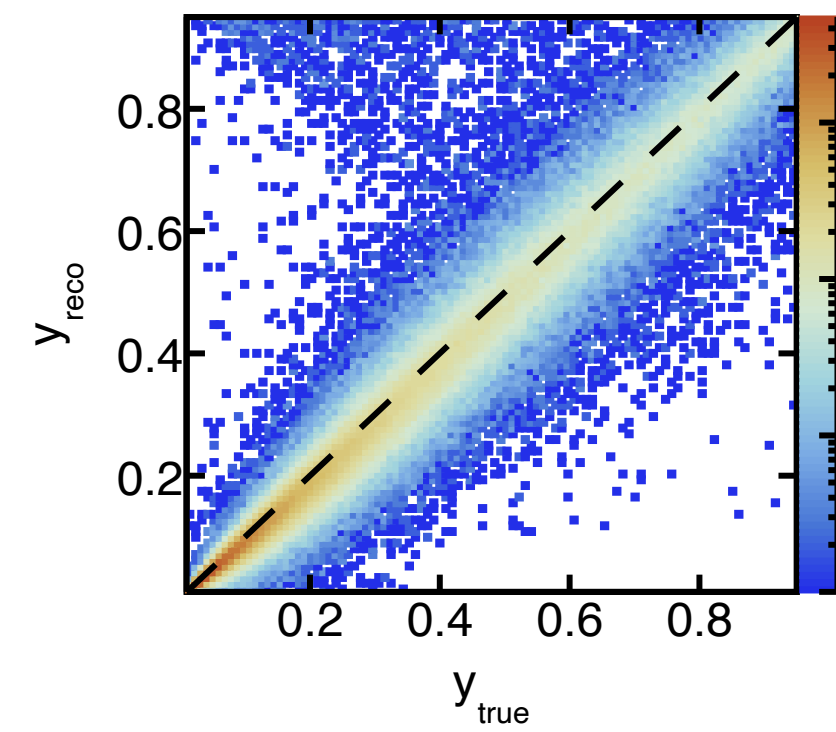
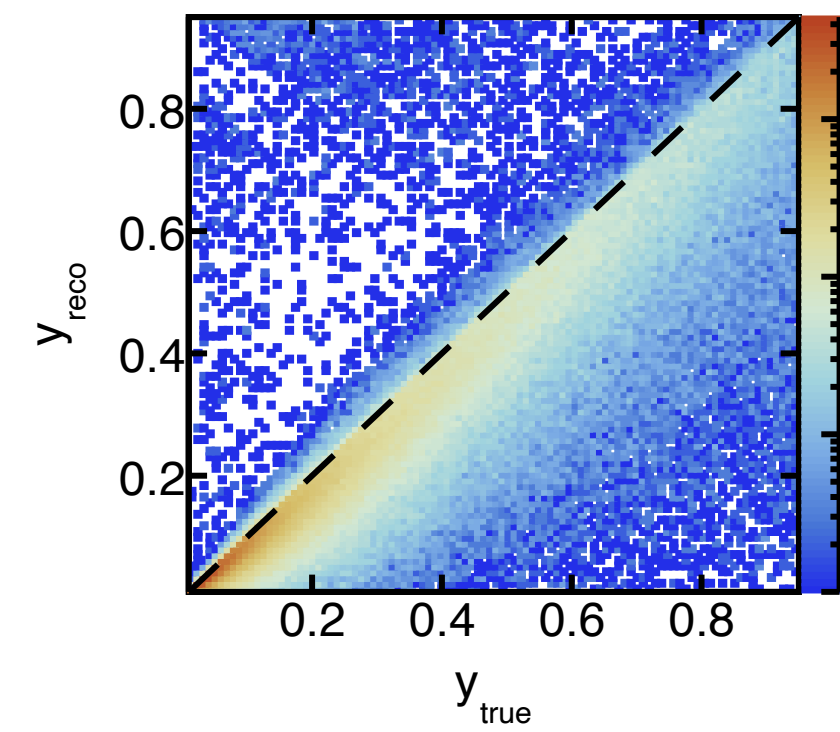
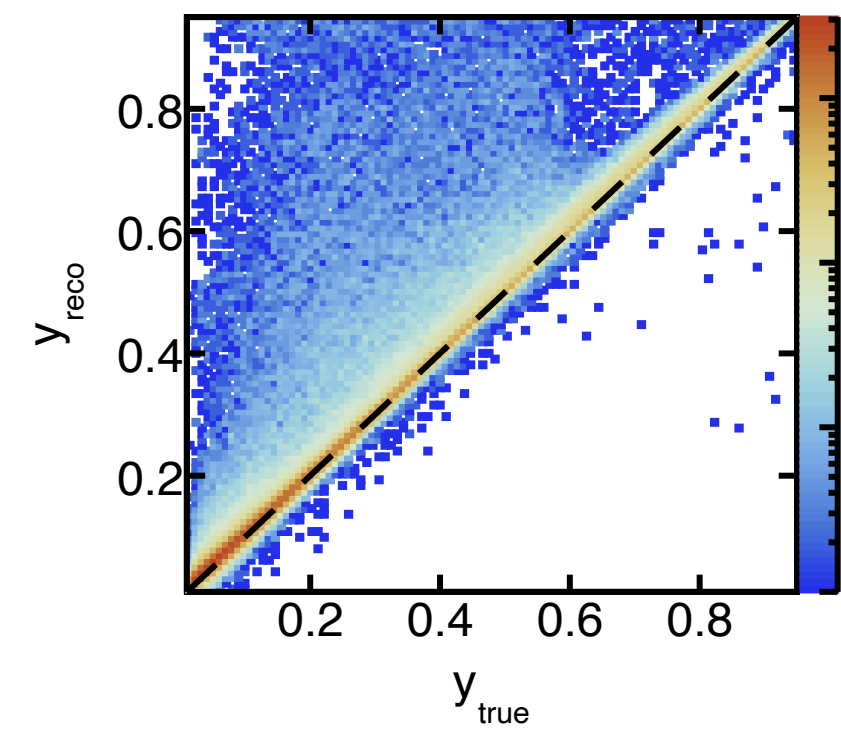
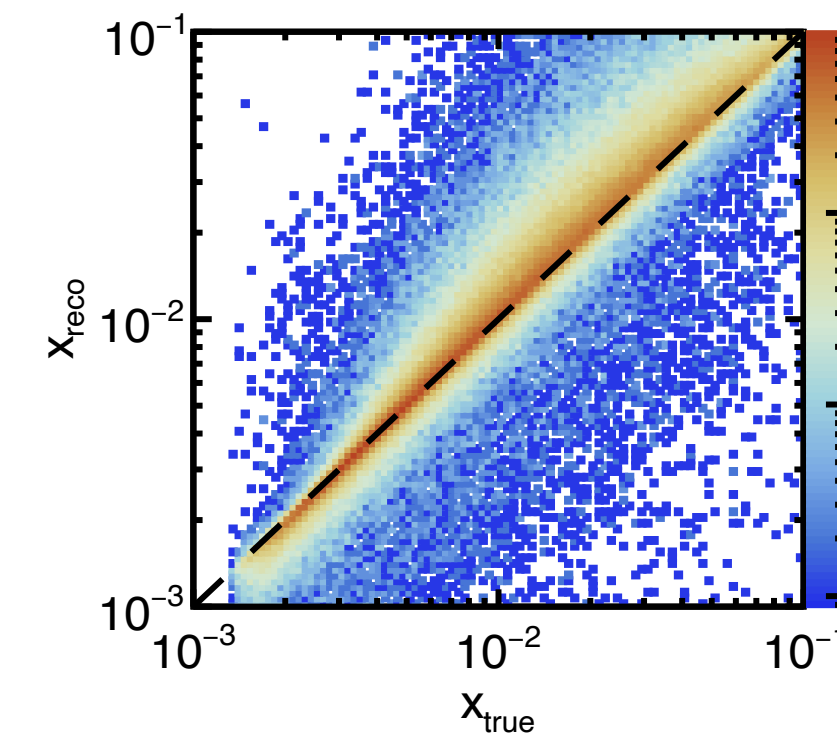
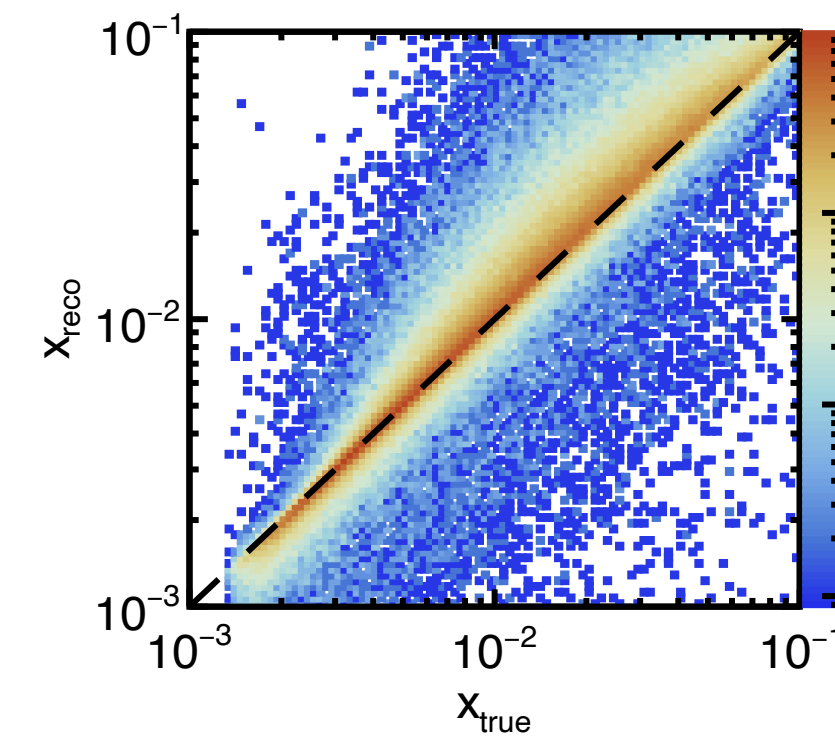
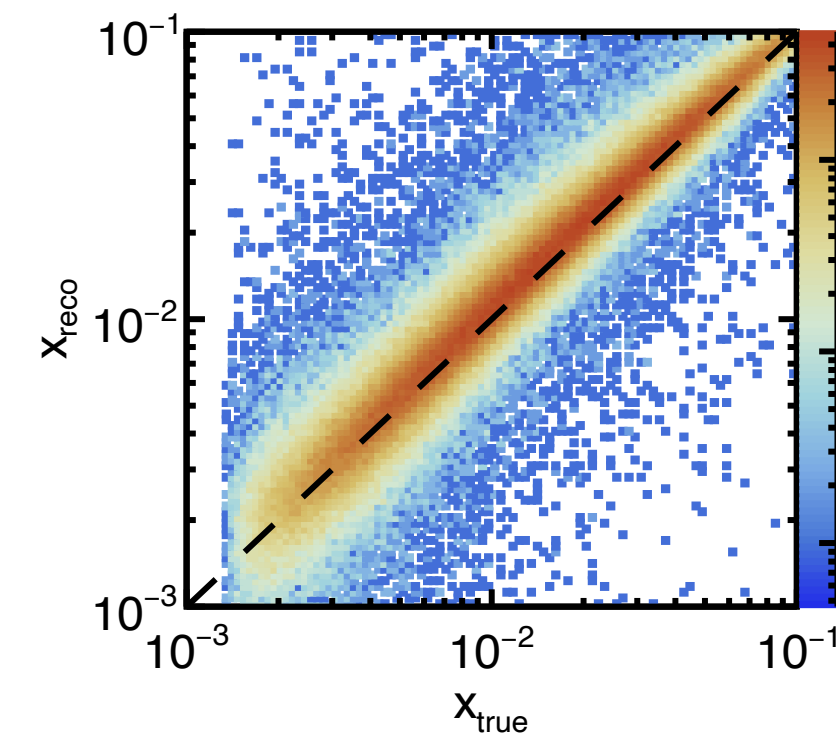
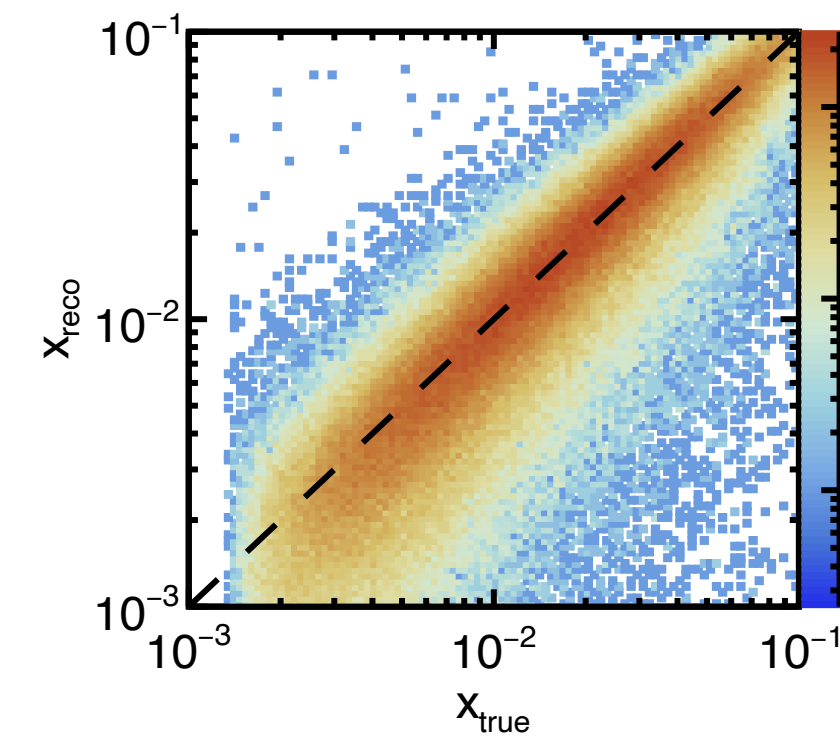
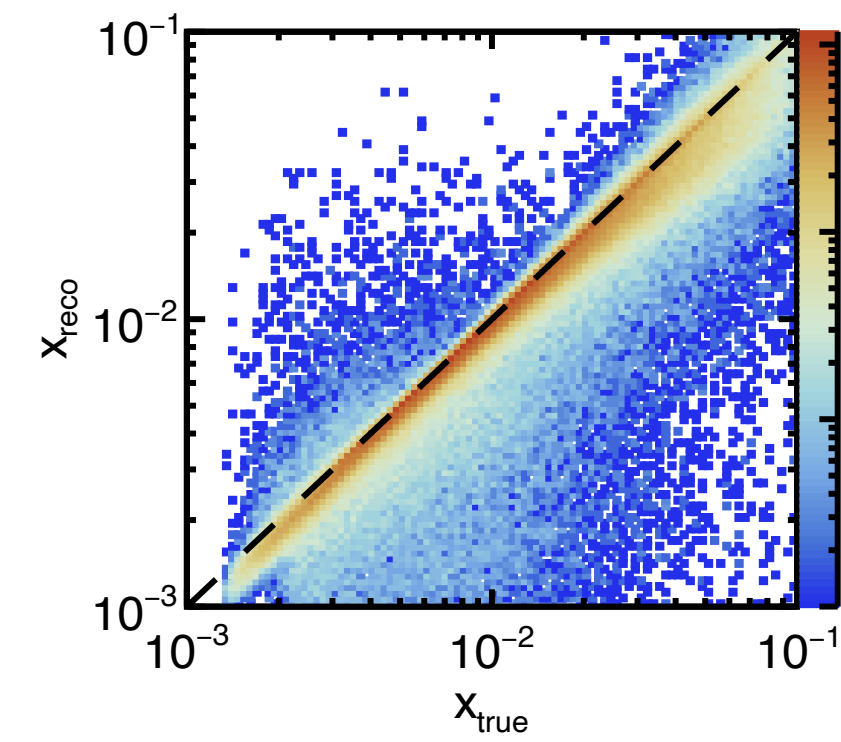
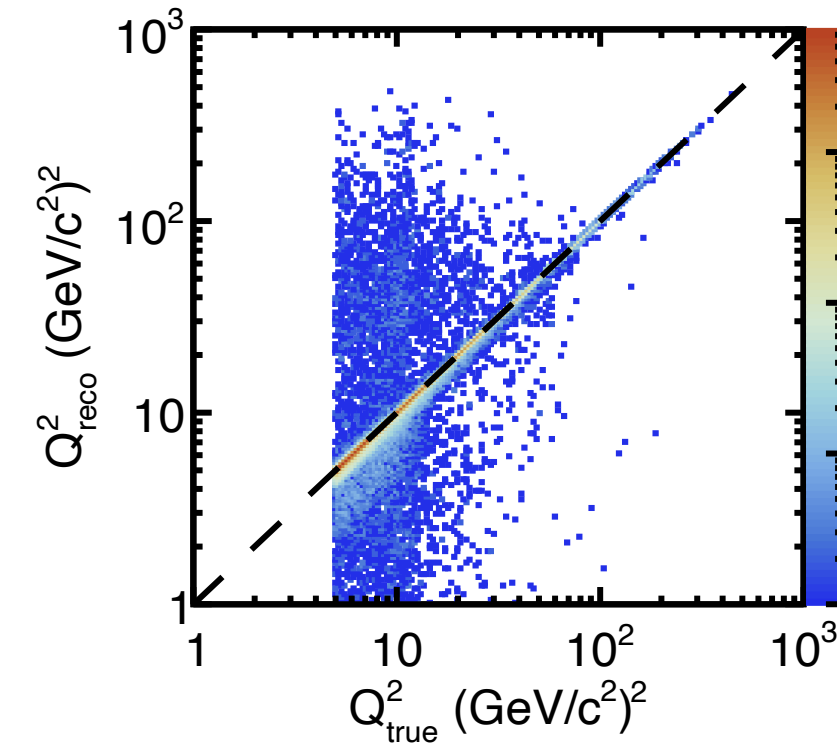
$$\delta_h = \sum_h E_h - p_{z,h}$$

# Correct bin assignment / stability



# Correct bin assignment / stability



**E****JB****DA****Sig****ESig**

# Next Steps

- Diffractive structure functions and t-spectrum
- Radiative effects
- Rapidity gap method